WAR DEPARTMENT TECHNICAL MANUAL **TM 5-1116**

LOADER, SNOW, BELT TYPE, CRAWLER-MOUNTED, GASOLINE ENGINE-DRIVEN, 10 TO 20-CU YD, (WITH BUCKET LOADER ELEVATOR ATTACHMENT), BARBER-GREENE, MODEL 38-D, WITH BUDA ENGINE, MODEL HP-217

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MAINTENANCE INSTRUCTIONS AND PARTS CATALOG

WAR DEPARTMENT • OCTOBER 1943

Combined

OPERATOR'S MANUAL
MAINTENANCE MANUAL
and
PARTS CATALOG

for

LOADER, SNOW, BELT TYPE,
CRAWLER-MOUNTED, GASOLINE-ENGINE
DRIVEN, 10 to 20-Cu Yd, (WITH
BUCKET LOADER ELEVATOR ATTACHMENT),
BARBER-GREENE MODEL 38D,
WITH BUDA ENGINE, MODEL HP-217

Manufactured for

CORPS OF ENGINEERS

by

BARBER-GREENE COMPANY
AURORA, ILLINOIS

War Department Purchase Order C-5720
This book covers machines having serial
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TM 5-1116 [Loader, Snow, Belt Type, Crawler-Mounted, Gasoline-Engine Driven, 10 to 20-Cu Yd, (With Bucket Loader Elevator Attachment), Barber-Greene Model 38D, with Buda Engine, Model HP-217], is published for the information and guidance of all concerned.

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Barber-Greene
Model 38D
SNOW LOADER WITH BUCKET LOADER ATTACHMENT

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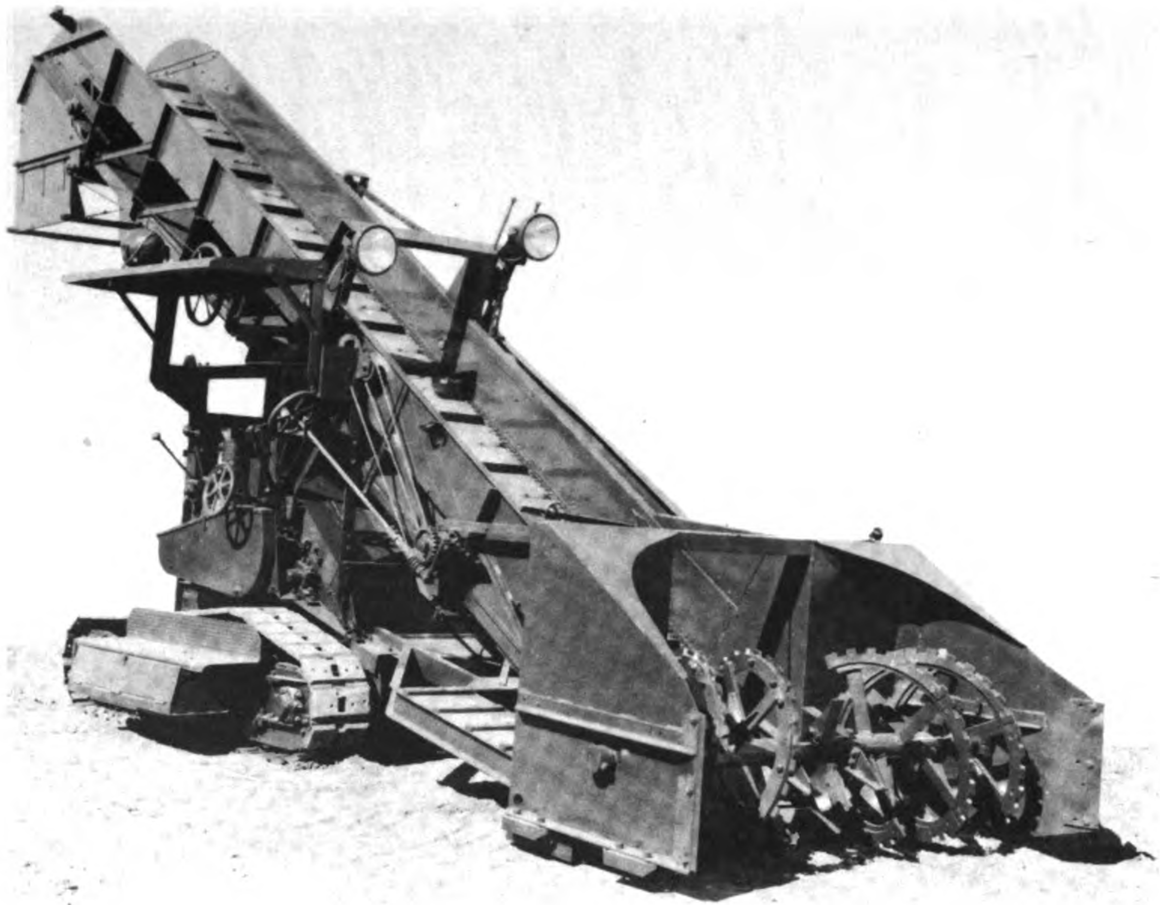


Fig. 1. Snow Loader

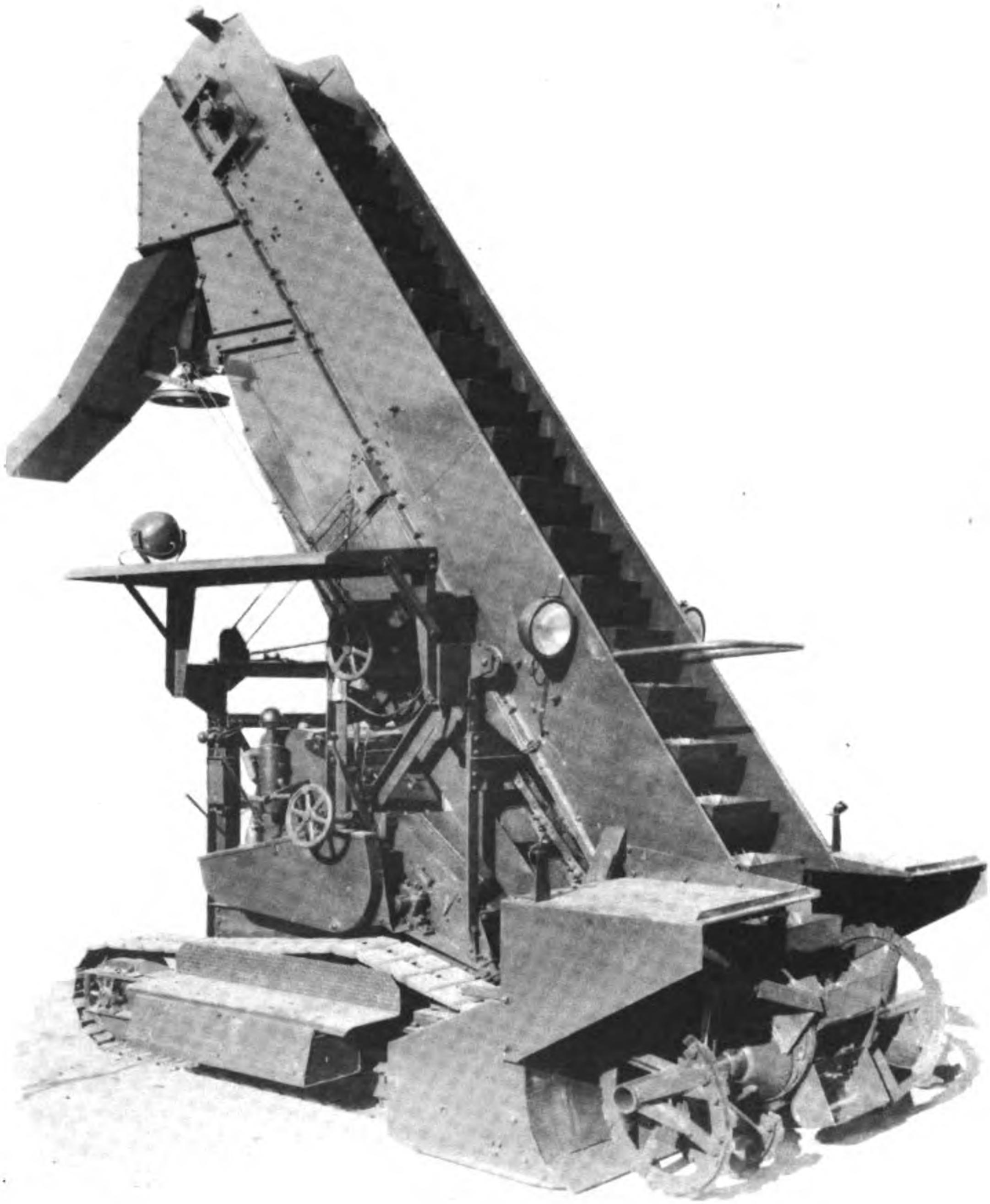


Figure 2. Bucket Elevator

Introduction

This training manual covers the Model 38D Snow Loader and the Model 38D with bucket elevator attachment. The snow loader has a single function—that of loading snow from windrows or piles to trucks. By removing the elevating conveyor from the snow loader and installing the bucket elevator attachment, the snow loader is converted to a bucket loader. As a bucket loader its function is that of loading bulk materials (not including snow) from stockpiles, windrows or banks to trucks.

The two loaders have a common chassis. This chassis is a full crawler mounted self propelled unit. All driving machinery for loading and propelling is assembled within this unit. Power is provided by a 38 H. P. four cylinder, water-cooled gasoline engine. All operating controls are centrally grouped within easy reach of the operator.

The snow loader is essentially a power propelled self feeding belt conveyor. The machine propels itself into a windrow or pile of snow and elevates the snow to trucks. Its capacity ranges from 10 to 20 cubic yards per minute depending upon the condition of the snow and the size of the windrow or pile.

The application of the snow loader should not be confused with other types of snow removal equipment which move the snow to one side of the area to be cleared. Instead, the snow loader loads the snow from runways, streets or highways to trucks which haul the snow to a disposal point, thereby entirely removing the snow from the area.

The Model 38D with bucket elevator attachment is essentially a self propelled self feeding bucket elevator. Its function is that of loading bulk materials from windrows, piles and banks to trucks. The bulk materials generally handled are sand, gravel, crushed rock, slag, cinders, dirt, coal and coke. When handling these types of materials its rated capacity is 3 cubic yards per minute.

When loading gravel or crushed rock, the maximum sized particles, when mixed with fines, should not exceed 6". When loading the same materials of uniform size, the maximum size should not exceed 4".

Before using the bucket loader for loading coal, it should be determined whether the breakage of coal by the feeding spirals will be a serious factor. Any coal up to 2" maximum sizing may be handled with a minimum of breakage. Above this size, considerable breakage will result.

The loading of coke will result in greater than average wear due to the abrasive quality of coke. Even so, in comparison with other methods, the loader will be found economical for this application.

Other applications for which the bucket loader may be used includes the stripping of shallow deposits of top soil, such as stripping gravel deposit overburden and shaping of highway shoulders.

OPERATOR'S MANUAL

for Barber-Greene
Model 38D Snow Loader
including
Bucket Loader Elevator Attachment

OPERATOR'S MANUAL

for Barber-Greene

Model 38D Snow Loader

including

Bucket Loader Elevator Attachment

Chapter I

Analysis of Component Assemblies

In this section, the machine is "broken down" into the major assemblies that comprise the complete machine. Each section covering an assembly includes the description, location, function, principle of operation and points covering specific operation with which the operator should be familiar.

This section is important and should be thoroughly studied, as it is necessary to learn about each separate assembly before a well rounded knowledge of the machine as a whole can be gained.

Chassis—Main Frame

(1) Substructure

This is the basic structural unit of the loader. Within this unit is assembled all driving mechanism of the loader. All controls for operation of machine are assembled on this unit.

The substructure is a box type unit fabricated from plates and electric welded throughout. Two sills, welded to the base of the box supports the power unit. Push arms from the loading unit attach to the box at the base towards the feeding end. A pivot axle is contained in the base of the unit. The unit receives support from both crawlers through the pivot axle. The end of the unit towards the discharge end is supported at the center by a parallelogram type axle. Through the two axles the basic unit is given a three point support.

(2) Superstructure

The superstructure forms the support for either loader elevating conveyor. The superstructure is fabricated of angles and plates welded into a single unit. On both sides of the frame at the top is welded a track on which the boom pivot shaft rollers ride. The movement of the elevating conveyor or bucket elevator on these tracks provides the "floating elevator" feature of the loader. The superstructure frame bolts at six junctions to the base of the substructure.

On the upright angles of the superstructure towards the discharge end are bolted two wooden bumpers faced with steel plates. These protect the end of the frame and power unit from damage when trucks back in to be loaded. Truck drivers, however, should be cautioned not to strike these bumpers heavily as the upright angles to which the bumpers are attached may become bent from such practice.

(3) Canopy

The canopy is a cover over the operating platform.

It is fabricated of sheet metal, one piece construction and is attached by two brackets to the front and rear upright angles of the superstructure.

The canopy protects the operator from material which might fall, while the machine is loading.

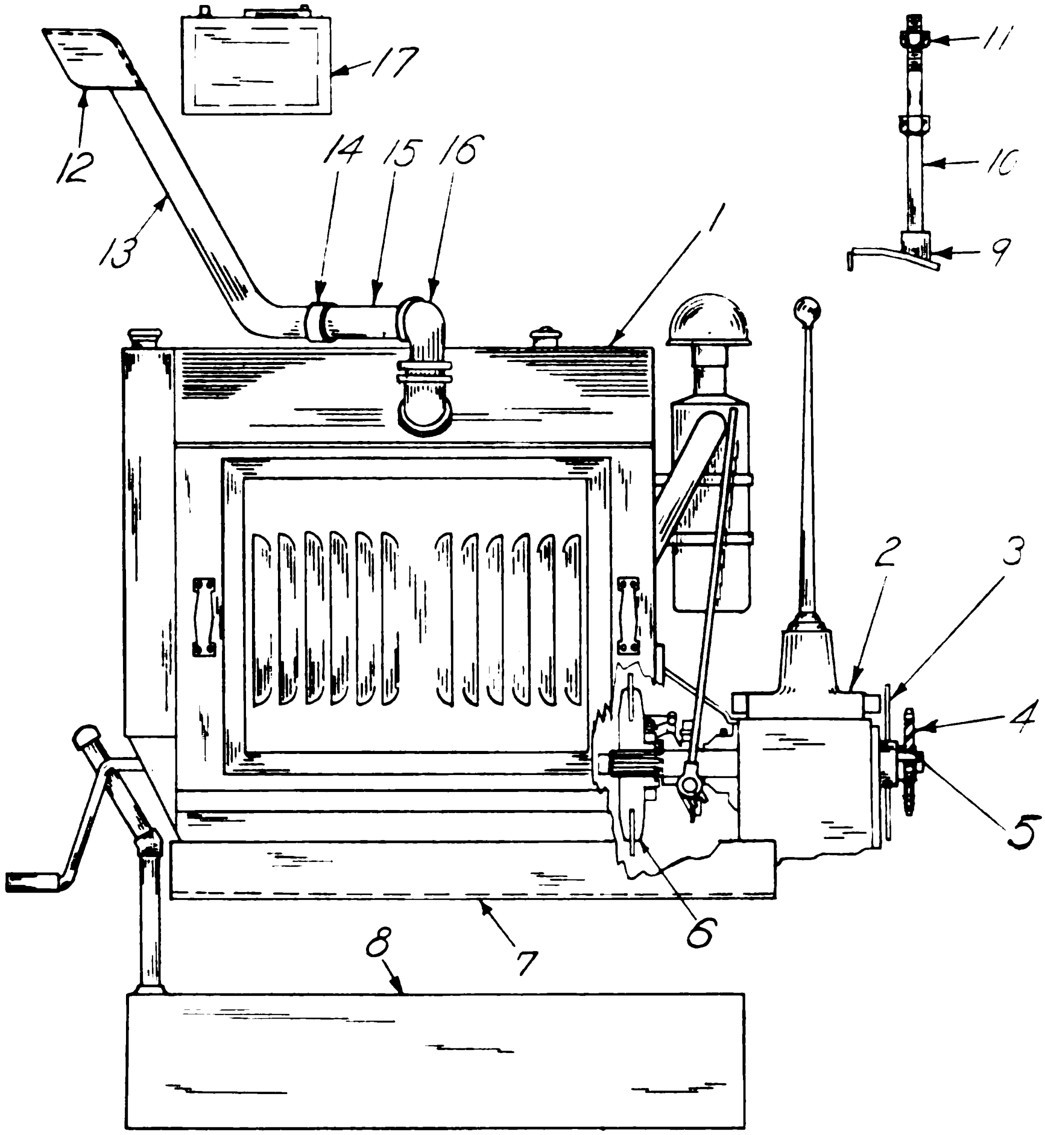


Figure 3.

(4) Power Unit

The power unit (Figure 3) consists of a Buda Model H. P. 217 gasoline engine, C S 110 Twin Disc Clutch and Fuller Model S U Transmission.

The power unit is bolted to the two angles (7) which form the unit base. Each end of the two angles (7) bolt to the chassis sills. The four holes of the angle base are slotted so the power unit may be moved for adjusting the drive chain.

(5) General Description of Engine

This Buda, Model HP-217, gasoline engine is of the well-known Buda-Hivelo Series—high velocity lubrication and cooling systems, and is a heavy duty engine, designed especially for heavy duty jobs. With reasonable care, no matter how tough the going, this Buda engine not only can "take it," but it can deliver the power as well.

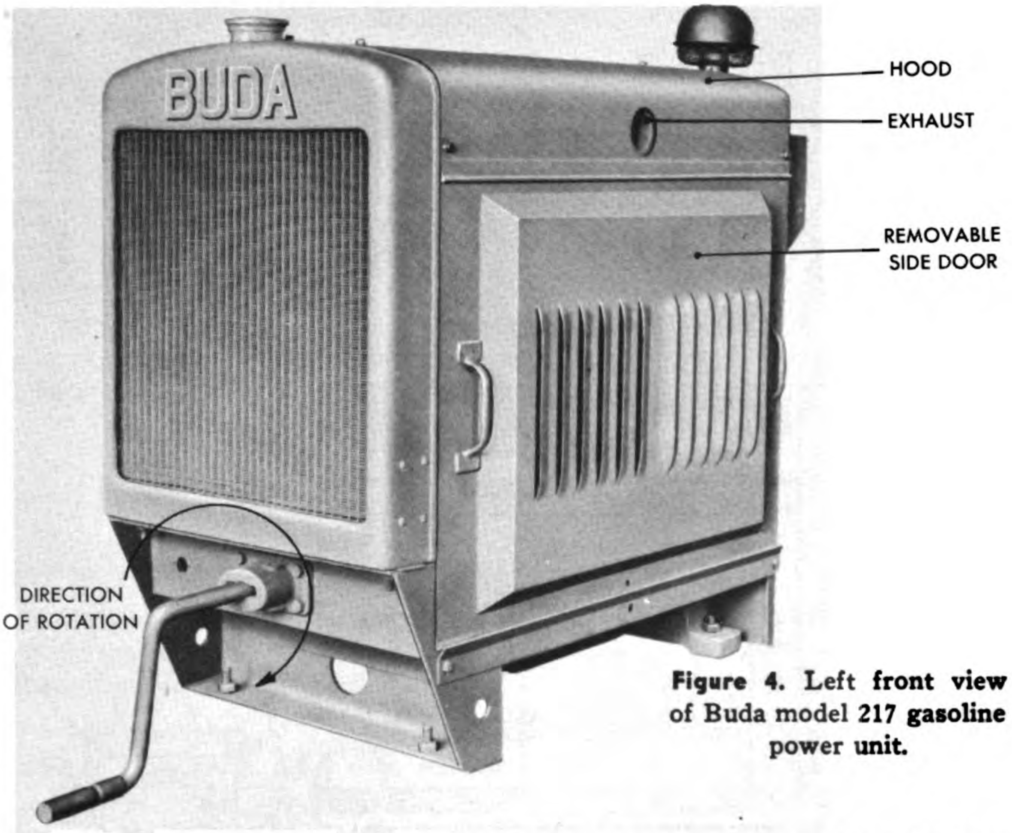


Figure 4. Left front view of Buda model 217 gasoline power unit.

The engine is of four stroke cycle design, right hand rotation (viewing fan end) (see figure 4) and the firing order, as given on the valve instruction plate fastened to the side of the cylinder head, is 1-3-4-2.

(6) Principle of Operation of Engine

Within each cylinder of the engine is a piston which has an upward and downward movement. This movement is controlled by a crankshaft to which each of the four pistons is attached by means of a connecting rod and piston pin.

The full movement of a piston in either direction is called a stroke. There are two strokes of the piston to each full revolution of the crankshaft.

By "one cycle of the engine" is meant the complete cycle or circle of operations which takes place in the engine from the time the charge of gas is first drawn into the cylinder until it is again time for a new charge to be drawn in.

In the four-stroke cycle engine four strokes, or two complete revolutions of the crankshaft, are required for one complete cycle of operation, i.e., one down stroke, one up stroke; one down stroke, one up stroke. It will be seen that in any engine two strokes of the piston (one down stroke and one up stroke) are required for one revolution of the shaft. These four strokes are named in the order in which they always appear, namely: (a) Suction Stroke, (b) Compression Stroke, (c) Firing or Power Stroke, and (d) Exhaust Stroke.

There are two valves to each cylinder, the intake valve and the exhaust valve, for the purpose of opening and closing passages between the intake and exhaust manifolds and cylinders. The valves are made to open by the action of cams upon a camshaft located within the crankcase, and driven at half

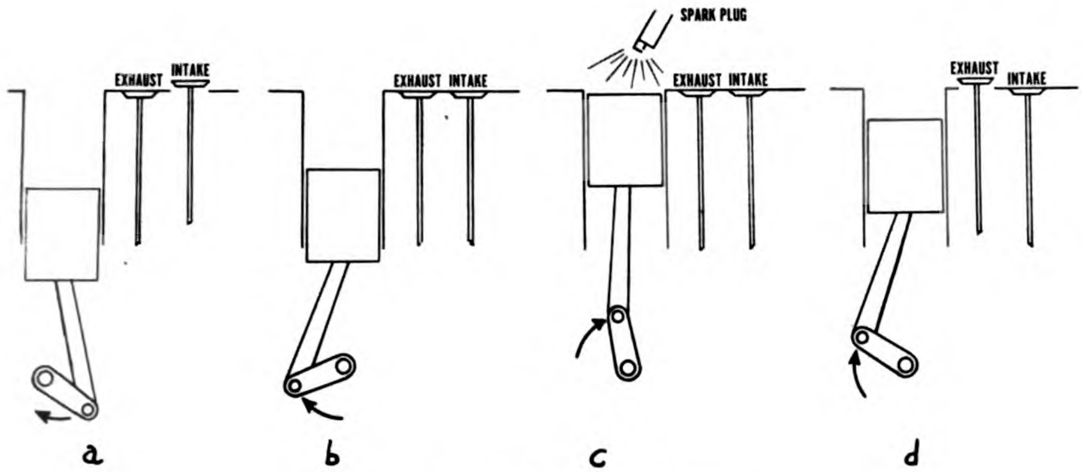


Figure 5. Engine cycle.

crankshaft's speed, through gears, by the crankshaft. They are closed by springs.

If the crankshaft of the engine is revolved until the first explosion occurs, the following action takes place within the cylinder: (The following is illustrated in figure 5.)

Upon the Suction Stroke (a) of the piston, the intake valve is mechanically opened, and as the piston moves downward gas is drawn from the carburetor (by the partial vacuum created) into the increasing space between the top of the piston and the head of the cylinder. (The exhaust valve is closed at this time.)

At the end of this stroke, the piston starts upward (b Compression Stroke), both valves are made to close and the gas is compressed into a small space, making it highly explosive.

When the end of the stroke is reached, and just before the piston starts downward again, the compressed charge is ignited by means of an electric spark which takes place between the points of a spark plug screwed into the top of the cylinder head.

The ignition of the gas causes an expansion or explosion which drives the piston rapidly downward (c Firing or Power Stroke), at the same time imparting movement to the other three pistons which are attached to the main crankshaft. Both valves remain closed during this stroke.

In the next stroke, which is upward (d Exhaust Stroke), the exhaust valve is opened to allow the burnt gas to be forced out by the piston through exhaust manifold and muffler into the open air. The intake valve remains closed during this stroke.

These strokes follow each other in the manner described as long as the engine is in operation and exactly the same series of actions occur in all four cylinders, although no like strokes are taking place at the same time in any of the cylinders.

In this way, the explosions are so divided that there are two power impulses to each revolution of the crankshaft. The explosions always occur within the cylinders in this order: No. 1, No. 3, No. 4, No. 2. This is termed the firing order of the engine. No. 1 cylinder is the one nearest the fan.

(7) Major Components of the Engine

In an internal combustion engine there are certain component functions that are necessary to keep the engine running properly.

The engine must not be allowed to overheat, hence, there must be a cooling system. There must be a continuous flow of fuel, (fuel system), electrical energy (electrical system), and lubrication (lubricating system). Also a method of timing must be provided so that all necessary action will take place at the right instant, (timing system).

(8) Timing System

Timing is obtained by so setting the camshaft gear with the crankshaft to which the pistons are attached, that the camshaft opens and closes the valves for each cylinder in their firing order, so that each step necessary in a four-stroke cycle engine can be performed at the right time.

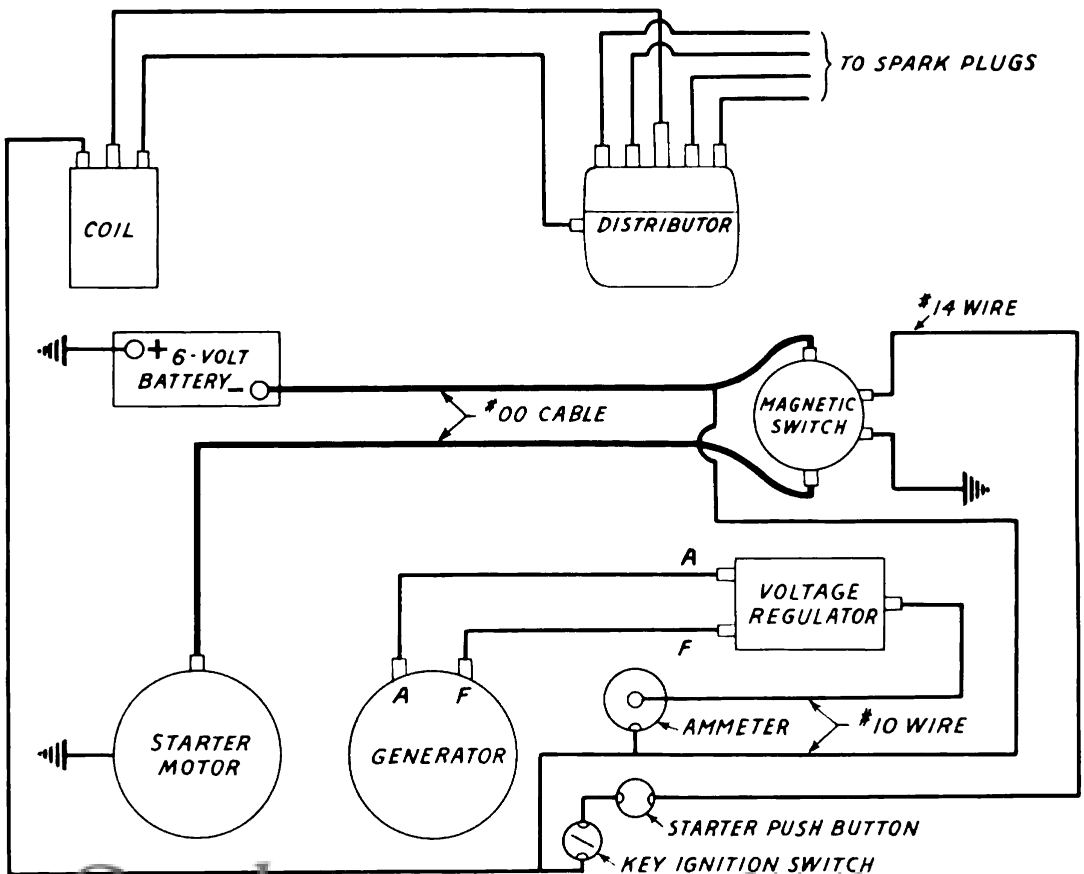
(9) Electrical System

The same is true of the timing of the ignition that it, too, will perform its function at the proper instant. Whether the electrical energy for the spark comes from a magneto or from a storage battery, a distributor must so time the spark that it will occur at the right position of the piston to produce the power stroke.

The distributor, or the magneto which also acts as the distributor, is geared in time with the crankshaft. The distributor shaft, whether of the battery type or magneto, turns at ½ crankshaft speed, as it takes two complete revolutions of the crankshaft to fire all four cylinders. The distributor shaft turns at ½ crankshaft speed because the shaft has a four lobe cam for opening the interrupter points. Therefore, to get four interruptions, or sparks, for two revolutions of the crankshaft, the ½ to 1 ratio is necessary (two revolutions of the crankshaft turn the shaft one revolution).

The electrical system includes a starter motor for cranking the engine, a generator for charging the battery, a voltage regulator for regulating the charging, and switches and cables for connecting the various units of the system. See the Wiring Diagram, figure 6.

Figure 6. Buda wiring diagram HP-217.



(10) Fuel System

The fuel system cleans, prepares, and regulates the mixture of air and gas to the engine.

The fuel is pump fed from the fuel tank to the carburetor; there the gasoline is vaporized by the rush of air through the carburetor as it is drawn into the cylinder of the engine. The air must, however, first pass through an air cleaner to remove all impurities since most of these are abrasive and will wear the engine.

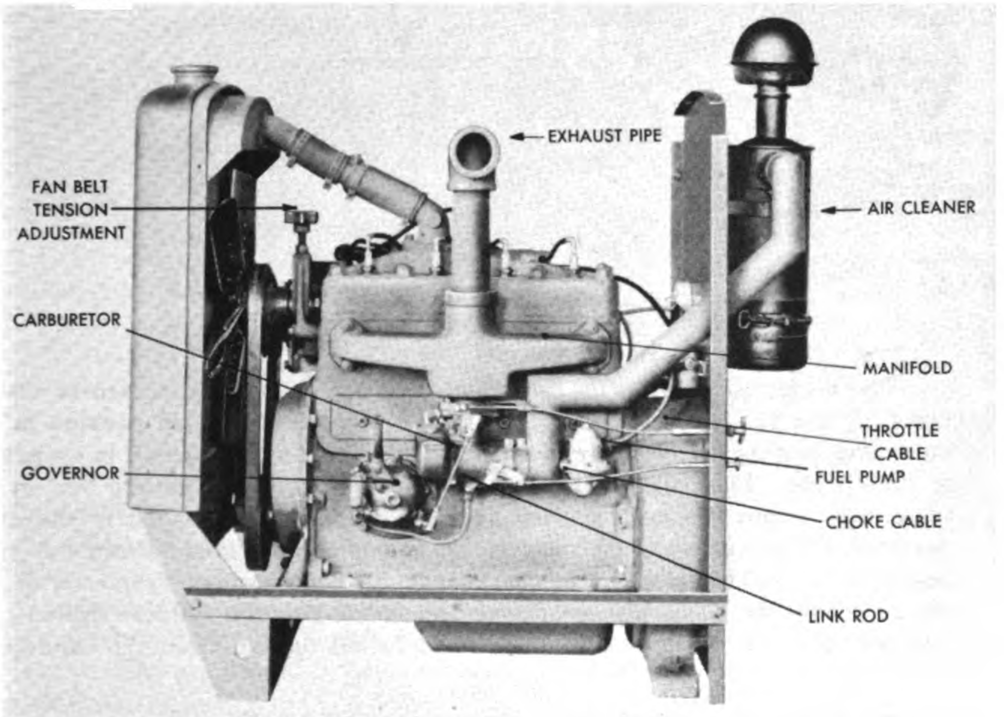


Figure 7. Left side of engine with cover removed.

In the carburetor, the proper amount of fuel is mixed with the air to produce a powerful explosive mixture. The rate of flow of the fuel and air mixture controls the engine speed.

A variable speed governor automatically regulates the speed of the engine. When the load on the engine increases, the governor opens the throttle, and will not allow the engine to operate beyond its maximum safe speed. Thereby, the governor maintains the rate of operation at an even pace, increasing engine power when necessary or decreasing it to the minimum requirements. Figure 7 illustrates and shows the location of the units of the fuel system.

(11) Lubricating System

Without a lubricating system, the engine would not run for long. The heat produced by friction would destroy the engine. Oil cushions the moving parts from each other and carries away fine particles of wear which are cleaned out of the oil by an oil filter. A high velocity oil pump provides full force lubrication to the internal workings of the engine. Figure 8 illustrates the lubricating system.

The oil pump assembly fits in a recess in the flywheel end of the crankcase, and is driven directly from the rear end of the camshaft. Connection to the pressure and suction passages in the crankcase is made by hollow dowels and sealed against oil leaks by copper asbestos gaskets.

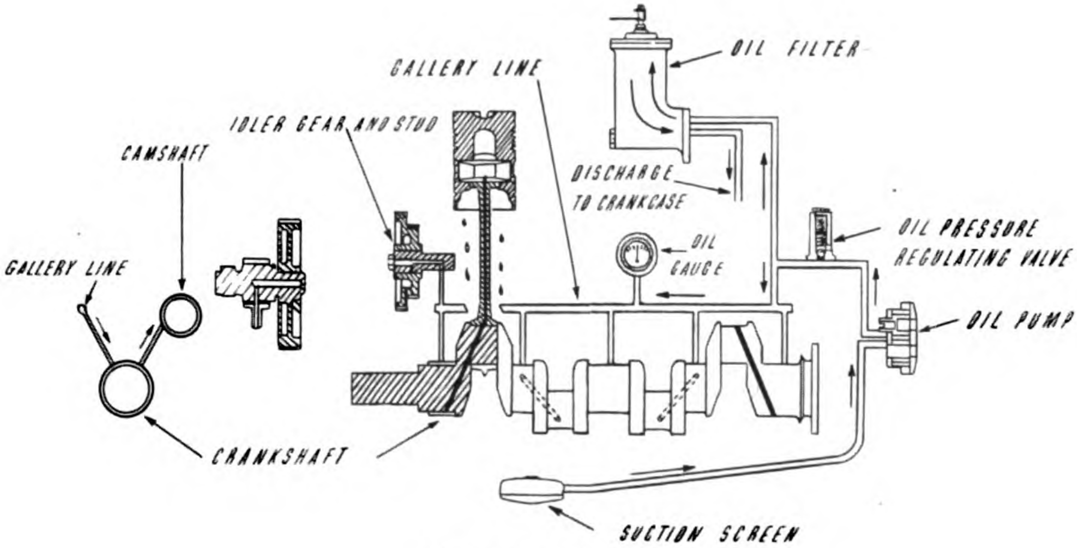


Figure 8. Oil flow chart.

The oil is drawn from the pan through a floating suction screen to the oil pump. From the pressure side of the pump, it enters a drilled passage in the crankcase casting to the oil pressure relief valve. Here excess oil is by-passed to the oil pan. The balance of the oil passes on to the main gallery line, in the crankcase. From the main gallery line, side passages are drilled to the main bearings, oil pressure gauge connections, and idler gear stud. From the main bearings, the oil is delivered to the connecting rod bearings by means of the drilled crankshaft. The piston pin receives its oil through the rifle drilled connecting rods. The cylinders are lubricated by oil thrown from the connecting rod bearings.

From the main bearings, side passages lead to the camshaft bearings. A supply of oil is delivered to the idler gear hub through the drilled idler gear shaft. Oil from the hub of this gear is thrown out through drilled holes and is picked up by a groove in the rim of the gear where it passes through small drilled holes to the gear teeth, spraying the entire gear train.

(12) Cooling System

The water cooling system carries off the excess heat from the engine and holds it to a temperature that makes for efficient operation. The water is circulated, by a centrifugal pump, through the water jacket and radiator where the cooling takes place. A fan creates a draft through the radiator. See figure 9.

(13) Crankcase and Cylinder Assembly

The crankcase and cylinder assembly is a one-piece Ni-Chrome semi-steel casting. The cylinder head, flywheel housing, timing gear housing, and oil pan are removable.

(14) Connecting Rods and Pistons

The connecting rods are made of special open-hearth steel-heat treated. The I-beam sections are drilled throughout their entire length for piston pin lubrication. Pistons pins are a special case hardened alloy steel. The pistons are cast iron with four piston rings placed in deep and narrow ring grooves which allow a minimum wear of the rings in the grooves.

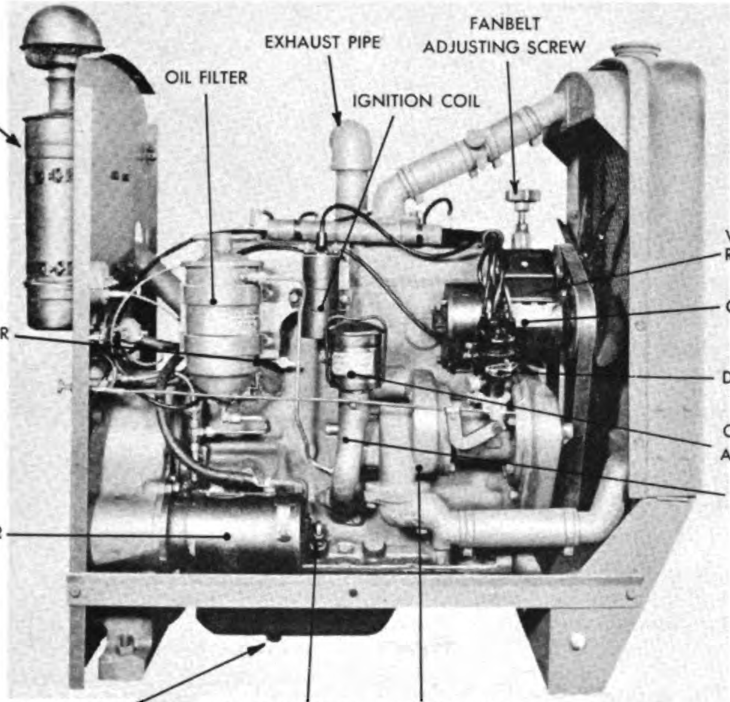


Figure 9.

(15) Crankshaft and Timing Gear

The generously large crankshaft is a special open-hearth No. 1045 S.A.E. steel forging—heat treated. The five main bearings are located between every crankpin throw, and at each end of the crankshaft. All main bearings are of the "precision" type. No reaming, scraping, or fitting is necessary in field replacement. The crankshaft is balanced both statically (at rest) and dynamically (in motion).

The timing gears are made from cast iron and steel. This selected combination of metal assures long wear and quiet running.

(16) Valves

The inlet valves are made of a chrome nickel alloy steel and the exhaust valves are made of Silchrome alloy steel. The exhaust valves seat on case-hardened rings inserted in the block. The valve push rods or lifters are the mushroom type and are a gray iron casting with chilled heads.

(17) Camshaft

The camshaft is made from open-hearth steel, case hardened, and runs in four bronze bushings which are pressed in the crankcase. Holes are drilled in the camshaft bearings to allow force feed lubrication from the oil pump.

(18) Name Plate

The name plate is on the right hand side of the engine. This carries the engine identifying model, serial, and B/M numbers, all of which should be referred to and quoted when ordering spare parts, etc.

(19) Master Clutch

This is a Twin Disc C S 110 single plate (17) figure 10 dry type clutch which controls power from the engine to the transmission.

The clutch is bolted to the engine flywheel and rides on the high speed splined drive shaft (3) figure 11 of the transmission. The clutch (6 figure 3) is located between the engine and transmission within the bell housing.

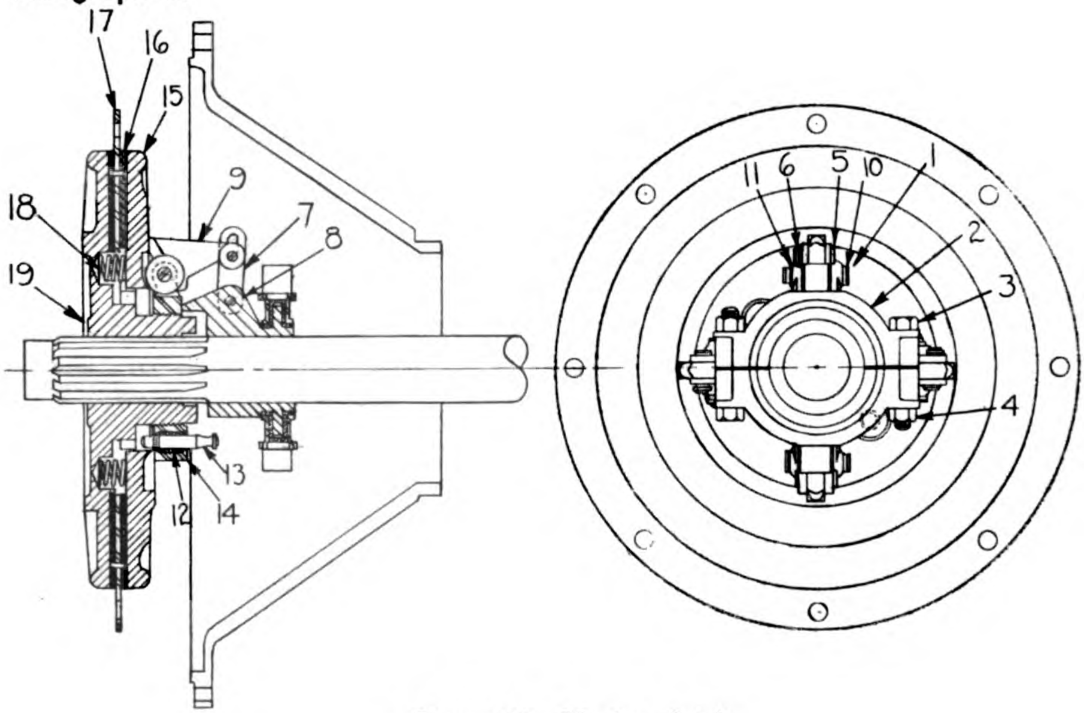


Figure 10. Master clutch.

The driving plate (17) figure 10 has friction discs (16) riveted to both sides. This plate bolts to the engine flywheel. Located inside the recessed section of the flywheel and mounted on the splined shaft is the back plate (19). This plate has a hub which extends through the driving (17) and floating plate (15). The transmission end of the hub is threaded to take the adjusting yoke assembly (14).

The floating plate (15) is located next to the transmission side of the driving plate (17). This plate has teeth around its inner circumference which engage teeth on the back plate hub when assembled in position. Through these teeth, power is transmitted from the plate to the back plate hub. The floating plate (15) is free to move toward or away from the driving plate (17), but its travel is limited by the driving plate on one side and the finger levers (9) on the other side. Between the back plate (19) and floating plate (15) are assembled six release springs (18). These springs hold the floating plate (15) and back plate (19) away from the driving plate (17) when clutch is disengaged.

Mounted on the adjusting yoke (14) are four finger levers, (9) the arms of which attach to the sliding sleeve (8) by lever links (7). The sliding sleeve has the throwout collar (2) assembled to it. This collar (2) has two lugs which are engaged by the throwout fork (78) figure 11. The fork is bolted to the clutch hand lever control shaft (77).

As the clutch handle is engaged the sliding sleeve (8) figure 10 moves towards the engine causing the lever links (7) to raise the finger levers (9). As the sleeve end of the lever links (7) pass under and beyond the center of the finger lever pins, the clutch, with a distinct snap felt in the control, engages.

This being a dry type clutch any oil or grease which may collect in the bell housing should be washed out with gasoline allowing washings to drain from bell housing through hole in bottom of the housing. Oil on the friction discs (16) may cause loss of power on account of slipping clutch.

If clutch does not pull, heats, or operating lever jumps out, adjustment is necessary at once. See Master Clutch in "Adjustment Section" for adjustment.

A clutch which is allowed to slip will cause friction discs to glaze necessitating replacement. WARNING: Inspect flexible tube to clutch shifter yoke weekly. Should this become loose or broken the grease would enter clutch and cause yoke to burn out from lack of lubrication.

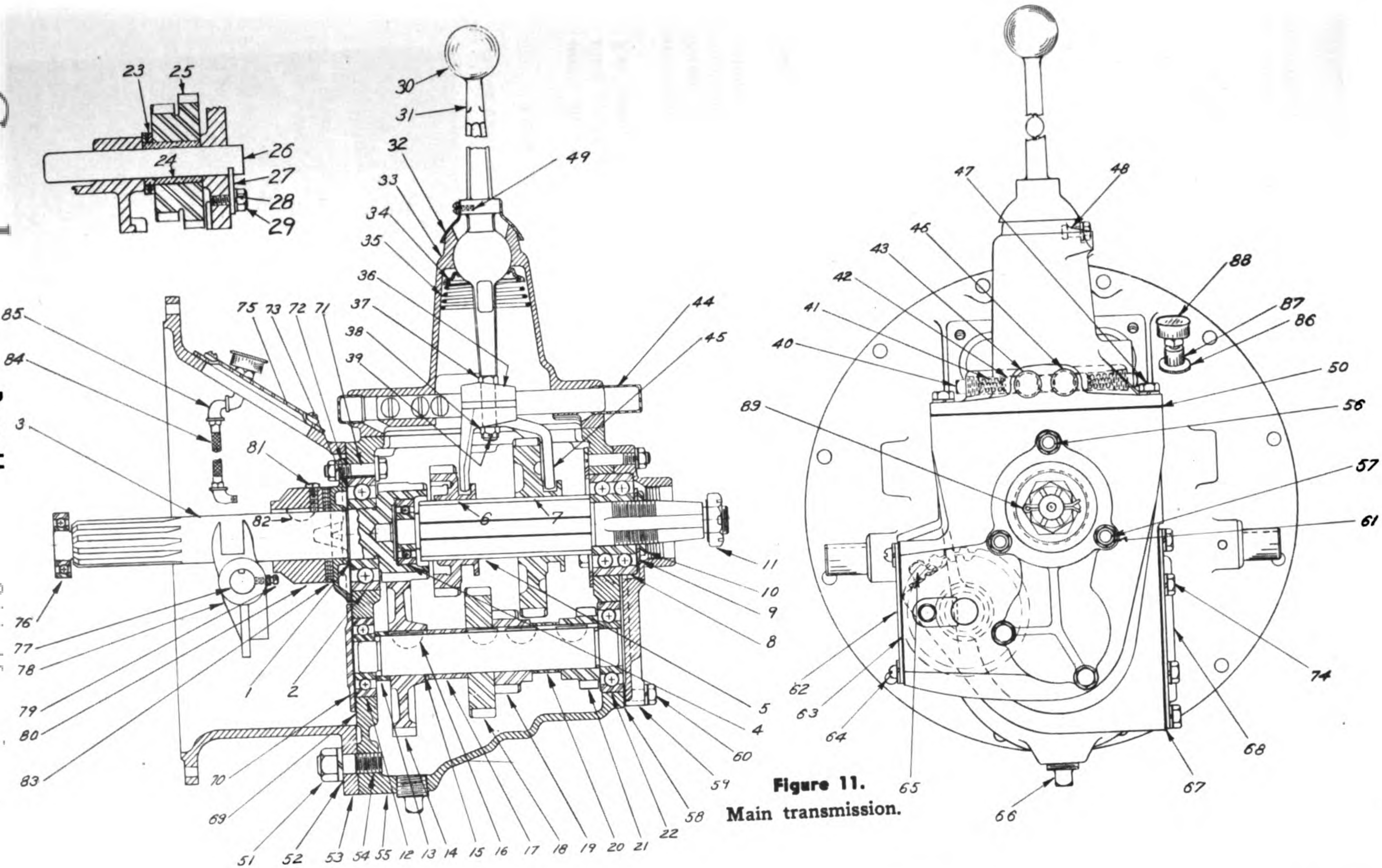


Figure 11.
Main transmission.

(20) Master Transmission

This is a standard shift pattern—Fuller Model S U truck type transmission. The transmission has a gear shift lever (31) figure 11, which gives operator the following selective traveling speed range.

First	62.7 feet per min.	Third	2.85 miles per hr.
Second	125.5 feet per min.	Reverse	55.8 feet per min.

The transmission is attached to the engine flywheel housing through a bell housing.

Drive for the transmission is provided by the drive gear and shaft (3) figure 11 which is a one piece part supported at one end, by a ball bearing (76) (pilot bearing), located in recessed center of the engine flywheel and a ball bearing (2) in front of transmission where shaft enters.

The mainshaft (5) is a splined shaft supported by a ball bearing (4) inside recess of drive gear and bearing (8) at rear of the case where mainshaft extends to receive main jackshaft drive sprocket. (8) figure 12. A Double Row ball bearing is employed at this point to take pull of main jackshaft drive chain.

Two sliding gears (6) (7) figure 11 for the selection of speeds are assembled on the mainshaft. (5). Two shifting forks (36) (45) which are controlled by the shift lever (31) engage these gears.

The countershaft (15) located below the mainshaft (5) is supported by two ball bearings (12) (22). Upon this shaft in fixed position are the drive (14), first (19), second (18), and reverse (21) speed gear.

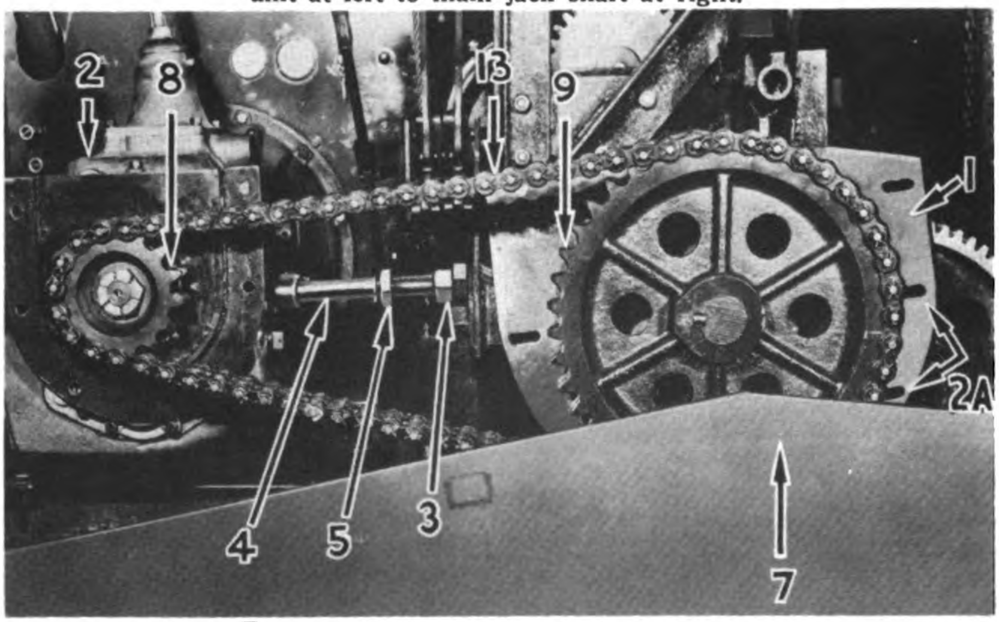
Below the countershaft assembled on stationary stub shaft (26) is a bronze bushed reverse idler gear (25).

When the transmission is shifted one of the sliding gears engages a countershaft gear. The power flow is then from engine through transmission drive shaft, through the countershaft to mainshaft on which is assembled the driving sprocket. The engine speed is reduced by the transmission to the various speeds required for loader operation.

At the side of the transmission towards the feeding end of the loader is a combination thrust and take-up bolt (4) figure 12. This bolt should be kept tight against transmission. If this is allowed to become loose an undue strain is put on transmission and bell housing by the drive chain pull.

The Master Clutch must always be disengaged when shifting gears.

Figure 12. Chain guard removed showing transmission drive chain from power unit at left to main jack shaft at right.



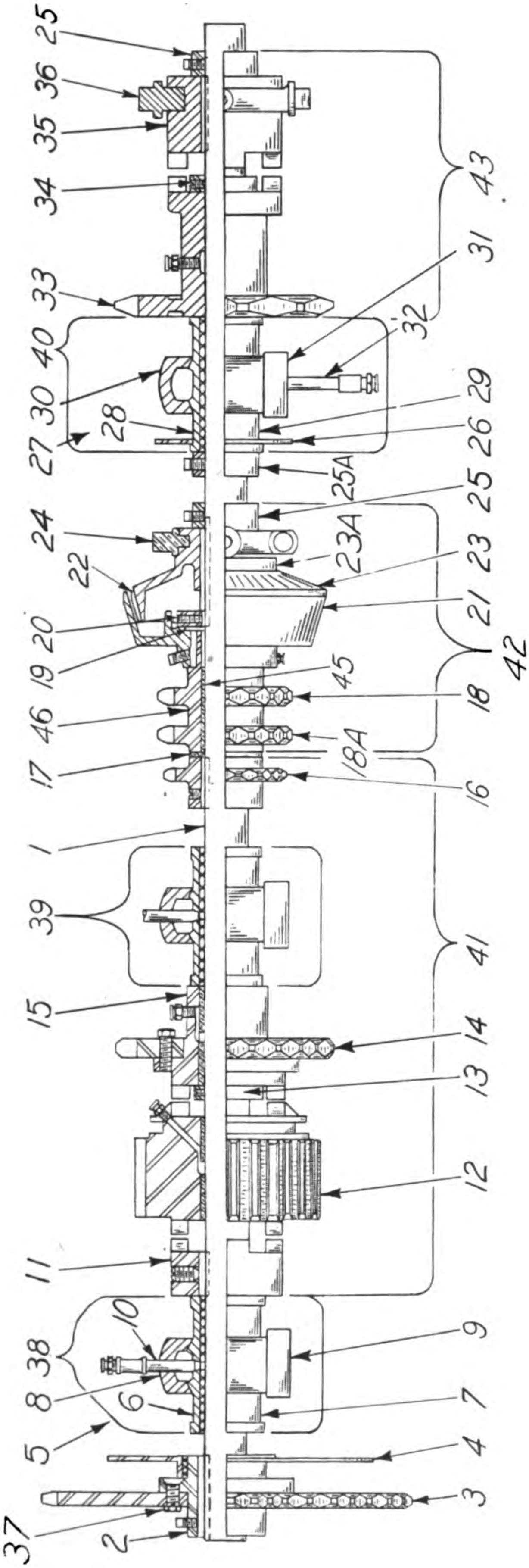


Figure 13. Main jack shaft.

(21) Main Drive Chain and Guard

Power is transmitted from the transmission to the main jackshaft by a roller chain (13) figure 12. The guard (7) housing the chain is oil tight and has a spring snap cover. The housing contains sufficient oil so that a constant oil bath is supplied the chain and sprockets.

Assembled on the jackshaft is a patch plate (4) figure 13. This has slotted holes in it and bolts to the guard with a gasket between patch plate and guard. When engine is moved to adjust chain the bolts are loosened so guard moves with the power unit. Care must be exercised to prevent damage to gasket in this operation.

(22) Main Jackshaft

The main jackshaft (1) is an alloy steel shaft located inside the chassis housing. The ends of the shaft extend beyond the chassis housing.

The main jackshaft is the main drive shaft of the loader. Upon this shaft is assembled all the parts through which power is transmitted to all power driven units of the loader.

In the following discussion the main jackshaft parts are taken in the proper order from the operator's platform.

a. Drive Sprocket

The drive sprocket (3) is on the operator's end of the shaft and is located in the oil tight chain guard. The main jackshaft is driven through this sprocket by the chain from the Master transmission.

This is a plate type sprocket and is bolted to the driving hub (2). The hub is keyed to the main jackshaft. When replacing this sprocket, only the bolts need be removed.

b. Bearings

Three ball and socket self aligning bearings (38) (39) (40) support the shaft. One is located each side of the chassis housing, the third near the center of the shaft. The bearings have four parts, a base, a cap and two bearing halves which are babbitt lined. The base of this type bearing is bolted to the supporting frame and retains the cap bolts. The shaft lays in the lower half of the bearing, the second half lays on top of shaft. The bearing cap bolting to the base secures the bearing halves. When bearings are to be replaced the base is not disturbed —only the cap is removed which permits removal of bearing halves.

The main jackshaft is divided into three groups of parts; the crawler drive group, the hoist drive group, and the bucket line drive clutch group. In the following discussion the groups and parts thereof are taken in the proper order on the shaft starting from the first bearing, the end of which extends inside chassis housing. Identification of groups is from operator's platform.

c. Crawler Drive Group

The traveling speed clutch (11) is a three jaw hub which is keyed to the shaft. This is assembled next to the first bearing (38), therefore, this hub together with a collar (25A) set against the near end of the third bearing prevents end play of the shaft.

The principal part of the crawler drive group is the crawler clutch shaft drive gear (12) which is bronze bushed. This gear has three jaws machined in each end of the gear. A shifter yoke—assembled on the gear connects it with the crawler speed change lever. When the lever is in one position the gear jaws mesh with the traveling speed jaw (11), and in the second position with the crowding speed jaw (15). This gear meshes with gear (9) figure 17 on crawler clutch shaft.

The crowding speed jaw clutch (15) figure 13 is a hub with three jaws to which is bolted a plate type sprocket (14). This assembly is free on the main jackshaft and is driven from auxiliary transmission.

The auxiliary transmission drive sprocket (16) is the next part just beyond the main jackshaft center bearing (39). This sprocket is keyed to the shaft.

d. Operation of Crawler Drive Group

When the machine is operated in traveling speed the crawler speed change lever is shifted forward. This engages the drive gear with the traveling speed jaw clutch. The traveling speed jaw clutch being keyed to the shaft rotates the gear at jackshaft speed. When the gear is in this position the three speeds and reverse of the Master transmission are transmitted direct to the crawler shaft.

When the machine is operated in feeding speed the crawler speed change lever is pulled back. This engages the drive gear with the crowding speed jaw clutch.

The Gear box is driven by the drive sprocket (16) on the main jackshaft. The speeds are decreased therein through a train of gears. This reduced speed is transmitted by chain to the crowding speed jaw clutch. When the gear is in the crowding speed position the crowding speed jaw clutch and drive gear rotates at a reduced speed while the main jackshaft operates at the high speed as transmitted direct from the Master transmission.

e. Hoist Drive Group

This group is in two separate halves. First, or female half, is a bronze bushed hub with two sprockets (18) (18A). The female half of the cone clutch is assembled on the far end of the hub. This half is free on the jackshaft. A chain runs from the first sprocket up to the sprocket on the handwheel control shaft (3) figure 16. The second chain transmits the power down to the hoist unit.

The second half (23) figure 13 is the male portion. To this half of the cone clutch is riveted the renewable lining (22). This half of the clutch is keyed to the jackshaft but is permitted free horizontal movement. A shifter yoke (24) assembled on this half connects to the hoist lever.

f. Operation Hoist Clutch

The female section being free to rotate on the jackshaft may be turned by the handwheel control through the first chain on the hub, which in turn operates the hoist through the second chain. This part of the operation comes into play when boom is being lowered by hand.

The male section, being keyed to the shaft, rotates at jackshaft speed. When the jackshaft is rotating with the Master transmission in first speed and the hoist clutch lever is pushed forward the driving half of the clutch engages the free half which in turn operates hoist and raises the boom. When the Master transmission is in reverse and hoist clutch is operated as above the boom is lowered.

No adjustment is required for this clutch. However, if the clutch slips the linings may have become greasy. In this case the linings should be washed with gasoline.

The clutch should be inspected once a month so lining may be renewed before rivets become exposed and score female half of clutch.

g. Conveyor Drive Clutch Group

This clutch Group (43) is on the main jackshaft next to third bearing outside chassis housing, opposite operator. The driven portion (33) is a sprocket and hub with three jaws and is free on the shaft. The driving portion (35) is a hub with three jaws which is keyed to the shaft but permitted free horizontal movement. Through a shifter yoke (36) assembled to the hub it is connected to the bucket line clutch lever.

This clutch should be engaged only when Master Clutch is disengaged.

The Conveyor is operated only in first speed.

Under no circumstances is the clutch left in engaged position while the machine is being operated in reverse speed. If clutch is left engaged the jaws may be damaged beyond repair.

(23) Gear Box

The Gear box reduces the speed of the crawlers in the loading operation.

Twelve speeds are available, ranging from 2.60 feet per minute to 33.36 feet per minute. The speeds are made available by shifting gears (15) figure 14 within the transmission and by changing gears (9), (12) on the side of the transmission. The speed range and method of changing Gears is given under section, "Determining Proper Crowding Speed."

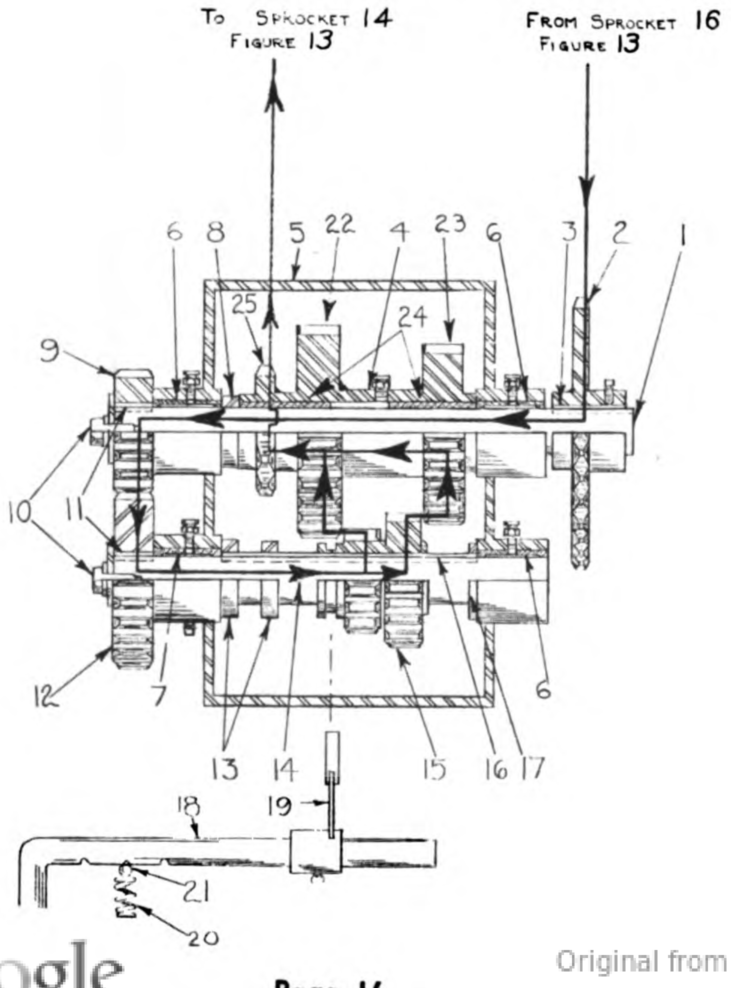
The Gear box is mounted on sloping back of chassis housing under cross brace of superstructure center support.

The lower shaft (1) extends beyond both sides of transmission box and is supported by a bronze bushed bearing (6) on each side of the box.

Outside of the box opposite operator's platform is the sprocket (2) which drives the gear box. This sprocket is keyed to the gear box drive shaft. Inside the box assembled on a single bronze bushed sleeve are two gears (22) (23) and the crawler speed drive sprocket (25). The shaft also extends outside of the gear box towards operator to receive one of the change gears used to obtain speeds within the operating range.

The upper shaft (14) in the box is supported in bronze bushed bearings (6) (7) on each side of box. The shaft extends beyond the box only on the operator's side to receive the second change gear used to obtain speeds within the operating range. Assembled on this shaft is a two gear cluster (15). The cluster is keyed to the shaft but permitted horizontal movement. A shifter yoke (19) attached to the shifter lever engages the gear cluster.

Figure 14. Gear box.



(24) Operation of Gear Box

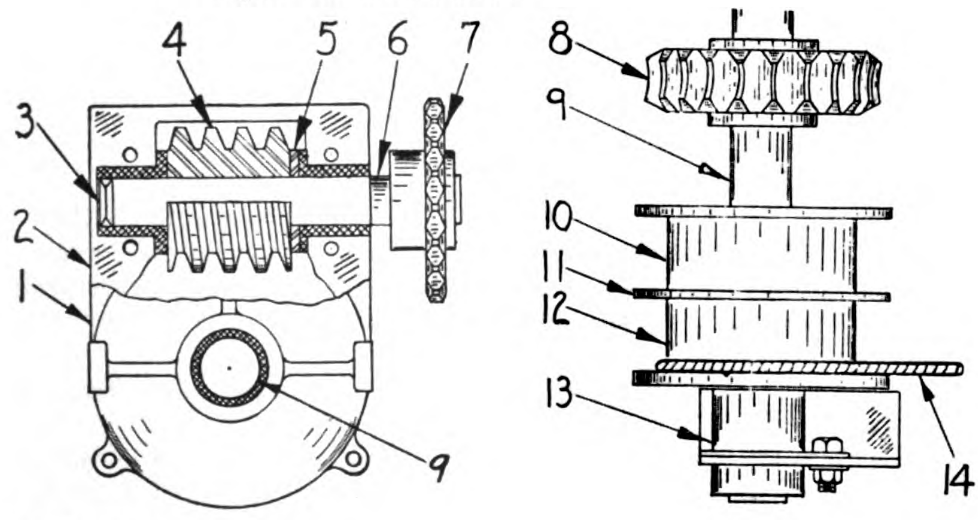
The Gear box has power transmitted through it only in the loading operation. When the loader is traveling the machinery of this unit is in motion, but no power is put through it.

To put it in operation the crawler speed change lever is pulled out all the way to obtain the slow speed and pushed in all the way for the higher speed. Two crowding speeds are available with each combination of removable gears.

The power flow when using this gear box is as follows (See arrows, figure 14): The power is transmitted by the gear box drive sprocket on the main jackshaft to driven sprocket on the lower shaft of the gear box. The lower shaft rotates the upper shaft through the change gears which are outside of case. The upper shaft to which the sliding gear cluster is keyed rotates the sleeve assembled on the lower shaft when either of the gears are in mesh with either of the gears on the sleeve. The sprocket on the sleeve drives down to the crowding speed jaw clutch on the main jackshaft. Since the crawler clutch shaft drive gear is engaged with the crowding speed jaw clutch the gear transmits the reduced speed to the crawler clutch shaft.

The shifting of the gear box will be easier if the tension is relieved by disengaging the crawler steering levers.

Figure 15. Power hoist.



(25) Hoist

The power hoist function is to raise or lower the conveyor. It is power operated for raising and lowering. It may also be lowered by hand. See Fig. 16.

The hoist is mounted below the main jackshaft and towards the power unit end within the chassis housing. The hoist is a worm gear unit enclosed in an oil tight case. The gear shaft (9) figure 15 is extended through the rear of chassis housing, and upon this extended section the drum (10), (11), (12) is mounted. The end of shaft is supported by a bracket to which is bolted a babitted outboard bearing (13).

The worm shaft (6) is the driven shaft. A sprocket (7) is assembled on the outer end of this shaft and is driven by the second sprocket on the female half of the cone clutch.

The one piece cable used for hoisting is run through the drum in such a manner that no anchoring is necessary at the drum. The drum face is divided in the center by a plate (11) to prevent the two strands of cable from being fouled.

The drum should be inspected occasionally to make sure the cables are wound evenly on the drum. Care should be taken when lowering. Do not continue the lowering operation after the scraper is on the pavement and the

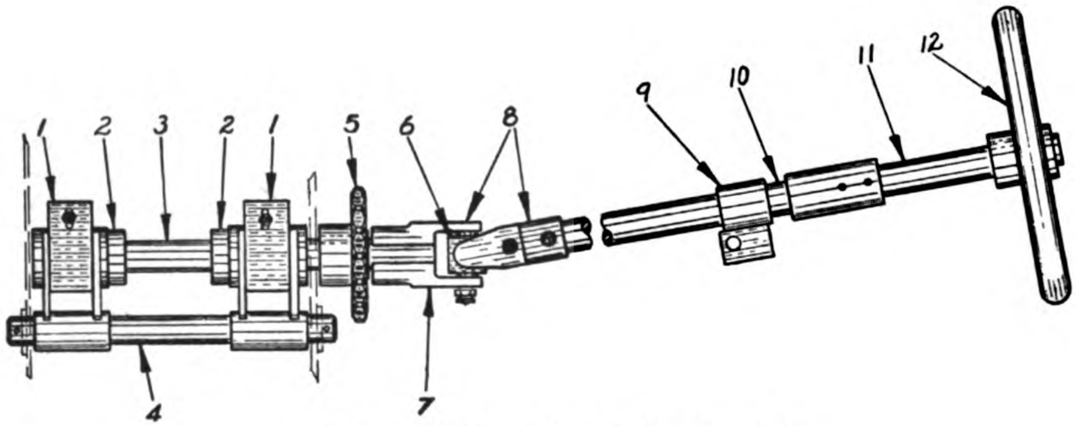


Figure 16. Handwheel hoist assembly.

cables have become slack This will cause the cable windings to loosen on the drum and will result in uneven winding when the conveyor is again raised.

As the conveyor is raised or lowered, the flanged wheels on the convevor pivot shaft ride up and down the tracks at the top of the chassis superstructure. With the loader in operating position the limit of raising the elevator is reached, when the flanged wheel comes to the upper end of the tracks. Likewise, the limit on lowering the elevator is reached when the flanged roller is at the lower end of the tracks. This rarely occurs, however, as the spiral and scraper would be several inches below pavement level if the lower limit of the elevator travel were reached.

(26) Crawler Clutch Shaft

The crawler clutch shaft (11) figure 17 transmits power for traction and the clutches (4A) assembled hereon are also used for steering the loader.

This shaft is located below and a little forward of the main jackshaft in the chassis housing and is mounted in two ball and socket bearings which are outside of housing.

The shaft is gear driven, the gear (9) meshing with the crawler clutch shaft drive gear on the main jackshaft.

Two identical clutches (4A) and brakes (5A) are assembled on this shaft, one for driving or braking each of the crawlers. Both the clutches and brakes are of the external, split band contracting type.

Each clutch assembly consists of two functional parts—the driving half and the driven half. The driving half receives power from the clutch shaft and transmits the power through friction to the driven half which, in turn, drives the reduction sprockets on the crawler oscillating shaft.

The driving half is made up of the following parts:

(a) The clutch carrier (1) which is keyed and set screwed to the clutch shaft . This is actually the foundation of the driving half of the clutch as all other parts of this half are mounted on or attached to the carrier.

(b) The friction clutch bands (10) which are not rigidly attached to the carrier, but are held in proper position by the carrier.

(c) The clutch levers (7) which are tied to the bands through adjusting bolts (3).

(d) The shifter collar (21) which is connected to the clutch levers through the toggle links (6).

The driven half of the clutch assembly consists of a combination clutch and brake drum (12) with driving sprocket attached. This unit is bronze bushed and turns freely in the shaft.

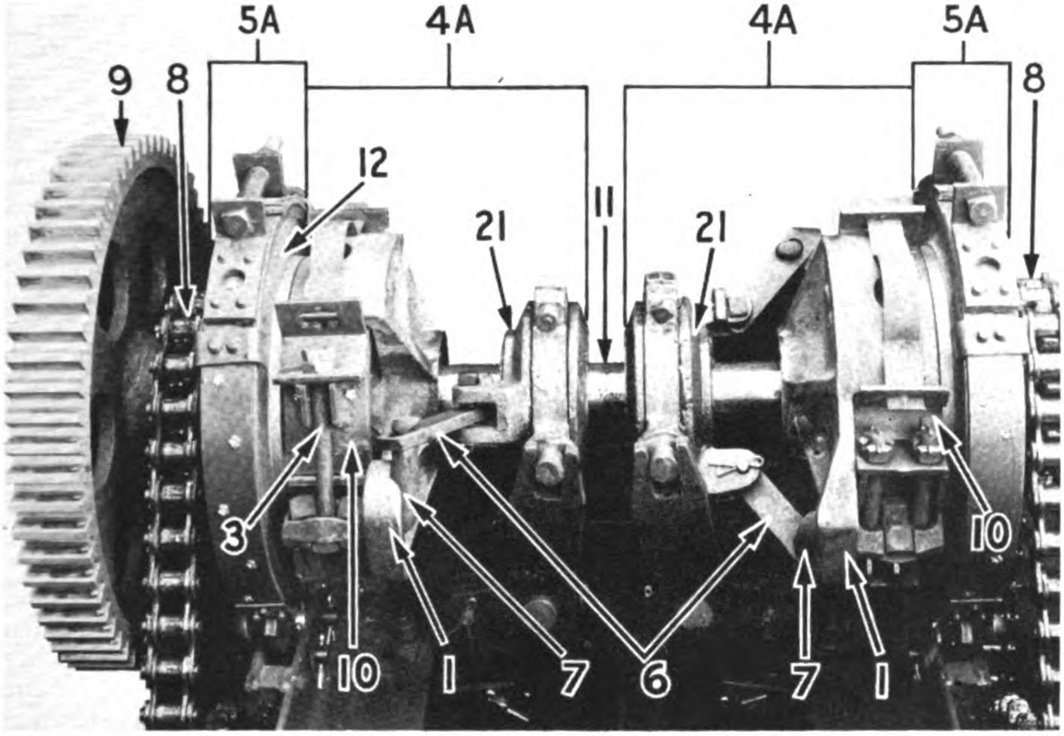


Figure 17. Crawler clutch shaft.

(27) Operation of Crawler Clutches and Brakes

When the clutch operating lever is engaged, the shifter collar is moved toward the clutch. This motion causes the toggle links to move the clutch levers outward resulting in the band halves contracting tightly around the clutch drum. The friction developed causes the drum to rotate and transmit power to the crawler oscillating shaft.

With the crawler clutch engaged, the brake bands fit loosely around the brake drum and develop no braking action. When the crawler clutch is disengaged and a downward pressure is exerted on the clutch operating lever, the brake bands contract and exert a braking effect on the drum. This stops all drives from the clutch through to the crawler. Steering of the loader is accomplished by braking the drive to one crawler while power is applied to the other.

The position of the steering levers when neither the clutch or brake is engaged is neutral position. With these assemblies in neutral, the rest of the drives in the loader can be in operation without moving the machine.

(28) Oscillating Shaft

This shaft (2) figure 18 carries the greater part of the weight of the loader and provides the pivot for crawler oscillation.

This shaft is located below the clutch shaft in bottom of chassis housing. The shaft extends beyond each side of the chassis and sets in brackets (3) figure 18 on each crawler frame.

Mounted on the shaft inside the chassis housing are two sprocket clusters (7) figure 18 which are bronze bushed. These are held in position against the chassis frame by two set collars (6).

When the loader is operating, power is transmitted by chain from the crawler clutch sprocket to the larger sprocket of the cluster. The power then flows to the crawler final drive by a chain running from the small sprocket of the cluster.

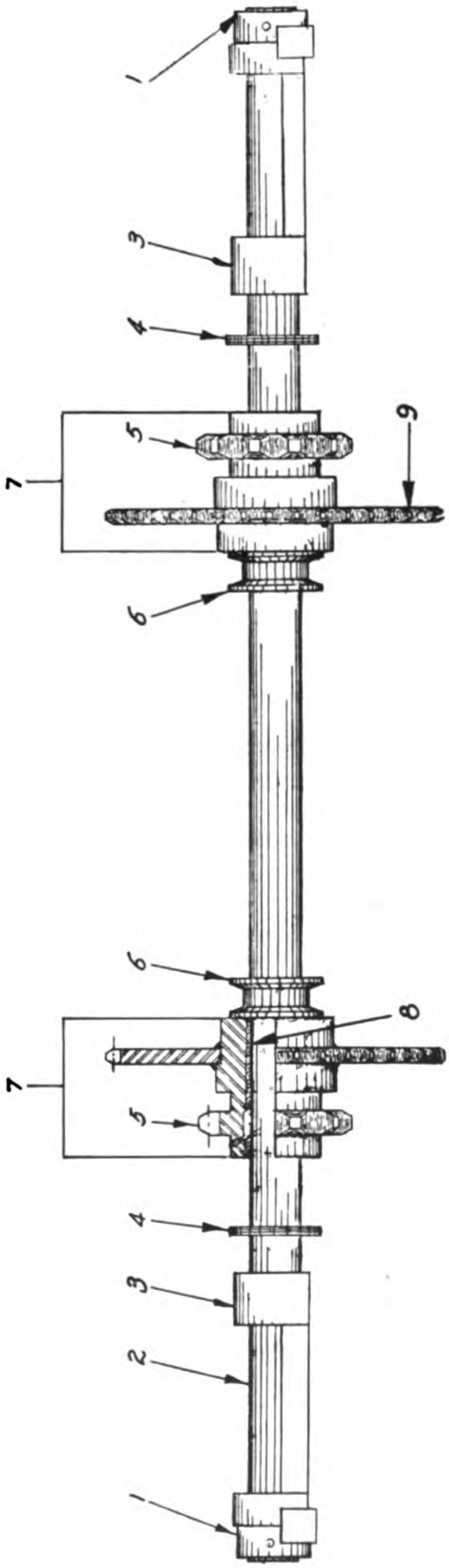


Figure 18. Oscillating shaft.

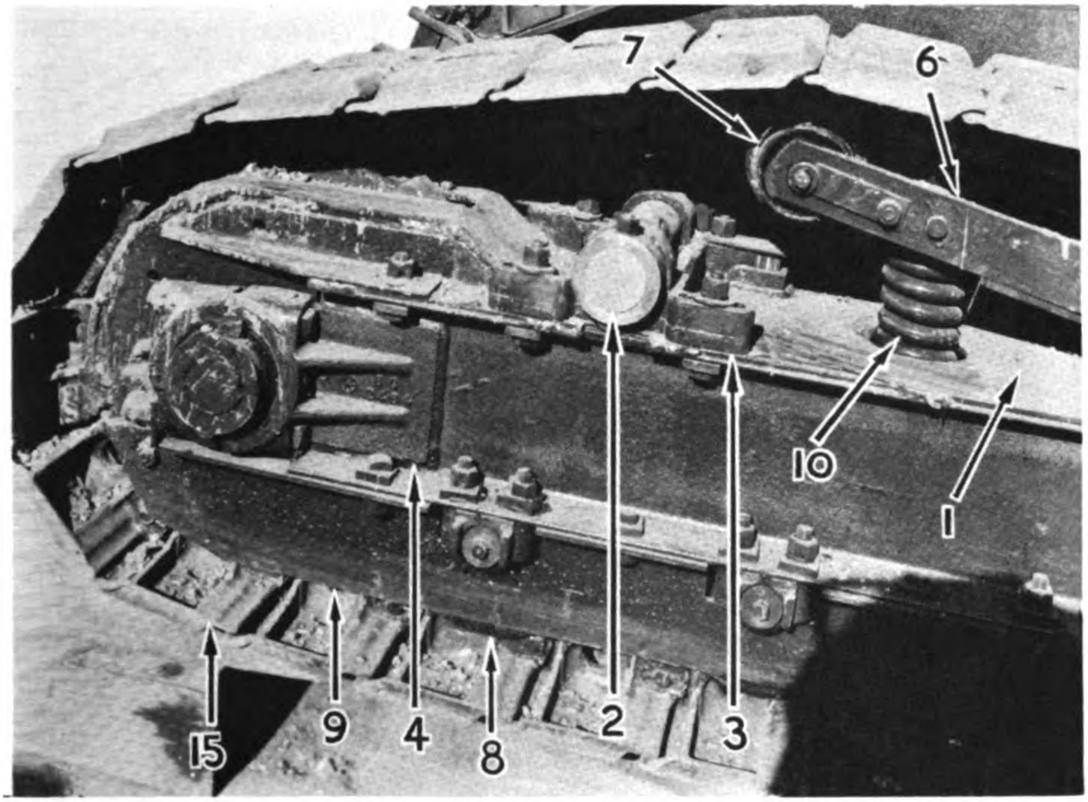


Figure 19. Crawler parts.

(29) Crawler Frame

There are two crawler frames on the loader. Each are constructed alike but are opposite hand. Into these frames are assembled all the parts of the crawler unit.

The frames (1) figure 19 are fabricated of channels and plates electric welded throughout. The bearing bases (4) for the drive end are electric welded to the frame. Near the take-up end are welded two lug angles (10) figure 22 to which the parallelogram type axle attaches. Near the drive end assembly the oscillating shaft attaches to the top of crawler frame by a bracket (3) figure 19 which has slotted holes to provide crawler drive chain adjustment.

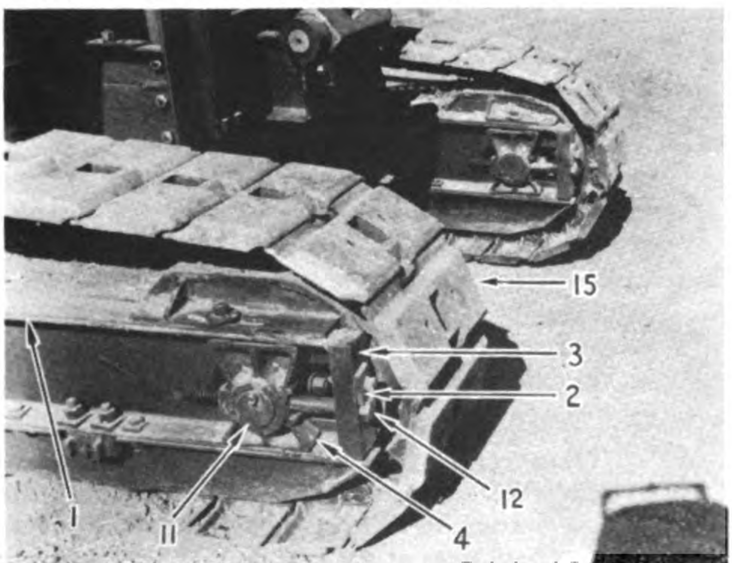


Figure 20. Crawler take-up adjustment.

(30) Crawler Drive Sprockets

The crawler drive sprocket and crawler head sprocket provide the final drive for the crawlers. Both sprockets are keyed to the drive shaft.

The drive sprocket (8) figure 21 is located outside of the frame towards the center of the loader. The crawler head sprocket (5) figure 22 is located in the center of the frame. The shaft to which these sprockets are assembled is mounted in two bronze bushed ball and socket bearings. The bearings are held by caps which bolt to the bases welded to the crawler frame.

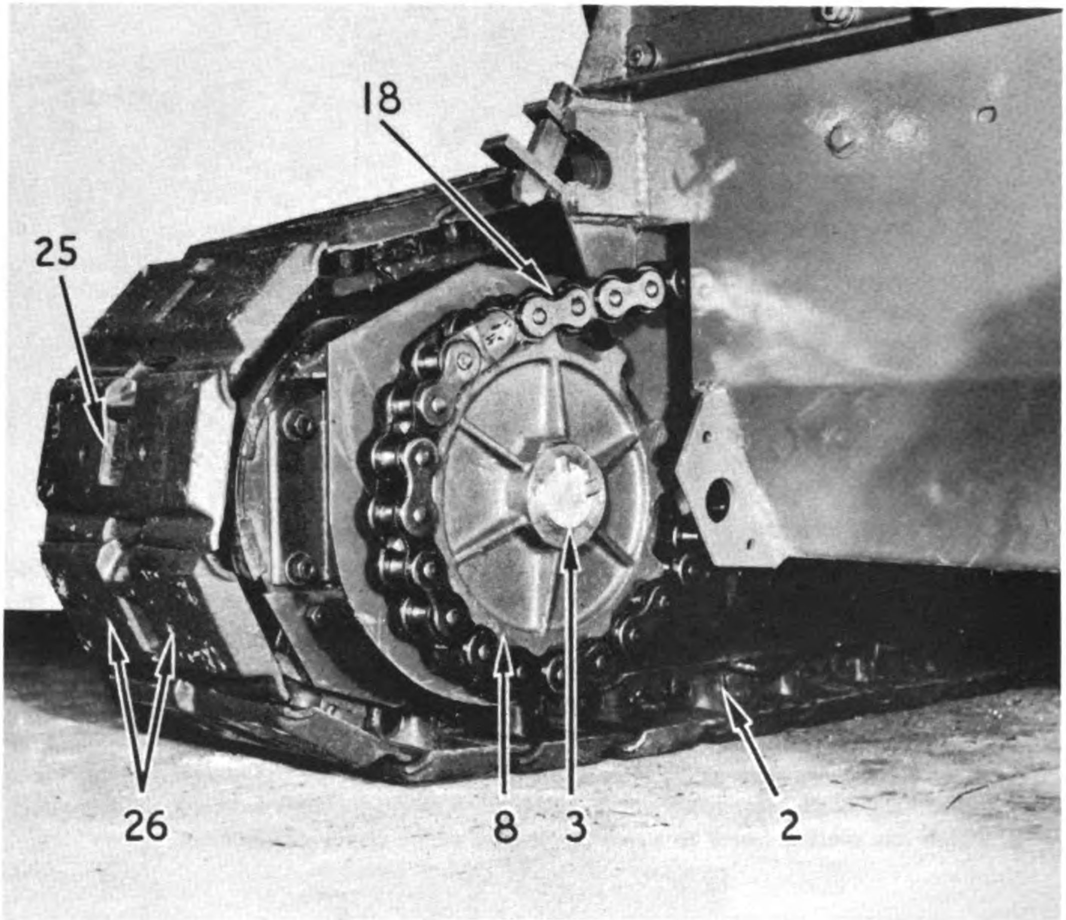


Figure 21. Crawler final drive.

(31) T.U. Shaft

The crawler take-up shaft (11) figure 20 on which the crawler traction wheel is assembled is movable for adjusting the crawler treads.

The shaft is bolted into the two take-up bearings (4). The take-up bearings are supported between the lips of the crawler frame channels (1). Two take-up bolts (12) are assembled through the bearings and shaft with the heads of the bolts outside the take-up fixed bar (3).

The take-up bolt heads are held in position with bolted lock plates to prevent crawlers from becoming loose through vibration.

When making this adjustment alignment must be carefully checked so traction wheel and crawler links will not chafe. Measure from same point on the take-up bearing to a point on the fixed bar. This measurement must be the same on both sides of the take-up.

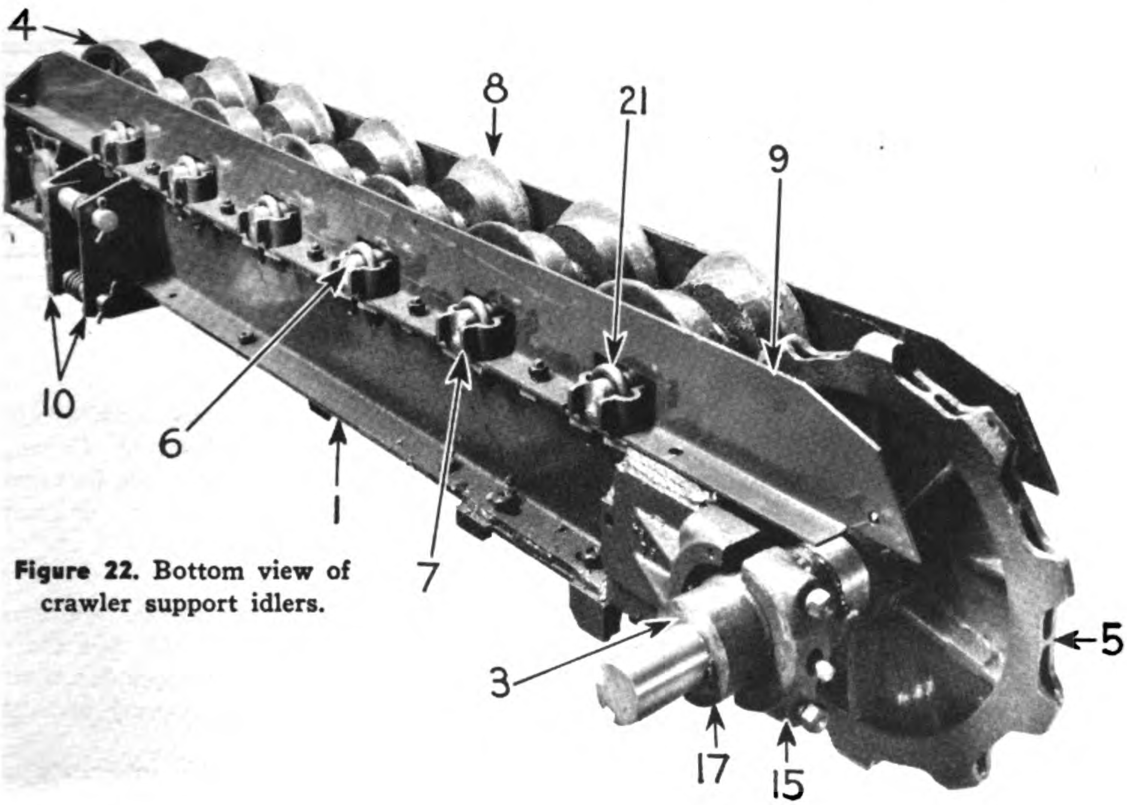


Figure 22. Bottom view of crawler support idlers.

(32) Tread Rollers and Shaft Assemblies

The crawler tread rollers (8) figure 22 support the bulk of the machine weight.

Six crawler tread rollers are assembled in each crawler frame. The shafts (6) are held to the under side of the frame in saddle shaped keepers (7) by U bolts (21).

Along both sides of the frame on the bottom lip of the channel are bolted guard plates (9) which prevent stones from working in between tread rollers and tread links. As the tread rollers become worn the clearance between the tread links and the guard plates will decrease. When the guard plates begin to be scored the tread rollers should be rebabitted and new shafts installed if necessary.

(33) Spring Idler

The spring idler (6) figure 19 on each crawler supports the crawler tread and aids in maintaining tension. The spring idler permits tread tension to relieve in the event that stones should pass between treads links and sprocket teeth.

This idler is mounted on the top of the crawler frame with the flanged roller (7) towards the crawler drive end.

The assembly is a pivoted bar steel arm into which a 4" single flanged roller is assembled. The idler is activated by a tension spring (10).

(34) Treads

The crawler treads are endless chains upon which the machine is propelled.

The treads have 41 links which are held together with T head pins which are secured by cotter pins.

The tread links have rectangular holes (25) figure 21 through the face to allow sprocket teeth to force out obstructing material thus making them self cleaning.

The face of the tread links also have two holes (26) in them so grousers may be bolted to them.

Caution: Every two weeks the crawler T head pins should be inspected and any lost or worn cotter pins replaced. Failure to do this may result in broken T head pins and possible parting of the tread.

Keep crawler in proper tension as instructed in chain adjustment section. Failure to do this will cause excessive wear to tread roller flanges.

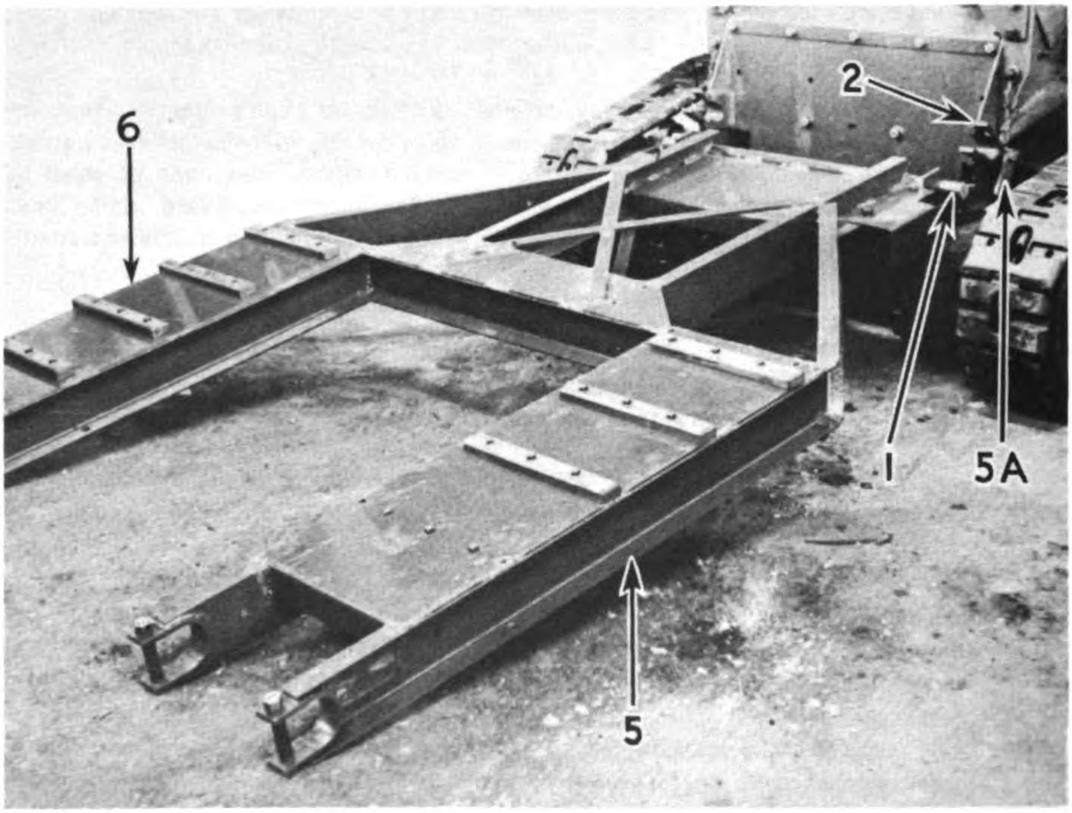
(35) Push Arm

The push arm (5) figure 23 transmits thrust from the chassis substructure to the feeding end of the conveyor frame. The push arm is fabricated of channels and plates electric welded into a frame. The frame is bolted to the foot end of the elevating conveyor frame. A shaft is welded in the chassis end of push arm for connection to the chassis.

The chassis end of the push arm connects to the chassis by fitting into two "U" shaped brackets (2) on the chassis superstructure. Two lock pins (5A) which are chained to the frame to prevent them from being lost, lock the shaft in the "U" shaped brackets. This connection forms a pivot allowing vertical movement of the elevating conveyor.

A platform is provided on the push arm at rear of scraper for the convenience of anyone wishing to observe operation of feed end.

Figure 23. Push arms.



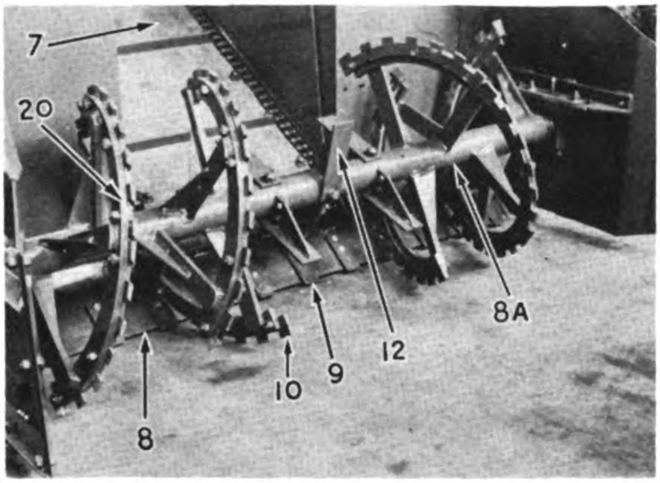


Figure 24. Spiral feeder.

(36) Spiral Assembly

The spiral unit Figure 24 breaks up the snow, brings it to and feeds the conveyor.

The spiral unit is a steel frame with spiral rims, welded to a tube foundation. To the tube (8A) at the center are assembled paddles (12) which aid in propelling snow to the conveyor (7).

The paddles are renewable and should be replaced at once should they become lost or broken since they aid in feeding the belt.

A double pitch spiral extends the full width of the feed.

Renewable notched wearing strips (10) are bolted to the spiral rims (20). The wearing strips are notched to give breaking and tearing effect to the windrowed snow.

The wearing strips should be renewed as soon as teeth wear away. New bolts should always be used with new wearing strips. Wearing strips are in segments so that should some section wear more rapidly only that segment need be replaced.

The spiral assembly is supported at each end by stub shafts (1) (14) figure 25 keyed and set screwed in the tube foundation. The shafts are mounted in ball and socket bearings (3). The bearings are bolted to angles on the inside of the scraper side plates.

On (opposite operator's) side of the loader the shaft extends through the scraper side plate to receive the final drive sprocket (13).

(Warning) Wearing strips should be watched closely. When they wear at any point near the frame they should be renewed immediately. Damage to frame rim will result in a costly welding job or complete renewal.

(37) Spiral Drive

The spiral drive transmits power to the spiral countershaft (8) figure 26. The conveyor drive chain idler sprocket (5) figure 29 on the pivot shaft has a second sprocket welded to the hub. The drive chain runs from this sprocket which is driven by conveyor drive chain, to the spring release sprocket (10) figure 26 on the spiral drive countershaft. This chain is provided with a spring take up sprocket mounted in the chain guard for keeping the chain properly adjusted.

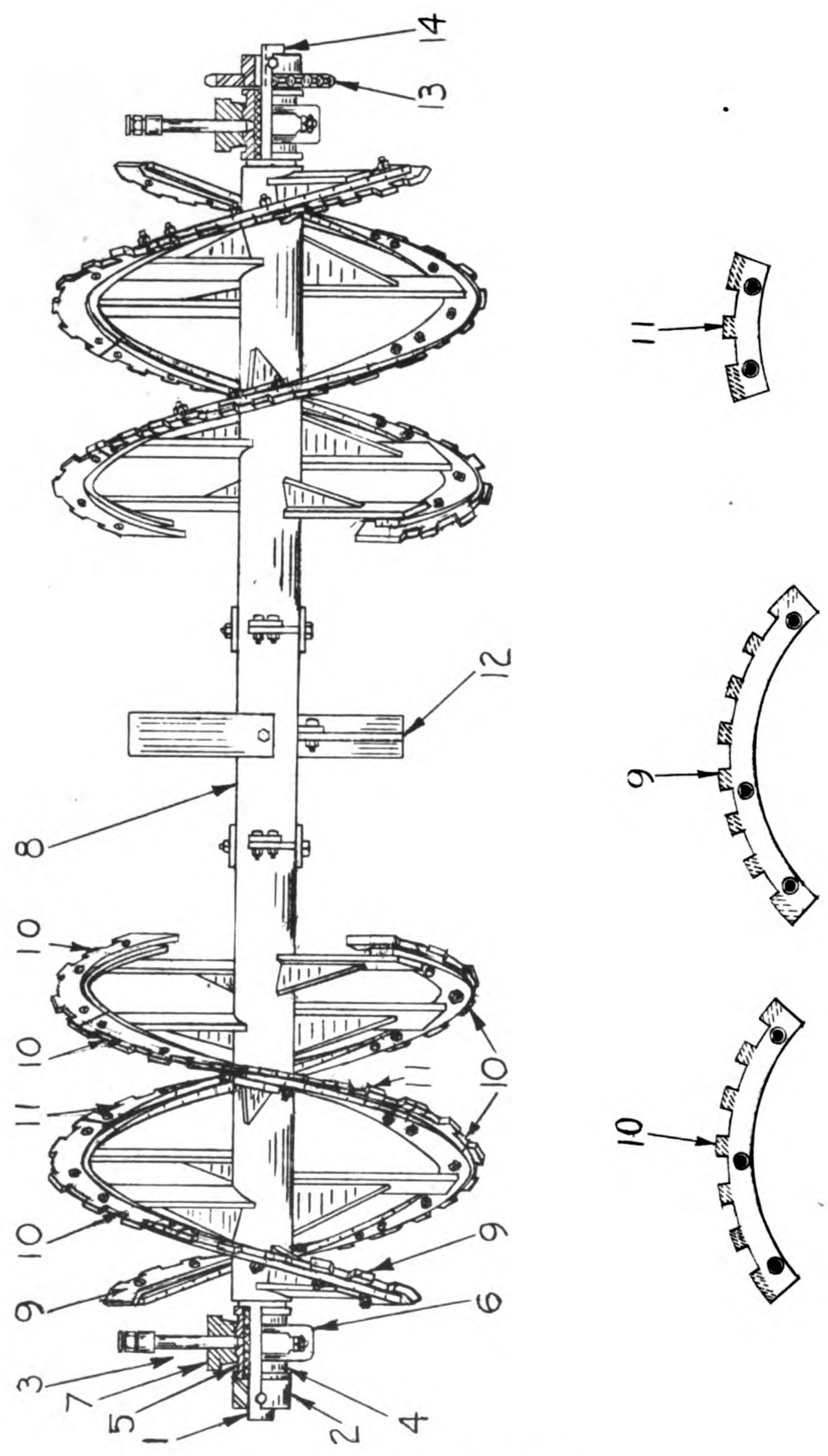


Figure 25. Feeder spiral.

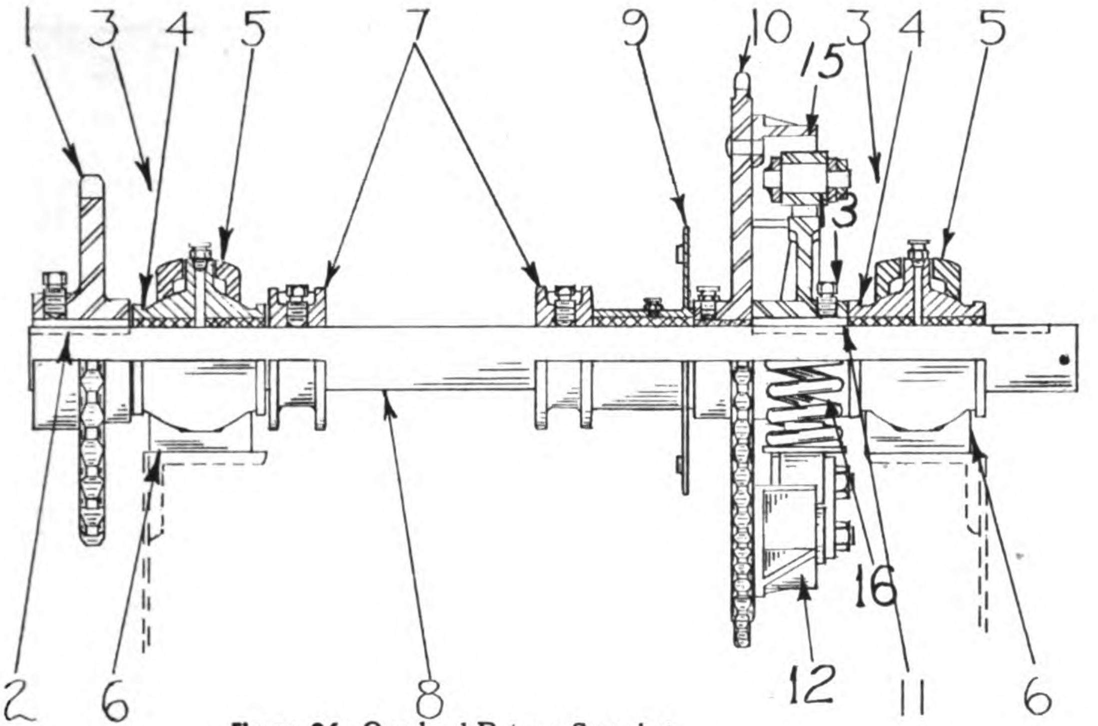


Figure 26. Overload Release Sprocket.

(38) Spiral Drive Countershaft

The spiral drive countershaft (8) figure 26 transmits power through the final spiral drive chain to the spiral. Upon this shaft is assembled the spring release sprocket (10).

This shaft is located over the push arm platform (opposite operator). It is mounted in two self aligning ball and socket bearings (3).

The lower end of the spiral drive chain guard is bolted to a bearing patch plate (9) which rides on the countershaft between the spring release sprocket and a set collar.

(39) Overload Release Sprocket

This is a safety device designed to protect the spiral and spiral driving machinery from damage when the spiral encounters an overload. Such overloads are usually caused either by a foreign object in the snow or by the bottom side of the spiral coming in contact with the pavement or a formation of ice on the pavement. When an overload occurs, the sprocket alternately releases and resets every half revolution until the overload is relieved.

The release sprocket assembly consists of two main parts i.e., the driving sprocket and the hub assembly. The hub assembly (13) figure 26 is keyed to the spiral drive countershaft. The driving sprocket (10) is free to rotate on the shaft. Power is transmitted from the sprocket to the hub through rollers (15) attached to the hub which engage cams (12) on the sprocket.

The principle of operation of the release sprocket is as follows:

The driving sprocket is not rigidly attached to the shaft. This sprocket has two cams (12) riveted to the face of the sprocket, one diametrically opposite the other. When in driving position, the rollers engage the recessed portion of the cams and are held in the recess by pressure of the tension springs (16). When an overload occurs, the springs compress permitting the rollers to disengage from the recess and ride past the cams. At one-half revolution of the sprocket after disengaging the cams, the rollers reengage the cam recesses causing the hub to again rotate if the overload has been relieved. If the overload is still present, the assembly alternately trips and resets until the overload is relieved.

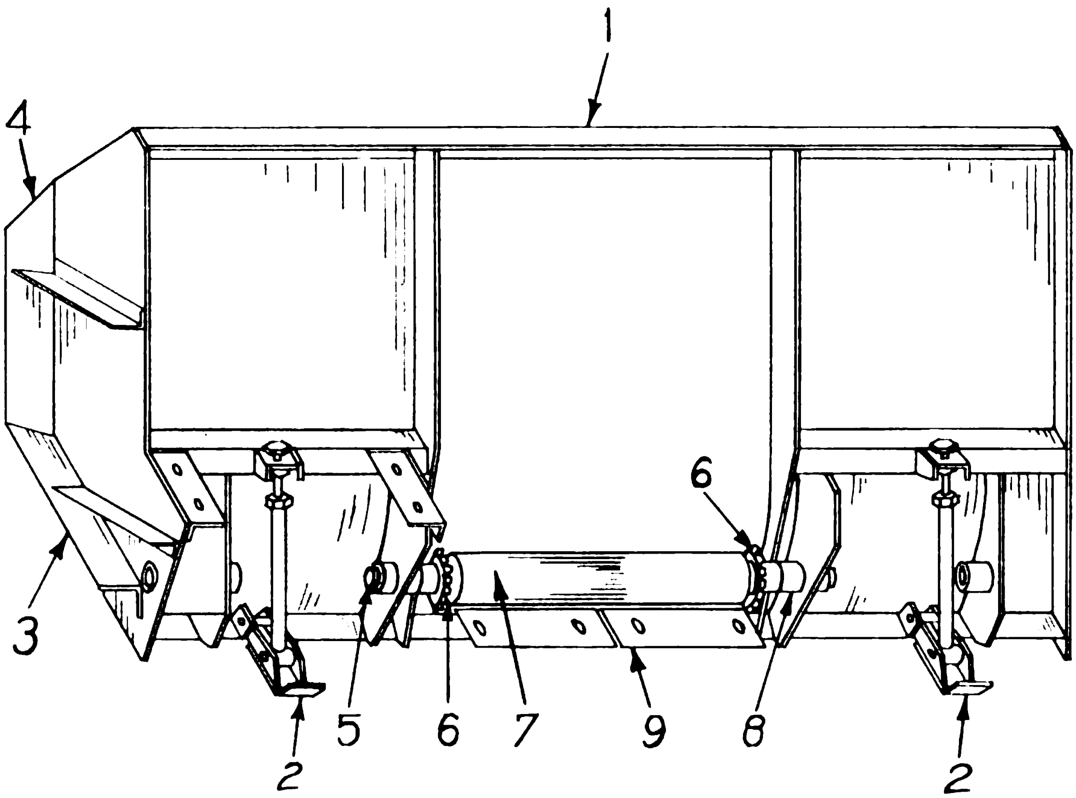


Figure 27. Scraper assembly (rear view).

(40) Scraper

The scraper assembly (1) figure 27 is located at the foot end of the elevating conveyor, directly behind the feeding spirals. Its function is that of obtaining a uniform, clean pickup of snow.

The scraper is fabricated of plates and angles welded into a one piece unit. At the rear of the scraper is an opening for the feeding of the conveyor.

Along the front lower edge is a renewable scraper blade (8) figure 24 and renewable teeth (9) which may become worn through contact with the pavement. The teeth mounted on the scraper blade facilitate breaking up of hard packed snow or ice.

This unit cleans a width of 8′-1″ and is pivoted at the foot end of the elevating conveyor frame for clean up control.

While operating the scraper teeth are held so that they engage the windrows as close as possible to the pavement. Usually about ½″. The scraper is held in any given position by the hand operated worm gear unit.

The adjustable scraper is needed so the operator may control the clean up and also raise the blade if it contacts obstructions in the pavement.

(41) Shoes

The scraper (1) figure 27 is equipped with two adjustable shoes (2), one located on either side and to the rear of the scraper. These shoes carry the weight of the conveyor foot end, and ride the surface of the pavement.

The shoes are pivoted in the center with an adjusting bolt at the rear end. These are adjusted to maintain proper relationship of feeding end to the ground for best clean up control. These shoes are used in conjunction with the scraper control. (See fourth paragraph under "Starting Loader" for proper adjustment.)

(42) Curb Guard

The curb guard (3) figure 27 is a heavy bar fixed to either side of scraper. The purpose of these are to gauge distance when operating next to a curb. Secondly, the curb guard protects the scraper wings (4) as it holds the wings a fixed distance from the curb. When curb guard is running along curb machine should not be forced toward curb so guard rubs heavily against curb.

(43) Footshaft

The footshaft (5) figure 27 is assembled in the feeding end of conveyor frame. The belt chain sprockets (6) and belt pulley (7) are assembled on this shaft. Both the pulley and sprockets revolve freely on the shaft. The foot shaft is stationary and is held in solid bearings (8) with nut locked set screws on both sides of conveyor frame. This shaft may be removed from the tail pulley through holes provided for this purpose in the push arms and scraper side plates.

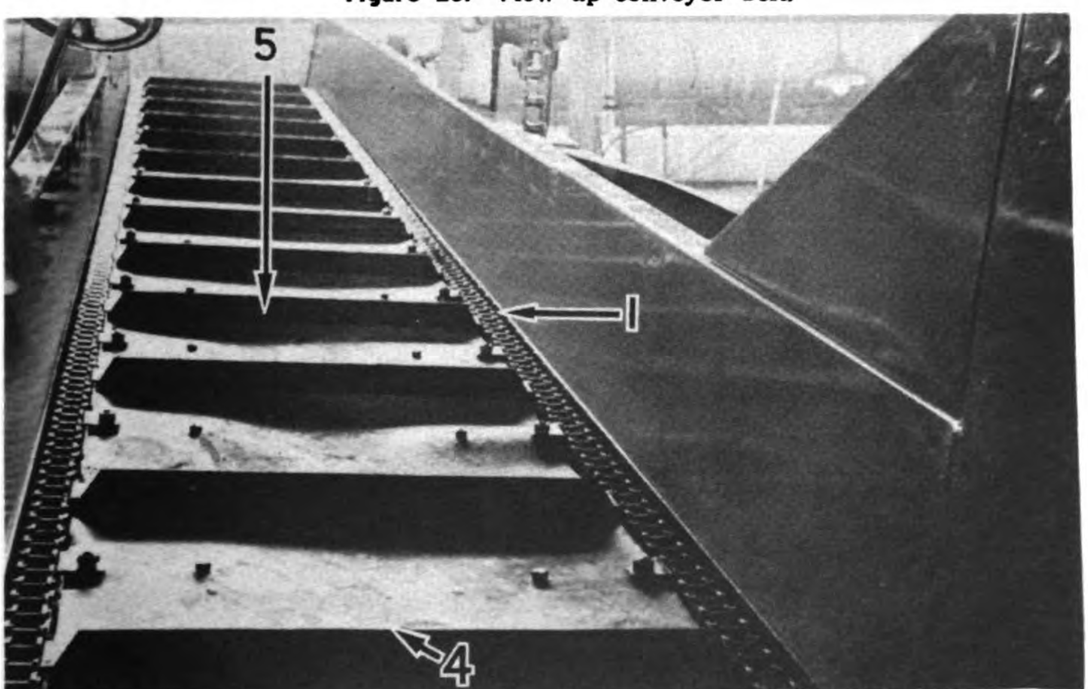
(44) Footshaft Pulley Scraper

At the rear of the tail pulley mounted on the cover pan is a scraper (9) to keep ice from building up on tail pulley. The tail pulley must be kept free of ice otherwise the ice will raise belt causing damage. Ice may freeze on tail pulley forcing uprun belt chains against cover angles at foot end causing hard starting and premature chain wear. There are two plates to the scraper, one each side of machine center line. Each plate is held by two ½" bolts. The scraper edges should not touch pulley at any point. A 1/16" clearance will serve to keep pulley clean. Snow which accumulates from the scraper should not be allowed to build up and lay so it will freeze. A snow hoe is provided so this area may be cleaned easily. The snow should always be cleared away if loader is to lay idle for sometime.

(45) Belt

The conveyor belt (4) figure 28 is 28" wide with 2" high angle cleats (5) spaced about 19" apart. The belt is assembled between two strands of continuous roller chain (1). The belt carries the snow and the chains provide positive drive. All bolts in belt assembly are riveted. (Note) These bolts may become loose therefore it is good practice to check over these once a season, retighten and rerivet those which have become loose.

Figure 28. View up conveyor belt.



The belt operates at a speed of 214 feet per minute. On the conveyor uprun, the belt chains ride on replaceable wearing strips. These strips should be checked weekly and replaced when the inner edges of the chain side bars show wear. Failure to replace the strips may result in an early replacement of the belt chains.

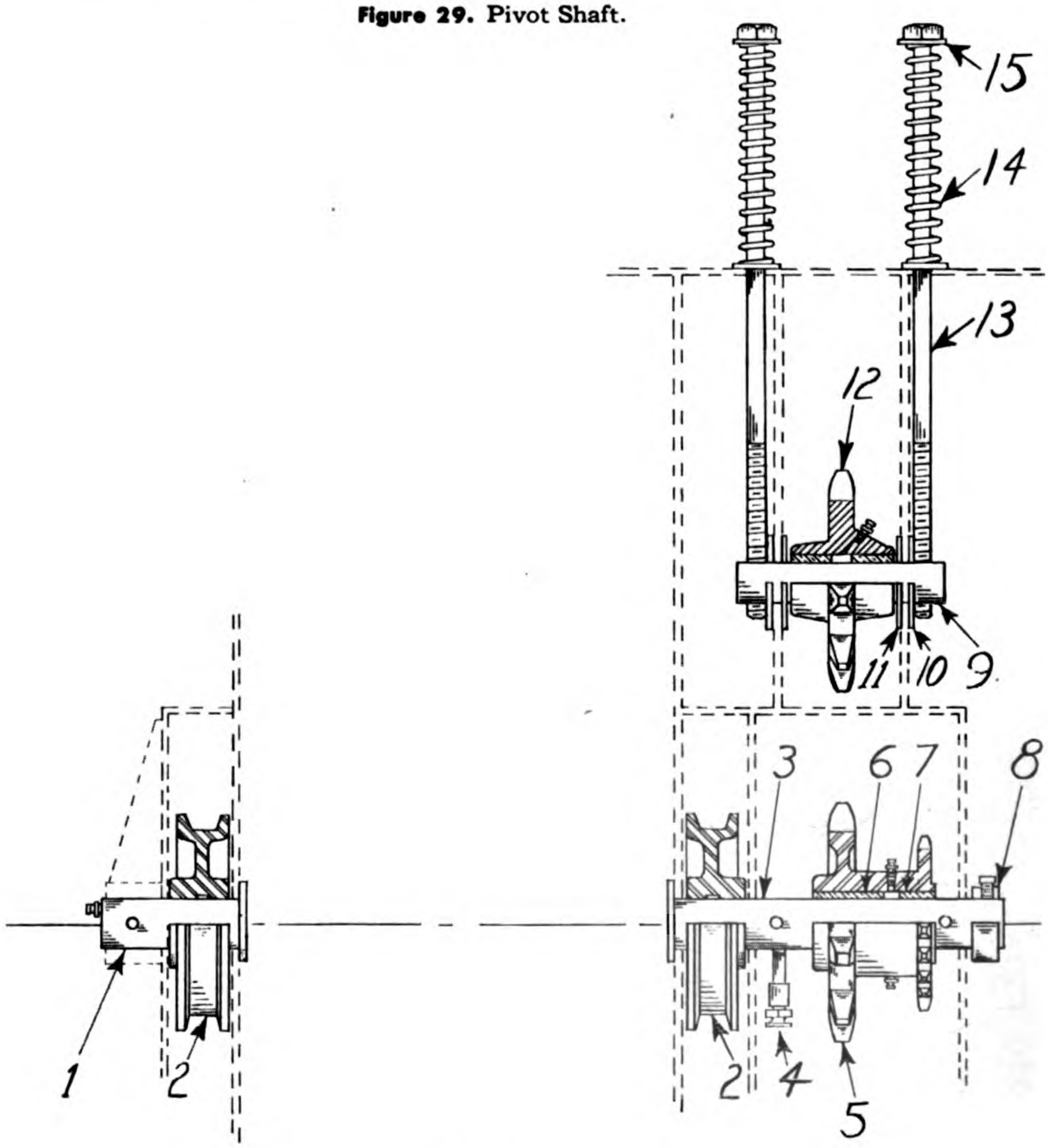
(46) Pivot Shaft

The conveyor is carried by two stub shafts. On the operator's side the shaft (1) figure 29 fits through a structural bearing into a bearing on the conveyor frame. The shaft is held in place by a bolt through the bearing and shaft. A double flanged roller (2) is mounted on this shaft.

Opposite operator the shaft (3) fits through two structural bearings into a bearing on the conveyor frame. The shaft is held in place by two bolts through the structural bearings. A double flanged roller (2) and the conveyor drive chain idler sprocket (5) are mounted on this shaft.

As the elevator is raised and lowered it rides on the superstructure tracks through the double flanged rollers.

Figure 29. Pivot Shaft.



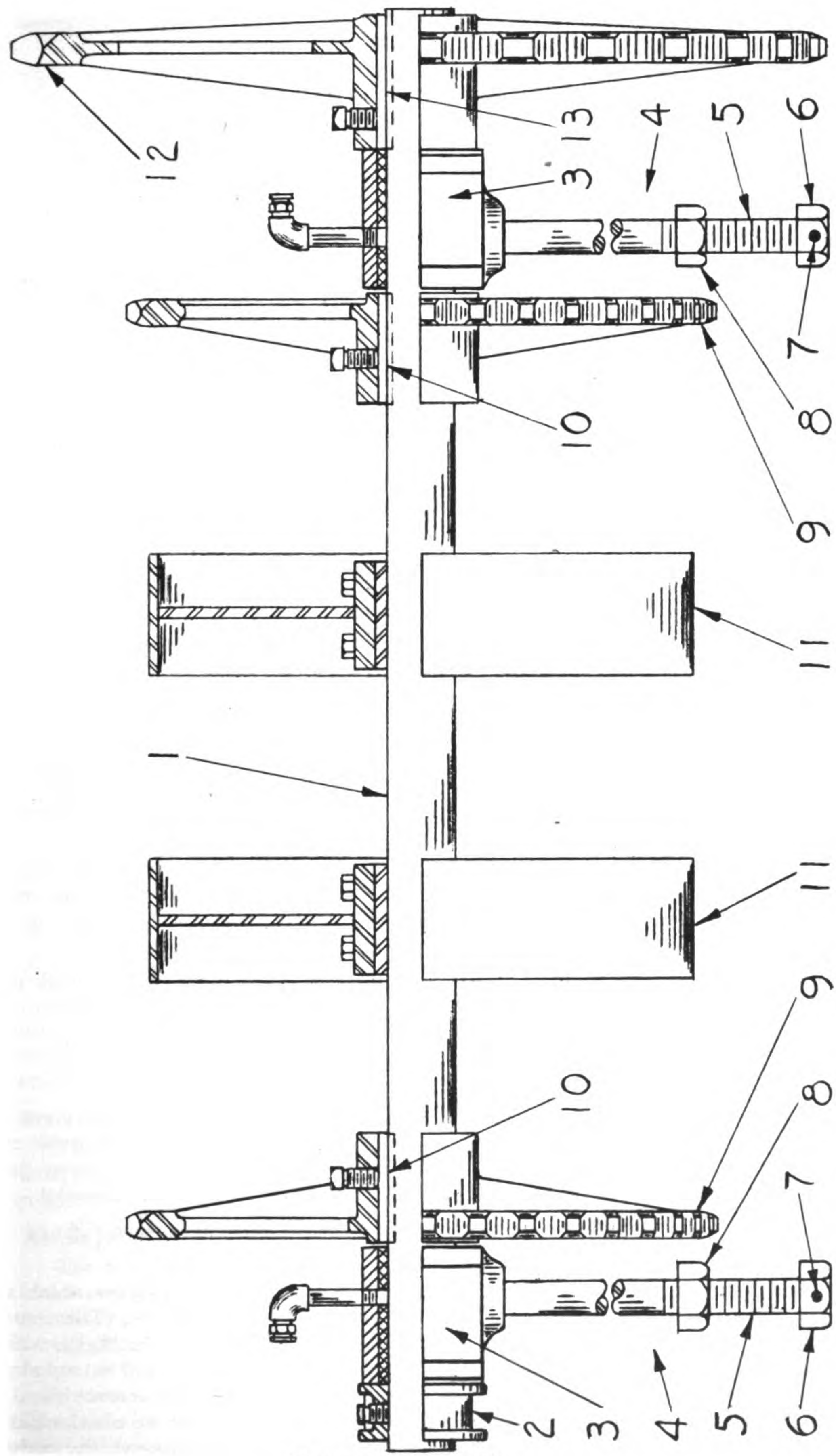


Figure 30. Headshaft.

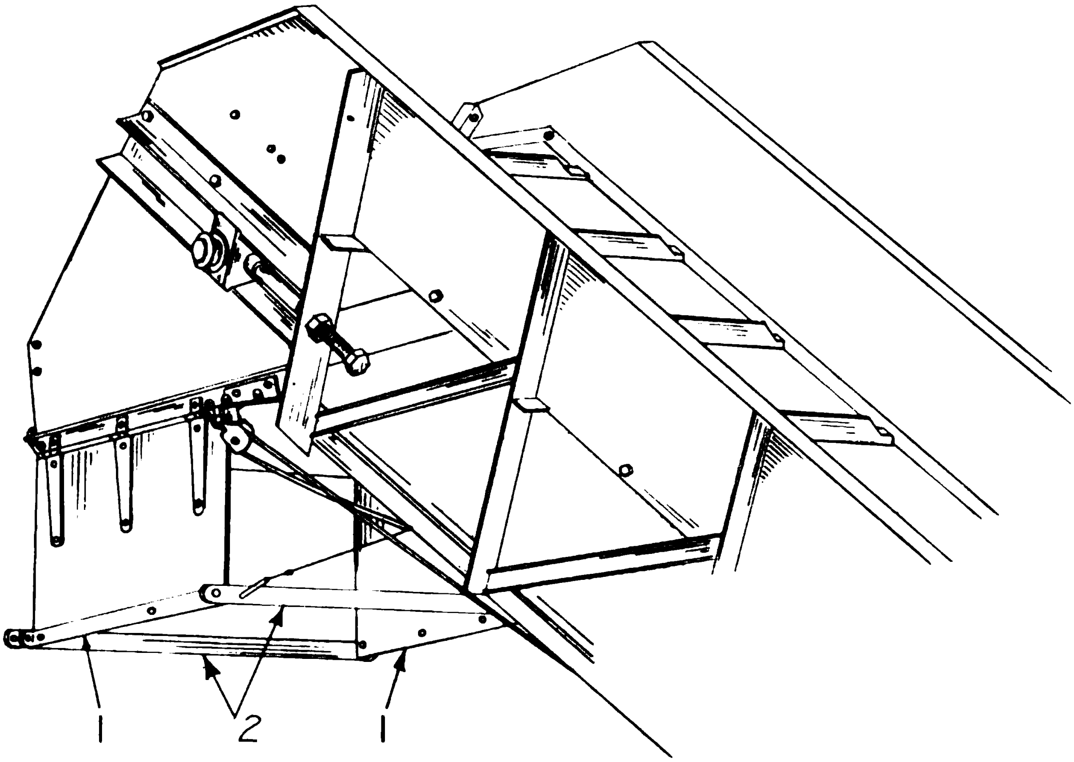


Figure 31. Conveyor discharge baffles.

(47) Head Shaft

The head shaft (1) figure 30 is the drive end of the conveyor and discharge point for snow.

On the head shaft are mounted two sprockets (9) which drive the conveyor belt chains. Two steel pulleys (11) assembled on the shaft near the center provide support for the belt. Opposite the operator side on the outside of the frame is located the conveyor drive sprocket (12).

The shaft is supported by two take up bearings (3). The bearings each have a take up bolt (4) so the shaft may be moved to tighten the elevator conveyor belt.

(48) Discharge Control Baffles

Two baffles (1) figure 31 are located at the discharge end of the elevating conveyor. These baffles consist of hinged plates which attach to the under side of the discharge housing. Two bars (2) attached to the baffles keep them equally spaced and allow both baffles to move from side to side in unison.

The purpose of the baffles is to deflect the discharging snow to right or left as desired to fill the sides of the truck.

The baffle control mechanism consists of the control shaft on which are assembled two cable drums, a ratchet disc and a control wheel. The control shaft attaches to the elevating conveyor frame directly above the engine within reach of the operator. Cables are wrapped around each drum and extend along the boom to the discharge end and attach to each baffle. The control wheel is held stationary by a pawl which engages notches in the ratchet wheel when it is desired to lock the position of the baffles. By lifting the pawl, the control wheel is free to turn in either direction.

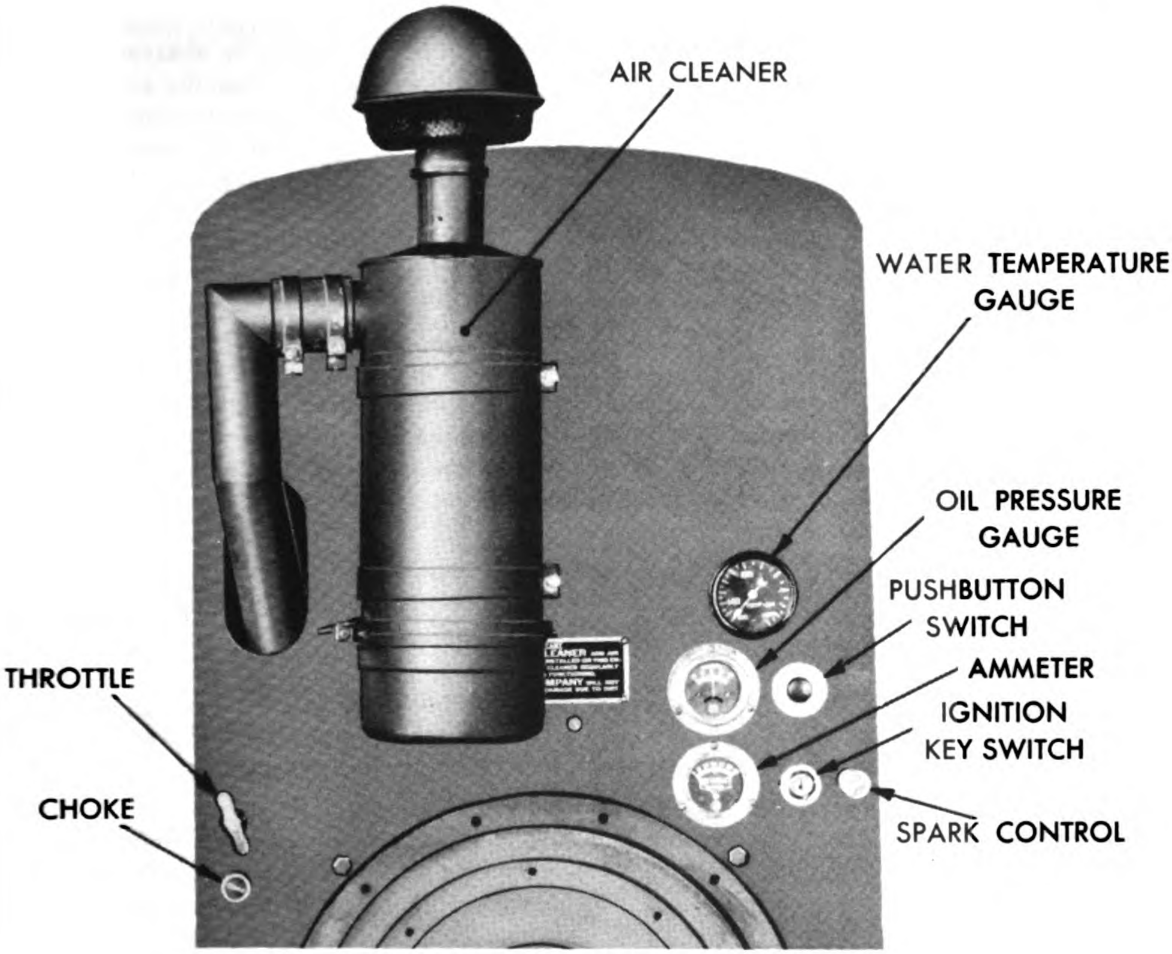


Figure 32. Engine control panel.

Chapter II

Operating Controls

(49) Controls, Engine

The hand controls necessary to start and operate the engine are: the choke, throttle, starter push button switch and spark control. These are conveniently located in one place on the control assembly of the machinery for which the engine supplies the power. See figure 32.

(50) Instruments

The instruments used on this engine to indicate efficiency of its component functions are an ammeter, an oil pressure gauge, and a temperature indicator gauge. See figure 32.

(51) Ammeter

The ammeter indicates the rate of charge or discharge. The readings are from 0 to 30 (charge) and 0 to —30 (discharge). Because the voltage regulator controls the rate of charge, it is common for the reading to be at 0 or close thereto. This indicates that the battery is fully charged or in a high state of charge. If the reading continues at a high figure (over +10), this indicates trouble with the voltage regulator. However, a rundown battery will take a higher rate of charge for a few hours. If the reading shows high on the discharge, there is a short somewhere between the ammeter and the generator. See Voltage Regulator and Generator, Chapter VI.

(52) Oil Pressure Gauge

This gauge is located at the operator's controls and should be observed a number of times during the operation period and especially just after the engine is started. See figure 32. This gauge indicates whether or not the proper amount of pressure is being delivered to lubricate satisfactorily the internal workings of the engine. The pressure for normal operating speeds is approximately 30 pounds when engine is warm. The connection to the pressure system is on the right side of the crankcase just ahead of the flywheel. See figure 9.

If the reading indicates low oil pressure, checks for the following conditions should be made: oil in crankcase is low, or oil is too thin; leaks in oil pressure line; leaks in the line to the oil filter and in the line to the governor. If those items are all right, the pressure loss is in the engine and a maintenance mechanic should check as indicated in the Maintenance Manual, Section II. If the reading is high, either the oil being used is too heavy or the check valve spring tension is too high. In the case of the latter, this condition should be corrected by the maintenance repair man.

(53) Temperature Indicator Gauge

The temperature indicator registers a temperature of the engine and has a scale of 100 to 215 degrees. Any temperatures over 215° is regarded as dangerous and indicates over-heating due, in most cases, to lack of water.

(54) Bayonet Gauge

The bayonet gauge, or dip stick, or oil level stick, is located at the right side of the engine, and it indicates the level of the oil in the crankcase. The level of the oil should show "F" or full.

(55) Master Clutch Lever (1) Figure 33

Push lever in to engage motor, pull out to disengage motor. This lever should be slowly but firmly operated. A distinct snap is felt as clutch engages and disengages. (Note) Do not wait until clutch burns or smokes before adjusting.

(56) Main Transmission Gear Shift Lever (2) Figure 33

Master clutch must be disengaged before shifting gears. Gearshift plan is standard. (NOTE) USE ONLY FIRST SPEED IN ALL LOADING OPERATIONS. SECOND AND THIRD SPEEDS FOR TRAVELING ONLY. Reverse speed for lowering elevator or traveling only.

(57) Conveyor Hoist Clutch Lever (3) Figure 33

Power is transmitted to the power hoist through a friction cone clutch. Push clutch lever forward to engage. Lever must be held in until conveyor is at desired position. To raise conveyor shift master transmission to first and engage master clutch before engaging hoist clutch.

To lower conveyor shift master transmission to reverse and engage master clutch before engaging hoist clutch.

CAUTION: Do not operate hoist clutch when main transmission is in second or third speed. Keep free of hand hoist wheel when raising and lowering conveyor with power hoist.

(58) Steering Levers (4) Figure 33

The crawlers are separately controlled. Right lever controls right crawler. Left lever controls left crawler.

Clutches are engaged when levers are up. Brakes are applied when levers are down. Midway between these positions the clutches are disengaged and the brakes are off. Either crawler may be engaged or braked independently of the other.

CAUTION: Do not attempt to lock one crawler and cause it to pivot when the footing is soft or when the elevator is in operating position with material on either side of the scraper. If operator is inexperienced he should practice steering and turning before attempting to operate on a job.

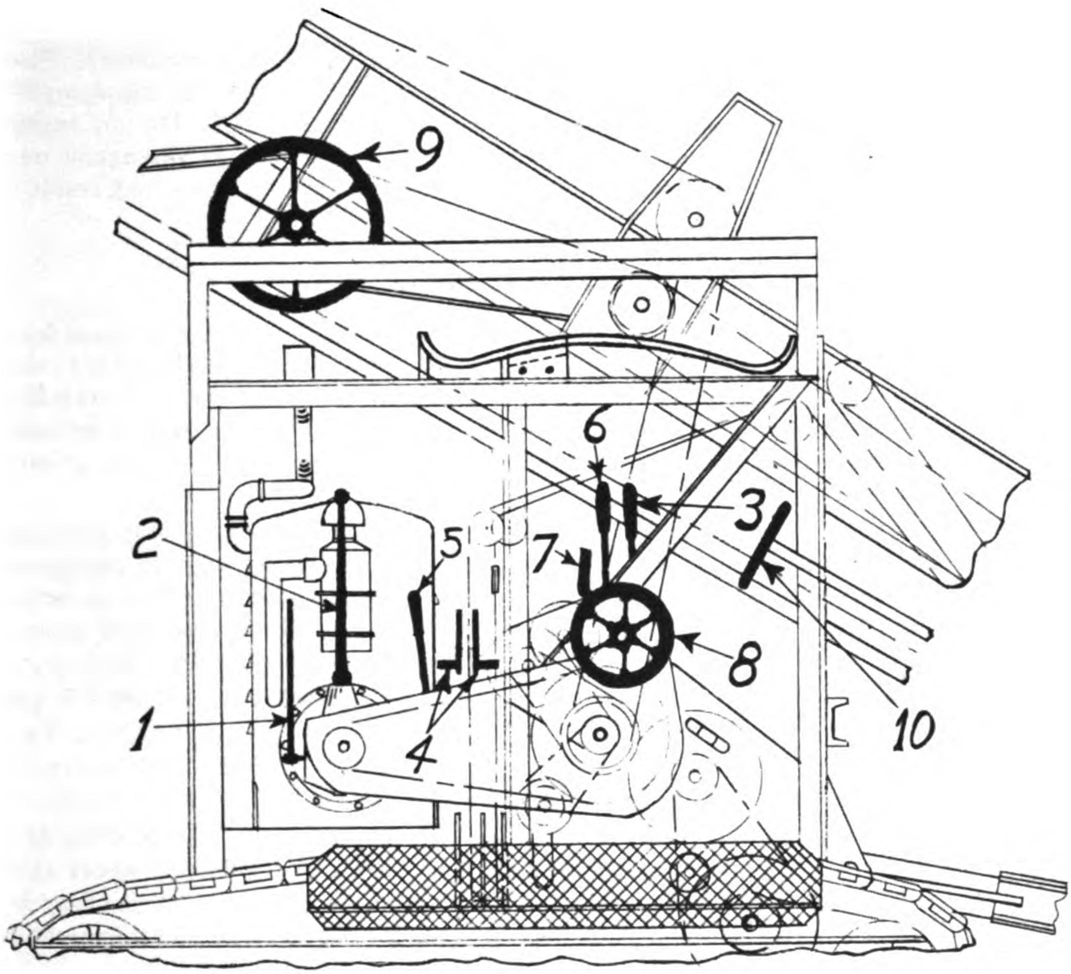


Figure 33. Operating levers.

(59) Elevating Conveyor Clutch Lever (5) Figure 33

The conveyor and spiral feed are engaged by means of a jaw clutch. Push forward to engage and pull back to disengage. When lever is disengaged it should be behind stop to prevent slipping ahead. WARNING: Do not engage conveyor clutch unless Master Clutch is disengaged. Always disengage conveyor clutch before operating loader in reverse. Failure to do so may result in irreparable damage to the clutch jaws.

(60) Crawler Speed Change Lever (6) Figure 33

The function of the speed change lever is to change the crawler speed from traveling range to crowding range. In traveling speed the power from the main jack shaft is transmitted directly to the crawler clutch shaft. When in crowding speed, the power is transferred through the auxiliary crowding transmission where speed reduction takes place before being transmitted to the crawler clutch shaft.

The speed change clutch consists of a combination sliding spur gear and double jaw clutch. The speed change lever is pushed forward to change to traveling range and back to engage crowding range. Be sure the lever is moved far enough so that the lever lock pin will engage the holes in the speed change quadrant. The lever will shift easier if crawler clutches are first disengaged. It is then necessary to turn main jack shaft over slowly until the jaws are in position to fall in mesh.

(61) Gear Box Shift Lever (7) Figure 33

When the speed change lever is shifted into crowding range there is a choice of two crowding speeds available by shifting the crowding speed shift lever. The high crowding speed is available by pushing the lever all the way in. Low crowding is available by pulling the lever all the way out. Disengage both steering levers before shifting this lever.

(62) Hoist Handwheel (8) Figure 33

The conveyor may be lowered by turning the hand hoist wheel clockwise. The conveyor must be raised by power. This handwheel may be used for the fine adjustment in cleaning pavement. Time is saved by using this handwheel because when elevating conveyor is operating he does not have to stop machine and shift in reverse any time the feeding end needs lowering a few inches. When operating, the cables should be slightly slack but not enough to allow cables to lose position on drums. This allows feeding end to ride properly on scraper shoes. If cables are taunt while loading and the crawlers should ride over a rise in the pavement the feeding end would be lifted enough to cause improper clean up.

(63) Baffle Control Handwheel (9) Figure 33

This handwheel is used for controlling discharge baffles. The rachet wheel immediately behind the handwheel is held in place by a stop. When this is lifted and held the handwheel may be turned in either direction. Baffles may be swung to and from operator which aids in distributing load in truck body.

(64) Scraper Control Handwheel (10) Figure 33

The scraper blade may be raised or lowered by hand. The blade may be lowered toward the pavement for better clean up. It may be raised in case the teeth on the blade encounter an obstruction. The scraper is held in any given position by the worm gear unit which is operated by this handwheel.

Chapter III

Specifications

38D Snow Loader

Capacity 10 to 20 cu. yds. per minute
Weight 17,300 pounds—Operating Weight 19,450 pounds

Overall Dimension—Operating		Shipping
Height	15'-5"	11'-3"
Width	8'-4"	8'-0"
Length	28'-4"	31'-0"

Discharge Height 10'-6"
Cleanup Width 8'-2"

Engine

Model—Buda HP-217
TYPE—Vertical en-bloc "L" head, four cycle, four cylinder, water cooled.
POWER—38 HP at 1400 R.P.M. Laboratory Test.
BORE AND STROKE—3-13/16" x 4¾".
DISPLACEMENT—217 cubic inches.
ROTATION—Clockwise, viewing it from front or fan end of engine.
CAPACITIES—
Crankcase Oil Capacity—5½ qts.
Cooling System Water Capacity (including radiator)—
4 gallons
Air Cleaner Oil Capacity—1 quart

Accessories

Description	Buda Part No.	Manufacturer	Manufacturer's Model No.
1. Air Cleaner	AP6563	Donaldson Co., Inc. St. Paul, Minn.	A-5329
2. Starter	2734	Delco-Remy Anderson, Ind.	1107421
3. Generator & Voltage Reg.	H-12175	Delco-Remy Anderson, Ind.	1101671
4. Distributor	3884	Delco-Remy Anderson, Ind.	629-N
5. Governor	H-11925	Pierce-Governor Co. Anderson, Ind.	A-1728-E
6. Carburetor	H-11385	Zenith Carburetor Div. Detroit, Mich.	124½ TOX
7. Oil Filter	H-11676	DeLuxe Products Corp. La Porte, Ind.	CUL
8. Fuel Pump	H-12170	A-C Spark Plug Div. General Motors Detroit, Mich.	1523621
9. Coil	1755	Delco-Remy Anderson, Ind.	528-C

Accessories (Cont'd)

Description	Buda Part No.	Manufacturer	Manufacturer's Model No.
10. Magnetic Switch	AP-6297	Delco-Remy Anderson, Ind.	001453
11. Ammeter	AP-6592	U. S. Gauge Co. New York, N. Y.	30-30
12. Push Button Starter Switch	AP-3696	Leece-Neville Co. Cleveland, Ohio	103SS
13. Key Switch	3998	Briggs Stratton Co. Milwaukee, Wis.	404224
14. Pressure Gauge	AP-3883	U. S. Gauge Co. New York, N. Y.	#60
15. Temperature Gauge	DP-594	Stewart-Warner Corp. Chicago, Ill.	692-B
16. Spark Plugs	H-11629	AC Spark Plug Div. General Motors Flint, Mich.	#86
17. Radiator	AP-6079	Yates American Machine Beloit, Wis.	

Chassis

Frame

Tank type—Main frame is welded box of ¼" plate, dirt tight, contains all driving mechanism. All levers and controls assemble on this unit. Superstructure is also of welded construction and bolted to box unit. Crawler pivot axle is located in base of box and two 8" sills, welded to the box, support the engine and transmission.

Transmission and Machinery

Fuller Model S U transmission, having three speeds forward and one reverse, directly connected to engine. 10" Twin Disc Master Clutch in the bell housing. Other drives and reductions are through steel bushed roller chains running on cut tooth steel sprockets and through cut tooth spur gears.

Crowding Speeds

With main transmission in low gear:

Multi-speed gear box gives possibility of 12 crowding speeds, paired as follows in feet per minute:

2.60	3.88	5.60	7.31	10.53	15.75
5.51	8.23	11.86	15.49	22.32	33.36

Any two paired speeds may be selected by interchanging two gears or substituting one or the other of two sets of change gears. Once selected the two speeds are immediately available by shifting lever.

Traction Speeds, in Feet Per Minute

1st 63
2nd 126
3rd 251 or 2.85 M.P.H.
Reverse 56
Belt speed is 214 F.P.M.

Crawlers

Shoes 14" wide, 7'-8" long. Forged heat-treated alloy steel cleats or grousers are added to increase the traction. Tread links are self cleaning.

Steering

Each crawler may be driven, disengaged, or braked independently. Each is controlled by a separate lever connected to an 8" band friction clutch which is easily adjustable.

Oscillating Axle

Consists of two steel cross bars assembled as a parallelogram, which keeps crawlers in definite vertical alignment. Main structure mounted by three-point suspension, with pivot point at center of oscillating axle.

Elevating Conveyor Frame

Structural steel, all welded construction and including 15" skirt boards.

Return belt is housed top and bottom, to keep out snow and water and prevent spillage. Wearing strips are provided on chain run angles.

Combination Belt and Chain

Chain is No. S S-378 bolted to sides of belt which is 28" wide, 4 ply, 28 oz. duck 1/16" rubber covered. Angle flights 2" high bolted across every 19".

Conveyor Drive Chain

Chain is 2.62" pitch steel bushed roller chain.

Feeding End

Consists of 6" hardened steel scraper blade 7'-6" wide, on which are fastened at intervals hardened steel teeth and a spiral feeder, having notched, replaceable, wearing strips of heat-treated alloy steel bolted to spiral rim. A double pitch spiral extends full width of the feed. Entire feeding end rides on adjustable shoes and may be pivoted about foot shaft of conveyor, by means of a hand controlled self locking worm gear. Overall pick-up 8'-2" wide.

Overload Release Sprocket

An overload spring release on spiral feed drive protects driving mechanism from breakage. Automatically resets itself.

Conveyor Hoist

Conveyor is raised by power by means of a self locking worm gear hoist and a cone clutch located in the chassis housing. Internally lubricated.

Discharge

Baffle plates attached to the head end of the conveyor and controlled by a handwheel in convenient reach of the operator's platform, deflect the snow to one side or other.

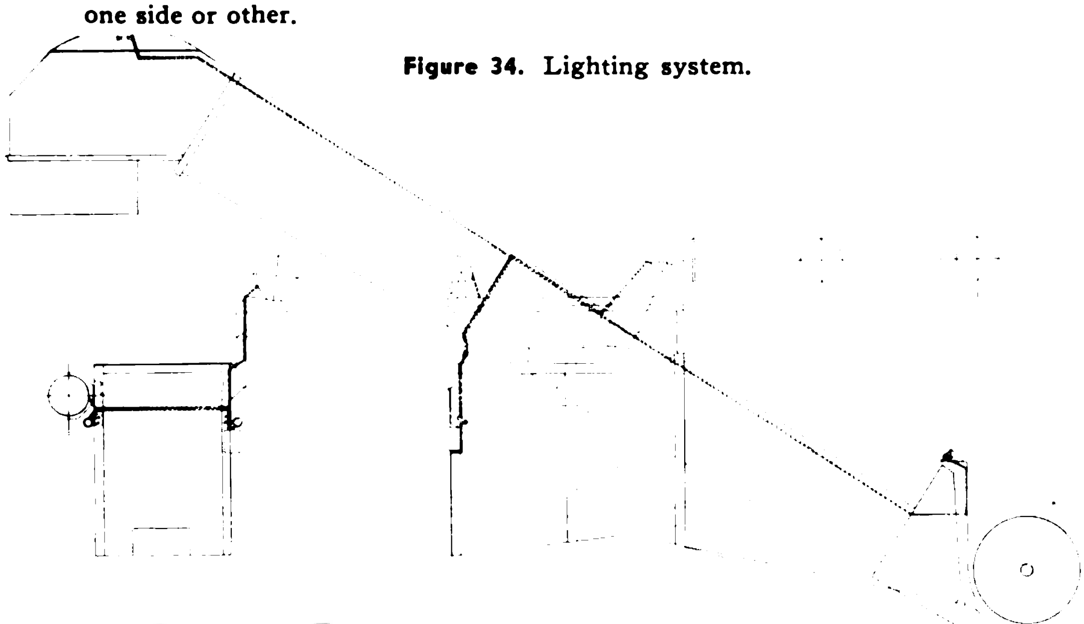


Figure 34. Lighting system.

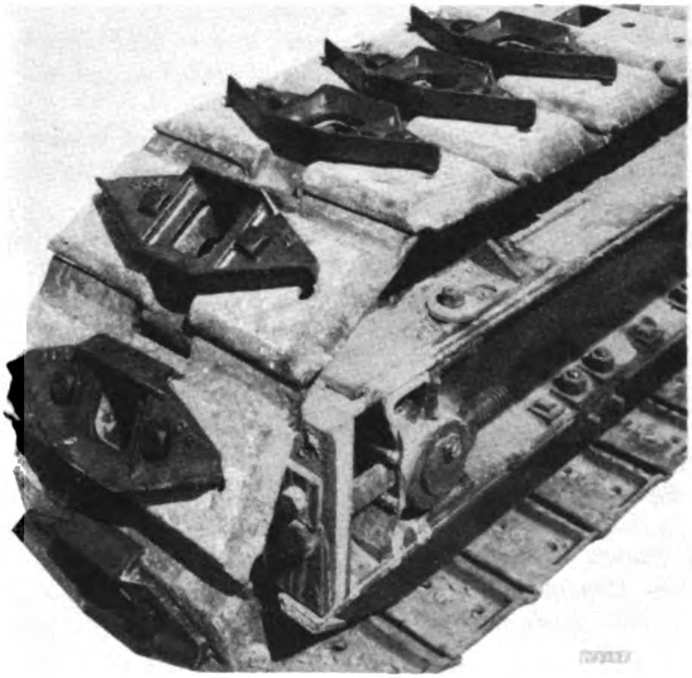


Figure 35. Grousers attached.

Chapter IV

Preparing Loader for Operation

(65) Assembly of Loose Parts Which Are Normally Removed For Transporting

The operator's canopy, lights and grousers are removed for shipping and must be installed before operating the loader. The canopy has two supports. The left hand support bolts to a bracket which is mounted at the top of the vertical angle of the superstructure nearest the power unit. The left hand support bolts to an angle which is attached to the vertical angle of the superstructure nearest the feeding end.

The flood and warning lights are located on the machine as shown in figure 34. The flood lights are attached to a bracket which is bolted in position with one ½" bolt. The lights may be tilted up and down in the bracket. The bracket may be swiveled on the ½" attaching bolt.

The wiring for lights is completely installed. A plug is located at each light position and fits into the lamp socket.

The red warning lights are assembled to brackets as shown. These brackets bolt to the machine with ⅜" bolts. These lights are kept in stationary position.

The loader is shipped without the grousers being assembled on the tread links. The machine is shipped this way so if the loader is to be traveled in the warm weather the treads will not mark the pavement over which it is driven.

Before the machine is ready for operation the grousers must be installed, one to each tread link. The proper position of the grouser on the tread link is shown in figure 35.

The loader should be lubricated, the clutches and chains should be checked for proper adjustment as shown in operation adjustment section.

Chapter V

General Precautions

(66) Preparing Engine for Operation

To prepare a new engine or one which has been standing for a long period of time and has the fuel and lubricating oil drained, follow these steps:

(a) Give the engine a detailed inspection. See that all drain plugs are tightly replaced. Figure 9 shows location of all drain plugs and cocks.

(b) Check wiring and electrical connections, as well as the hose connections, both for the cooling and air induction systems.

(c) Remove the spark plugs and pour about ½ an ounce of engine oil into each cylinder. This pre-oils the rings and cylinder walls so as to immediately assure good compression.

(d) See that the engine turns freely by hand—two or more complete revolutions. This will distribute the oil on cylinder walls.

(e) Fill the crankcase with the recommended oil for the prevailing temperature. Lubricate the governor link ball joints, governor throttle shaft and the carburetor throttle shaft. Apply WB #2 grease to the clutch housing bearing and the clutch pilot bearing. Oil the generator and the water pump. See figure 36.

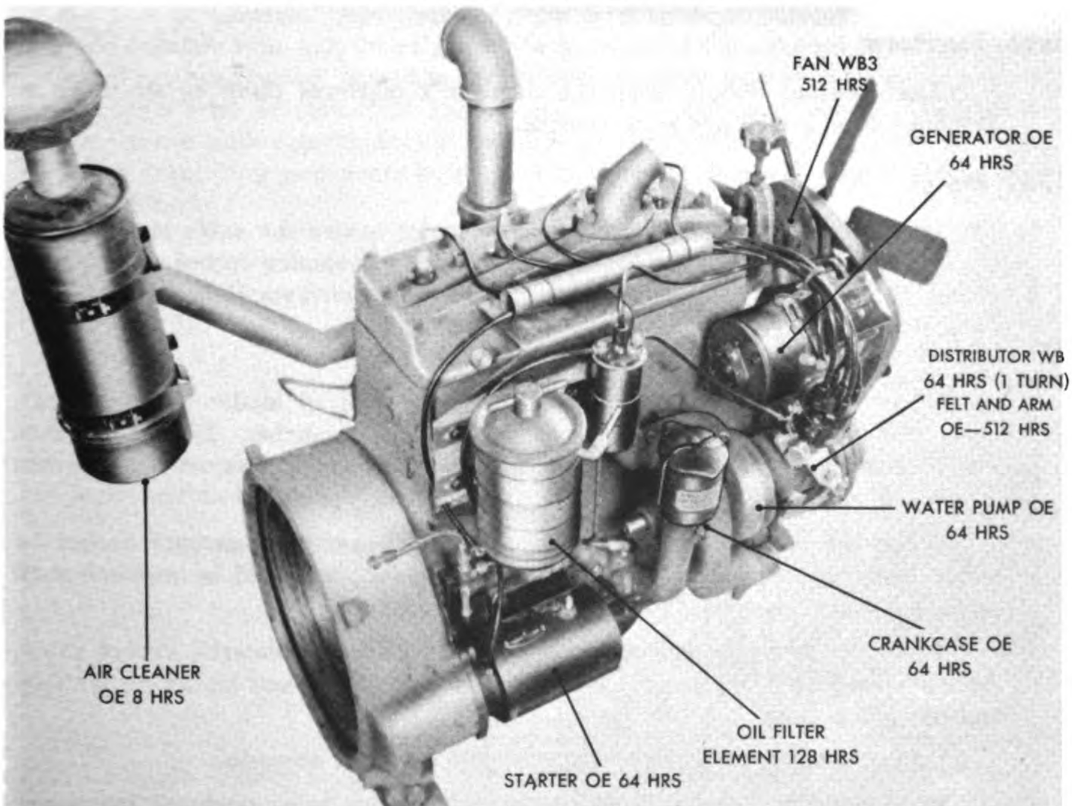
(f) Fill cooling system with clean water or proper anti-freeze mixture if below freezing weather is to be expected.

(g) Connect storage battery. See wiring diagram, figure 6.

(h) Fill fuel tank with gasoline. Open valve.

(i) Open the drain plug on the bottom of the carburetor and crank engine until the gasoline flows. (See Figure 7.)

Figure 36. Points Requiring Regular Lubrication.



(67) Engine

The following general precautions of engine operation are the road to a long and useful life, free from days of engine trouble:

(a) Know your engine. Read this manual of instruction and do the things advised herein.

(b) Keep the engine and its accessories clean. Dirt often hides trouble in the making. Look for loose connections or bolts as you clean.

(c) Keep the radiator filled with clean water. Never add water to an overheated engine. Allow it to cool first.

(d) Use only the oil of recommended specifications.

(e) In starting, use the choke no more than necessary, as too much use of the choke allows gasoline to dilute the oil.

(f) Warm up the engine slowly when the weather is cold. Never race a cold engine.

(g) Do not force the engine—avoid over-load. When not using the engine —idle it; stop it if the period is prolonged, unless the weather is sub-zero, then allow the engine to idle.

(h) If trouble develops, correct it before it becomes serious. Don't run an engine that is not operating properly.

(i) Always keep the air and oil filtering systems clean.

(j) Visually inspect the engine and its accessories daily.

(68) Spirals

Workmen and spectators should be cautioned to stay a safe distance from the feeding end of machine while it is in operation. Anyone falling or slipping into the spirals might be seriously injured.

(69) Platform

The operator should keep the operator's platform clean at all times so standing upon it will not be hazardous.

(70) Hoist

After the conveyor is lowered to the point where the cable is slack, disengage hoist clutch. This is to avoid cables from becoming fouled on the hoist drum. If any doubt on this check drum each time conveyor is lowered.

(71) Conveyor

When machine is loading watch discharge end of loader so head shaft drive sprocket will not come in contact with tree branches. If tree branches are encountered damage may result to the trees, also a branch may be encountered which will throw the drive chain off the sprocket.

When the machine is traveled on its own power the conveyor should be raised to the horizontal position. Overhead clearances should be watched such as high voltage electrical wires, telephone wires, etc.

The belt conveyor should not be used to load any material except snow. Abrasive materials will quickly wear out the belt chains and tracks on both up and down run sides.

Do not attempt to lubricate machine while it is in operation.

Keep clear of the hoist handwheel when hoist is being operated by power.

Chapter VI

Specific Operation

(72) To Start Engine

(a) Move the throttle about one-quarter open. See figure 32.

(b) Pull the choke out all the way.

(c) Turn on the ignition.

(d) Push the starter button. Allow the engine to turn approximately two revolutions, then move the choke back to mid-position; this allows the engine enough air to run on after it commences firing. Release the starting button as soon as engine fires. As the engine warms up, gradually push the choke control all the way in. At the same time move throttle to idling position to prevent the engine from racing. Always allow engine to warm up to normal operating temperature range before beginning actual operations.

(73) To Stop Engine

Always slow down the engine to idling position of throttle, and allow the engine to idle a few minutes before stopping. This allows the engine to cool off gradually so the temperature of the contracting parts will remain approximately the same. Too rapid cooling may warp valves or even crack manifold. Shut off the ignition switch to stop the engine.

(74) Cold Weather Operation

With proper care the usual satisfactory operations can be maintained in cold weather. Make certain the lubricating oil is correct for the prevailing temperature.

If the weather is —20°, drain the crankcase.

To assure a hot spark and fully charged battery, check the ignition and test the battery.

Push the starter button, or crank the engine by hand until gasoline flows. This assures that no water from condensation has frozen, thereby restricting the flow of gasoline. Also remove drain plug from carburetor (see figure 37) if no gasoline runs out, insert a short wire to see if the opening is plugged with ice; if ice has formed, thaw the carburetor by either pouring hot water over it, or heat a brick or stone and hold it against the carburetor bowl. (DANGER: Do not use a blow torch on the carburetor). When the gasoline flows through, insert drain plug and continue to turn the engine over as advised above until full of fuel.

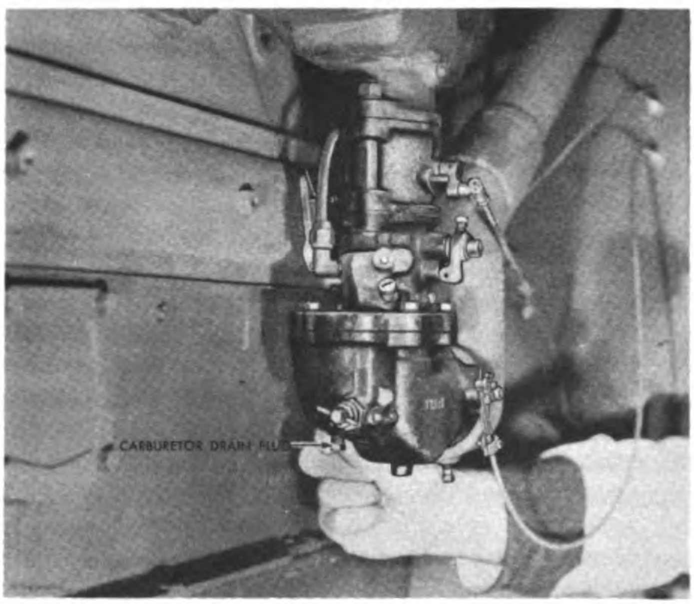


Figure 37. Removing plug to drain carburetor.

Except for turning the engine over by hand two revolutions before starter is used, follow the regular instructions for starting engine. The hand-turning before using starter assures that the engine is free to turn. If the water pump is frozen and the starter is then used, serious damage may result, such as a broken water pump shaft or a broken impeller.

If engine does not start, see trouble chart. CAUTION: The starting motor is not designed for continuous running. Stop it after ten seconds to allow it to cool and the battery to rest for about ten seconds.

(75) Anti-Freeze Mixtures

The anti-freeze mixtures recommended are as follows:

Denatured Alcohol and Water

Freezing temperature degrees Fahrenheit	Amount of alcohol to add to each gallon of water
20	2 pts.
0	4 pts.
—20	6 pts.
—40	10 pts.
—60	19 pts.

For example, for each gallon of water placed in the radiator when the temperature draws near 20° below zero, add six pints of denatured alcohol.

Ethylene Glycol (Prestone) and Water

Freezing temperature degrees Fahrenheit	Amount of ethylene glycol to add to each gallon of water
16	2 pts.
0	4 pts.
—19	6 pts.
—24	8 pts.
—49	10 pts.
—62	12 pts.

(76) Hot Weather Operation

In extremely hot weather conditions check the cooling system every four hours and keep the system filled with clean water. Use the oil specified for the prevailing temperature as outlined in ¶87, 88.

(77) Starting Loader

With engine running and having become familiar with all operating levers, we can proceed to put machine to work.

With machine at windrow it should be started at a point where feeding end can be let down on the pavement. While feeding end can be worked down to the pavement from the height of say 8 to 10" this takes some time particularly if snow is packed. This is poor practice because, while working down, poorly cleared pavement will make it very difficult to maneuver trucks backing in for loading.

In case of working where there is a curb, gauge approximate distance machine should be from curb to allow curb guard to rest against curb when feeding end is lowered.

When machine is stopped after maneuvering into position disengage both steering levers. Shift transmission into reverse, engage master clutch, push in and hold hoist clutch lever until scraper shoes are on the pavement with the hoist cables slightly slack. Turn scraper control handwheel to the neutral position. (When neutral position is reached handwheel will turn in either direction without resistance). Adjust scraper shoe adjusting bolts so teeth on scraper blade clear pavement 1" to 1½". Shift transmission into first speed. Pull back crawler speed change lever for crowding speed. Pull out feeding speed lever which will give the lower of two available speeds with any given gear combination. When engaging these two latter mentioned levers it may be necessary to slip the master clutch at same time applying slight pressure on lever so gears will mesh when aligned. Engage both steering clutch levers. Release conveyor clutch lever from the stop; spring tension will pull this clutch to engaged position as soon as loader is started. Engaging master clutch will start machine loading and feeding forward. Keep machine steered parallel to curb with curb guard bearing lightly against curb. The discharge baffles can be moved either way to distribute snow in truck body. When machine is to be stopped disengage only master clutch lever as this stops all machine operation. When operating, after initial starting adjustments are made, operator will use a minimum of levers. With machine loading snow only the master clutch should be disengaged when stopping after truck is loaded. Consequently only this one lever needs to be engaged to resume loading. While loading, machine can be steered by holding down the proper steering clutch lever. In case loader feeds too fast into windrow both steering levers may be disengaged. This stops forward movement of loader but allows conveyor to run. When resuming forward motion, both steering clutch levers should be engaged at the same time to prevent machine from turning.

(78) Proper Control of Feed End

While loading, the operator should devote most of his attention to feeding end. The machine should be kept running as close as possible to curb, however, curb guard should not be forced against curb as damage may result. Keep the scraper doing a good cleanup job at same time avoiding obstructions in pavement such as manholes, etc. When a manhole or other obstruction is encountered machine will buck as crawlers turn without moving machine forward. In this case machine should be stopped at once. Disengage conveyor clutch, shift transmission to reverse and back up machine 2 or 3 feet. Raise scraper blade by tilting up with scraper adjusting handwheel. Proceed with loading, if loader is still fouled raise conveyor with power hoist until machine is cleared and moves forward. Immediately after machine is freed the feeding end should be lowered first with hoist handwheel until cables are slightly slack. If machine continues to be free slowly tilt scraper down until satisfactory clean up is obtained.

(79) Operation of Overload Release Sprocket

The overload release sprocket will release when spirals encounter something which prevents them from turning. This may be an obstruction in the pavement in which case exactly the same procedure is followed as above when scraper blade is fouled. Stop machine at once, tilt scraper upward and resume loading. If obstruction persists, raise conveyor. Lower to good clean up position as soon as possible. In case pavement has many obstructions causing frequent stops it may be necessary to adjust scraper shoes to give feeding end a higher working level. Doing this means scraper handwheel will tilt blade at a higher plane thus clearing higher obstructions.

Overload release sprocket may also release when ice or some foreign matter is present in windrows. In either case the machine is stopped at once and reversed two or three feet. When ice is encountered, feeding speed should be reduced. Should machine then fail to load, the feeding end will have to be hoisted allowing machine to run over ice. In this case try to get down to good pavement clean up as soon as possible. Should foreign matter be found in windrows which will not load and cause overload release sprocket to release it will have to be removed by hand.

(80) Determining Proper Crowding Speed

When a new operator is starting the loading operation for the first time it is a good plan to operate in the lowest feeding speed. With the 13-32 gear combination on the gear box the speed is 2.6 feet per minute with crowding speed lever pulled out.

The trucking facilities also should be taken into consideration when determining operating speeds.

There is nothing to be gained by running the loader at full capacity when trucks can handle only half the amount. It is far better to slow down machine than to load trucks at the highest capacity and then have to wait some time for the next truck.

As soon as the operator is capable to handle the machine at a higher capacity the crowding speed lever may be pushed in, giving a speed of 5.51 feet per minute.

In order to get the rated capacity out of the machine the volume of snow in the windrows must be taken into consideration.

As an example, if the windrow is 3'-0" across the top, 6'-0" high and 7'-0" wide at the base there would be 30 cubic feet of snow per lineal foot. In this case installing the 28-17 gear combination would give a crowding speed of 10.53 feet per minute in low or 12.87 feet per minute in high.

In low crowding speed the loader would be operating at a capacity of 11.7 cubic yards per minute. In high crowding speed the loader capacity would be 14.3 cubic yards per minute.

Therefore when operator becomes proficient the speeds should be chosen to give a loading speed which will be within the rated capacity of 10 to 20 cubic yards per minute.

The most desirable feeding speed is one where conveyor can be kept to full capacity without making it necessary to disengage crawler clutches continually to keep from overloading the conveyor.

After it is determined more speed and capacity is required the gears on the side of the gear box may be changed.

There are twelve different feeding speeds available, from 2.6' per minute to 33.36' per minute. These speeds are made available by changing gears on the side of the gear box and by shifting gears within the gear box.

Six sizes of change gears are furnished with each loader, consisting of 13T, 17T, 21T, 24T, and 32T. These gears are installed in combinations as follows:

13T and 32T: 17T and 28T: 21T and 24T: 24T and 21T: 28T and 17T: 32T and 17T:

Each combination permits the instant selection of two different speeds by shifting gears in the gear box. For instance, with the 13T and 32T combination installed, the forward speed of the loader is 2.6' per minute, with the gear box shift lever in low or "Lever Out" position. By shifting the gear box shift lever to high speed or "Lever In" the forward speed is increased to 5.51' per minute. CAUTION: Always disengage the crawler clutch levers before shifting this lever. To change to a higher or lower range of crowding speeds, use the following chart for gear combinations.

Feeding Speeds—Ft. Per Min.

Change Gears		Lever Out	Lever In
13-32	Gears in left column, lower shaft, right column upper shaft.	2.60	5.51
17-28		3.88	8.23
21-24		5.60	11.86
24-21		7.31	15.49
28-17		10.53	23.32
32-13		15.75	33.36

The figures on the left in the Change Gear column apply to the number of teeth on the gear to be placed on the lower left shaft at (2). Figures on the right in the Change Gear column apply to the number of teeth in the gear to be placed on the upper right shaft at (4). "Lever Out" column gives feet per minute of forward travel with the gear box in low speed, "Lever In" column gives feet per minute of forward travel with the gear box in high speed.

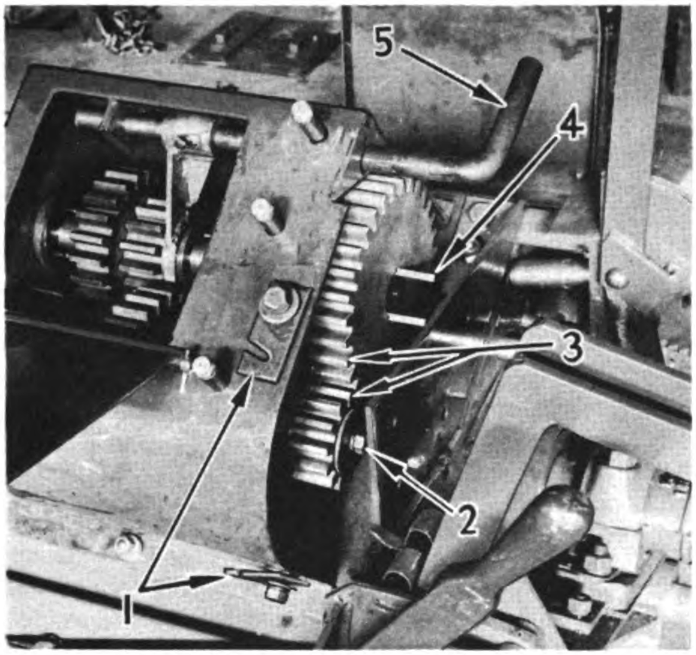


Figure 38. Showing sequence to be followed to change gears.

(81) To Change Gears—

Unlatch cover fasteners (1) figure 38 and remove gear cover.
Remove cap screw and washers from each shaft.
Slide gears (3) off shaft. CAUTION: Do not lose keys.
Install correct gears before keys are put in place.
Insert keys. Keys should be a slip fit to make future gear changes easy.
Shift lever (5) is in for high and out for low.

(82) Moving Machine

As a rule it is not advisable to drive loader any great distance on its own crawlers. However, in loading snow the working areas are sometimes rather large necessitating a great deal of traveling. During the snow season when there is no dust or dry dirt to get in to the crawlers and driving mechanism the wear is considerably decreased.

If loader is to be moved from one location to another, say a distance of 5 to 6 miles a trailer should be used.

In any case it should be kept in mind that the machine should not be used as one would a tractor, making long continuous trips.

When it is necessary to travel the loader in excess of the normal loading operation consult Lubrication chart for additional lubrication of certain parts.

The elevating conveyor should be put in the horizontal position for traveling the longer distances so the overhead clearance is reduced to the minimum.

Anyone of the forward speeds may be used for traveling however, third speed should not be used over rough ground.

(83) Plan of Operation

A carefully thought out plan of operation will be advantageous to all concerned.

Snow should be loaded as soon as possible after it has fallen and been plowed into windrows. Loose fluffy snow loads readily with less effort for machine and operator. If snow is allowed to lay in windrows it may form into ice at the bottom and become very difficult to handle. Since atmospheric temperature is a controlling factor when handling snow many different loading conditions may be encountered. Snow which has not been allowed to form into ice should give no trouble at all. Ice encrusted piles will probably give little trouble but ice formed at base of windrows create somewhat of a problem.

Snow which has melted then refrozen will form base ice of varying thickness. When this condition develops and loading is being done in below freezing temperature the ice will be so bonded to the pavement that the spirals will be unable to break the ice. However, if loading should be done in above freezing temperatures and water is running under ice thus loosening it from pavement it will load quite satisfactorily. However, when base clean-up difficulties do exist it is far better not to spend too much effort towards perfect clean up and devote it to removing the bulk. Since the loader is equipped with grousers it will operate with satisfaction on ice.

A capacity of 10 yards per minute minimum may be expected provided the windrows contains 29 cubic feet or more per lineal foot. Therefore, sufficient trucks should be provided taking into consideration time hauling to disposal point and time consumed at the disposal point.

(84) Traffic Control

When loading is to be done from city streets the loader should be operated against traffic. This allows empty trucks to approach machine in traffic and pull into cleared lane without disruption of traffic. After loading, the trucks can then merge with traffic causing little or no complications. Traffic control plays a very important part in the efficient loading of snow. Various communities have their own particular problems therefore it is difficult to give a plan which would fit all conditions.

Since snow is plowed in windrows along the curbs it is obvious that parking of cars must be eliminated. Some cities post temporary no parking signs on street light poles where loading is to be done. Others publish in newspapers streets which are to be closed. In all cases each snow loading crew should have a police officer with them who can work ahead and have cars moved which have disregarded previous notices. In such cases where owners cannot be found cars are usually towed to city garage or police pound.

(85) Formation of Windrows

Formation of windrows is also a specific problem in some localities. Generally speaking in narrow streets the snow is plowed from the center to each curb forming windrows. In wide streets of the super highway type if more feasible, windrows may be formed in the center of the streets.

In runway work, since it is most important to clear the entire runway in the shortest possible time, the method is somewhat different than used in street work. The snow on runways may be plowed in many ways. We suggest this plan as an example.

All snow should be plow entirely off the runway onto the shoulders. Due to the width of runways the volume of snow is much greater than in street work. To handle this volume it will probably be necessary to form several windrows parallel to the runway.

With this in mind plowing should be started at the edge, moving the cut far enough from the runway to allow for succeeding windrows. The last plow cut from the center would form the windrow nearest to the runway. Windrows should be approximately 15′-0″ apart to allow sufficient room for truck maneuvering.

The ideal windrow is one with approximately an 8′-0″ base, however, it is realized this cannot always be accomplished. In case of wider windrows they may be removed by taking cuts of approximately 7′-0″. While the windrow method is the most desirable because it affords snow for continuous loading without maneuvering, the loading can be done from piles. This condition calls for slicing the piles in about 7′-0″ cuts similar to wide windrow operation.

Chapter VII
Lubrication

(86) Lubricants Recommended

Nothing can add to the life of the machine more than thorough lubrication of the moving parts, properly executed at the correct intervals. When time and availability of the machine are at a premium, it is absolutely inexcusable to have a breakdown resulting from improper lubrication, since this can so easily be avoided. A machine which cannot be used in an emergency because it requires repairing loses all of its value and, instead, becomes a handicap. Therefore, it is very important to maintain the machine carefully, following the instructions which have been prepared.

Lubrication Chart Key

Numbers appear inside symbols on the lubrication chart at every important lubrication point. The symbol indicates type of lubricant as shown below. The number indicates the paragraph giving detailed instructions on following pages.

			Grade		
Reference Symbol	Lubricant Symbol	Type of Lubricant	Below 0°	0° to 32°	Above 32°
◇	OE	Oil—Engine	Refer to EFSB L-1000-D	SAE 10	SAE 30
○	CG	Grease—general purpose	Refer to EFSB L-1000-D	No. 0	No. 1
□	GO	Lubricant, gear universal	Refer to EFSB L-1000-D	SAE 80	SAE 90
△	CW	Oil, lub., chain and wire rope	Refer to EFSB L-1000-D	Grade 2	Grade 2
◎	WB	Grease, general purpose	Refer to EFSB L-1000-D	No. 2	No. 2

Figure 40.

(87) Lubricants Recommended—Engine

Because lubrication is so vital to efficient engine performance, one of the first concerns should be lubrication.

The Army lubricants recommended for the Buda HP-217 Engine and their symbols are as follows: OE-10, OE-30, OE-50-engine oil. This is a fluid lubricant provided in three S.A.E. grades—10, 30, 50.

These lubricants are based on U. S. Army Specifications 2-104A and are for use in crankcase, air cleaner, water pump, starting motor and generator, and such other lubrication points requiring a fluid lubricant. See Lubrication Chart for periods of lubrication and other lubricants required.

	Capacity (Approx.)	Lowest Expected Air Temperature		
		Above +32°F.	+32° to 0°F.	Below 0°F.
Crankcase	5½ qts.	OE S.A.E. 30	OE S.A.E. 10	See ¶88 below. Refer to EFSB L-1000-D

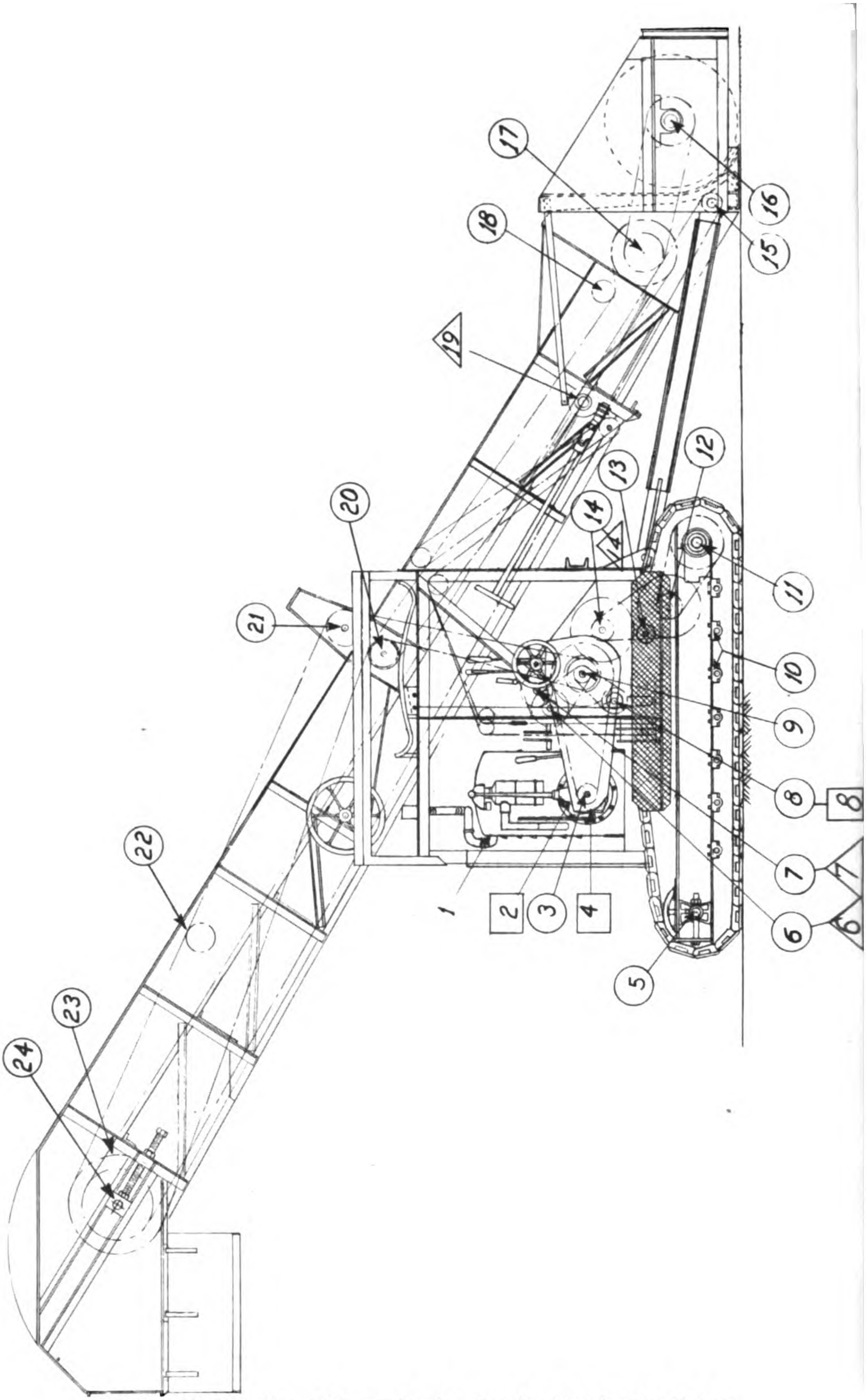


Figure 39. Side view of Snow Loader showing Lubrication Points.

High Temperature: Engines operating in high temperatures and under heavy load conditions for long periods of time consume more oil. Hence, crankcase oil level should be checked and crankcase refilled more frequently than normally. If OE (S.A.E. 50) is available it may be used. Always be sure to bring oil level to FULL mark on the gauge. Refer to EFSB L-1000-E).

Note: If unit is operated indoors where the temperature readings will be higher than if operated outdoors where the prevailing temperature is lower, judgment should be used in selecting the oil required for the indoor operation.

(88) Cold Weather

In temperatures below 0°F, the engine crankcase should be drained at the end of the day's operation. Before the start of the next day's operation, the oil should be heated to 180° before pouring it back into the crankcase.

(89) Greases

WB-grease, wheel bearing heavy duty No. 2. This grease is designed to withstand heavy load and temperature above 90°F.

Figure 36 shows the points of lubrication of engine and accessories.

(90) Engine Lubrication Chart

Interval	Points of Lubrication	Lubricants Required
	1. Air Cleaner—clean, change oil.	OE
8 hrs.	2. Check crankcase—add if necessary.	OE
	1. Drain and refill crankcase.	OE—5½ qts.
	2. Water Pump—Oil cup.	OE
64 hrs.	3. Distributor—Grease cup.	WB—(1 turn)
	4. Generator—Oil cups.	OE
	5. Starting Motor—Oil cup.	OE
	1. Change oil filter cartridge and refill crankcase.	OE—6½ qts.
128 hrs.	2. Carburetor throttle shaft, choke, and control cables—flex cables to apply.	OE
	3. Governor throttle shaft and ball joints.	OE
	4. Distributor Breaker Arm Hinge Pin.	1 Drop OE
	5. Distribution Cam Felt.	5 Drops OE
	6. Distributor Governor Weight Pivot and Slot.	1 Drop OE
512 hrs.	1. Fan—Grease plug.	WB-3

(91) Loader Lubrication Intervals

(Does not include engine)

Every 2 hrs.—Nos. 5, 6, 9, 10, 11, 12, 13, and 14

Every 4 hrs.—Nos. 6, 7, 9, 12, 14, 15, 16, 17, 18, 20, 21, 22, and 24

Every 8 hrs.—Nos. 2, 3, 4, 5, 8, 10, 11, 13, 23 and 26

Every 32 hrs.—Nos. 6, 7, 25, and 19

Every 256 hrs.—Nos. 2 and 4

Every 512 hrs.—No. 8

Note: The 2 hour interval is used only when machine is travelled extensively.

(92) Lubrication Instructions—Loader Machinery

(1.) BUDA ENGINE:

(2.) MASTER TRANSMISSION:
Check lubricant level every eight hours. Drain and refill after 256 hours of operation. Use 8 quarts of GO.

(3.) MASTER CLUTCH THROW-OUT COLLAR:
One alemite on the outside of bell housing. Grease every 8 hours. Do not give cup more than two turns as excessive grease may get into clutch discs causing slippage. Use WB.

(4.) HIGH SPEED CHAIN GUARD:
Maintain lubricant level so that chain is about half covered at its lowest point. Check every 8 hours. Drain and refill every 256 hours with 2 quarts of GO.

(5.) CRAWLER IDLER WHEEL:
One alemite for each idler wheel and one wheel for each crawler. Grease every eight hours with CG.

(6.) GEAR BOX DRIVE SHAFT:
Three alemites—one inside case between gears. Grease wtih CG every four hours with one or two strokes of gun. Apply CW to gear every 32 hours.

(7.) GEAR BOX IDLER SHAFT:
Three alemites—Alemites extend through gear box housing. Grease with CG every four hours with two strokes of gun. Apply CW to gears every 32 hours.

(8.) ELEVATOR HOIST:
Five alemites—all alemites are piped out to side of machine and located near the oil level petcock of hoist. Grease alemites with CG, two strokes of gun every eight hours. Keep hoist filled to level cock with GO. Drain and refill every 512 hours.

(9.) MAIN JACK SHAFT:
Ten alemites. Grease the following every four hours: hoist clutch—one stroke of gun, two shifting collars, three bearings, one bucket line sprocket, one clutch shaft driving gear, and one pinion drive gear. For convenience, there are two alemites on gear box drive gear; grease either one. Six of the above ten alemites are located inside the transmission housing. Two bearings, one shifting collar and the bucket line drive sprocket are located outside the housing. Four strokes of gun. Use CG.

(10.) CRAWLER TRACK ROLLERS:
One alemite for each roller and six rollers for each crawler. Grease every eight hours with four strokes of gun. Use CG.

(11.) CRAWLER DRIVE SHAFT:
Two alemites for each crawler drive shaft. There is one shaft for each crawler. Grease every eight hours. Use CG.

(12.) OSCILLATING SHAFT:
Four alemites. Two to each sprocket hub. Only one alemite on each hub need be greased. The alemites are located inside and near the bottom of the transmission housing and are rather difficult to see. Therefore, care should be taken not to overlook these alemites. Grease every four hours with three strokes of gun. Use CG.

(13.) CRAWLER SPRING TAKE-UP WHEEL:
One alemite for each take-up wheel and one wheel for each crawler. Grease with CG every eight hours.

(14.) CRAWLER CLUTCH SHAFT:

Eight alemites—grease every four hours. Two bearings, two shifting collars and two crawler drive sprockets. There are two alemites on each drive sprocket—grease either one. All but the two bearing alemites are located inside the transmisssion housing. Use two strokes of CG per fitting. Apply CW to gears every 32 hours.

(15.) ELEVATING CONVEYOR FOOT SHAFT:

Two alemites—One on each end of foot shaft. Since shaft runs through frame one alemite is located on each side of frame. Grease every four hours with CG. Six strokes of the gun.

(16.) SPIRAL SHAFT:

Two alemites—One in each bearing. Grease every four hours with CG.

(17.) SPIRAL DRIVE COUNTER SHAFT:

Two alemites—One in each bearing. Grease every four hours with CG.

(18.) SPIRAL DRIVE TAKE-UP IDLER:

One alemite located on sprocket. Grease every four hours with CG.

(19.) SCRAPER ADJUSTING WORM:

Coat gear and worm with CW every 32 hours.

(20.) ELEVATING CONVEYOR DRIVE PIVOT SHAFT IDLER:

One alemite. Grease every four hours with CG.

(21.) ELEVATING CONVEYOR DRIVE CHAIN TAKE-UP:

One alemite located in sprocket hub. Grease every four hours with CG.

(22.) ELEVATING CONVEYOR DRIVE CHAIN IDLER:

One alemite located in end of idler shaft. Grease every four hours with CG.

(23.) OVERLOAD RELEASE SPROCKET:

Three alemites—One on the sprocket hub and one for each center roller. Grease every eight hours with CG.

(24.) ELEVATING CONVEYOR HEAD SHAFT:

Two alemites—One for each bearing. Grease every four hours. It is necessary to climb up belt to grease these bearings. Four to six strokes of gun. Use CG.

(25.) DRIVE CHAINS:

Lubricate with OE every 32 hours. Keep free of dirt and grit with gasoline. NOTE: Do not lubricate the belt chain.

(26.) HOIST HAND WHEEL: (NOT SHOWN):

Two alemites, one to each of two bearings. Grease every eight hours. Use CG.

Chapter VIII
Operating Maintenance

(93) Periods of Engine Lubrication Inspection and Maintenance

To maintain the efficiency of this Buda engine, it is necessary that the operator lubricate, inspect and care for the engine at regular intervals. Regularity in lubrication and other normal maintenance operations eliminates the development of serious trouble and unnecessary delays and is called preventive maintenance.

Here let it be noted that distinction is made between the maintenance, adjustments and minor repairs which the operator can and should normally perform, and the disassembly, major repairs and reassembly by the service maintenance man who has the required tools, equipment and special data. Information on the latter is contained in the Maintenance Manual, and is referred to as MAINTENANCE REPAIRS.

Because operating conditions may vary, it is somewhat difficult to lay down rigid rules as to the time intervals when lubrication and other maintenance should be made. However, the periods given in the accompanying Inspection and Maintenance Chart can be followed under most all operating conditions. This chart includes all paragraph references which give detailed instruction for the various servicings.

The items the operator will have to check, adjust or repair as the result of the regular periods of inspection and maintenance are listed alphabetically immediately after the Inspection and Maintenance Chart.

(94) New Engine

After the first 8 hours of operation, and also after the first 128 hours, the cylinder head studs should be tightened. Figure 41 shows the correct sequence of tightening the cylinder head studs. See Maintenance Chart for servicing to be done.

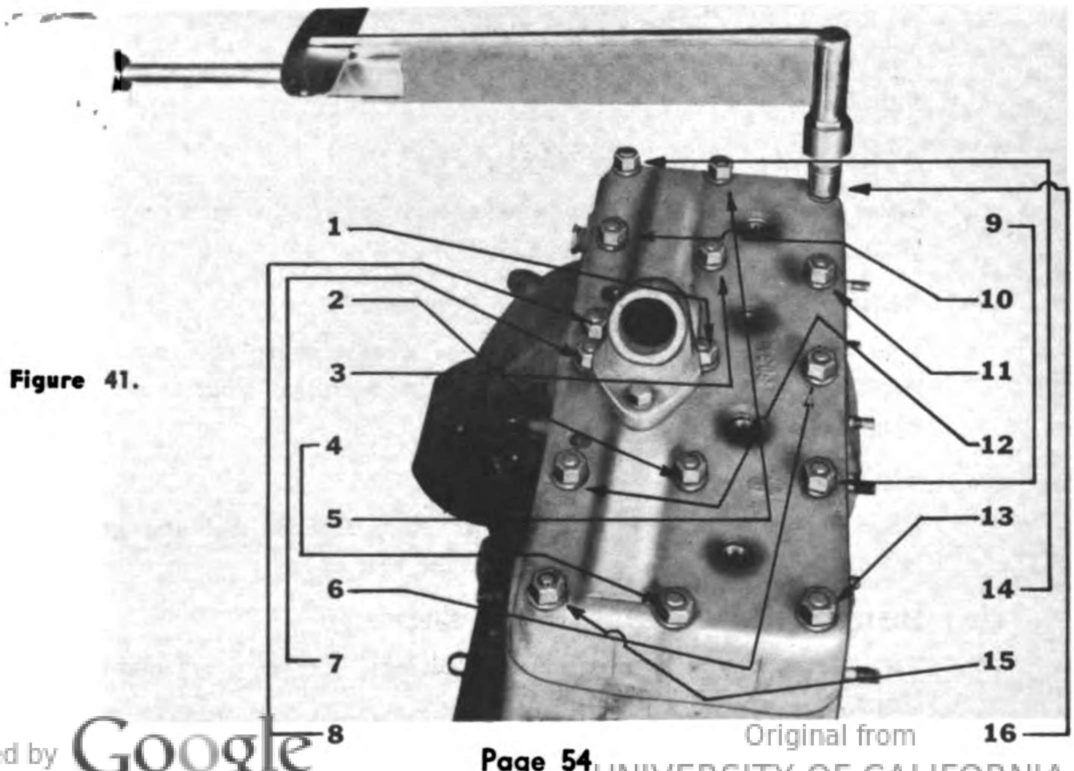


Figure 41.

(95) Tools and Equipment Needed

The following tools are furnished with the Loader.

1—Can, oil
1—Chisel, ¾" octagon
1—Drift, ¾" octagon
1—Gun, Alemite gat, alemite No. 6637D
1—Hammer, Ball peen, 1¾ pound
1—Hose, Heavy duty ind. (for gat gun) No. 1189
1—Pliers 8"
1—Screw driver 6"
1—Wrench, adjustable 12"
1—Wrench, Allen set screw ⅜"
1—Wrench, Allen set screw ⅝"
1—Wrench, Buda spanner
1—Wrench, Check nut
1—Wrench, Construction 1"
1—Wrench, Crank case plug, ⅝" x ⅝" x 4"
1—Wrench, Engineers, ⅜" x ½"
1—Wrench, socket for grouser bolts, ⅝"
1—Wrench, Engineers, ⅝ x ¾"
1—Wrench, Construction, 1¼"

It is suggested the following items be procured to perform all operations of engine operating maintenance.

Socket wrench set 7/16" x 1"
Tappet wrenches
No. 00 sand paper
Feeler gauge
Machinist rule

(96) Inspection and Maintenance Chart

WHEN	SERVICING TO BE DONE	REFERENCE
Every 8 Hrs. of Operation	1. Check bolts, nuts, capscrews and connections.	Figures 7 and 9
	2. Check radiator, fill if necessary, check radiator fins and passages between tubes, remove any restriction to air flow.	Paragraph 112
	3. Check crankcase oil level; keep full.	
	4. Clean air filter cup; refill with OE.	Paragraph 98
Every 64 Hrs.	1. Change crankcase oil; drain while engine is warm.	
	2. Check battery water level.	Paragraph 99
	3. Oil water pump, starter and generator.	Figure 36
	4. Grease distributor shaft.	Paragraph 101

Inspection and Maintenance Chart (Cont'd)

WHEN	SERVICING TO BE DONE	REFERENCE
Every 128 Hrs.	1. Renew oil filter cartridge.	Paragraph 111
	2. Oil governor link ball joints and shafts.	Figure 7
	3. Oil throttle and choke cable, flex cable to apply.	Figure 7
	4. Oil generator and starter.	Figure 36
	5. Check valve tappet clearance.	Paragraph 116
	6. Check spark plugs for carbon and gap.	Paragraph 115
	7. Check generator brush and commutator.	Paragraph 104
	8. Check starting motor brushes and commutator.	Paragraph 114
	9. Check fan belt tension.	Paragraph 102
	10. Clean crankcase oil breather in gasoline, dip in oil.	Figure 9
	11. Check battery specific gravity.	Paragraph 99
Every 512 Hrs.	1. Lubricate fan.	Figure 36
	2. Overhaul generator.	Maintenance Manual
	3. Overhaul starting motor.	Maintenance Manual
	4. Tune up generator and voltage regulator.	Maintenance Manual
	5. Tune up starter motor and switch.	Maintenance Manual
Every 1,024 Hrs.	1. Wash engine with kerosene or fuel oil.	Maintenance Manual
	2. Remove oil pan, wash out sludge, clean suction screen float.	Maintenance Manual
	3. Check oil float bracket.	Maintenance Manual
	4. Check connecting rod, cotter pins, and bearing lock wire.	Maintenance Manual
	5. Install new spark plugs, check gaps.	
Every 2,048 Hrs.	1. Overhaul engine.	Maintenance Manual

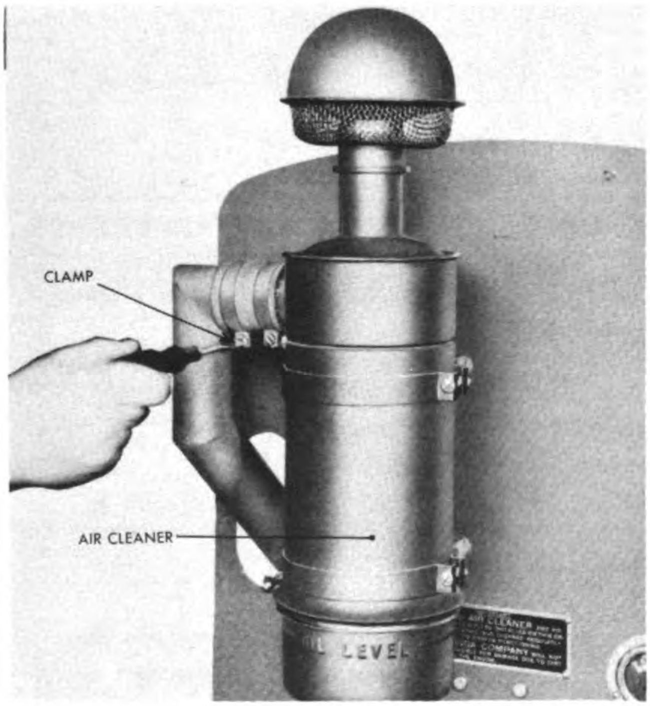


Figure 42. Tightening the air cleaner hose connections.

(97) Engine Servicings, Adjustments and Repairs

a. General Precautions

As indicated in the Maintenance and Lubrication Chart, there are certain adjustments, servicings and repairs which the operator must perform in the line of regular maintenance. Detailed instructions for these servicings are given in this section, including the references given in the Maintenance Chart. These instructions, however, give only those repairs and servicings which come within the scope of the operator. Complete engine maintenance and repair instructions are given in the Maintenance Manual.

For convenience, the items that the operator may have to check, adjust or repair are listed alphabetically.

(98) Air Cleaner

It is the function of the air cleaner to prevent the abrasive dust, which is the chief cause of engine wear, from entering the engine. In order to remove the dirt efficiently, the air cleaner must be properly serviced.

a. Checking Hose Connections

The CONNECTIONS between the air cleaner and engine MUST BE KEPT AIRTIGHT AT ALL TIMES. Tighten the clamps on the hose connections. See figure 42.

b. Cleaning Cleaner

Remove the oil cup at the lower end of the cleaner, empty the oil and scrape out the dirt. See figure 43. Any coating of dirt on the walls of the center tube should be removed by ramming a cloth through the tube with a stick so that the flow of air to the engine will not be restricted. See Figure 44. Refill the oil cup to the oil level with new engine oil. Replace the oil cup securely. NEVER REMOVE THE OIL CUP WHILE THE ENGINE IS RUNNING, AND DO NOT RUN THE ENGINE UNLESS THE OIL CUP IS FILLED WITH OIL TO THE PROPER LEVEL.

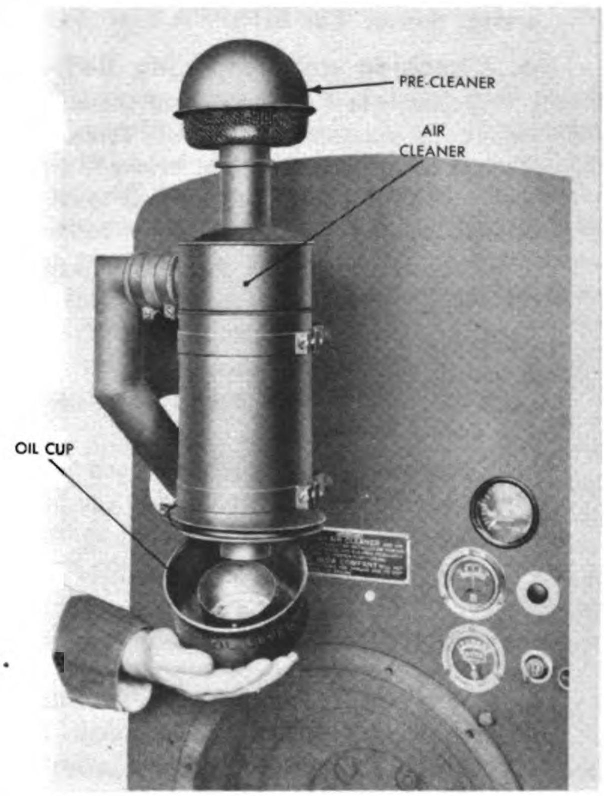


Figure 43. Removing the air cleaner oil cup.

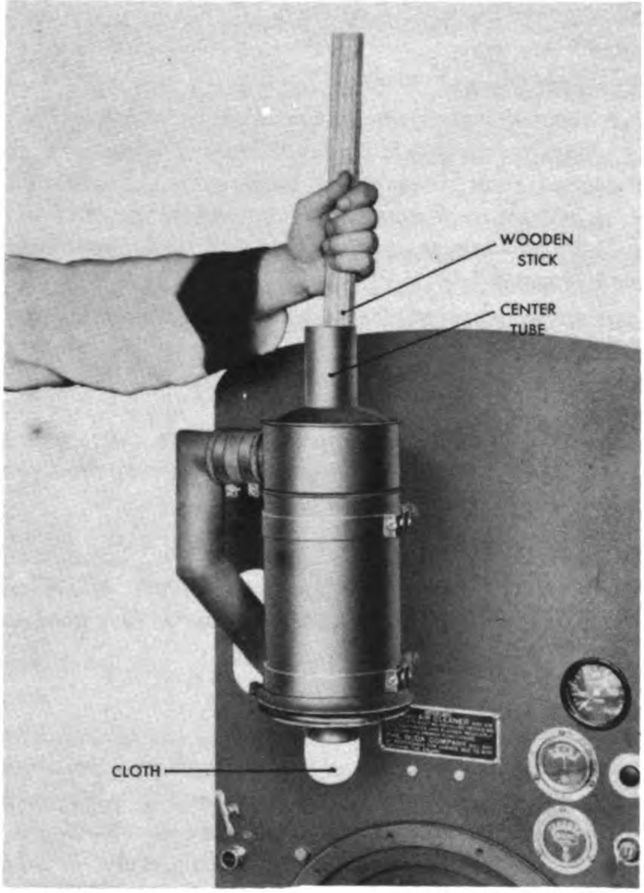


Figure 44. Cleaning the air center tube.

(99) Battery

The battery is the storehouse for the electrical energy used to operate the starter motor. The battery is kept charged by the generator.

a. Checking and Servicing Battery

Do not allow the surface of the electrolyte (battery water) to get below the top of the separators. Use only clean, distilled water to keep the battery filled. Do not fill higher than just below the bottom of the filling tube, for "gassing" will cause the electrolyte to spill over. Never add acid to the battery, as this will give a false reading as to the condition of the battery.

Keep the terminals tight and clean. If they show a tendency to corrode, clean and apply a thin coat of vaseline to protect them from the acid. Keep the outside of the battery clean. Neutralize any electrolyte that may be on the metal surfaces with a cloth saturated with ammonia or bicarbonate of soda solution (one pound of baking soda to one gallon of water), then wash off the water and dry.

Test the specific gravity of each cell with a hydrometer. A reading of 1.270 to 1.285 indicates fully charged; 1.230 half charged; and 1.150, dead. Never take a reading just after adding water, as the reading will not be true. CAUTION: do not allow battery to stand in the discharged state. It will become ruined by sulphation.

If the battery requires frequent addition of water and is gassing excessively, test it. If in good condition, it is undoubtedly due to overcharging. The voltage regulator should be checked by maintenance repair for faulty adjustment, as outlined in the Maintenance Manual. If one or more cells continually require more water than others, it is an indication of a damaged cell which should be checked by maintenance repair.

b. Cold Weather Care

It is especially important in cold weather to test the specific gravity. A battery freezes between the temperatures 20 degrees above zero and 50 degrees below zero, depending on the state of its charge. Do not add water after shutting down for the night, or it will freeze quickly; see that it gets a charge after adding water.

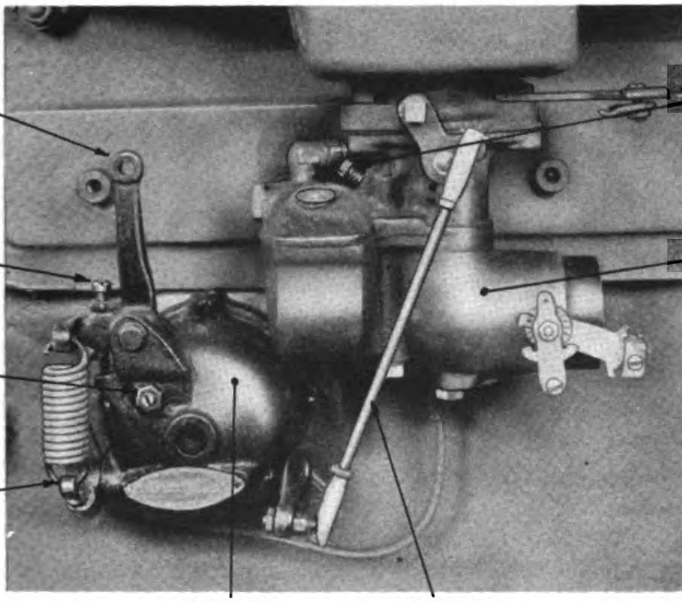


Figure 45

(100) Carburetor

The carburetor mixes the proper amounts of air and gasoline in order to produce a highly combustible mixture. See figure 45.

a. Adjusting the Main Jet

The main jet determines the maximum amount of fuel which may be obtained for high speed operations. The main jet adjustment reduces this amount as it is turned towards its set. Ordinarily the main jet adjustment has no effect after it is two turns open. To set this adjustment, open the throttle to approximately one-quarter open with the engine running. Turn the adjustment clockwise shutting off the fuel until the engine speed decreases due to a very lean mixture. Now open the adjusting screw until the engine speed decreases due to too much fuel. The adjustment should be set at a position half-way between these two extremes. See figure 45.

b. Adjusting Fuel-Air Mixture

Before making an adjustment of the idling system, the engine should be run until it reaches normal operating temperature. To make the mixture richer, turn the idling needle valve IN; to make the mixture leaner, turn the idling needle valve OUT. See figure 46. After the engine is warm, set the throttle stop screw for normal engine idling speed. Turn the idling needle valve adjustment to the right or left until the engine runs steady and as fast as this throttle position will permit. After the engine runs smooth and steady, it may be necessary to change the position of the throttle stop screw.

c. Adjusting Choke

The carburetor choke is set properly when the air shutter is opened all the way.

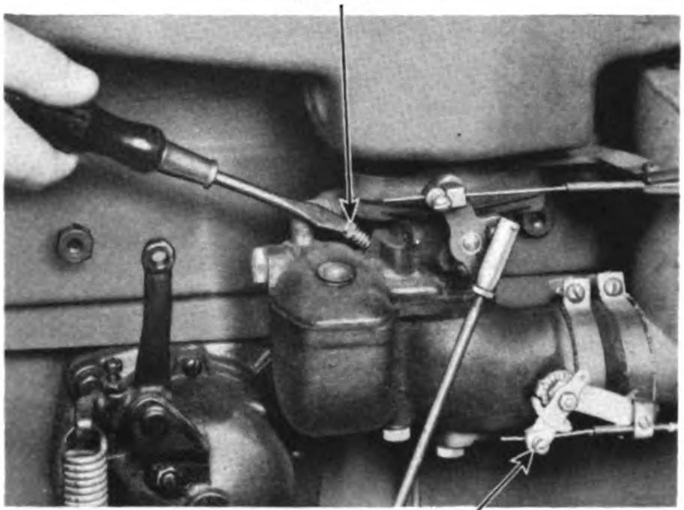


Figure 46. Making adjustments for idling.

(101) Distributor and Ignition Coil

a. Specifications

Cylinder—4.
Rotation—Right hand, viewed from top.
Drive—Gear.
Control—Automatic and Manual.
Length—Overall 3½ inches. From mounting arm 6 inches.
Diameter of Base—3 inches.
Advance—Automatic.
Weight—2-1/6 pounds.

The purpose of a distributor is to provide current to the primary winding of the ignition coil at the proper time and also to distribute the high tension voltage to the proper spark plug. See figure 9.

The breaker contacts of the distributor are connected in the coil primary circuit so that the rotation of a cam opens the coil circuit at the proper instant to generate a spark. The distributor cap and rotor are arranged so that the high tension voltage is connected to the correct spark plug for firing each cylinder.

The distributor is equipped with a centrifugal governor for the control of the timing and has the cam connected to the drive shaft through the governor. This is arranged so that as the speed is increased the relationship of the cam to the breaker arm is changed by the centrifugal action of the governor. The rate and amount of spark advance is controlled by the weight springs and the design of the centrifugal governor mechanism.

b. Ignition Coil

The function of an ignition coil is to transform the low voltage energy supplied by the car battery into the high voltage energy necessary to jump the spark plug gap. See figure 47.

An ignition coil has two windings, one the primary winding which consists of a comparatively few turns of heavy wire and the secondary winding which consists of many turns of very fine wire. The secondary winding is wound on a soft iron core while the primary winding is wound around the outside of the secondary winding. A soft iron shell encloses the outside of both windings and serves to complete the magnetic circuit. Carefully selected and tested insulation is placed between the winding layers, the primary and secondary windings and between the outside of the primary winding and the outer soft iron shell.

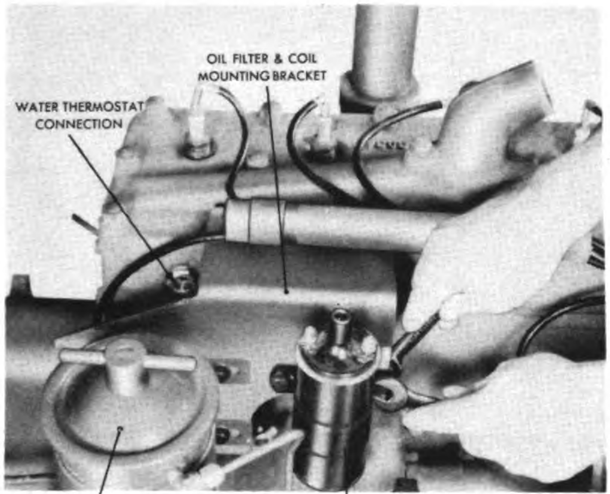


Figure 47. Showing mounting bracket for oil filter and ignition coil.

Whenever current is built up and broken in the primary winding, a voltage is induced in the secondary winding. The design of a coil is such that the induced current will be sufficiently high to produce a spark at the spark plug.

c. Lubricating and Distributor

Every 64 hours turn the grease cup one turn.

Every 512 hours, add one drop only of OE-10 to the breaker arm hinge pin and saturate the felt in the top of the cam with OE-10. Add one drop of OE-10 to each governor weight pivot and slot. Do not over-lubricate. Apply sparingly WB-3 to the breaker cam. Be careful not to get oil or grease on the cap and rotor or breaker contacts as oil or dirt materially shorten their life. See figure 48.

d. Checking Breaker Contacts

If the contacts are a grayish color and are not burned or pitted, they need not be replaced. Check with a feeler gauge the breaker contact gap. This gap should be .021" plus or minus .003". Readjust if necessary. See figure 48. After adjusting, retighten the locknut as shown in figure 48. Then recheck the gap. Check the contact point alignment. The contacts should be aligned so as to make contact near the center of the contact surfaces. Bend the stationary contact bracket to secure proper alignment. Then recheck the maximum gap as just given above.

c. Timing Distributor With The Engine

Since the distributor is equipped with an automatic spark advance, only a temporary setting can be made. The final setting can be made when the engine is running underload. The following steps are necessary to make the temporary setting:

1. Crank the engine until the piston in No. 1 cylinder moves upward on the compression stroke. (The compression stroke can be obtained by cranking the engine until the intake valve opens and closes. The intake valve is the second valve from the fan end. This will necessitate removing the valve cover plate.) Slowly continue cranking the engine so that the top dead center line on the flywheel centers in the timing hole of the flywheel. See figure 49. With a wrench on the crankshaft jaw back up the flywheel 1-1/16 to 1¼", as measured on the surface of the flywheel through the timing hole.

Figure 48. Distributor adjustments.

2. Remove the distributor cap from the distributor (see figure 48) and loosen the clamp screw and locknut of the distributor advance arm. Turn the body of the distributor in the opposite direction of the distributor cam rotation just until the points begin to open. Tighten the clamp screw and locknut in the advance arm. See figure 48. NOTE: Advance arm should be left in full manual advance position.

3. Before installing the distributor cap, note the position of the rotor as the contact in the cap coming squarely opposite the rotor will be the No. 1 cylinder spark plug cable terminal connection. Install the cap.

4. Install the high tension cable from the spark plug of the No. 1 cylinder to the No. 1 distributor cap outlet and install the rest of the cables in their proper order. The firing order is 1-3-4-2. Note that the position of the rotor determines which outlet on the distributor cap will become the No. 1 cylinder high tension spark plug cable connection. From this point the firing order is clockwise.

The temporary setting has now been obtained. The permanent setting can now be made with the engine running under full load by carefully advancing or retarding the advance clamp screw whatever is necessary to get the most efficient engine operation.

(102) Fan Belt

The fan belt drives the fan and the generator from the pulley on the crankshaft.

a. Checking Belt and Adjusting Fan Belt Tension

There should be approximately ¾ of an inch slack as all V-belts must run just loose enough to prevent slipping. See figure 50.

Figure 49. Timing marks to be found on flywheel thru timing hole.

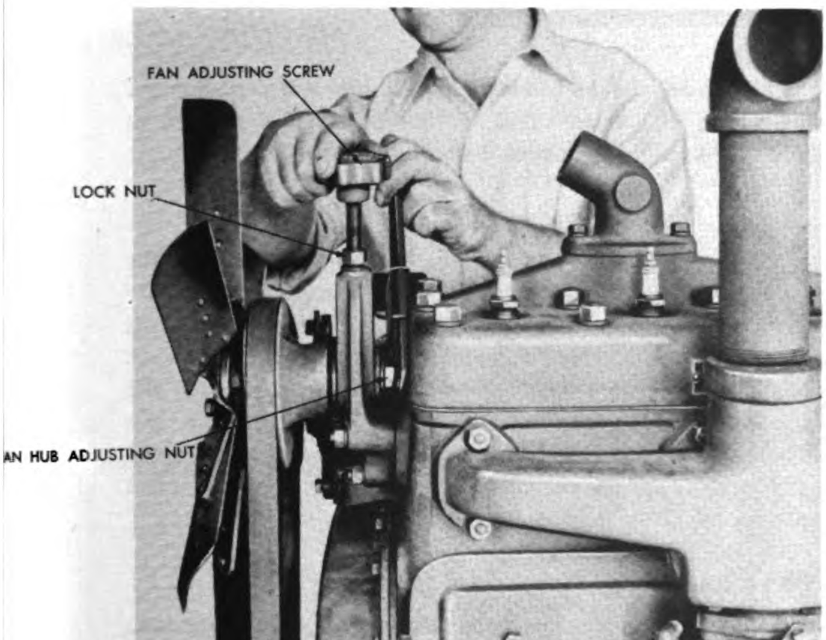


Figure 51. Adjusting fan belt.

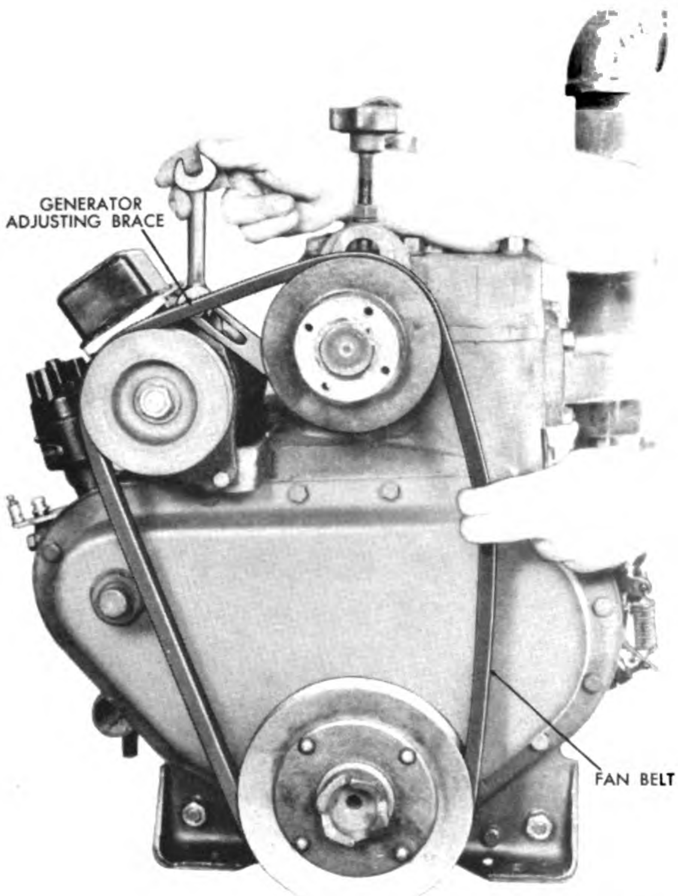


Figure 50. Check belt slack (Fan blades removed for clear view of pulleys and belt).

Loosen the lock nut of the fan belt tension adjusting screw shown in figure 51, and turn the adjusting screw to the left to tighten, right to loosen. When proper tension is obtained, tighten the lock nut.

b. Installing Belt

Whenever installing a new belt, always loosen the fan belt adjustment and generator adjusting screw, figure 50, so as to allow the belt to be slipped in place without forcing. This will avoid any internal damage to the belt.

(103) Fuel Pump

The AC mechanical fuel pump supplies fuel from the supply tank to the carburetor to meet engine requirements at all speeds. The power is applied to the rocker arm by an eccentric on the camshaft. The rocker arm movement through the link and rod pulls the diaphragm away from the fuel chamber against a spring pressure of 2½ to 6 pounds. The vacuum created by the diaphragm movement pulls the gasoline from the supply tank through the inlet valve and into the fuel chamber. The return stroke (low point of cam) releases the compressed diaphragm spring expelling the fuel through the outlet valve into the carburetor bowl.

a. Inspecting, Cleaning, and Adjusting Fuel Pump

Inspect the pump for: (1) dirt in the sediment bowl; (2) dirty screen; (make certain that the cork gasket is properly seated when replacing bowl); (3) loose valve plugs or worn gaskets; (4) leaky tubing or connections; (5) bent or kinked tubing; (6) loose cover screws—any of these conditions will contribute to the lack of fuel at the carburetor.

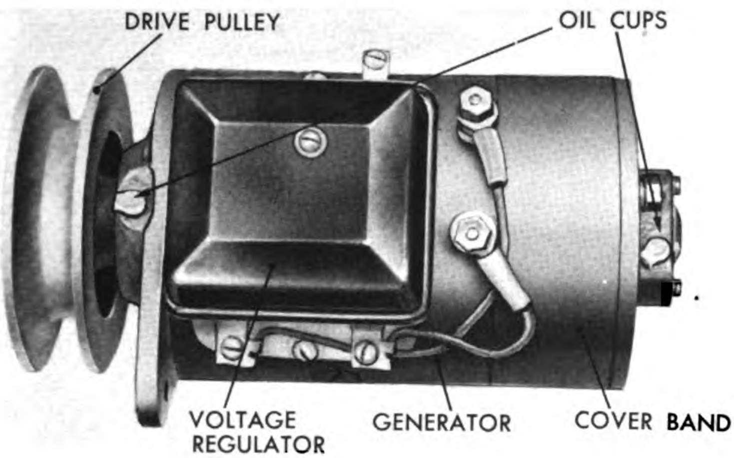


Figure 53. Generator.

If the valves are damaged or warped, they must be replaced. It is not necessary to remove the fuel pump from the engine. Just unscrew the valve plugs and remove the spring carefully so as not to scratch the valves.

Before inserting the new valves, assemble the valve seats to make certain that there are no irregularities which prevent proper seating. (If there are any, pump cover should be replaced). Place the valves in the valve chamber. Reassemble the valve plugs and springs. Make certain that the springs are inside the lower stems of the valve plugs. Use new gaskets under the valve plugs.

Fuel leakage at the edge of the diaphragm is usually caused by loose cover screw. Tighten the cover screws alternately and securely. Also check inlet and outlet pipe connections.

(104) Generator

The generator changes mechanical energy into electrical energy, which is stored in the storage battery to be used as needed. Figure 53.

a. Checking Commutator and Brushes

Remove the cover band to inspect the commutator and the brushes for dirt and wear, and also check for high mica (the insulation material between the copper bars) or for the commutator being out of round. This latter can be determined by watching the brushes as the commutator is revolved. If the commutator is out of round or has high mica, this becomes a job for maintenance repair as outlined in the Maintenance Manual.

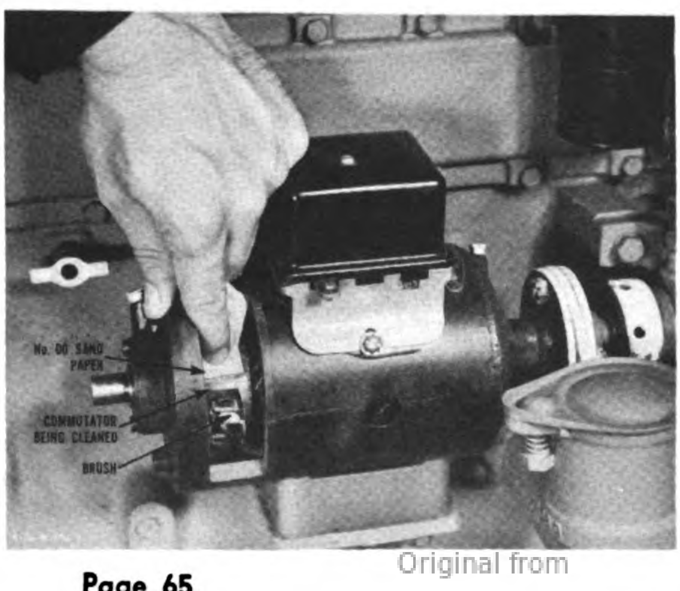


Figure 54. Cleaning generator commutator.

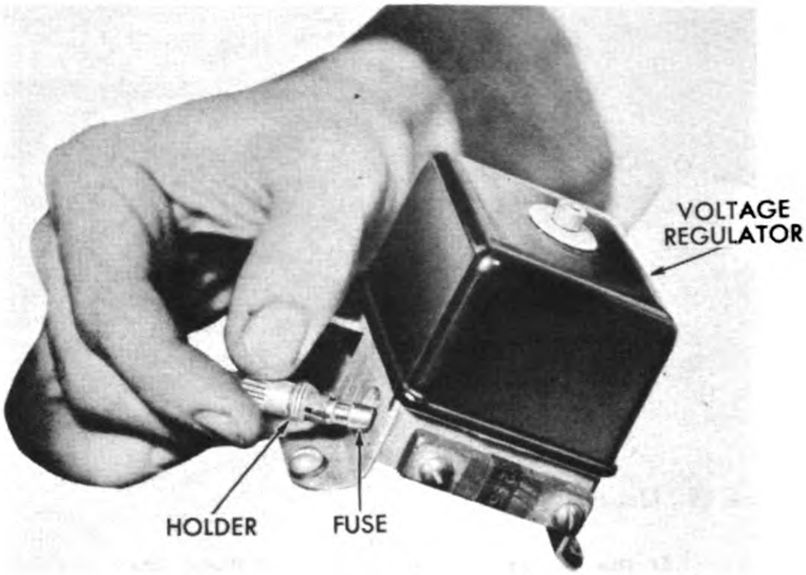


Figure 55.

b. Cleaning Commutator

Clean the commutator with No. 00 sandpaper. Cut a strip of sandpaper as wide as the commutator and hold the sandpaper against the revolving commutator as illustrated in figure 54. Never use emery cloth. All dust must be blown from the generator with dry compressed air or a hand bellows.

c. Checking Brush Wear

New generator brushes are 13/16" long. Brushes worn down to ½" long must be replaced.

d. Replacing Generator Fuse

The generator fuse is located in the base of the voltage regulator, as shown in figure 55. It is a five ampere fuse and is held in place by a thumb screw.

e. Checking and Adjusting Brush Movement

Brushes must move freely in their holders. Do not fold or twist the brush "pigtails" so that they prevent free brush movement. If the brushes are gummed, clean them with gasoline. Do not soak them, allow them to dry thoroughly before using. If brushes are caked with any substance, do not sand excessively or round the contact edges of the brush. Clean the brush holders. Brushes worn down to ½" must be replaced.

f. Removing Brush Dust and Dirt

Blow the brush dust or dirt out of the motor and the generator, especially at commutator end and brush rigging, with dry compressed air or hand bellows, to prevent short circuits, grounding, etc.

g. Replacing Brushes

Place the new brushes in their holders and connect brush pigtails. To seat brushes properly, cut a strip of No. 00 sandpaper slightly wider than the brush. See figure 56. Slip under one brush at a time. With the abrasive side against the brush and the brush at its proper spring tension, draw the paper upward or downward, making certain that the entire face of brush is being ground. DO NOT GRIND EXCESSIVELY. The other brush barely showing in the picture is released from its spring tension to permit clearance for the sandpaper as the sandpaper is drawn upward. Blow out the dust and examine both edges of the brush to see that they are touching the communtator properly.

Before replacing cover band, fold brush "pigtail" wires down so that they will not touch the band. They must not touch any metal except that of the brush holder to which they are attached. This precaution prevents a short or ground at the generator. The connection screws attaching the brush pigtails to the holders must be tight.

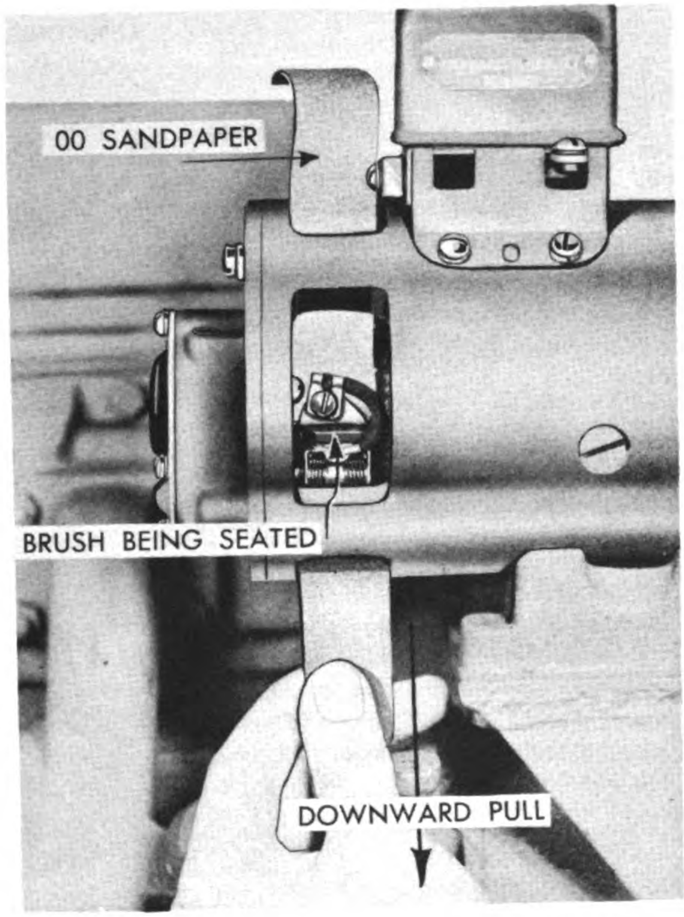


Figure 56. Cleaning starter commutator.

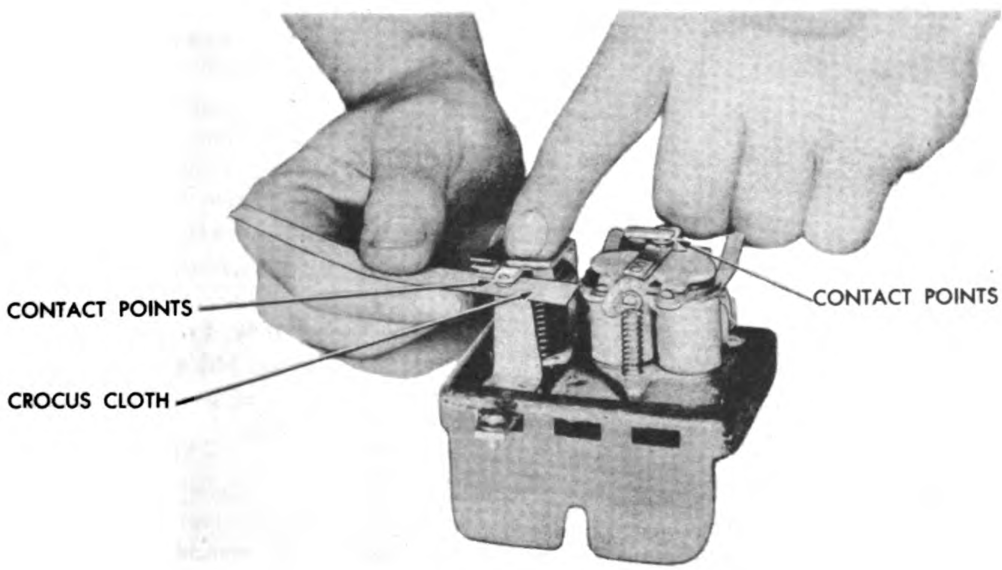


Figure 57. Cleaning Contacts.

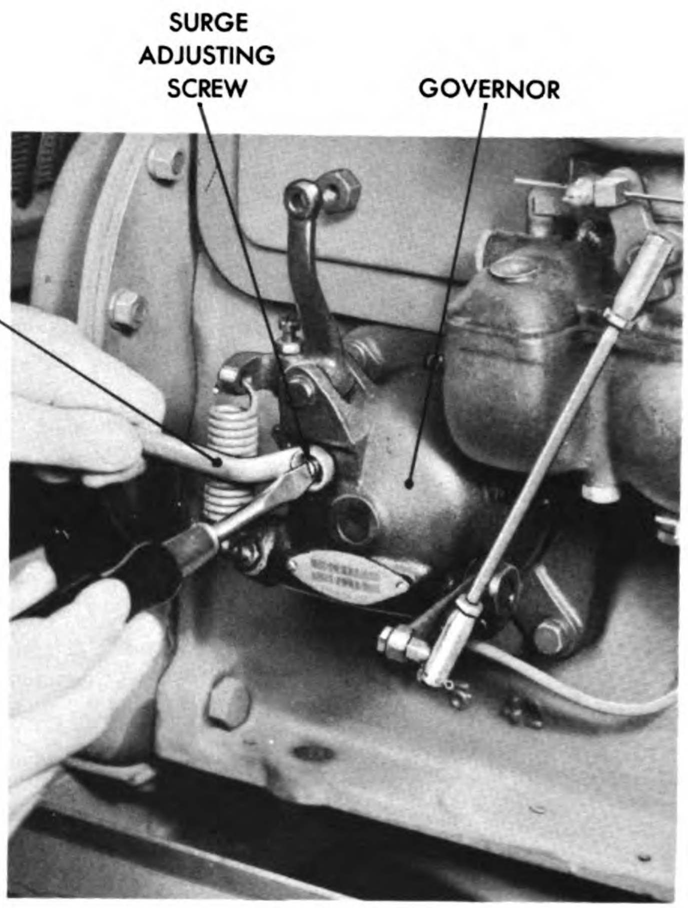


Figure 58. Adjusting governor surge.

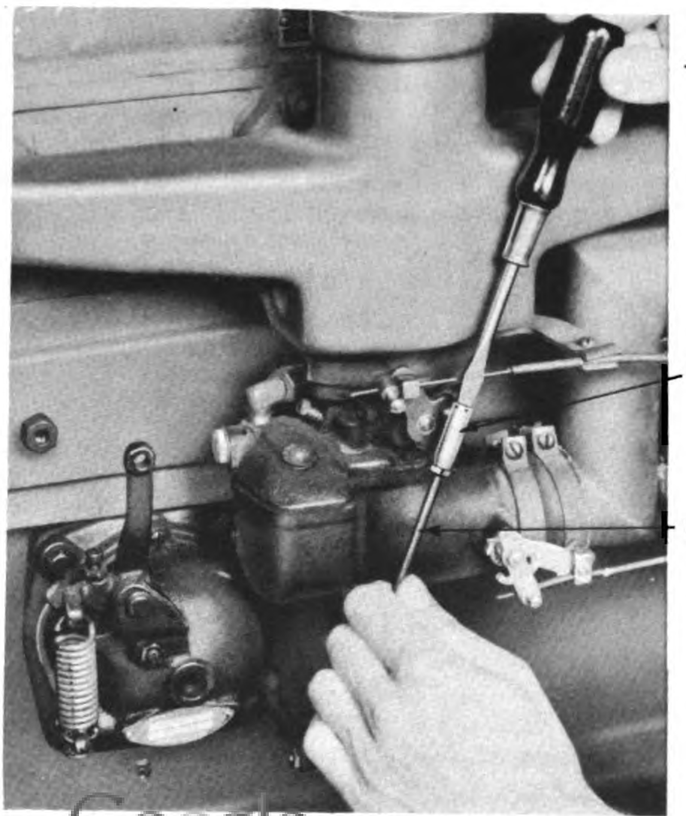


Figure 59. Governor link rod adjustment.

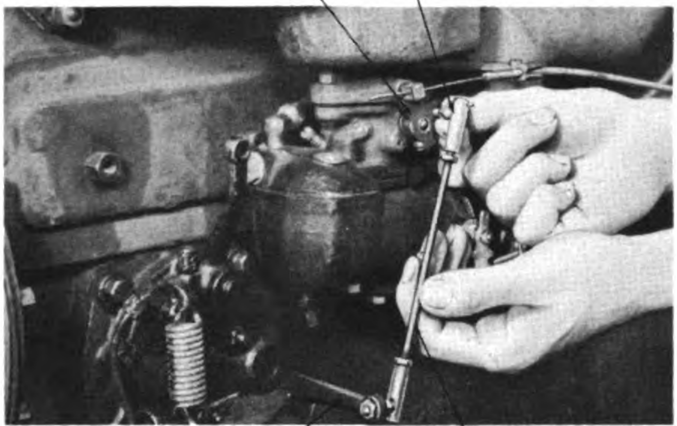


Figure 60. Adjusting Governor Link Rod.

(105) Voltage Regulator

The voltage regulator which is mounted on the generator automatically controls and limits the generator voltage in order to properly charge the battery. The voltage regulator permits a comparatively high charging current when the battery is in a discharged condition, and will cause this current to gradually decrease as the battery becomes charged, thereby protecting the battery from damage by continued high charging currents. The regulator also cuts out the generator from the battery when the generator is not running, to prevent the battery from discharging back through the generator.

WARNING: Because the regulator is precision adjusted and special electrical meters are needed for this setting, the operator should turn the job of adjusting the regulator over to maintenance repair, as outlined in the Maintenance Manual. However the operator can clean the contacts if he has the necessary material and is careful in so doing.

a. Cleaning Contacts

First make certain to disconnect the battery from the control unit or regulator while cleaning the contacts. Take off the cover. Clean the contacts by drawing crocus cloth between them while holding the contacts together under SLIGHT pressure. See figure 57. Crocus cloth is a very fine abrasive. DO NOT USE COARSE ABRASIVES. Blow away the cleaning dust. Be careful not to leave lint or dust between the contacts, because that will prevent operation. Gently snapping the contacts open and closed may dislodge the lint or dust, or drawing a piece of smooth hard paper between the contacts will also dislodge the particles. Do not use a file except to remove projections or extreme roughness, and be sure to use only a fine mill cut file. Continuous filing will remove all contact material from the thin metal disc to which it is welded. DO NOT FILE TOO MUCH.

NOTE: If the regulator must be sent to maintenance repair for adjustment, the regulator and the generator must always accompany each other. One should not be adjusted or repaired without the other being adjusted and checked.

(106) Governor

The governor maintains within close regulation any desired engine speed with the normal idling and nominal maximum speed range, irrespective of engine load. In addition, the governor controls the engine idling speed to prevent stalling and the maximum speed to prevent racing. The governor is connected to the governor throttle box butterfly valve located between the carburetor and the intake manifold by a link rod. See figure 45. The governor is pressure lubricated internally.

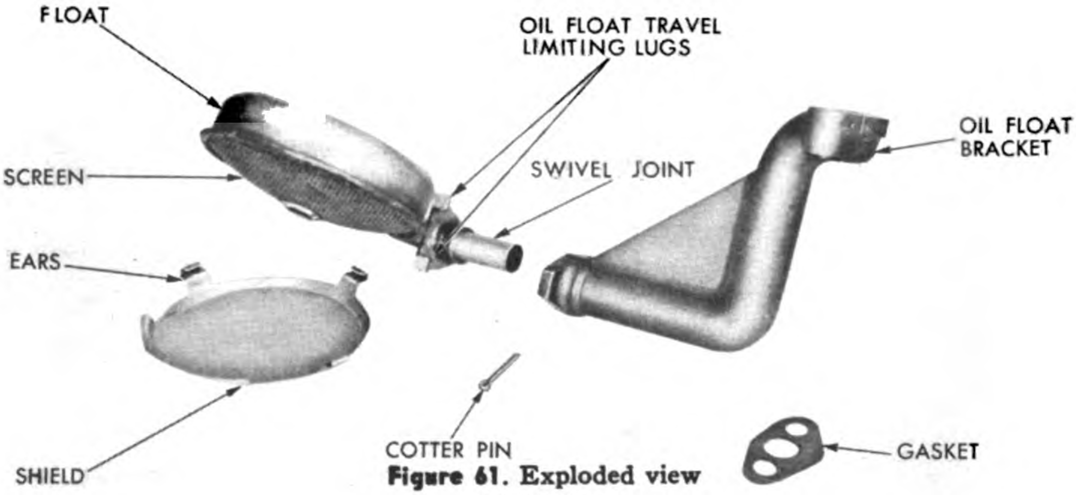


Figure 61. Exploded view of oil float.

CAUTION: The main speed adjustment is correctly set at the factory and should not be changed. If, because of some mishap or damage, it becomes necessary to reset the adjustment, the operator must turn this job over to the maintenance repair, as outlined in the Maintenance Manual, because the distances must be accurately calibrated.

a. Adjusting Engine Surge

If the engine is unstable at top engine speed, running without load or part load, turn the adjusting screw, as in figure 58, inward a half turn at a time until the surging stops, being sure that you do not raise the speed of the engine by so doing.

b. Adjusting Governor Link Rod Ball Joints

The governor link rod ball joints at both ends of the link rod should be snug, but move without friction. See, in figure 59, the screwdriver is turning the ball joint adjusting plug and the fingers are testing for friction at the carburetor end. A small cotter pin through the screw must be removed to make the adjustment. Replace the cotter pin after the adjustment is made. NEVER BEND THE ROD. Keep ball joints lubricated.

c. Adjusting Governor Link Rod

With engine stopped, loosen both the ball joint locknuts, remove the ball joints from the governor arm, and, with the governor throttle in wide open position, adjust the rod by turning the ball joint either to the right or left, depending upon the adjustment required. The rod must be so adjusted that when the engine is stopped the rod holds the governor throttle lever with a very slight amount of slack from the wide open position. See figure 60.

(107) Manifold

The manifold provides a means of entrance of the combustible gases into the combustion chamber and also a means of exit of the burned gases from the combustion chamber.

a. Checking a Warped Manifold

With a straight edge, check across the gasket faces lengthwise. If warped, the ends usually bow in and the center bows out. The manifold must be either replaced or machined by maintenance repair as outlined in the Maintenance Manual. Frequent blowing of the gasket is an indication of a warped manifold.

(108) Magnetic Switch

The magnetic switch, when the push button switch is operated, completes the starting circuit between the battery and the starting motor. The push button switch is a simple button type with a retracting spring that opens the contact when the finger is removed from the button.

In time, the contacts of the magnetic starting switch will require resurfacing or possible renewal. Resurface perfectly flat with a fine mill file, then polish the surface on sandpaper laid on a perfectly flat surface. A rounded surface will not permit sufficient contact for heavy current. The switch comes as a complete unit or assembly and if worn or damaged must be completely replaced.

(109) Oil Float

The oil float is a floating oil pump suction screen arranged to rise and fall with the oil level in the crankcase so that only the best oil is taken for the bearings—thus avoiding the sludge and the foam, either of which would cause bearing damage. See figure 61.

a. Checking the Float

When the oil pan is removed, check the joints about which the body of the float swings. It must be free of any binding. A damaged tube on the float or a damaged casting in which the float tube pivots can cause binding at these points. The damaged part should be replaced. Since the tube cannot be removed from the float body assembly, the entire unit must be replaced if the tube is damaged.

b. Cleaning the Float Screen

When the oil pan is removed, examine the screen and if necessary, clean it by removing the float and washing it in gasoline, naphtha, or a good cleaner. Blow the screen with compressed air. If the fouling is particularly bad, bend out the ears, and remove the shield. The screen can then be thoroughly cleaned with a wire brush. The shield should be carefully positioned and the ears turned back over the body flange. Clinch the ears with pliers; never use a hammer.

(110) Oil Pan

a. Cleaning Out the Sludge

Remove the oil pan and wash out the sludge with kerosene. If the sludge is thick, the engine is being incorrectly operated, and an investigation of operating conditions should be made. Sludge is the result of moisture being present in the oil pan. The moisture is caused either by the natural sweat of the engine, leaky piston rings, or water in the oil.

(111) Oil Filter

The oil filter removes dirty particles that are the result of engine operation. Not only does the filter help to cut down engine wear, but also to prolong the usefulness of the oil.

a. Renewing Filter Element

Unscrew the cover assembly by turning the handle at the top of the filter counterclockwise until the threads disengage. Remove the drain plug to drain the accumulation in the sump and to break the vacuum created while removing the element. Pull out the dirty element by the wire handles. Flush out the filter housing with kerosene. Be sure to have the oil pan drain plug out. Insert the new element and replace the drain plugs. Inspect the top gasket; if recessed, replace it with a new non-laminated DeLuxe gasket. With filter completely assembled, check for leakage by running the engine till filter is warm. See figure 62.

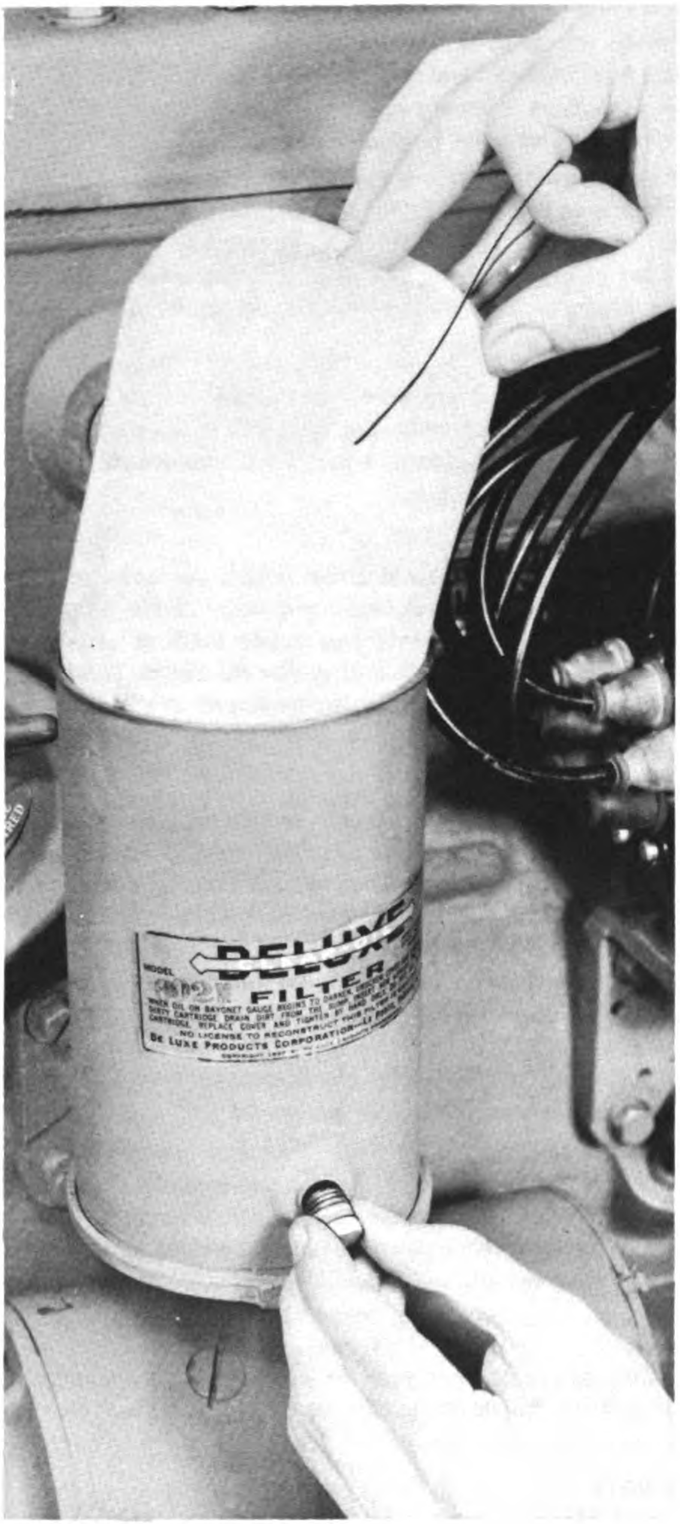


Figure 62. Removing element of oil filter.

(112) Radiator

With the air pulled through the radiator tubes by the fan, the radiator cools the water in the cooling system. It is important that only clean, soft water be used in the cooling system. The use of hard water will cause scale to form in the engine jackets and in the radiator, thereby tending to clog up the circulation. Where the use of hard water cannot be avoided, use a commercial water softener.

a. Flushing Radiator

Drain the radiator, refill and flush it. Examine the hose connections for disintegration. Anti-freeze solutions have a tendency to cause the rubber hoses to deteriorate. Particles of rubber thus pass into the system and fill up the water passages. If the system is clogged, attach a hose to the bottom of the radiator at the drain hole, and turn on 20 or 30 pounds of water pressure. This reverses the flow and will tend to carry the dirt, which has been lodged down in the tube, back upward and out through the top of the radiator. While doing this allow the radiator to overflow through the top. If the radiator is so badly clogged that this does not serve to free the circulation, then the following steps must be taken:

b. Cleaning the Radiator

Use a solution of one part of muriatic acid to three parts of water in sufficient quantity to fill the radiator, or a solution made up with three or four cans of commercial lye added to a sufficient quantity of water to fill the cooling system. Allow either of these solutions to stand in the system for three or four hours. Drain the radiator and thoroughly flush the cooling system with clean water. After flushing, fill with clean water.

CAUTION: Do not use liquid solder or radiator compounds to stop leaks, as these tend to clog the radiator tubes. A leaky radiator should be repaired in the regular manner by maintenance repair as outlined in the Maintenance Manual.

(113) Spark Plugs

The spark plug has two electrodes so arranged that, when the high-tension electric current passes through the plug, a spark is produced which ignites the compressed gas mixture. The center electrode is insulated and the outer electrode is grounded.

a. Checking and Adjusting Spark Plugs

The gap between the electrodes should always be set at .025 inch. Use a wire feeler gauge as shown in figure 63 to check the gap. Inspect the porcelain for cracking and chipping; if porcelain is damaged, discard the plug. Where

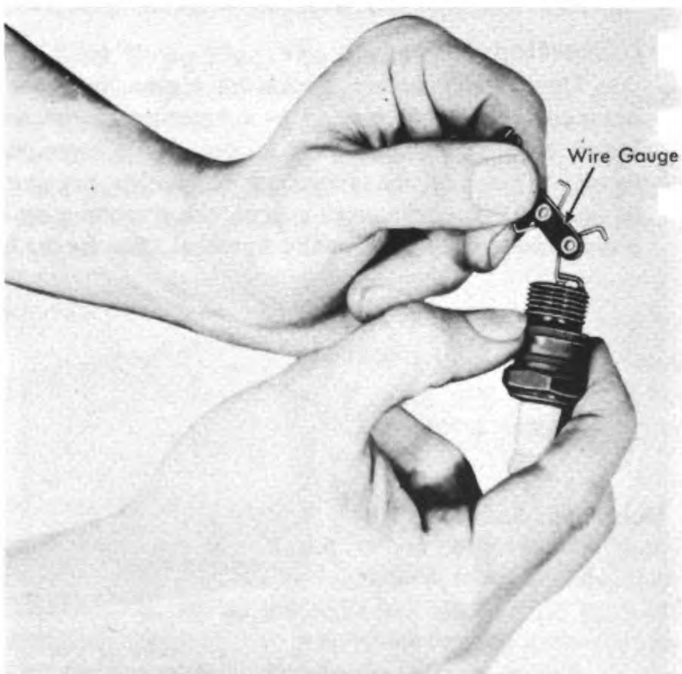


Figure 63. Checking spark plug gap.

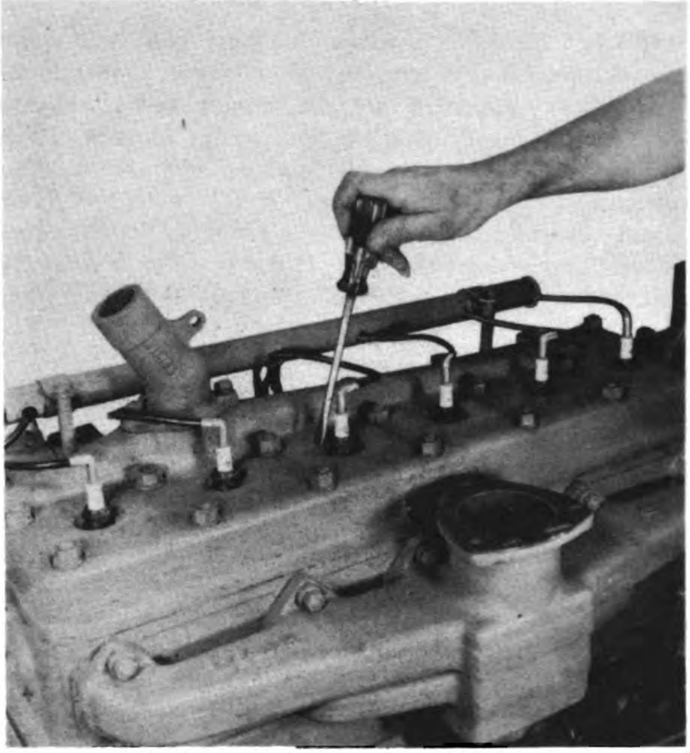


Figure 64. Checking spark plug failure.

possible, use a spark plug sand blaster to clean, or scrape off the carbon with a knife. The outside of the porcelain should be kept free from oil and dirt on which moisture can collect and "short" the plug. Spark plugs should be renewed every 1,000 hours of operation.

b. Checking Misfiring Spark Plugs

To find the plug, or plugs, not firing, ground a screwdriver to the block (as shown in figure 64) and tilt the screwdriver to contact the metal terminal on the cable connecting the spark plug to the distributor. The plugs, or plug, not firing will have no effect on the running of the engine when shorted by the screwdriver and indicates misfiring.

(114) Starting Motor

The starting motor cranks the engine; however, it does not start the engine, because the actual starting is a function of the engine itself. A Bendix drive keyed to the armature shaft automatically engages the cranking pinion to the flywheel gear as the armature begins to revolve when the magnetic switch is closed. When the engine fires, the overrunning effect of the flywheel on the pinion disengages it from the flywheel. See figure 65.

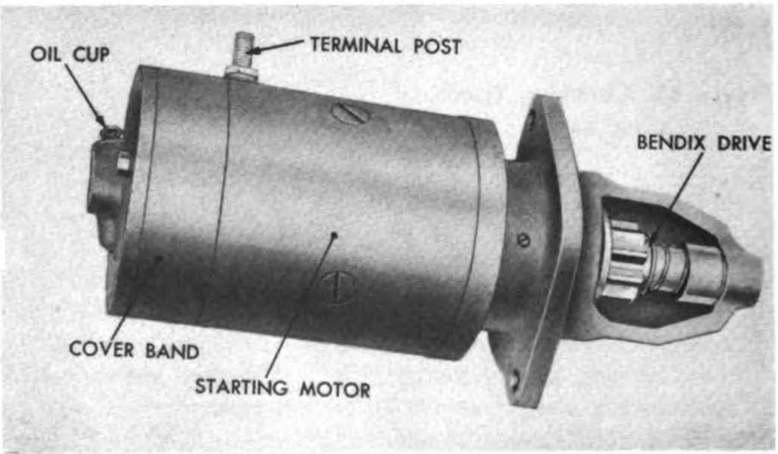


Figure 65. Starter.

CAUTION: Avoid prolonged cranking, as this may cause overheating of the cranking motor and the battery. If the engine does not start in a few seconds, investigate and correct the cause. The cranking motor must be used only when the engine is free of other loads. Be sure the clutch is disengaged.

a. Checking and Cleaning Commutator

If the commutator becomes slightly rough or coated, it will be necessary to remove the starter from the engine, take off the end plate and brush assembly. Now with a strip of 00 sandpaper, holding the ends of the paper in each hand, polish the surface smooth. Do not use metal for holding sandpaper and DO NOT USE EMERY CLOTH for cleaning. If the commutator has high mica or is out of round it must be machined and the mica undercut. This will necessitate removing starter from engine. This procedure is outlined in the Maintenance Manual.

b. Checking and Servicing Brushes

The brushes should be checked for wear, sticking or insufficient spring pressure. New motor brushes are 13/16 inches long, and the brushes must be replaced when they are worn down to ½ inch in length. Grind in the new brushes with No. 00 sandpaper held on the contour of the commutator with the sanded side against the brush. Then pull the sandpaper in the direction of the rotation of the armature, as shown in figure 56, the same method that is used in seating generator brushes.

The brushes must move freely in the holders. If they are oily or dirty, clean the brushes in gasoline, but do not soak them. If brushes are caked with any substance, remove with fine sandpaper laid on a true, flat surface. Do not sand them excessively or round the contact edges of the brush.

For new full length brushes there is usually enough spring pressure when the brush spring ends are in the first notch of the lever. When the brushes are worn down to 21/32 inch long, or if "arcing" is occurring between the brushes and the commutator, it is advisable to put the brush spring ends in the second notch, counting from the brush end of the lever. If the spring temper has been taken out by overheating, replace the brush holder. Attempting to use worn-out brushes may cause overheating of the brush springs.

c. Checking, Cleaning, and Repairing the Bendix Drive

Remove the starter from the flywheel housing. To remove the Bendix, first loosen the shaft spring screw, which is accessible through the hole in the pinion housing. Take out the housing screws and slide the pinion housing and the Bendix off the shaft. See figure 65. If Bendix is worn or the spring distorted, they should be replaced. When re-assembling the Bendix on the shaft, give the shaft a thin coating of OE-10.

(115) Switches

The magnetic switch, when the push button switch is operated, completes the starting circuit between the battery and the starting motor. The push-button switch is a simple button type with a retracting spring that opens the contact when the finger is removed from the button.

a. Checking and Servicing Switches

In time, the contacts of the magnetic starting switch will require resurfacing or possible renewal. Resurface perfectly flat with a fine mill file, then polish the surface on sandpaper laid on a perfectly flat surface. A rounded surface will not permit sufficient contact for heavy current. There are no adjustments or servicing necessary to the push-button starter switch or the magneto ignition switch other than to replace when they fail to operate.

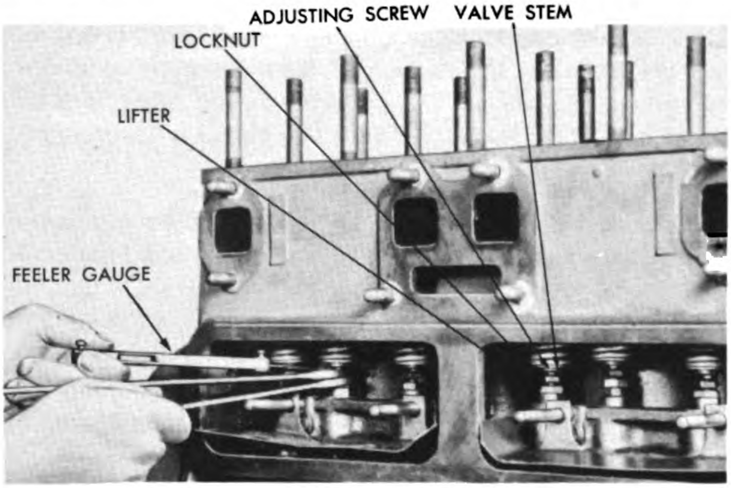


Figure 66. Checking Tappet Clearance.

(116) Tappets

The tappets bear directly on the ends of the valve stems and provide a means of adjusting the valve so they will seat and open correctly.

a. Checking Tappet Clearance

It is of utmost importance that at all times there is the correct amount of clearance between the tappets and the valve stems.

To check this clearance (see figure 66): First remove the valve cover plate. Turn the engine over by hand until the intake valve closes on the particular cylinder you are working on. Continue to turn the engine ½ revolution to be certain that the cam is out from under the lifter. The piston is now approximately at top dead center, and both the intake valve and exhaust valve are in position for checking or adjusting. Figure 67 shows the positions of the exhaust and intake valves.

With feeler gauge, check the clearances: For the intake valve on a hot engine, 6 thousandths of an inch; for the exhaust valve, 9 thousandths of an inch.

To adjust: The lifter must be held rigid while loosening the middle locknut. Turn the top adjusting screw in either direction, depending upon the adjustment that is needed, until the correct clearance is checked. Tighten locknut and check to be sure that the adjusting screw has not moved. Repeat this procedure for all the valves and bear in mind that both the intake and exhaust valves can be checked together for that particular cylinder. CAUTION: The position for adjusting and checking is determined by the closing of the intake valve; therefore, check the ports in the manifold to be certain that it is the intake valve you are closing to obtain the proper position as shown in figure 67.

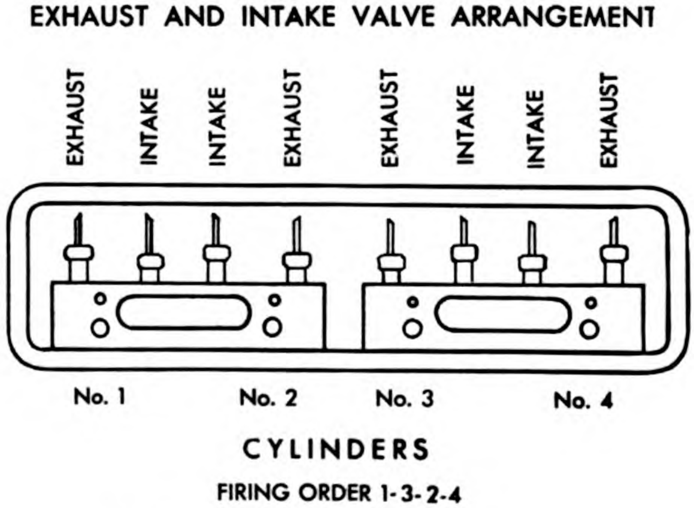


Figure 67. Firing order diagram.

(117) Wiring

The cables or wires carry the electrical current from the source of supply to where it is used or stored. See figure 6.

a. Checking and Removing Wiring

The wiring should be kept free from grease and oil which causes the insulation to crack and break down. When the cables show signs of cracking or the wiring becomes frayed, replacement is necessary, for they are no longer waterproof. CAUTION: The wires or cables needing replacement must not be replaced with other than the specified size cables as indicated in the Wiring Diagram. If smaller cables or wires are used, the flow of current is restricted which will result in inefficient operation of the electrical system. Keep the ground cable free from corrosion at the battery terminal connection.

(118) Trouble Shooting and Emergency Treatment

Over 90% of engine trouble can be prevented by good preventive maintenance as outlined in preceding section. The time and energy consumed in preventive maintenance is only a fraction of what must be incurred when trouble ties up operations.

To remedy as quickly as possible troubles that may develop, the following list of symptoms, cause and remedies is given. Where the remedy is not within the scope of the operating personnel, it is so indicated in the "Remedy" column. This means that the engine needs the attention of the maintenance shop, which has the necessary tools, skill and data, as outlined in the Maintenance Manual.

(119) Trouble Shooting Chart

TROUBLE	PROBABLE CAUSE	REMEDY or "WHAT TO DO"
A. Engine Hard to Start.	1. Water in the fuel.	1. Let stand. When the water has settled to the bottom, drain the water from the carburetor, sediment bowl and gasoline tank.
	2. Gasoline flow obstructed.	2. Check fuel lines, carburetor screen, the fuel valves in the carburetor, and the sediment bowl. Locate and remove obstruction.
	3. Improper valve clearance.	3. Adjust. (See Tappet Adjustment), ¶ 116.
	4. Spark plug gap too wide or plug is shorted.	4. Adjust gap. (See Spark Plugs), ¶ 113a. If short is caused by fouled plugs, clean; if short is caused by cracked porcelain, replace with a new plug.
	5. Defective wires.	5. Replace with new wires.
	6. Improper gas mixture.	6. Adjust. (See Carburetor Adjustment), ¶ 100.
	7. Incorrect timing.	7. (See Ignition Timing), ¶ 101.
	8. Leaks at the intake manifold.	8. Tighten manifold to cylinder block and the carburetor to the manifold. If gaskets are defective, replace, and check the manifold for warping; if warped, it must be machined as outlined in the Maintenance Manual.
	9. No compression.	9. (Valves not seating properly.) This is a job for maintenance

TROUBLE	PROBABLE CAUSE	REMEDY or "WHAT TO DO"
A. Engine Hard to Start. (Cont.)		repair. Piston rings may also be worn out and should be replaced as described in Maintenance Manual.
	10. Carburetor choke not set properly.	10. Adjust. (See Carburetor Adjustment), ¶ 100.
	11. No spark at the plugs.	11. Distributor breaker point not opening. Adjust. Ground wire may be shorted, or faulty switch connections. Check and connect. This may also be due to internal trouble in distributor—a job for maintenance repair. See Maintenance Manual.
B. Engine Stops Suddenly	1. No fuel.	1. Refill tank.
	2. Carburetor fuel valve closed.	2. Check carburetor fuel valve. See ¶ 100. Carburetor Adjustments.
	3. Dirt in fuel.	3. Drain out. Refill with fresh fuel only after sediment bulb, carburetor and gasoline tank have been cleaned. See Fuel System, ¶ 103.
	4. Dirt in filter.	4 Clean the carburetor and air filters.
	5. Water in fuel.	5. Follow instructions of Trouble A, Remedy 1.
	6. Plugged fuel lines.	6. Disconnect fuel lines, blow and remove obstructions.
	7. Ignition failure.	7. See distributor, ¶ 101.
	8. Internal breakdown.	8. This is a job for maintenance repair.
C. Engine Misses.	1. Spark plug fouled.	1. Remove carbon with a pocket knife.
	2. Spark plug gap not properly adjusted.	2. Adjust as outlined under Spark Plugs, ¶ 113.
	3. Chafed wiring, broken cable or loose connec.	3. Replace or tighten the connections.
	4. Leaks at cylinder head gasket.	4. Tighten head or replace gasket. See new engine, ¶ 94.
	5. Leaks at the intake manifold gasket.	5. Replace gasket and check the manifold for warping.
	6. Warped valves.	6. This is a maintenance repair job, as outlined in Maintenance Manual.
	7. Stuck valve.	7. Remove valve cover and with screwdriver free the sticking valve. Valve stem and guide will have to be cleaned to restore proper clearance. If condition continues, valves need regrinding. This then becomes a maintenance repair job as outlined in the Maintenance Manual.

TROUBLE	PROBABLE CAUSE	REMEDY or "WHAT TO DO"
C. Engine Misses (Cont.)	8. Valve tappets out of adjustment.	8. Adjust. See Tappet Adjustment, ¶ 116.
	9. Engine overheats, causing valves to stick.	9. Check cooling system. Do not add cold water immediately. Allow engine to cool to avoid cracking the cylinder head. Free the valves by cleaning the valve stems.
D. Engine Knocks.	1. Carbon in combustion chamber, "pinging"; knocking in the cylinder.	1. Remove cylinder head, scrape and clean out carbon. See Maintenance Manual.
	2. Loose connecting rod bearings. (Sharp knock and low oil pressure).	2. This is a job for maintenance repair as outlined in the Maintenance Manual.
	3. Loose main bearings (heavy thump)—low oil pressure.	3. This is a job for maintenance repair as outlined in the Maintenance Manual.
	4. Loose piston pins (sharp double knock).	4. This is a job for maintenance repair as outlined in the Maintenance Manual.
	5. Piston and cylinder wear.	5. This is a job for maintenance repair as outlined in the Maintenance Manual.
	6. Ignition timing fast ("pinging" knock in the cylinder if not caused by carbon).	6. See Distributor Timing, ¶ 101.
	7. Improper tappet clearance.	7. Adjust. See Tappet adjustment, ¶ 116.
E. Engine Overheats.	1. Lack of water.	1. Add water.
	2. Scales on water jacket.	2. Use solvent solution and thoroughly flush the cooling system.
	3. Particles of rubber hose. Sticks or other foreign substances inside the cooling system.	3. Remove by thoroughly flushing out radiator and cooling system. See Radiator, ¶ 112.
	4. Intake hose at pump collapses.	4. Replace with wire-reinforced hose.
	5. Damaged water pump caused by ice or other substances.	5. This is a maintenance repair job as outlined in the Maintenance Manual.
	6. Lubricating oil thin or dirty.	6. Drain oil pan and add new oil of correct viscosity for the prevailing temperature. See Lubrication, ¶ 87.
	7. Broken fan belt, or belt is slipping.	7. Replace if broken, or adjust tension as outlined under Fan Belt Tension, ¶ 102. If slipping is caused by grease, it may be necessary to replace the belt.

TROUBLE	PROBABLE CAUSE	REMEDY or "WHAT TO DO"
E. Engine Over-heats (Cont.)	8. Carburetor choke not set properly.	8. Adjust. See Carburetor Adjustment, ¶ 100.
	9. The core of the radiator clogged with bugs and leaves.	9. Remove by use of air hose or whisk broom.
	10. Leaky radiator.	10. Repair. Do not use quick stop-leak solders as these tend to clog the circulation. Lead solder must be used.
	11. Engine running in close quarters, not getting enough ventilation.	11. Open up the ventilation.
F. Loss of Power.	1. Low oil pressure, due to (a) external oil leaks, (b) thin oil, or (c) sticking of oil relief valve. (d) worn connecting rod or main bearings.	1. (a) Repair leaks by tightening the line. (b) Drain and fill with fresh oil. (See Lubrication), (c) Remove oil relief valve and clean it. Do not stretch spring, (d) See Maintenance Manual.
	2. Faulty ignition or timing.	2. See Distributor, Spark Plugs and Cables, ¶ 101, 113, 117.
	3. Leaky valve.	3. This is a job for the maintenance repair as outlined in the Maintenance Manual. However, if the leaky valve is caused by its improper adjustment, the operator can correct as outlined in Tappet Adjustment, ¶ 116.
	4. Worn piston rings.	4. This is a job for maintenance repair as outlined in the Maintenance Manual.
	5. Blown cylinder head gasket.	5. Replace.
	6. Air cleaner obstruction.	6. Clean air cleaner and tighten connections. See Air Cleaner, ¶ 98.
	7. Obstruction in exhaust line.	7. Remove obstructions.
	8. Improper mixture.	8. Adjust. See Carburetor Adjustment, ¶ 100.
	9. Improper governor butterfly valve adjustment.	9. See Governor Adjustment, ¶ 106.
	10. Improper fuel.	10. Be sure to use only a good gasoline.
	In high altitude operation there is approximately 3% loss of horse power per 1,000 feet of altitude.	

TROUBLE	PROBABLE CAUSE	REMEDY or "WHAT TO DO"
G. Smoky Exhaust.	1. Carburetor float sticking. (Black smoke).	1. Tap carburetor lightly with hammer handle. If this does not correct the condition carburetor must be cleaned. See Maintenance Manual.
	2. Carburetor needle valve open too much. (Black smoke).	2. Adjust. See Carburetor Adjustment.
	3. Worn piston rings and out of round and tapered cylinders. (Blue smoke).	3. This is a job for maintenance repair as outlined in the Maintenance Manual.
	4. Thin lubrication oil. (Blue smoke).	4. Use of oil of correct viscosity.
	5. Oil level too high.	5. Drain surplus oil from crankcase.
H. Explosion in Exhaust.	1. Late ignition.	1. Retime ignition. See Distributor Timing, ¶ 101.
	2. Weak spark.	2. Check Coil. Spark Plugs and Cables, ¶ 101, 113, 117.
	3. Partially open exhaust.	3. (a) Remove gum from valve stem or (b) Adjust tappet clearance, or (c) Replace broken spring.
	4. Warped exhaust valve.	4. This is a job for maintenance repair as outlined in the Maintenance Manual.
I. Engine runs irregularly (sputters).	1. Out of adjustment.	1. See Carburetor Adjustment, ¶ 100.
	2. Leaky valves.	2. This is a job for maintenance repair as outlined in the Maintenance Manual.
	3. Leaky intake manifold.	3. Tighten or replace gaskets: if manifold is warped it must be machined (maintenance repair job).
	4. Air leaks in gaskets.	4. Tighten or replace gaskets.
	5. Partially closed tank shut-off valve.	5. Open valve.
	6. Water and sediment in carburetor.	6. (a) Let water settle to bottom, and drain, (b) Drain out sediment and clean screens.
	7. Fuel lines partially blocked.	7. Check line and remove obstruction and any kinks in tubing.
	8 Clogged air cleaner.	8. Clean.
	9. Loose jets in the carburetor.	9. This is a job for maintenance repair.
J. Generator does not charge	1. Commutator dirty.	1. Clean commutator. (See paragraph on "Cleaning the Commutator" under Generator), ¶ 104.
	2. Worn brushes.	2. Replace. See Brush Replacement, Generator, ¶ 104.
	3. Blown field fuses.	3. Renew field fuse.

TROUBLE	PROBABLE CAUSE	REMEDY or "WHAT TO DO"
J. Generator does not charge. (Cont.)	4. Loose fan belt.	4. Adjust as outlined under Fan Belt Adjustment, ¶ 102.
	5. Broken external connection.	5. Reconnect.
	6. Shorted armature.	6. This is a job for maintenance repair as outlined in the Maintenance Manual.
	7. Shorted field.	7. This is a job for maintenance repair as outlined in the Maintenance Manual.
	NOTE: Inspect for short circuits in the generator, requiring special test meters. This is a job for maintenance repair. The generator should be overhauled at the 2,048-hour general inspection and overhaul period of the engine.	
K. Starter motor failure.	1. Broken connection.	1. Reconnect or replace cable.
	2. Faulty switches.	2. See Switches, ¶ 108. If magnetic switch needs repairs, have maintenance repair install a new one.
	3. Battery dead, or low charge.	3. Recharge or renew.
	4. Commutator dirty.	4. Clean with No. 00 sandpaper; do not use emery cloth.
	5. Worn brushes.	5. Replace. See Brush Replacement under Generator, ¶ 104.
	6. Broken bendix.	6. Replace. See Repairing Bendix Drive. ¶ 114.
	7. Bad teeth on flywheel gear.	7. Renew. This is a job for maintenance repair as outlined in the Maintenance Manual.
	NOTE: Any short circuit in the starter motor requires special test meters. This is a job for maintenance repair, which has all the tools and data necessary, as outlined in the Maintenance Manual.	
L. No gasoline at the carburetor.	1. Clogged fuel line.	1. Check the fuel lines between the tank and the carburetor.
	2. Float stuck (dirty needle valve. Valve closed.	2. Tap the carburetor bowl gently —or remove the carburetor and clean the needle valve and float chamber. See Carburetor. Maintenance Manual.
	3. Fuel tank empty.	3. Refill.
M. Engine surges.	1. Surge spring out of adjustment.	1. Adjust Governor as outlined in Governor, ¶ 106.
	2. May be caused by rich gasoline mixture.	2. Adjust Carburetor as outlined in Carburetor. ¶100.

TROUBLE	PROBABLE CAUSE	REMEDY or "WHAT TO DO"
N. Carburetor leaks gasoline when idling.	1. Float stuck (dirty needle valve).	1. Tap carburetor gently to dislodge the dirt in the fuel valve. If this does not correct the condition, remove the carburetor and clean the valve. See Maintenance Manual.
	2. Float level incorrect.	2. Adjust. See Carburetor, Maintenance Manual, Float Level Adjustment.
	3. Drain plug not tight.	3. Tighten.
O. Radiator boils.	1. Lack of water.	1. Add water.
	2. Frozen radiator.	2. Run engine for three minutes with blanket covering radiator. Stop for five minutes. Again run engine for three minutes and stop for five minutes. Continue this operation until radiator is thawed. Check for leaks. Do not run continuously to thaw, as water will boil away and overheat, thus seriously damaging the engine.
	3. Leaky radiator.	3. Repair radiator. Do not use liquid solder, as it tends to clog the system.
	4. Faulty hose connections.	4. Tighten or replace hose.
	5. Internal collapse of suction hose at the pump.	5. Renew with wire-reinforced hose.
	6. Leaky pump.	6. This is a job for maintenance repair as outlined in the Maintenance Manual.
	7. Dirt, rust, scales and sediment in the water jacket.	7. Use a solvent to remove; flush and drain entire system.
	8. Pieces of broken hose in system.	8. Remove by draining and flushing the system.

(120) Emergency Treatment

With an engine which has been submerged in fresh water or salft water, a complete tear-down is necessary. Although this is a job for the maintenance repair personnel, there are certain steps the operating personnel can take to aid in salvaging the engine.

Because it is so important that air be kept from contacting the wet steel and iron parts, it is oftentimes much better to allow the engine to remain under water if the maintenance repair personnel cannot immediately service the submerged engine. Of course, the engine should not remain under water for an unreasonable length of time. NOTE: Too much stress cannot be given to the importance of working quickly if it is expected that the engine is to be salvaged. Therefore, arrangements must be promptly made to dismantle the engine as quickly as possible and to thoroughly clean and slush each part.

All parts of the engine should be thoroughly dried and coated with oil to prevent the air reaching them. If the submersion occurred in salt water it is recommended that as soon as the engine is dismantled all parts other than electrical equipment be washed in hot fresh water, dried, and slushed with lubricating oil that has been heated to 180°F. Electrical equipment such as starters and generators, should be thoroughly flushed with fresh water, dried and overhauled before using.

If circumstances are such that the operating personnel can dismantle the engine, they should do so, thoroughly drying and carefully handling the machine surfaces so as not to mar or injure them, leaving the job of reassembly of the engine to the maintenance repair personnel.

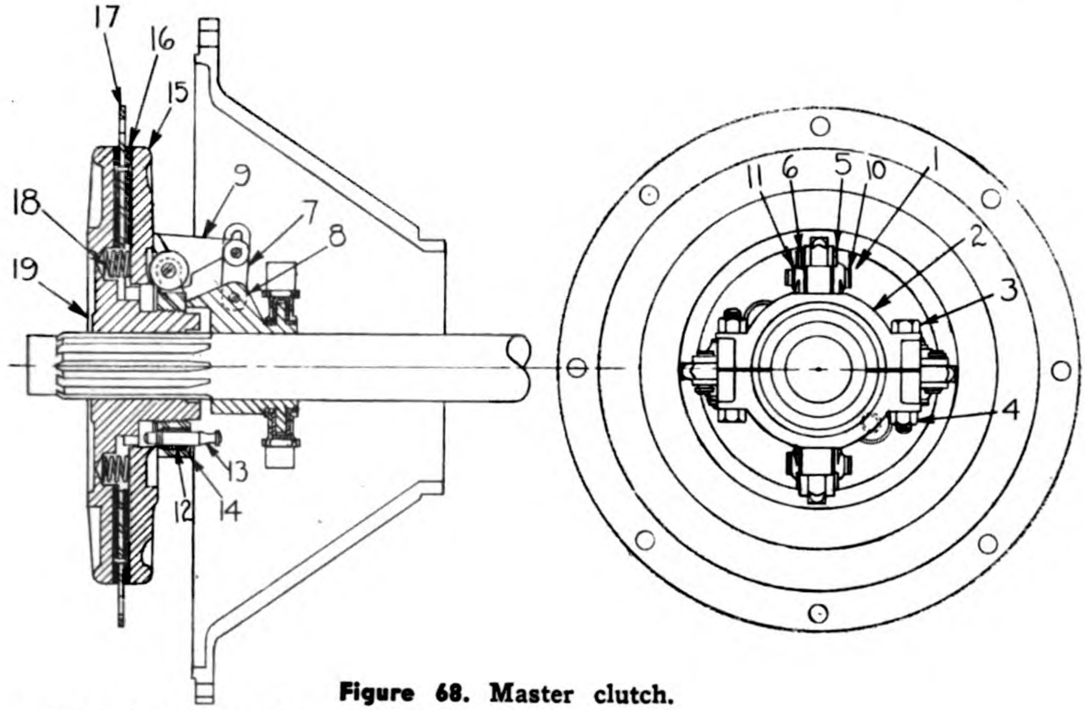


Figure 68. Master clutch.

(121) Adjustments—Clutches and Brakes

a. Master Clutch

If the clutch does not pull, heats, or operating lever jumps out, adjustment is necessary.

Remove hand hole plate on the clutch housing and turn the clutch until the adjusting lock pin (13) Figure 68 can be reached. CAUTION: Be sure that the engine is not running. Pull the lock pin out and turn adjusting yoke (14) one notch to the right, allowing the lock pin to drop into the notch. One notch is usually sufficient to adjust the clutch. A new clutch requires more frequent adjustment until the friction discs (16) are worn in.

b. Crawler Brakes and Crawler Clutches

The crawler brakes and clutches are operated by the same levers, making it necessary to check both brake and clutch adjustments at the same time. When the levers are pressed down the brakes are applied. Unless the distance between these two positions is properly adjusted the brakes may drag when the clutch is engaged, wearing the brakes and clutches excessively. If there is a definite drag when the clutches are disengaged, and the loader tends to move forward, the clutches are too tight. If the crawlers do not take hold positively when the clutches are engaged and the brakes properly adjusted, the clutches are too loose. If levers disengage themselves, the clutches need tightening. It is useless to attempt to adjust the brakes unless the clutches are checked and in proper adjustment first.

The crawler clutches are of the split band, external contracting type. There is a clutch for each crawler, located on the crawler clutch shaft. Essentially each clutch consists of two clutch bands that compress on a drum when the clutch lever is engaged.

When the clutches are in proper adjustment, the clutch levers engage with a distinct snap as the shifter yoke throws past center.

CAUTION: Always be sure before making an adjustment of the clutches that the lack of effectiveness is not due to slippage due to grease on the band. If the band is greasy wash with gasoline.

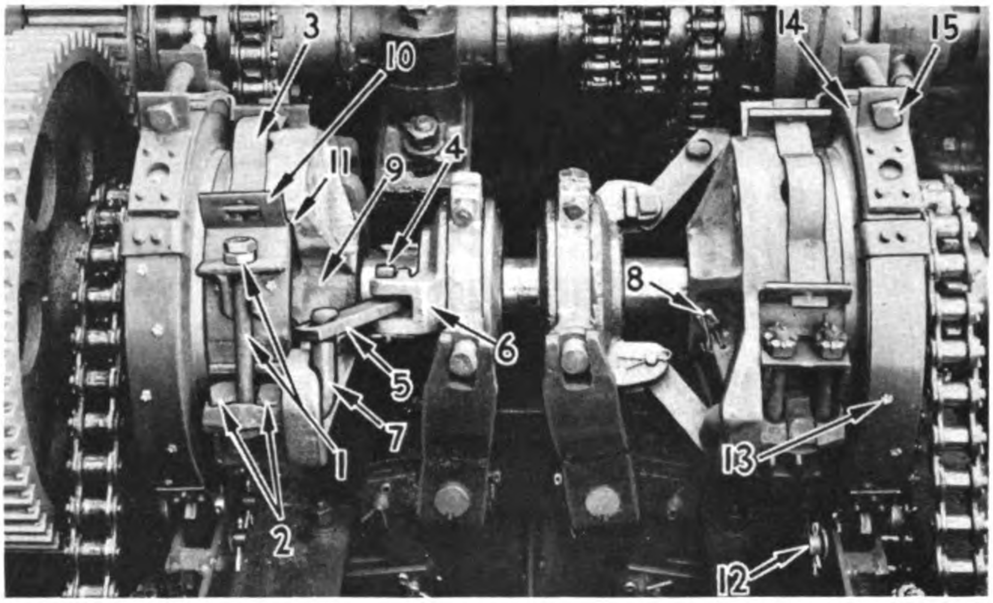


Figure 69.

To tighten clutch, loosen half nut on adjusting bolt (1) Figure 69 and turn inside nut down ¼ to ½ turn. Then turn clutch half way around and repeat procedure on opposite take-up bolt. Be sure to take up an equal amount on both bolts.

If this is not done, the ends of both clutch bands nearest to the bolt taken up the most will drag resulting in damage to the clutch. To determine if both have been taken up an even amount proceed as follows:

(A) Turn clutch over until the clutch band half, having no shims between the spring clip and clutch carrier at (11) is accessible.

(B) Disengage clutch.

(C) Grasp firmly with fingers, both clips (10) that hold the spring (3) in position. If clutch band is free on the drum, the take-up bolts have been tightened properly. If band cannot be moved, the bolts are not evenly adjusted and the clutch will drag. To correct proceed as follows:

(D) Check the clearance between the spring clip (10) and carrier (9) at (11) and the clearance between the clip and carrier at the other end of spring (3). You will find there is no clearance at one end and possibly ¼" at the other. Therefore, the bolt at the end having ¼" clearance must be loosened and the opposite take-up bolt tightened until the clutch band has been centered having equal clearance between clips (10) and carrier (9) at point (11), and then continue to tighten bolts evenly until the clutch is in proper adjustment. A new clutch may require several adjustments until friction bands wear in.

When the clutch is properly adjusted, the clutch band must be free on the drum as described under "C".

c. Brake Adjustment

With the clutches properly adjusted, proceed with the brake adjustment. After the clutch adjustment, operate the loader to see if the brakes need adjustment. This adjustment is a very easy and simple operation. However, these adjustments require periodical checking particularly when the loader is new.

To tighten either brake, loosen half nut on adjusting bolt, (15) and turn inside nut down ½ to ¾ turn. If this should not be sufficient, continue to turn nut ½ turn until proper braking is obtained. Never tighten brakes more than is necessary to brake each crawler when turning on level ground.

To loosen either brake, reverse above procedure.

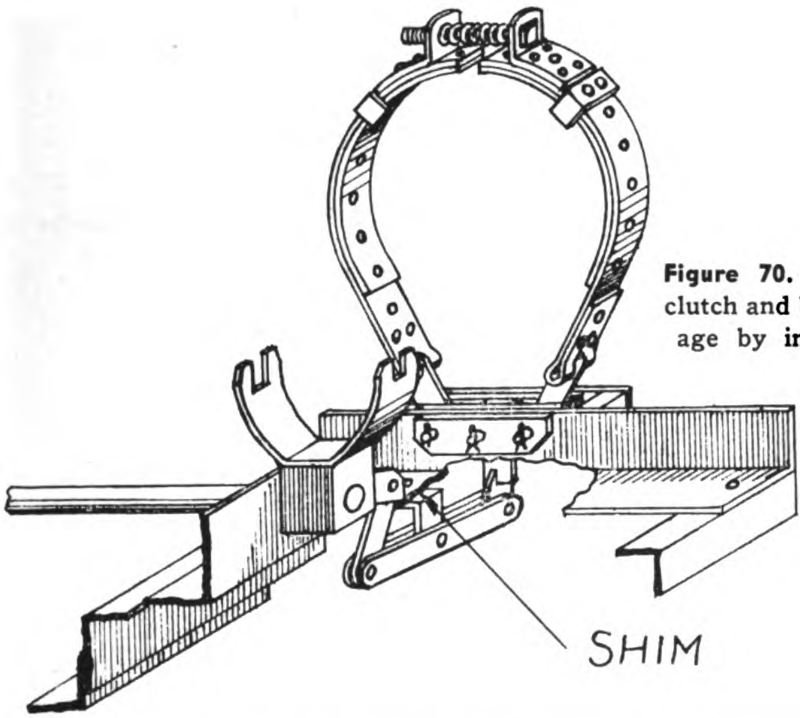


Figure 70. Adjustment of clutch and brake lever linkage by inserting shims.

After the brakes have been adjusted several times, remove the inspection cover from the chassis housing and check the various parts of braking mechanism. After this final check up and adjustment is made the brakes should need little adjustment for a long period. If adjustment is necessary it will usually be the clutch that needs adjusting. Parts and alignment to inspect and maintain are as follows:

Check the brake bands to make sure they are free of grease. Should bands become greasy, they may slip although they are already sufficiently tight. In such case, wash with gasoline.

If, when applying the brakes, the levers should hit the drive chain gear case, so that proper braking cannot be obtained, it will be necessary to shim the linkage of the brakes. See Figure 70. These shims are placed between the linkage, and the support angles, and held in place by bolts. Always insert an equal amount of shims on both sides. This is necessary to maintain proper alignment of the steering levers.

CAUTION: Be sure that when the clutches are engaged, the brake bands are free on the drums and with brakes set the clutch bands are free as per instruction "C" in "Clutch Adjustments". The brakes may be set up too tight so they engage before the clutches completely disengage, resulting in a condition where clutch and brakes are working against each other.

d. Hoist Clutch

The hoist clutch lever permits full travel to point where lining is worn out therefore, no adjustment is necessary. However, it may become oily and slip. In this case wash with gasoline. Lining on male half should be watched closely and relined before rivet heads score female cone necessitating replacement.

Figure 71. Crawler take-up end.

(122) Adjustments—Chains

a. Crawler Treads

When the sag in the crawler treads from the spring take-up idler to the front idler wheel exceeds three inches, the crawler tread should be tightened To do this, loosen the two bolts (1) Figure 71, holding take-up guard plates and clean out slots so the guard plates can be free to slide. Remove lock plates (2) from head of take up bolt. Turn bolts (3) equally on both sides until there is no sag in the tread and the spring on the spring take-up idler begins to compress. The tread will then be in proper adjustment. It is important to take up on each bolt an equal amount to insure proper alignment of idler wheel and crawler tread.

b. Crawler Final Drive Chain

This chain is in proper adjustment when there is about ½" sag in slack side of the chain. This chain should be watched closely as experience has shown that most of the trouble which has occurred in the past has been due to neglect of proper adjustment of this chain. Loosen the four bolts (1) Figure 72 which attach pivot shaft bracket to crawler frame. Removal of the covers (2) will expose the shims used to shift crawler and help to hold it in position. Remove shims (3) towards discharge end and force them in opposite side. This moves crawler forward for adjustment of chain. Shims not used in adjusting are left in the rear to form a positive hold at this point. In the event crawler is moved forward to the limit of the slots and the chain becomes loose it will be necessary to put all the shims at rear of bracket. This will loosen chain and permit removal of a link. If the chain has offset link this may be removed If the chain has not an offset link remove a roller link, a connecting link, and put in an offset link.

After the chain is connected crawler is shifted by the shims to proper adjustment. While this adjustment is made it will be easier if crawler tread is parted at the point over the bracket.

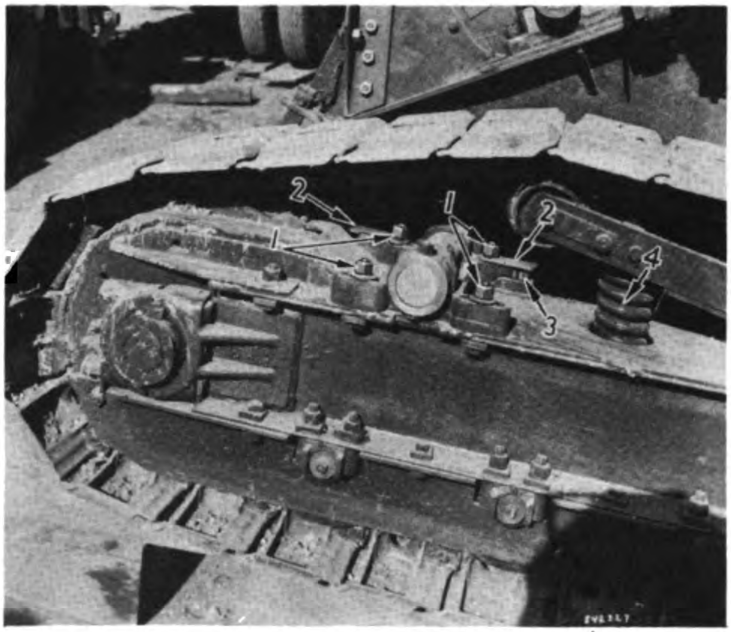


Figure 72. Crawler drive end.

c. Adjustment of Chains Within Chassis Housing

Within the chassis housing are three power shafts with seven drive chains. The oscillating shaft is fixed. The main jack shaft and clutch shaft bearings are mounted in bearing bases with slotted holes making adjustment possible. It is desirable to disturb this shafting as little as possible since moving a shaft to tighten one chain will affect the adjustment of the other chains running from the shaft. The chains driving from these shafts are all short centers consequently considerable wear can develop before becoming so loose to cause unsatisfactory operation. Generally speaking when they are so badly worn that they are too loose to operate safely the whole driving mechanism will need attention. In this case the worn chains and sprocket should be replaced. When rebuilding, the movable feature of the shafts permits adjustment of the chains, and aligning travel gear and pinion.

d. Spiral Drive Chain

Assembled in the lower end of spiral drive chain guard (11) Figure 73 is a spring loaded idler, (12). When properly adjusted the chain should be depressed approximately 1½" at point where chain runs thru idler. To take up chain loosen lock nut at end of tension spring, (5) tighten adjusting nut until proper depression in chain is obtained. Lock the lock nut.

e. Conveyor Belt Chains

Take up of these chains is accomplished by means of two adjusting bolts (4) at Figure 74 at the conveyor discharge end. To tighten these chains loosen lock nuts (8) and take up on bolts until chain is in proper adjustment. Then tighten lock nuts. Each bolt should be taken up an equal distance to maintain sprocket and chain alignment. Proper tension may be tested in the following manner. Standing on top of superstructure at about center of conveyor grasp one of the belt flights and lift upward. When chains can be lifted 2 to 2½" adjustment is proper. CAUTION: When the conveyor belt chain is tightened, the conveyor drive chains are also tightened. This should be checked for proper tension after conveyor belt chains are tightened.

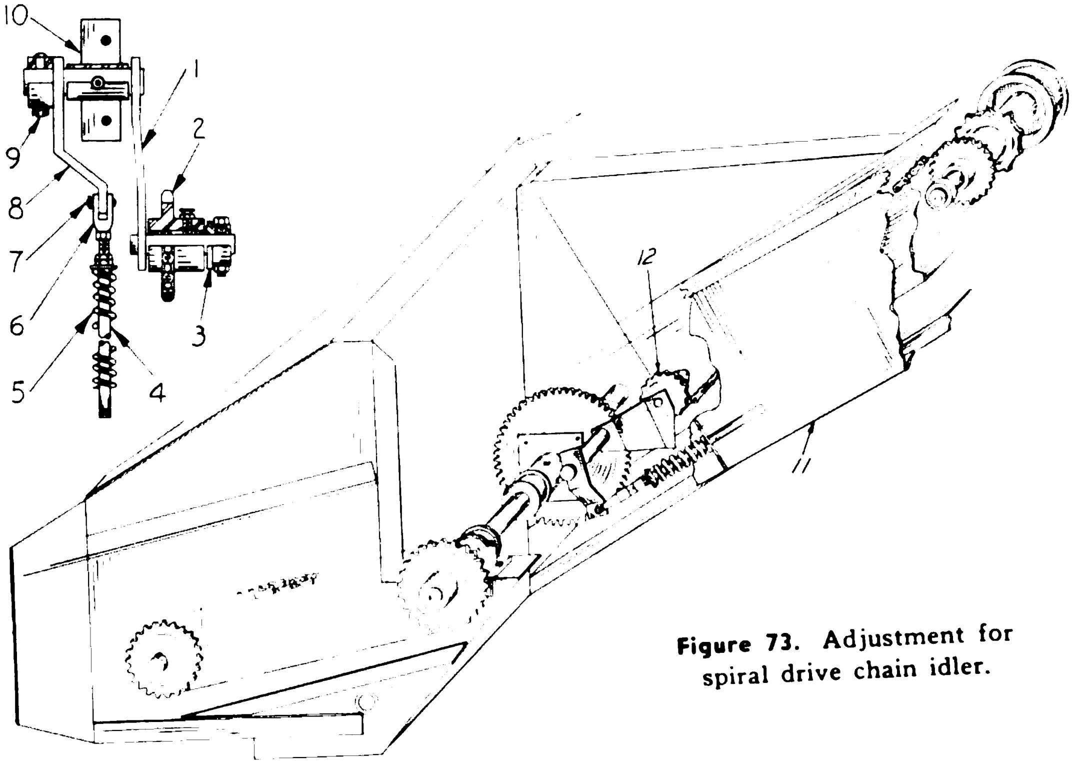


Figure 73. Adjustment for spiral drive chain idler.

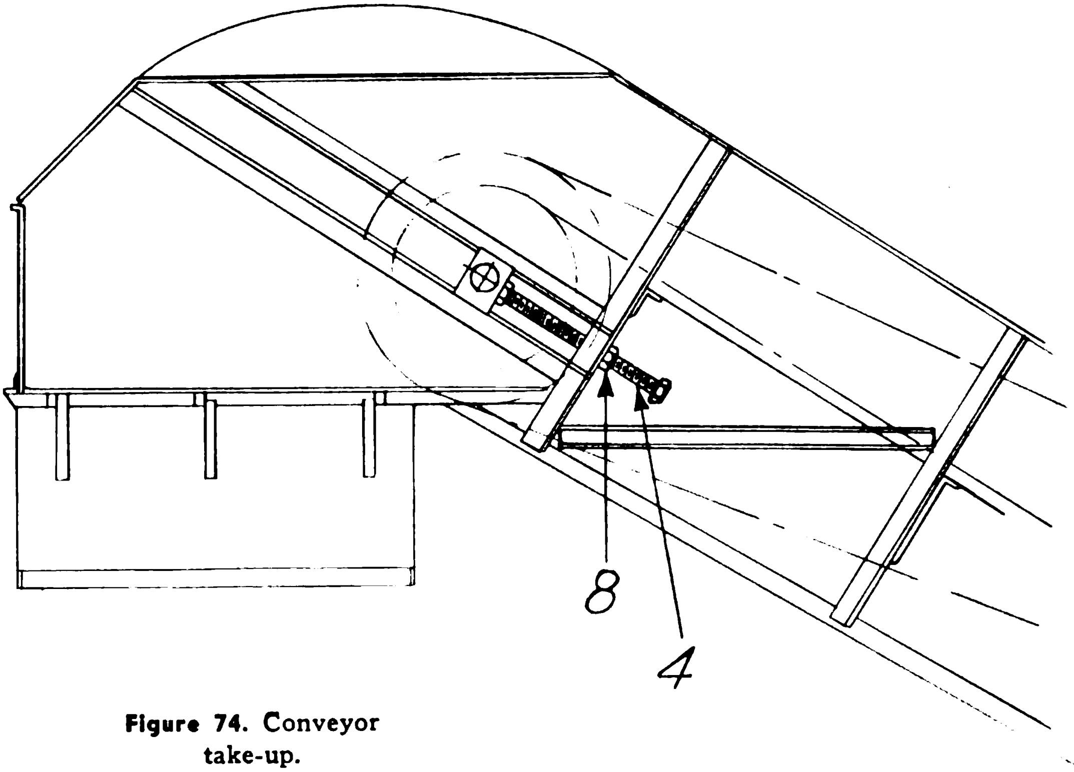


Figure 74. Conveyor take-up.

Chapter IX
Replacement of Highly Expendable Items

Highly expendable items are those which come in contact with the snow and pavement when machine is in operation and are subjected to more or less rapid wear. These wearing surfaces are easily inspected and replaced.

The other parts of the machine are subject to normal wear and tear.

(123) Spiral Wearing Surfaces

Spiral wearing strips should be renewed as soon as teeth are worn away.

The spiral assembly paddles usually wear very little. They should be replaced if broken off.

These items should be observed daily so they may be replaced before the frames become worn.

(124) Scraper Wearing Surfaces

The scraper teeth on the scraper blade may be lowered one hole when they wear down, however, if the cutting edge of the tooth has become dull it should be replaced. When teeth are replaced, generally speaking, all twelve should be replaced so they will all be the same length.

The scraper cutting blade along the front and the two side blades have two cutting edges. When the blades become dull they should be reversed. Only after both cutting edges have worn out should the blades be renewed.

(125) Scraper Shoe Wearing Surface

When the shoe wearing plates become thin they should be replaced before they wear thru allowing shoe frame to become damaged. These plates should also be renewed if the bent up ends become broken. If these ends are broken off and machine is operated in reverse while scraper is on the ground the shoe may catch on an obstruction and become damaged.

Chapter X
Preparation for Storage and Shipment

(126) Preparing Engine for Storage

REFER TO TM5-9715 INSTRUCTIONS FOR EXTENDED STORAGE AND SHIPMENT OF ENGINE.

(127) Processing Instructions for Extended Loader Storage

(128) Shipping Data

38D Snow Loader

Cubage—Not boxed
- Knocked down—2100 cu. ft.
- Assembled —2910 cu. ft.

Boxed for export
- Chassis 792 cu. ft.—13,645 pounds
- Elevator 840 cu. ft.—11,900 pounds

Rail Shipment
- Two machines per flat car.

Chapter XI
Unloading Methods

(129) By Crane

The best method to use to unload this machine is to pick it up with an overhead crane and set it down where desired. The crane should have a capacity of 22,000 lbs. The boom should be left in a horizontal position. Care should be taken that the lift chains are fastened to the lifting rings. Four lift chains are necessary.

(130) To Platform

The next best thing to a crane is a platform to which the machine may be run over short planks. A 4" x 12" timber under each crawler is sufficient if the platform is near the car, but if it is more than six feet away, heavier supports must be provided.

CAUTION: Be sure the platform will hold a weight of 23,000 lbs. before running the machine onto it.

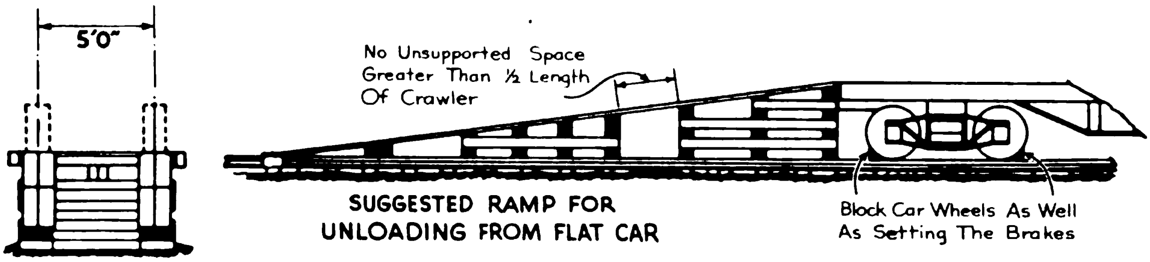


Figure 76X

(131) By Ramp

If neither crane nor platform is available a ramp must be built down which to run the machine. It should be planned and built carefully.

The ramp should be built at the end of the car if possible. It should be about thirty feet in length, the runways being built of eight 3" x 12" x 16'-0" planks. These planks should be cribbed up underneath with ties and small blockings so that at no place is there an unsupported length of planking greater than half the crawler length. About 5 lbs. of 60 penny spikes are necessary to put the ramp together solidly. About 32 ties will be necessary for cribbing the ramp.

CAUTION: If planks are not available and the ramp is made entirely of ties, be sure that they are dry ties that have not been creosoted as the creosote makes them slippery and dangerous. Sanding ties that have been creosoted keeps the crawlers from slipping to a certain extent, but the use of any but dry ties is to be avoided whenever possible.

Block the car so that it cannot move either way as the machine is being run off, and set the car brakes to insure safety.

(132) Running Machine Down Ramp

Lower boom so the scraper clears the car floor by about an inch. Run machine off with spirals ahead.

Line up the machine carefully so steering will not be necessary while going down ramp. Disengage main transmission. Place change gears in low crowding speed. Engage crawler clutches. When ready to start, shift main transmission into first. This will move loader at a slow speed. Use of the crawler clutch steering levers may throw the loader out of alignment. If it is necessary to stop the machine while going down the ramp, disengage master clutch.

The critical point is when the loader rocks forward from the car floor level to the angle of the ramp.

The ramp must be well designed and carefully built.

BUCKET ELEVATOR ATTACHMENT

Only that phase of operation, adjustments and lubrication peculiar to the bucket elevator attachment and the machine application as a bucket loader will be treated in this section.

Index by Chapters to Section Explaining

BUCKET ELEVATOR OPERATION

For Bucket Elevator Maintenance see Chapter XXXII.

Alphabetical Index by Paragraphs
to
Operation Section
of
MODEL 38D BUCKET ELEVATOR ATTACHMENT

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Alphabetical Index by Paragraphs to Bucket Elevator Attachment Operation Section (cont'd)

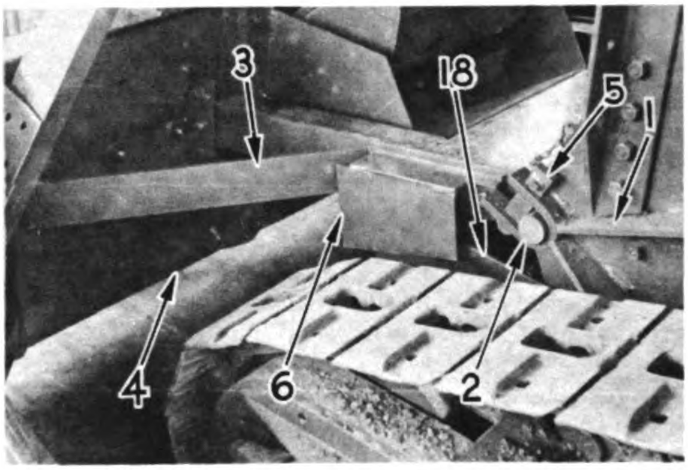


Figure 76. Showing push arms attached.

Chapter XII

Analysis of Component Assemblies

(133) Push Arms

The push arm transmits thrust from the chassis substructure (1) Figure 76 to the feeding end of the elevator.

The push arm (3) is fabricated of angles and plates electric welded into a frame. The scraper end of the push arm is fork shaped to provide equal support across the entire width of the scraper through four connections. A shaft is welded in back of the push arm frame for connection to the chassis.

The chassis end of the push arm connects to the chassis by fitting into two "U" shaped brackets (2) on the chassis substructure. Two lock pins (5) which are chained to the frame to prevent them being lost, lock the shaft in the "U" shaped brackets. This connection forms a pivot allowing vertical movement of the elevator.

Welded to each side of the push arm is a right angle guard (6). When the elevator is in loading position the guards protect the crawler drive chains (18) from falling material.

FOOT SHAFT

(134) Footshaft

The bucket line footshaft (10) Figure 77 is supported by two bronze bushed, ball and socket bearings (7) and (9) which are attached to the lower end of the elevator main frame. Bronze washers (11) located at the ends of each bearing take the thrust developed by the action of the spiral (6).

The footshaft extends on either side of the bearings. The spiral sections slip over and are bolted to each extended end of the shaft.

Located between the bearings and assembled in the shaft are the two bucket line foot sprockets (8). These sprockets support the feeding end of the bucket line, and drive the spirals. The sprockets are of the split type which eliminate the necessity of removing the footshaft when replacing them.

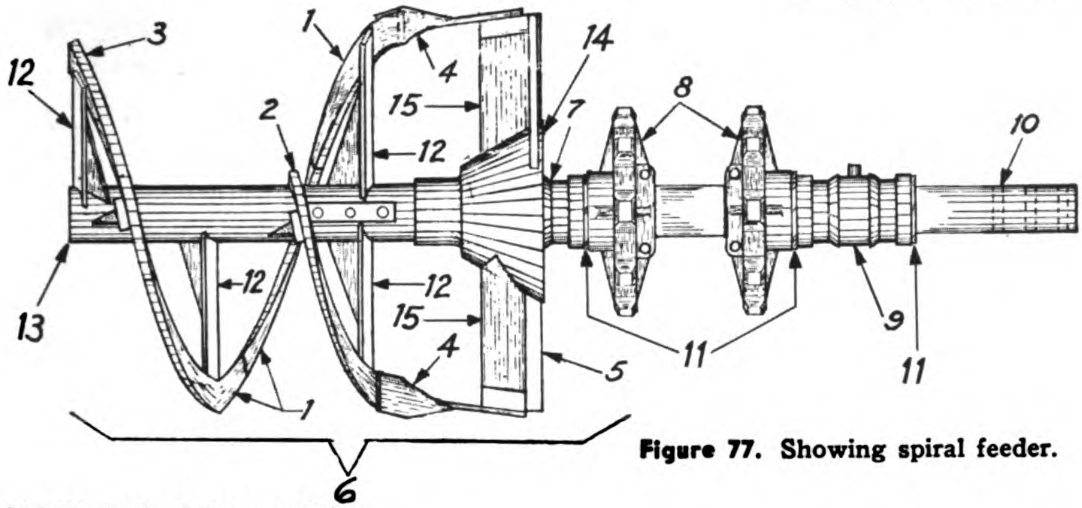


Figure 77. Showing spiral feeder.

(135) Spiral Assemblies

The spiral assemblies (6) are mounted on the footshaft one on either side of the bucket line. These spirals break up semi-hard and compacted material, and convey the material from the entire width of the cleanup in to the bucket line. Each spiral structure is welded into a one piece unit. A heavy tube (13) serves as the foundation and center of the structure. To the bucket line end of the tube is welded a cast steel cone (14). This cone fits over the outer end of the footshaft bearing and prevents, to a large extent, any abrasive material coming in contact with the bearing. Also to the tube are welded the arms (12) which support the spiral rims. Two cutters (15) are welded to, and extend outward from each spiral cone. These cutters are set at an angle, so that as the spiral assembly revolves, material is thrown into the buckets. These cutters are provided with renewable wearing faces.

The spiral rims are protected from abrasive wear by the wearing strips (1) (2) (3) which bolt to the rims. These strips are made of special abrasion resisting steel. The strips are notched to provide a digging and tearing action when loading compacted materials.

The wearing strips should be observed closely and replaced as soon as the teeth wear away. If not replaced at this time, the spiral rim will wear away making necessary replacement of the entire spiral assembly or a costly welding job. New bolts should be used to install new strips. The strips are made in segments so that if one segment wears more quickly than the others, only the segment need be replaced.

(136) Stone Ejector Cam

Located between the spiral cutters and the footshaft sprockets are two stone ejector cams (8) Figure 78. The purpose of these cams is to eject any stone which may become lodged between the buckets and the spiral cutters.

(137) Scraper

The scraper (4) Figure 79 is assembled on the foot end of the bucket elevator for the purpose of cleaning up material behind the spirals. The scraper extends the full width of the machine, cleaning a path 8′-0″ wide. The scraper is fabricated of plates and angles assembled into a one piece unit. Along the lower edge of the scraper is bolted a renewable wearing blade (1) which takes the wear of cleaning up operation. At the points where the scraper bolts to the elevator slotted holes (2) and shims (3) are provided. Using this adjustable feature the scraper blade should be kept approximately ¼″ below the lowest point on the spirals when loading from stock piles or banks of material. Should machine be used for grading, the scraper should be raised to ¼″ above the lowest point on the spirals. This setting allows the spiral to cut packed material rather than throwing the full cutting load on the scraper assembly.

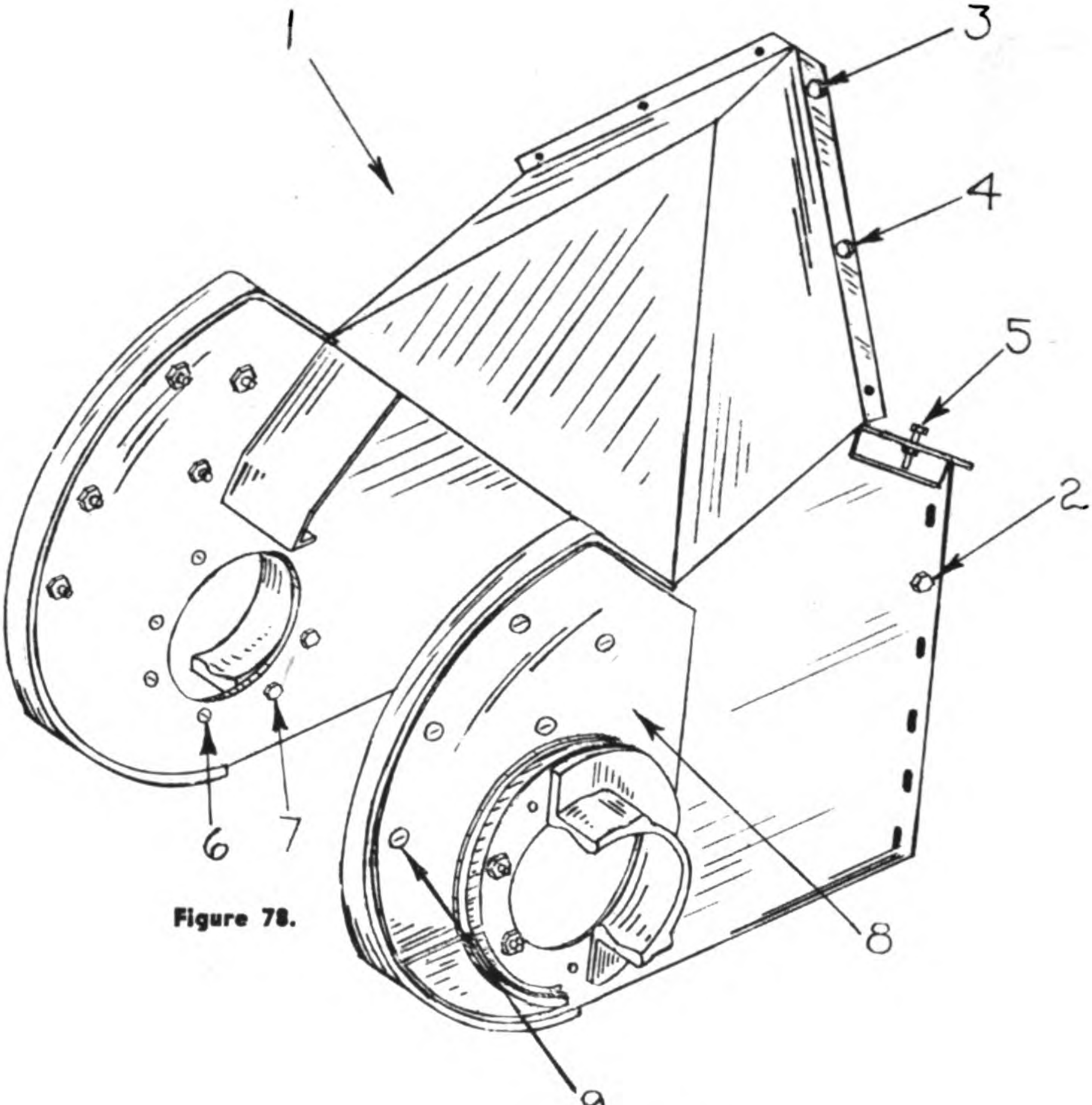


Figure 78.

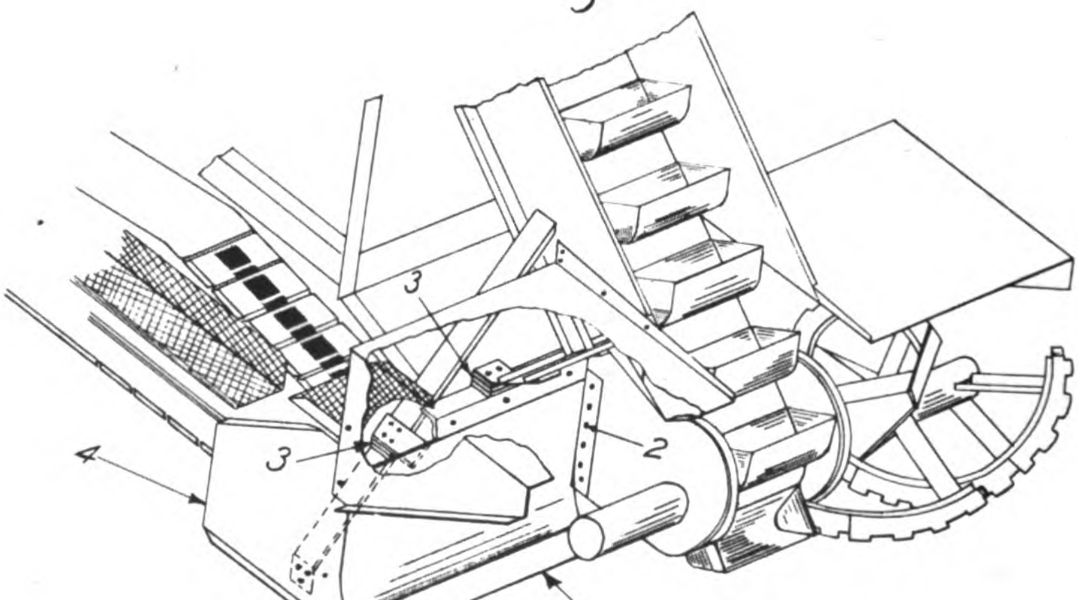


Figure 79. Scraper assembled on foot end of bucket elevator.

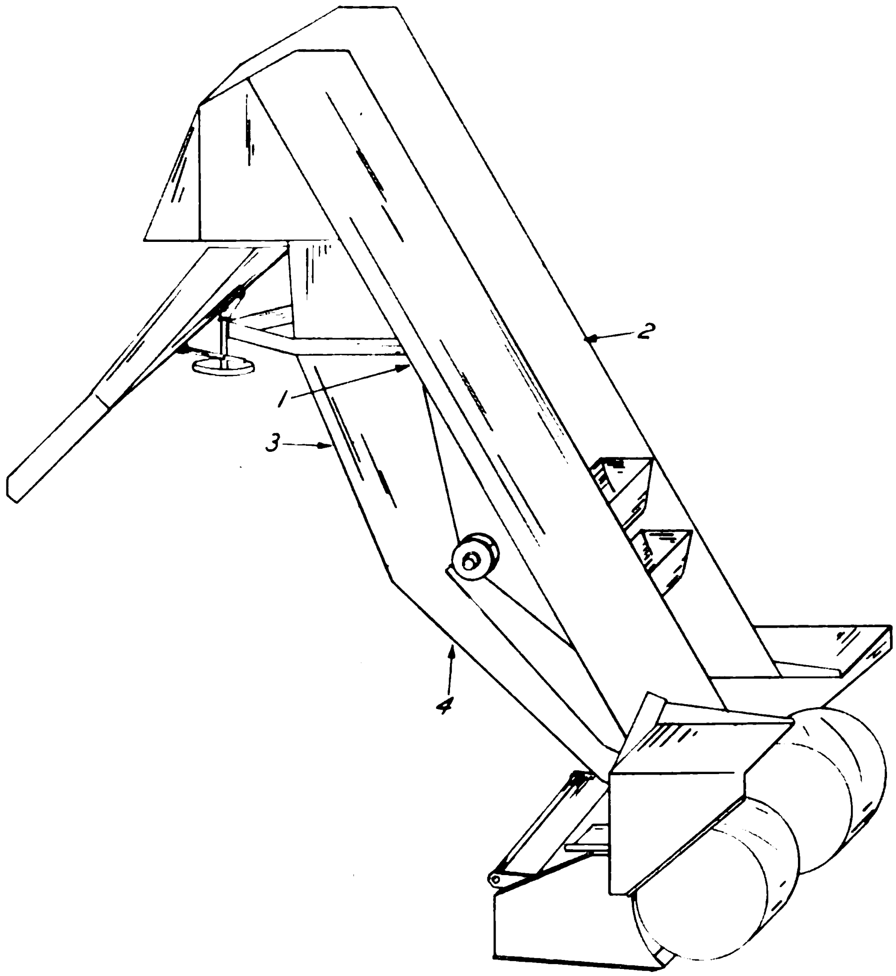


Figure 80. Bucket elevator.

(138) Elevator Frame

The bucket elevator frame (1) Figure 80 has assembled on it all the parts which make up the elevator unit.

The frame is fabricated of two 6" channels with decking to return spilled material from uprun buckets to the feed end. High skirt boards (2) assembled to the outer sides of frame protects the operator from falling material and aids in keeping material from the chassis.

(139) Bucket Line

The bucket line assembly (1) Figure 81 carries the material from the feed end to the discharge point. The assembly is made up of two continuous chains on which the buckets (5) are bolted to attachment links (2) every 12". The bucket line running around the foot sprockets drives the spiral feed.

(140) Bucket Line Idlers

The two bucket line idler assemblies (Figure 82) support the uprun side of the bucket chain. The idlers are spaced an equal distance along uprun side of the elevator frame. The idler shafts (1) are held stationary in upright supports (2) by set screws.

Three spacers (3) on the shaft keep the two single flange rollers (4) in their proper place.

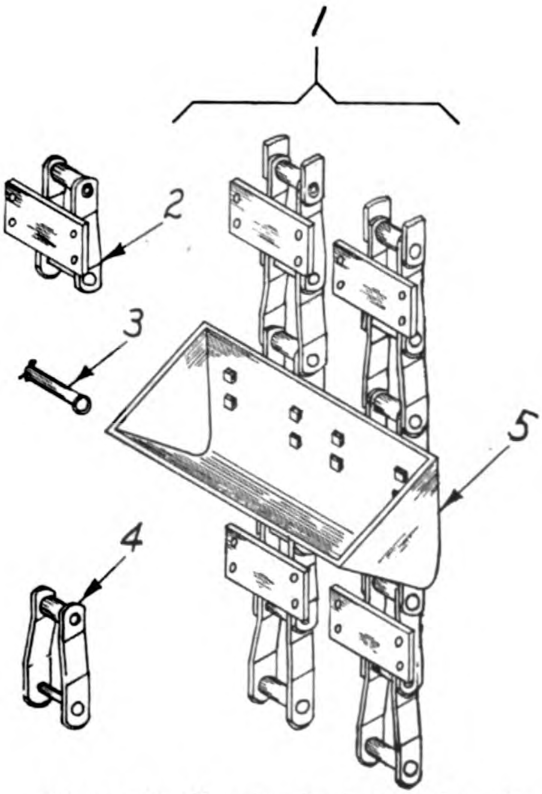


Figure 81. Showing buckets and parts.

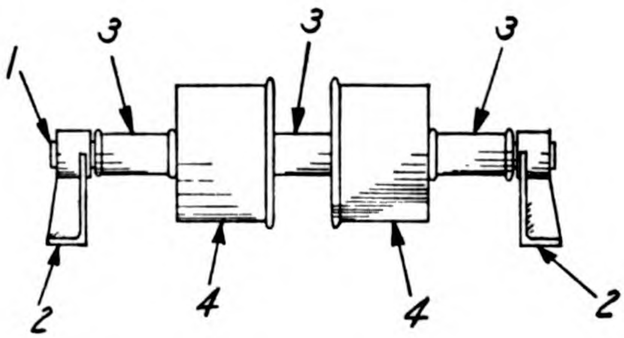


Figure 82. Bucket line idlers.

(141) Bucket Line Housing — Return Pans

To protect the operator and prevent bucket spillage from falling on the loader mechanism the down run side of the bucket is housed (3) Figure 80 half way down. Return pans (4) run the full length of the down run side to carry all spillage back to the feeding end. The two sides of the housing bolt to the elevator frame on the under side.

The return pans are in three sections. The first bolts into the fixed housing of the discharge end. The second and third pan bolts into the preceding pan. These pans are suspended from the elevator frame by four lengths of twisted chain. The pans and housing are removed only when the elevator is put in the horizontal position for transportation where minimum clearance is necessary.

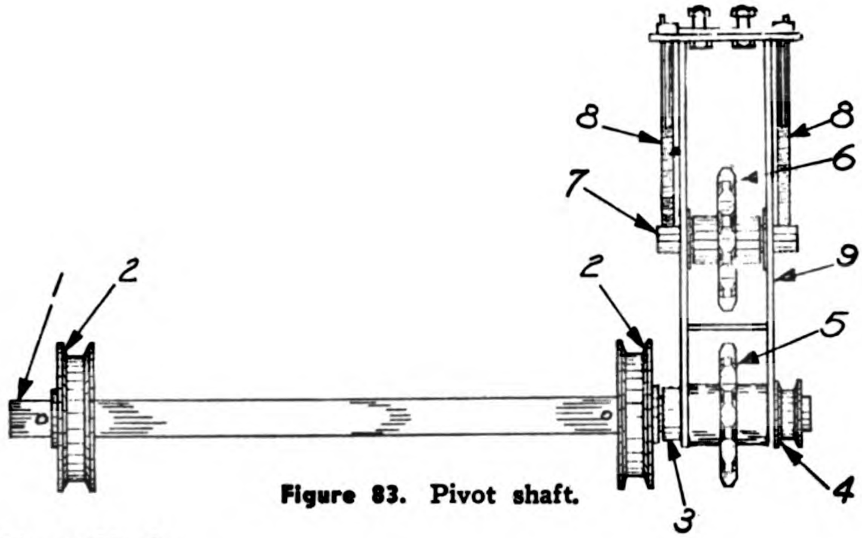


Figure 83. Pivot shaft.

(142) Pivot Shaft

The bucket elevator is carried by this shaft assembly Figure 83. This assembly mounts in a structural bracket on the under side of elevator frame.

On this shaft (1) is assembled two double flanged rollers (2). As the elevator is raised and lowered it rides on the tracks through these rollers.

Opposite the operator the bucket line drive chain fixed idler (5) is assembled on the shaft. Spanning this sprocket and assembled to the shaft is the frame (9) which contains an idler sprocket (6) and two take-up bolts (8). The uprun side of the bucket line drive chain runs on this idler sprocket.

The take-up which moves vertically is used to adjust the bucket line drive chain.

(143) Headshaft

The headshaft (8) Figure 84 is the drive end of the bucket line and the point of discharge for material. On the headshaft is assembled the two bucket line sprockets (5). These sprockets are split so they can be renewed without removing entire headshaft. The headshaft is mounted in two babbitted take-up bearings (4) each being held in position by a locked bolt (1) used for taking up bucket line slack. On this shaft outside of frame (opposite operator) is assembled the overload release sprocket (7). Refer to "Bucket Line Drive" for further information on the overload release sprocket).

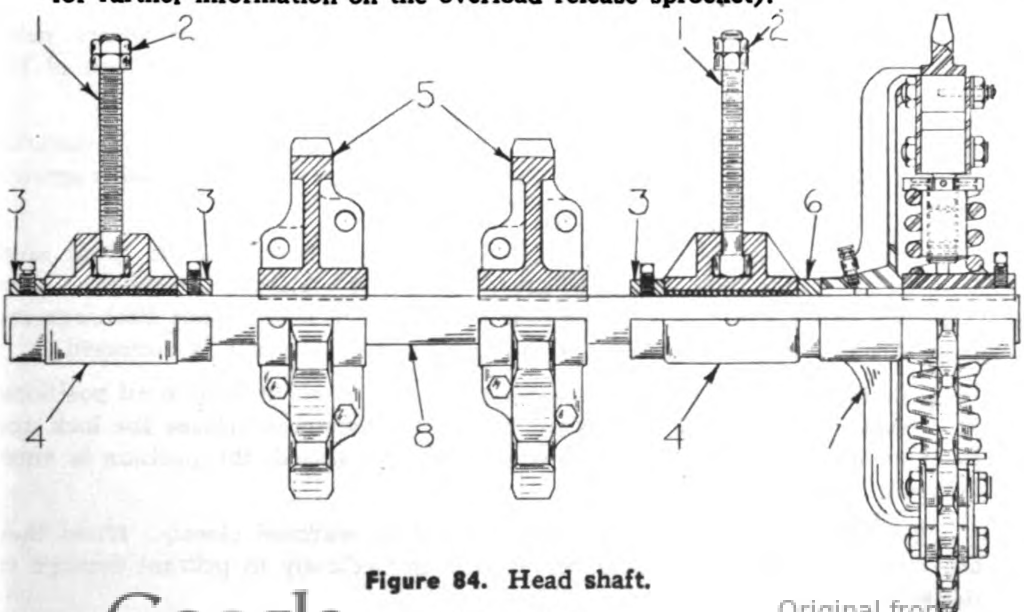


Figure 84. Head shaft.

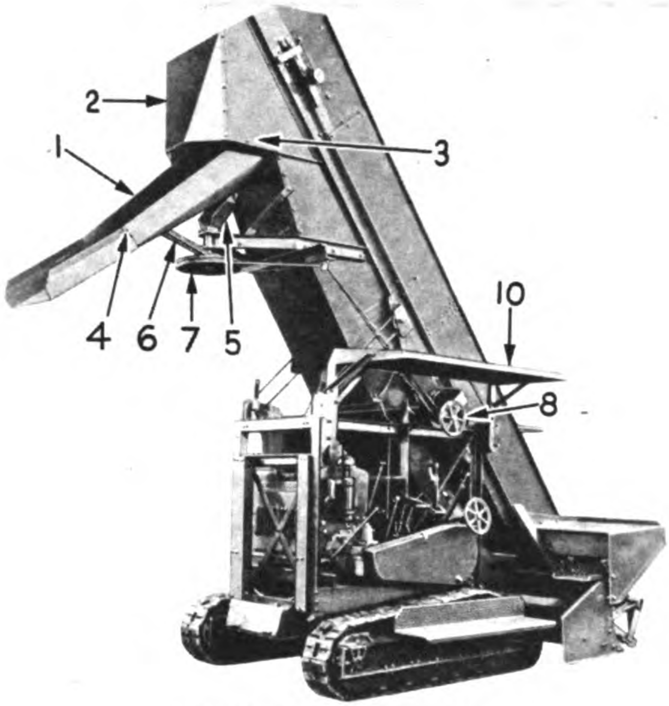


Figure 85. Swivel spout.

(144) Swivel Spout

Inside the discharge hood (2) Figure 85 is mounted a baffle behind plate (3) which concentrates the material for discharging into the swivel spout (1). The swivel spout is used for distributing the loading material. The spout is controlled from the operator's platform and can be turned 180° — therefore trucks can be loaded when spotted anywhere within this range. When used on material which is to be aerated the spout can be used swiveled to maximum for discharging on either side when shifting windrows.

The spout is fabricated of plate and has renewable liners which take the wear of discharging material. The end of the spout is hinged (4) so it can be swung up and out of the way if a shorter spout is desired. The spout is mounted on a yoke (5) to which is attached a turntable (7), a cable runs from turntable to the control mechanism at operator's platform. A bar (6) with several holes bolts to the lower end of the spout and runs through the lower end of the yoke permitting adjustment of the spout angle.

The spout should be kept as clean as possible at all times. If material packs in the spout it may plug the discharge baffle causing an excessive amount of material to flow down the return dust pans.

Generally speaking when working in wet sticky materials the spout must be set at a rather steep angle. In dry free flowing materials the spout may be used at a flatter angle. In the first case the clearance of the spout discharge end from the ground is decreased. In the second, this clearance is increased.

The handwheel (8) which controls the spout is self locking in all positions, by a spring control. The handwheel is pushed inward to release the lock and must be held inward to turn the wheel. When released, the position is automatically locked.

CAUTION: Swivel spout liners should be watched closely. When they are worn through they should be replaced immediately to prevent damage to the spout proper.

(145) Bucket Line Drive

The bucket line drive transmits power from the main jackshaft to the bucket line headshaft (8) Figure 84. The chain runs from the drive sprocket on the main jackshaft across the idler sprocket (6) Figure 83 on the pivot shaft (1) to the bucket line head shaft. The chain runs through the take up frame at which point the chain may be adjusted.

(146) Overload Release Sprocket

The overload release sprocket (7) Figure 84 on the headshaft is an automatic overload release to protect the spirals (6) Figure 77 and the drive chains from damage should an overload or foreign objects be encountered. The sprocket driven by the drive chain is not keyed on the shaft. The sprocket has two cam recesses cast in the roller track. The roller and spring unit is keyed to the shaft with the rollers running inside the cam race of the sprocket (7) Figure 84. In operation the rollers are driven by contact with the sprocket cams. When an obstruction is encountered or the bucket line is overloaded the springs compress allowing the rollers to ride through the cam recesses. Each half revolution thereafter the rollers press in the recesses and automatically release again until the obstruction is cleared or the overload relieved. At no time should the tension of the springs be so great that the engine will pull down to a stall without the sprocket releasing.

Chapter XIII
Operating Controls

(147) Bucket Line Clutch Lever

(5) Figure 86. The bucket line is engaged by means of a jaw clutch. Push the lever forward to engage and pull the lever back to disengage. When the lever is disengaged it should be behind the stop to prevent engaging when only traction is used. WARNING: Do not engage the bucket line unless the master clutch is disengaged. Always disengage the bucket line clutch lever before operating the loader in reverse. Failure to do so may result in irrepairable damage to the jaws.

(148) Hoist Handwheel

(8) Figure 86. The hoist can be lowered by turning the hoist handwheel clockwise. The elevator must be raised by power. This handwheel is used for maintaining the proper grade. The operator can save time by using this handwheel because, when the bucket line is operating, he does not have to stop the machine and shift into reverse when the spirals need lowering a few inches.

(149) Spout Control Handwheel

(9) Figure 86. This handwheel is used for controlling the swivel spout. The control is spring locked. Pushing in on the handwheel releases the lock. Holding in on the handwheel permits the turning of the spout in either direction within the 180° range. When the handwheel is released the swivel spout automatically locks in position.

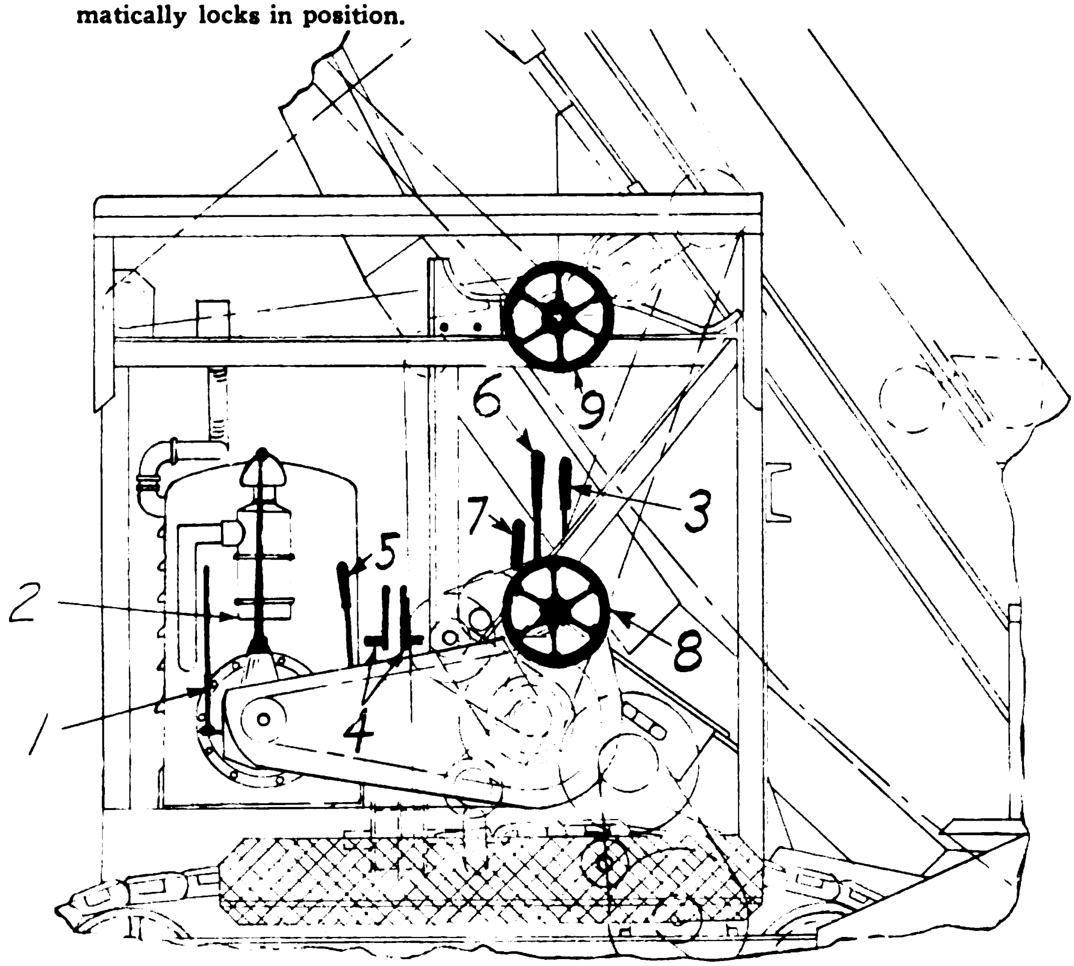


Figure 86. Hoist, spout and other controls.

Chapter XIV

Specifications 38D with Bucket Elevator Attachment to be Operated as a Bucket Loader

Capacity

Approximately 3 cu. yards per minute, depending on the nature of the material.

Weight 17,580 pounds. Operating weight 18,130 pounds.

Overall dimensions

	Operating	Shipping
Length	17′-10″	21′-2″
Width	8′- 4½″	8′-0″
Height	17′- 4″	11′-1½″

Discharge Height 9′-1″ @ 50° swivel spout angle

Clean up width 8′-0″

Loading Speed

Bucket line speed is 168 F P M

Elevator Frame

Two 6″ channels with bottom plate and skirt plates form a rigid frame and a trough to catch spillage from the buckets.

A steel return chute, fully enclosed at the head end, returns spillage at the discharge end to spirals.

Bucket Line

Buckets are high backed, 19″ x 8″ x 9¾″, welded steel construction, lips hard faced to resist abrasion, attached to two stands of No. 2842 6″ pitch, steel bushed roller chain. Buckets are spaced 12″ apart.

Overload Release Sprocket

The elevator drive sprocket has a patented overload release feature which protects the drive from overloads by automatically tripping and resetting itself.

Spiral Feed

8′-0″ wide, spirals are of all steel welded construction. Replacable wearing strips of heat treated alloy steel bolt to the spiral rims.

The wearing strips are notched. A spiral is on each side in staggered position so synchronized as to individually feed each bucket. Special shaped steel cutting bar, hard faced, bolted to bucket end of spiral and to separate spiral arm next to bucket.

Follow Up Scraper

8′ wide. Extends full width of machine. Has smooth curved back. Replacable scraper blade.

Swivel Spout

Swivels 180°. Operated by convenient hand wheel. Self locking. Spout angle adjustable.

Chapter XV
Preparing Loader for Operation

(150) Converting from Snow Loader to Bucket Loader

The method of removing and storing either elevator is dependent upon local facilities. The elevator can be removed by crane. In this case low cradles may be built so the elevator can be stored on the ground as nearly horizontal as under structure of elevator will permit.

As a rule there are no crane facilities with which to lift the elevator. Any overhead structure high enough to drive the machine under and rugged enough to hold the weight of the elevator may be used. In case such a structure is not available an "A" frame, well braced, may be built. In this latter method the stored elevator may be left in "working position" so a minimum amount of work is necessary to change the elevator. The replacement elevator will have to be hoisted into position the first time a change is made securing the elevator to an "A" frame or overhead structure. However, after this initial hoisting job on the replacement elevator there is no further hoisting problem since the elevator is to be stored in an upright or "working position." See Figure 87.

(151) Removal of Snow Loader Conveyor

Drive the machine under a storing structure. Lower the conveyor, resting the feed end on solid blocking 8″ high. Lash the elevating conveyor frame to an overhead structure permitting a minimum amount of slack in the lashing operation. Use a cable or chain when lashing the conveyor. Rope may stretch thus changing position and necessitating raising the conveyor when another change is made. In lashing conveyor run cable through conveyor frame at discharge end just over take-up bolts (1). Remove pins holding push arms in U shape chassis brackets (2). Block up under push arms (5) so it does not fall to ground when tractor unit is driven away. Remove cable clamps (9) Figure 88, where ends of cables join. Unreave cables but do not remove cable from the hoist drum (10). Remove conveyor drive chain. Remove flood lights from the boom and disconnect wiring to elevator frame at connection which is in the condulet that is mounted on the center upright angle of the superstructure, operator's side. Tractor unit can now be driven away from conveyor. Remove bolted extensions of both pivot shaft tracks and sheave (5) with bracket, oppo-

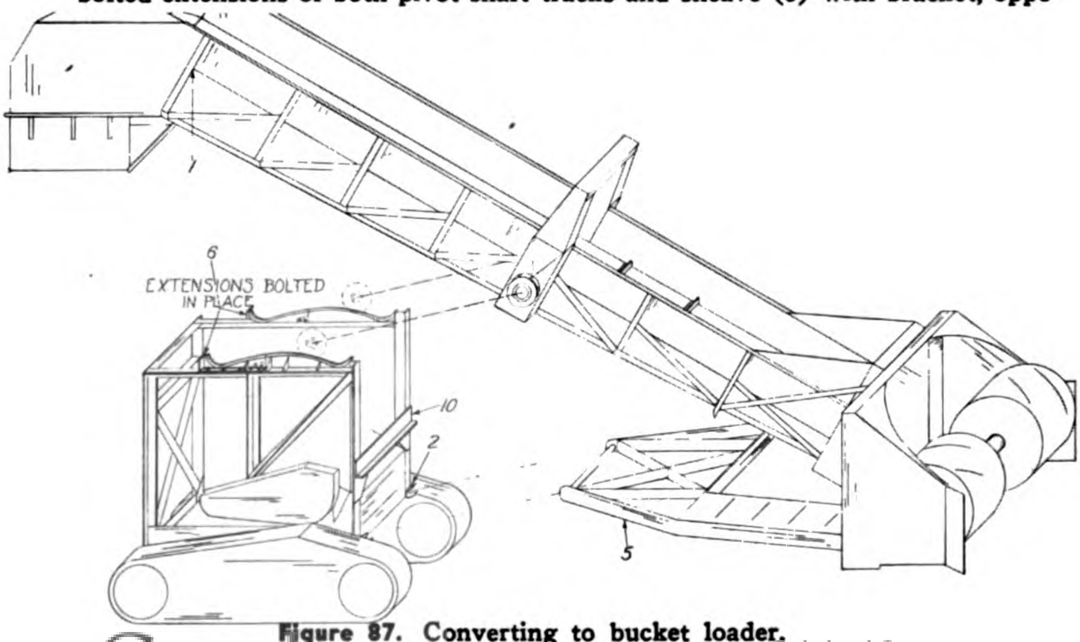


Figure 87. Converting to bucket loader.

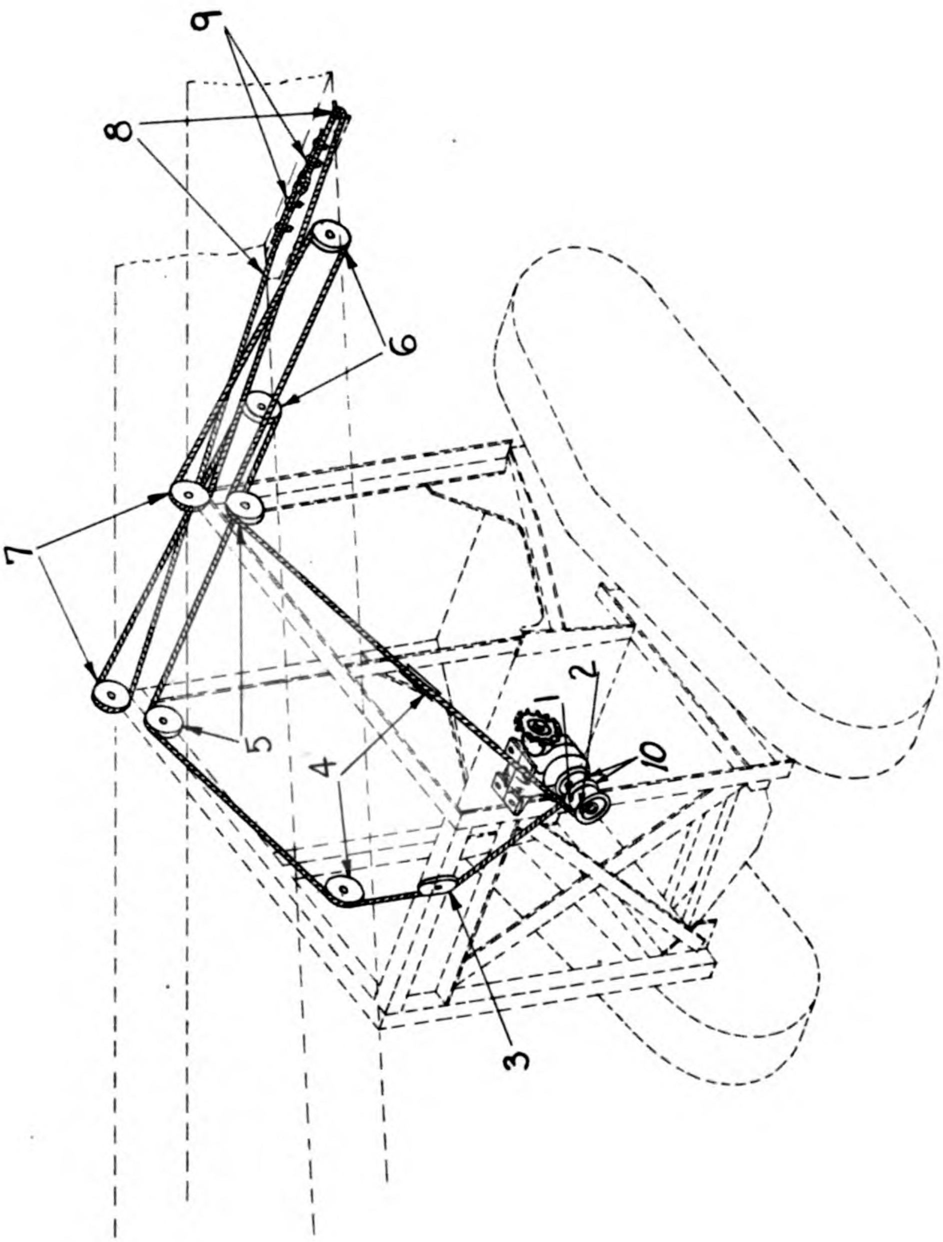


Figure 88. Installing cables.

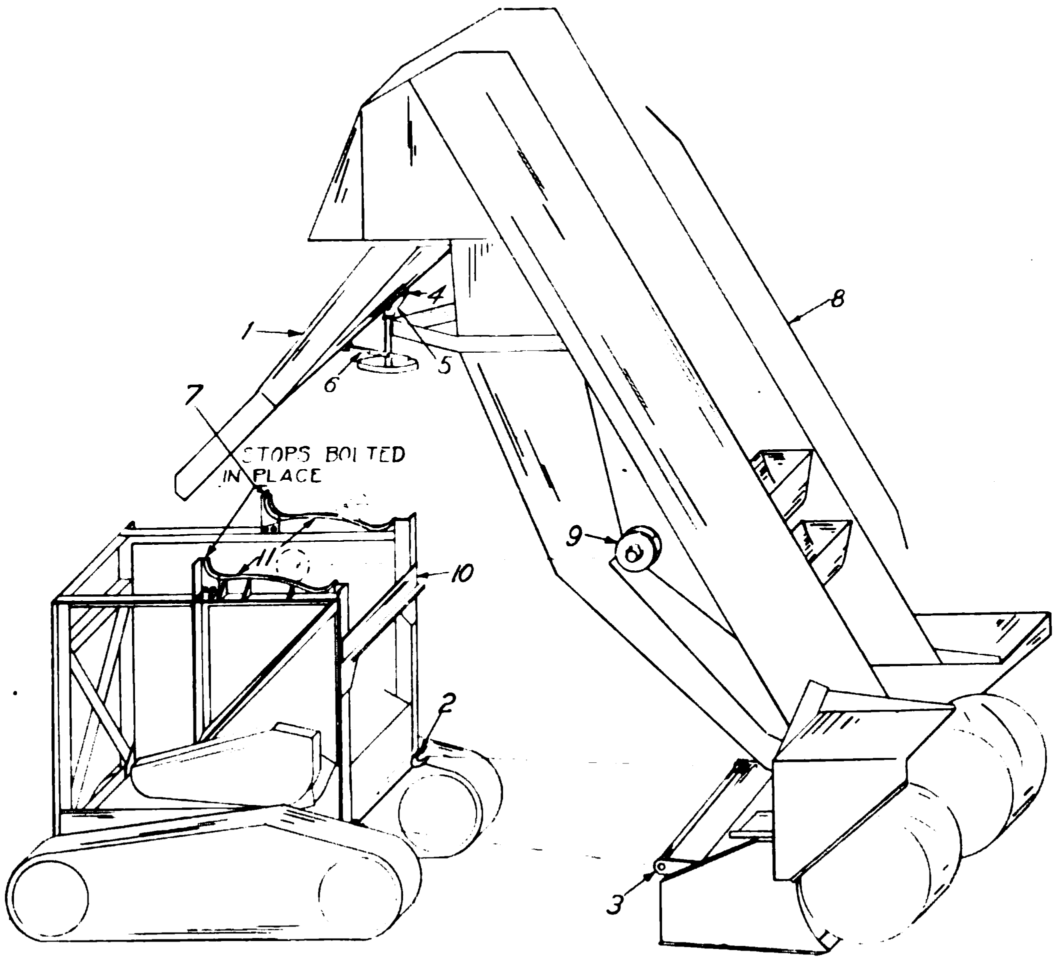


Figure 89. Placing bucket elevator.

site operator. Remove brackets with eye bolts and sheave (5) tension springs, also scraper handwheel control bracket. These are bolted in the holes used for cross angle (10) figure 89. These track extensions should be stored with the boom.

(152) Installation of Bucket Elevator

The bucket elevator (8) Figure 89, must be raised to working position with a crane or with a hoist slung from an overhead "A" frame or overhead structure. Rest feed end on 8" blocks. Cable slings should connect to the elevator at the headshaft between the headshaft sprockets and take-up bearings. When the elevator is stored it may be lashed at this point and left in the working position.

(153) Installation of Swivel Spout

Raise the elevator until the head end is 7 or 8 feet off the ground. Install the swivel spout (1) as follows:

Remove bar (4) from swivel spout yoke. Lift the upper end of the spout to yoke (5) and insert bar through swivel spout lugs. Replace cotter pin which holds bar in place. Lift lip of the spout and bolt on angle control bar (6). The control bar has several holes for various spout angles. Choose a hole giving the spout a steep angle.

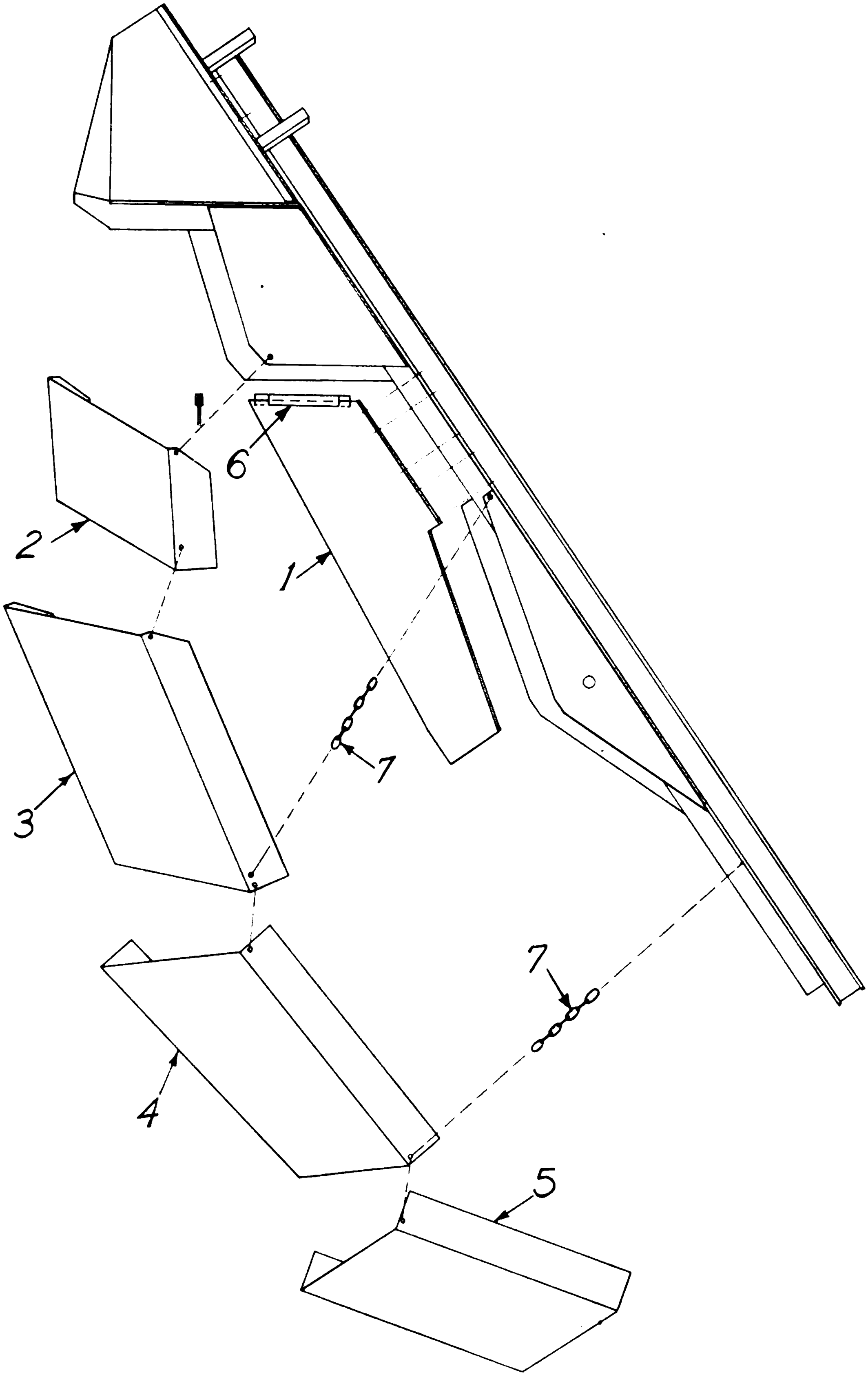


Figure 90. Placing return dust pans.

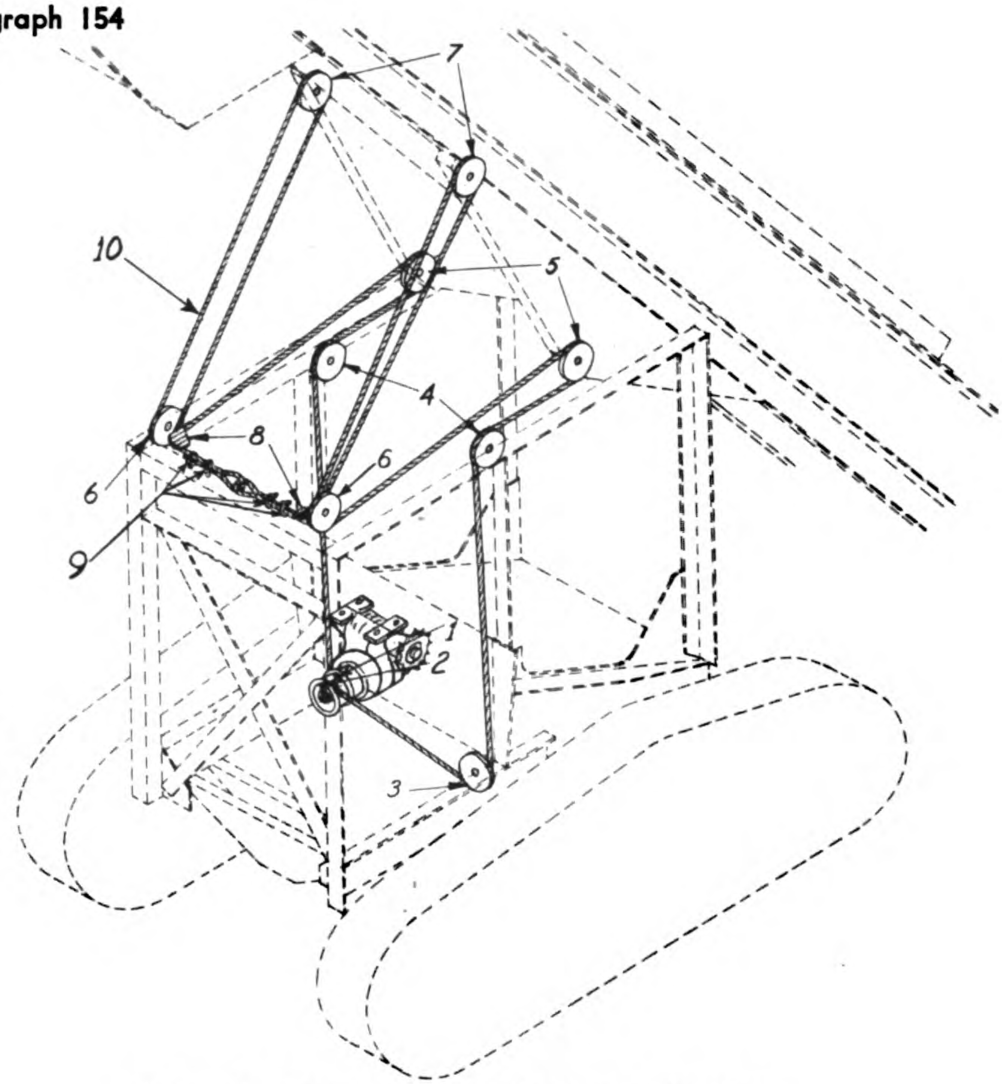


Figure 91. Showing cables with elevator in place.

(154) Installation of Housing and Return Dust Pans

The housing (1) Figure 90, and return pans (2) (3) (4) (5) may be installed while the elevator is partly raised. The installation of pans and the swivel spout may be made after boom is raised to working position. However, installing these parts at the time suggested simplifies the operation because these parts do not have to be lifted to the higher position.

The pans are installed as follows:

The side plates (1) are installed first. These plates are right and left, the flange side of these plates goes to the outside. The slot (6) on the upper end of the plates fits into the permanent upper section of the elevator housing. The flange of the plates bolt to the lower lip of the 6″ elevator frame.

The top pan (2) can be identified by the fact that the corners are cut. This section bolts to the lower end of the permanent housing. The next pan (3) is bolted onto the lower end of pan (2). The last pan (5) is tapered, the narrow end of which rests in the scraper back plate. The wide end bolts onto pan (4). Four twisted chains (7) are furnished, two for each side of the return pans. These bolt onto pans and lower lip of boom channel. The longer pair attaches at junction of pan (3) and (4). The second pair attaches at lower end of pan (4). The chain lengths should be adjusted so side plates (1) are inside of pan (3) enough so there is no gap between pan and housing. The chains should hold the return pans high enough so they will not ride on top of the chassis housing. The elevator may now be raised to working position.

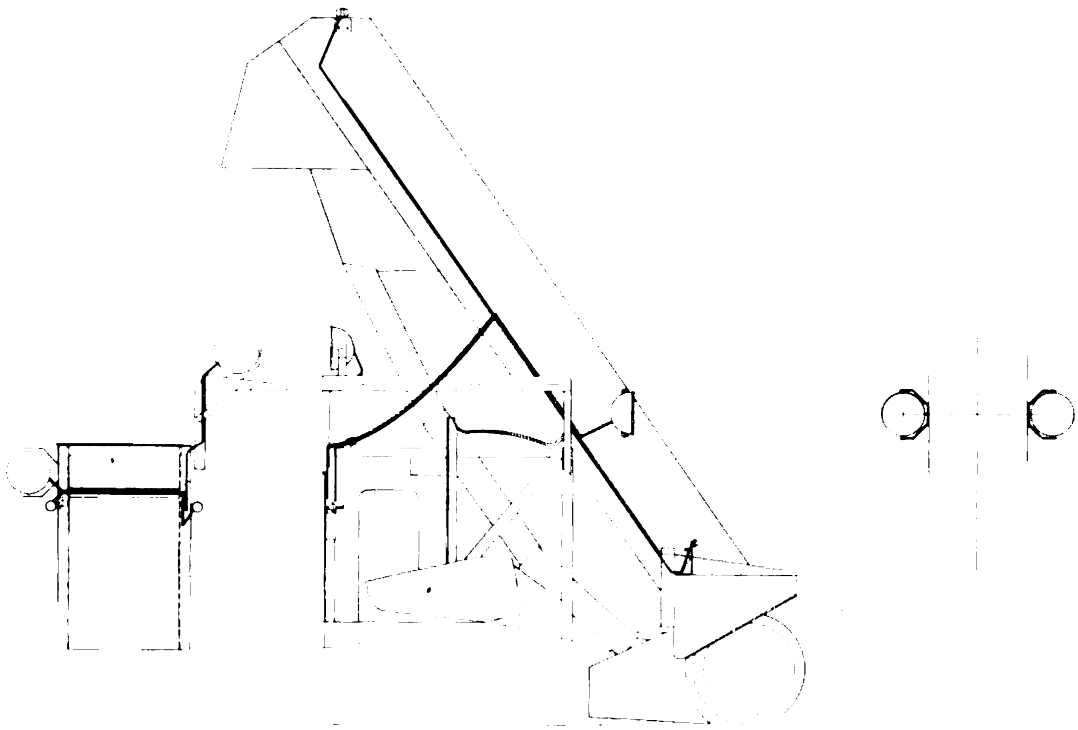


Figure 92. Lighting system.

(155) Installation of Elevator on Tractor Unit

Remove cross brace (10) Figure 87 on front upright angles of superstructure.

Bolt pivot shaft track stops (7) Figure 89, to the ends of tracks (11) on both sides of the superstructure. Install sheaves (4), install sheaves number (8) Figure 91.
on track (11) Figure 89. Enter push arms (3) in U shape brackets (2) on the chassis. Insert push arm lock pins. Reave hoist cables as shown in phantom drawing (Figure 91). The bucket loader requires a shorter chain for the bucket line drive, therefore remove 32 links. These links should be stored with the snow loader as they will be required when the conveyor is again installed on the chassis.

The bucket line drive chain may now be connected and properly adjusted as explained under chain adjustment section. Bolt cross brace (10) Figure 89 to the front upright angles of the superstructure.

(156) Installation of Lights

The flood and warning lights are located on the machine as shown in Figure 92. The flood lights are attached to a bracket which is bolted in position with one ½" bolt.

The lights may be tilted up and down in the bracket. The bracket may be swiveled on the ½" attaching bolt.

The wiring for lights is completely installed. Connect elevator wiring at connection which is in the condulet that is mounted on the center upright angle of the superstructure, operator's side. A plug is located at each light position and fits into the lamp socket.

The red warning lights are assembled to bracket as shown. The brackets bolt to the machine with ⅜" bolts. These lights are kept in a stationary position.

(157) Engine Service When Converting Loader

The carburetor is disconnected from the air cleaner for snow loader operation. In place of the air cleaner a flexible tube is connected to the carburetor intake with the open end of tube held in a bracket against the exhaust pipe. This is so warm air will be forced into the carburetor intake by the fan.

The louvres in the removable sides of the engine housing are blocked on the inside with a sheet metal plate held by four bolts.

When converting from snow loader to bucket loader the warm air pipe to the carburetor is removed. Remove the wooden plugs from the air cleaner inlet and outlet. Install the pre-cleaner unit on the inlet and the pipe which connects the air cleaner line to the carburetor air intake is installed. The louvre covers should be unbolted, and removed to permit more free circulation of air during warm operating conditions.

The warm air intake pipe and louvre covers should be stored with the snow loader conveyor so they are available for snow loader operation.

(158) Assembly of Loader from Shipping Position

When the machine is in the shipping position the elevator will be in a horizontal position. The elevator is held in this position by the hoist cables and two safety straps.

To assemble the machine, first be sure elevator hoist cables are taut. If the cables are loose they can be tightened with the hoist handwheel. The safety straps which are bolted to the sheave assembly at the top of the superstructure can now be removed. The cross brace between the upright angles on the front of the chassis superstructure must be removed. Assemble swivel spout as directed under "Installation of Swivel Spout" ¶153, while elevator is in a horizontal position.

The elevator can now be lowered. It may be lowered either by the hoist handwheel or by power. If power is used place all levers in disengaged position. Start engine, shift master transmission into reverse, engage Master Clutch, then hoist clutch.

To start the elevator down it will be necessary to run the hoist until there is a slight amount of slack in the cables, then pull the spiral end down by hand until the cables tighten. Repeat this process until the elevator weight shifts towards the spiral end enough to lower by its own weight.

When the elevator is almost down, guide the push arms into the U shaped yokes on the chassis and insert lock pins. The elevator can then be lowered further until the scraper rests on the ground. The cross brace between upright angles on the front of the superstructure can now be replaced.

Return dust pans may now be installed as directed under, "Installation of Housing and Return Dust Pans" ¶154.

Chapter XVI
Specific Operation

(159) Plan of Operation

Since the applications of the bucket loader are so varied it is impossible to set up any hard and fast rules regarding methods of approach to all loading problems. While the caution of using common sense covers the main point of this section, some hints may be of value. Many loading problems can be solved by choosing the most advantageous location for loading. Choosing a spot for the best footing will give the loader the best working base and aid truck maneuvering.

When working in sand or gravel pits where there is a high face, the bank should not be under cut. Under cutting will result in cave-ins which will bury the foot end of the machine. Material should be fed down to the machine by breaking down the face with bars or shovels.

In both stock pile and sand bank work the lowest feeding speed should be used so steering levers do not have to be continually engaged and disengaged. In other operations it may be advantageous to use any one of the higher feeding speeds. On all occasions when starting loading operations, it is a good plan to start in the slowest feeding speed. As the operator becomes more proficient and understands the particular loading problem the feeding speed can be increased if practicable. The loader should be used to load only loose and comparatively free flowing materials. If the material does not fall within this classification it should be prepared to bring it to a condition where it can be loaded.

The loader may be used in a stripping operation. Due to undergrowth encountered in such a job the ground should be plowed. If the material to be loaded is shallow in depth where the loader would have to be operated in a very high feeding speed it would be advantageous to plow the material into windrows about 8′-0″ at the base. This would give the machine a larger loading face and permit a slower feeding speed.

(160) Starting Loader

With the engine running and having become familiar with all operating levers we can proceed to put machine to work. After the machine is brought into the loading position and stopped, disengage both steering levers. Shift the transmission into reverse, engage the Master Clutch, push in and hold the hoist clutch lever until the scraper blade touches the ground. Shift the transmission into first speed. Pull back the crawler speed. Pull out the feeding speed lever which will give the slowest feeding speed of 2.6′ per minute. When engaging these two latter mentioned levers it may be necessary to quickly engage and disengage the Master Clutch several times so the jaws will line up and mesh. Engage both steering clutch levers. Release the bucket line clutch lever from the stop; spring tension will pull this clutch to the engaged position as soon as the loader is started. Engaging the Master Clutch will start the machine loading and crowding forward.

The swivel spout can be moved to any position where the material is to be discharged. When the machine is to be stopped disengage only the Master Clutch, this stops all machine movement. While operating after initial starting adjustments are made, the operator will use a minimum of levers. With the machine loading only, the Master Clutch should be disengaged when stopping while waiting for a truck or other reasons where the loading operation will be resumed. Consequently, only this one lever needs to be engaged to resume loading.

While the machine is loading it can be steered by disengaging one clutch lever and holding it down. However, if the machine is loading from a bank or pit face where feeding end and wings on the back of the scraper are banked with material no attempt to steer should be made until the feeding end is cleared. When working in any banked material, if the course of machine must be changed, drive the loader away from the loading face, change the machine and position, then return to the face and resume loading. Therefore while loading in piles of material the machine should travel in a straight forward course. In case where the loader is feeding too fast and overloading the bucket line both steering clutch levers are released together; this stops the forward motion of the machine but allows the bucket line to operate. After the bucket line clears and the machine is to be again started into the material, both levers must be raised together so a straight line course is resumed.

(161) Proper Control of Feed End

While loading, the operator should devote most of his attention to the feed end. The feeding end should be kept at approximately crawler level. If it works at a higher level the feed end may climb the pile, if allowed to feed too slow it may run into hard ground, and cause the overload release sprocket to trip. When the bucket line is overloaded or an obstruction which cannot be loaded is encountered, the spring release sprocket will trip. When this occurs, the machine is to be stopped at once. Disengage bucket line clutch, put transmission in reverse, and back up machine 2 or 3 feet. If an obstruction is encountered, it must be by-passed or if it should be a boulder, or similar object, it may be dug out and removed by hand. Should the feed end be so low that it is bucking hard ground the feed can be raised slightly.

When the hard going is passed, the feed end should be lowered slowly until the spiral is operating at crawler level. Crowding speed should be fast enough to keep the buckets full and yet not so rapid that the loader is liable to continuous overloading.

When working in a high face, the loader should not be crowded so fast that material will pile on the spiral housings.

(162) Maintaining Grade

The track (1) Figure 93, for the pivot shaft rollers on the operator's side is graduated. The pivot shaft roller shield (2) serves as a guide.

When the guide is in line with the longest mark it denotes the spiral and scraper are level with the crawlers. Each line towards the power unit indicates an inch the spiral end is raised above crawler level. Each line towards the feed end indicates an inch the spiral is lowered below crawler level.

Every effort should be made to keep the loader on a level course. If the elevator is raised and lowered too much the results will be the same as overcontroling a bull-dozer blade. When the loader tips over a bump the spirals may dig so deep that the overload release will trip. As the loader climbs out of a hole the spirals will climb the face from which it is loading.

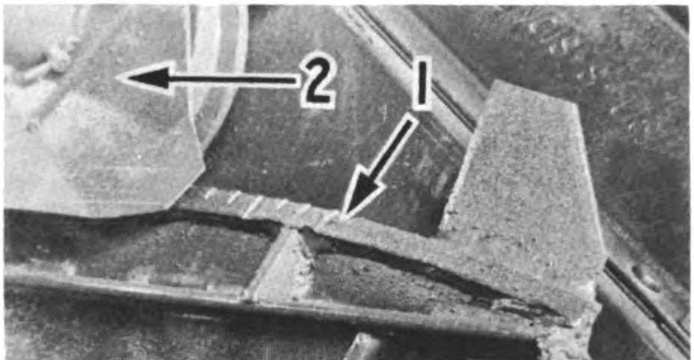


Figure 93. Floating mounting for pickup control.

(163) Operation of Overload Release Sprocket

The overload release sprocket is on the machine to prevent damage to the loading mechanism.

When it releases, the machine should be stopped at once as previously instructed. Loading should be resumed only after trouble is found and corrective measures taken.

The overload release sprocket will not turn the bucket line until the spirals are free from obstruction or the bucket line relieved of the overload. Therefore it is useless to let sprocket continue to release several times before the machine is stopped.

(164) Determining Proper Crowding Speed

When a new operator is learning the operation it is always a good plan to start operating in the lowest crowding speed, 2.6 feet per minute.

After the operator has become familiar with the machine and various applications he can, from experience, choose an operating speed which he thinks will fit the immediate job.

The proper crowding speed is evident when the bucket line can be operated at full capacity without the crawler steering levers having to be disengaged continually to allow the bucket line to catch up. After the loader has operated for some time, if a higher speed is desired, push in the crowding speed change lever which will give a crowding speed of 5.51 feet per minute.

In the event a still higher speed is desirable the gears on the side of the auxiliary transmission may be changed. (See Snow Loader).

"Determining proper crowding speed" in "Specific Operation Section" for speed range and instructions for changing gears.

(165) Moving Machine

It is not advisable to drive the loader any great distance on its own crawlers as this causes undue wear on the crawlers and the driving mechanism. When moving distances greater than a mile a trailer should be employed. When hauling the loader, if the minimum clearance is required, the dust return pans will have to be disassembled and the elevator laid horizontal.

Short distances may be traveled if there is plenty of overhead clearance, by raising the spiral 10" to 12" off the ground.

If the machine is to be moved under its own power and overhead clearances interfere, break the bucket line drive chain and wire it off of the drive sprocket. Remove the cross brace between the upright angles on front of the superstructure. Remove the lock pins from the U shaped yoke on the chassis so the push arm will lift out. The elevator may now be raised until the dust pans touch the top cross angle of the superstructure.

WARNING: When the loader is to be moved under its own power and the elevator is raised, be certain before traveling that the bucket line drive chain is loose. If this warning is not heeded and the machine is "traveled" the taut bucket line drive chain will burn out bushing in bucket line drive sprocket and score the shaft. In case of any doubt on this point the safer thing to do is break the chain and wire it free of the drive sprocket.

When elevator is raised beyond point where push arms must be detached, bucket line drive chain must be parted before raising of boom is continued.

Chapter XVII

General Precautions

(166) Spirals

Workmen should be cautioned to stay a safe distance from the feeding end of the machine while it is in operation.

When operating in a high face of material where men are employed to loosen material, extreme caution should be practiced. Bank may cave in sliding men into the spirals.

(167) Moving

When the machine is traveled on its power, overhead clearances should be watched such as high voltage electrical wires, telephone wires etc.

The machine should not be driven any place where a truck would not be taken. Extremely slanting roads should be avoided.

Soft roads which would allow the machine to bog down fouling the crawler drive sprocket should be planked or avoided.

(168) Elevator

If the elevator is raised above the upper limit of the normal operating range be certain the bucket line drive chain is broken and wired together before the machine is traveled.

Do not attempt to lubricate the machine while it is in operation.

Keep clear of the hoist handwheel when the hoist is being operated by power.

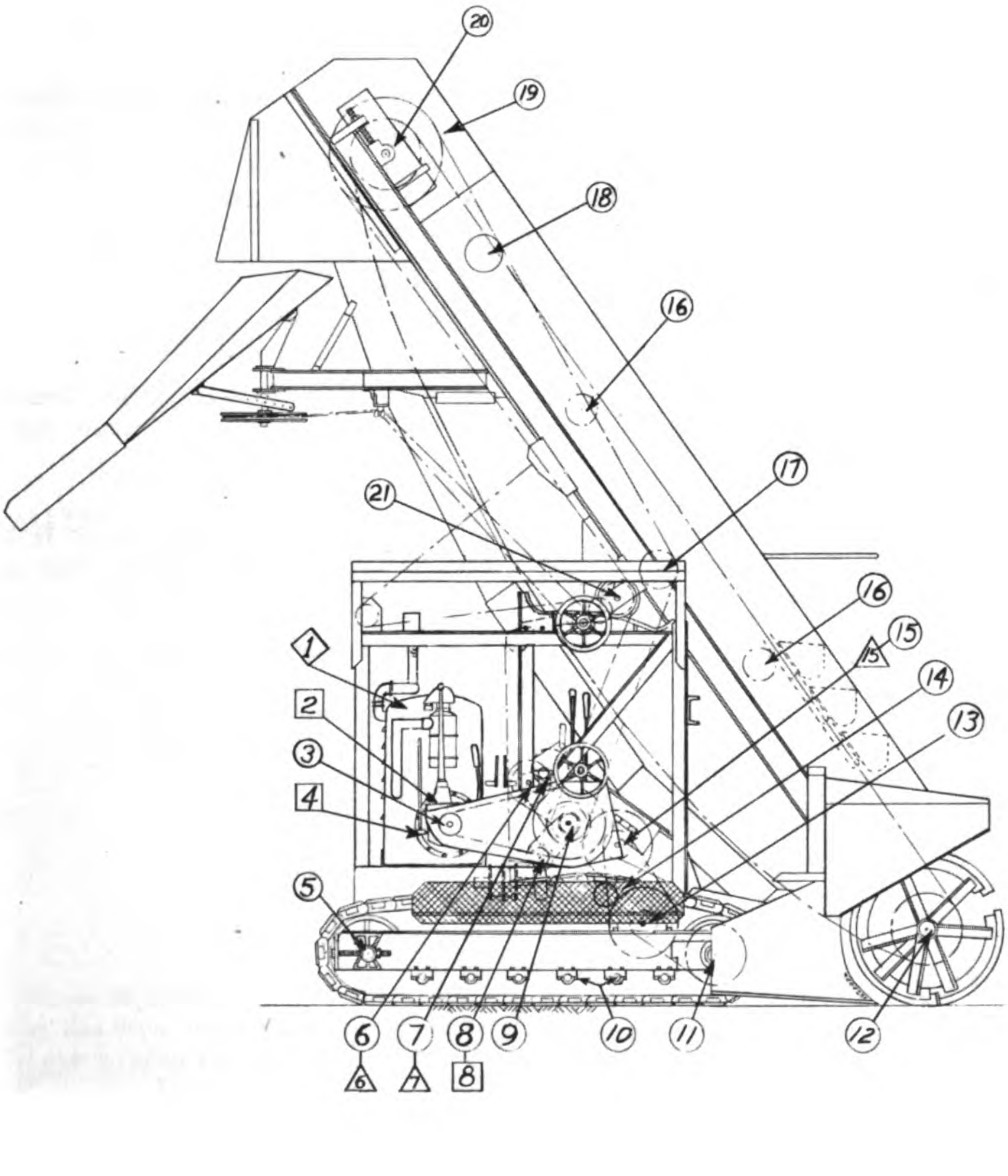


Figure 94. Lubrication points.

Chapter XVIII
Lubrication

(169) Lubrication Instructions

For information regarding types of lubricants and instructions for lubrication of points 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14 and 15, refer back to Chapter VII.

(12.) BUCKET LINE FOOT SHAFT:

Two alemites—one for each bearing. Grease every four hours. The bucket line must be stopped and master clutch should be disengaged before these fittings are greased. Six to eight strokes of gun. Use C G.

(16.) BUCKET LINE IDLER ROLLS:

Two alemites for each roller assembly—two roller assemblies. Grease every four hours with four strokes of gun for each roller. The alemites for these rollers extend through holes in the sides of boom. Use C G.

(17.) BUCKET LINE DRIVE PIVOT SHAFT IDLER:

One alemite. Grease every four hours with C G.

(18.) BUCKET LINE DRIVE TAKE-UP IDLER:

One alemite—grease every four hours with C G.

(19.) OVERLOAD RELEASE SPROCKET:

Three alemites—one on sprocket hub and one for each roller. Grease every eight hours. Stop bucket line before climbing up to grease these fittings. Use C G.

(20.) BUCKET LINE HEAD SHAFT:

Two alemites—one for each bearing. Grease every four hours. It is necessary to climb up loader boom to grease these bearings. Four to six strokes of gun. Use C. G.

Chapter XIX
Operating Maintenance Adjustments

(170) Overload Release Sprocket

The tension of the springs in the release sprocket governs the point at which the sprocket will release. These springs are adjusted properly for ordinary working conditions at the factory. Ordinarily, when loading sand or gravel, the sprocket will release when the buckets are fully loaded and the spirals are half to two-thirds covered. Should the sprocket release with the bucket line full, but with only a small amount of material in the spirals, the tension on the springs should be increased. At no time, however, should the spring tension be such that the engine will pull down to a stall without the sprocket releasing. This adjustment consists of removing the locks from the spanner nuts and turning the nuts to right to increase the tension. Be sure the locks are replaced or the adjusting nuts are apt to unscrew, thereby losing proper tension.

(171) Bucket Line Chain

Take up of this chain is accomplished by means of two adjusting bolts (1) Figure 84, at the elevator headshaft. To tighten the chain loosen the lock nuts (2) and take up on the bolts till the chain is in proper adjustment. Then tighten the lock nuts. Each bolt should be taken up an equal amount to maintain proper sprocket and chain alignment. This chain is properly adjusted when the clearance between the return bucket line chain and the cross brace on the chassis superstructure is from 4" to 6". At no time should the chain be allowed so much slack that the bucket lips on the return line scrape the return pans at any point as the pans will wear through very quickly if this condition exists.

CAUTION: When the bucket line chain is tightened, the bucket line drive chain is also tightened. This should be checked for proper tension after the bucket line is adjusted.

(172) Bucket Line Drive Chain

This chain is in proper adjustment when the amount of sag in the chain from the take up sprocket to the headshaft is not less than 1" or more than 3". The adjustment of this chain is accomplished by lifting the lock plates (2) figure 95 away from the heads of the adjusting bolts (3). Take up on the bolts until the chain is in proper adjustment. Each bolt should be taken up an equal amount to maintain proper sprocket and chain alignment. Replace the lock plates after adjusting.

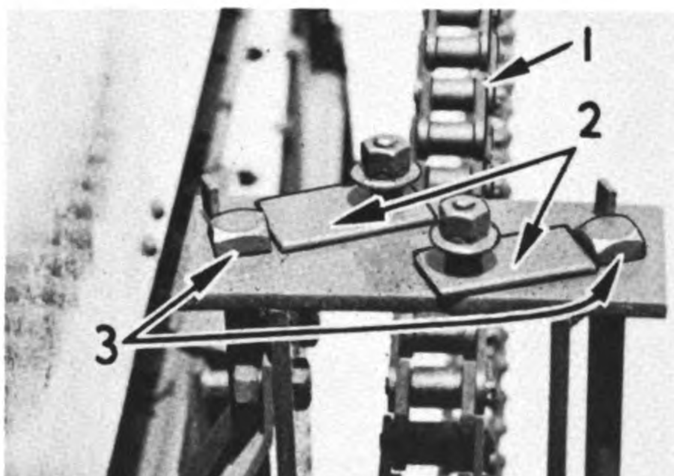


Figure 95. Takeup for bucket line drive chain showing lock plates and takeup bolts.

Chapter XX

Replacement of Highly Expendable Items

Highly expendable items are those which come in contact with the material being loaded and are subjected to more or less rapid wear.

These items are easily observed as daily inspection takes only a moment. No set time for inspection can be determined as these wearing surfaces wear faster in abrasive materials than they would in the nonabrasive materials such as gypsum, coal, etc.

The other parts of the machine are subject to normal wear and tear.

(173) Spiral Wearing Surfaces

The spiral wearing strips should be renewed as soon as the teeth are worn away.

The cutter bar faces are protected with a welded hardened surface. When the welded surface wears away the wear on the bar accelerates rapidly. Therefore the replacement should occur before the frames become worn.

(174) Scraper Wearing Surface

The scraper blade has two cutting edges. When the blade becomes dull or damaged otherwise, it should be turned upside down.

Only after both cutting edges have worn out should the blade be renewed.

(175) Swivel Spout Liners

The swivel spout is protected with three liner plates.

These plates should be replaced at once when worn through, otherwise the spout will be damaged.

Chapter XXI

(176) Processing Instructions for Extended Storage—Loader Attachment

REFER TO TM5-9715, INSTRUCTIONS FOR EXTENDED STORAGE PROCESSING.

(177) Shipping Data

38D Bucket Elevator Attachment

Cubage—Elevator—Not boxed.

Knocked down 680 cu. ft.
Assembled 870 cu ft.

Boxed for export—705 cu ft.—12,095 pounds

MODEL 38D SNOW LOADER
MAINTENANCE SECTION
GENERAL INDEX

Alphabetical Index by Paragraphs to MAINTENANCE SECTION of MODEL 38D SNOW LOADER

(Continued on next page)

Alphabetical Index by Paragraphs to Maintenance Section of Model 38D Snow Loader (cont'd)

POWER TRANSMISSION MACHINERY

Model 38D Snow Loader

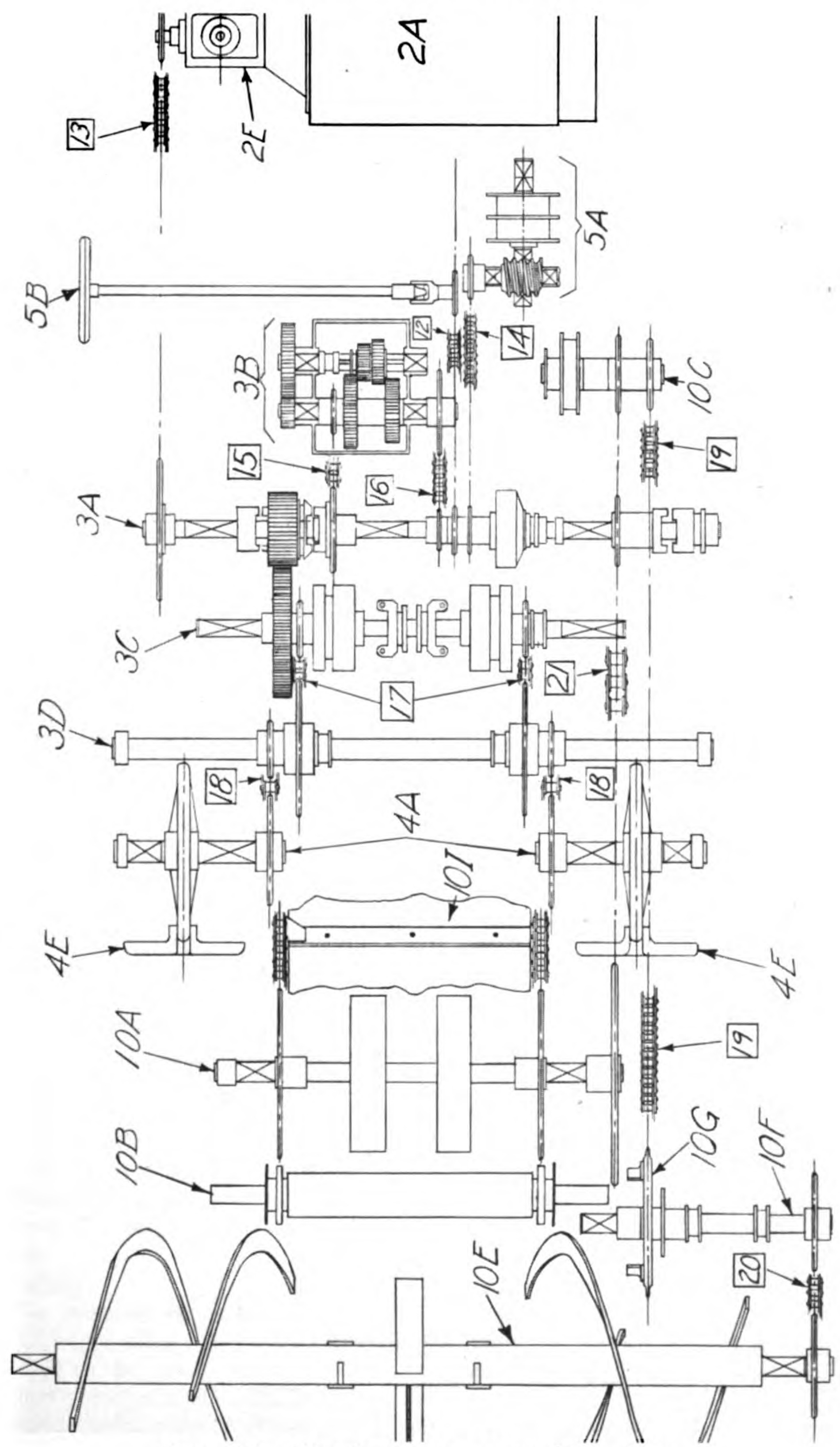


Figure 96. Showing power transmission line.

POWER TRANSMISSION CHART

Shafting Identification and Speeds

Ref. No.			R.P.M.		
2A		Engine		1400	
			1st	2nd	3rd
2E	1.	Transmission	350	700	1400
5B	2.	Hoist Hand Wheel Shaft			
5A	3.	Hoist Drum Shaft			
		Hoist Drive Shaft		Varies	
	4.	Gear Box Idler Shaft			
3B					
	5.	Gear Box Drive Shaft			
			1st	2nd	3rd
3A	6.	Main Jack Shaft	140	280	560
3C	7.	Crawler Clutch Shaft			
3D	8.	Crawler Oscillating Shaft		Varies	
4A	9.	Crawler Drive Shaft			
10A	10.	Conveyor Headshaft		42.0	
10E	11.	Conveyor Spiral		73.4	
10I		Belt Speed		214 F.P.M.	
4E		Crawler Speed			

(See determining "Crawler Speed" in Operating Section)

Drive Chain Identification

- 12. Hoist Hand Wheel Chain
- 13. Main Jack Shaft Drive Chain
- 14. Hoist Drive Chain
- 15. Jackshaft Pinion Drive Chain
- 16. Gear Box Drive Chain
- 17. Oscillating Shaft Drive Chain
- 18. Crawler Drive Chain
- 21. Conveyor Drive Chain
- 19. Spiral Drive Chain

Chapter XXII

Master Clutch and Main Transmission

(178) Master Clutch

Partial Repairs—None

General Overhaul

The clutch may be removed and disassembled as follows:

(a) Remove the hoist handwheel shaft at the splice.

(b) Remove the chain guard cover (2) Figure 97 and guard (3).

(c) Take out the cap screws in the transmission and the main jackshaft patch plates (9) (10) Figure 98, and remove the bolt in the case support bracket.

(d) Remove the transmission thrust bolt (12).

(e) Disconnect the main jackshaft drive chain.

(f) Remove all cap screws (6) from the clutch housing.

(g) Remove the grease pipe (84) Figure 100 from the shifter collar (2) Figure 99.

(h) The transmission may now be pulled away and removed from the engine.

(i) Remove the cap screws holding the driving plate (17) Figure 99 to the engine flywheel. The clutch may now be taken off as a unit.

(j) The leverlinks (7) and the finger levers (9) may be removed by taking out the pins (5), and (10). Removing these seperates the sliding sleeve (8) from the adjusting yoke (14). It is not necessary to remove these levers and pins to dismantle the clutch. Remove only if they are to be replaced.

(k) Pull out the adjusting lock pin (13) and screw off the adjusting yoke (14) from the back plate hub (19). This releaves the floating plate (15), driving plate (17) and release springs (18).

(l) The cone collar halves (2) may be removed from the sliding sleeve (8) by taking out the bolts (3).

(m) Brake (80) Figure 100 may be taken off the transmission shaft after removing the stop bolt (81). The brake lining disc (83) may be taken off the shaft after the Woodruff key (82) is removed.

Inspection for Replacement

The following parts should be examined and replaced if there is excessive wear. Cone collar (2) Figure 99, sliding sleeve (8), finger levers (9), pins (5) and (10) and adjusting yoke (14).

Examine floating plate (15), back plate (19) for excessive scoring on the face and condition of the teeth.

Renew friction discs (16) if they are glazed or worn to the point where the rivets may contact the faces of the plates (15) and (19). If the driving plate (17) is warped or damaged in any way renew this plate as well as the linings. A warped driving plate will cause the clutch to drag and make shifting of transmission gears difficult.

The release springs (18) lose their tension due to the clutch heat. They should be renewed unless one is certain the tension is O.K.

The brake lining disc (83) Figure 100, should be renewed if glazed. The stop bolt (81) should be replaced if the end which contacts the Woodruff key is worn.

Assembly

The assembly is the reverse of the disassembly operation.

Screw the adjusting yoke (14) Figure 99 tight enough against the floating plate (15) so the release springs (18) do not fall out of place but do not attempt to adjust the clutch until the installation is complete.

Before bolting the clutch to the flywheel be sure to pack the pilot bearing in center of the flywheel with grease.

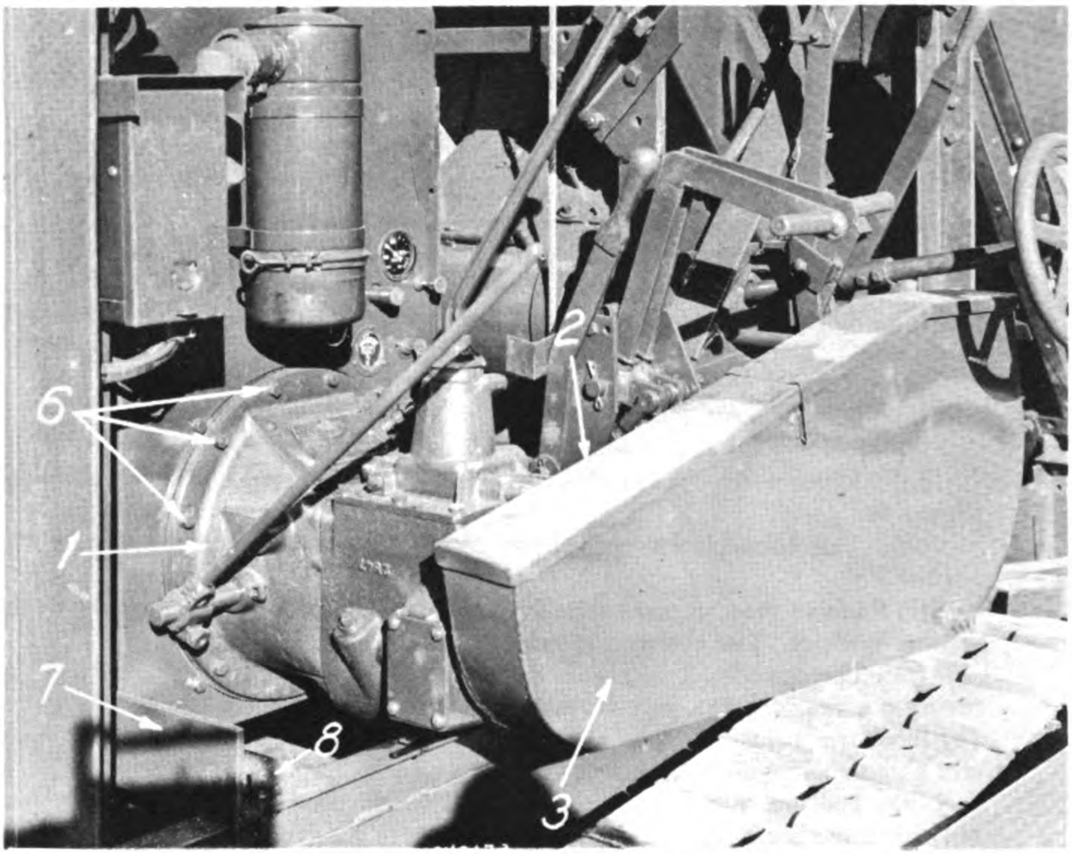


Figure 97. Showing main transmission.

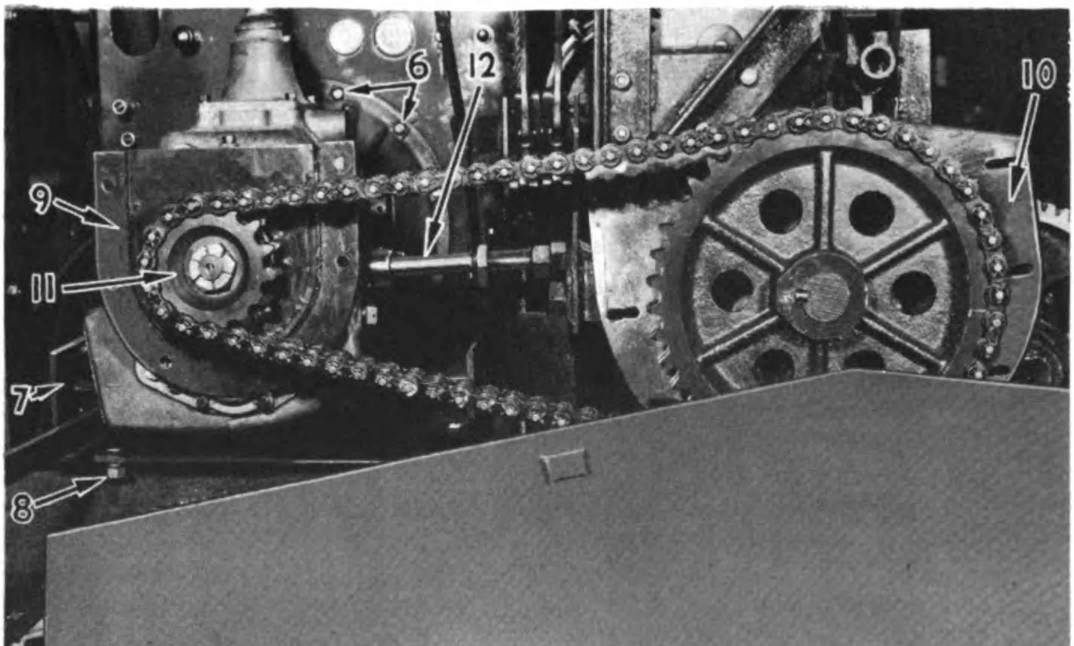


Figure 98. Showing main transmission and main drive chain.

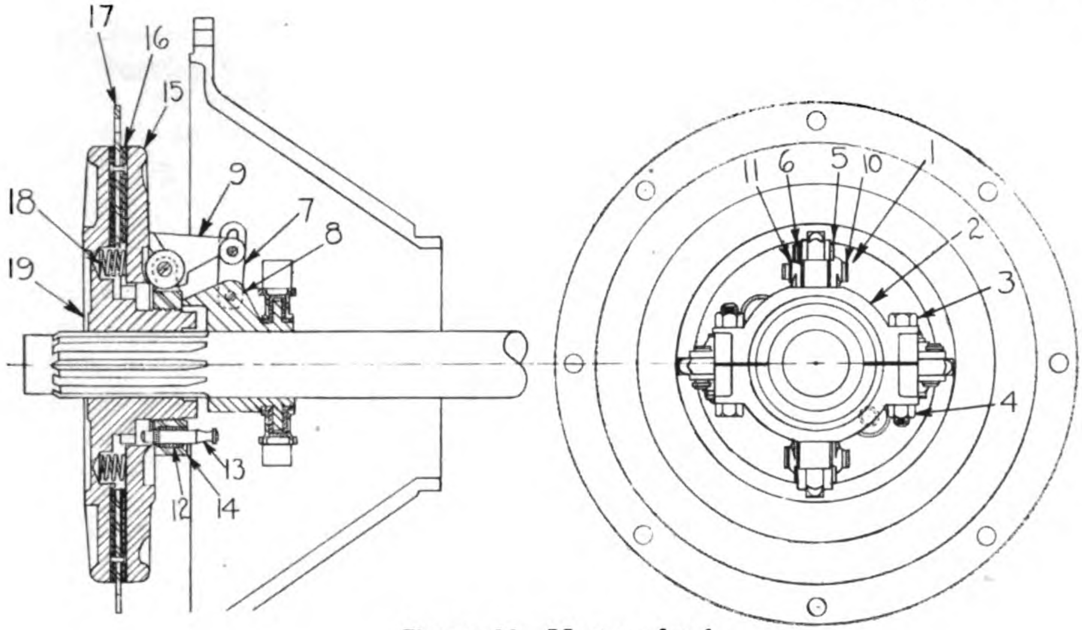


Figure 99. Master clutch.

Adjustment

Adjust the clutch by holding the lock pin (13) out and turning the yoke (14) clockwise until the lever engages with a distinct snap. Figure 99.

A newly relined clutch may have to be adjusted after a run of a day or so. Be certain this is done so the new plates do not become glazed.

Lubrication

Be sure the cone collar (2) is lubricated before the machine is put into operation. The grease cup may have to be filled several times to load the grease piping and lubricate the collar.

(179) Main Transmission

Partial Repairs

Repairs to the transmission (2E) Figure 96, without removing it from the power unit is confined to the control assembly and the reverse idler assembly.

The control assembly may be removed and disassembled as follows:

(a) Shift transmission lever (31) to neutral position. Figure 100.

(b) Remove cap screws (47).

(c) Control assembly can be removed from the transmission.

(d) Remove bolts (37) from shifter yokes.

(e) Remove pipe plugs (40) which will release springs (41) and two ½" balls (42).

(f) Drive out yoke bars (43) (46). These will carry out the thimbles (44). When the bars are removed the shifter yokes (36) (45) and third ½" ball (42) will be released.

(g) Remove ball (30) and screw (49), lever bell (32) can then be removed.

(h) Remove pivot pin (48), release spring (35) from boss inside control cover (33). This releases washer (34), shift lever (31) will pull out through the bottom of control cover.

The reverse idler assembly may be removed as follows:

(a) Remove chain guard, chain and transmission sprocket (11) Figure 98 as instructed in paragraphs (a), (b) and (c) under "General Overhaul."

(b) Drain oil from transmission by removing pipe plug (66) Figure 100.

(c) Remove screws (64), plate (62) and gasket (63).

(d) Remove cap screws (29) which frees lock (27).

(e) Shaft (26) can be pulled out of case releasing gear (25) and thrust washers (23).

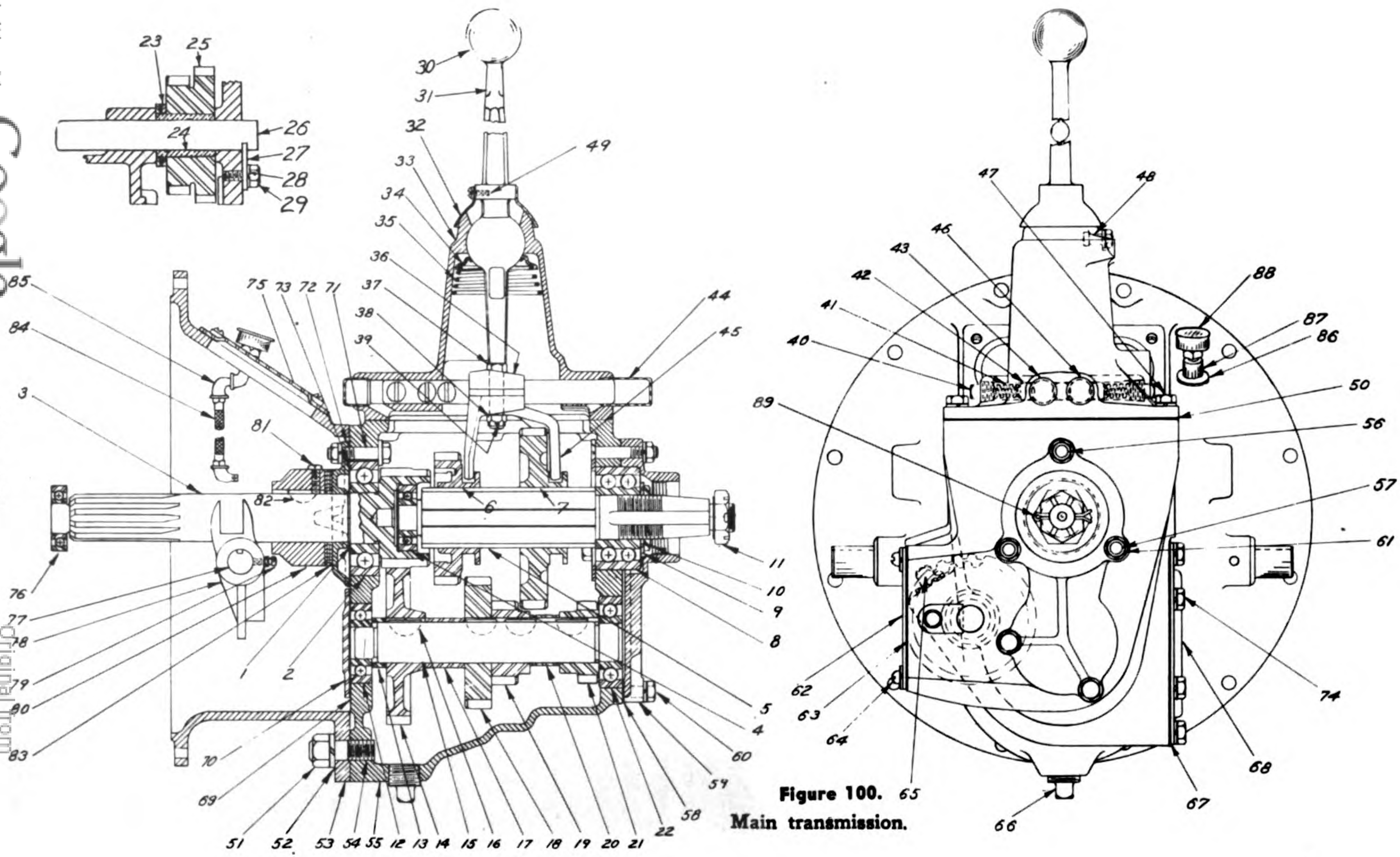


Figure 100. Main transmission.

Partial Repairs (Cont'd)

All parts should be thoroughly cleaned and laid on a clean bench in the same sequence as removed. This procedure will not only simplify reassembly of the control assembly but will also reduce the possibility of losing the springs (41) and the three steel balls (42). Figure 100.

While the control assembly is removed from the transmission one should be certain no foreign matter is dropped in the case. Any foreign matter in the transmission may cause extensive damage.

Inspection for Replacement

The yokes (36), (45) should be replaced if broken or worn thin. Yoke bars should be in good condition, special attention is directed to the slots. The springs (41) should not be used if their tension is lost. Excessive wear in these parts may cause the transmission to slip out of gear.

The teeth of the reverse idler gear should be checked for excessive wear. The bushing of the gear and the shaft should be renewed if excessively worn, so this idler does not weave when operating.

Replace gaskets (50) and (63) if broken or if they have become brittle.

Assembly

Assembly is the reverse of the disassembly operation.

Care should be taken that one of the balls is assembled between the two shifting bars. If it is omitted the transmission can be shifted into two speeds at the same time thus locking it causing extensive damage.

The pipe plugs (40) control the spring tension and care should be taken to insure that the unit shifts freely after the balls, springs and plugs are replaced.

Lubrication

After the transmission is completely assembled be certain the transmission is filled with clean oil to top of the overflow hole.

General Overhaul

(a) Remove cover (2) Figure 97 on chain guard (3). D rain and flush oil out of guard. This guard is held to a plate (9) Figure 98, on the transmission and another plate (10) on the main jackshaft end by 3/8" cap screws. Use care in taking this off to avoid damage to gaskets. The chain guard will drop down to rest on the crawler treads after removal of the cap screws.

(b) Uncouple and remove the drive chain and the guard can be completely taken away.

(c) Remove sprocket (11) on the transmission. This is secured to the splined shaft by means of a slotted nut, with cotter. The plate (9) on which the chain guard mounts may then be removed.

(d) Remove the thrust bolt (12) located just back of the chain guard.

(e) The transmission may now be taken off the engine by taking out all cap screws (6) around the bell housing.

The control assembly may be removed and disassembled as instructed under "Partial Repairs."

To remove drive gear and main shaft proceed as follows:

(a) Drain oil from transmission by removing pipe plug (66).

(b) Remove cap screws (60) and nuts from bolts (56), (57). This releases rear bearing cover (59).

(c) Pull main shaft (5) from case, this will release gears (6) and (7).

(d) Remove lock nut (10) and lock nut clip (9), bearing (8) may be pressed off the main shaft (5).

(e) Remove nuts from bolts (71).

(f) Withdraw drive gear and shaft (3) bearings (2), (4) and cover (72).

(g) Remove the pilot bearing (76) from the gear recess.

(h) Remove the pilot bearing (76) from shaft if it has remained on the shaft instead of in the engine flywheel recess.

General Overhaul (Cont'd)

(i) Remove cap screw (81).

(j) Remove brake sleeve (80) and Woodruff key (82).

(k) Remove brake lining (83) and front bearing cover will slide off the shaft.

(l) Remove snap ring (1) and bearing (2) may be pressed off the shaft.

To remove contershaft proceed as follows:

(a) Remove cap screws from countershaft front bearing cover (70).

(b) Pull countershaft (15) to rear to remove bearing (22).

(c) Tilt countershaft assembly and remove it through top of the case.

(d) Remove countershaft front bearing (12). The gears (14) (18) (19) (21) must be pressed off the shaft. After a gear is pressed off remove the Woodruff key. This frees spacer (20) when gear (21) is removed. Spacer (13) may be removed after bearing (12). Spacer (17) may be removed after gear (14).

Clutch shifter fork (78) can be removed from the clutch housing as follows:

(a) Remove set screws (79).

(b) Pull out shafts (77) which will release shifter fork (78).

Reverse idler assembly may be removed as instructed under, "Partial Repairs."

Inspection for Replacement

The parts of the transmission should receive very close inspection. The gear teeth should not be damaged or excessively worn.

All ball bearings should be replaced if worn excessively or if the balls or races are pitted.

When they are examined if they appear rough when bearing is tested it should be replaced.

The spline of the shafts and gears should be examined and if they are worn excessively, replaced.

All gaskets should be replaced if broken or if they have become brittle.

When the transmission is disassembled if there is any doubt about whether a part is worn excessively, it should always be replaced. A part failure may cause extensive damage to the whole unit.

Assembly

The assembly of the transmission is the reverse of the disassembly operation.

Adjustment

Adjust the drive chain to the main jackshaft as instructed under, Adjustment, "Main Jackshaft."

Lubrication

After the transmission is completely assembled be certain the transmission is filled with clean oil to top of the overflow hole, replace pipe plug (65).

Chapter XXIII
Chassis

(180) Main Jackshaft

Partial Repairs

Certain repairs may be made to the main jackshaft (3A) Figure 96, without removing the entire shaft from the unit. The drive sprocket (3) Figure 101, the bearings (38) (39) (40), the conveyor hoist shifter (24), the conveyor drive sprocket (33), the jaw clutch (35) and all the chain fall into this category.

For removal of the drive sprocket (3), the chain guard (3) Figure 98, must be removed. This is accomplished by the following steps: Remove the hoist handwheel shaft at splice. Remove the chain guard cover (2), take out the cap screws in the transmission and jack shaft patch plates (9) (10) and remove the bolt in the case support bracket.

After the guard is removed, the drive chain and drive sprocket (11) may be removed.

While the chain guard is removed, either one or all the bearings may be replaced. The necessary steps are as follows: Secure the conveyor in a horizontal position, remove the cover from the substructure housing. Remove the cap of the bearing to be replaced, the top half of the bearing will lift off. Loosen the caps of the remaining bearings and pry the shaft up to relieve the weight. The bottom half of the bearing can then be turned to the top of the shaft and lifted out. The conveyor hoist shifter may be replaced by removing the lever link and unbolting the two shifter halves. Assembly of these parts upon the shaft is in all cases the reverse of the disassembly operation.

Conveyor drive sprocket (33) Figure 101, jaw clutch (35), and shifter yoke (36), may be replaced by removing chain guard, disconnecting conveyor drive chain and stripping shaft up to the bearing (40). This may be assembled by reversing the order of stripping.

General Overhaul

The shaft may be removed for a general overhaul by the following steps:

(a) Remove transmission drive chain and guard (see above) and sprocket (3) Figure 101, which is keyed and set screwed to the end of the shaft, remove the patch plate (4) to which the chain guard bolts. Uncouple Bucket Line Drive Chain.

(b) If the conveyor is not removed it should be raised in its horizontal position, and the bolted cover with hinged doors of the substructure housing removed, thus exposing the machinery within for easy access.

(c) Strip the bucket line drive end of the shaft by removing clutch lever yoke (not shown), collar (25), jaw clutch (35), clutch collar (34) and sprocket (33) in the order named.

(d) Uncouple chain (32) Figure 102, which transmits manual power to hoist from hand wheel, take out bolts (14) to remove hoist hand wheel and shaft. Take out the two bolts in bearings (15) and cotter on inside end of shaft (16). Pull out shaft (16) and idler shaft (17) with bearings.

(e) Take out hoist clutch shifter (18), hoist lever link (29), gear shifter (30), alemite piping (31), and bolted plates (28), on both sides.

(f) Uncouple chains (27), (26) and (25), then take off bearing caps (8) and (30) Figure 101, and the main jackshaft is free for removal. In taking the shaft out it must be pulled up and out the side opposite the operators side of the loader.

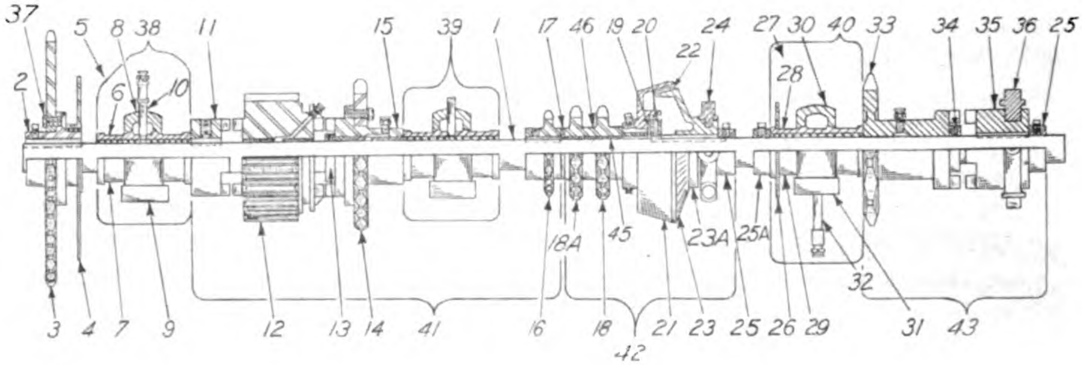


Figure 101.

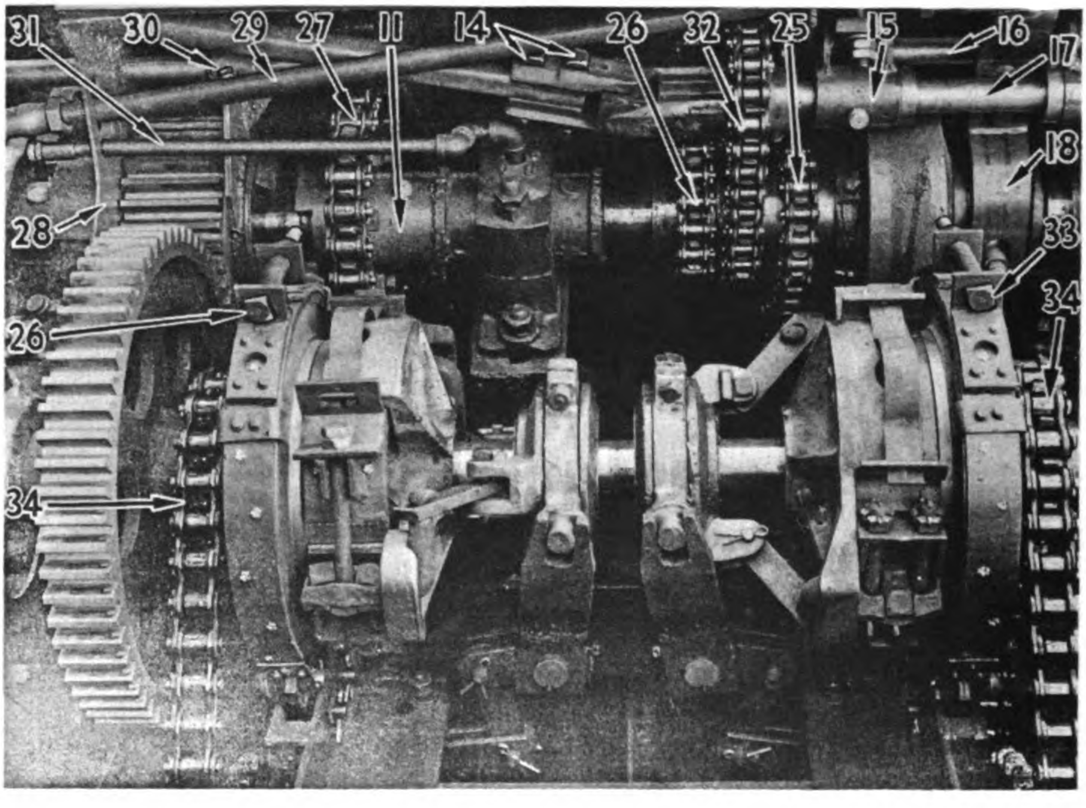


Figure 102. Main jackshaft

(g) The remainder of the parts may now be stripped from the shaft. Collars (25) (25A), hoist clutch male half (23A) with feather key, collar (20) inside hoist clutch, felt washer (19), female hoist clutch half (21), washer (17), and sprocket (16) which is keyed and set screwed to the shaft, then jaw clutch hub (11) which is keyed and set screwed to the shaft, sliding gear (12), collar (13) and sprocket (14) with clutch hub (15).

Inspection for Replacements

Parts which show excessive wear should be replaced. Particular attention should be given to the following: Gear (12). The gear should not be used if the bushing is a "sloppy" fit. This gear is heavily loaded when the machine is in crowding speed, therefore a loose fit on the shaft may wear the teeth prematurely also the teeth on the clutch shaft gear (7) Figure 108.

This same thing should be noted with hub (15) Figure 101, and sprocket (33). If bore is worn excessively the oscillation of these parts may damage jaws of engaging clutch. Jaw clutch (35) which is not locked in engaged position may disengage while operating if bore of sprocket (33) is worn excessively. The jaws of the driving clutches should not be rounded as this condition may also cause clutches which are not locked in position to disengage under load. The felt washer (19) should be renewed if it is worn so it will no longer function as a grease retainer. Hoist clutch lining (22) should be replaced if rivets contact drum (21).

The shaft and parts not mentioned above may continue in use with greater wear because their function is not directly connected with another part where perfect alignment is essential. As an example, sprockets may work, if necessary, until teeth become very pointed because chains may be adjusted.

Assembly

The main jackshaft assembly is the reverse of the disassembly operation. The following hints may aid in the assembly operation. If a new shaft is to be used, locate sprocket (16) evenly on the key and set it. Assemble parts on the shaft which are located within the housing but do not tighten any set screws. After the shaft is replaced in the machine install the bearings first, but do not tighten them as the shaft may have to be aligned after all parts are assembled on it. Set the jaw clutch (11) evenly on the key. Hub (15) should fit tight against the center bearing and the set screw in collar (13) tightened. Sprocket hub (46) is fitted tight against the spacer washer (17) and the set screw in collar (20) tightened. Spacer collar (25A) is set tight against the bearing and (25) against the hoist clutch feather key.

Slotted holes are provided in the bearing bases so the shaft may be moved to get the proper mesh with the crawler clutch shaft gear (7) Figure 108. Check the back-lash of the gear around the entire circumference. When the shaft is moved, be certain it is aligned in the three bearings so it may be turned by hand. Should a shim be required under one bearing all bearings should be shimed so the shaft does not bind. This is essential because the shaft is supported by three bearings.

Adjustment

After the chains are connected each one should be adjusted. The two chains to the gear box may be tightened by adding shims under the gear box. The hoist drive chain may be tightened by removing shims from under the hoist angle bracket. The hoist manual control chain is adjustable by taking up evenly on the two take-up bolts. The main jackshaft drive chain is adjusted by loosening the bolts (8) Figure 98, in engine structural angles. Move the engine (operator's side) with the transmission thrust bolt (12). Move the opposite operator's side of the engine so it is square. Be certain the bolts are tight and the stop plates are replaced.

Lubrication

After the shaft is assembled, each part should be thoroughly lubricated before any operation is undertaken. Particular attention should be centered on the gear (12) Figure 101. If this gear is not lubricated sufficiently, and heat is created under load, there is danger that the bushings may seize to the shaft and become loose in the gear.

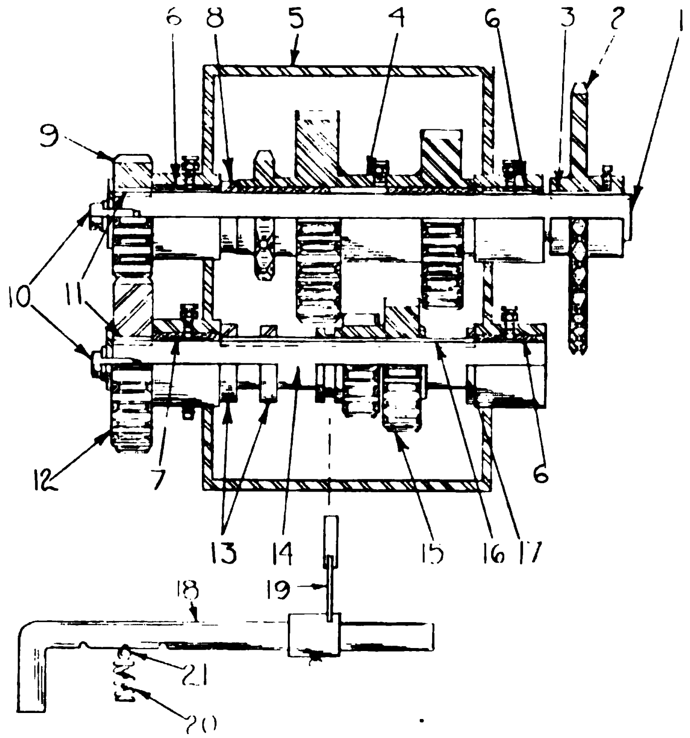


Figure 103. Gear box.

(181) Gear Box

Partial Repairs

A few repairs may be made to the gear box (3B) Figure 96, without complete disassembly or removing the unit from the machine.

The change gears (9) and (12) Figure 103, could be replaced anytime by installing new gears, this operation being the same as changing gears for a different speed.

The chains, sprocket (2) and shift lever (18) assembly may be replaced. Sprocket (2) may be removed after chain guard on box (opposite operator) is removed and chain disconnected. Shaft (18) may be pulled out of yoke (19) after loosening set screw in yoke. Care should be exercised so spring (20) and ball (21) is not lost.

The assembly of all these parts are the reverse of the disassembly operation.

General Overhaul

(a) Uncouple the chains (26) and (27) Figure 102, which run to and from the gear box. The bolts which hold the gear box in place may be removed, along with the guards over the change gears and the drive sprocket (2) Figure 103. The entire unit may be taken off the machine.

(b) To dismantle, change gears (9) and (12), are taken off. These gears are held in place on the ends of the shafts by a capscrew (10) and a washer. Each gear is double keyed. Loosen the shifter yoke and slide out the shifter shaft (18). This is held in positions by ball (21) and spring (20). Remove sprocket (2) on the side of the box opposite the change gears. To take out the shaft (14) carrying the gear cluster (15) loosen the two set collars (13) on this shaft, and loosen the set screw on the under side of the bearing just back of the gear (12). This set screw holds the bushing in the gear box bearing in place. The shaft must be pulled out in the direction of the change gear (12). The collars (13) are keyseated to allow the double feather key for sliding gears (15) to pass. The bushing on the change gear side must slide out in order to allow the keys clearance to pass through the bearing hub. To take out shaft (1) carrying change gear (9) loosen the collar (8) on this shaft and it will slide out.

Inspection for Replacement

Any part which has excessive wear should be replaced. Particular attention should be focused on the bushings (6), (7) and (24), as wear would affect the gear mesh. If the sprocket teeth are badly worn or "hooked" replacement is imperative. The gear teeth should be in good condition if the gears are to be used again when the gear box is overhauled.

Assembly

The gear box may be completely assembled, except for guards, while it is outside machine. After assembly, it may be bolted in place on the loader.

Adjustment

The gear box rests on shims. Both chains to the main jackshaft may be tightened by adding shims under the gear box.

Lubrication

After an overhaul job, be certain all parts are thoroughly lubricated before the loader is put in operation.

(182) Elevator Hoist

Partial Repairs

The repairs to the elevator hoist (5A) Figure 96, which may be accomplished without removing the unit from the substructure housing are very few.

Sprocket (7) Figure 104, and the drive chain may be replaced. Drum parts (10), (11), (12) and the outboard bearing (13) are assembled to gear shaft (9) which extends through the stubstructure housing towards the engine. These parts are accessible and may be renewed without removing hoist. Any parts removed are installed by reversing the disassembly operation.

General Overhaul

The main jackshaft will have to be removed before the hoist can be removed from the substructure housing. See instructions under "Main Jackshaft Overhaul."

(a) After removal of the Main Jackshaft, take off the bearing (13) Figure 104, and cable drum parts (10), (11), (12), on the outside of the substructure housing alongside the engine. Remove the grease and oil piping which extends outside of the substructure housing, (opposite operator). Take out the bolts holding the hoist in place and the hoist assembly may be removed.

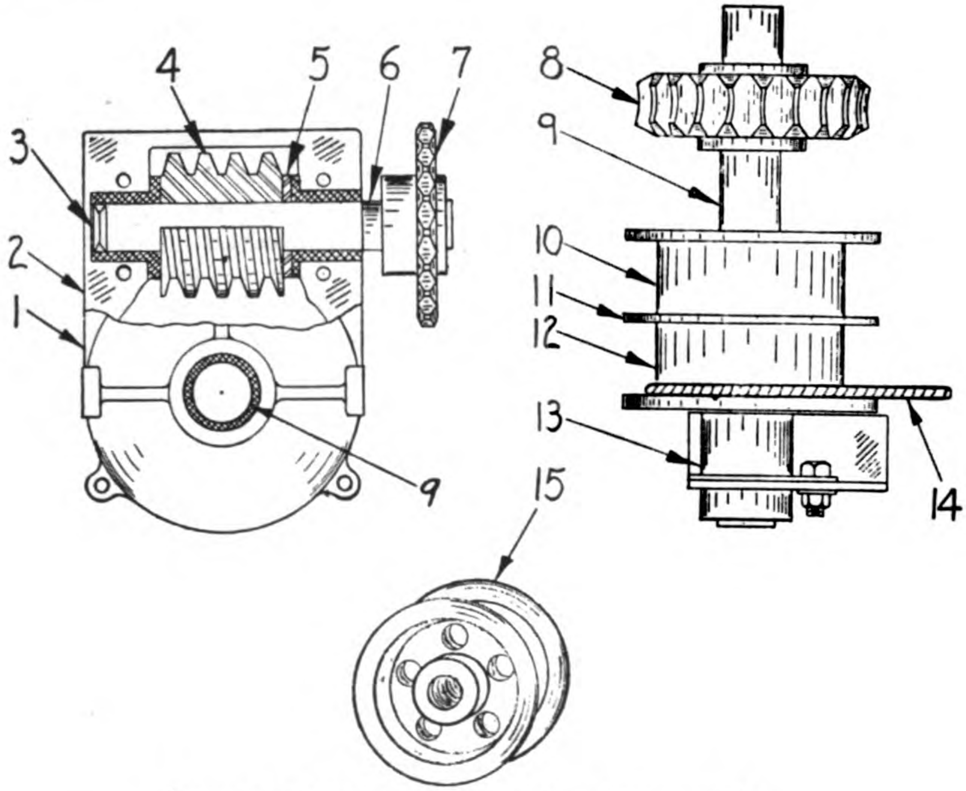


Figure 104. Cross section drawing of power hoist.

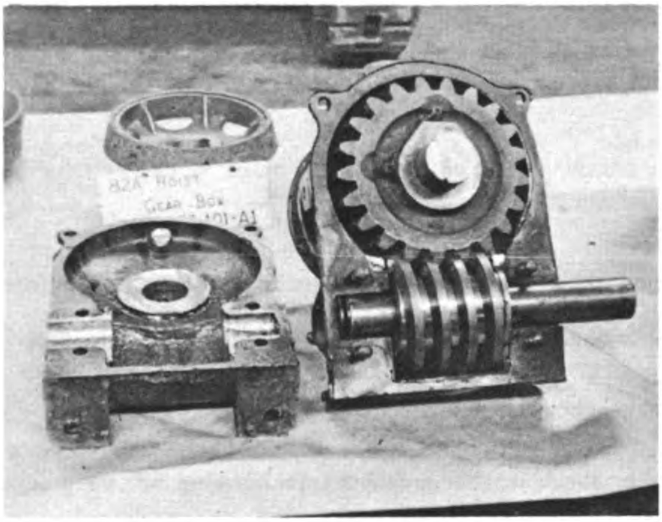


Figure 105. Showing housing of power hoist taken apart.

(b) The hoist housing is bolted together in two halves and may be taken apart as shown, Figure 105.

(c) Sprocket (7) Figure 104, is keyed and set screwed to shaft (6), worm (4) is keyed and set screwed in place with thrust washer (5) against hub and thrust button (3) in housing at end of shaft. Worm gear (8) is keyed and set screwed to shaft (9).

Inspection for Replacement

The hoist is rather inaccessible, therefore, when it is removed for overhaul it should be carefully inspected and parts showing any excessive wear replaced.

The worm and gear profile should be checked. Wear of the bearings and shafts should not be excessive as the oil in the unit would be liable to leakage. The thrust buttons (3) and washer (5) should be replaced if worn as these prevent worm shaft end play.

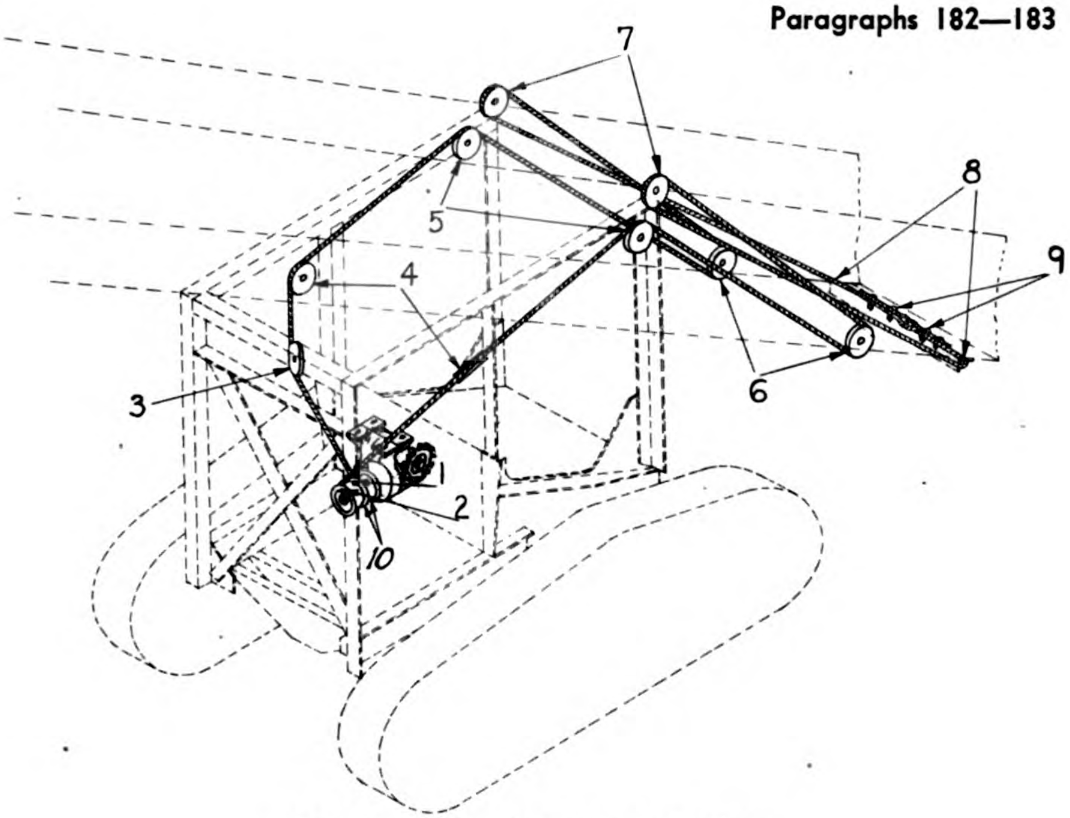


Figure 106. Reaving cable for hoist.

Assembly

The assembly is the reverse of the disassembly operation. A new gasket should be installed between the hoist halves. If a new gasket is not available, use shellac or Permatex with the old gasket to assure a good seal. When the unit is replaced in the substructure housing, leave the bolts loose until the jackshaft is installed.

Adjustment

After the jackshaft is installed and adjustments made, install the hoist drive chain. The chain may be adjusted by the shims under the hoist bracket. When properly adjusted, be sure all bolts are tight.

Lubrication

The hoist must be filled to test drain cock with oil. All bearings should be thoroughly lubricated before the loader is operated.

(183) Installing Hoist Cables

The double cable drum for the Hoist is mounted between the engine and the front of the substructure housing. The cable for the loader is furnished in one strand and is mounted in the following manner, with the conveyor lowered to the operating position:

(a) Run one end of the cable through the hole next to the inner flange (1) Figure 106, in the hoist drum, then through the inside of the drum and out hole (2) next to the outer flange. Pull the cable across to sheave (4) on the superstructure frame on the side opposite the drum and run the cable over this sheave.

(b) Reave the other end of the cable so that it runs from hole (1) under sheave (3) on the superstructure frame above the drum. Run cable end up from sheave (3) and over sheave (4). Now pull the ends of cable out from sheaves (4) so that there is an equal amount of cable for each side of Conveyor Frame.

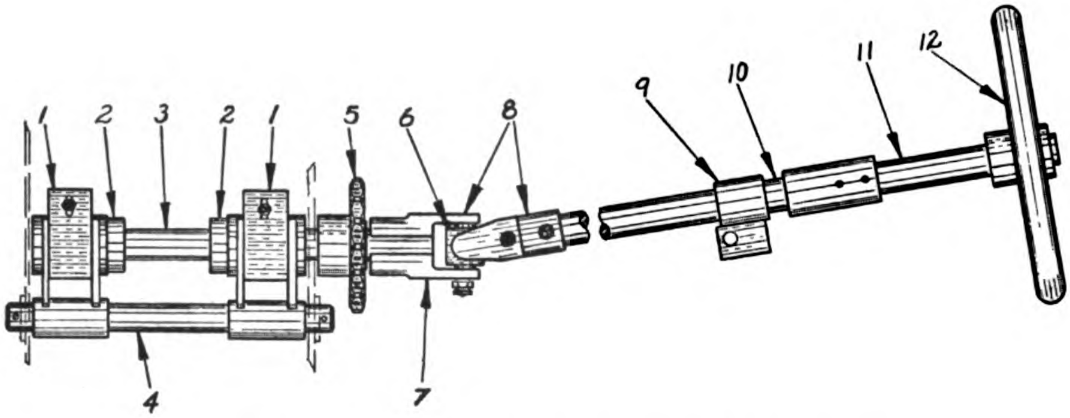


Figure 107. Hand wheel hoist for making minor adjustments.

(c) Each cable end is now reeved in the same manner on its respective side, from sheave (4), over sheave (5), under and up from sheave (6), over and down from sheave (7) on the loader conveyor frame, through holes at (8) and across the frame so that the ends meet and overlap about eighteen inches. Clamp ends securely together with four clamps (9).

(d) Now guide the cables, manually, so that they run evenly onto the drums, to remove the slack, as the hoist is operated. Adjust cable ends with clamps, as required, so that the cable to each side pulls the conveyor frame up evenly.

(184) Hoist Handwheel Shaft

Partial Repairs

The hoist handwheel (5B) Figure 96, (12) Figure 107, shafts (10) and (11), bracket (9), and universal joint made up of parts (6), (7) and (8) may all be renewed without removal of any other parts.

General Overhaul

(a) Remove cover from substructure housing.

(b) Take out shafts (10) and (11) without breaking splice. Unbolt bracket (9) and Universal fork half (8).

(c) Disconnect chain from sprocket (5).

(d) Remove take-up bolts and shaft (4).

(e) Unit may now be lifted out of substructure housing.

(f) Loosen collars (2) and bearings may be taken off. Sprocket may also be removed from shaft (3).

Inspection for Replacement

This assembly is subject to very little wear however, if the sprocket, shafts, bearings and bracket are worn excessively they should be replaced.

Assembly

The assembly is reverse of the disassembly operation.

Adjustment

After the chain is installed on sprocket (5), the shaft may be tilted upward with the take-up bolts to tighten the chain. After the adjustment is complete, tighten the lock nuts on the take-up bolts.

Lubrication

Lubricate both bearings (1) before the machine is put into operation.

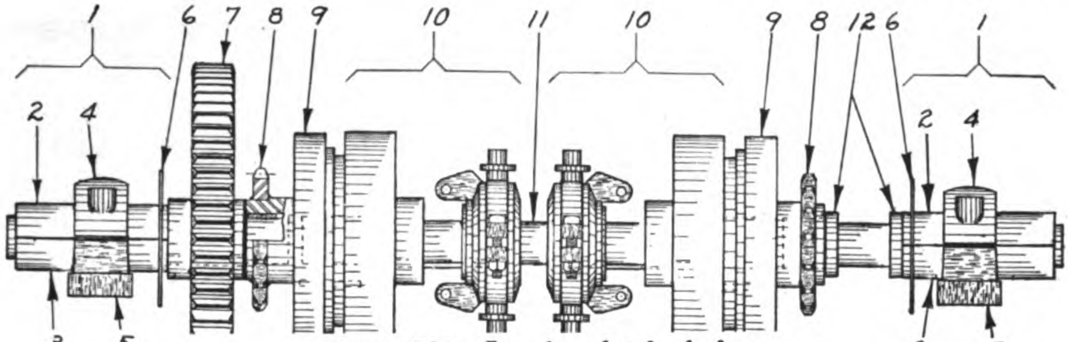


Figure 108. Crawler clutch shaft.

(185) Crawler Clutch Shaft

Partial Repairs

The chains, bearings (1) Figure 108, clutch bands, clutch linkage and brake bands of the Crawler Clutch shaft (3c) Figure 96, may be renewed without removing the shaft (11) Figure 108, from the substructure housing.

In all repair work on this shaft it is best to raise the conveyor to the horizontal position.

To remove the bearings proceed as follows:

(a) Remove take-up bolts (15) Figure 109, in brake bands.

(b) Disconnect chains (34) Figure 102, if they are not loose enough to permit lifting shaft about ½".

(c) Remove bearing caps (4) Figure 108, lift out upper hearing half (2). Turn lower bearing half (3) to top of shaft and lift out.

While shaft is lifted the shifter yokes are free of the shifter forks, removing the shifter yoke bolts allows the two halves to come free of the shifter collar (6) Figure 109.

Caution:

Note the positions of the bands on the drum so they may be replaced in this same position. Do not remove the shims found on one clutch band as they can be used as a guide in reassembly. The purpose of these shims is to prevent either clutch lever from binding in the holes provided in the carrier through which they extend. The amount of shims used is entirely dependent on the amount of shims required to prevent these main clutch levers from binding. Never insert sufficient shims to cause clutch band to bind between the spring band clips (10) and the carrier with clutch disengaged. If the band should bind before the clutch is free, remove lever and grind down the edge that binds in carrier hole. Shim one band only. For replacement of clutch bands proceed as follows:

(a) Remove both adjusting bolts (1) Figure 109.

(b) Remove all four bolts (2). The slotted nuts on these bolts are held in place by cotter pins.

(c) Remove both spring bands (3).

(d) Remove the toggle pin (4) that secures the toggle link (5) to shifter collar (6).

(e) Remove the main clutch lever (7).

(f) Loosen both set screws (8) in the clutch carrier (9) and slide the clutch carrier back on shaft away from the clutch drum and remove bands. When sliding the carrier back be sure that the clutch bands remain in position on the clutch drum as this will simplify their removal.

(g) Pry the old lining from the shell of clutch band half and remove the rivets with a chisel. Install new lining. This is done by placing the linings in place on the clutch band half so the holes in the lining and shell are aligned. Secure with the rivets provided, making sure the rivet heads are imbedded in the linings so that rivet heads will not drag on the clutch drum.

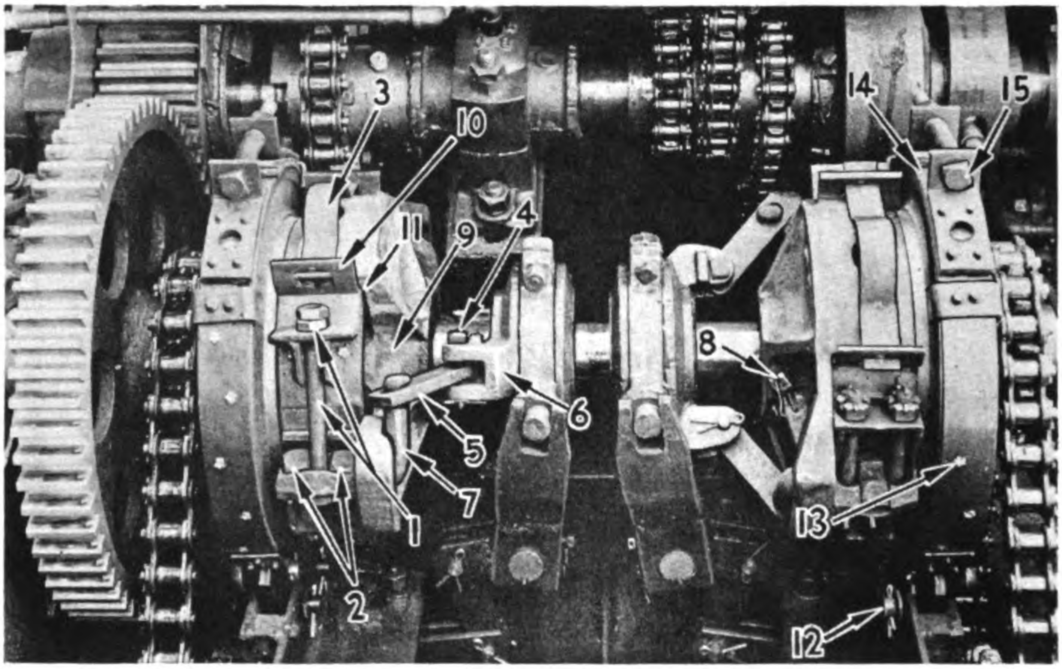


Figure 109. Crawler control clutches.

Partial Repair Assembly

(h) Place the relined bands in original positions on the drums and slide the carriers (9) back in place. Turn down set screws (8) in carriers and wire.

(i) Insert the main clutch levers (7) through the holes in carriers.

(j) Insert the four bolts (2) in place and put the slotted nuts on bolts only as far as is necessary to keep nuts on bolts.

(k) Insert the take-up bolts (1) and start half nut on bolt.

(l) Secure toggle links (5) Figure 109, to shifter collar (6) with toggle pins (4).

(m) Engage clutch.

(n) Turn down, the same amount, the nuts on both adjusting bolts so they will be good and snug.

(o) Turn down, the same amount, the slotted nuts on the remaining four bolts until the bolts are tight enough so they can not be moved with the fingers. Line up the slotted holes in nut with the holes in bolts and insert a cotter pin.

(p) See adjustment section for clutch adjustment.

Toggle links (5), toggle pins (4), spring bands (3) and clutch lever (7) may be replaced at any time without removing clutch bands.

For replacement of brake bands proceed as follows:

(a) Remove the adjusting bolt (15) Figure 109, from brake bands.

(b) Remove the anchor pin (12) from each brake band, remove bands.

Caution:

Do not bend the brake band while removing and replacing the lining. The curvature of the band must correspond with that of the drum to maintain proper surface contact when the brakes are applied.

The brake bands may be relined as follows:

Pry the old lining from the shell of the brake bands and remove the rivets (13) with a chisel. Install new lining. This is done by placing the linings on the brake band so the holes in the lining and shell are aligned. Secure with the rivets provided making sure the rivet heads are embedded in the linings so that the rivet heads will not drag on the brake drum (14).

The assembly of the brake bands is the reverse of the disassembly operation. See adjustment section for brake adjustment.

General Overhaul

The clutch shaft may be removed from the substructure as follows:

(a) Release crawler clutches and take out adjusting bolts (15) Figure 109, on the brake bands so they may be laid back out of the way.

(b) Uncouple crawler intermediate chains (34) Figure 102, and remove the bearing caps.

(c) It is not necessary to remove side plates (28), as for the main jackshaft since there are separate patch plates (6) Figure 108, provided over each bearing (1) on this shaft. Remove these plates then the shaft assembly is free to be lifted out of the housing.

(d) To strip the shaft completely, remove gear (7) which is keyed and set screwed to the shaft, then collars (12) should be removed. Clutch hubs with sprocket (9) will now slide off the shaft. Clutch carriers (9) Figure 109, are keyed and set screwed to the shaft and will slide off as a unit with clutch bands and shifter collars.

Inspection for Replacement

Parts which are worn excessively should be replaced. Attention should be directed to sprockets (8) Figure 108, if teeth are worn and none are available they can be interchanged with the one on the opposite side. The clutch drums can be pressed off the sprocket hub if drums are to be replaced and sprockets are to be used again. Sprocket hubs may be rebushed.

Check condition of gear teeth and cluth shifter collars.

Assembly

Assembly is the reverse of the disassembly operation.

Adjustments

To tighten the chains from the clutch shaft use shims under the bearings on the Crawler Clutch Shaft. NOTE: Be sure that the alignment of the gears is correct after this operation.

After the shaft is assembled in place, adjust both crawler clutches as follows:

To tighten clutch, loosen half nut on adjusting bolt and turn inside nut down ¼ to ½ turn, (1) Figure 109. Then turn clutch half way around and repeat procedure on opposite take-up bolt. BE SURE TO TAKE UP AN EQUAL AMOUNT ON BOTH BOLTS. If this is not done, the ends of both clutch bands nearest to the bolt taken up the most will drag resulting in damage to the clutch. To determine if both bolts have been taken up an even amount proceed as follows:

(a) Turn clutch over until the clutch band half, having no shims between the spring clip and clutch carrier at (11) Figure 109, is accessible.

(b) Disengage clutch.

(c) Grasp firmly with fingers, both clips, (10), that hold the spring (3), in position. If clutch band is free on the drum, the take-up bolts have been tightened properly. If band cannot be moved, the bolts are not evenly adjusted and the clutch will drag. To correct, proceed as follows:

(d) Check the clearance between the spring clip (10) and carrier (9) at (11) and the clearance between the clip and carrier at the other end of spring (3). You will find there is no clearance at one end and possibly ¼″ at the other. Therefore, the bolt at the end having ¼″ clearance must be loosened and the opposite takeup bolt tightened until the clutch band has been centered giving equal clearance between clips (10) and carrier (9) at point (11), and then continue to tighten bolts evenly until the clutch is in proper adjustment. A new clutch may require several adjustments until the friction bands wear in.

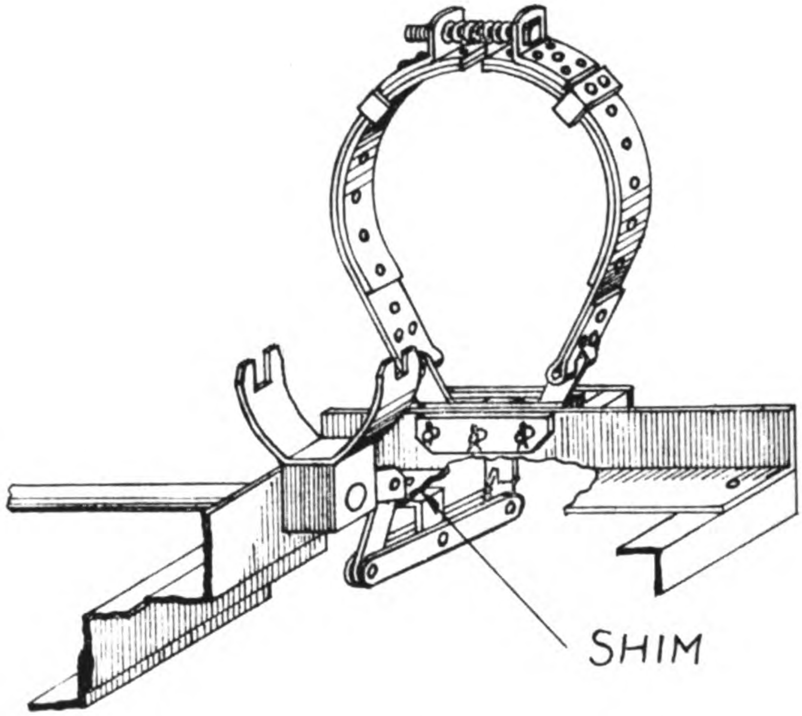


Figure 110. Showing how to shim the linkage for the brakes of the crawler control.

Adjustments (Cont'd)

When the clutch is properly adjusted, the clutch band must be free on the drum as previously described, and the clutch levers engage with a distinct snap as the shifter yoke throws past center.

The brakes should be adjusted as follows:

To tighten either brake, loosen the half nut on the adjusting bolt, (15) fig. 109 and turn the inside nut down ½ to ¾ turn. If this should not be sufficient, continue to turn the nut ½ turn until proper braking is obtained. Never tighten the brakes more than is necessary to brake each crawler when turning on level ground.

If, when applying the brakes, the levers should hit the drive chain gear case, so that proper braking cannot be obtained, it will be necessary to shim the linkage of the brakes. See figure 110. These shims are placed between the linkage, and the support angles, and held in place by bolts. Always insert an equal amount of shims on both sides. This is necessary to maintain proper alignment of the steering levers. CAUTION: Be sure that when the clutches are engaged, the brake bands are free on the drums and with the brakes set, the clutch bands are free as per instructions in "Clutch Adjustment." The brakes may be set up too tight so they engage before the clutches completely di-engage, resulting in a condition where clutch and brakes are working against each other.

Lubrication

Lubricate bearings (1) figure 108 and sprocket hubs (8) thoroughly before the machine is put into operation.

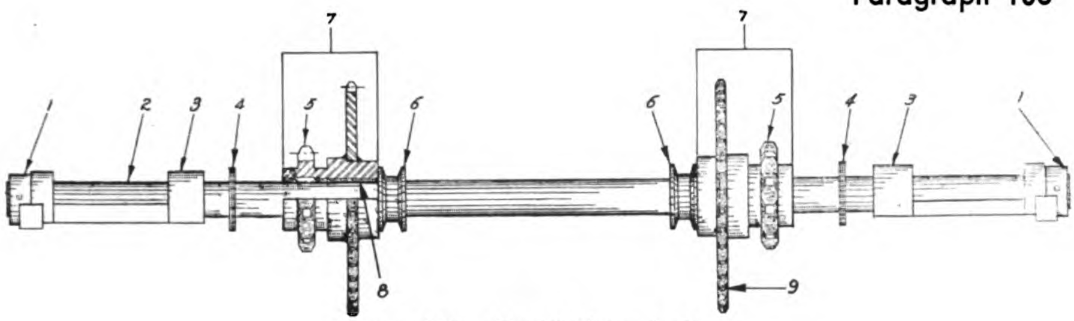


Figure 111. Oscillating shaft.

(186) Oscillating Shaft

Partial Repairs

The only repairs to the oscillating shaft (3d) Figure 96, without complete disassembly is the replacement of the chains to the clutch shaft and those to the crawler final drive.

General Overhaul

To remove the shaft proceed as follows: (a) Raise conveyor frame to horizontal position. (b) Uncouple chains (34), Figure 102 and chains (1), Figure 113. Now remove the four bolts (2) in each of the crawler pivot brackets (3), Figure 114. (c) Use two jacks under housing at (4), Figure 113, and raise the loader just enough to take the weight of the loader off the crawlers on each side. (d) Now remove pins from collars (1), Figure 111 and loosen set screw in structural bearings of substructure, and collars (6). The shaft is now free to slide out releasing the sprocket clusters (5).

Inspection for Replacement

If it is found that the teeth are only partially worn, the cluster may be rebushed if necessary, and interchanged. It is not advisable to make this change if the teeth and shaft are worn excessivly and replacement parts are available.

Assembly

The assembly is the reverse of the disassembly operation.

Lubrication

Both clusters should be thoroughly lubricated before the loader is put into operation.

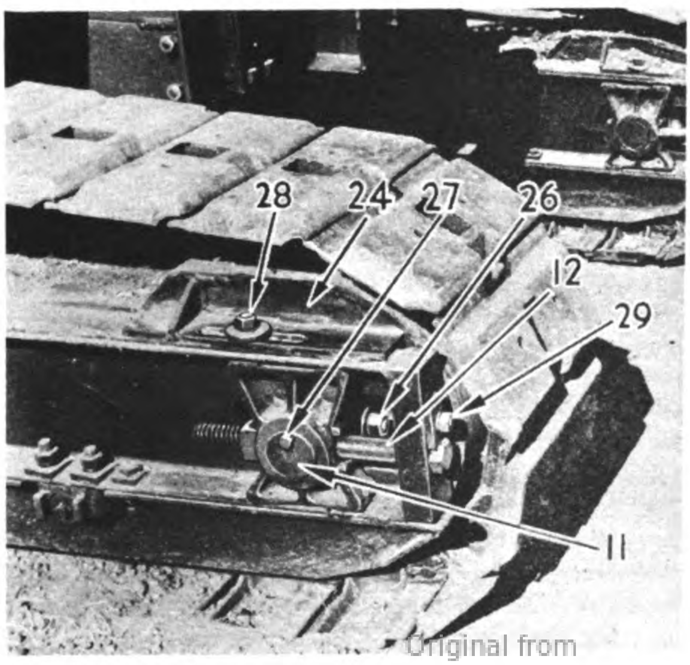


Figure 112. Bolts to be loosened in taking off crawler links.

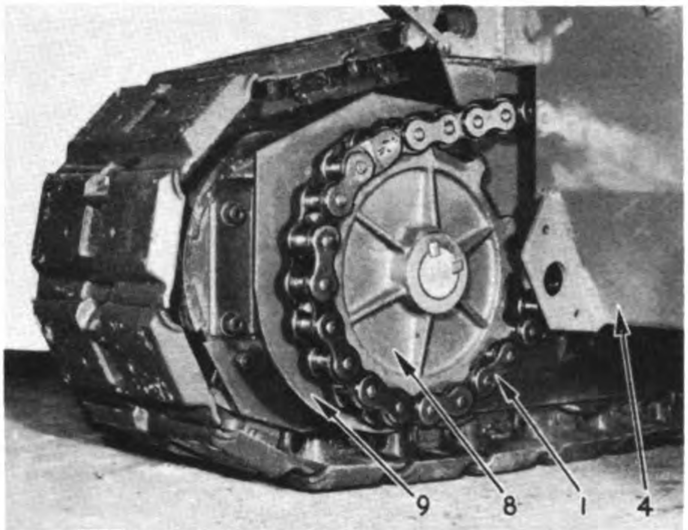


Figure 113. Crawler drive sprocket.

(187) Crawler Treads

Partial Repairs

The crawler treads (4e) Figure 96 are parted by the following steps: Loosen bolts (28) Figure 112 on sides of the crawler, remove bolts (29) and lock plates. Loosen takeup shaft (11), and force back towards drive end, and remove T head pin in crawler tread, above spring idler (10), Figure 114.

One or all of the links across the top of the frame may be removed, if desired.

General Overhaul

To remove the crawler treads follow the partial repair operation. Jack crawler up 4 to 6 inches, then the entire crawler tread may be pulled from under the frame.

Inspection for Replacement

Each link should be examined and replaced if it is bent or the T head pin hole is excessively elongated.

The T head pins should be replaced if worn in heavy ridges. All cotter pins should be replaced if worn to any extent.

Assembly

The assembly of the crawler tread is the reverse of the disassembly operation.

Adustment

The crawler treads are tightened by taking up on the bolt (12) on each side of the crawler frame.

There should be about 1" sag in the treads between the spring idler and the traction wheel. Be certain the take up is adjusted even, bolts (28) tightened and that the lock plates (29) are secured in position.

Lubrication—(None)

(188) Crawler Take-up Shaft

Partial Repairs—(None)

General Overhaul

When any repairs are necessary on the crawler take-up shaft the unit may be disassembled by the following steps: (a) Follow instructions under "Crawler Tread" and lay the treads away from the traction wheel which is on this shaft. Use jacks at (19), Figure 117, to take the weight of the loader off this shaft. (b) Remove covers (24) Figure 112, takeup bolts (12), lock bolts (26), and the shaft is free to slide out of the takeup bearings and bushed traction wheel.

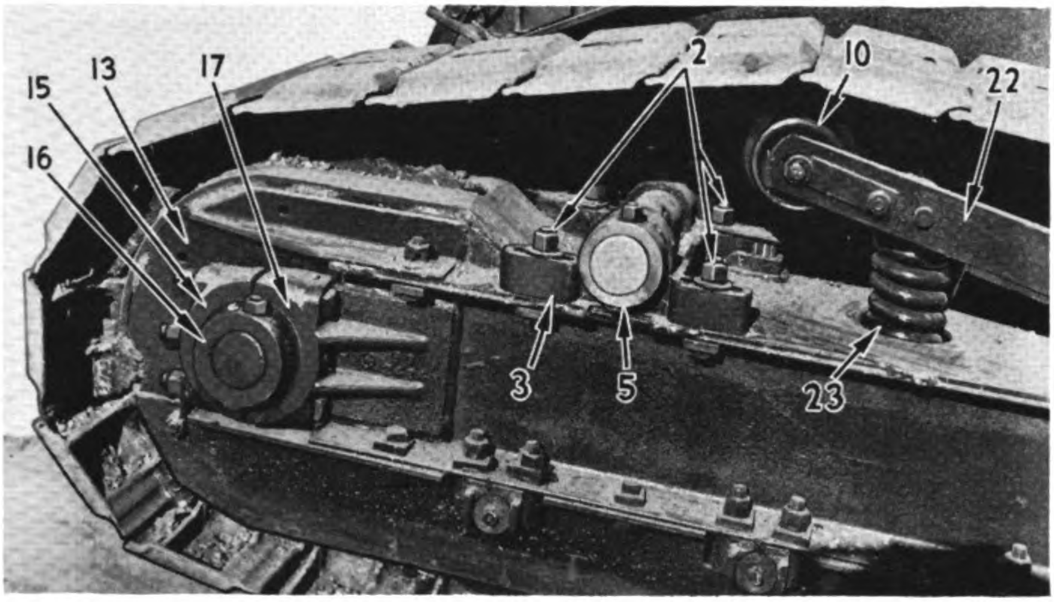


Figure 114. Crawler bearings.

Inspection for Replacement

Replace the bushings in the traction wheel and install a new shaft when worn excessively. A loose fit in these parts will cause the traction wheel to "wobble" wearing the wheel rim and cause premature wear to the inside of the crawler tread links.

The take-up bolts should be straight and the threads in good condition.

Assembly

The assembly of the unit is the reverse of the disassembly operation.

NOTE: When reassembling this shaft, be sure that alemite (27) Figure 112 is at the top.

Adjustment

Adjust crawler treads as instructed under Crawler Treads adjustment.

Lubrication

The traction wheel should be thoroughly lubricated before the loader is put into operation.

(189) Crawler Drive Shaft

Partial Repairs

The drive chain (1) Figure 113 may be replaced, also the drive sprocket (8) without removal of the unit from the crawler frame.

General Overhaul

The crawler drive shaft may be removed by the following disassembly operations. Raise the conveyor feeding end to the maximum height. (a) Uncouple chain (1), Figure 113 and remove sprocket (8) which is double keyed and set screwed to the shaft, remove shield (9). (b) Follow instructions under "Crawler Tread" and lay the treads back away from the crawler sprocket on this shaft. Use a jack at (4), to take the weight of the machine and raise the crawler sprocket (14), Figure 115, clear off the track shoes at the bottom. (c) Remove covers (13), Figure 114 and bearing caps (15). This shaft may now be taken out of the crawler frame. (d) To dismantle the shaft, take off collar (16), slide off bearing (17) Figure 115, remove the washer between bearing and sprocket (14), collar (18) may be removed after bearing on opposite side of frame is removed. Note that the longer of these collars fits in place between the sprocket and the hub of the inside bearing. Sprocket (14) is double keyed and set screwed to the drive shaft.

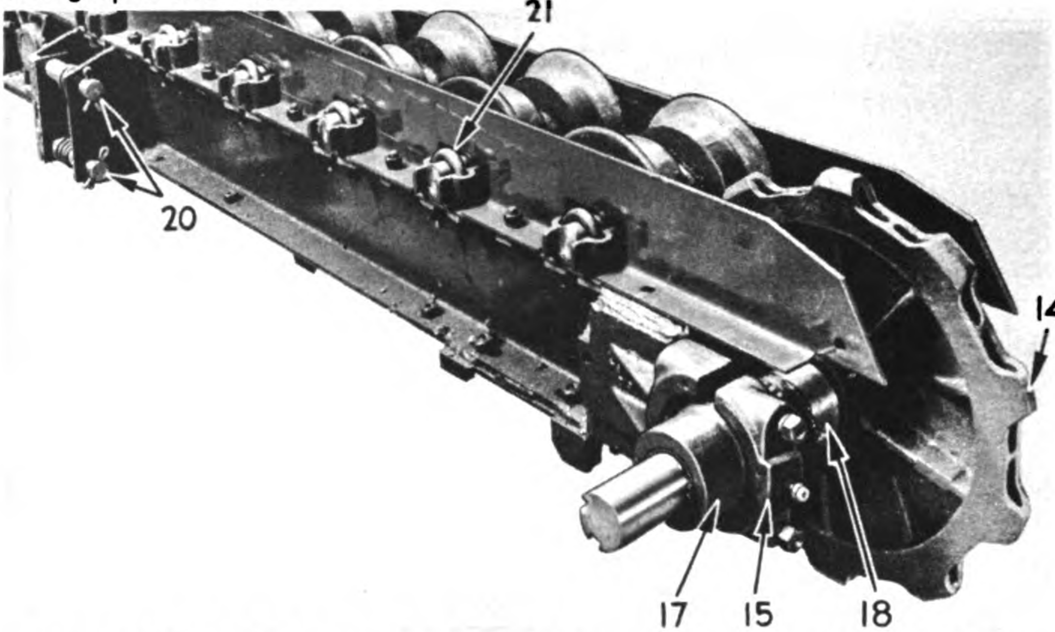


Figure 115. Crawler frame, turned upside down to show tread support idlers.

Inspection for Replacement

Teeth of both sprockets should be checked and the sprockets removed if the teeth are worn to the point where they might cause damage to chains.

If the sprockets are alright except for partial teeth wear they may be interchanged from one frame to the other. This will bring unused side of teeth in contact with chains. Bearing bushings and shaft should be replaced if worn excessively.

Spacer collar (18) and washer between outside bearing and sprocket (14) should be replaced if worn as the shaft would have excessive end play if these spacers are short.

Assembly

Assembly of the unit is the reverse of the disassembly operation.

Adjustment

The crawler oscillating bearings are exposed when the tread is parted. Remove nuts of bolts (2) Figure 114. Remove caps covering shims in rear of bearings (3). Shift crawler towards feeding end by shifting shims. Drive chain should have about 1" slack. Replace shim covers and tighten all bolts. Adjust the crawler treads as instructed under "Crawler Tread Adjustment."

Lubrication

The unit should be thoroughly lubricated before the machine is put into operation.

(190) Crawler Tread Rollers and Guards

Partial Repair—(None)

Overhaul

To remove the crawler tread rollers proceed as follows:

(a) Jack up crawler at both axles so they are about 10" off the ground.

(b) Uncouple crawler tread as directed under "crawler treads" and remove it.

(c) Remove tread roller guard plates from both sides of crawler frame. (The guard plates do not have to be removed but the job is much easier if they are removed).

(d) Remove U bolts (21), Figure 115 if guard plates are removed tread roller, shaft, keepers and spacer washers will drop out. With guards in place shaft will have to be pulled out to free the assembly.

Inspection for Replacement

The treads rolls should be replaced if flanges are broken or worn. If rolls are in good condition except babbitt they may be used again if rebabbitted. Shafts which are worn excessively or the grease groove is damaged should be replaced.

Assembly

The assembly is the reverse of the disassembly operation.

When replacing the shaft be certain the grease groove is turned up and a spacer washer is placed on each side of the roller.

Lubrication

All shafts should be thoroughly lubricated as they are assembled.

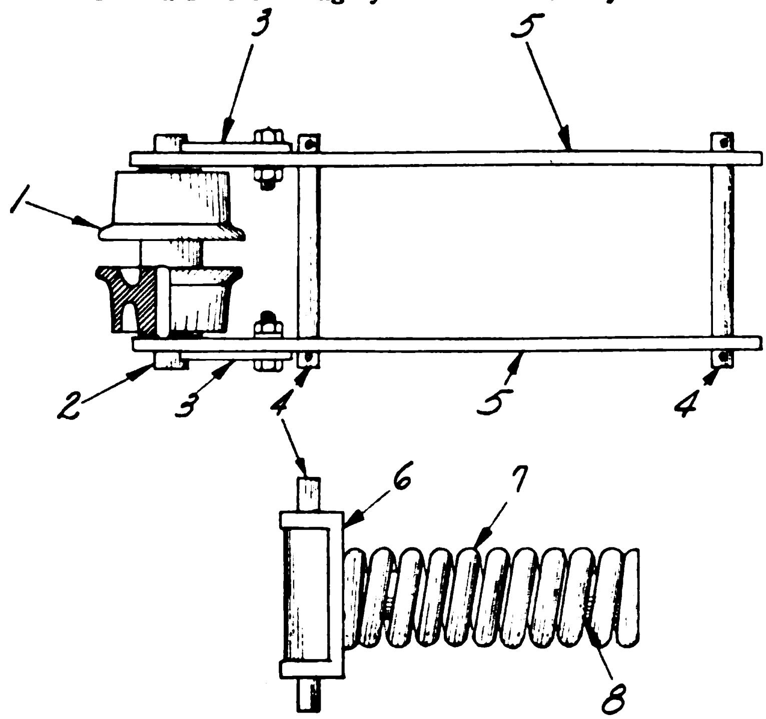


Figure 116. Spring tension idler.

(191) Spring Tension Idler

Partial Repair—(None)

Overhaul

To remove the spring tension idler from the crawler and disassemble proceed as follows:

Uncouple treads as directed under "Crawler Treads," partial repairs. Remove pins (4) Figure 116 and keepers (3), take up arms (5) may now be removed and shaft (2) pulled out of flanged roller.

Inspection for Replacement

The flanged roller should be replaced if it is worn excessively or if the flanges are broken.

Pins (4) and spring seat (6) should be examined for excessive wear. Excessive wear in these parts will cause the idler to weave causing premature wear of the roller flanges.

Assembly

The assembly of the spring idler is the reverse of the disassembly operation.

Lubrication

Thoroughly lubricate the idler before the loader is put into operation.

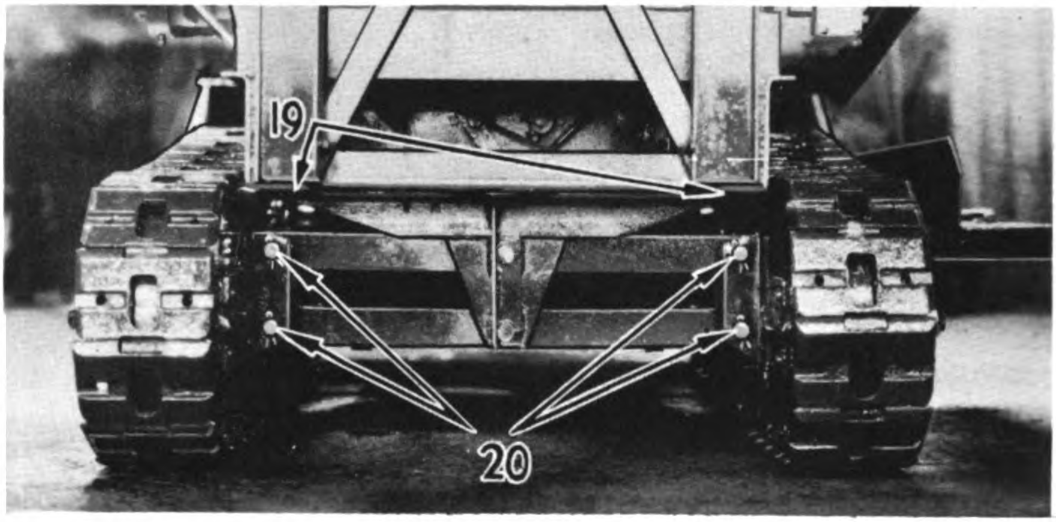


Figure 117. Removal of crawler assembly.

(192) Removal of Crawler Assembly

To accomplish this operation, proceed as follows:

(a) Uncouple crawler drive chain (1), Figure 113. Remove the operator's platform over crawler on operator's side.

(b) Jack up the entire loader with jacks at points (4), Figure 113, and at (19), Figure 117. The crawler treads may be removed separately, to reduce the total crawler unit weight, if so desired, as per instructions under "Crawler Treads." As the weight of the loader falls on jacks at (19, remove pins (20) in oscillating axle. Remove bolts (2) Figure 114.

(c) The crawlers are now free of the chassis and may be skidded to one side.

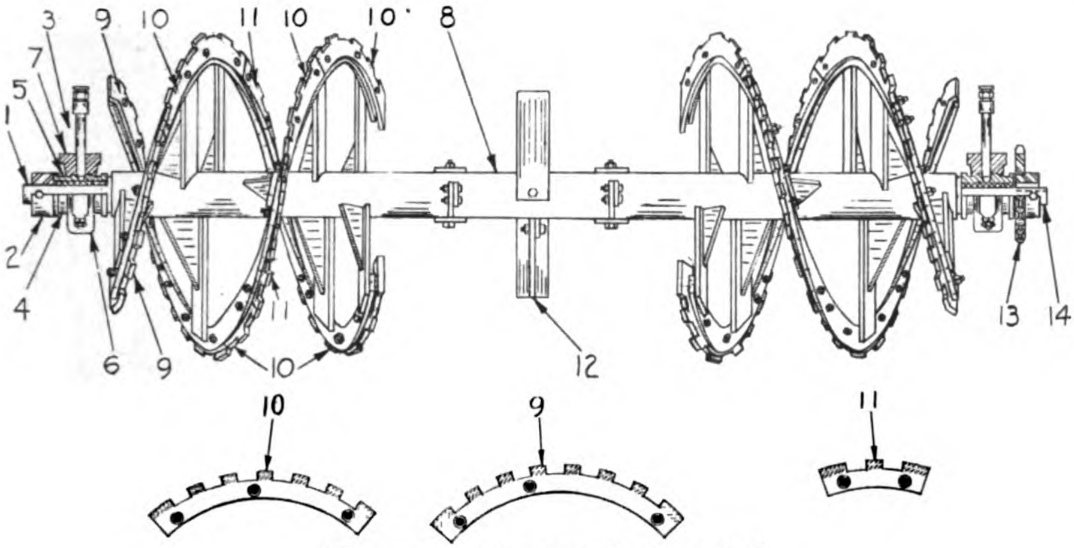


Figure 118. Conveyor feeder spiral.

Chapter XXIV
Conveyor

(193) Spiral Assembly

Partial Repair

The spiral assembly (10e), Figure 96 wearing strips, (9), (10), (11), Figure 118 paddles, (12) bearings (3) and shafts (1), (14) may be renewed without removing the assembly from the scraper. The wearing strips protect the spiral rims therefore, they should be replaced before the rim becomes worn. Paddles (12) should be replaced if they become broken or bent.

Either bearing (3) and either shaft (1), (14) may be replaced separately by following directions in "General Overhaul."

The assembly in each case is the reverse of the disassembly.

General Overhaul

To remove the spiral assembly proceed as follows:

(a) Remove guard which covers spiral final drive chain.
(b) Remove chain which runs from spiral countershaft to sprocket (13).
(c) Block up under spiral assembly.
(d) Remove bearing caps (6).
(e) Remove bearing halves (4) and (5) from each end of spiral.
(f) Remove jam nut and set screw from each end of spiral.
(g) Shaft (1) may be pulled out of spiral and collar (2) removed from shaft if either are to be renewed.
(h) Stub shaft (14) may be pulled out of spiral and sprocket (13) removed from shaft if either are to be renewed.
(i) After the stub shafts (1) and (14) are removed spiral (8) may be removed from scraper.

Inspection for Replacement

Bearing halves (4) and (5) and stub shafts (1) and (14) should be replaced if they are worn excessively. Drive sprocket (13) should be replaced if teeth or keyway are worn out of shape.

Assembly

The assembly of the spiral is the reverse of the disassembly operation.

Lubrication

Lubricate both spiral bearings before the machine is put into operation.

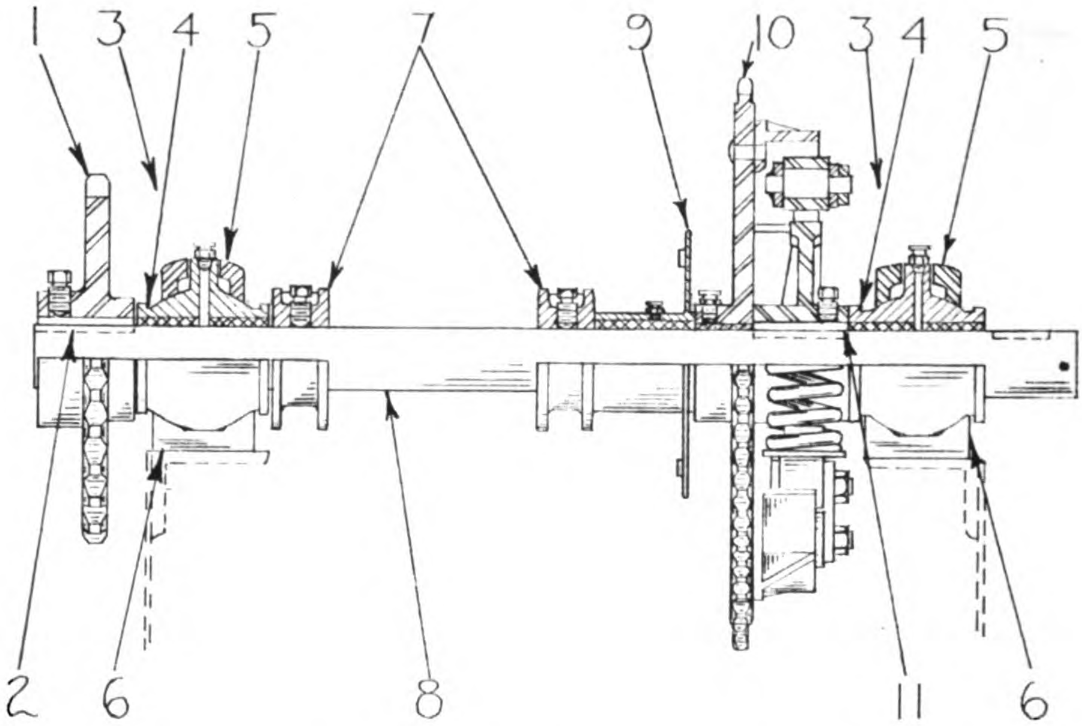


Figure 119. Spiral drive countershaft.

(194) Spiral Drive Countershaft

Partial Repairs

The Spiral Drive Countershaft (10f), Figure 96 chains to sprocket (10), Figure 119 and from sprocket (1), also sprocket (1) are the only parts which may be replaced without complete disassembly of the countershaft. See general overhaul for disassembly.

General Overhaul

To remove the countershaft proceed as follows:

(a) Remove guard which covers spiral final drive chain.
(b) Uncouple and remove spiral final drive chain.
(c) Remove guard which extends from pivot shaft to bearing patch (9).
(d) Uncouple and remove chain driving overload release sprocket (10).
(e) Remove bearing caps (5). Countershaft assembly may now be lifted out.
(f) Bearing (4) next to overload release sprocket may be removed.
(g) Loosen set screws and remove spring release sprocket hub (3), Figure 120.
(h) Overload release sprocket (10), Figure 119 may be removed.
(i) Bearing patch (9) may be removed.
(j) Loosen set screws and remove collars (7).
(k) Loosen two set screws and remove sprocket (1).
(l) Remove bearing (4) which is next to sprocket (1).

Inspection for Replacement

Bearings (4) should be inspected for excessive year. Sprockets (10) and (1) should be replaced if the teeth or keyway are worn out of shape.

Assembly

The assembly of the countershaft is the reverse of the disassembly operation.

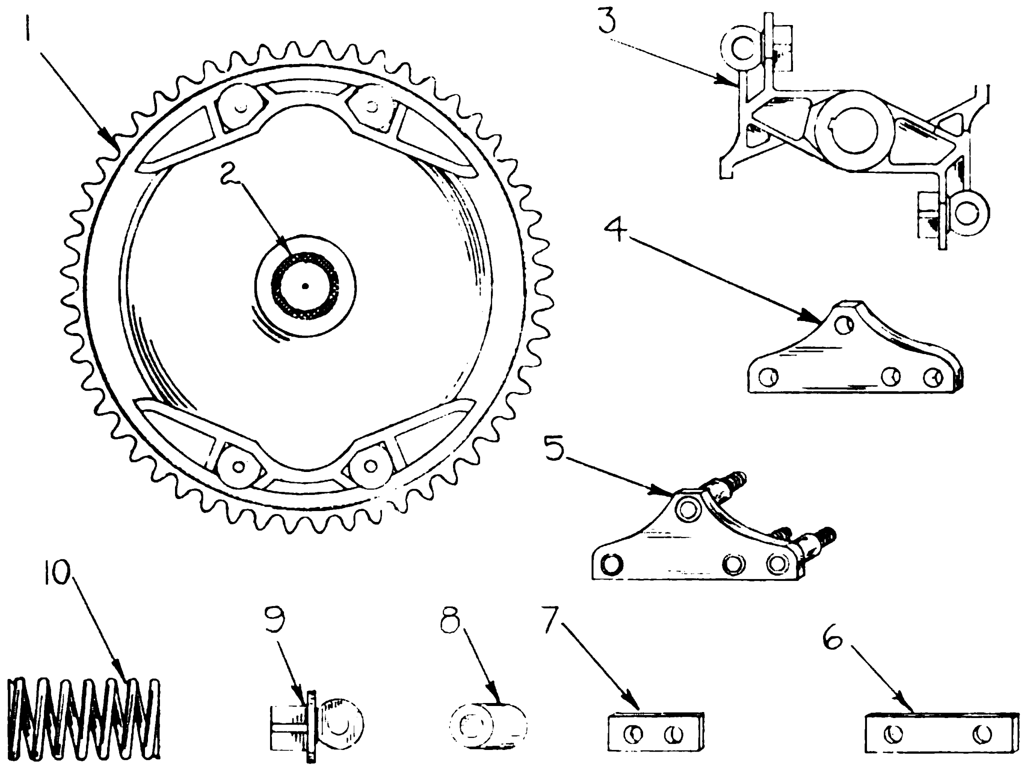


Figure 120. Overload release sprocket.

Adjustment

Adjust the final drive chain by moving either the countershaft towards the power unit or the spiral assembly away from the countershaft. When either assembly is moved to adjust the chain, check the shaft alignment. After the final drive chain is adjusted, the drive chain to the pivot shaft may be adjusted by the spring take up idler which is in the countershaft drive chain guard.

Lubrication

The six points on this shaft and overload release sprocket should be thoroughly lubricated before the machine is put into operation.

(195) Overload Release Sprocket

Partial Repair—(None)

General Overhaul

The overload release sprocket (10g), Figure 96 is removed as instructed under "General Overhaul, Spiral Drive Countershaft" (a) to (h) inclusive.

To dismantle the hub assembly proceed as follows:

(a) Remove nuts and lock plates from pins in side bars (5), Figure 120.

(b) Roller plates (4) may now be removed.

(c) Rollers (8), spring retainers (9) and springs (10) may be removed after roller plate.

Inspection for Replacement

Examine pins in side bars (5), rollers (8) and spring retainers (9) and replace if worn excessively.

Assembly

The assembly is the reverse of the disassembly process.

Adjustment—(None)

Lubrication—Same as Spiral Drive Countershaft.

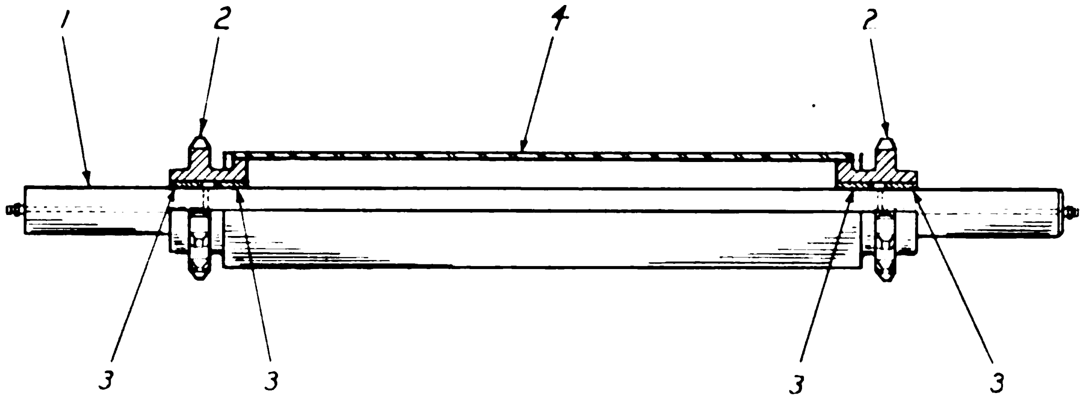


Figure 121. Conveyor foot shaft.

(196) Conveyor Foot Shaft

Partial Repair—(None)

General Overhaul

To remove the conveyor foot shaft (10b), Figure 96, and tail pulley proceed as follows:

(a) Run conveyor until lacing is at head sprockets.

(b) Loosen take up bearings and force head shaft back toward feeding end as far as possible.

(c) Uncouple belt chains, pull out belt lacing rocker pins from operators side.

(d) Pull uprun side of belt out of conveyor frame laying it over the spirals. This will expose tail pulley (4), Figure 121.

(e) Remove jam nuts and set screws from footshaft bearings on both sides of conveyor frame.

(f) Pull out foot shaft (1) either side of machine through holes in scraper provided for this purpose.

(g) Foot shaft assembly may be lifted out of foot end at rear of spiral assembly.

(h) Sprockets (2) may be pulled out of pulley (4).

Inspection for Replacement

The pulley takes very little wear. It may become corroded but cleaning it of rust and painting it will possibly be the extent of repair to this part.

The sprockets should be rebushed if necessary.

If the teeth are partly worn, the sprockets may be interchanged.

The shaft should be replaced, if worn excessively. Particular attention should be given the grease rifling at both ends of the shaft. If this rifling is damaged or plugged, and grease does not reach the sprockets, they will be damaged quickly as this pulley runs at rather high speed.

Assembly

The assembly of the foot shaft is the reverse of the disassembly operation.

Adjustment

Conveyor Belt Chains

Take up of these chains is accomplished by means of two adjusting bolts, (4), Figure 126, at the conveyor discharge end. To tighten these chains loosen lock nuts (8) and take up on bolts (6) until the chain is in proper adjustment. Then tighten lock nuts, each bolt should be taken up an equal distance to maintain sprocket and chain alignment. Proper tension may be tested in this manner. Standing on top of superstructure at about the center of the conveyor grasp one of the belt flights, when chains can be lifted 2 to 2½" adjustment is proper. CAUTION: When the conveyor belt chains are tightened, the conveyor drive chain is also tightened. This should be checked for proper tension.

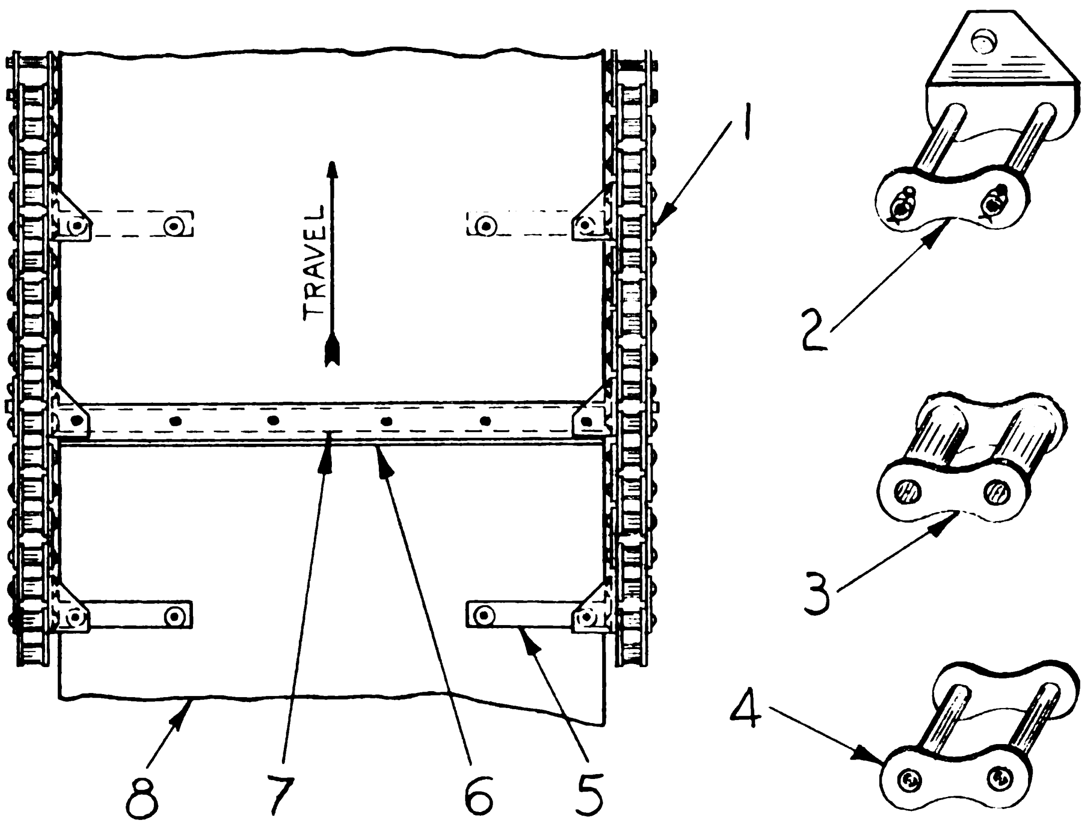


Figure 122. Showing conveyor belt parts.

Conveyor Drive Chain

This chain is in proper adjustment when the amount of sag in the chain from the take up sprocket to the headshaft is not less than 1″ or more than 3″. The adjustment of this chain is accomplished by taking up on the bolts 13, Figure 125 until the chain is in proper adjustment. Each bolt should be taken up an equal amount to maintain proper sprocket and chain alignment.

Lubrication

Lubricate both sprockets thoroughly before the loader is put into operation.

(197) Conveyor Belt

Partial Repairs

Considerable repairs may be made to the belt (10i), Figure 96 without removing it.

Any bolts missing from cross angles (6) or attachment link bars (5) should be replaced at once. Bolts should be riveted when installed.

Should the belt become torn it should be repaired immediately. If repair is impossible, the torn portion should be cut away. Under no circumstances should machine be operated with any loose bars (5), angles (6), or a torn belt as there is danger that these may catch somewhere in the conveyor frame and render the entire belt useless.

If it is necessary to remove links from the belt chains, this may be accomplished at the headshaft after it has been moved towards the footshaft as far as possible.

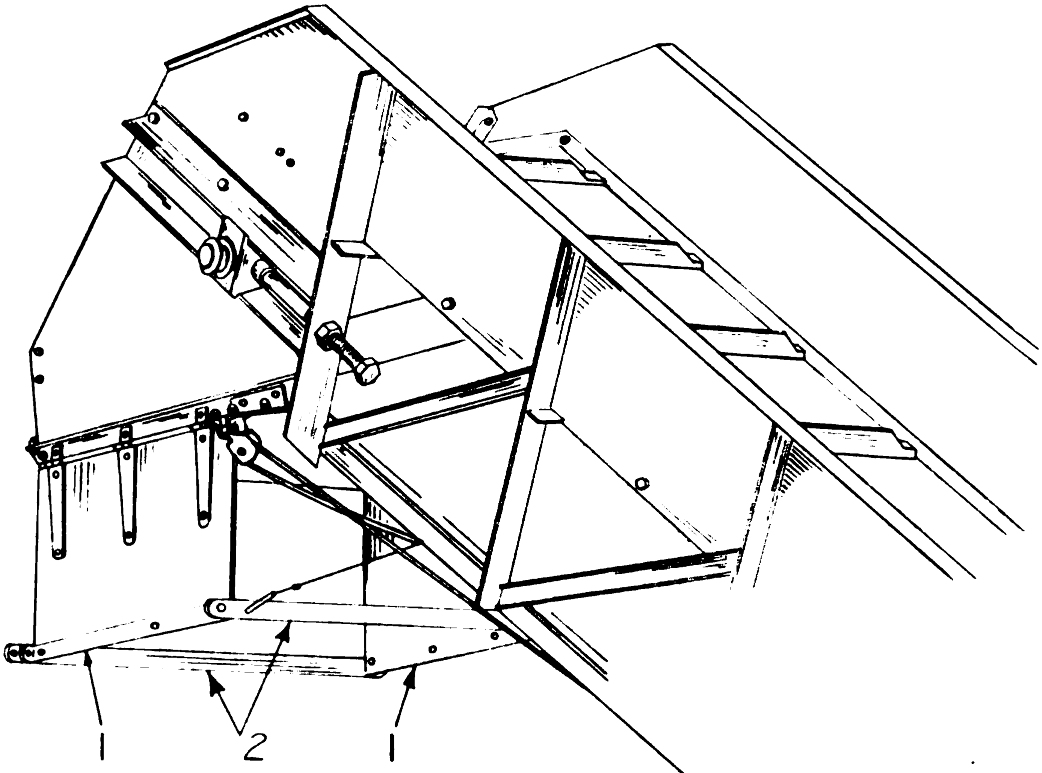


Figure 123. Conveyor discharge baffles.

General Overhaul

The following instructions give two methods of removing belts. The first to be followed when belt is to be removed without immediately replacing it. The second to be followed if new belt is available at the time belt is renewed.

(a) Remove cables and tie bars (2), Figure 123 from baffles (1).

(b) Swing each baffle out of the way and wire it to hold it in place.

(c) Run belt until lacing is at head shaft.

(d) Loosen take-up bearings and force headshaft back towards feeding end as far as possible.

(e) Uncouple conveyor belt chains.

(f) Pull out belt lacing rocker pins from operator's side.

(g) Back truck under discharge end.

(h) Run engine in idling speed; start conveyor and run belt off machine into truck body.

In the event a new belt is to be installed and is available at time belt is removed proceed as follows:

(a) Mount roll of belt with a shaft through the center of roll. Support shaft on each side with two wood horses. This roll should be near as possible to discharge end.

(b) Connect new belt to down run end of old belt.

(c) Run engine in idling speed and start conveyor. The old belt is pulled over new belt roll to truck body near cab as new belt is fed in down run side.

Inspection for Replacement

Belt chains may be used two, and in some cases three times with a new belt. Examine the rollers, bushings and condition of the chain side bars. Particular attention should be given to the point where the chain pins (1), Figure 122 rivet to the side bars.

The angles (6) and bars (5), (7) of the belt assembly may be used several times with a new belt provided they are not bent or the holes elongated.

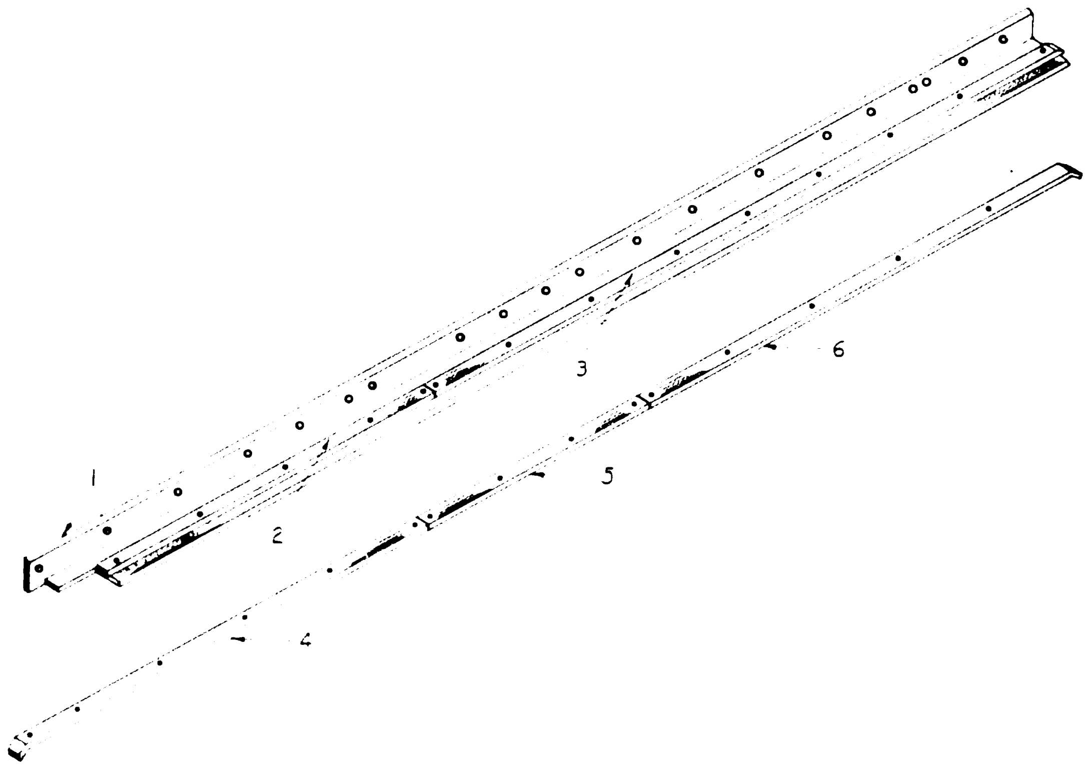


Figure 124. Conveyor wearing strips.

Assembly

Instructions for replacing the belt is as follows:

(a) Mount roll of belt to be installed as given in instruction (a) for new belt.

(b) Attach a yoke made of No. 9 wire running through lacing at end of the belt.

(c) Thread a rope thru down run side of conveyor frame around foot shaft pulley and up to head shaft.

(d) Attach rope to wire yoke on end of the belt.

WARNING: In all these operations care must be exercised in guiding the belts and a man should be available at the Master clutch at all times so the machine may be stopped instantly should the belt become fouled.

(e) Rope may be wrapped around head shaft between split steel pulleys and handled as though headshaft is a capstan for this operation.

(f) Run engine in idling speed, start conveyor.

Adjustment

Adjust the conveyor belt chains and the conveyor drive chain after the belt is connected as instructed under adjustment, "Conveyor Footshaft Overhaul."

Lubrication

If the machine is to be idle for some time the chains should be lubricated as instructed in "Preparation for Storage," Operator's Manual.

(198) Conveyor Wearing Strips

Partial Repairs—(None)

General Overhaul

When the belt is removed from the machine the wearing strips (2 to 6 inclusive), Figure 124 on the up and down run sides are exposed.

Any one or all of the five sections (2 to 6 inclusive) may be replaced.

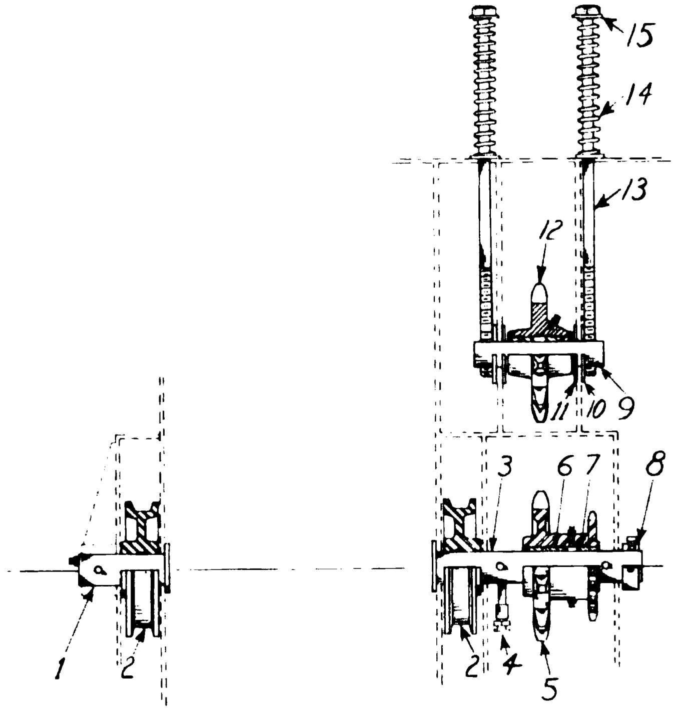


Figure 125. Conveyor drive chain takeup and pivot shaft.

Inspection for Replacement

Any section which is worn so thin that the chain rollers lose this support and the side bars ride the angles, should be replaced.

Assembly

Any section which is replaced should have new bolts.

Adjustment—(None)

Lubrication—(None)

(199) Pivot shafts and Conveyor Drive Chain Take-up

Partial Repair

Either pivot shaft (1) or (3), Figure 125 may be removed without disturbing the other. Any single disassembly operation in the Overhaul section may be performed without removing any parts except those which are to be replaced.

The conveyor frame has to be lifted for removal of either pivot shaft but not for the conveyor drive chain take up shaft.

Sprocket (12) may be reversed if the teeth become worn but the bore is O.K. This will put the alemite fitting on the side towards the operator. The drive chain does not have to be disconnected to remove this sprocket.

General Overhaul

These assemblies may be removed by the following steps:

(a) Lower spiral feed end to rest on 8″ blocks placed on the ground under the scraper and provide slack in hoist cables.

(b) Uncouple conveyor drive chain and spiral drive chain, both run on double sprocket (5).

(c) Secure sling around head end running it thru frame above take up bolts and hoist head end up until boom rollers (2) are clear of the curved track on the superstructure. The conveyor frame is now supported on the spiral end and by the sling at the head end so the Pivot shafts (1) and (3) are free for removal.

(d) Remove bolt thru pivot shaft (1) on (operators side). This stub shaft may be removed freeing flanged roller (2).

(e) Remove the two bolts one each side of sprocket (5). Remove alemite fitting and pipe which is located between flanged roller (2) and sprocket (5). This stub shaft may be removed freeing flanged roller (2) and sprocket (5).

(f) Set collar (8) may be removed if either the collar (8) or shaft (3) is to be removed.

(g) Remove bolts (13), shaft (9) will pull out releasing sprocket (12) and spacer washers (10) and (11).

Inspection for Replacement

Rollers (2) should be replaced if the bore is worn excessively or the flanges are damaged. Sprocket (5) may require rebushing to use again if the teeth are O.K.

Shafts (1) and (3) should also be replaced if worn excessively. Particular attention should be given the grease rifling in these shafts.

Sprocket (12) may be rebushed and turned around if the teeth are worn out of shape.

Threads in shaft (9) should be inspected. Spacer washers (11) should be replaced if worn so thin the sprocket has excessive end play. End play may cause both chain and sprocket to chafe.

Assembly

The assembly of these units are in all cases the reverse of the disassembly operation.

Lubrication

Lubricate all points of these units before the machine is put into operation.

(200) Conveyor Head Shaft

Partial Repairs

Some repairs may be made without removal of the head shaft (10a), Figure 96.

Sprocket (12), Figure 126, bearings (3) and take up bolts (5) are the parts which may be removed.

Sprocket (12) may be removed after the drive chain is taken off the sprocket.

Bearings (3) may be taken off the shaft by the following steps: Loosen conveyor belt, remove drive chain, take off sprocket (12) and collar (2). Pry up the shaft and the bearings (4) may be pulled off.

The assembly of any of these parts is the reverse of the disassembly operation.

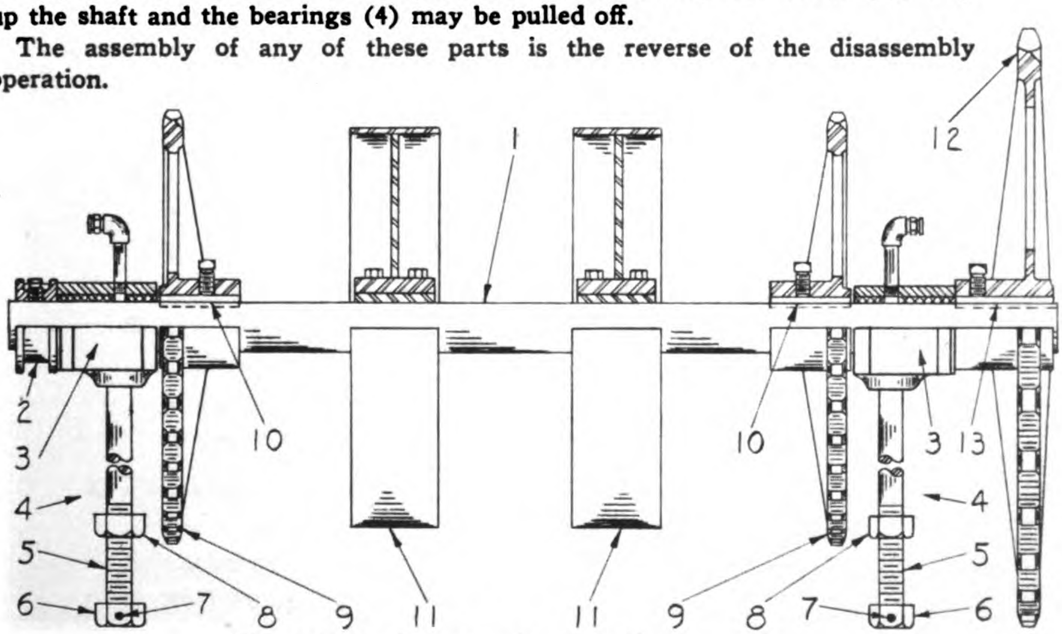


Figure 126. Conveyor head shaft.

General Overhaul

The headshaft may be removed by the following steps:

(a) Remove plates which bolt to take-up bearing guide angles.

(b) Remove angles which bolt to discharge hood and ends of take-up guide angles.

(c) Run belt until lacing is at the head sprocket.

(d) Loosen take-up bearings and force headshaft back towards feeding end as far as possible.

(e) Uncouple conveyor belt chains.

(f) Pull out belt lacing rocker pins towards operator's side.

(g) Head shaft assembly (1), Figure 126 may now be pulled to end of take-up guide angles and lifted out.

(h) Remove bolts from hubs and rims of split steel pulleys (11). Pulleys and bushings may now be removed.

(i) Remove collar (2) and sprocket (12).

(j) Bearings (3) may now be taken off shaft.

(k) Removing sprockets (9) completes stripping of the shaft.

Inspection for Replacement

The bearings and shaft should be replaced if worn excessively. Sprockets (9) and (12) should be examined for tooth wear.

Sprockets (9) may be interchanged if the teeth are worn but the sprocket is otherwise O.K.

Pulleys (11) are subjects to very little wear, however, they should be examined and if corroded, cleaned and painted.

The take-up bolts should not be bent and the threads should be in good condition.

Assembly

The assembly of the head shaft is the reverse of the disassembly operation.

Adjustment

Adjust the conveyor belt chains and elevator drive chain after the assembly of the head shaft is completed and the belt is connected.

Lubrication

Lubricate bearings thoroughly before the machine is put into operation.

Engine Maintenance

Chapter XXV.—Specifications, Tolerances, Tools and Equipment, Hints for the Mechanic.

Chapter XXVI—General Overhaul, Steps for Disassembly.

Chapter XXVII—Inspection and Repair of Engine.

1. Camshaft and Camshaft Bushings—Thrust Collar.
2. Crankcase, Valve Seats, Valve Guides.
3. Crankshaft.
4. Cylinder Head and Manifold.
5. Flywheel and Bell Housing.
6. Gears.
7. Main Bearings.
8. Piston and Connecting Rod Assembly.
9. Sheet Metal.
10. Timing Gear Housing and Front Support.
11. Valves and Bracket Assembly—Valve Grinding.

Chapter XXVIII—Inspection and Repair of the Component Systems and their Accessories.

1. Cooling System
   - A. Water Pump
   - B. Fan and Belt
   - C. Radiator
   - D. Thermostat
     Temperature Gauge
2. Electrical Group
   - A. Starting System
     - a. Starting Motor
     - b. Magnetic Switch
     - c. Battery
     - d. Starting Switch
     - e. Push Button
   - B. Generating System
     - a. Generator
     - b. Control Unit or Voltage Regulator
     - c. Ammeter
   - C. Ignition System
     - a. Distributor
     - b. Ignition Coil
     - c. Spark Plugs
3. Fuel System
   - A. Air Cleaner
   - B. Carburetor
   - C. Fuel Pump
   - D. Gas Tank

Chapter XXV

Engine, Specifications, Tolerance, Tools and Equipment and Hints for the Mechanic

Buda Engine, Model HP-217

TYPE—Vertical—en-bloc "L" head, four cycle, four cylinder.

SIZE—Bore 3 13/16 in. (96.8 mm.)
Stroke 4¾ in. (120.6 mm.)

PISTON DISPLACEMENT—217 cu. in.

ROTATION—Clockwise, viewing from front or the fan end of the engine.

POWER—

N. A. C. C. rating	23.2
B. H. P. at 1000 R. P. M.	27.5
B. H. P. at peak	54.5
R. P. M. at peak of brake H. P.	2400
Torque in foot lbs. at peak	146
R. P. M. at peak of torque	1200
B. H. P. at peak of torque	33.5

SUSPENSION—3 point.

IGNITION—Battery.

SPARK PLUGS—Standard Metric 18 mm. thread AC 87.

CARBURETOR FLANGE—S. A. E. 1¼ in.

LUBRICATION—Force feed pressure to all crankshaft, camshaft, and connecting rod bearings and to piston pin bearings. Distribution effected through holes rifle drilled in crankshaft (no loose oil pipes). Oil pump drives directly from the rear end of the camshaft. Constant oil bath at the point of gear contact on the timing gears.

CAPACITIES—
Crankcase oil capacity—5½ quarts.
Cooling system capacity—4½ gallons.
Air Cleaner oil capacity—1 quart.

COOLING—Centrifugal pump driven from accessory drive shaft. Pump shaft of stainless steel.

CRANKSHAFT—3 inch diameter, statically and dynamically balanced. Special open hearth No. 1045 S. A. E. steel forging, heat-treated. Number of bearings—5.

CRANKCASE—CYLINDERS—
One-piece Ni-Chrome semi-steel casting.
Crankcase divided horizontally three inches below crankshaft center.
Removable cylinder head.

CONNECTING RODS—
Special open hearth steel. Heat treated. I-beam sections are drilled out through entire length for lubrication. Length, center to center—9½ in.
Diameter of connecting rod bolts—7/16 in.
Number per rod—2.
Babbitt is "spun in" in the large end of rod.
Phospher bronze bushing at the wrist pin end.

CAMSHAFT—
Open hearth steel, case hardened.
Gear driven.
Number of bearings—3.

PISTONS—Four rings—lower ring is an oil control ring.
Gray iron, length 3¾ in.

(continued on next page)

(Engine Specifications Cont'd)

PISTON PINS—Open hearth alloy steel, 1⅛ in.

VALVES—Inlet valves—clear diameter 1½ in.—chrome nickel steel.
Exhaust valves—clear diameter 1⅜ in.—silchrome, No. 1 steel.

VALVE LIFTERS—Mushroom type—No. 1045 S. A. E. steel body with chilled white iron head.

TIMING GEARS—Four helical gears, 1 in. wide; namely, crank gear, idler gear, cam gear, and accessory drive gear.

CRANKSHAFT BEARINGS—
- Bronze shell—babbitt lined—precision type.
- Diameter—
  - Front, 3 in. (76.2 mm.).
  - Intermediate, 3 in. (76.2 mm.).
  - Center, 3 in. (76.2 mm.).
  - Rear, 3 in. (76.2 mm.).
- Length—
  - Front, 1½ in. (38.1 mm.).
  - Intermediate, 1$\frac{1}{16}$ in. (27.0 mm.).
  - Center, 2 in. (50.8 mm.).
  - Rear, 2⅛ in. (54.0 mm.).

CAMSHAFT BEARINGS—
- Diameter—
  - Front, 2⅛ in. (54.0 mm.).
  - Intermediate, 2⅛ in. (54.0 mm.).
  - Rear 1½ in. (38.1 mm.).
- Length—
  - Front, 1⅜ in. (34.9 mm.).
  - Intermediate, 1 in. (25.4 mm.).
  - Rear, 1$\frac{1}{16}$ in. (27.0 mm.).

CONNECTING ROD BEARINGS—
- Diameter 2⅛ in. (54.0 mm.).
- Length, 1⅝ in. (41.3 mm.).

PISTON PIN BEARINGS—
- Diameter, 1⅛ in. (28.6 mm.).
- Length, 1¼ in. (31.8 mm.).

BASE—Cast iron front and rear supports.

Nominal Clearances for the HP-217 Engine

Fits and Clearances

The clearances given in the left-hand column are maintained at the factory in new engines. The clearance given in the right hand column are the maximum permissible clearances before the various parts should be replaced. Judgment must be used when the clearances do not exceed the permissible maximum but are close thereto. If, in the opinion of the mechanic, the wear will exceed the maximum permissible before the next overhaul period, the part must be replaced.

New or Desired	Allowable
Piston to cylinder clearance: Fit piston with 6 to 10 lb. pull on .003 x ½ in. feeler gauge	.009
Compression ring gap: .009/.014	
Oil ring gap: .009/.014	
Piston pin in piston: .00025/.00045	.001

Fits and Clearances (cont'd)

New or Desired	Allowable
All ring to groove clearance:	
Top—.0015/.003	.005
2nd and 3rd—.001/.0025	.004
Oil—.001/.0025	.004
Piston pin to rod bushing:	
.00025/.00045	.002
Crankshaft end play:	
.003/.009	.015
Main bearing clearance:	
.002/.0042	.006
Connecting rod side clearance:	
.004/.009	.012
Connecting rod bearing clearance:	
.0015/.003	.005
Camshaft bearing clearance:	
.001/.0045	.007
Camshaft end play:	
.003/.009	.015
Idler gear end play:	
.004/.007	.015
Idler gear to stud:	
.002/.0035	.005
Crank, cam, and idler gear backlash:	
.0005/.0015	.010
Valve stem to guide:	
Intake, .002/.0035	
Exhaust, .002/.004	.006
Tappet adjustment (set hot):	
Intake, .006	
Exhaust, .009	
Valve lifter or tappet fit to guide:	
.00125/.00025	.002
Oil pump gears backlash:	
Not over .002	.005
Oil pump gears to case:	
.002/.003 on a side	.005
Oil pump gears to case flange:	
Flush	.001
Spark plug gap:	
.025	
Distributor point gap:	
Water pump shaft to bushing:	
.002/.003	.005

Tools and Equipment Needed

Tools

Socket Wrenches

½ inch, 9/16 inch, ⅝ inch, ¾ inch, and 13/16 inch.

An 18 inch breakover handle.

A 12 inch extension.

Open End Wrenches

5/16 inch, ⅜ inch, 7/16 inch, ½ inch, 9/16 inch, ⅝ inch, 11/16 inch, ¾ inch.

Tools (cont'd)

Pipe Wrench

One 18 inches long.

Screw Drivers

One ¼ inch blade, one ⅜ inch blade, one ¾ inch blade. (Note: the ¾ inch blade is for the front support plate screws; a drag link socket can be used instead.)

Pliers

One diagonal, one flat nose.

Hammer

Medium size, ballpeen.

Lead hammer.

Pin Punches

One set 3/16 inch to ½ inch.

Chisels

One set, medium size.

Miscellaneous Tools

Valve lifter, putty knife, feeler gauge, piston ring compressor, gear puller, and machinists square, stub valve lifter, and valve grinder.

Accessories

Description	Buda Part No.	Manufacturer	Mfr's Model No.
1. Air Cleaner	A-6563	Donaldson Co., Inc. St. Paul, Minn.	A-5329
2. Starter	2734	Delco-Remy Anderson, Ind.	1107421
3. Generator and Voltage Reg.	H-12175	Delco-Remy Anderson, Ind.	1101671
4. Distributor	3884	Delco-Remy Anderson, Ind.	629-N
5. Governor	H11925	Pierce-Governor Co. Anderson, Ind.	A-1728E
6. Carburetor	H11385	Zenith Carburetor Div. Detroit, Mich.	124-½TOX
7. Oil Filter	H11676	DeLuxe Products Corp. La Porte, Ind.	CUL
8. Fuel Pump	H-12170	A-C Spark Plug Div. General Motors, Flint, Mich.	1523621
9. Coil	1755	Delco-Remy Anderson, Ind.	528-C
10. Magnetic Switch	AP-6297	Delco-Remy Anderson, Ind.	001453
11. Ammeter	AP-6592	U. S. Gauge Co. New York, N. Y.	30-30
12. Push Button Starter Switch	AP-3696	Leece-Neville Co. Cleveland, Ohio	103-SS
13. Key Switch	3998	Briggs-Stratton Co. Milwaukee, Wis.	404224
14. Pressure Gauge	AP-3883	U. S. Gauge Co. New York, N. Y.	60#
15. Temperature Gauge	DP-594	Stewart-Warner Corp. Chicago, Ill.	692-B
16. Spark Plugs	H-11629	AC Spark Plug Div. General Motors, Flint, Mich.	#87
17. Radiator	AP-6079	Yates American Machine Beloit, Wis.	

Equipment

Chain hoist, (1 ton) work bench and vise, valve refacer, and valve reseater, (if the latter two are not a part of the regular equipment, new valves can be ordered and the seats ground at a machine shop), cylinder grinder, piston pin hone, or reamer, small lathe, cylinder hone, connecting rod aligner.

Ammeters
- One, range 0 — 600 amperes.
- One, range 0 — 30 amperes.

Voltmeter
- Range 0 — 10 volts

Electrical Test Equipment
- Test light, storage battery with cables, and a spring balance 0 to 100 lbs.

Micrometer
- Outside — 2 inches to 3 inches
- Outside — 3 inches to 4 inches
- Inside — ½ inch to 6 inches

Tachometer
- Range 50 to 10,000 R.P.M.

Carburetor Tools

The following tools can be obtained from the Zenith factory and are needed for overhauling the carburetor.

T30016 Fuel Valve Seat, assembly bolt and lower plug wrench. C 161-2 Valve tool — C 161-5 Extractor — C 161-9 (782932) idle jet wrench — C 161-25 (15517) cap jet wrench — C 161-81 (15522) main jet wrench — (30137) driver.

Hints for the Mechanic

1. Keep tools in efficient working order.
2. Good "housekeeping" in the shop saves time.
3. Never guess — always investigate the source of trouble.
4. Use the proper measuring gauges and electrical test meters — guessing is not accurate enough.
5. Every part, no matter how small, has a job to perform — don't overlook the smallest detail.
6. Carefully handle and store bearings and parts with machined surfaces, so as to prevent damage either by scratching or by falling objects.
7. Always use new gaskets. Whenever a piston, or pistons, are removed, replace the rings if they are more than 100 operating hours old, for it would be impossible to place the rings back in exactly the same position they "wore in".
8. Provide clean boxes for small parts, capscrews, and bolts, — never strew them on the bench or floor.
9. Don't send an engine "back to work" until you are certain that the engine and its accessories are in good working order.

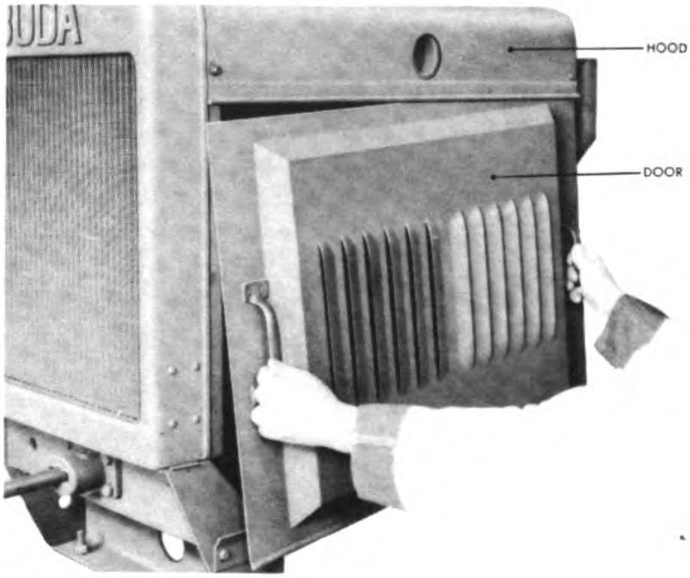


Figure 127. Removing Sliding Doors and Sills.

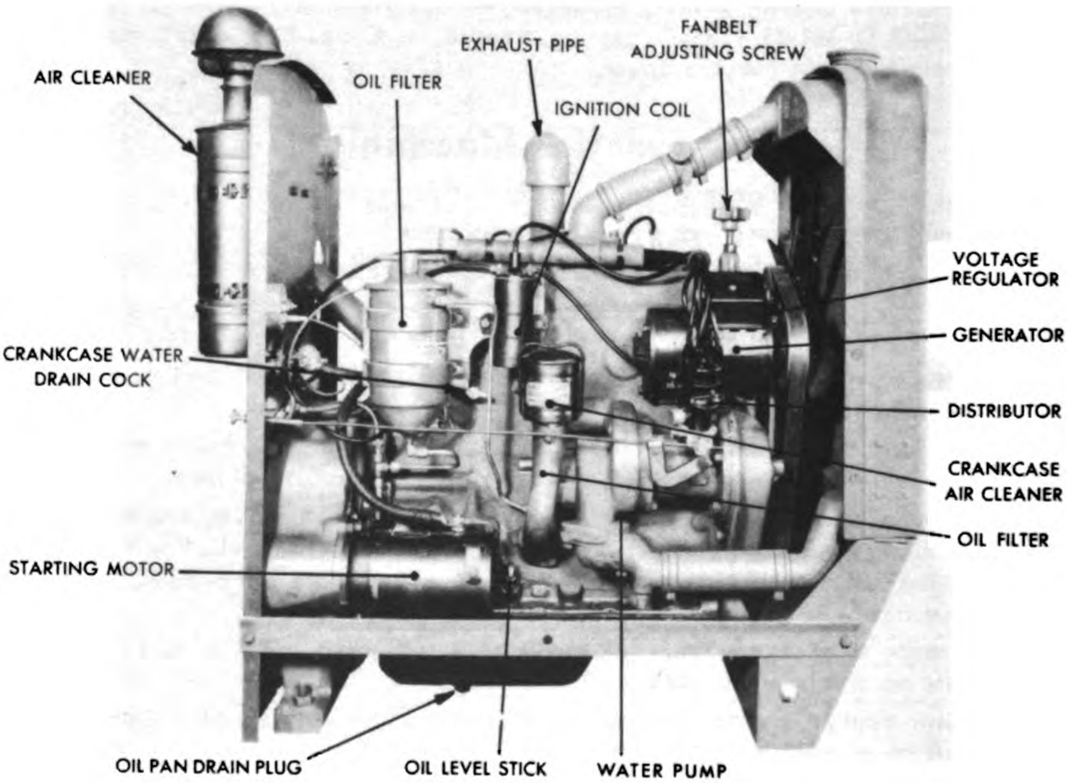


Figure 128. Right Side of Engine.

Chapter XXVI
Engine, General Overhaul

In this chapter, the necessary steps for a general overhaul will be considered in their recommended sequence. It is obvious that where it becomes necessary to repair the engine due to an accident to one or more of the parts all these steps may not apply.

And it is also pointed out that before the general overhaul, there are four servicings that the maintenance repair man will have to give the engine after every 1024 hours of operation. They are grinding valves, checking the voltage regulator, the magnetic starting switch, and visually checking the engine and its accessories. The procedures for these servicings are given under the items involved, Valves (Chapter XXVII). Voltage Regulator and Magnetic Switch (Chapter XVIII).

The general overhaul should take place after every 2048 hours of operation when the engine and its accessories should be disassembled completely and any worn parts replaced. If this disassembly and inspection results in only a thorough cleaning of the engine and its accessories, much will have been gained in lengthening the engine life and enable it to give trouble-free performance.

STEPS OF DISASSEMBLY

The following steps are the recommended sequence of disassembly:

(201) Draining Engine

Remove the two sliding doors, exhaust pipe, figure 127 and the two steel strips that connect the front to the back panel; drain oil, gasoline, and water from the engine. Remove the drain cocks from the side of the engine and bottom of water pump. See figure 128.

(202) Removing Clutch

See Paragraph 178, (f) to (i) inc.

(203) Removing Power Unit

To remove the power unit from the substructure without removing the clutch and the transmission follow steps a to e inc. paragraph 178.

The clutch and transmission may be removed before or after the power unit is removed by following additional steps f to i inc. paragraph 178.

After steps a to e inc., Par. 178 are completed remove bolts (8) figure 97 from both ends of structural angles and the stop plates on top of the substructure channels at radiator end.

Uncouple battery cables, gasoline line and remove exhaust pipe.

Crib up alongside the loader with timbers, in line with the power unit at the radiator end. Pipe rollers may be used under the structural angles (7) to facilitate moving the power off the substructure on to the cribbing.

(204) Disconnecting Electric Wires, Cables, etc.

Disconnect the electric wires, cables, oil pressure line, gasoline line, governor link rod, and all control cables and wires leading from the operator's control panel to the engine. Fig. 129.

(205) Removing Fuel Pump

Take off the two capscrews that hold the pump to the engine, and remove the fuel pump. See figure 130.

(206) Removing Air Cleaner

Loosen hose connections at the carburetor. Remove the four capscrews that hold the air cleaner to the instrument panel and take off the air cleaner and tube. See figure 130.

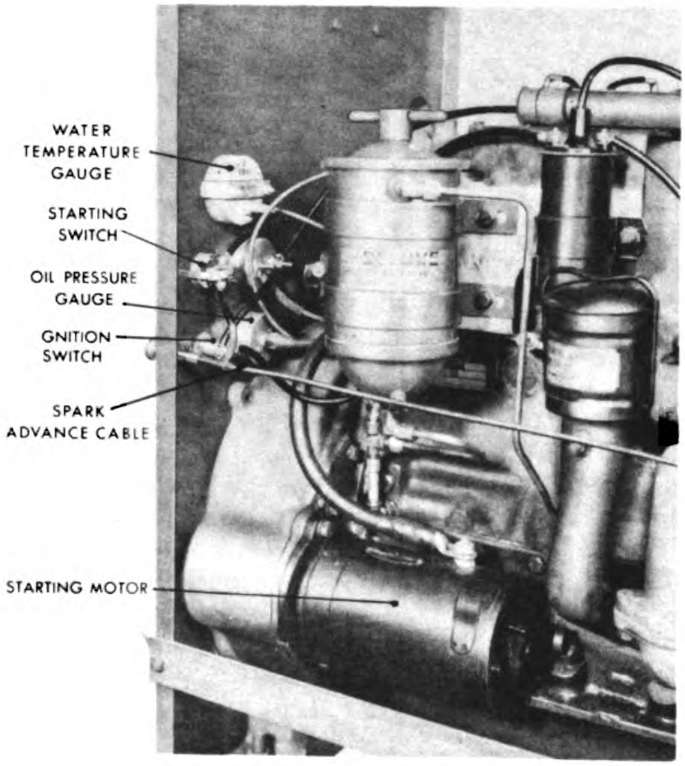


Figure 129. Disconnecting Wires, Cables, etc.

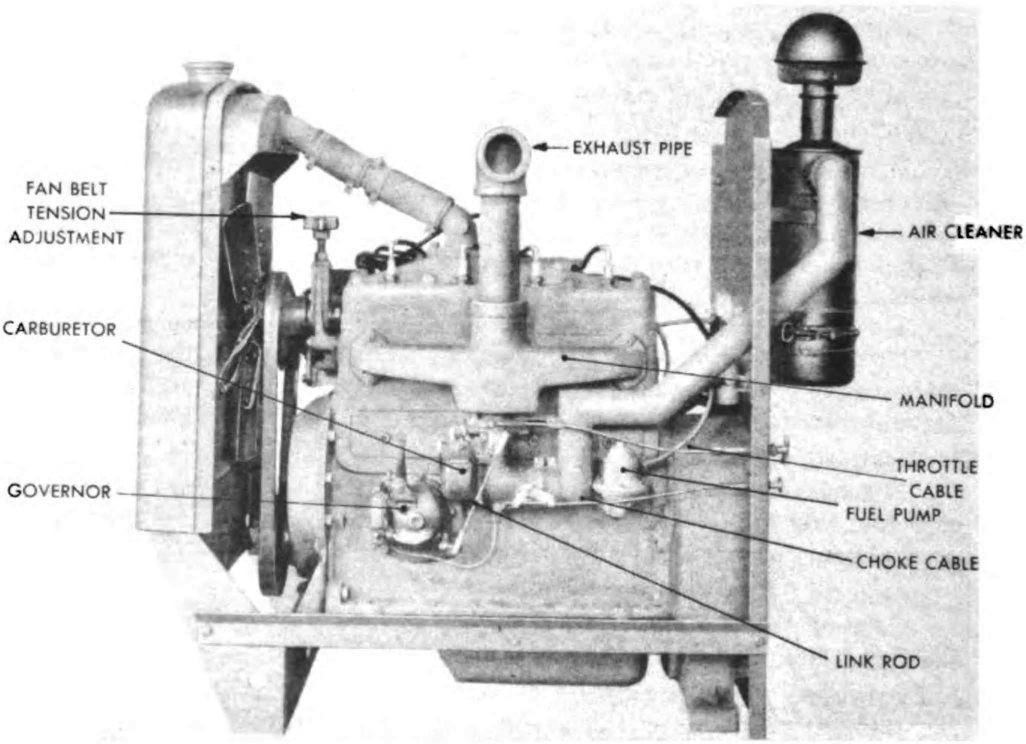


Figure 130. Left Side of Engine.

(207) Removing Hood, Gas Tank, and Rear Panel

Remove the four capscrews that fasten hood to radiator frame. Remove the four capscrews that hold the rear panel to the flywheel housing and remove the hood, gas tank, and rear panel as a unit.

(208) Removing Radiator

Loosen all hose connections. Remove the two nuts that hold the radiator to the base, see figure 131, pry up the radiator until the studs clear the holes and pull off the radiator with hose attached.

(209) Lifting Engine From Chassis

The engine head is provided with a tapped ¾" hole, National Coarse threads to permit inserting an eye screw for lifting the engine with a hoist. If you plan to use an assembly stand, remove the bolts (two at front of sill under radiator; two that bolt the flywheel at the rear) figure 132 and lift the engine with a hoist onto the assembly stand. See figure 133.

However, if assembly stand is not available and you intend to use a flat platform stand, it will be necessary to block up the front of the engine in order to remove the sill to which the front is bolted. Following are the steps:

a. Remove the two vertical bolts and nuts that tie the engine to the front support. See figure 132.

b. Remove the two square nuts that hold the flywheel housing to the chassis. See figure 128.

c. Lift the engine with a hoist removing the front sill which should be blocked up with lumber before setting the engine down on the platform stand. See figure 134.

(210) Removing Fan Assembly

Loosen the vertical setscrew. Remove the axle adjusting nut and spacer. See figure 135. Loosen the generator capscrew that holds the bracket to the fan support, figure 136, and pull off the fan assembly.

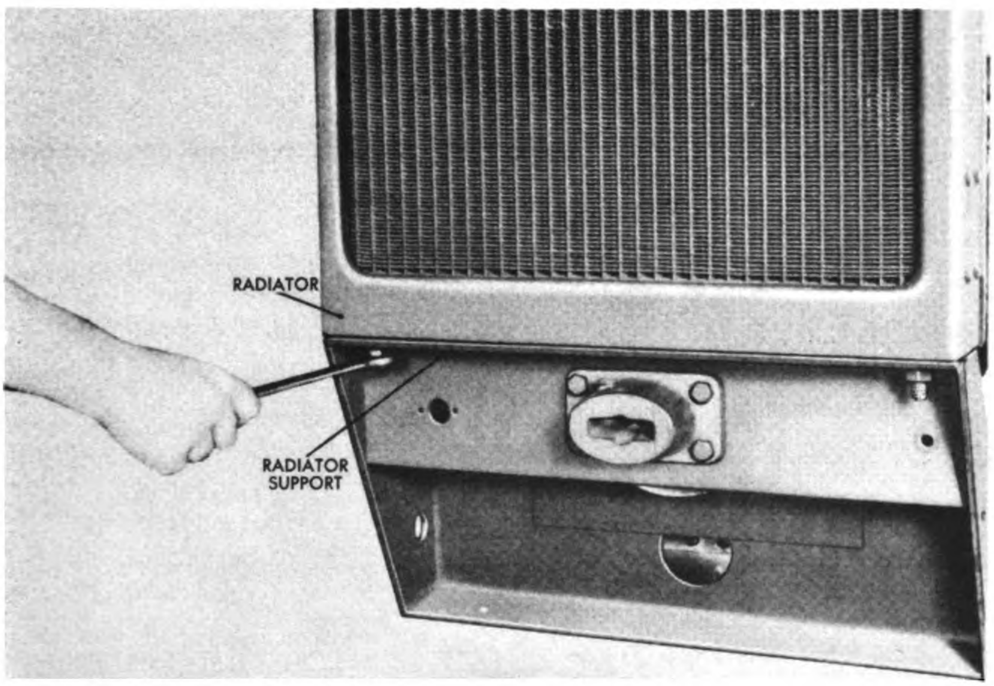


Figure 131. Removing Radiator

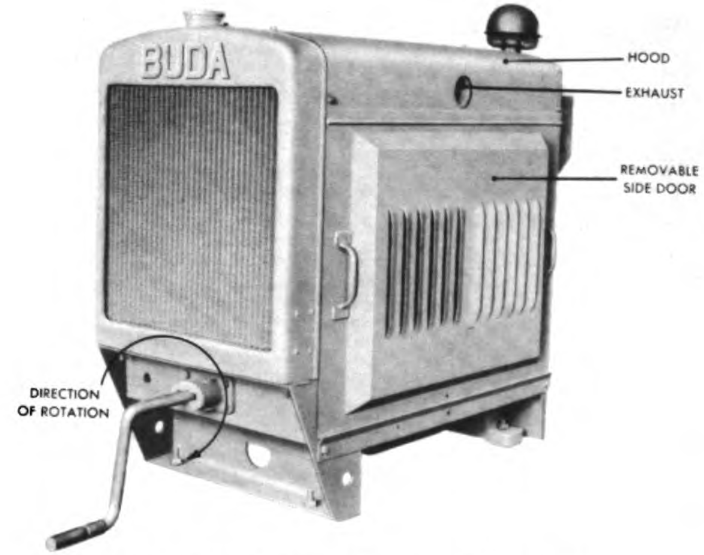


Figure 132. **Engine Enclosed in Metal.**

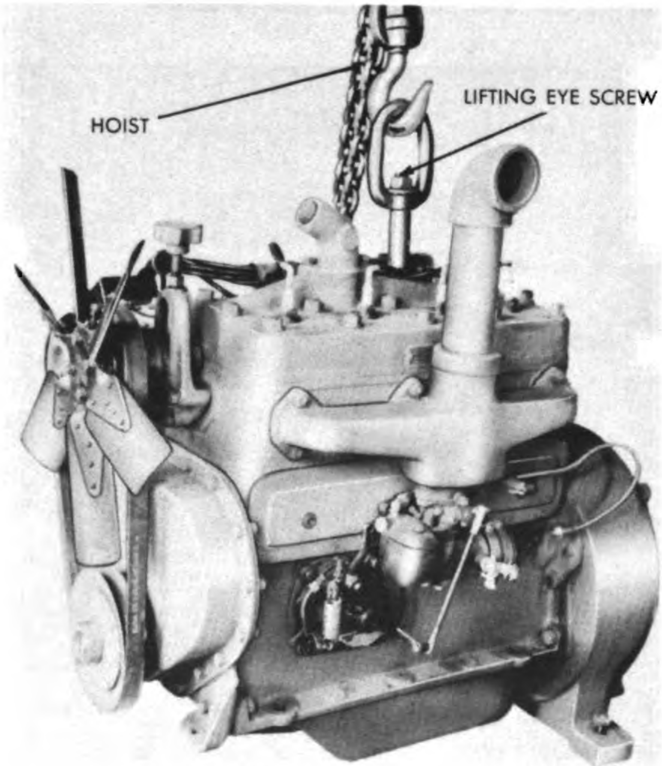


Figure 133. **Lifting Engine with Hoist.**

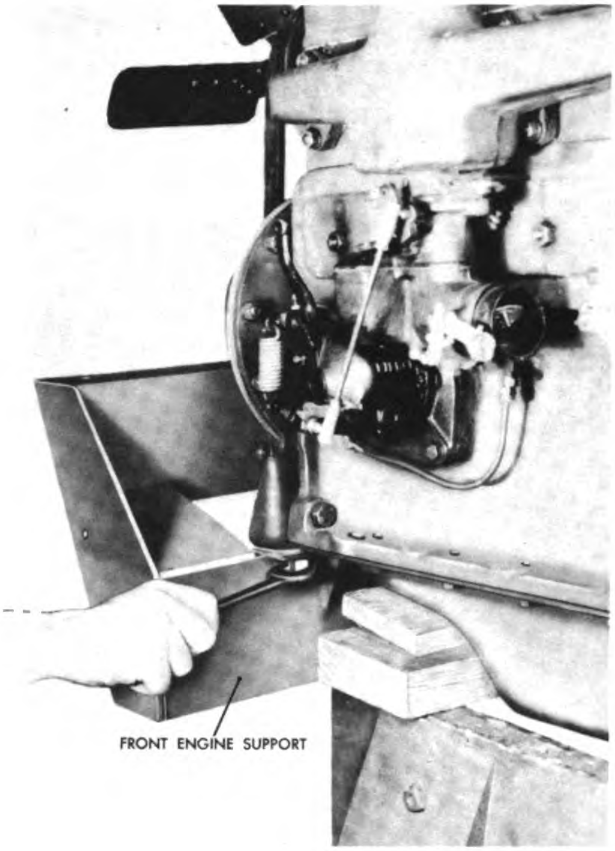


Figure 134. Removing Front Sill.

(211) Removing Accessories

a. OIL BREATHER TUBE
Remove the two capscrews. See figure 129.

b. STARTER MOTOR
Remove the two capscrews. See figure 129.

c. OIL FILTER, COIL, AND BRACKET
Oil filter, coil, and bracket should be kept intact by removing as a unit. Remove the bolt and nut that holds up the steel bracket that runs from the engine to the big bracket. See figure 137. Then remove the two cylinder head nuts and the two caps that hold the cable tube in place. Then pulling off the oil filter, coil, and bracket which can be disassembled on the bench.

d. REMOVING DISTRIBUTOR
Remove the distributor by removing the capscrew that holds the distributor gear shaft in the engine well and pull off. Loosen set screw holding bracket and take off. See figure 128.

e. REMOVING GENERATOR
Remove generator by taking off the two caps that hold it to the generator bracket. See figure 136.

f. REMOVING WATER PUMP AND INLET CONNECTIONS
Remove the two capscrews at the water inlet and the five capscrews that go into the gear housing, and take off the complete unit. See figure 138.

g. DISCONNECTING GOVERNOR LINK FROM THROTTLE
Loosen small hexagon swivel stud nut as pictured in figure 139.

h. REMOVING GOVERNOR ASSEMBLY
Remove the governor assembly by taking off the four stud bolts that hold it to the crankcase. See figure 133.

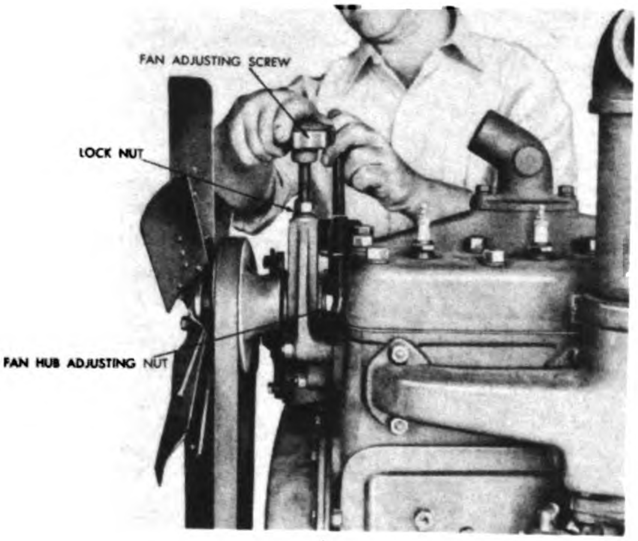


Figure 135. Removing Fan Assembly.

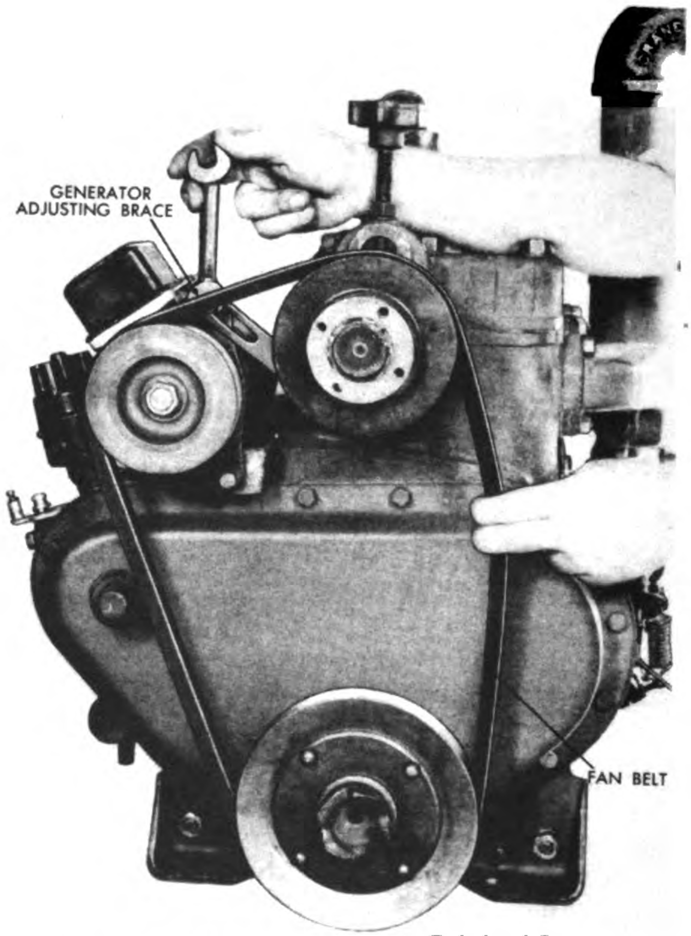


Figure 136. Loosening Generator Bracket.

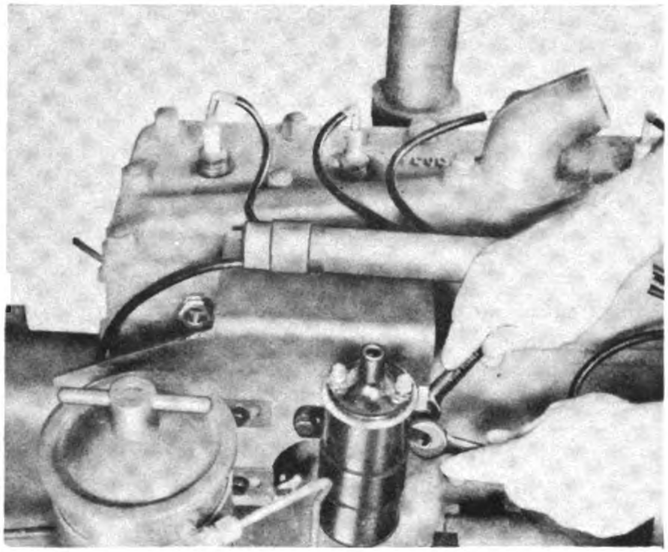


Figure 137. Removing Oil Filter, Coil and Bracket Assembly.

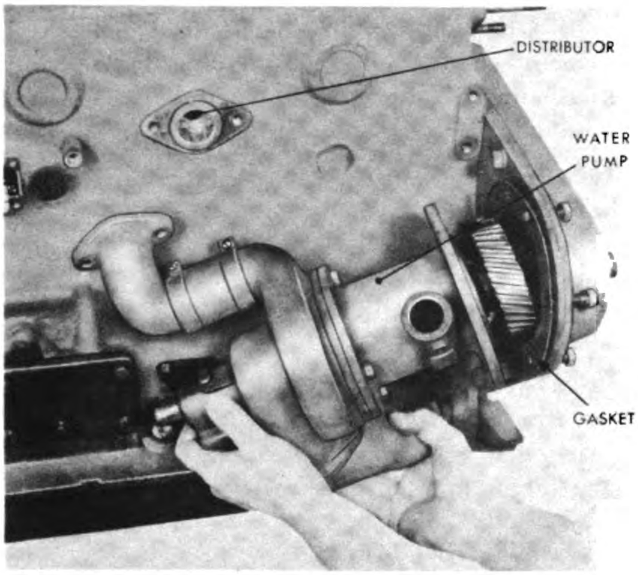


Figure 138. Removing Water Pump and Inlet Connections.

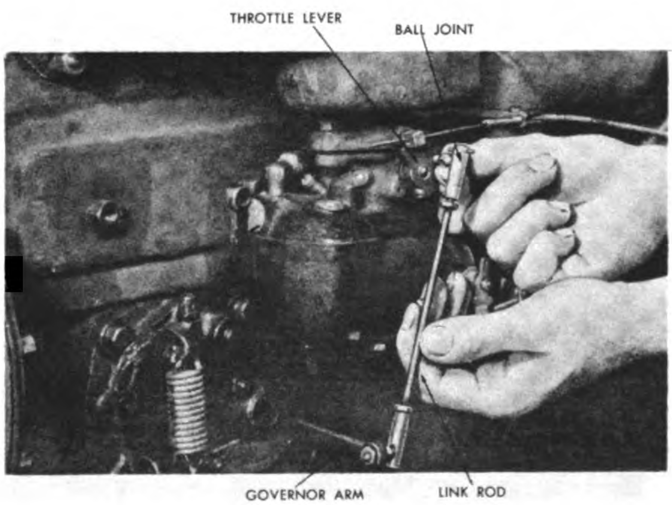


Figure 139. Disconnecting Governor Link from Throttle.

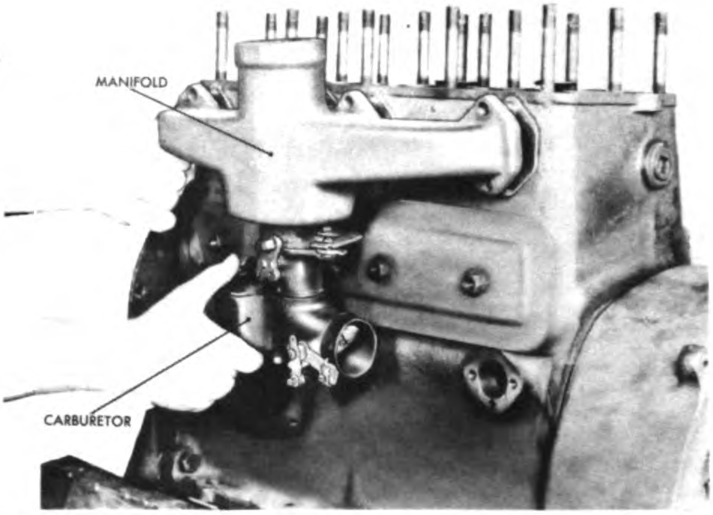


Figure 140. Removing Manifold and Carburetor.

(212) Removing Manifold with Carburetor

Remove nuts that hold manifiold to engine and lift off the manifold with carburetor attached. The carburetor can be disassembled on bench. See figure 140.

(213) Removing Cylinder Head

Remove the cylinder head by taking off the nuts on the top of the engine.

(214) Valve Chamber Cover

Remove the four cone-shaped nuts.

(215) Removing Valve Chamber Baffle Plate

Pull off each of the two metal baffle plates. See figure 141.

(216) Removing Valve Lifter Bracket Assembly

Take off the two capscrews that hold the valve bracket assembly and with the fingers hold each of the lifters to prevent them from falling out of the bracket. Note: Turn the engine over until the valve springs release one lifter and pull off the valve lifter assembly. See figure 142.

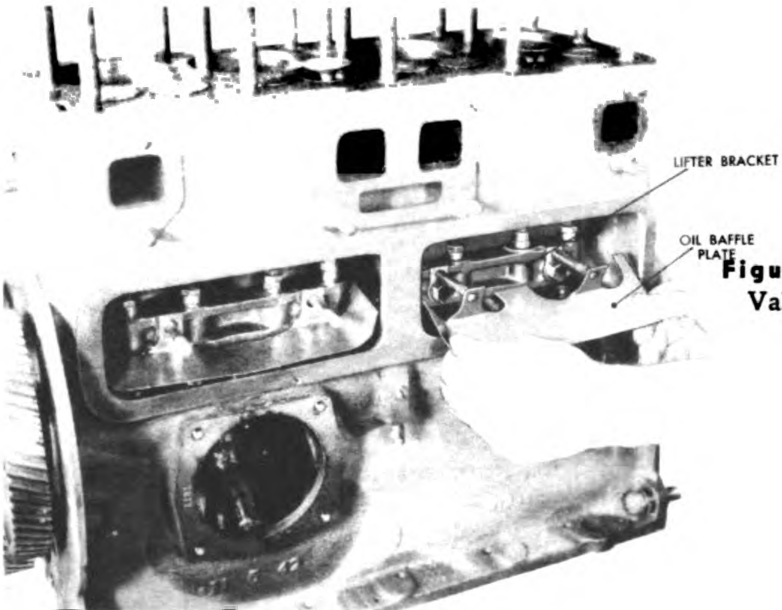


Figure 141. Removing Valve Chamber Baffle Plate.

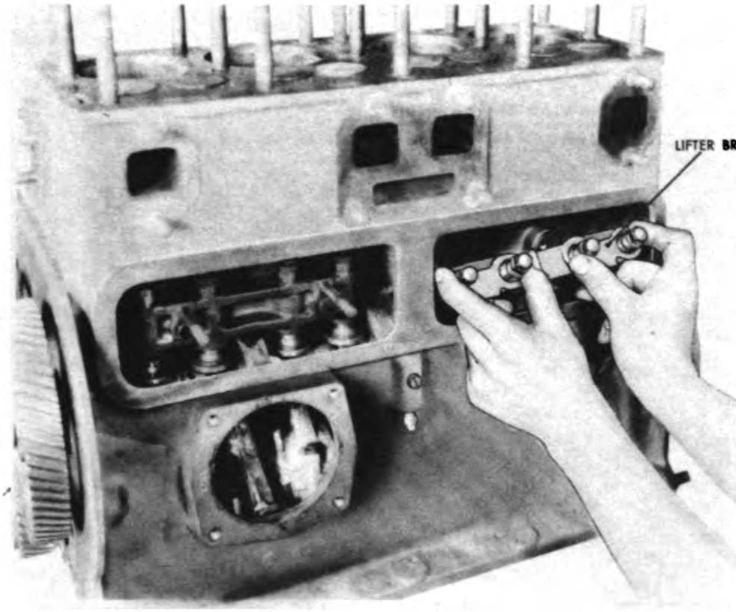


Figure 142. Removing Valve Lifter Assembly.

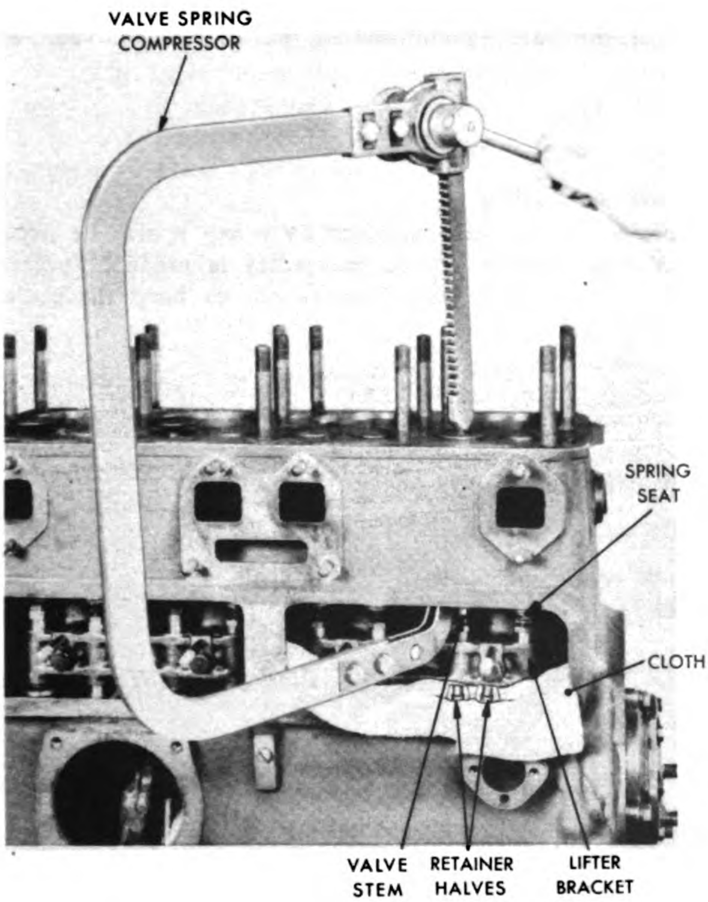


Figure 143. Removing Valves and Spring with Valve Lifter.

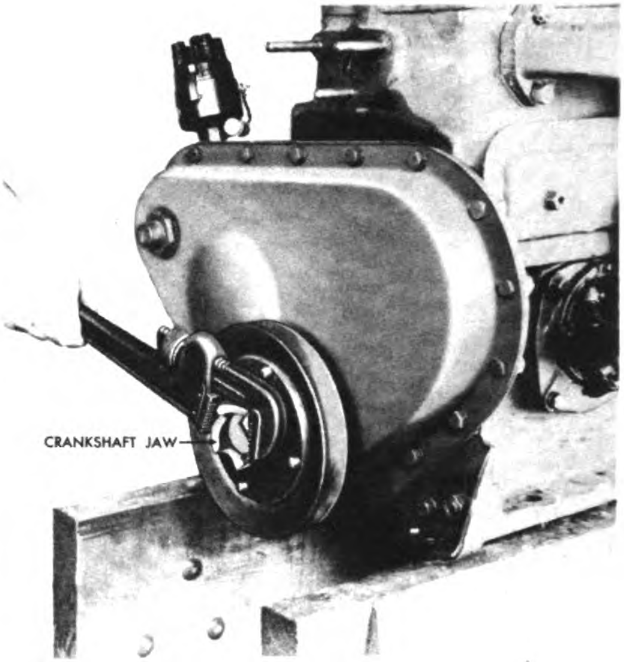


Figure 144. Removing Crankshaft Jaw.

(217) Removing Valves and Springs

Insert a valve lifter under the valve spring cup. The valve should be in a closed position. It is advised here at this point to place a cloth between the camshaft and the inside of engine to prevent the retainer halves from falling into the crankcase. Compress the valve lifter, reach in and remove the retainer halves and the balance of the valve assembly can easily be removed. See figure 143.

(218) Removing Crankshaft Jaw

With a large adjustable wrench remove as in figure 144.

(219) Removing the Fan Drive Pulley

As this pulley is pressed on and held in place by a key it will be necessary to use a wheel puller to remove. Since the pulley is made of pressed steel and bends easily care must be exercised so as not to bend the pulley. See figure 145.

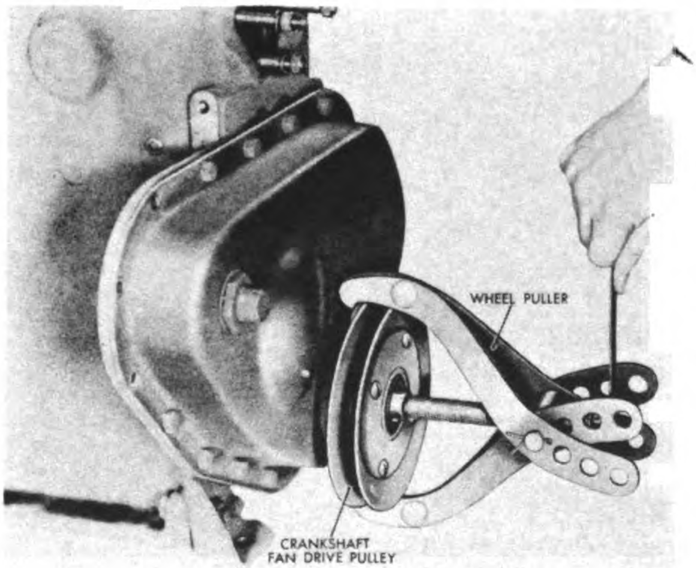


Figure 145. Removing Fan Pulley with Wheel Puller.

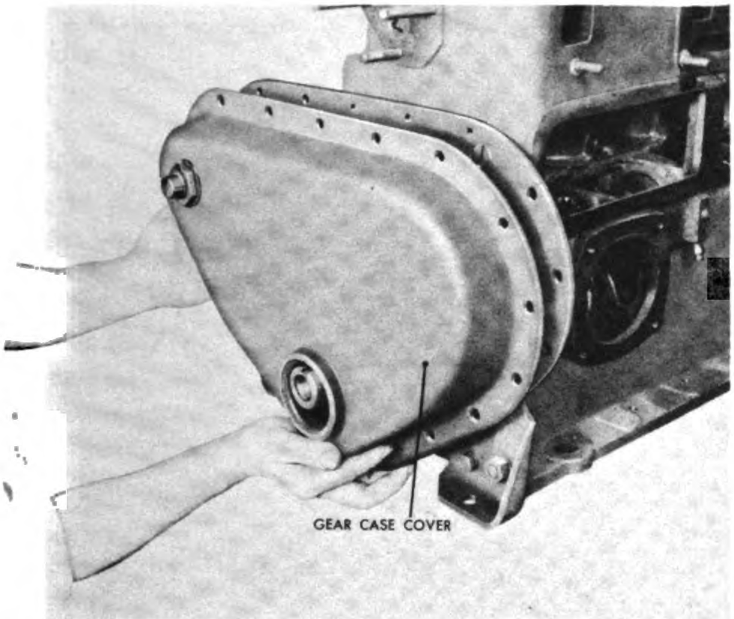


Figure 146. Removing Gear Case Cover.

(220) Removing Gear Case Cover

Remove the capscrews that hold it in place. See figure 146.

At this point it is recommended that the mechanic stop and check the gear case assembly to determine what further disassemblies or replacements are needed.

a. Check the idler gear end play by inserting a feeler gauge between the idler gear hub and the retainer washer. See figure 147. Desired clearance should be .004 maximum .007.

b. Also check for backlash between the idler gear at all three points where it meshes with the other two gears. If more than .005 of an inch replace the idler gear with an average one. Check as similar to figure 148. Now back to disassembly.

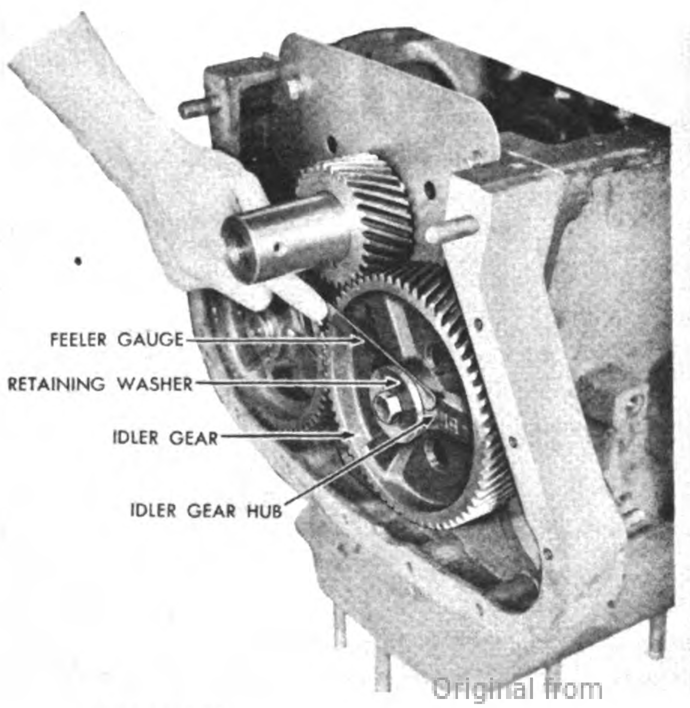


Figure 147. Checking Idler Gear End Play.

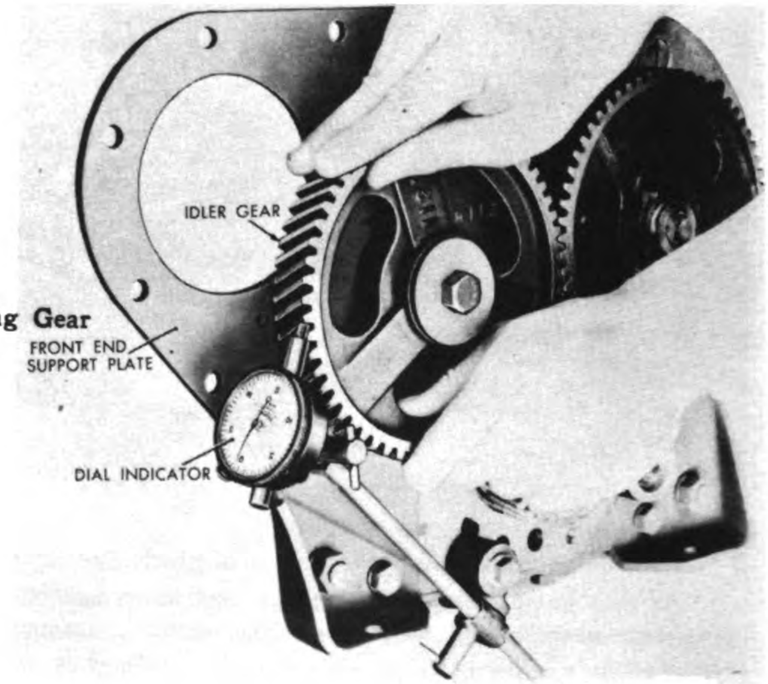


Figure 148. Checking Gear Back Lash.

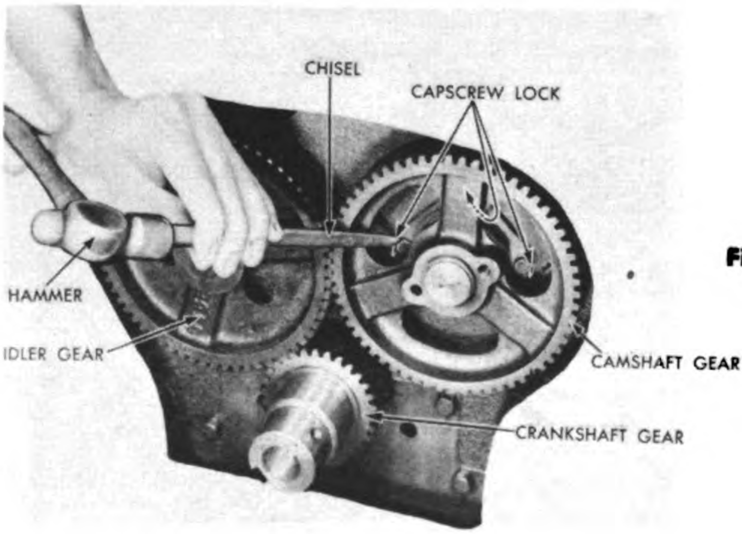


Figure 149. Removing Camshaft Capscrew Lock.

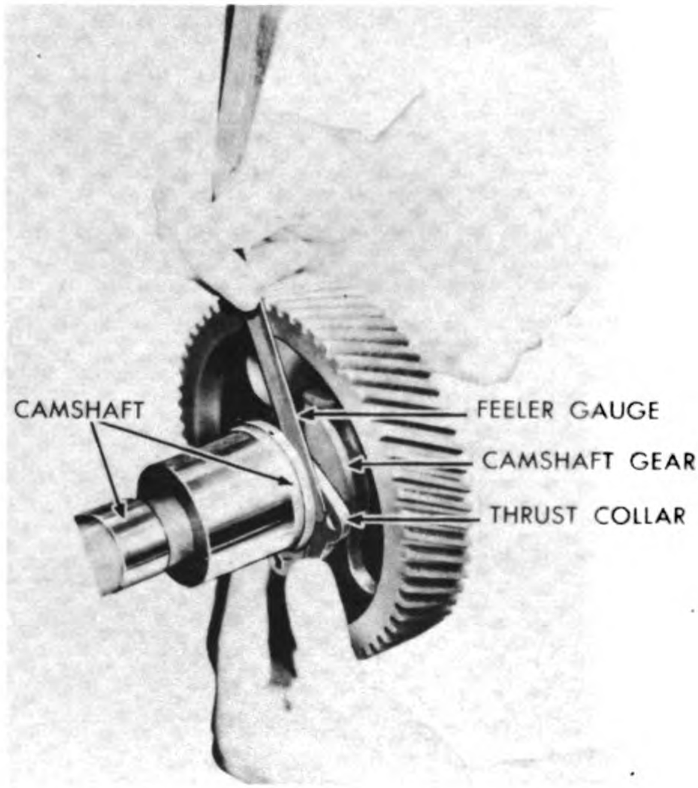


Figure 150. Checking Camshaft End Play.

(221) Removing Camshaft Gear

First, flatten out the metal plate locks around the capscrews. Figure 149. Before you pull out the camshaft, check the end play by measuring the space between the hub of the gear and the thrust collar. See figure 150. The measurement should be .003 to .009. If excessive, correct by replacing the thrust plate holding the camshaft to the crankcase. In case of necessity remove the gear from the camshaft and grind the worn surface of the gear hub smooth. When pulling out the camshaft be careful you do not damage the bearings. See figure 151.

(222) Removing Flywheel

Take off the five flywheel nuts and washers. These are thin washers so do not use them in any other place. Now note the three ½" threaded holes that have been drilled into the flywheel. Into these insert three one-half inch by four inch capscrews with 1½" of thread. Continue to screw these into the flywheel which will permit ease in removing. The capscrews can be used to lift the wheel out of the housing. See figure 152. Put the five nuts back on the flywheel threads in order to prevent injury of the threads.

(223) Removing Flywheel Housing

Take off the dowel bolts that hold the housing to the crankcase and remove the four capscrews that go into the crankcase. See figure 153.

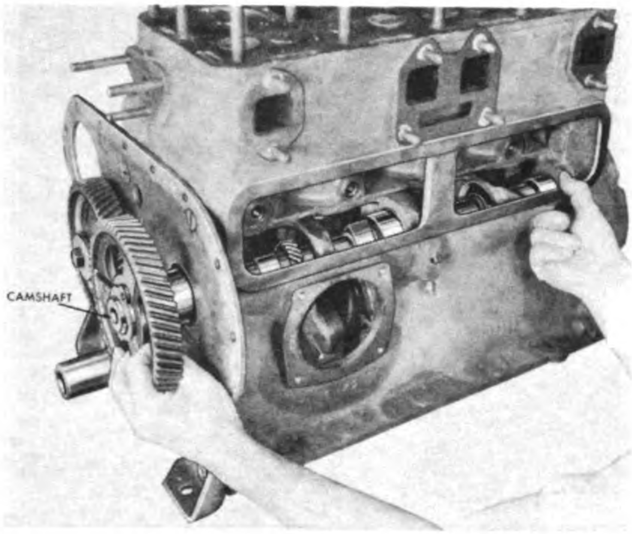


Figure 151. Removing Camshaft.

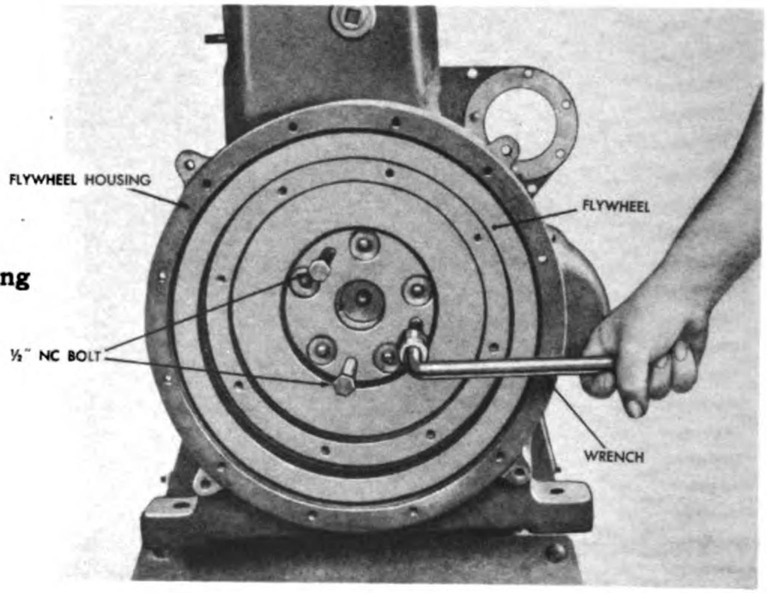


Figure 152. Removing Flywheel.

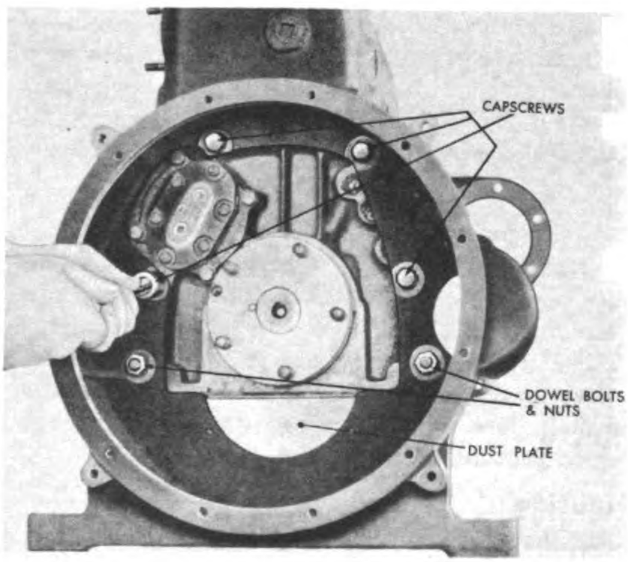


Figure 153. Removing Fly-wheel Housing.

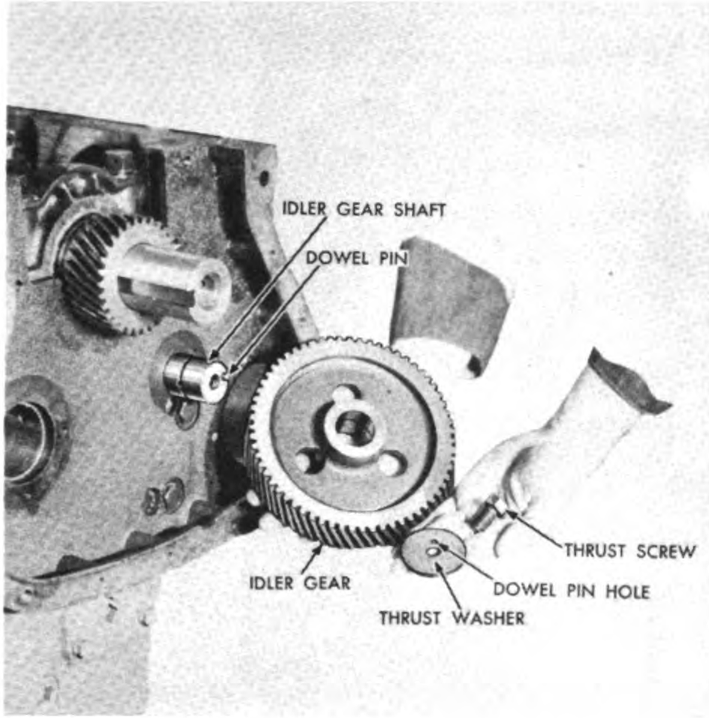


Figure 154. Removing Idler Gear.

(224) Removing Idler Gear

NOTE: The idler gear thrust screw has a left-handed thread and must be turned clockwise to remove it. See figure 154. Now remove the idler gear shaft lockscrew acorn nut located on the outside of the crankcase behind the water pump. See figure 155. Be sure and remove the lockscrew that holds the gear to the idler shaft and now with the wheel puller like the one used to install gear in crankshaft pull out the idler gear shaft. CAUTION: Be sure you do not break off the dowel pin that holds the spacer on the front of the shaft.

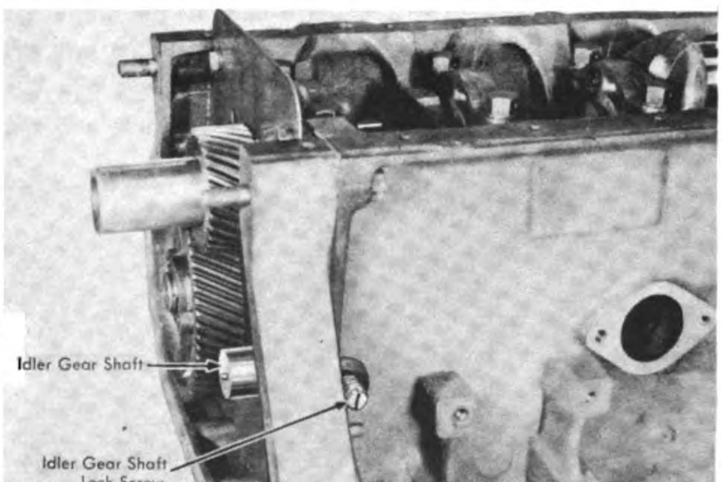


Figure 155. Removing Idler Gear Shaft Lock Screw.

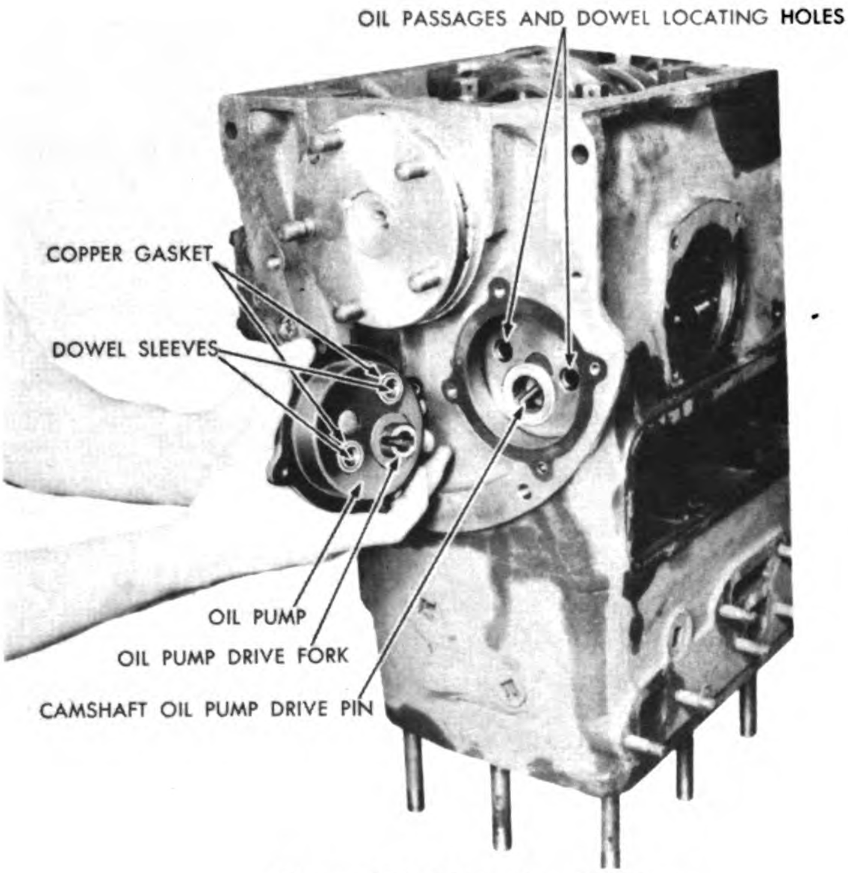


Figure 156. Removing Oil Pump.

(225) Removing Oil Pump

Now take off the oil pump as shown in figure 156.

With a chain hoist lay the engine on its right side. CAUTION: Timbers should be so laid so that both ends of the crankcase are free.

(226) Removing Oil Pan, Drain Tube, and Oil Float

Take off the screws that hold the oil pan to the bottom of the engine. With a pipe wrench remove the drain tube and then remove the oil float and bracket assembly. See figure 157.

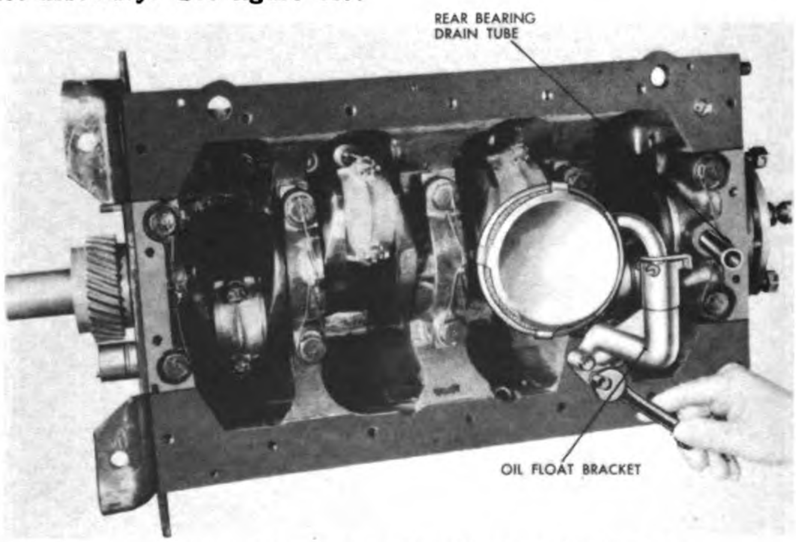


Figure 157. Removing Oil Float and Bracket.

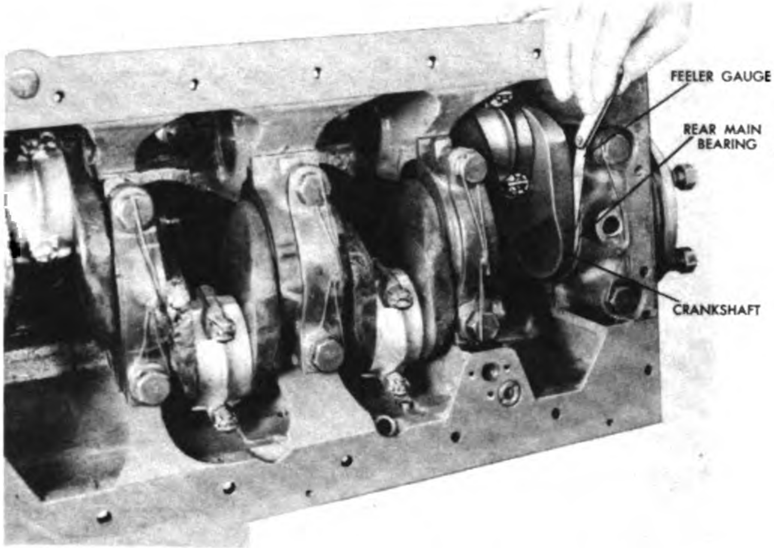


Figure 158. Checking Crankshaft End Play.

Before going further we suggest that the mechanic stop and do some more checking to see what further disassembly and replacements will be necessary.

a. Slip a feeler gauge between the end of the rear main bearing and the crankshaft. See figure 158. Run the gauge clear around the shaft. The proper clearance is .002" to .0042". If more than .0042", new rear bearing will be needed.

b. Check the connecting rod side clearance by inserting a feeler gauge between the bearing and crankshaft. Figure 159. The clearance should be .004" to .009". If there is no side play, the piston and rod must be removed and checked as follows:

Place the connecting rod cap on the crankshaft journal to see if it can be moved side ways. If it cannot, the cap and rod must be filed together. Usually a few strokes are sufficient to provide clearance. If there is side play but the movement is not free when tapping the cap and rod, there is either dirt on the bearing or the bearing is of improper size.

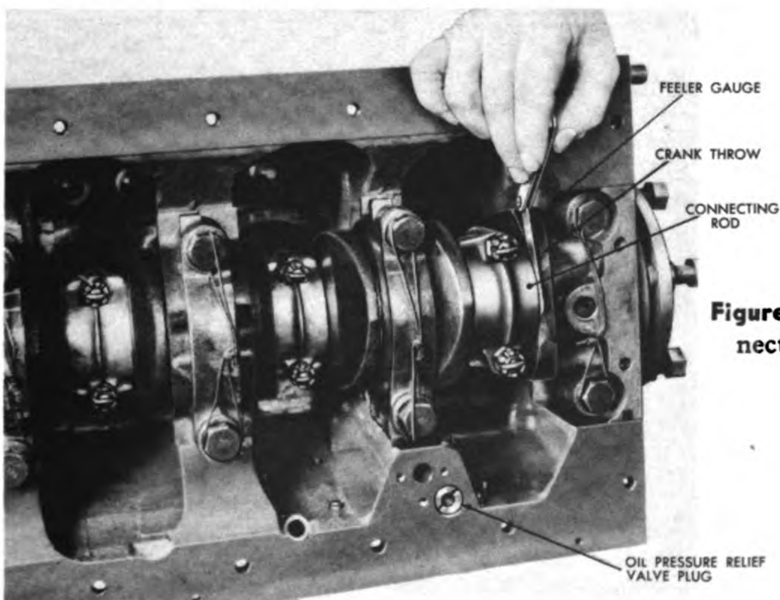


Figure 159. Checking Connecting Rod Side Play.

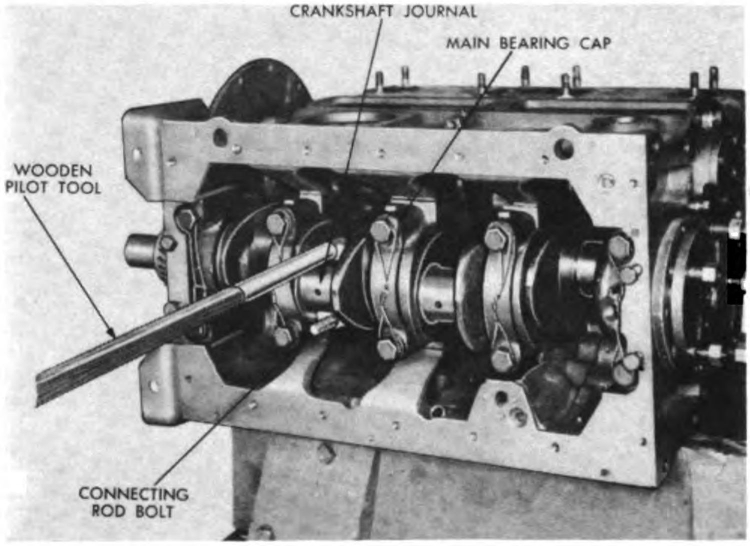


Figure 160. Removing Connecting Rod with Wooden Tool.

(227) Removing Connecting Rods and Caps

Remove and discard the cotter pins from the connecting rods. Remove the caps and push the rods off through the cylinder bores. CAUTION: Be careful not to mar the crankshaft or the connecting rod bearing. NOTE: A good tool for pushing out the piston is a short wooden handle with a piece of copper tubing fitted to one end. The tube slips over the bolt and the handle acts as a guide to avoid damaging the bearing surfaces. See figure 160. Replace the caps and the nuts on their respective rods. The caps and the connecting rods are all numbered for this purpose. CAUTION: Do not reverse the position of the caps for they must be replaced in their original position.

With the chain hoist, now stand the engine on the cylinder head studs so when the bearing caps are removed, there will be no danger of the crankshaft falling out.

(228) Removing Lower Half Rear Bearing Cap and Oil Seal

Remove and discard the lock wires of the main bearing caps and remove the caps. The rear bearing cap with the lower half of the oil seal attached can be removed as shown in figure 161 with a pry bar, two blocks of wood, and bolts. (The main bearing caps are numbered consecutively starting at the front end, or fan end of the engine, 1 to 5 inclusive).

Now carefully lift the crankshaft out of the crankcase so as not to damage the bearing surfaces.

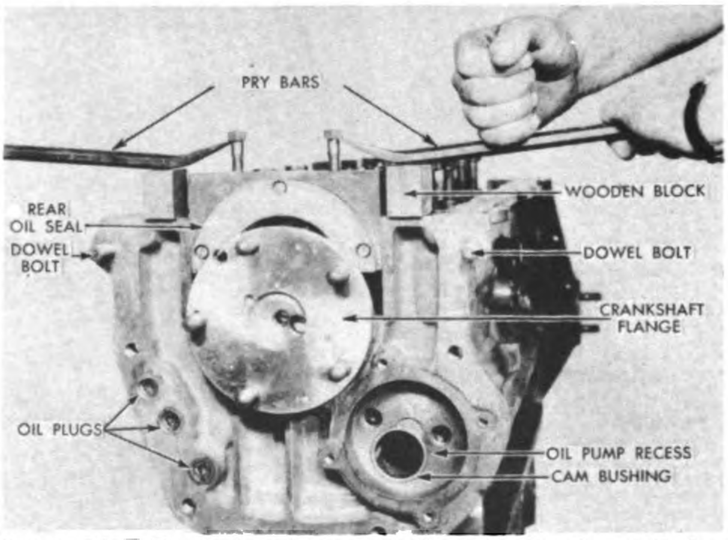


Figure 161. Removing Lower Half Rear Bearing Oil Seal.

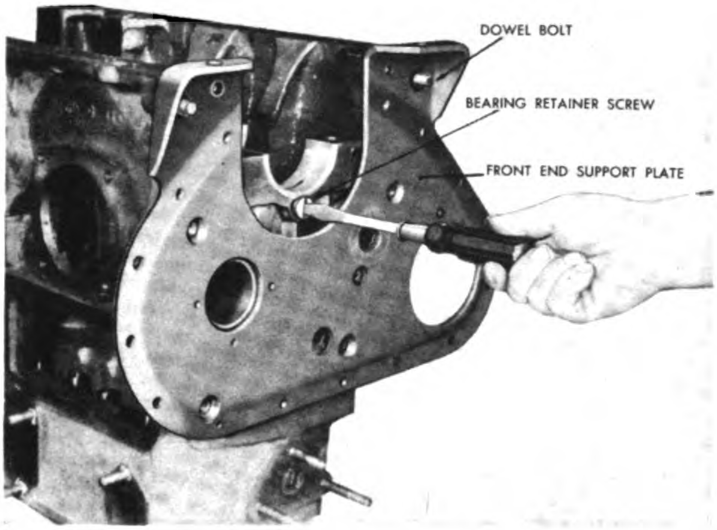


Figure 162. Removing Front Upper Bearing Retainer Screw.

(229) Removing Upper Half of Rear Bearing Oil Seal

Remove the bearing retainer screw. See figure 162.

Remove the upper half of the rear bearing oil seal and discard the felts and gaskets. See figure 163.

Remove the bearings from both the crankcase and the caps. See figure 164. NOTE: These bearings are not numbered. Therefore, they must be laid away just as removed so that they can be placed back in their respective places exactly as they came out. Even their individual positions in the crankcase and in the caps must not be reversed. If any one of the bearings is pitted or burned, it is recommended that they all be replaced, and not just one.

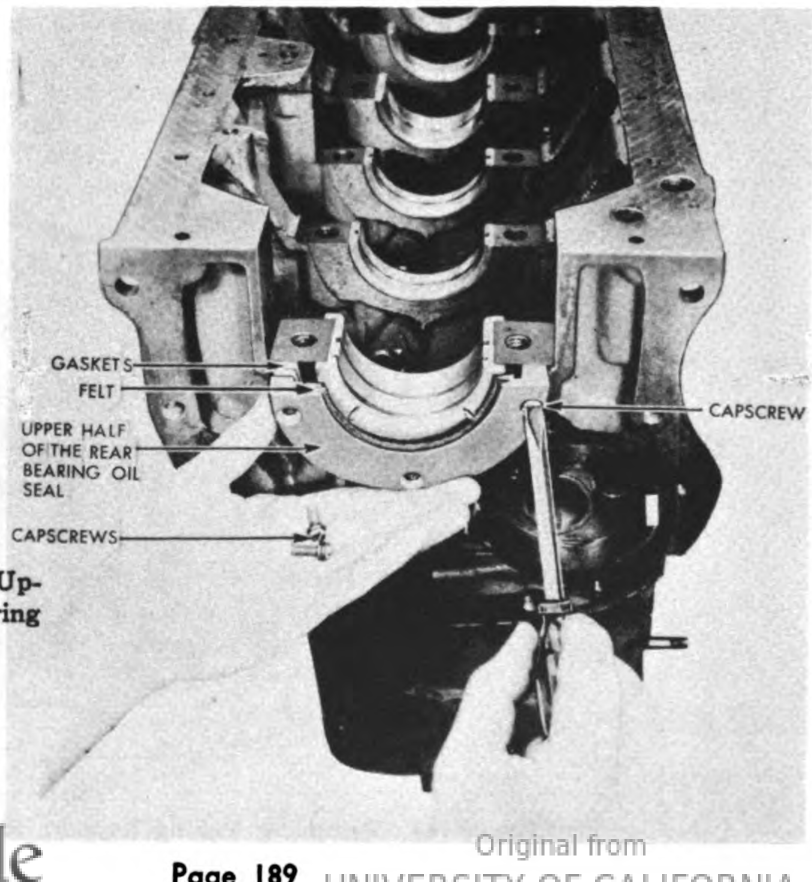


Figure 163. Removing Upper Half of Rear Bearing Oil Seal.

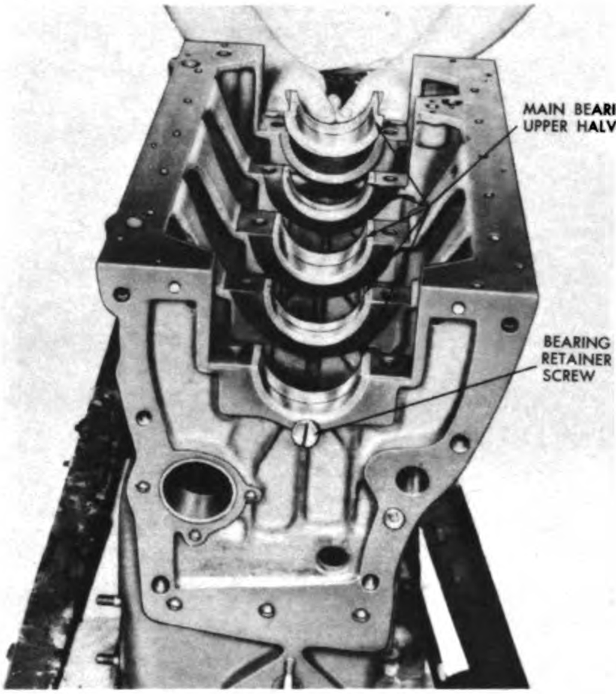


Figure 164. Removing Upper Bearings.

(230) Removing Timing Support Plate

First, remove the two nuts that fasten it to the engine body, the two capscrews that are right alongside and now remove the four large flat-headed screws whose slots have been punched to prevent loosening. These screws can be loosened by punching the heads counter-clockwise after which they can be removed with a screw driver. See figure 165.

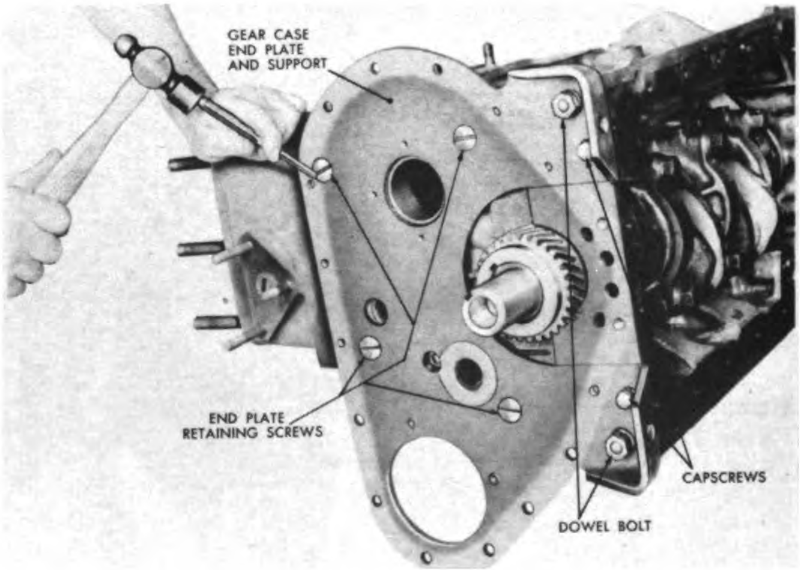


Figure 165. Removing Timing Support Plate.

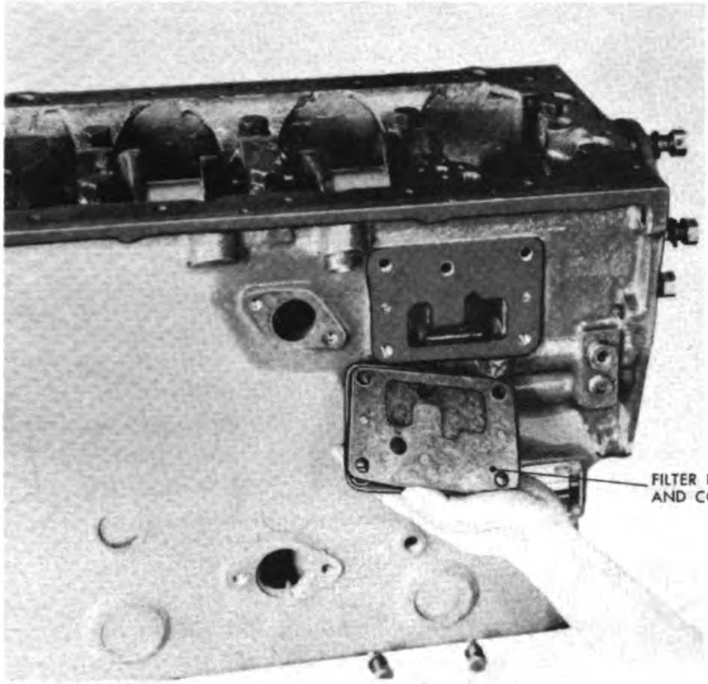


Figure 166. Removing Oil Pressure Relief Valve.

(231) Removing Oil Pressure Relief Valve

Remove the oil pressure relief valve assembly and the oil plug which you will find at the bottom of the crankcase as shown in figure 166.

(232) Removing Filter Pad and Oil Line Plugs

Remove filter pad and oil line plugs as shown in figure 167.

(233) Removing Front Oil Plug

Remove the one plug found in the front end of engine case. See figure 168.

(234) Removing Rear Oil Plugs

Remove the three rear oil line plugs. See figure 169.

The engine is now completely disassembled except for the accessory units. Inspections and conditions for replacement of any parts are given in the following Chapter XXVII.

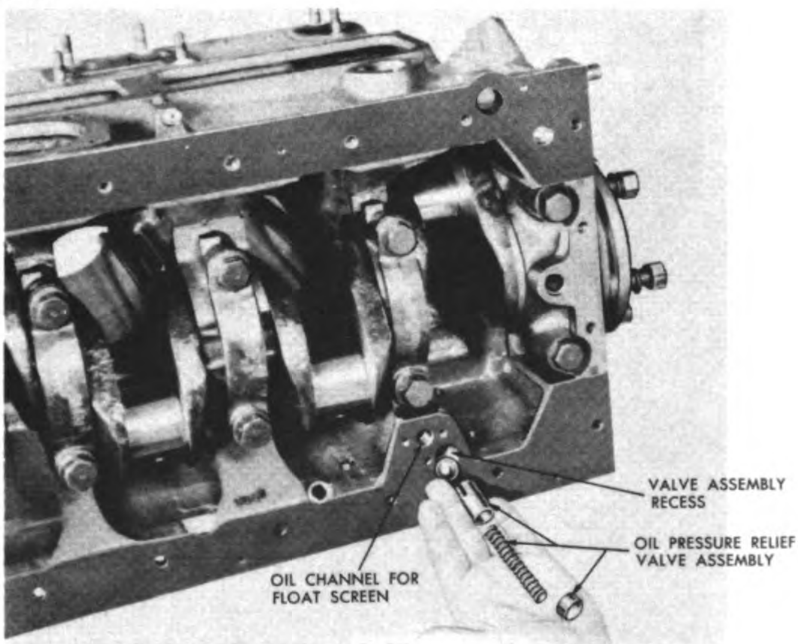


Figure 167. Removing Filter Pad and Oil Line Plugs.

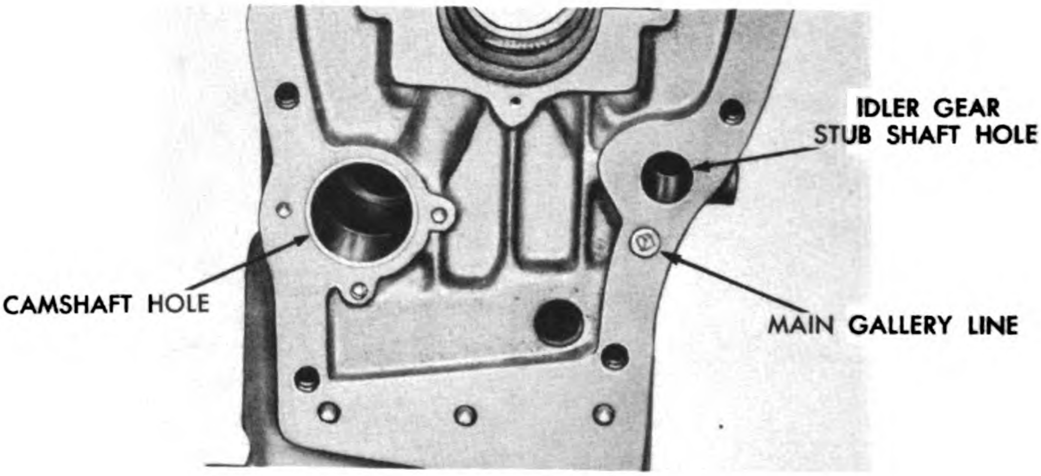


Figure 168. Front Oil Plugs.

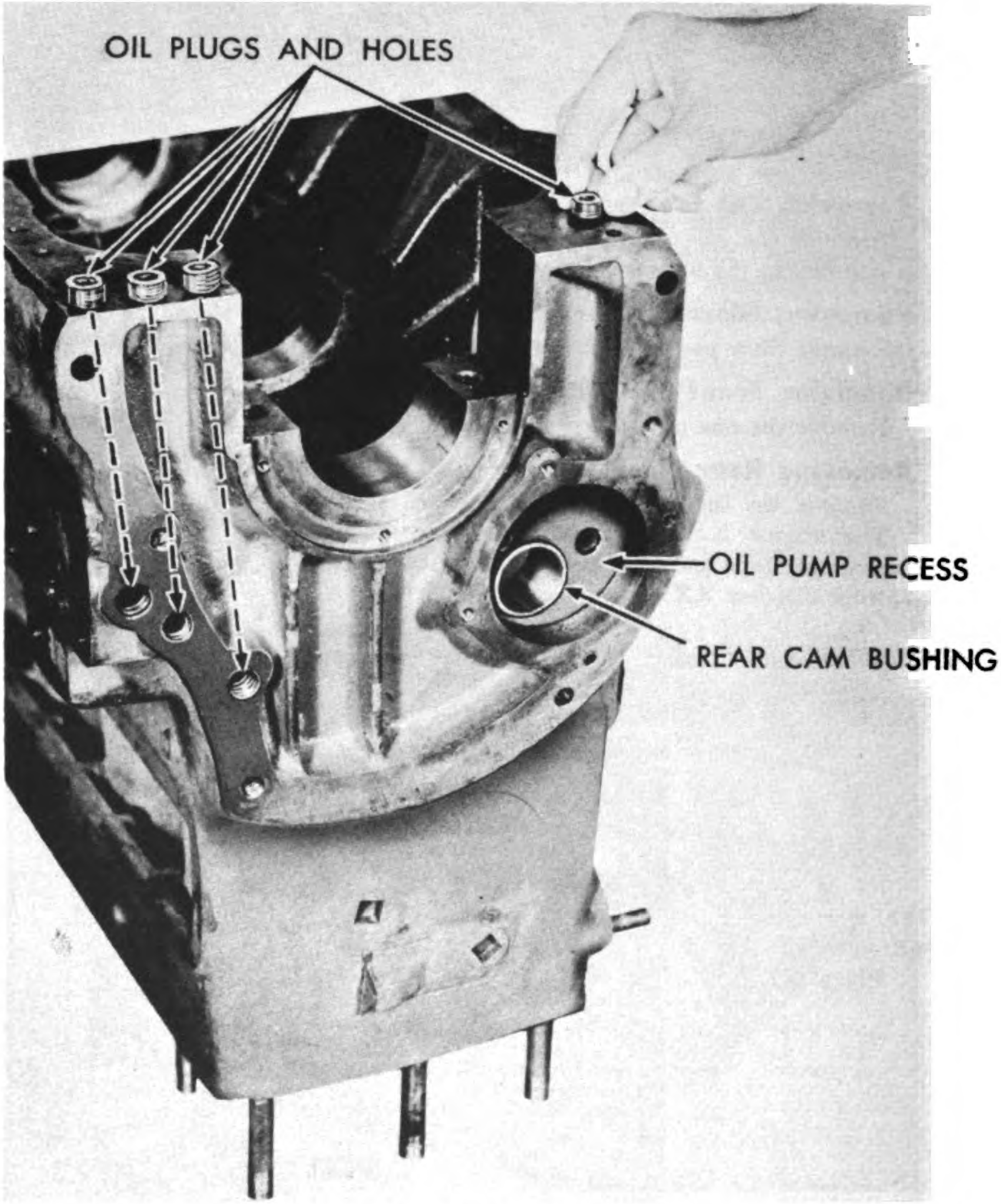


Figure 169. Rear Oil Line Plugs.

Chapter XXVII
Engine, General Overhaul, Inspection and Repair of Engine Parts

This chapter deals with the inspection and repair of the engine proper. The instructions here given take into consideration EVERY POSSIBLE REPAIR or REPLACEMENT that can be made. Therefore, it should not be assumed that all of these repairs or parts replacements are normal. For the most part, they will be rare, but all these extreme conditions are given in order to aid the mechanic to do a skillful job no matter what the condition might be.

An accurate inspection can be made only if the parts are thoroughly cleaned both inside and out. If no cleaning tank is available, washing the parts in kerosene is recommended. No further mention will be made of cleaning, as the first rule of a good mechanic is to keep tools and parts clean.

The assemblies, or parts, of the engine proper to be serviced are listed alphabetically.

Camshaft

The camshaft is of open-hearth steel, case-hardened, and runs in three bronze bushings which are pressed in the crankcase.

(235) Checking Camshaft

The clearance should be .001 to .0045. The camshaft, being casehardened, will never have to be replaced because of too much clearance. The bushings will need replacement to maintain the proper clearance. The instructions for the replacement are given in paragraph 236. The camshaft will need replacement only if the gear that drives the governor is worn or damaged. See figure 170.

The camshaft is held in place by a thrust collar which is fastened to the crankcase by three capscrews which are prevented from coming loose by a camshaft thrust collar lock plate. This lock plate is bent over the sides of the heads of the capscrews. The desired camshaft end play should be between .003" to .009", maximum permissible .015". If it is excessive, this excessive end play can usually be overcome by replacing the camshaft thrust collar. Figure 171.

Examine the oil pump drive pin in the rear end of the camshaft. If worn or cut, replace with a new one. Be sure the ends of the new pin are below the surfaces of the rear bearing surface. See figure 156.

The camshaft governor drive gear is placed towards the front end. See figure 170.

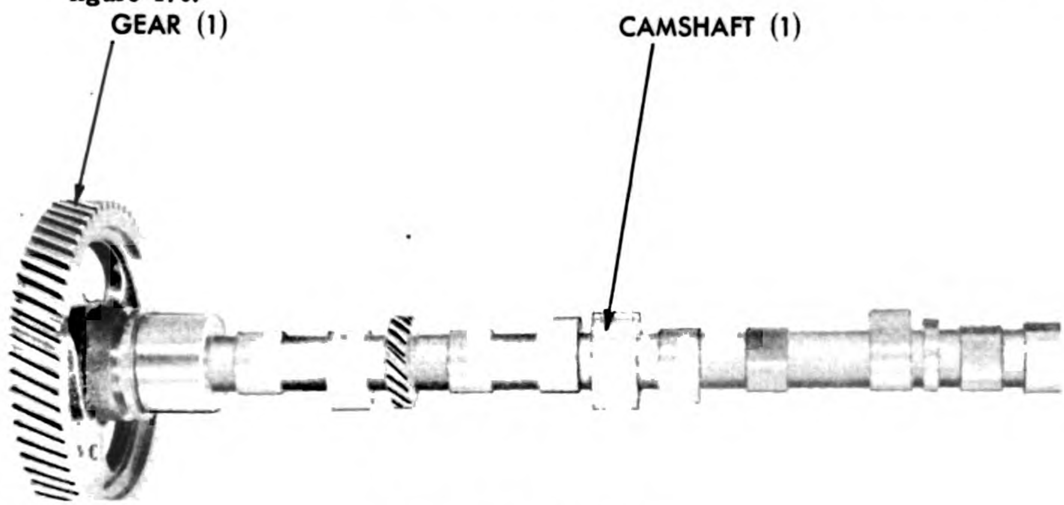


Figure 170. Camshaft.

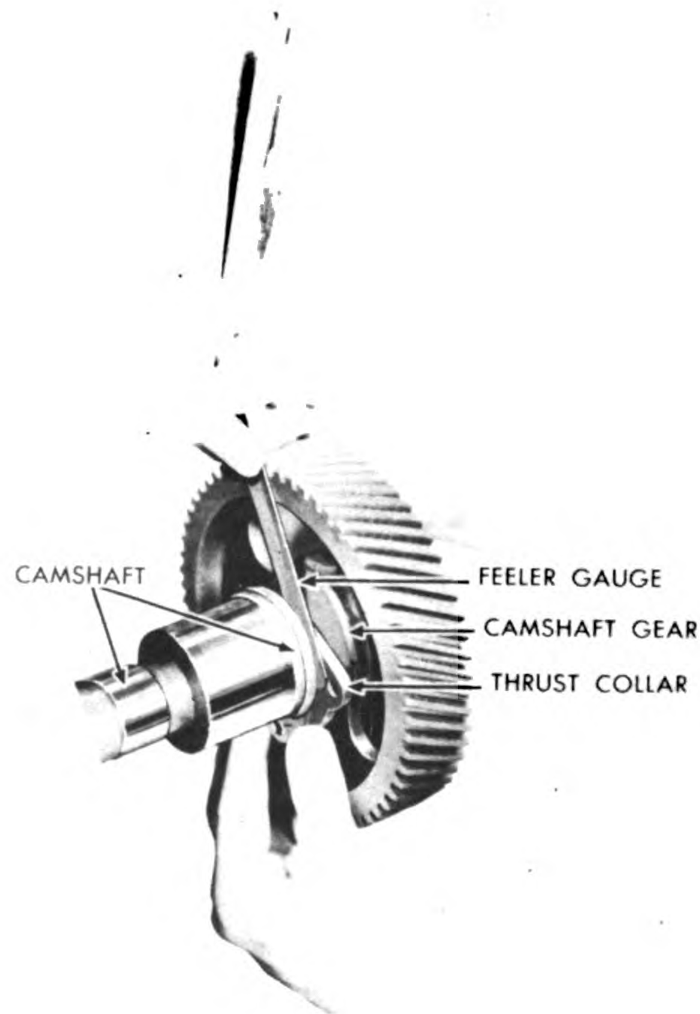


Figure 171. Checking Camshaft End Play.

(236) Checking and Replacing the Camshaft Bushings

The camshaft runs in three bronze bushings which are pressed into the crankcase. The camshaft bearing clearance should be between .001" to .0045". If clearance is more than .0045" replace the bushing, figure 172.

The bushings are of precision type and do not require reaming after being pressed into the case. However, all burrs and high spots must be removed so the camshaft will turn easily.

(237) Removing Camshaft Bushing

With a hacksaw blade, carefully cut through the bushing, being careful not to cut into the crankcase. With a cold chisel and hammer, break the bushing loose and knock it out.

(238) Installing Camshaft Bushing

With a tool similar to the one shown in Figure 173, put the bushing in place and drive it in, being careful to line up the oil hole.

If such a tool, as shown in Figure 173, is not available, use two washers slightly larger than the bushing and with holes in the center just large enough through which a bolt ½" in diameter and at least 2" to 3" long can pass. Put one washer on one side of the web of the hole in which the bushing fits and the other on the opposite side. Insert the bolt and screw on the nut and carefully turn the nut to pull the bushing into position.

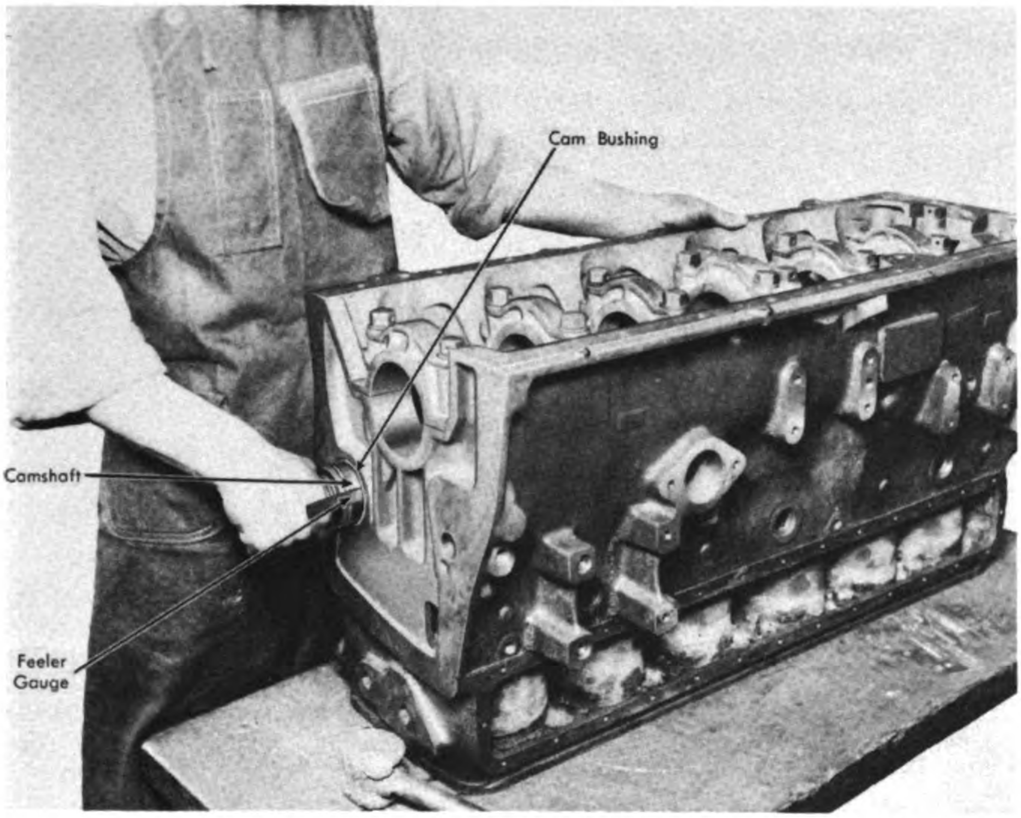


Figure 172. Checking Camshaft to Bushing Clearance with Feeler Gauge.

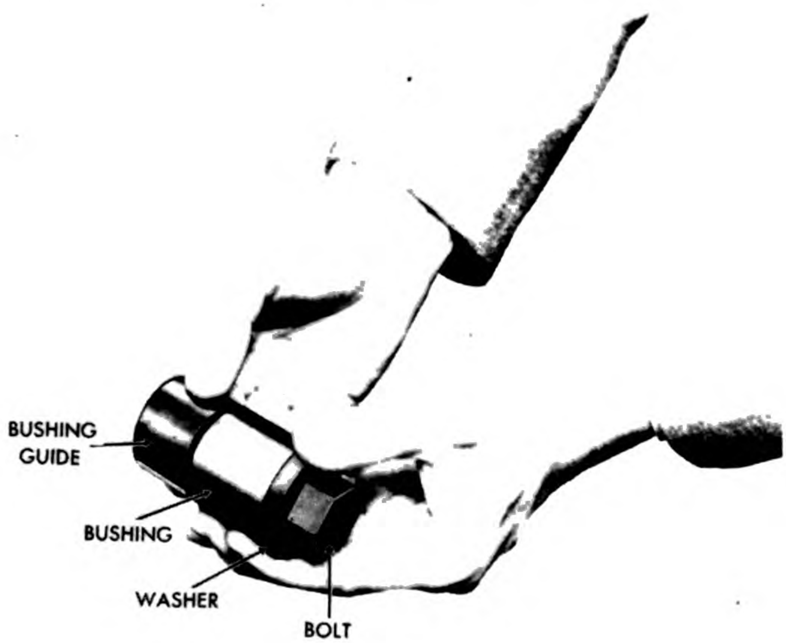


Figure 173. Cam Bushing Installing Tool.

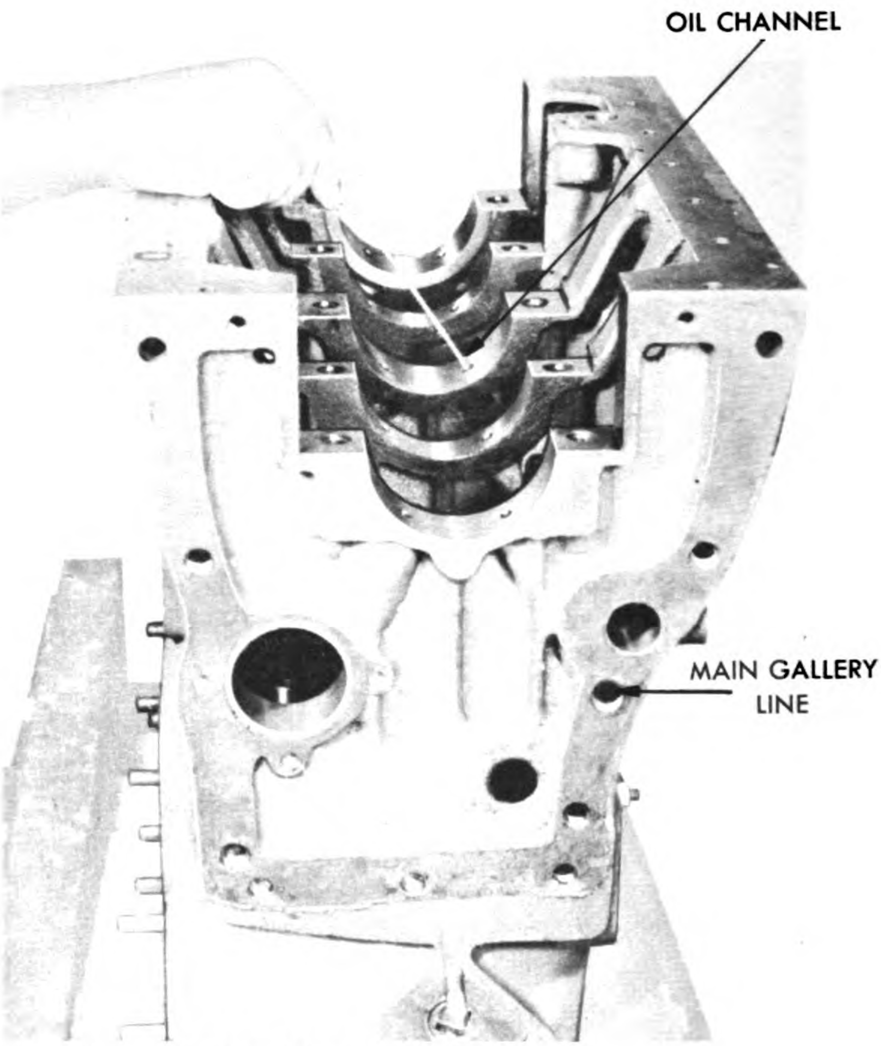


Figure 174. Brushing Out Oil Passages.

Crankcase

In order to thoroughly clean the crankcase for inspection, all the plugs must be removed as indicated in the Steps of Disassembly, Chapter XXVI.

(239) Brushing Out Oil Lines

With a wire brush, as shown in figures 174 and 175, brush out all the oil lines to remove any sediment.

(240) Checking For Out Of Round and Taper

Check each cylinder with an inside micrometer at the upper end of the ring travel, as shown in figure 176.

First, check in a position parallel to the crankshaft and then in a position at right angles to the crankshaft, as shown in figure 176. The difference between these two readings shows the amount the cylinder is OUT OF ROUND.

To obtain the amount of each cylinder taper, measure the bottom of each cylinder and again take two readings, one position parallel to the crankshaft and the other at right angles to the crankshaft. Compare the top "parallel" reading with the bottom "parallel" reading, and the top "right angle" reading with the bottom "right angle" reading to obtain the TAPER.

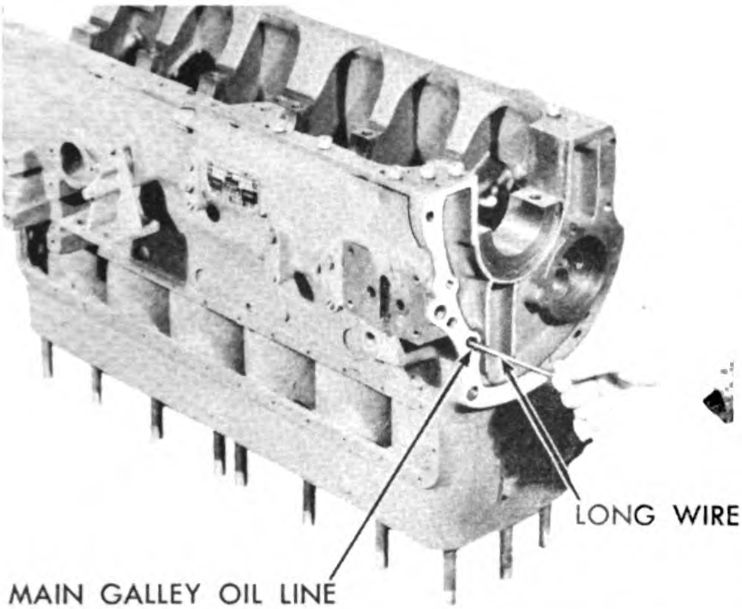


Figure 175. Brushing Out Main Galley Oil Line.

Figure 176. Checking Cylinders with Micrometer.

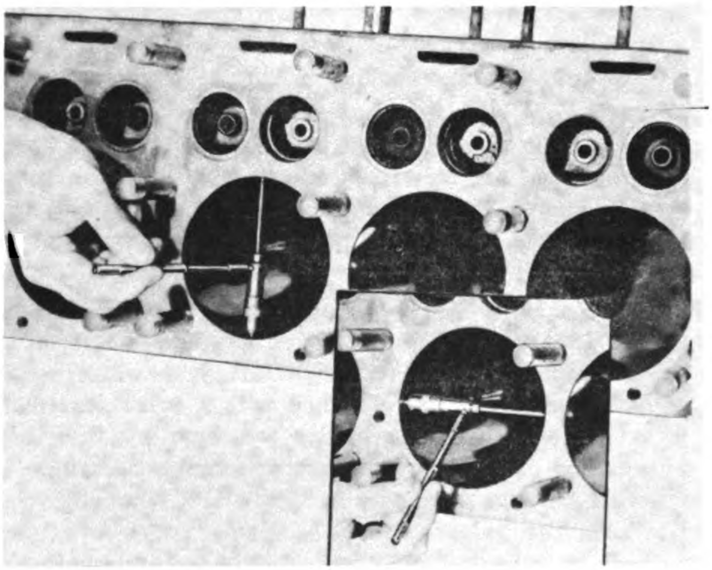
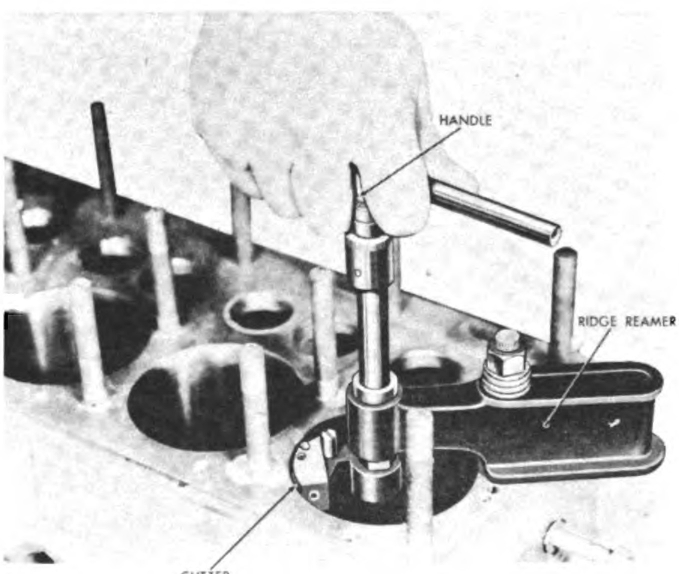


Figure 177. Removing Ring Travel Ridge.



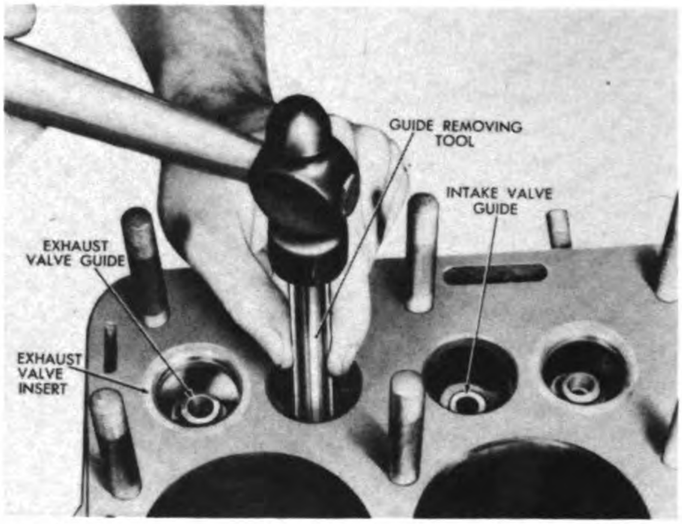


Figure 178. Removing Valve Guide.

If the out of round and taper is more than .005", the cylinders should be machined to a standard oversize by a grinder, a hone, or a portable boring bar: .010, .020, .030, or .040 of an inch oversize pistons are available. If the cylinders are machined to a special size, semi-finished pistons can be obtained for grinding to that special size. The best finish is obtained by using a hone after the cylinders are ground or bored.

(241) Reconditioning the Cylinders

If the cylinder bores are within the limits specified in the preceding paragraph and are free from scores and scratches, remove the ring travel ridge at the top of the cylinders with a ridge reamer as shown in figure 177. The removal of this ridge will forestall top ring breakage and unnecessary ring "clicking".

(242) Checking Valve Seats and Valve Guides

Inspect the exhaust and intake valve seats for pits and burns. The exhaust valve seats can be replaced if they are in a very bad condition. The intake valve seats can be refinished with a valve seat reamer.

Check the valve guides for wear by inserting a valve and noticing the amount of side play. If worn, remove the guide by driving it from the head with a driver as shown in figure 178. Install new guides with an arbor press. Ream the guide so that the clearance between the new valve and new guide will be between .002" and .004". Also replace the valve.

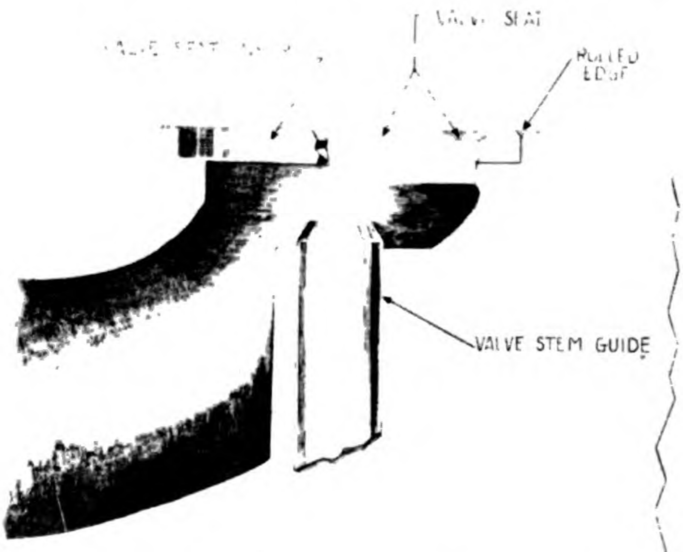


Figure 179. Exhaust Valve Insert.

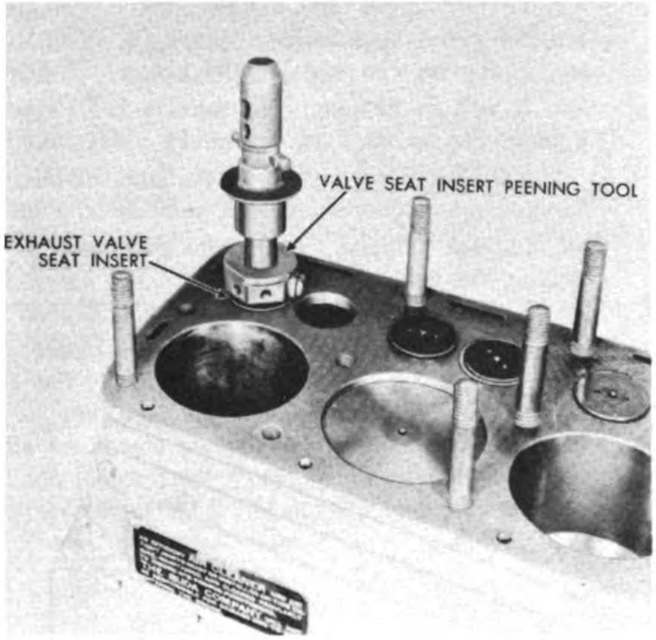


Figure 180. Valve Insert Peening Tool.

(243) Replacing Exhaust Valve Inserts

The insert is held in place by a shrink fit, and by rolling metal around the hole over the edge of the seat. See figure 179. This is sometimes referred to as peening.

To remove the insert, first roll the peened edge of the metal away from the insert, with a crimping or peening valve seat tool. (Fig. 180.) With a small punch, center punch the insert (see figure 181), and drill; be careful not to drill through into the valve seat insert recess. With a small, cold chisel, carefully break through the drilled holes and remove the insert.

Remove all burred edges around the hole and be sure the insert recess is clean.

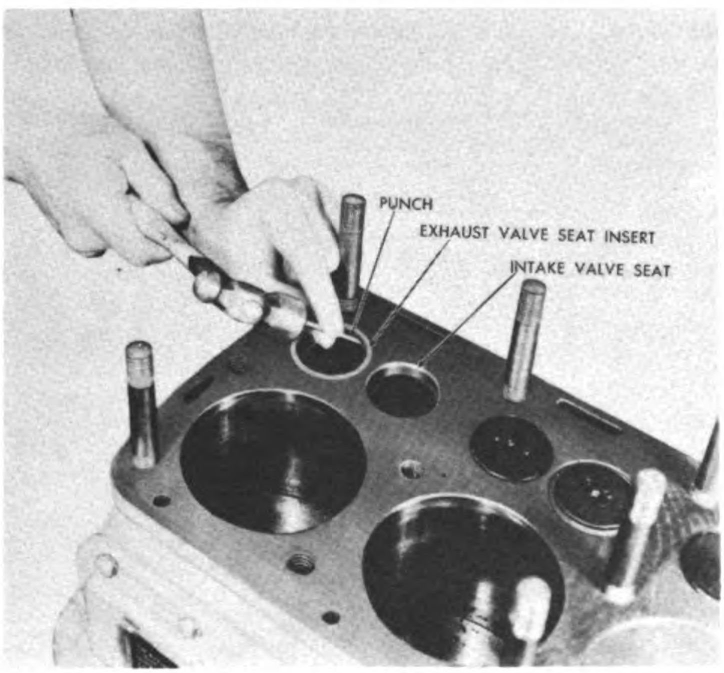


Figure 181. Removing Exhaust Valve Seat Insert.

To install the new insert, chill it with dry ice and drive it in place with a driving tool, as shown in figure 182. Roll the edges of the hole with a valve seat tool over the edge of the insert. See figure 120.

It will be necessary to refinish the valve seat with a grinder. The same grinder can be used on the intake valve seat.

NOTE: If no dry ice is available or climatic conditions are such that the foregoing procedures are not feasible, the following is recommended:

In Hot Climate: Allow the crankcase to stand in the sun until it gets as hot as the sun can heat it. Cool the valve seat insert as much as possible. Then drive the insert into the block and peen the edges with a valve seat tool.

In Cold Climate: Lay the valve insert on ice or let it remain outdoors until it is thoroughly chilled. Remove the chill from the crankcase and fill water jacket with boiling water. It may be necessary to change the water three or four times to warm the crankcase efficiently. With the water still in the block, to retain as much heat as possible, drive the valve seat insert and roll the edges of the block with a valve seat tool.

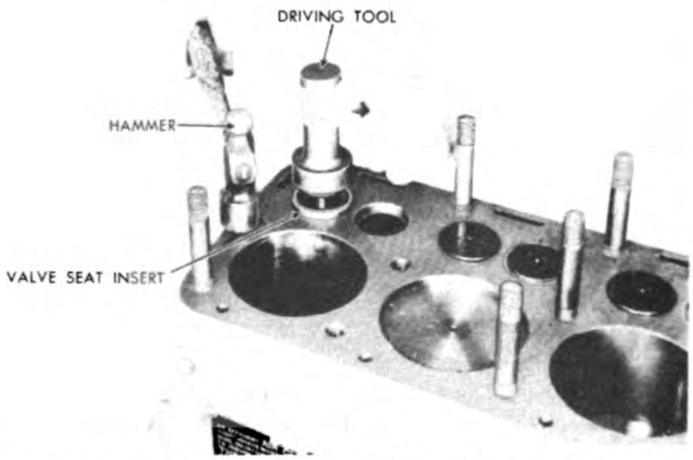


Figure 182. Installing Exhaust Valve Seat Insert.

Crankshaft

The crankshaft has five main bearing surfaces, one between each crankpin throw and at each end of the crankshaft. The crankshaft is balanced both statically and dynamically.

(244) Checking Crankshaft Wear

NOTE: Because of the number of micrometer readings necessary to find the taper and out-of-round of all the bearing surfaces of the crankshaft, as outlined in the following instructions, it is advisable that these readings be recorded in some such diagram as given in figure 183.

	MAIN BEARING #1			MAIN BEARING #2			MAIN BEARING #3			MAIN BEARING #4			MAIN BEARING #5			MAIN BEARING #6			MAIN BEARING #7		
HORIZONTAL																					
VERTICAL																					
	CONNECTING ROD BEARING #1			CONNECTING ROD BEARING #2			CONNECTING ROD BEARING #3			CONNECTING ROD BEARING #4			CONNECTING ROD BEARING #5			CONNECTING ROD BEARING #6					
HORIZONTAL																					
VERTICAL																					

Figure 183. Diagram for Recording Micrometer Readings.

Check the wear of each bearing surface, or journal, with a 2" to 3" outside micrometer. See figure 184. Before recording, take readings all around one journal to find the lowest reading on the micrometer, or the smallest diameter of the bearing surface, which usually will be at one end. Using that small end as a starting point, take three readings in line, one at the small end, the second at the middle of the bearing surface, and the third at the other end. Record these readings. These three readings will give the amount of taper in this line of this journal.

At a point 90° or one-quarter of the way around this bearing surface, again take three readings in line, the first at one end, the second at the middle, the third at the other end. If the first three readings were horizontal, the second three readings must be vertical or vice versa. The second three readings give the amount of taper in that plane, or the vertical position.

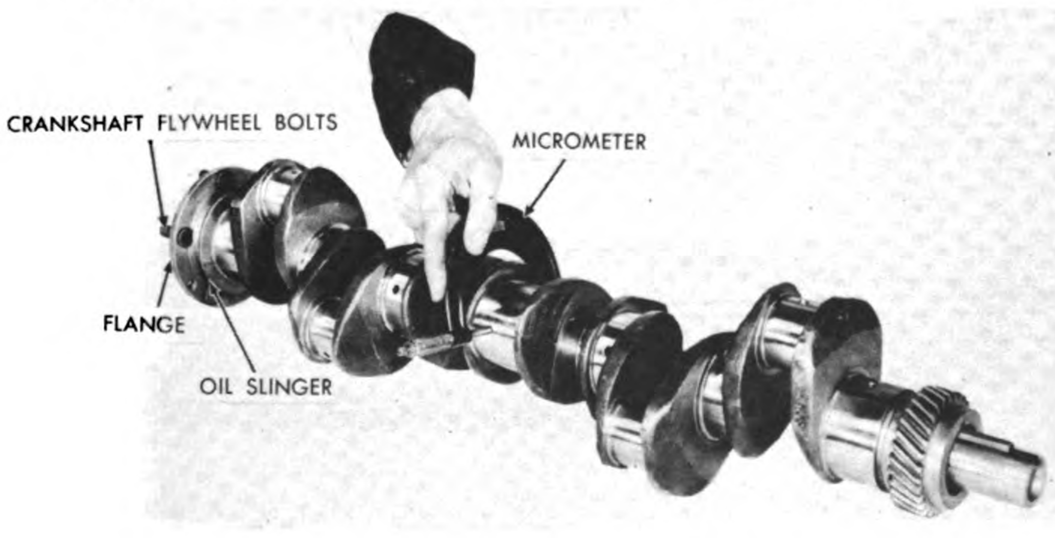


Figure 184. Checking Crankshaft Wear with Outside Micrometer.

For the amount of out-of-round, compare the first horizontal reading with the first vertical reading, the second horizontal reading with the second vertical reading, the third horizontal reading with the third vertical reading. Repeat this procedure on all the other bearing surfaces, both main and connecting rods of the crankshaft.

The main bearing size is 3" and the bearing clearance is .002 to .0042" which is taken off the shaft. Therefore the original size of the shaft is 2.997". If the wear of the shaft is more than .0015 or measures less than 2.995", the crankshaft should be reground to a standard undersize, .010, .020, .030, or .040 of an inch, depending upon the amount of wear.

The connecting rod bearings are 2.375" and the bearing clearance is .0015 to .003 which is size taken off the shaft. Therefore the original size of the crankpin is 2.3720" to 2.3735". If the wear of the crankpin is more than .0015 or measures less than 2.3705", it should be reground to one of the undersizes already mentioned. The connecting rods can be exchanged for the standard undersize to which the main bearings have been ground. The bearings in the rods are of the poured type, which necessitates the exchange of the entire rod.

Check the crankshaft flange for nicks and smooth them if necessary. The flywheel bolts should be tight in the flange. Also check the oil slinger for burrs that might cut the rear main bearing oil seal. If the oil slinger is bent, straighten it.

(245) Checking Crankshaft Gear

Check the crankshaft gear for wear. If worn excessively, replace the gear with the same size as marked on the gear. See Gears, paragraph 250, and paragraph 252.

Cylinder Head and Manifold

(246) Checking Cylinder Head and Manifold for Cracks and Warping

With a straight edge, as shown in figure 185, check for a warped condition of both the cylinder head and the manifold. For the cylinder head, place the straight edge diagonally from one corner to the other. If the head is warped, it can be machined. CAUTION: Do not remove more than 1/16" of metal from the cylinder head surfaces, because if more than that amount is removed, the compression ratio will be increased and this will require the use of a premium gasoline with high anti-knock value.

(247) Checking Manifold

For the manifold, place a straight edge ruler across the gasket faces lengthwise. If warped, the ends usually bow in and the center bows out. Remachine just enough so that all points still touch.

Figure 185. Checking Cylinder Head for Warping.

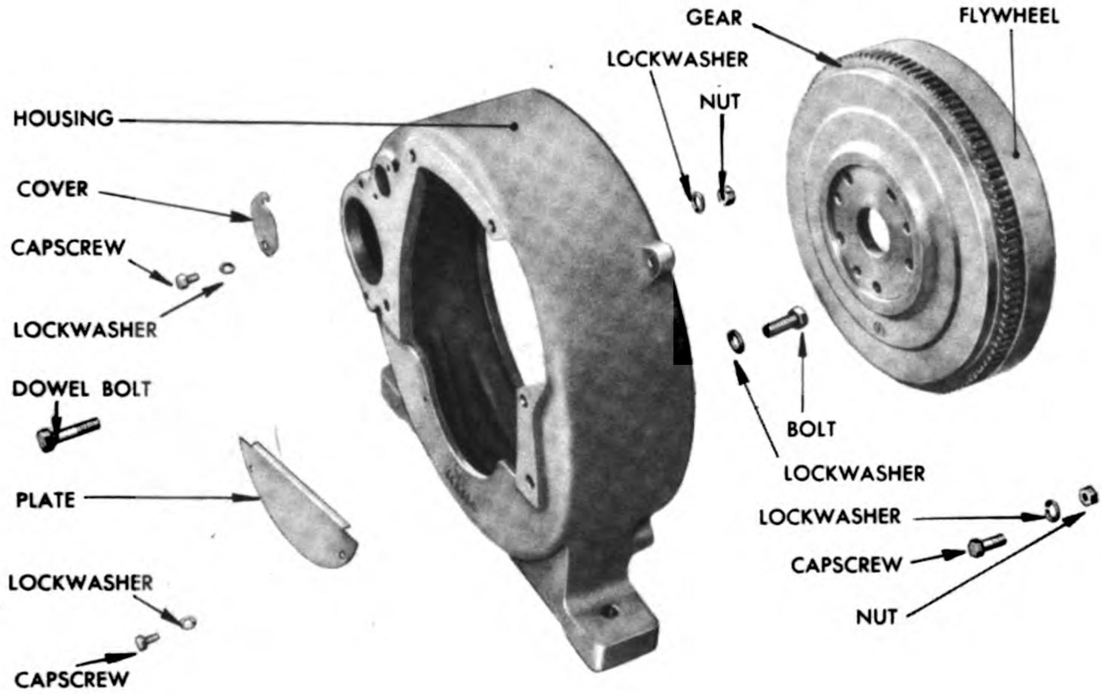


Figure 186. Exploded View of Flywheel and Flywheel Housing.

(248) Inspection of Flywheel and Flywheel Housing

Inspect the flywheel ring gear for damaged teeth. If teeth are mutilated, replace with a new ring gear. See figure 186. Examine the clutch pilot bearing hole. If the fit of the bearing in the hole is loose, either repair the flywheel by pressing in a bushing or replace the flywheel. Examine the bolt holes; if they are loose or warn, replace the flywheel. Inspect the bell housing for cracks. If not too badly cracked, the housing can be welded; otherwise replace the housing.

The flywheel housing bore should be checked for out of round and out of alignment when reassembling the engine. With a dial indicator attached to the flywheel as shown in figure 187 and 188, slowly crank the engine and check the dial reading. The maximum tolerance or out of round allowed is .005". If the out of round or the alignment is more than .005", remove the housing and thoroughly clean both the machined surfaces of the flywheel housing and the machined surfaces of the crankcase. If this does not correct the excessive out of round, or excessive out of alignment, replace the flywheel housing.

To check the run out of the flywheel see Paragraph 420, Chapter XXIV, reassembly of engine.

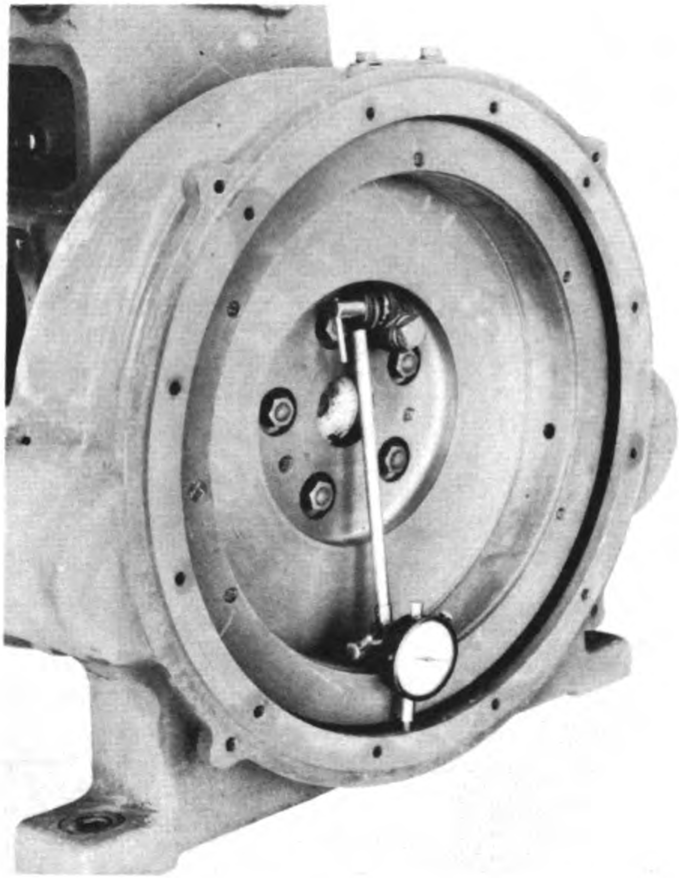


Figure 187. Checking Flywheel Housing Bore.

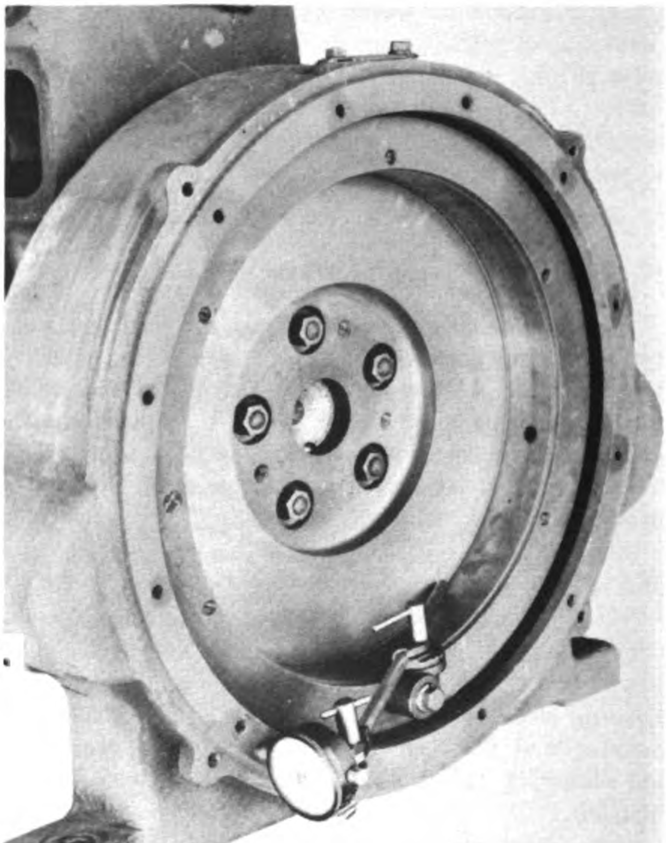


Figure 188. Checking Flywheel Housing Alignment.

(249) Installing Ring Gear

To remove the old ring gear, lay the flywheel flat on the floor with the front side of the flywheel up. With a 3/16" drill, drill two or more holes through the gear parallel with the teeth and in a line drawn from the center of the flywheel to the rim. Do not drill into the flywheel. With a cold chisel, cut the remaining metal between the holes to split the gear completely in two. Drive off the ring gear with a punch and hammer. See figure 189. Boil the new ring gear in oil for fifteen minutes, or heat evenly with a torch to expand the gear. With the flywheel flat on the floor front side, or crankshaft side, up, lay the heated ring gear in place with the bevel end of the teeth up. Be sure the ring gear is seated properly against the shoulder and allowed to cool.

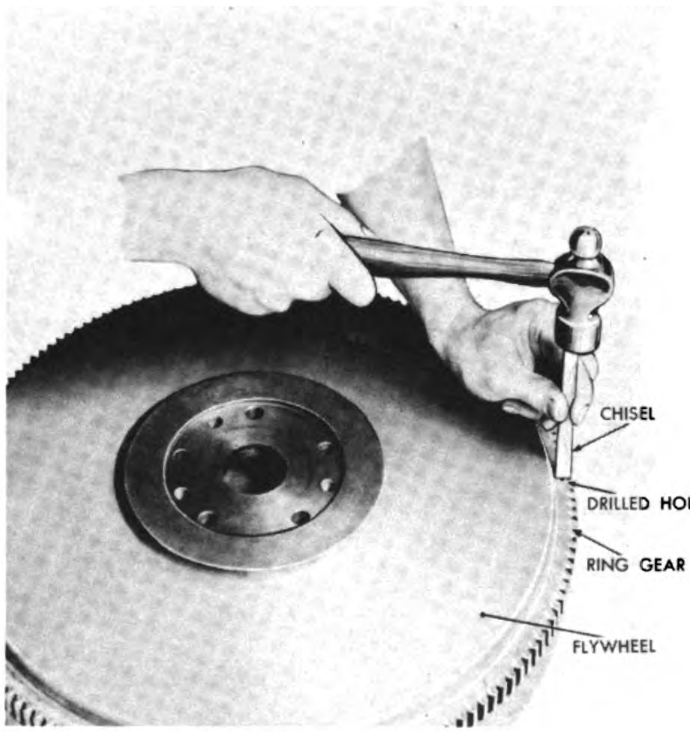


Figure 189. Removing Old Ring Gear.

Gears

The crankshaft gear drives the camshaft and the water pump drive gear through an idler interposed between the three. See figure 190. The camshaft and the water pump gear turn in the same direction as the crankshaft. The gears are on fixed centers, and adjustments are made by selecting oversize or undersize gears.

The idler gear rotates on a stud which is pressed into the crankcase. The stud is secured by a lock screw which screws into the right hand side of the case. See figure 191. The timing gears are made of cast iron and steel, a selected combination of metal that assures long wear and quiet running.

(250) Checking for Wear and Replacement

The crankshaft, idler, and camshaft gears should be fitted with .005 to .0015" backlash, while the water pump drive gear can have .005" backlash. See figure 190. When ordering one gear for replacement, use the size marking of the old gear with allowance for wear on the others.

Each gear is marked with a number within either a 0 or a letter U, thus 2 or 3. The surrounding symbol denotes oversize (0) or undersize (U) respectively, and the number gives the deviation from the standard in thousandths of an inch. The figures given represent radial and not diametrical variation. The letter S denotes a standard size. NOTE: The new gear, or gears, for replacement must correspond in size to the gear or gears replaced. Due allowances should be made for wear on the other gears.

(251) Replacing the Idler Gear Bushings

If the idler gear wabbles, the bushing needs to be replaced. NOTE: If the bushing is replaced, it MUST be bored in a lathe to a running fit on the stud. Hand reaming will not be straight and will cause the gear to run out. The clearance between the idler gear bushing and stud should be .002" to .0035" of an inch. (See figure 192.) The maximum limit is .005". NOTE: It is recommended that the gear be replaced rather than installing a new bushing into the old gear.

(252) Replacing Crankshaft Gear

Method A. The best method for installing the crankshaft gear is to boil it in oil for approximately fifteen minutes in order to expand the gear as much as possible. At the end of this time pick up the gear with tongs or pliers and slip it on to the crankshaft. Be sure to align the key seat and the key. This method of heating the gear assures maximum expansion with no injury to the gear.

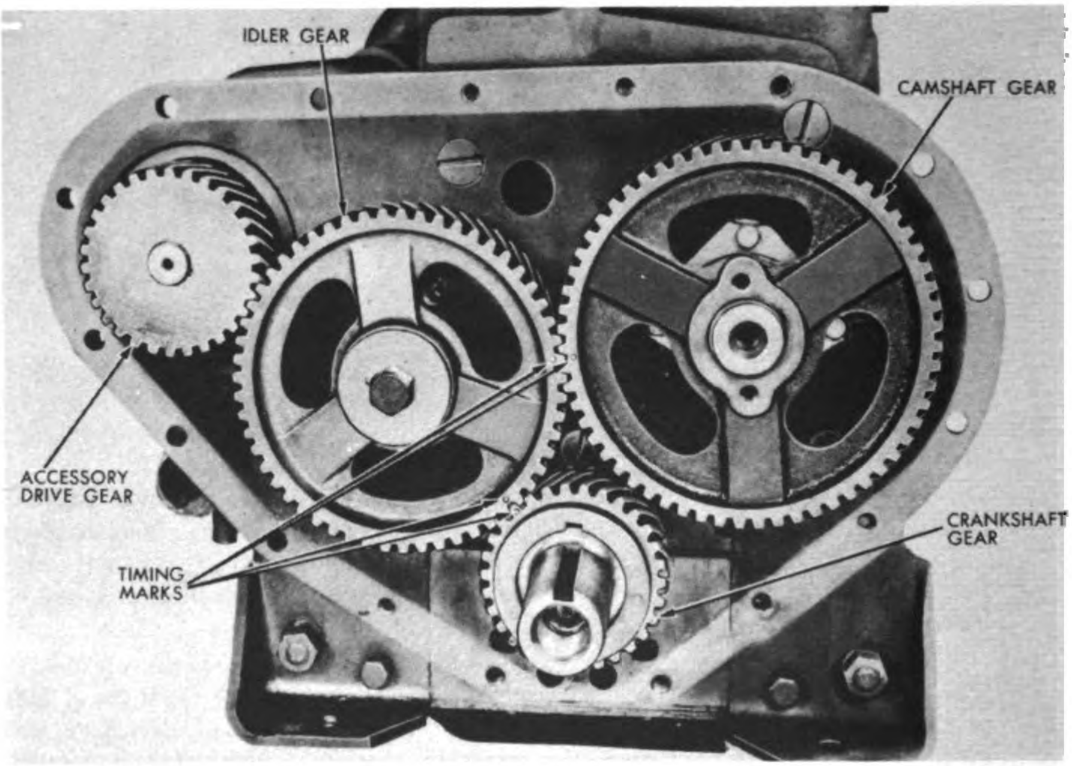


Figure 190. Gears.

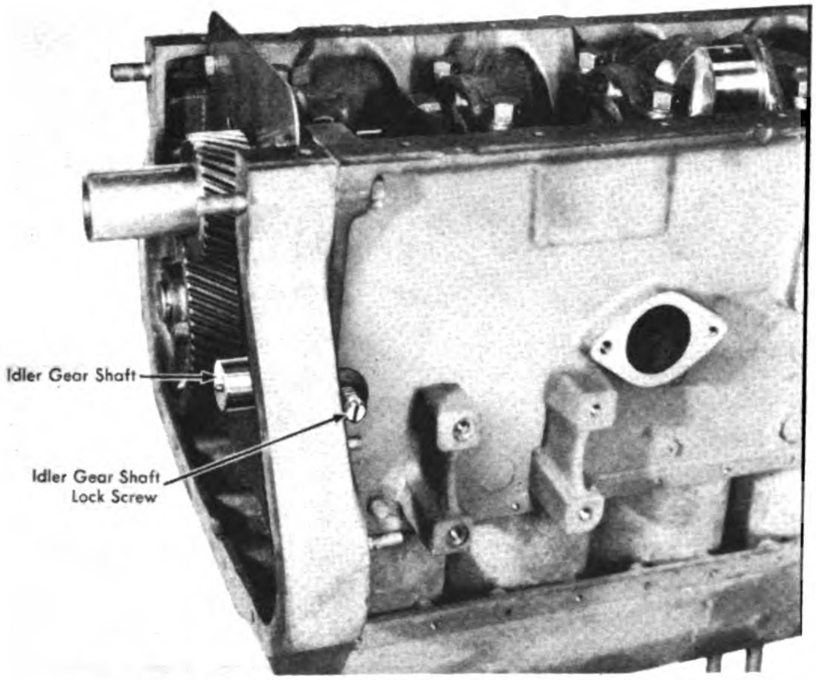


Figure 191. Removing Idler Gear Shaft Lockscrew.

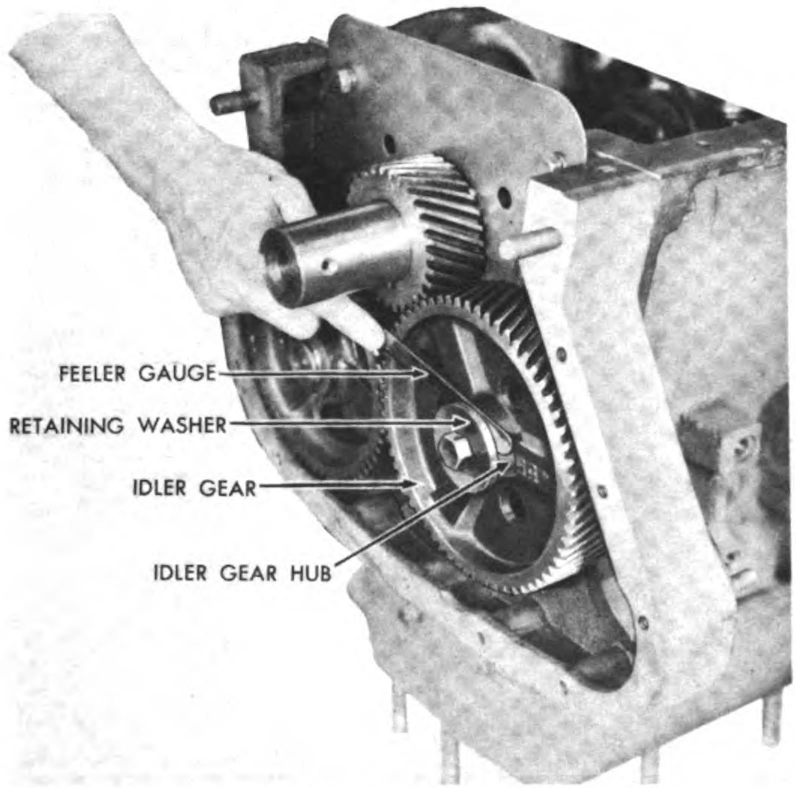


Figure 192. Checking Idler Gear End Play.

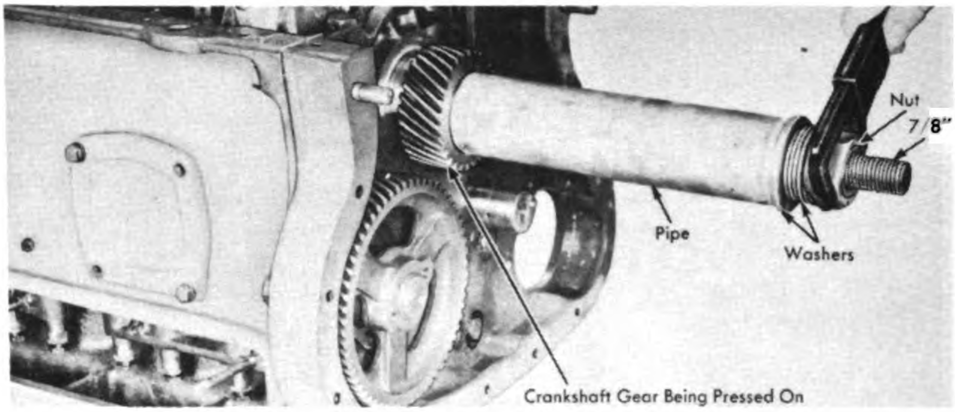


Figure 193. Pressing on Crankshaft Gear.

Method B. If step A is not feasible, method B can be used after the crankshaft has been installed in the engine. For this procedure a long ⅞" S.A.E. stud, a pipe with the same outside diameter as the gear hub, and washers to set over the end of the stud against the end of the pipe, and a nut to go on the end of the stud are needed.

First, coat the crankshaft with white lead. Place the gear in position on the shaft with the key way and the key in alignment. Screw the stud into the shaft. Place the pipe over the shaft with the washer in place and tighten the nut to press on the gear. See figure 193. Watch the key to be sure that it stays in position. NOTE: Method B should be done during the steps of engine reassembly and as indicated in paragraph 395.

(253) Replacing Main Bearings

The main bearings are of precision type and can be replaced individually. No scraping and fitting is required. Replacement can easily be made in the field by simply pushing out the old shell as shown in figure 194. This is best done by inserting into the oil hole in the crankshaft journal, a small bolt of practically the same diameter as the oil hole in the shaft, but with the head filed down to less than 3/16". Slowly turn the crankshaft by hand and push the old shell out.

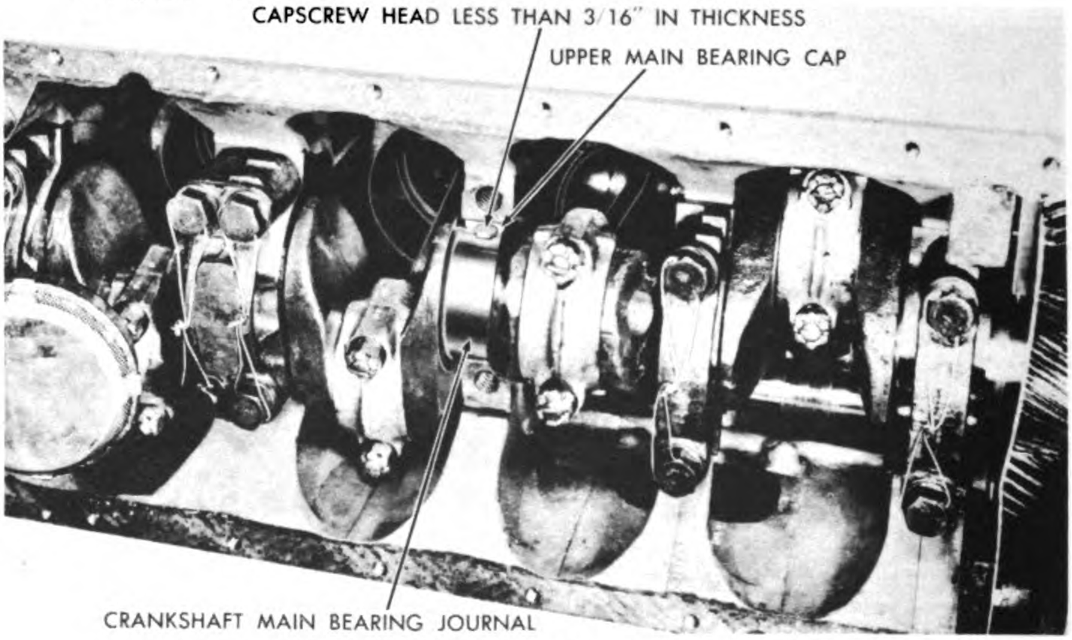


Figure 194. Removing Main Bearing Shell.

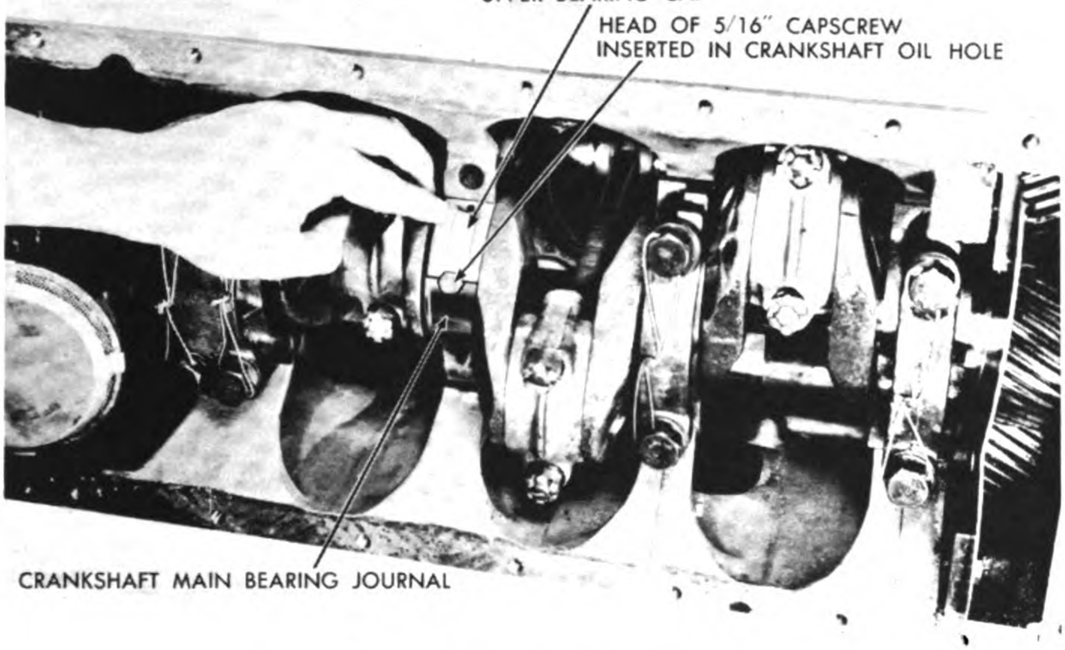


Figure 195. Installing Main Bearing Shell.

To install the shell, as shown in figure 195, start the shell into position by hand, being careful not to mar the bearing. After it is well started in, insert the same bolt that was used to remove it, only this time allow the head to project over the bearing shell and to keep it from raising up as you slowly turn the crankshaft by hand. When almost in place, stop and back up the crankshaft to release the bolt from over the shell and insert a bolt of the same diameter, but with a higher head, and slowly push the shell into position by turning the crank.

NOTE: It is recommended that if one main bearing needs replacing, they all should be replaced. The upper shells are not dowelled, the lower shells being dowelled in the caps to hold them in place. No shims are required.

(254) Inspecting Bearings

Look for holes or cracks in the bearing surfaces and check the assembled bearings with an inside micrometer. It is necessary that the main bearings be in the crankcase and the caps clamped on to obtain accurate measurements. If there are holes and cracks and the crankshaft wear is less than .0015", replace them with new bearings of standard size. New main bearings' standard size is 3". If the main bearing wear is more than .0015 and the crankshaft wear is less than .0015, replace them with new bearings of standard size.

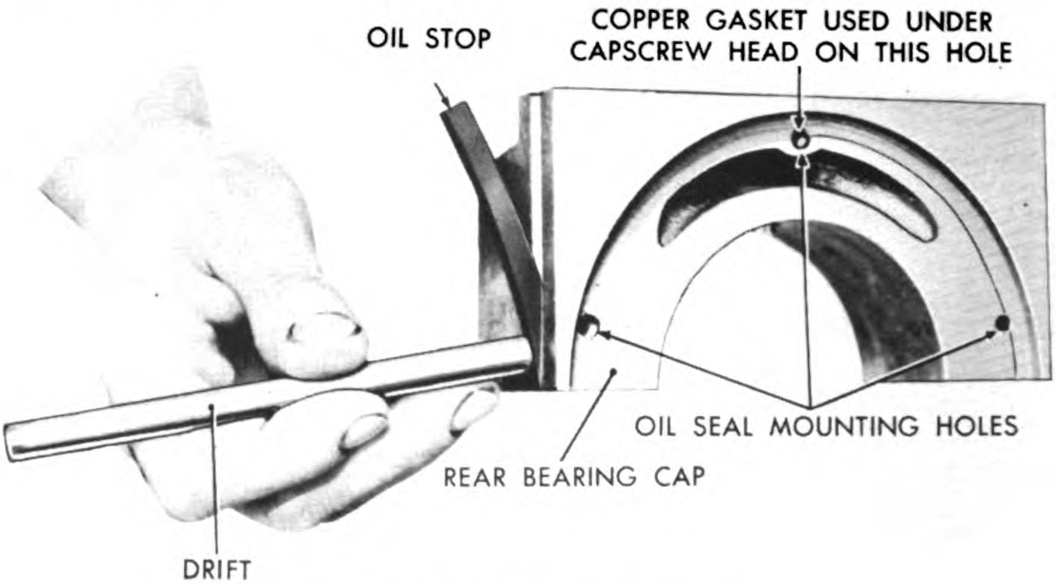


Figure 196. Installing Oil Stops.

(255) Replacing Bearing Cap Oil Stops

Replace the front and rear main bearing cap oil stops. See figure 196. If standard oil stops are not available the grooves can be packed with candle wick, which should be firmly calked into place by means of a small tapered tool or punch and hammer, pounding the yarn gradually up to the grooves until they are packed full.

The rear bearing cap has an oil drain tube attached to it which leads down below the oil level in the oil pan in order to assist in preventing oil leaks through the rear main bearings. Figure 197, shows a cap with a tube in place. Replace the rear bearing oil seal felt as follows:

First remove the old felt from the groove with a knife. Do not cut away any of the metal. Coat one side of the felt with shellac and calk the felt into the groove with the shellac side down as shown in figure 198. The shellac must not be allowed to penetrate through to the crankshaft side of the felt. Oil the surfaces of the felt with graphite grease to keep them from burning up when the engine is first started.

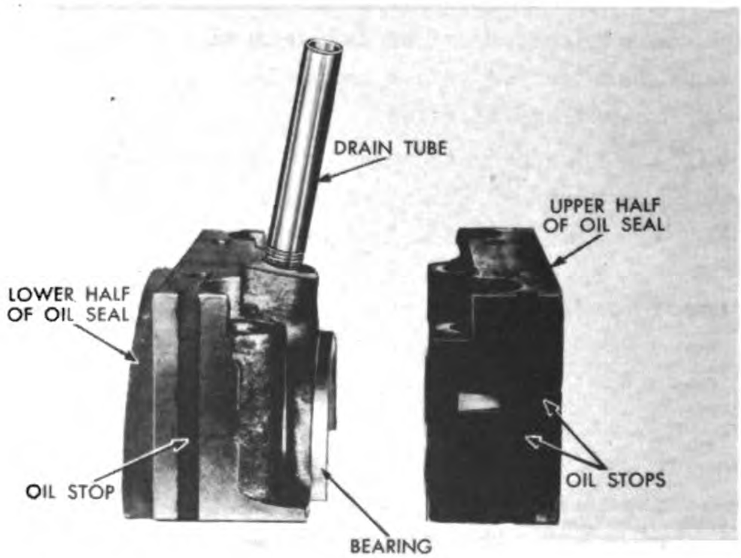


Figure 197. Rear Bearing Cap and Oil Tube.

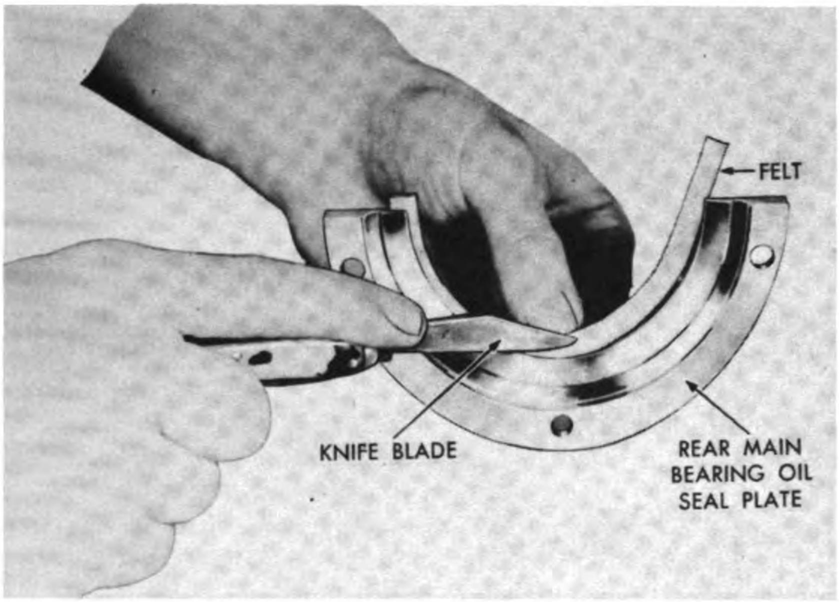


Figure 198. Installing Rear Bearing Oil Seal Felt.

(256) Checking Main Bearing Caps

The main bearing caps are numbered from 1 to 5 starting from the timing gear housing at the front end. Dowels in the cap hold the lower main bearing shells in place. The caps should be installed in their respective places so that the single cast lobe is pointed to the camshaft side of the engine. See figure 199. The caps should be checked for cracks or any indications of movement of the main bearing in the cap which will necessiate either the replacement of the bearing shell, the dowel, or the cap.

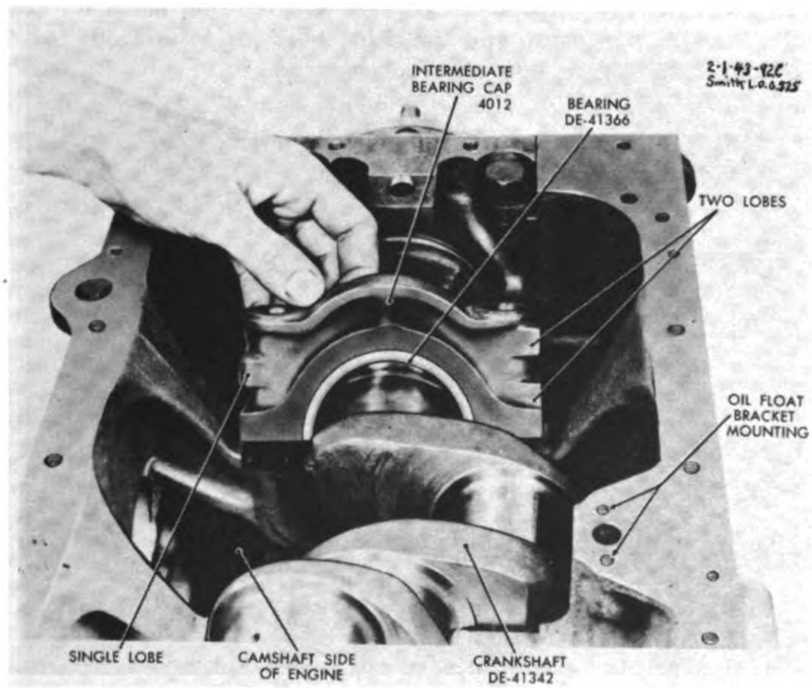


Figure 199. Installing Main Bearing Cap.

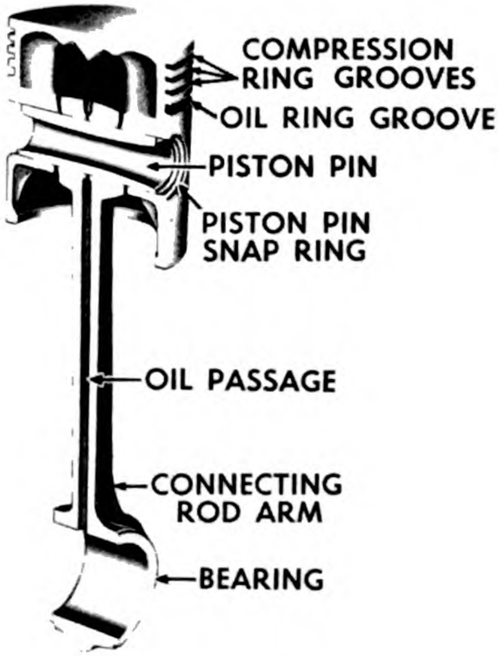


Figure 200. Sectional View of Piston and Connecting Rod.

Piston and Connecting Rod Assembly

The pistons are cast iron and have four rings all above the pin. The top, or firing ring, is a plain compression ring and is followed by two combination compression and scraper rings, and the lower is an oil control ring of the slotted type. See figure 200. If cylinders need regrinding, this necessitates replacing the pistons with a standard oversize, .010, .020, .030, and .040.

(257) Checking and Fitting the Pistons

After the pistons and connecting rods have been dismantled and the piston rings removed, visually inspect the grooves and the ring lands for cracks. Also check the head of the piston and the skirt, both inside and out for cracks. If there are any, the piston must be replaced.

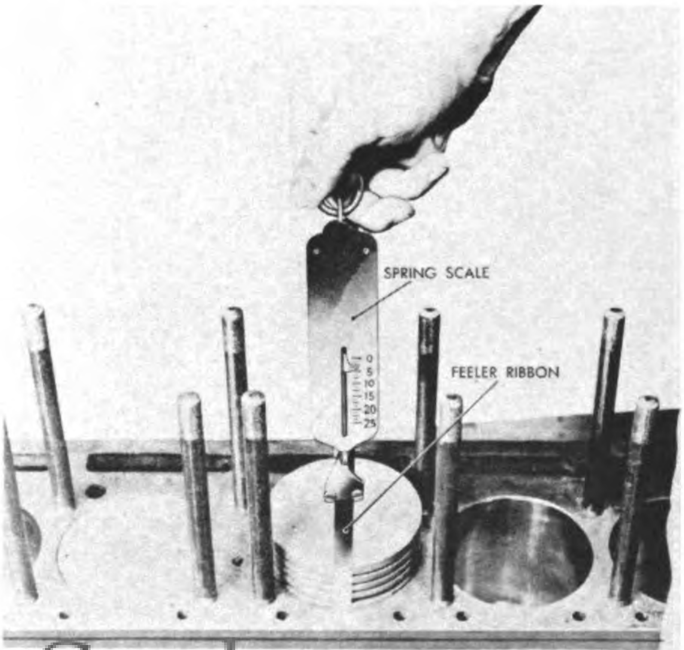


Figure 201. Fitting Piston to Cylinder.

The pistons should be fitted as follows: First thoroughly clean the cylinders and pistons with compressed air and wipe them dry with a clean cloth. With a .003″ feeler ribbon attached to a spring scale and the feeler ribbon inserted between the piston and the cylinder at a position 90° from the piston pin hole and in line with the thrust surface of the piston, pull out the feeler ribbon with approximately six to eight pounds tension, as shown in figure 201.

(258) Checking the Pin Wear and Replacing Pin

The piston pins are full floating type and are made to rotate in either the piston or the connecting rod bushings. The pins are held in place by means of two snap rings and lock in grooves in the outer end of the piston pin bosses which prevent the piston pin from coming in contact with the cylinder walls. If these grooves are worn so that the locks will not fit tightly in these grooves, the piston will have to be replaced.

The pins have the ends ground flat and polished to prevent their cutting through the lock ring. The pin to piston is a light tap fit with a raw hide mallet. Figure 202. The piston pin to connecting rod bushing is a light push fit with the palm of the hand. Figure 203.

If replacement is necessary, replace the pin with the next first oversize and ream out the piston and connecting rod bushings. The piston pin bushings should be reamed or honed to allow thumb push fit as shown in figure 203.

If the piston pin to bushing clearance exceeds .002″ replace the pin. Replace the lock rings if any signs of wear are visible.

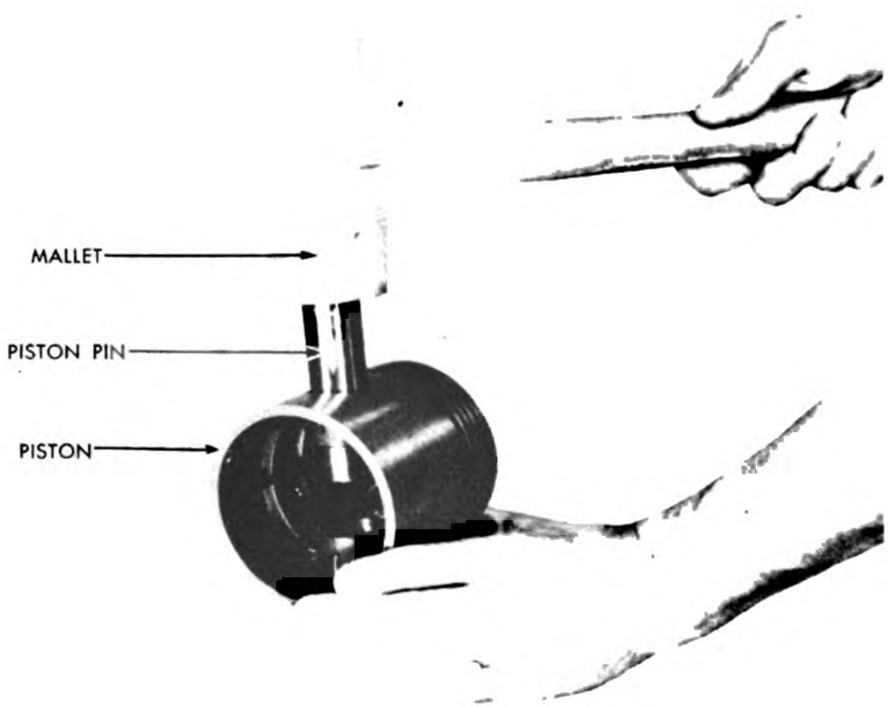


Figure 202. Installing Piston Pin in Connecting Rod.

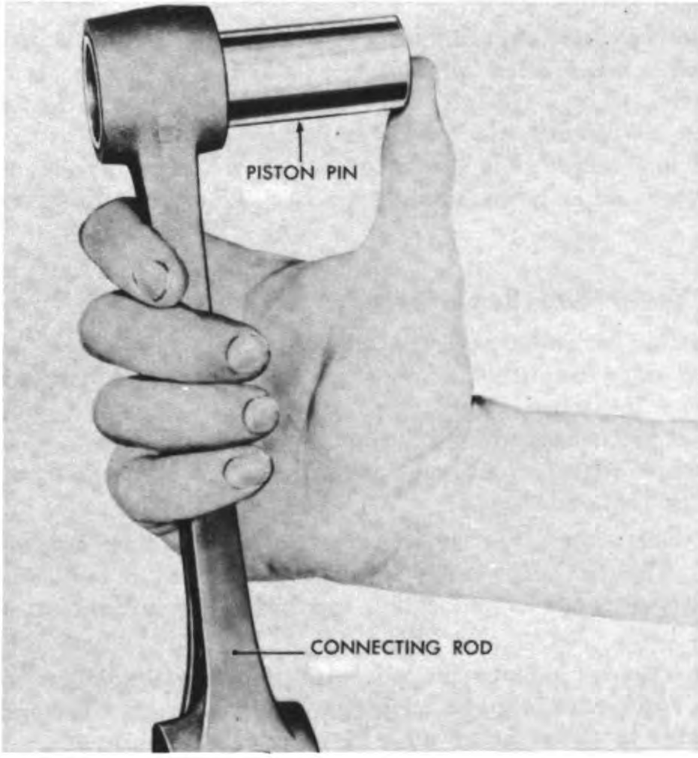


Figure 203. Pushing Piston Pin into Connecting Rod.

(259) Installing Piston Pin Snap Rings

Particular care should be used when installing the snap rings or retainer rings. Use a pair of long-nose pliers as shown in figure 204, and make sure that the rings fit snugly into the grooves. Do not force the retainer rings into or out of the grooves with a screw driver. When these retainer rings are installed correctly they cannot be turned with the fingers. If the pin has to be replaced, it will be necessary to realign the connecting rod as given in paragraph 263.

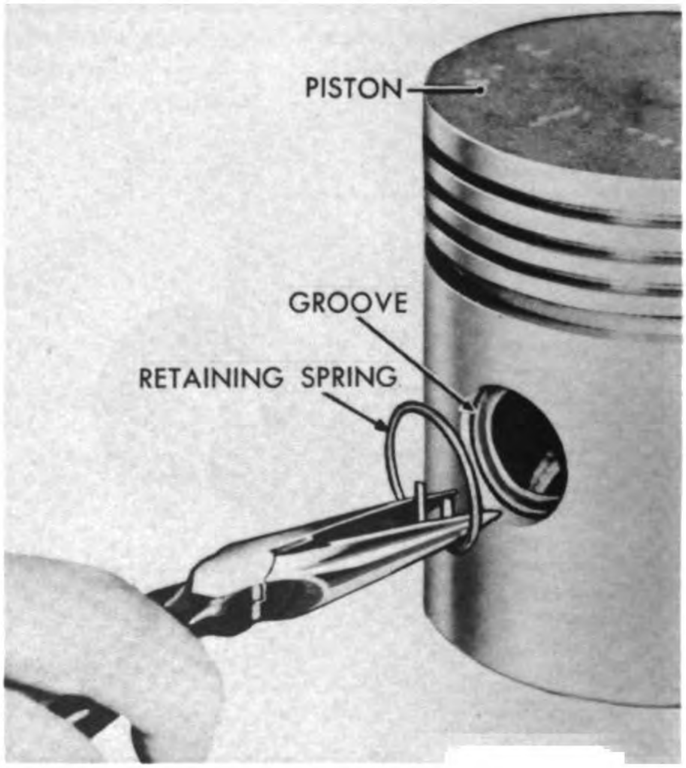


Figure 204. Installing Piston Pin Retainer or Snap Ring.

Figure 205. Checking Depth of Ring Groove.

(260) Replacing Piston Rings

Always replace the piston rings during the 2,000 hour overhaul whether or not the cylinders have to be machined.

NOTE: If at any time after 100 hours of operation, a piston, or the pistons, must be removed from the engine, always replace rings with new ones. This is advisable because it will be impossible to get the piston rings back into the same positions into which they had worn. Therefore, if they are not replaced, there is the possibility of the pistons pumping oil, and it is recommended not to slip the new rings on until ready to put the pistons back in the engine.

First check the depth of the ring groove in the piston, as shown in figure 205, and check the clearance between the ring lands and the ring with a feeler gauge, as shown in figure 206. The clearance should be .0005" to .0015". Check the gaps of all the rings with a feeler gauge, as shown in figure 207. Compression ring gap should be .009" to .014", the oil ring gap .009" to .014".

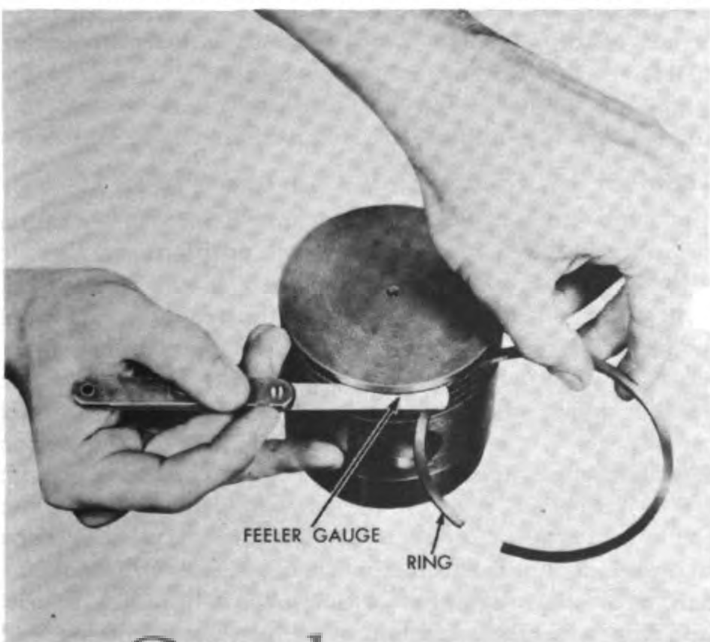


Figure 206. Checking Clearance of Ring Land and Ring.

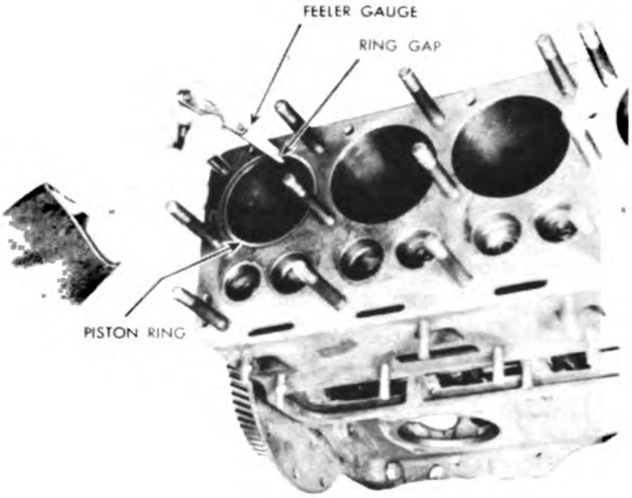


Figure 207. Checking Piston Ring Gap.

(261) Connecting Rods and Connecting Rod Bearings

The connecting rods are rifle-drilled for pressure lubrication to the piston pin. Side clearance of the connecting rod between the sides of the bearing and the crankshaft cheeks should be maintained at .004" to .009 and a uniform clearance allowed between the upper end of the rod and the piston pin bosses.

The babbit type bearings are spun directly into the connecting rods. When bearing replacement becomes necessary the entire rod and cap must be replaced. If the crankshaft is reground to a standard undersize, the connecting rod must be replaced with the same standard undersize, to fit, such as, .010" .020", .030", .040".

(262) Inspecting and Replacing the Connecting Rod

If the bushing is loose in the connecting rod, the entire rod must be replaced, as even a new bushing would fit loosely in the old rod. Check the wear of the connecting rod bearing (cap in place) with an inside micrometer. If worn more than .0015, or the reading is more than 2.3765, replace the entire rod with a new rod of standard size, provided the crank pin bearing surface wear is negligible and no regrinding of the crankshaft is necessary.

(263) Checking the Alignment of Connecting Rod and Piston

With the piston and connecting rod assembly clamped into the mandrel of the aligning fixture, swing the rod into a horizontal position (parallel to the floor). See figure 208. With the piston held diagonally to the rod (piston head pointing to the floor), observe the space between the face of the fixture and the skirt of the piston as shown in figure 209; if this space is not even, the rod is twisted out of line. NOTE: The ring lands at the top of the piston are smaller than the skirt; therefore, check the alignment of the rod along the full length of the skirt only. Twist the rod with a large wrench until space between the aligner and the piston is even. Now check for a twist in the opposite direction by moving the piston into the opposite diagonal line to the rod (piston head pointing up.) See figure 210. Observe the space between the aligner face and piston skirt; if the space is uneven, twist the rod with a large wrench until true alignment is obtained. Check for a bent rod by moving the piston into a parallel position with the connecting rod and

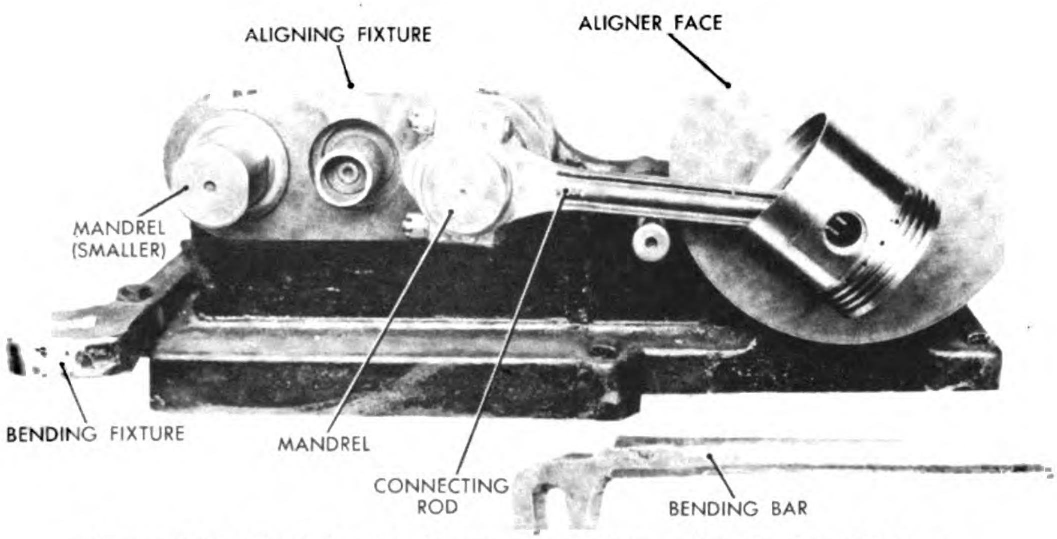


Figure 208. Checking the Alignment of Connecting Rod and Piston.

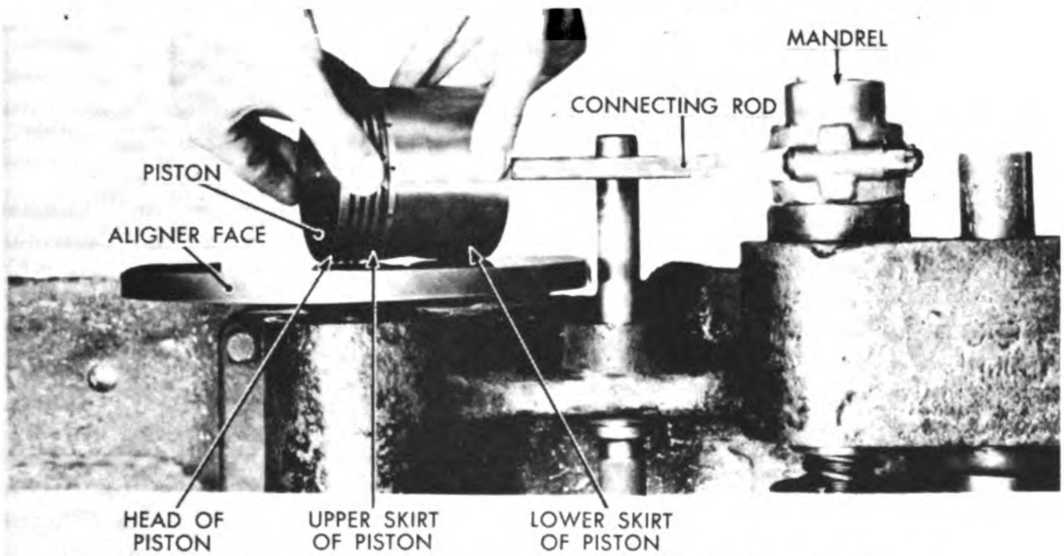


Figure 209. Checking Connecting Rod Piston Head Down.

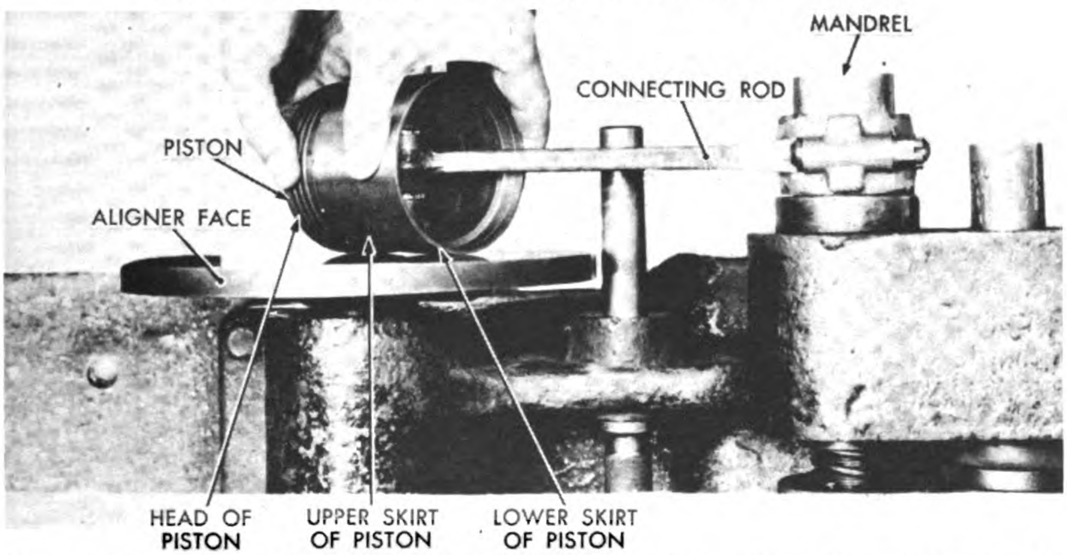


Figure 210. Checking Connecting Rod, Piston Head Up (Skirt Down) for Twist.

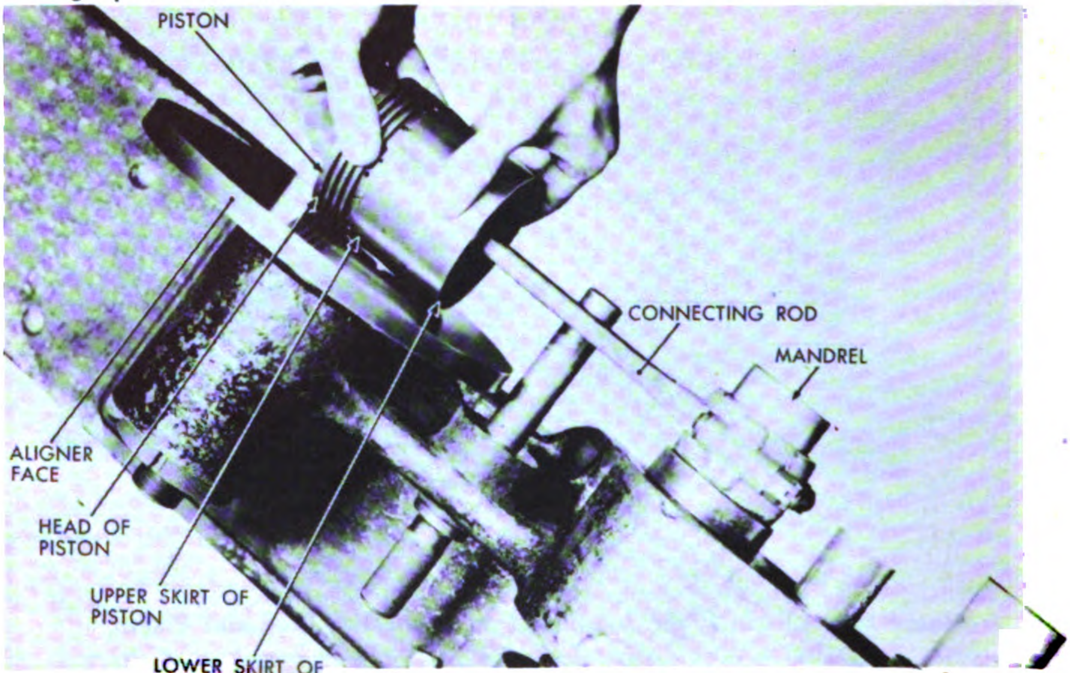


Figure 211. Checking for Bent Rod.

observe the space between the aligner face and the piston skirt; if the space is not even, the rod is bent. See figure 211. Straighten by carefully bending the rod with a large wrench.

(264) Checking Sheet Metal Housing and Front Engine Mounting Base

During the 2,048 hour overhaul, the sheet metal, radiator, and front engine mounting base, together with the flywheel housing, should be thoroughly cleaned and painted. Check all the mounting and fastening bolts and nuts and replace the threads that are worn or slightly stripped. Check the mounting pads on which the radiator assembly rests. If they are worn or cracked, replace with new ones.

(265) Checking Timing Gear Housing and Front Support

Examine the front end gear case cover for cracks; if cracked either weld or replace the cover. Always replace the oil seal in front gear case cover. Clean out the recess in which the oil seal sets. See figure 212. Also inspect the water pump shaft thrust button and spring for sufficient spring tension and freedom of movement. If the button sticks, clean the hole or button, and if the spring is weak, replace this with a new one.

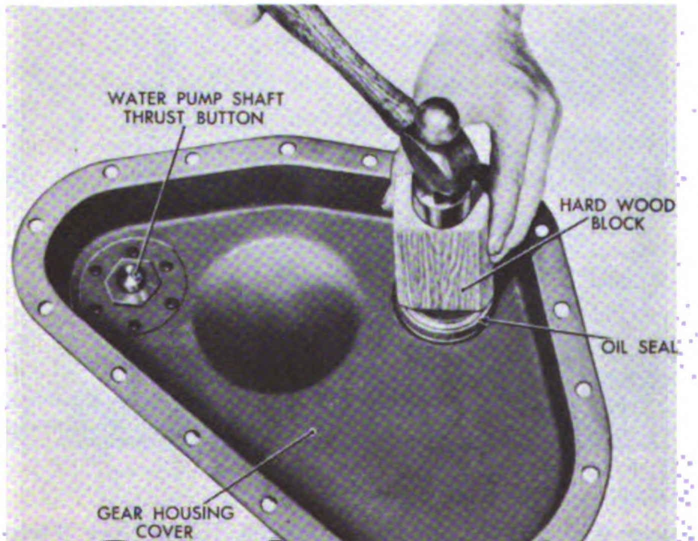


Figure 212. Inserting Oil Seal in Front Cover.

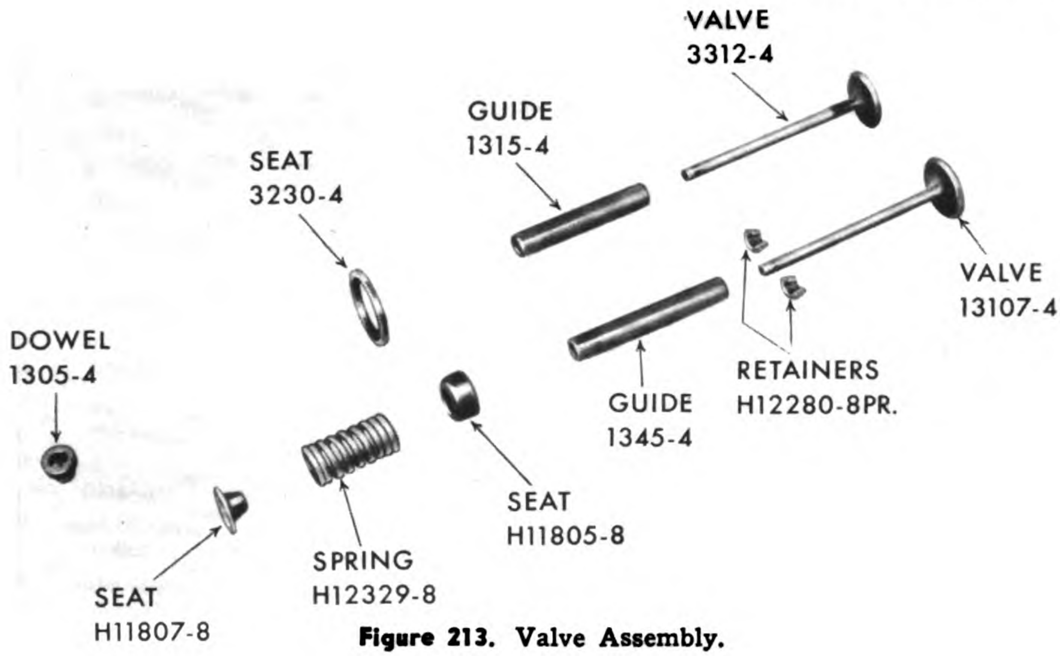


Figure 213. Valve Assembly.

Valves

Inspection of the valves includes the valve springs, valve spring seats, retainers, lifters, adjusting screws, and brackets. See figure 213. The inlet valve clear diameter is 1½" and the valve is made of chrome nickel steel. The exhaust valve clear diameter is 1⅜", and the head is made of silchrome No. 1 steel.

(266) Inspecting the Valves for Grinding and Replacement

If the valves are warped or burned, they must be replaced. If they are pitted, they should be refaced in a refacing machine at a 45° angle.

(267) Checking the Valve Springs for Replacement

Check the spring tension of each spring with a spring scale designed for this purpose. The tensions should all be equal. If weak, cracked or broken, replace the spring.

NOTE: When the spring is compressed to a length of 1-19/32 inches, which is equal to valve-open position, the scale should read 96 lbs. to 104 lbs.

(268) Checking the Lifter, Adjusting Screws and Brackets for Replacement

The lifter is of mushroom type and is made of grey iron with a chilled head. Check the head for cracks; replace if cracked.

The adjusting screw tends to become pitted where the valve stem strikes it. If the adjusting screw is at all pitted, it must be replaced.

Check the lifter holes in the bracket by inserting a lifter in the holes. If the fit, or fits, are loose more than .001", replace the bracket.

(269) Replacing the Retainers and Seats

Only because of loss or accident should it become necessary to replace the valve spring seats and retainers.

(270) Valve Grinding

When grinding the valves, a good quality, water soluble valve grinding compound should be used. This type of compound loses its cutting properties on contact with oil. A valve grinding tool like the one shown in figure 214 or one similar is recommended.

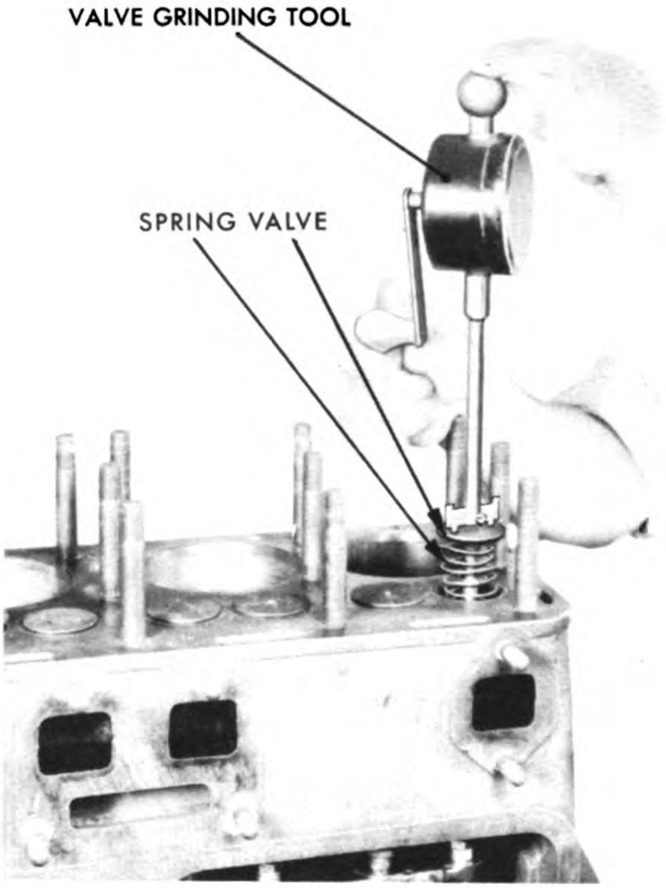


Figure 214. Grinding Valves.

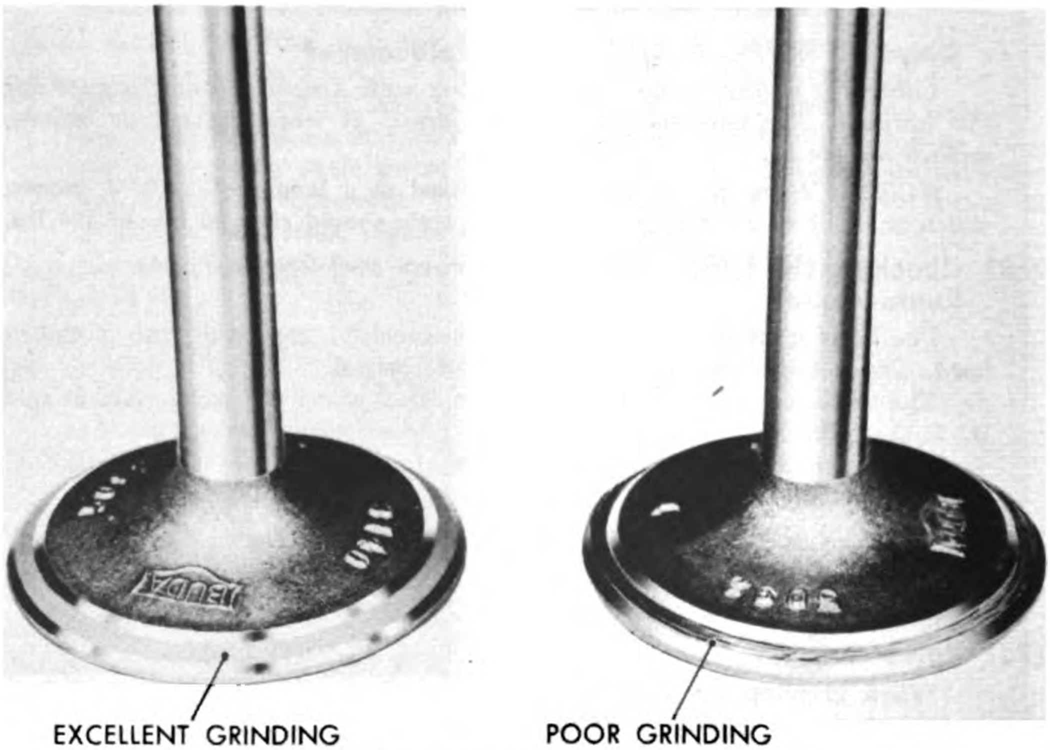


Figure 215. Example of Good and Poor Valve.

(271) Valve Grinding Procedure

Thoroughly examine the valve stems and the valve guide clearance before grinding the valves. Do not mix the valves during the inspection because the same valve must always go back into its original port. The intake and exhaust valves are made of different materials and if exchanged, they will not give proper service.

The valve stems can be cleaned with gasoline and a cloth buffer. Under no circumstances, use emery cloth or a wire brush on the stems, for the smooth glaze which is a normal result of engine operation will be destroyed. It is desirable to retain this glazed finish, since it prevents metal to metal contact. A wire brush may be used to free the valve heads of carbon.

With inside calipers or micrometers, check the valve guide clearance. The desirable clearance is from .00125" to .00025". If more than .0055", replace the valve guide, or guides.

Before beginning the actual grinding of the valves, all traces of carbon should be removed from the cylinder head and valve chambers, or ports. Care must be used so as not to scratch the valve seats or damage the metal in any way when removing the carbon.

It is not always necessary to reface the valves and recut the valve seats. Only if there are evidences of warping or serious pitting will the valves need refacing, figure 215. A good method of detecting warping is to put each valve stem in the chuck of a valve lathe and slowly rotate the valve while the grinding wheel is brought near the rotating valve face. The grinding wheel must be set to the proper valve seat angle. Move the grinding wheel toward the valve until it almost touches the valve. Any slight eccentricity will be noticed immediately.

If there are deep pits or grooves on the valve seats, it will be necessary to recut the seats.

If the valve faces and seats are believed to be in sufficiently good condition to grind in properly without reconditioning, a final test with valve compound should be made. First place a circular piece of fine emery cloth which is slightly larger than the valve port over an old valve head or a valve seat reamer so that the cloth will be between the valve and seat with the cutting side against the seat when the valve is placed in the cylinder. Pull firmly on the valve stem, with a grinding tool attached, and turn back and forth through several revolutions, to remove the hard glaze from the valve seat. Unless this is done, a great amount of unnecessary grinding will be spent in cutting through this glaze.

To test the seat and valve condition with grinding compound, place a very little bit of compound on the valve face, and grind against the seat in the usual manner. After a short time, remove the valve and clean both seat and valve of grinding compound. If both valve and seat show an even gray mark around their entire circumference, it proves that they are contacting fairly well, and that grinding may be accomplished without refacing and recutting. If either valve or seat shows a mark around but part of its circumference, then reconditioning is necessary before a satisfactory grinding job can be accomplished.

When refacing valves, be careful to avoid removing unnecessary metal. Just enough to clean up the valve face, and no more, should be removed.

When recutting valve seats, remove just enough to clean up the seat, and remove all evidence of pitting and grooving. Then place that particular valve in place, with a little grinding compound, and grind lightly. Remove, and observe where valve and seat contact. Then with proper refacing angle stones (usually 30° and 60°) narrow the seat down until it is slightly narrower than the valve face. The width of the finished seat should be between 1/16" and 3/32". Unless this is done, it will be impossible to get a good valve seat, no matter how long you grind.

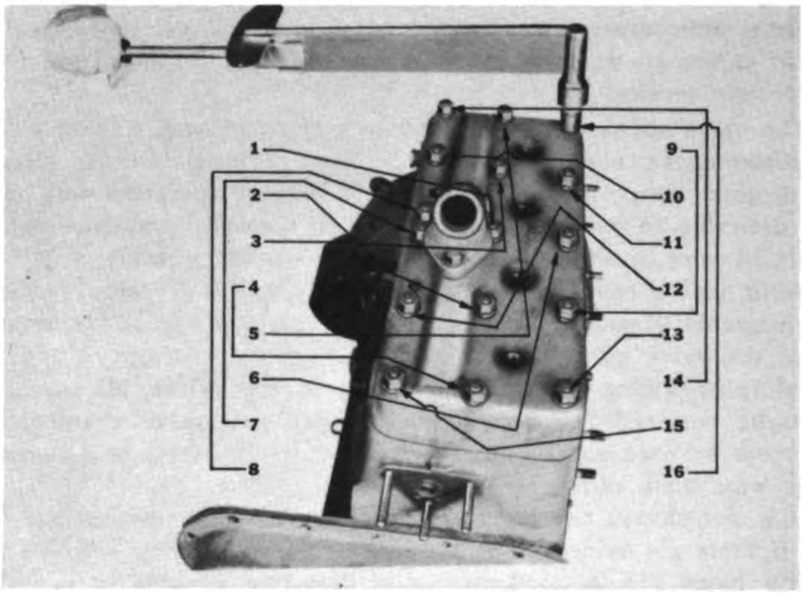


Figure 216. Tightening Cylinder Head Bolts.

To grind the valves, put a small quantity of valve grinding compound on the valves, just sufficient to cover the seating area. Grind the valves with a light but firm pressure, letting the spring lift the valve from the seat every two revolutions of the valve grinding tool crank. As soon as the "grinding feel" diminishes, wash the valve and seat in kerosene and examine the seat and valve. If the valve face or seat has lines or rings ground in it, this indicates that either the valve grinding compound was ground out, or too much pressure was applied, or the valve was not lifted off the seats often enough during the grinding operation. Therefore, the grinding must be done over.

If the valve and seat have the appearance of gray emery paper, apply a small amount of Prussian Blue on the valve face. Wipe off the excess so JUST A FAINT TRACE OF BLUE appears. Insert the valve and turn the valve on the seat one complete revolution under slight pressure. If the valve seat has a light blue ring completely around the seat, this indicates that the valve is seating properly. If the line is not complete, the valve and seat are not making complete contact and must be ground until they do.

Be sure to wash off the compound when the job is finished, and again check to see that all loose pieces of carbon around the valves and particularly between the piston head and cylinder walls are removed, for many well-done jobs of valve grinding are ruined by failing to remove small particles of carbon. Replace the head gasket with a new one. Tighten the cylinder head in the numerical sequence shown in figure 216.

Readjust the tappets as shown in paragraph 415, Chapter XXIV Engine Reassembly. The clearance on a hot engine should be .006" for the intake, .009" for the exhaust. After the engine has been run and is thoroughly warm, again tighten the cylinder head. See figure 216.

When grinding the valves, use care to avoid scratching or marring the seats or stems. Be very careful to avoid grinding compound entering the valve guides, and all traces of compound must be cleaned away at intervals during grinding, to avoid excess amounts spilling onto valve stem.

After valve grinding is completed, the parts should be thoroughly cleaned before reassembly, and the valve stems oiled.

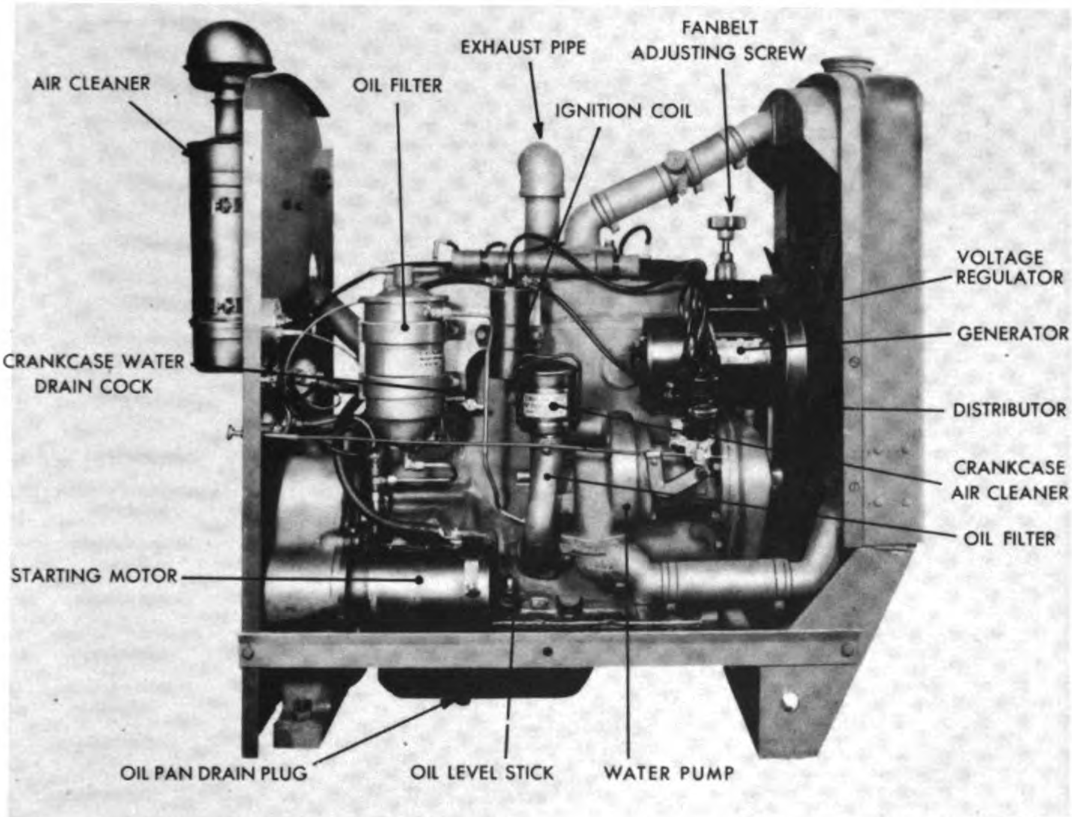


Figure 217. Right Side of Buda Model HP 217 Engine Showing Cooling System.

Chapter XXVIII

ENGINE INSPECTION AND REPAIR OF THE COMPONENT SYSTEMS AND THEIR ACCESSORIES

This chapter gives detailed instructions for the inspection, disassembly, repair and adjustment of the component systems of the engine and their accessories.

The same care and cleanliness used in overhauling the engine proper must be exercised in overhauling the component systems of the engine. For convenience, the instructions for the overhaul of the component systems are given alphabetically. They are: the cooling system; the electrical group which includes the starting system, generating system, and ignition system; the fuel system; and the lubricating system.

Cooling System

The efficient operation of the engine depends a great deal upon maintaining the proper operating temperatures in the cooling system. The cooling system must dissipate the heat of the engine under severe operating conditions and also to control efficient operating temperatures in cold weather. The cooling system includes the water pump, fan, radiator, thermostat, and a water temperature recording gauge. See figure 217.

(272) Water Temperature Gauge

This gauge records the temperature of the water that is circulating through the system. It has a range between 100°F. to 215°F. Any range over 215°F. is dangerous and indicates (a) shortage of water, (b) radiator clogged or not getting ventilation, (c) hose blocked, (d) engine out of time, (e) loose or broken fan, (f) defective or leaky water pump. (See Trouble Chart.)

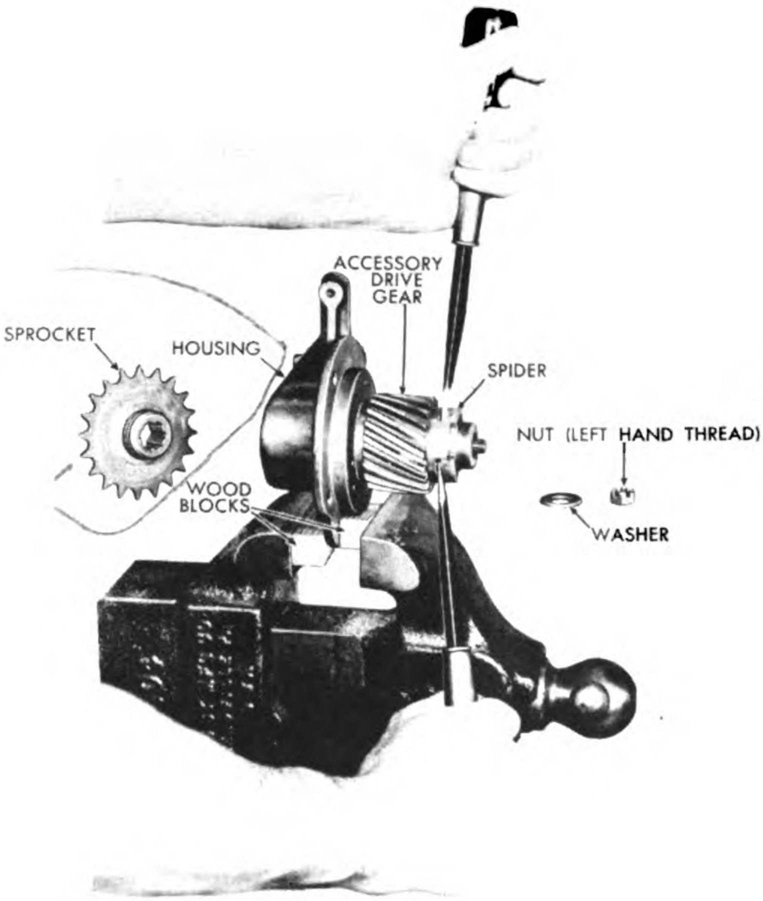


Figure 218. Removing Spider from Accessory Drive.

(273) Water Pump

The water pump is of the impeller type with spring gland packless seals. With the carbon washer seals, no adjustment is necessary or possible. The pump is driven by an accessory gear meshed with the idler gear. A shaft gear on the water pump also meshes with the gear on the distributor shaft.

(274) Disassembly of Accessory Gear

Remove the coupling sprocket with a wheel puller. Remove the cotter key and nut from the gear end of the shaft. NOTE: The nut is a left handed thread. (Figure 218). With a long nose pair of pliers, remove the lock or snap spring from the water pump side of the shaft. (Figure 219). Tap the threaded end of the shaft with a wooden mallet to remove the oil seal and the washer. (See figure 220). The unit is now disassembled and ready for inspection.

(275) Inspection and Replacement of Parts

Clean and examine the gear for wear in the following places: teeth, bushing and spider slot. Also examine the spider for excessive wear on the jaws and internal spline. Any wear on the latter will also show on the external spline of the shaft. Check the drive housing for cracks and mutilation, paying attention to bearing surfaces on which the shaft and gear ride. Examine the thrust washer for wear and roughness. Replace. Examine the shaft for wear in the following places: thrust washer surface, bearing surface, and splines. Always renew the felt retaining washer. To reassemble the gear, reverse the procedure under paragraph 274.

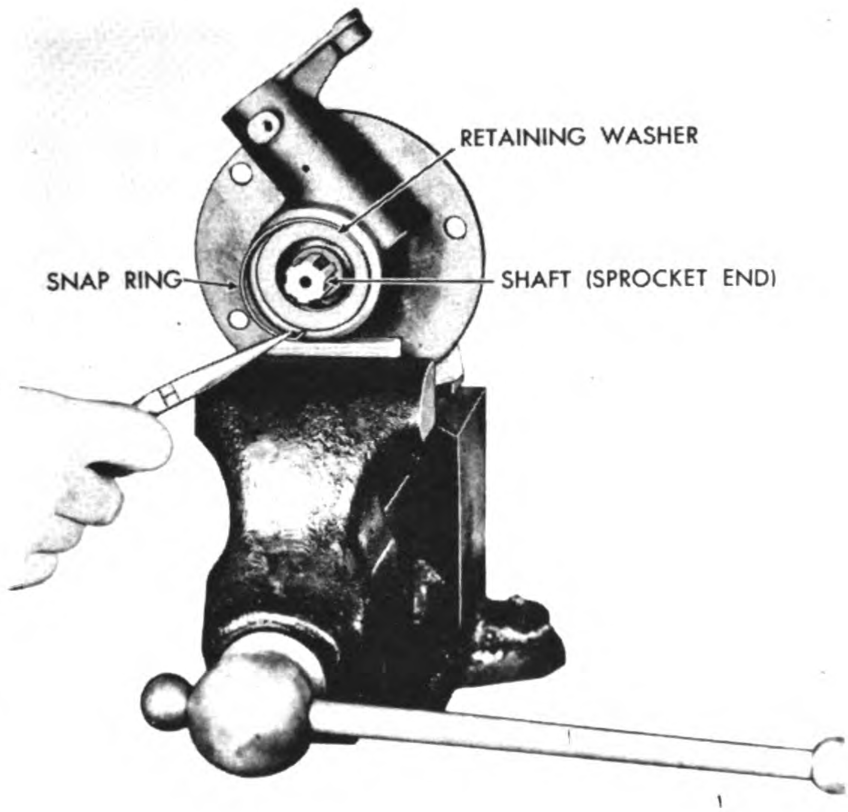


Figure 219. Removing Snap Ring.

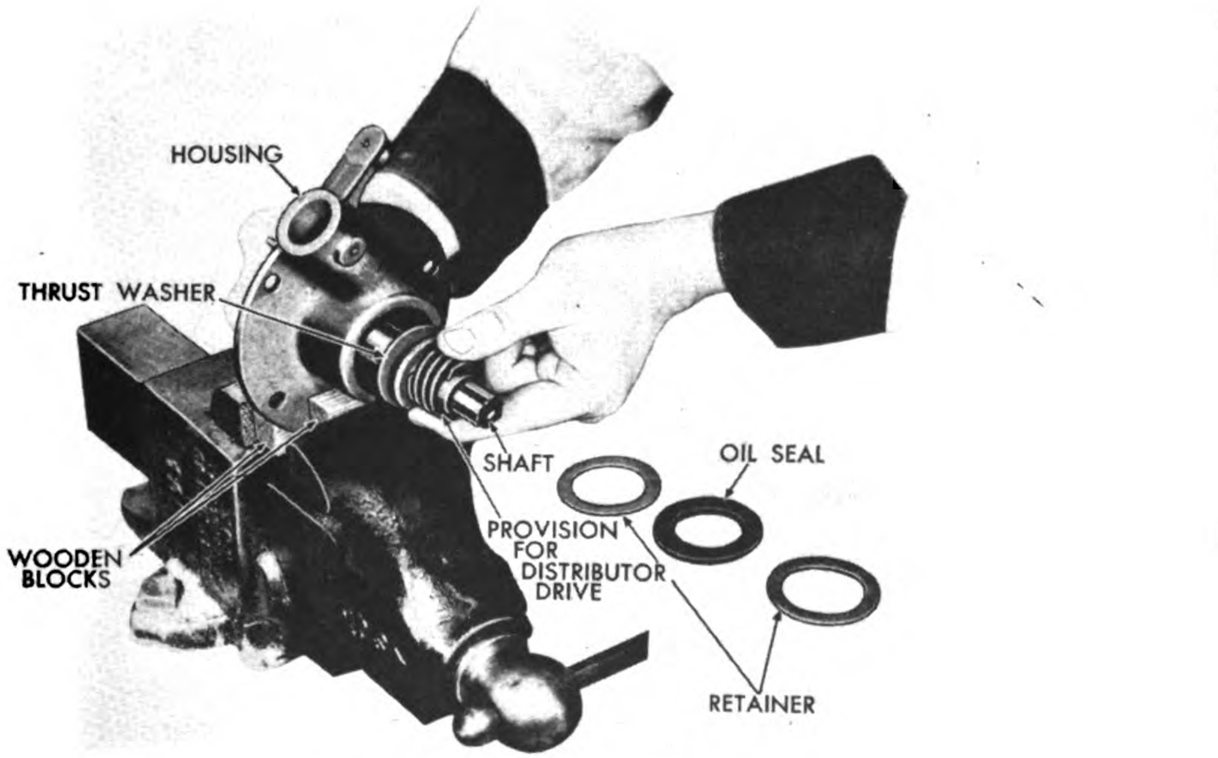


Figure 220. Removing Shaft and Retainer.

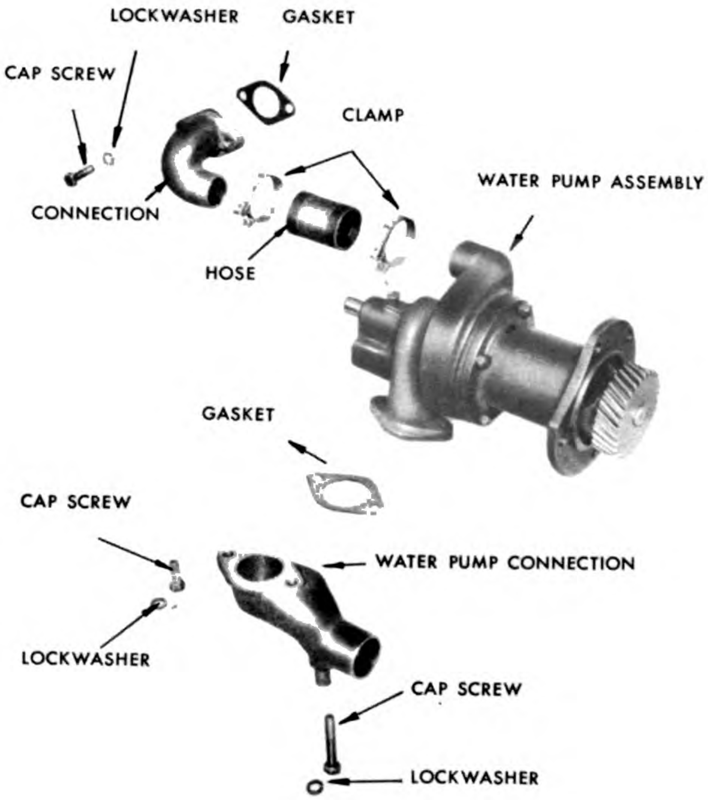


Figure 221. Water Pump Assembly.

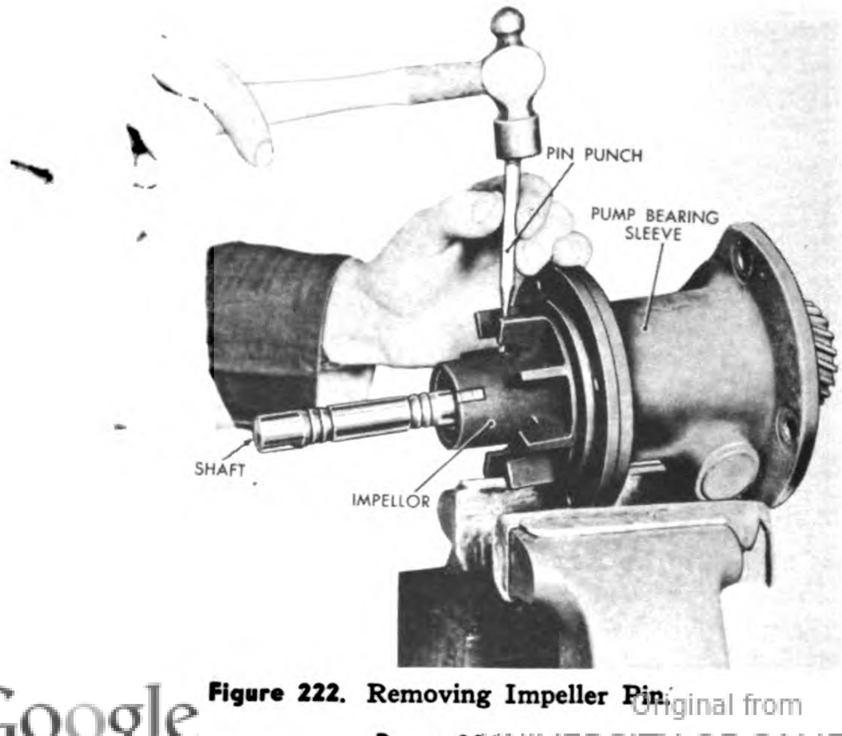


Figure 222. Removing Impeller Pin.

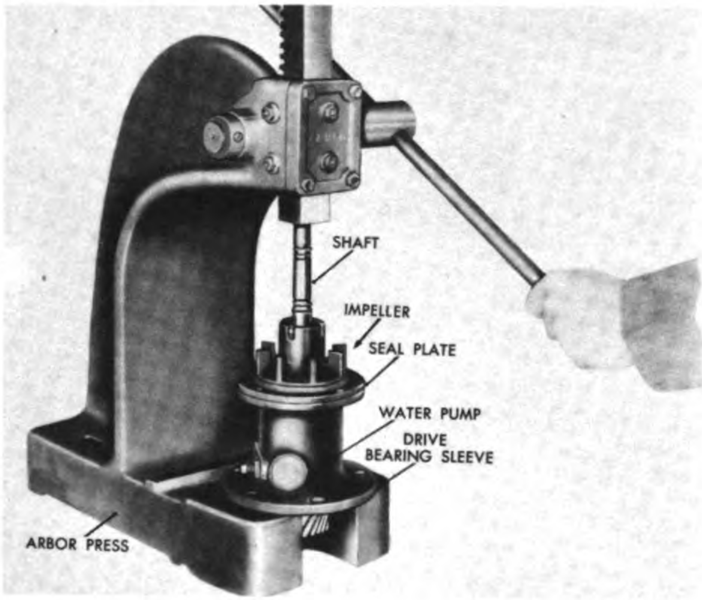


Figure 223. Pressing Water Pump Shaft through Impeller.

(276) Disassembling the Water Pump

a.. Remove the four nuts holding the water pump body to the drive bearing sleeve and separate the two parts as shown in figure 221. Drive out the impeller pin with a punch as shown in figure 222.

NOTE: This pin is a grooved taper pin which has two ridges that wedge the pin when it is driven into the impeller and the shaft, thus preventing the pin from turning and coming loose. Therefore, when driving the pin out, be sure to drive out the end that is flush with the impeller hub. Place the punch on the end that is slightly recessed.

b. Press the shaft through the impeller as shown in figure 223. NOTE: Mark on the shaft and the impeller body so that the impeller will be installed in the same original position when it is reassembled. Remove the spring clip in the end of the shaft by pressing the shaft slightly through the gear until the clip can be released and pried off.

c. Press the shaft out of the gear on an arbor press.

d. Remove the spring clip from the impeller as shown in figure 224 and remove the water pump seal assembly.

(277) Inspection and Replacement of Water Pump Parts

a. Always replace the water pump flexible seal and the water pump seal carbon washer. If the spring, clamp ring or guides are defective, replace the entire water pump seal assembly.

b. Check the impeller for cracks and broken impeller blades and for looseness of the impeller on the shaft and for looseness of the pin in the impeller. If it is just the impeller that is worn, replace the impeller, if the shaft, replace the shaft. In the event of a loose pin, usually a new pin will overcome the looseness.

c. The bearing in the bearing sleeve is not removable, and if it is worn, the whole bearing sleeve must be replaced. This condition is most unlikely and therefore should it occur, it will be necessary to replace the shaft as well.

d. Check the water pump body for cracks. If the shaft bushing is worn in the body, replace the bushing. This bushing is a simple "drive in" and "drive out" bushing. Be sure when replacing this bushing to line up the oil slot correctly with the oil reservoir.

e. Install new wicking in the oil reservoir. It will be necessary to first remove the expansion plug with a small cold chisel to remove the wick and install it. Replace the expansion plug.

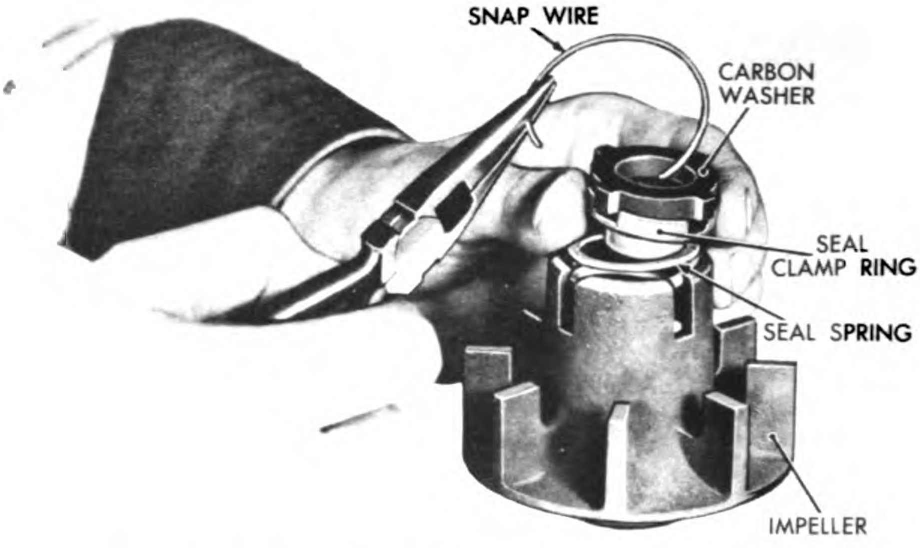


Figure 224. Removing Spring Clip from Impeller.

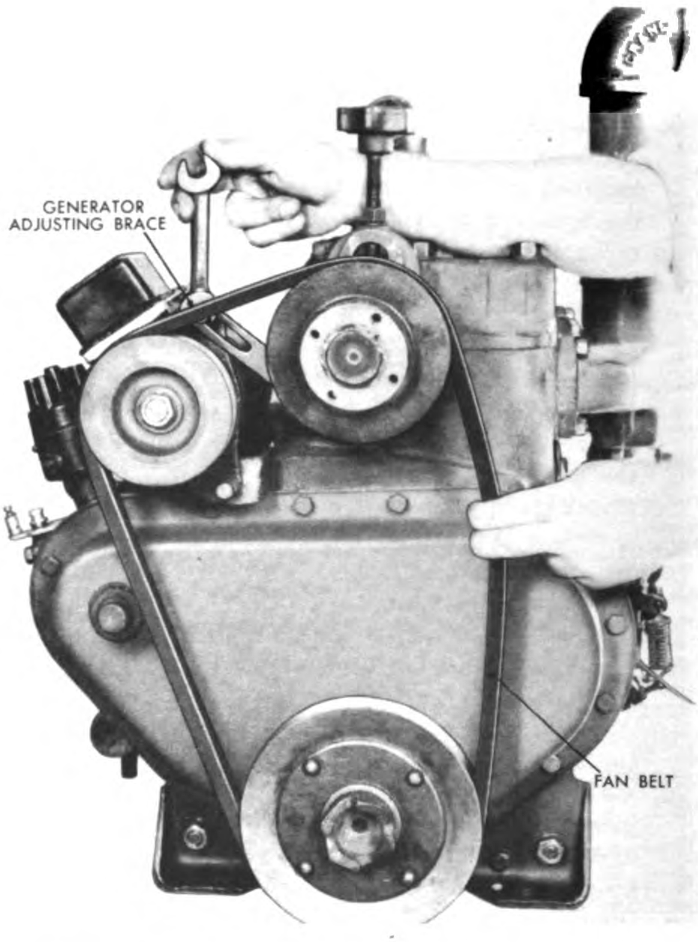


Figure 226. Checking Belt Slack.

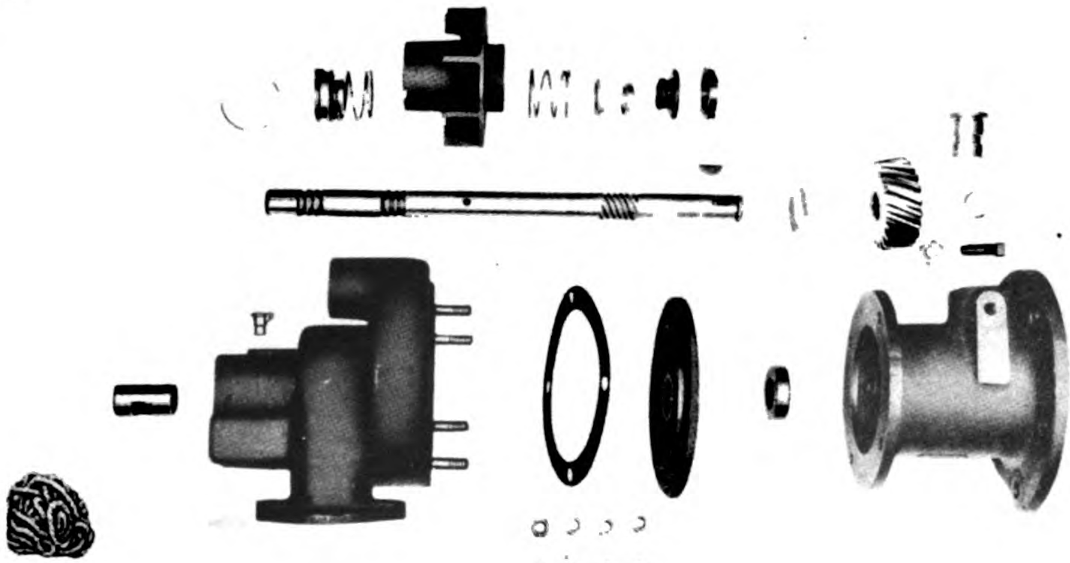


Figure 225. Exploded View of Water Pump.

(278) Reassembling Water Pump

a. Press the gear on making sure to line up the keyway with the key, pressing the gear down far enough so that the lockwire can be installed into the groove on the shaft. Press the shaft back down so that the snap wire will be down in the gear.
b. Install the thrust washer on the shaft.
c. Install the bearing sleeve onto the shaft.
d. Install the oil seal and seal plate.
e. Install both of the seals in the impeller in their proper order as shown in figure 225 and grease the inside of the water pump flexible seals.
f. Install the impeller and seals on the shaft and press it into place. CAUTION: Do not hammer the impeller on the shaft as this may result in breaking the carbon seals or the impeller.
g. Drive the grooved taper pin in place. Install the impeller body and gasket and the four nuts and lockwashers holding the water pump body to the bearing sleeve.

(279) Fan and Fan Belt

The fan is of the pusher type blowing the air through the radiator away from the engine. The fan is lubricated with wheel bearing grease WB-3 every 512 hours of operation as indicated in the lubricating chart. At the 2,048 hour overhaul, the fan should be disassembled, thoroughly cleaned, and the parts checked for any excessive wear and such replacements made as are found necessary. The instructions for the overhaul are given in paragraphs 280 and 281.

The fan belt is of the vee type. The vee type belt must run with some slack—just enough to prevent slippage in order to avoid excessive wear, must be approximately ¾" slack. To adjust fan belt tension loosen the generator adjustable bracket screw and nut and adjust the position of the generator for the desired fan belt tension. See figure 226.

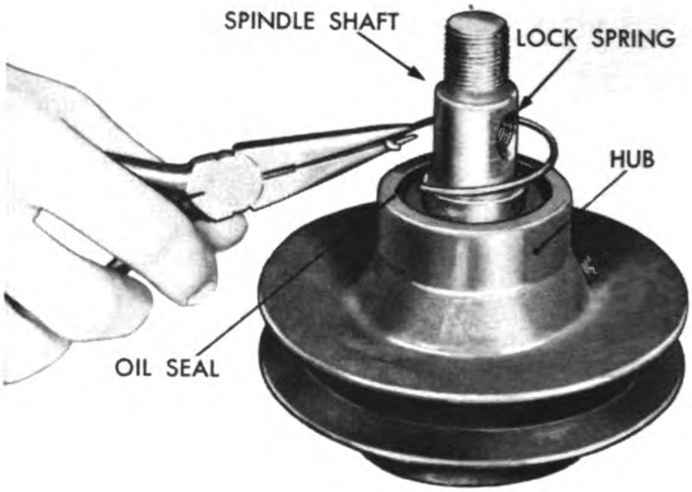


Figure 227. Removing Fan Hub Lock Spring.

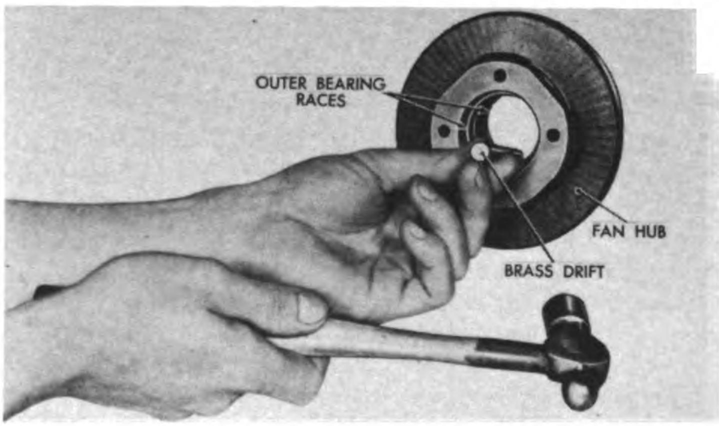


Figure 228. Removing Outer Race.

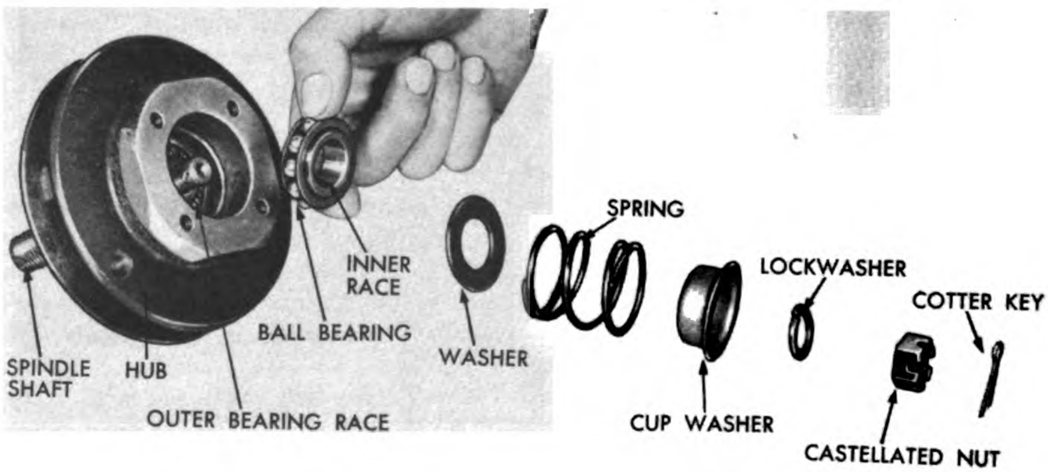


Figure 229. Removing or Installing Fan Bearing.

When reinstalling a new fan belt, always loosen the fan belt adjustment so as to allow the belt to be slipped in place without forcing. This will avoid any internal damage to belt.

(280) Disassembling Fan

a. Remove the four capscrews holding the fan blade assembly to the fan pulley. Place the fan pulley on a bench so that the fan mounting face is down.

b. Then remove the lock spring holding the oil seal in place as shown in figure 227.

c. Turn the pulley over and remove as much of the old grease as possible.

d. Remove the cotter key from the fan spindle shaft and remove the castellated nut. When the nut is removed the spring will force the cup shaped washer off the shaft revealing the ball bearing.

e. Tap the end of the shaft inside the pulley with a small block of wood to force the shaft and the oil seal from the pulley. The ball bearing and oil seal can now be removed from the shaft. The bearing on the opposite side left in the pulley will fall out when the pulley is turned over.

(281) Inspection and Replacements of Fan Parts

a. Always replace the felt seal and gasket.

b. Thoroughly clean the parts of the fan pulley assembly in gasoline or kerosene. NOTE: Both bearings are alike, but they should not be interchanged as to their positions on the shaft since they should operate the original race from which they were removed. Therefore, when cleaning them, be sure to keep them identified with regard to the races.

c. Examine the pulley bearings for pitting or irregularity in the balls and for wear, pits, and unevenness in the recess. If the races or the bearings are pitted or worn, remove the outer race as shown in figure 228 with a punch and hammer.

d. Examine the fan spindle shaft for mutilated threads and any evidence of the ball bearing inner race turning on the shaft. If either of the foregoing conditions exist, replace the shaft.

e. Check the fan pulley for cracked flanges, mutilated threads, looseness of the outer bearing races. If the foregoing conditions exist, replace the pulley.

(282) Reassembling Fan

a. If either of the bearing races were removed, drive the new race or races into the pulley with a block of wood, making certain to get the races in straight.

b. Push the ball bearing which is nearest to the seal onto the shaft and coat liberally with grease.

c. Push the shaft into the pulley through the seal end. Pack WP (water pump) grease around the shaft in the hub and push the other bearing in place on the shaft. See figure 229.

d. Install the large flat washer, spring, cup shaped washer, small washer and the nut on the fan side of the pump shaft. Secure the nut and insert the cotter key. Fill the pulley with water pump grease so that the grease is even with the fan mounting face. See figure 229.

e. Turn the pulley over and install the large paper gasket against the outer bearing race.

f. Install the slightly concave washer against the bearing so that the concave side is out. Push the cork seal into the retainer and install on the shaft and into the pulley. Install the lock or snap ring. See figure 227.

g. Install the fan blade to the fan hub.

(283) Radiator

The radiator is designed to cool the water under all operating conditions. However, the radiator core must be kept free from corrosion and scale at all times. The cleaning of the radiator, inspection of the connections and mounting bolts, and the use of corrosion preventives are part of the periodic service procedures that are recommended. During the engine overhaul, the radiator core should be cleaned inside and out in a clean solution. At the same time the core should be examined for leaks, bent tubes, and repairs that are necessary to be made.

It is important that only clean soft water be used in the cooling system. The use of hard water will cause scale to form in the engine jackets and in the radiator, thereby tending to clog up circulation. Where the use of hard water cannot be avoided, use a commercial water softener. Blow out bugs or any leaves or lint, or any other obstructions that may have lodged between the fins on the core and the tubes with air pressure. Bent fins should be straightened.

(284) Repairing a Leaky Radiator

Do not use liquid solder or radiator compounds to stop leaks as these tend to clog the radiator tubes. A leaky radiator should be tested under water with about four to five pounds of air pressure. Note the source of the air bubbles and solder the leaks. Be sure to wash off the acid after soldering, for many well-done jobs have been ruined by not washing off the acid which will eat into the tubes.

(285) Servicing a Clogged Radiator

If a hose is available through which there will be twenty to thirty pounds of water pressure, attach the hose to the bottom of the radiator at the drain hole. This reverses the flow and will tend to carry the dirt which has been lodged down in the tube back upward and out through the top of the radiator. If the radiator is so badly clogged that this does not serve to free the circulation, then use a solution of one part of muriatic acid to three parts of water in sufficient quantity to fill up the radiator. If muriatic acid is not available, a solution can be used make up of approximately three pounds of commercial lye added to a sufficient quantity of water to fill the cooling system. In either case, the solution should be allowed to stand in the system three or four hours. After draining the radiator and engine, the cooling system should be thoroughly flushed with clean water before filling with clean water.

(286) Hose and Hose Connections

Occasionally pieces of broken hose will clog the radiator and cause overheating. This condition can be overcome by draining and flushing the radiator. Be sure that all hose connections are tight.

(287) Adding Water to Overheated Engine

When engine is short of water, stop and let the engine cool off. When adding water keep the engine running at slow speed, to avoid cracking the block or radiator.

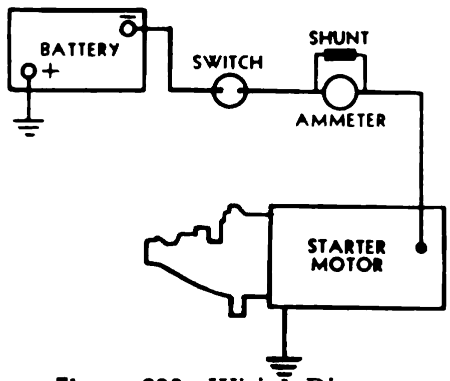


Figure 230. Wiring Diagram.

Electrical Group

The electrical group consists of the Starting System, the Generating System, and Ignition System.

The wiring diagram shows how the electrical group is connected to the engine. (See figure 230).

The Buda HP-217 Engine is equipped with a single wire electrical system. This single wire system contains various size wires and connections by means of which all electrical units are interconnected with a storage battery. The engine and metal parts act as a ground for completing the other circuits necessary for conducting the electrical energy to the various electrical units.

For accurate tests of the electrical units and satisfactory repairs, it is necessary that adequate tools, equipment, and precision gauges and meters are available. Although such units as starters, generators, and distributors are sturdily constructed, they have delicate mechanisms which require extremely accurate adjustments for precision operation.

No adjustments of the voltage regulator should be attempted without the necessary information, test meters, and such tools as are necessary for satisfactory repair jobs.

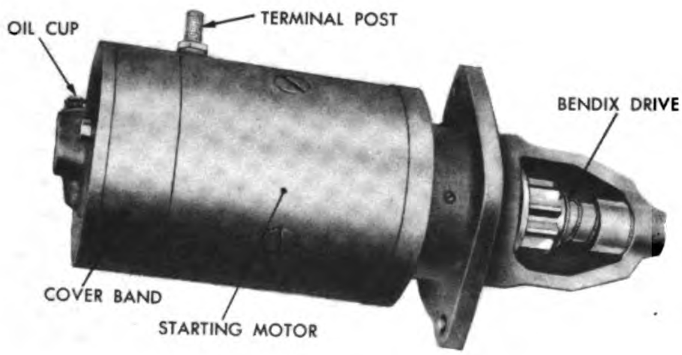


Figure 231. Starting Motor.

(288) Starting Motor and Magnetic Switch

The starting or cranking motor is a four pole, four brush, six volt unit with the armature supported by a grey iron bearing at the commutator end and a bushing at the drive end. When current is passed through the field coils, a powerful magnetic field is created. Current then flowing through the armature windings causes a strong force to be exerted on the armature windings so that the armature is forced to rotate or spin. This rotating movement is transmitted by the starting motor drive pinion to the engine flywheel so that the engine is cranked. The Bendix Drive provides meshing of the drive pinion with the engine flywheel when the cranking motor operates, and demeshes the drive pinion as soon as the engine starts running. See figure 231.

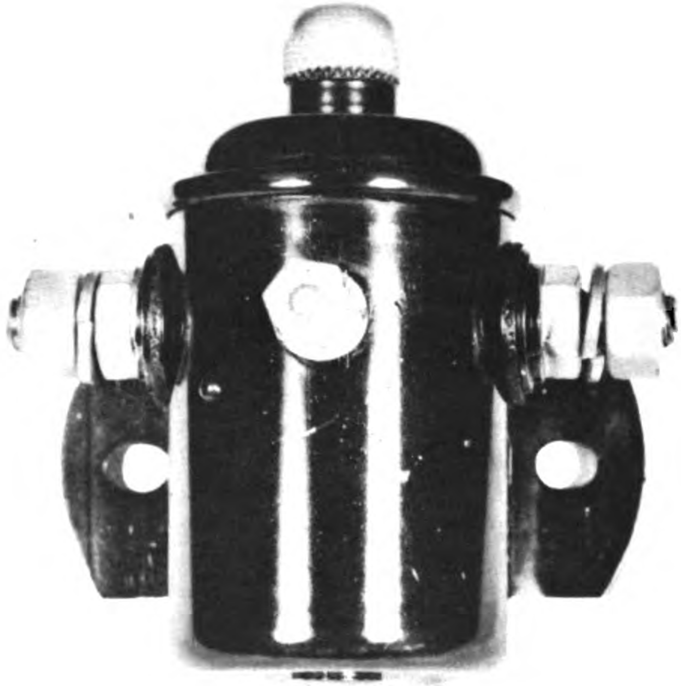


Figure 232. Magnetic Switch.

The magnetic switch consists of a winding, plunger, contact terminal, and contact disc. When the winding is energized (connected with the battery) by the closing of the cranking motor switch, the resulting magnetic field pulls in the solenoid plunger, forcing the contact disc against the contact terminals and connecting the cranking motor to the battery. Opening of the cranking motor switch disconnects the magnetic switch winding from the battery so that the magnetic switch spring can separate the contact disc from the terminals opening the circuit between the cranking motor and battery. See figure 232. Tabulated data on starter motor is as follows:

Clockwise rotation, viewing drive end.
Brush spring tension—32 to 36 ounces.
No load—65 amperes at 5 volts at 6000 r.p.m.
Lock torque test—15 pounds foot at 570 amperes at 3.15 volts.

(289) Servicing Starting Motor Every 128 Hours of Operation

a. Remove the head band and inspect the commutator. If the commutator is dirty or discolored, it can be cleaned by holding a piece of No. 00 or No. 000 sandpaper against it while turning the armature slowly. Blow the sand out of the motor after cleaning the commutator. If the commutator is rough or worn, the motor should be removed from the engine for an overhaul. CAUTION: NEVER USE EMERY PAPER.

b. Inspect the brushes. The brushes should slide freely in their holders and make full contact on the commutator. Make sure that the brushes are perfectly in line with the commutator segment. If the brush holders need repair or if the brushes are worn to any shorter than 5/16" (from an original length of ½", the motor should be removed for an overhaul and brushes replaced, as given in paragraph 316.

c. Inspect the wiring from the battery to the ground and from the battery to the starting switch, and from the switch to the motor for loose or corroded connections and for frayed insulation. Also check the mounting bolts which must be tight.

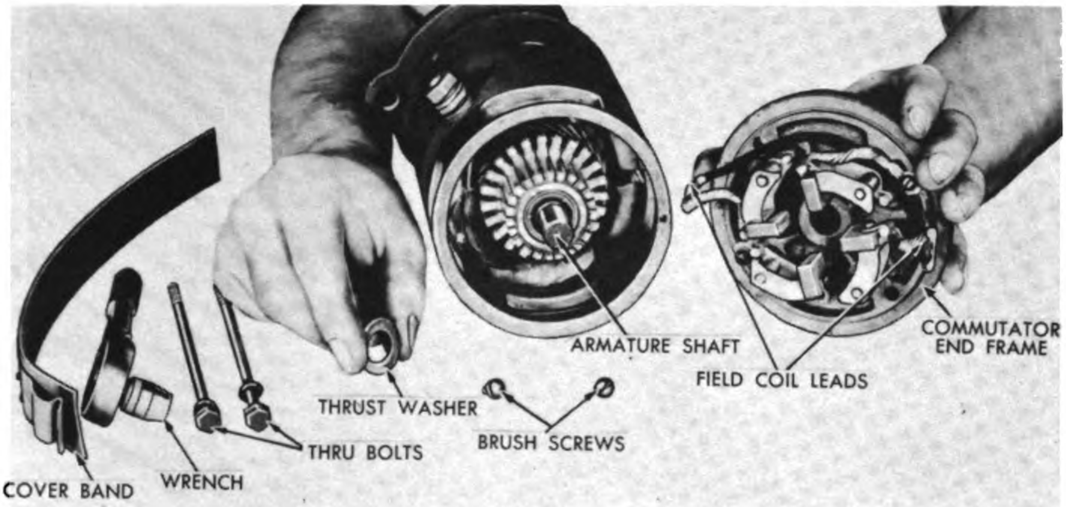


Figure 233. Removing Commutator End Frame.

(290) Tuning Up Starting Motor Every 256 Hours of Operation

a. Remove the starting motor from the engine.

b. Detach the commutator end frame by removing the cover band and by removing two brush screws and lockwashers so that the field coil may be detached, and then removing the two through bolts and lockwashers. See figure 233.

It may be necessary to tap the commutator end frame lightly with a soft hammer to loosen it.

c. Remove thrust washer from armature shaft. See figure 234.

d. Tap the drive housing away from the field frame and remove the armature with the Bendix Drive and the drive housing. See figure 234. Then remove the armature and Bendix Drive from the drive housing as shown in figure 235.

e. The Bendix Drive may be removed from the drive shaft by bending down the tang of the lockwasher and unscrewing the Bendix Drive head attaching screw. The Bendix Drive assembly will slip off the shaft. Remove the woodruff key from the shaft. If necessary, the Bendix Drive may be further disassembled by removing the other drive spring attaching screw after bending down the tang of the lockwasher. See figure 236.

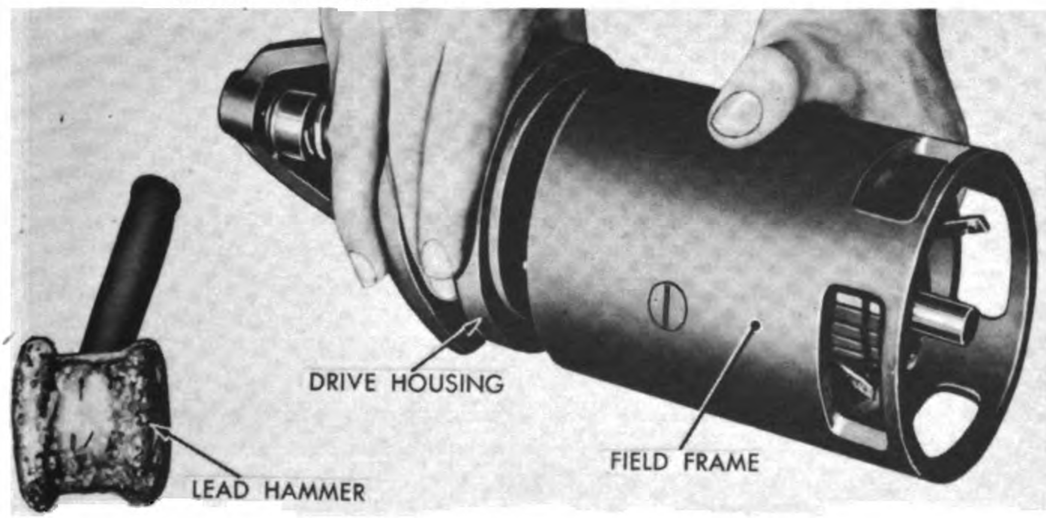


Figure 234. Removing Drive Housing and Armature from Frame.

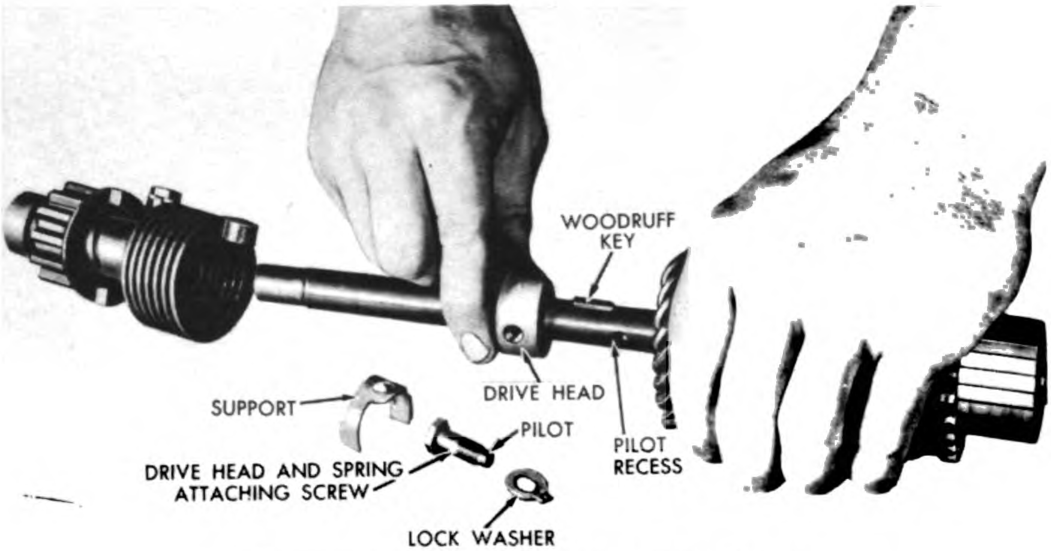


Figure 235. Installing Bendix Drive Head.

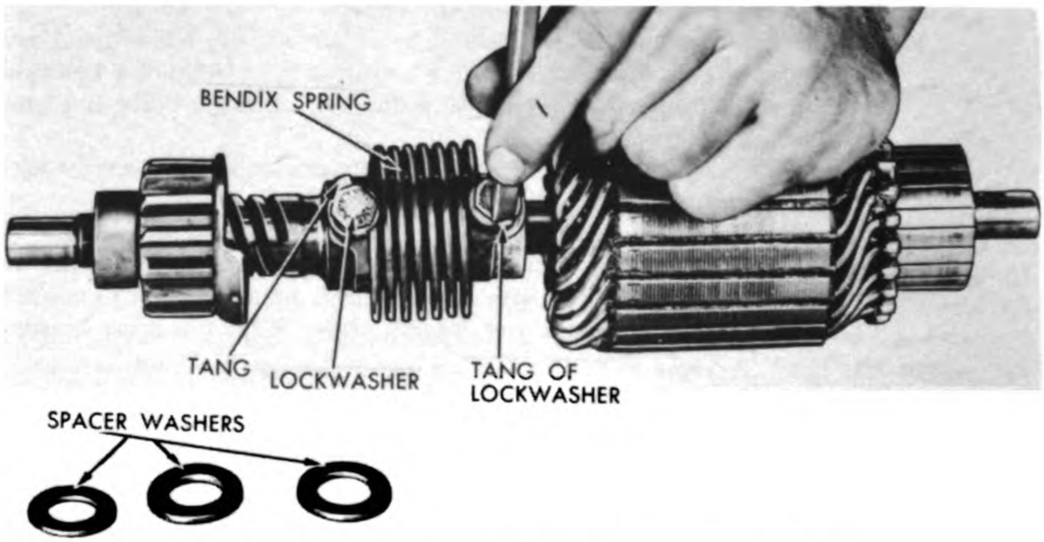


Figure 236. Bending Lockwasher Tang on Bendix Drive.

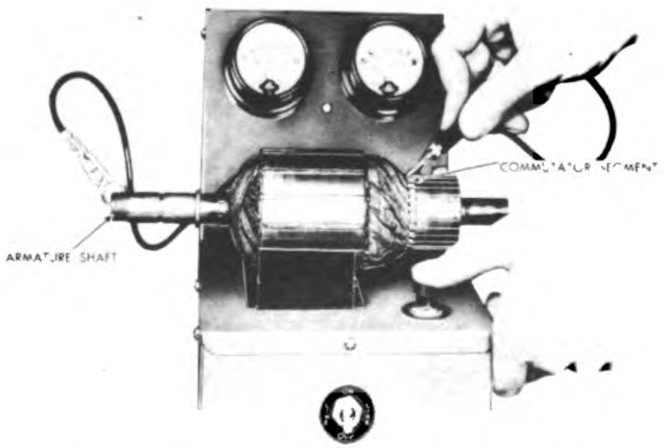


Figure 237. Testing Armature for Grounds.

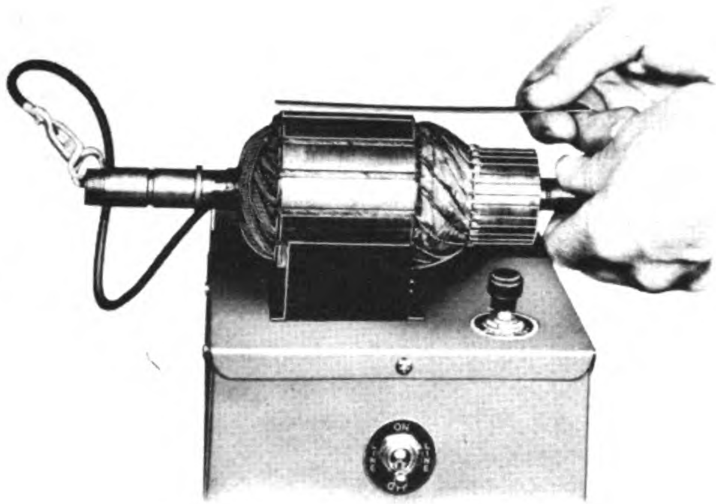


Figure 238. Testing for Shorts on Growler.

(291) Servicing and Checking the Armature

a. 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 a high mica, filled slots, or is burned, it must be turned down in a lathe and the mica undercut. See paragraph 304. Armature may be checked for ground, open, or short circuit as follows:

b. Check the 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. See figure 237.

c. 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. See figure 238.

d. 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.

(292) Inspecting the Fields

The fields should not be cleaned by a 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 charred 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.

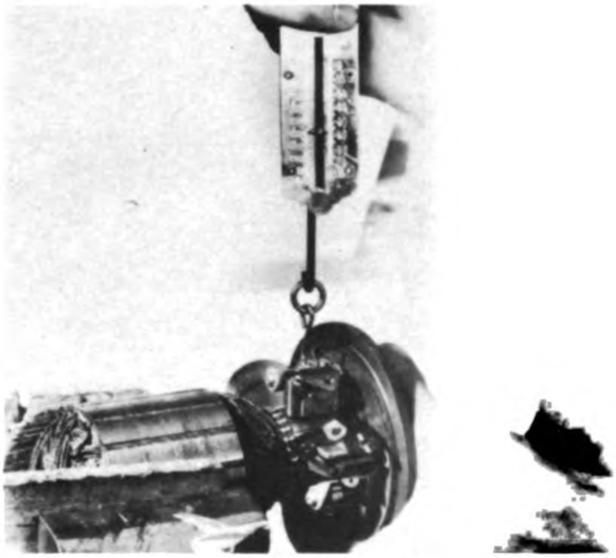


Figure 239. Checking Brush Spring Tension.

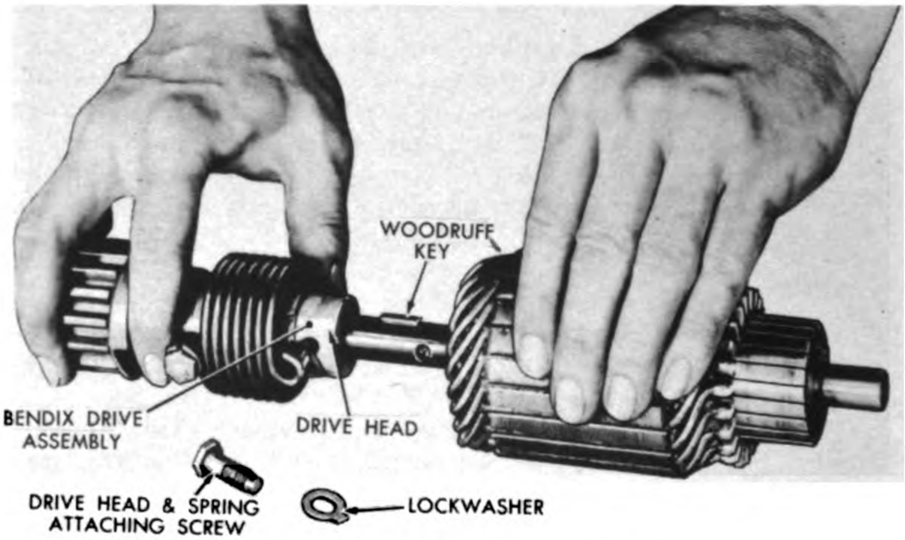


Figure 240. Installing Bendix Assembly.

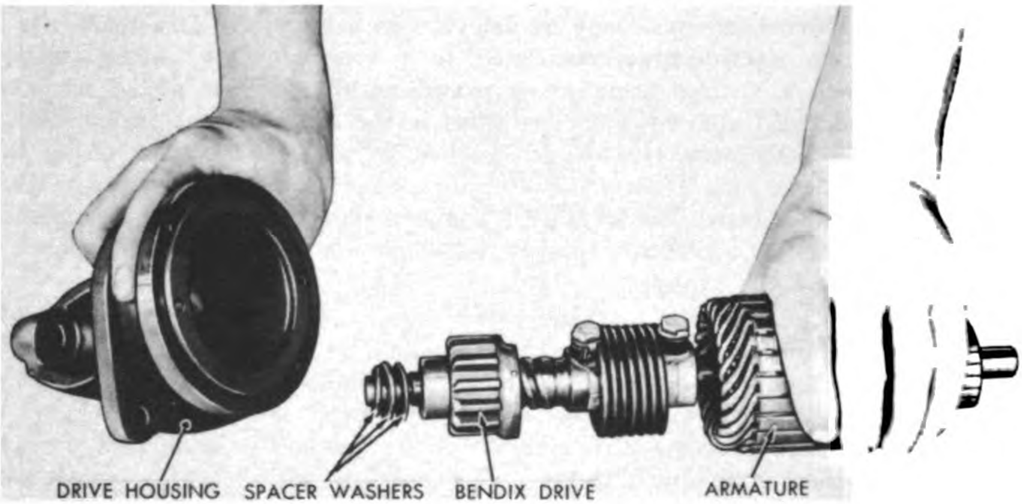


Figure 241. Installing Armature Shaft and Bending Assembly into Drive Housing.

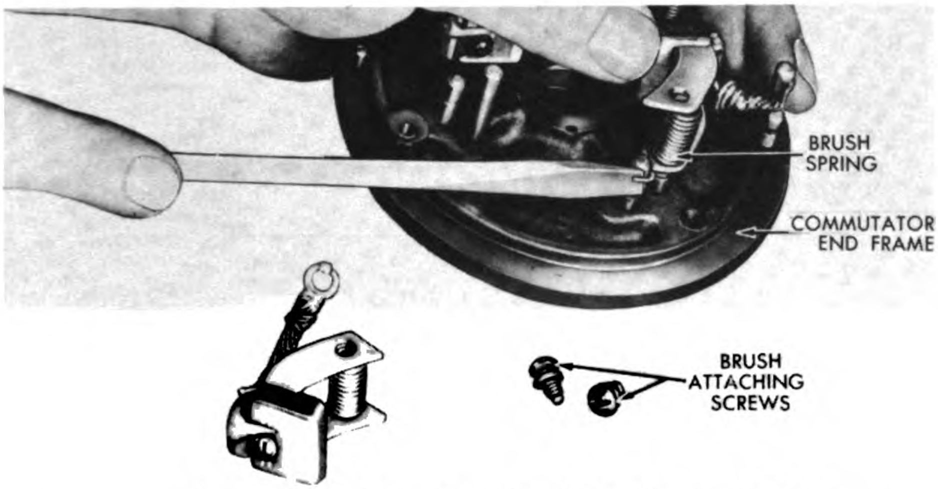


Figure 242. Removing Brush Holders and Spring.

(293) Checking the 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 and 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 brushes against the commutator can be measured with a spring gauge. Replace springs if the tension is not 32 to 36 ounces. See figure 239.

(294) Checking the Brush Holders

If the brush holders, spring pins, insulators, washers, etc., are warped, cracked, burned, or otherwise damaged, replace them.

(295) Inspecting the Bendix Assembly

Clean the Bendix assembly in kerosene and inspect the Bendix for worn parts or distorted springs, and replace any faulty parts. Lubricate sparingly with light oil.

(296) Reassembling the Starting Motor

a. To assemble the Bendix drive on the shaft, put the woodruff key in place followed by the drive head. See figure 235. Slip the drive spring and remainder of the assembly on the shaft and secure them by running down the Bendix drive spring screw. Be sure to use new lockwashers and place them with the bent lip in the gap in the drive spring eye. Bend the tangs up against the flat side of the screw head. See figure 240.

b. To assemble the gear housing with the armature to the field frame, place the thrust washer on the armature shaft and slip the shaft into gear housing.

c. To attach the drive housing with the drive, place the drive shaft with the gear and Bendix drive in the drive housing as shown in figure 241, and attach the housing to the field frame. Make sure that the dowel pins line up with the dowel holes.

d. To attach the commutator end frame, place the thrust washer on the armature shaft and cock the brush holders and slip the commutator end assembly into place on the field frame. See figure 242. Insert the two through bolts and lockwashers. Attach the two field coil leads to the brush lead clips with two screws and lockwashers. Install the cover band.

The starting motor should now be subjected to lock torque test and no load test.

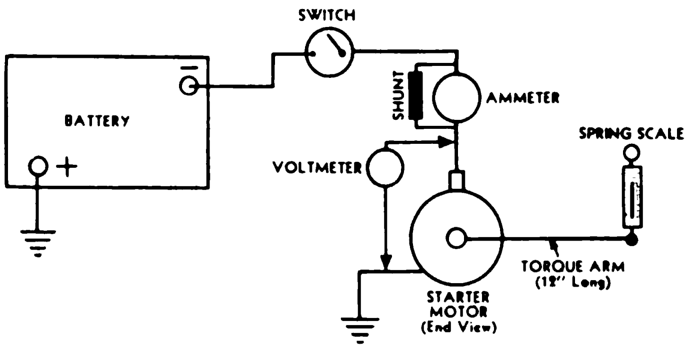


Figure 243. Hook-up for No Load and Torque.

(297) Starting Motor No-Load Test

Connect an ammeter, carbon pile rheostat, and battery in series with the motor terminal and the frame. (Starting motor should be removed from the engine for this test.) Connect a voltmeter from the motor terminal to the motor frame. See figure 243. Adjust the voltage to 11.0 volts and read the ammeter which should not show more than 35.0 amperes. Hold a tachometer against the drive end of the armature shaft and read the speed while operating at 11.0 volts. The speed should be at least 4100 r.p.m.

If the current is high and the speed low, inspect the bearings for correct alignment and make sure the armature turns freely without interference. If the current is low, inspect the brushes for correct seating on the commutator and inspect the internal connections of the motor for high resistance.

(298) Starting Motor Lock Torque Test

With the motor connected as given in the foregoing paragraph and using a spring scale and torque arm, measure the stall torque.

Fasten the torque arm securely to the starter motor shaft. The motor should be clamped rigid to a work bench. Hook the spring scale to the torque arm exactly 12" from the center of the motor shaft. With the current flowing through the motor, adjust the voltage to 6.0 volts and read the ammeter and spring scale. The current should be 440 amperes maximum and the torque should be more than 20.0 foot pounds. If the current is high or the torque too low, inspect the motor for high resistance connections, incorrect bearing alignment, and incorrect brush seating.

(299) 512 Hours Overhaul of Starter Motor

At this period a complete disassembly of the subassemblies of the starting motor should be done. After the disassembly of the starter motor into its major assemblies has been made according to paragraph 290, the disassemblies of the major assemblies are made as follows:

(300) Disassembly of Commutator End Frame Assembly

Remove two brush attaching screws (screw-driver) and lock washers so the four brushes may be detached. Two screws were removed when the field leads were disconnected to remove commutator end frame.

Detach brush springs by catching straight section of springs with pliers or screw driver and lifting off with brush holders. See figure 242.

(301) Disassembly of Field Frame Assembly

Remove field coils from field frame by removing 4 pole shoe screws (pole shoe screw driver) 4 pole shoes and coils. See figure 244. Be careful with coils to avoid bending lead connections or damaging insulation. Take off insulating strip under coil connections.

From terminal stud, remove nut (5/8" wrench), lock washer, washer nut (5/8" wrench), lock washer, washer, and insulating washer. Remove terminal stud from field frame and slip three bushings and insulating washer off stud.

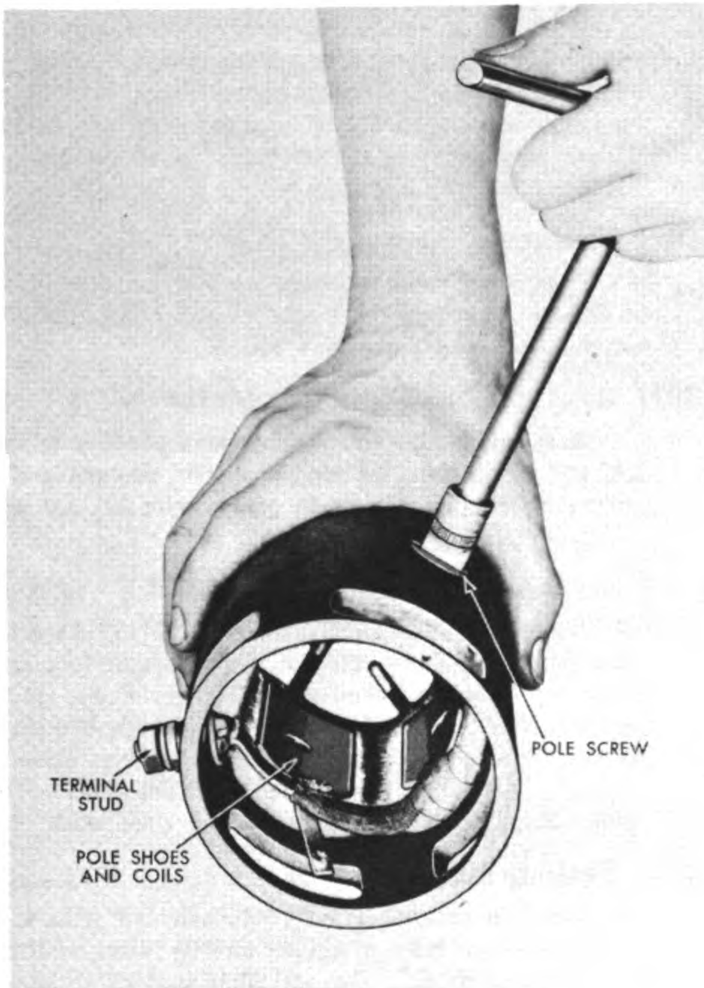


Figure 244. Removing Pole Shoe Screws.

(302) Disassembly of Magnetic Switch

The only disassembly is that the outside nuts and lock washers may be removed. The inner nuts should not be removed since this would allow the studs to turn so leads inside the switch would break off.

(303) Repairs and Replacements

Any defective insulator, screw, washer, lead, stud, plate, etc., should be replaced. Cracked, bent, worn, burned, insulators or washers are defective and must be replaced. 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, and must be replaced.

(304) Repairing Armature

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 1.5625 in. (original 1-11/16"). If it is necessary to turn commutator down below this diameter, discard armature. Undercut mica 1/32 inch.

Some bars badly burned, with other bars fairly clean, indicates an open circuited armature. The open circuit 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. Thrown solder is evidence of this condition. Repair is made by resoldering leads in riser bars (rosin flux) and turning down commutators.

(305) Repairing Fields

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.

(306) Replacing Bushings

If a new bushing should be installed in the drive and housing, it should be finished as follows: burnish to .624-.625; drive housing—burnish to .562-.564; commutator end—burnish to .500-.501.

(307) Reassembly of Starting Motor

Reassemble the starting motor according to the instructions in paragraph 296 and subject the starting motor to no-load and lock torque tests according to the instructions given in paragraphs 297 and 298.

Battery

KEEP THE TERMINALS TIGHT AND CLEAN. A loose battery connection will cause the voltage regulator to chatter—and this may result in early failure of the regulator. If they show tendency to corrode, clean and apply a thin coat of vaseline to protect them from the acid. Keep the outside of the battery clean. Neutralize any electrolyte that may be on the metal surfaces with a cloth saturated with ammonia or bicarbonate of soda solution (one pound to one gallon of water,) then wash off with water and dry.

(308) Testing Battery

Test the specific gravity of each cell with a hydrometer. A reading of 1.270 indicates fully charged; shortly after adding water. CAUTION: Use only distilled water. Do not allow battery to stand in a discharged state. It may become ruined by sulphation. A stored or unused battery should be given a slight charge once a month. A battery can sometimes be brought out of sulphation by a long and steady low charge.

If the battery requires frequent addition of water and is gassing excessively, test it. If in bad condition, it is undoubtedly due to overcharging. The voltage regulator should be checked for faulty adjustment. If one or more cells continually require more water than others, it is an indication of a damaged cell.

(309) Cold Weather Care

It is especially important in cold weather to test the specific gravity. A battery freezes between the temperatures 32 degrees above zero and 50 degrees below zero, depending on the state of its charge. Do not add water after shutting down for the night. It will freeze quickly. See that it gets a charge after adding water.

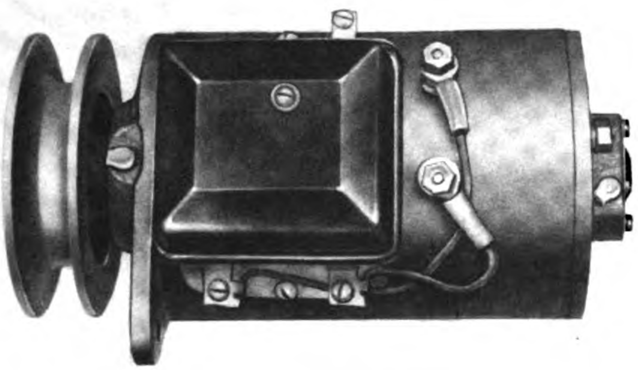


Figure 245. Generator.

Generating System

(310) Generator

The battery charging generator is a device for changing mechanical energy into electrical energy which is stored in the battery for starting the engine and operating such other engine accessories as are electrically operated. See figure 245.

Mounted on the generator frame is a combination circuit breaker and voltage regulator. The circuit breaker is an automatic switch which closes and opens the circuit between the generator and the storage battery. It consists of an electromagnet and a set of contacts. When the generator is not running, the contacts are open. When the generator is started, the contacts are automatically closed to connect the generator to the battery. When the engine is stopped or the generator loses speed, the voltage falls; and as soon as the generator voltage drops below the battery terminal voltage, the contacts automatically open, thus preventing the battery from discharging back through the generator.

The voltage regulator reduces the generator output when the maximum is not needed, thus preventing high voltage and an overcharged battery. When the battery is in a low charged state, the regulator automatically increases the generator output to its maximum, and when the battery reaches a high state of charge, the regulator automatically decreases the rate of charge.

(311) Tabulated Data, Generator and Voltage Regulator

GENERATOR

Clockwise rotation viewing drive end.

Brush Spring tension—16 ounces.

Cold Output—19-21 amperes at 8.35-8.5 volts at 1800 r.p.m.

Hot Output—9-12 amperes at 7.35-7.65 volts at 2000 r.p.m.

Field Current—4-6.1 amperes at 6 volts.

CUT-OUT RELAY

Air Gap	.015"
Point Opening	.020"
Points Close	6.3 to 6.9 volts

VOLTAGE CONTROL UNIT

Air Gap	.035"
Point Opening	.020"
Contact Spring Tension	.5 to 1.1 ounce
Armature Travel	.035"
Points Open	6.95 to 7.35 volts at 150° F.
Points Close	6.0 maximum volts at 150° F.

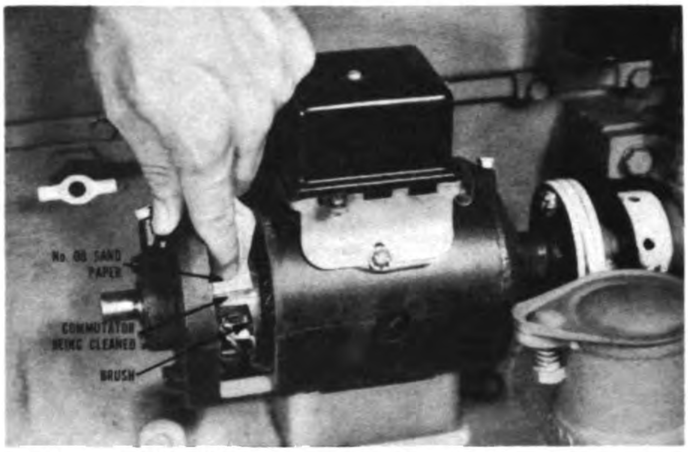


Figure 246. Cleaning Generator Commutator.

(312) Servicing the Generator and Voltage Regulator

There are three regular servicings which the maintenance repair personnel should give the generator. They are the 128 hour general inspection, 256 hour tune-up, and the 512 hour overhaul.

(313) 128 Hour General Inspection

a. Inspecting Commutator

Remove the head band and inspect the commutator. If the commutator is dirty or discolored, it can be cleaned by holding a piece of No. 00 or No. 000 sandpaper against it while turning the armature slowly. Blow the sand out of the generator after cleaning the commutator. See figure 246. If the commutator is rough or worn, the generator should be removed and completely overhauled. See paragraph 316.

b. Inspecting Brushes

Inspect the brushes and brush holders. The brushes should slide freely in their holders and should be perfectly in line with the commutator segments. If the brushes do not slide freely, are out of alignment, oil soaked, or worn to less than 7/16", the generator should be removed for a tune-up inspection given in paragraph 316.

c. Inspecting Wiring

Inspect all the wiring from the generator to the regulator, and from the regulator to the battery, and from the battery to the ground for worn or frayed insulation, broken wires, and for loose or corroded connections. Repair or replace the defective wiring.

d. Checking Brush Action

Run the generator at maximum output (approximately 1800 r.p.m.) and note the commutator action. If there is excessive arcing between the brushes and commutator, remove the generator for the tune-up inspection according to paragraph 316. Inspect the regulator. Check the wiring as indicated in "C".

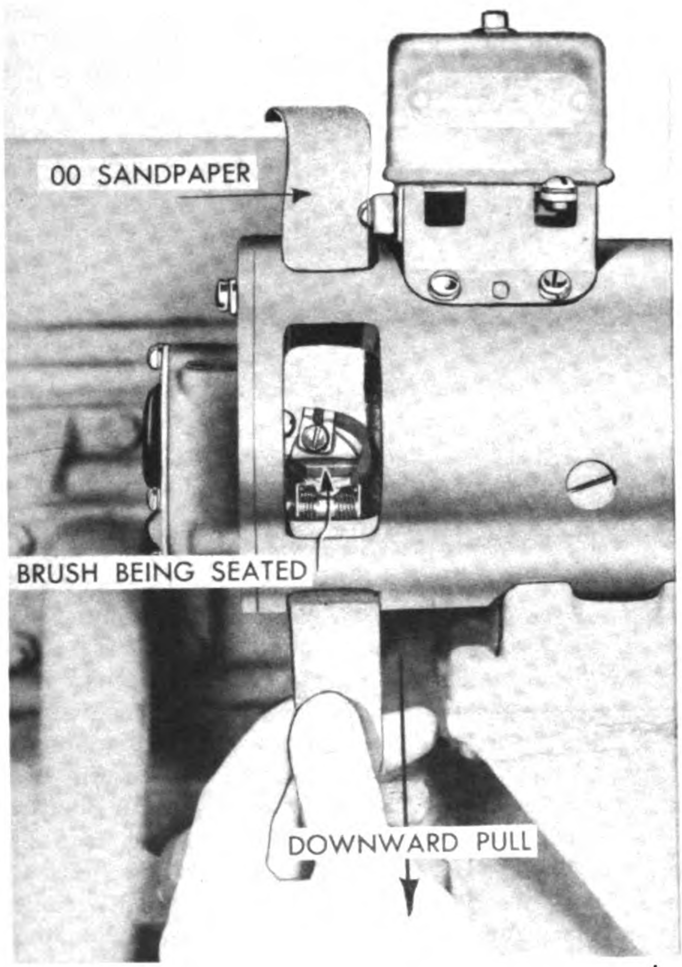
(314) Oiling Generator

The drive end ball bearings of the generator should be given three to five drops of medium engine oil in the hinged top oiler at the top of the end head. Fill the commutator end oil pocket with medium engine oil in the combination oiler in the commutator end cap cover.

(315) Checking Ammeter

During the starting and after the engine is in operation, the position of the ammeter hands should be noted. After the engine is electrically cranked and started, the generator, if operating normally, will immediately begin to return to the battery the current used in starting.

Figure 248. Seating Generator Brushes.



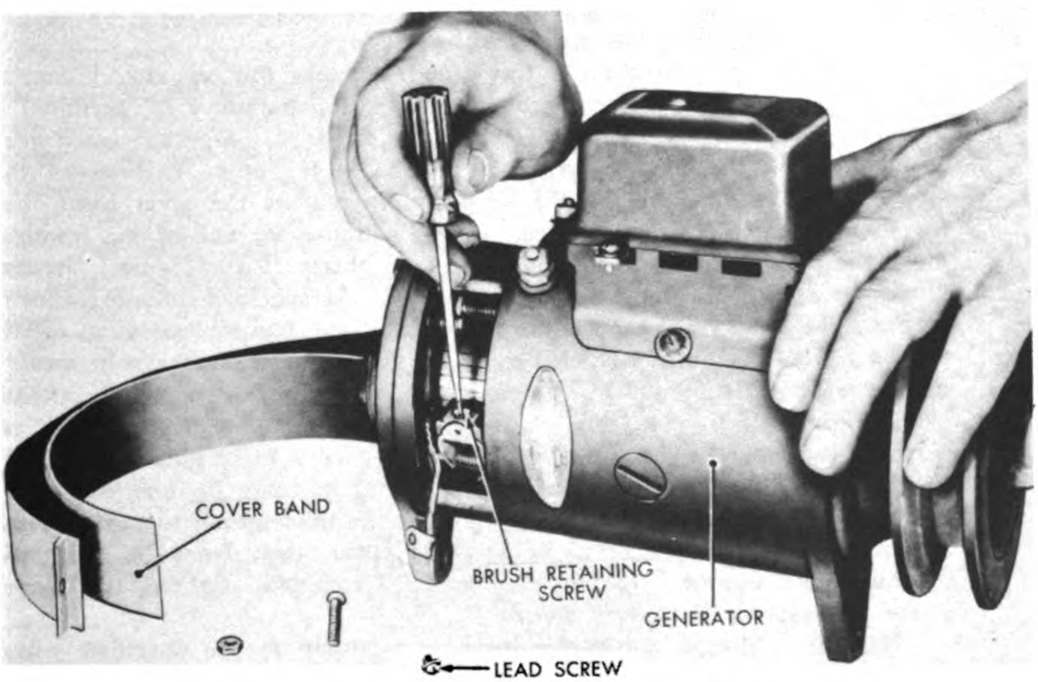


Figure 247. Removing Brush Lead Screw.

(316) 256 Hour Tune-up

a. Remove the generator from the engine and take off the head band.

b. Inspect the commutator and if it is dirty or discolored, clean it by holding a piece of No. 00 or No. 000 sandpaper against the commutator while turning the armature by hand. Blow the sand out of the generator after cleaning the commutator. If the commutator is rough or worn, the generator should be disassembled and completely overhauled according to paragraph 322.

c. Inspect the brushes. Each should slide freely and should be free from oil and dirt. Brushes that are oil soaked or are worn to less than 7/16" should be replaced.

d. To remove the brushes, disconnect the brush leads as illustrated in figure 247, and remove screw from the brush holding it to the holder. When installing brushes, make sure that the brushes are assembled so that the beveled face of the brush fits the commutator. Check the alignment to make sure that the brush edge is parallel with the commutator segments. If the alignment is off, or if the brushes do not slide freely, the commutator end plate should be disassembled and inspected as described in paragraph 324.

e. After new brushes are installed, they should be sanded to make sure of the proper fit on the commutator. To sand the brushes, cut a strip of No. 00 or No. 000 sandpaper to the exact width of the commutator. Slip this strip under a brush. With the abrasive side against the brush and the brush at its proper spring tension, draw the sandpaper following the contour of the commutator and make certain that the entire face of the brush is being ground. Do not grind excessively and be careful not to break the edge of the brushes. See figure 248.

f. Check the brush spring tension. Hook a spring scale under the third brush arm near the end or in the hole in the lip of the main brush arms and pull on a line parallel to the face of the brush. Take the reading just as the arm leaves the brush. The main brush spring tension should be 14 to 18 ounces, maximum. The third brush spring tension should be 16 to 20 ounces. If the tension is too great, the brushes and the commutator will wear excessively. See figure 239.

(317) Battery Charging Generator Bench Test

Mount the generator on a test stand, connect the test stand ammeter, and voltmeter. Connect the ammeter lead to generator "A" terminal and ground generator "F" terminal with a jumper lead. Operate generator at speed at which maximum output is obtained. If output exceeds 19 to 21 amperes with the generator cold, immediately remove the cover band, loosen the third brush ring locating screw in the commutator end of the frame and move the third away from the main brush to obtain 19 to 21 amp. Generator output at specified voltage must be checked. If specified voltage cannot be obtained, ¼ ohm variable resistance of sufficient current carrying capacity should be inserted into the charging circuit and resistance cut in until the specific voltage is obtained. Operate until the generator reaches operating temperature. This will take about thirty minutes. When operating temperature is reached, the generator should produce 9 to 12 amperes at 7.35 to 7.65 volts at 2000 r.p.m. The generator r.p.m. can be checked with a tachometer. Adjust the voltage by moving the third brush toward the main brush to increase output or move the third brush away from the main brush to lower the output. After adjustment is complete, tighten the locating screw and replace the cover band.

NOTE: Always check the generator output at the specified voltage. Never set the output beyond the specified value. Failure to observe these rules may cause a high setting which will damage the generator.

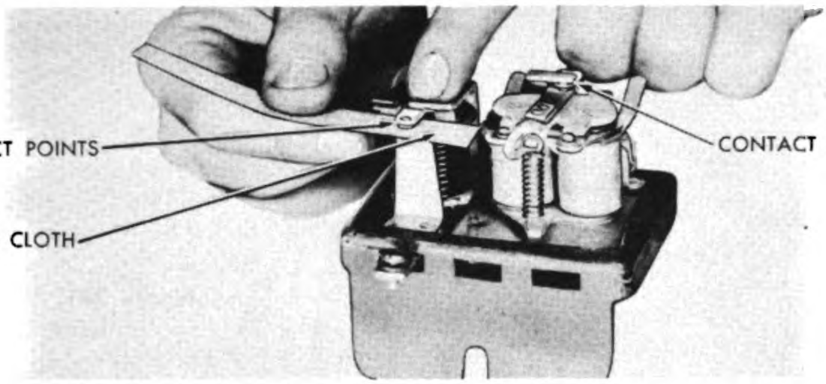


Figure 249. Cleaning Contacts on Voltage Regulator.

(318) Inspecting and Adjusting Voltage Regulator

NOTE: The regulator should be removed from the generator and the leads disconnected for the following inspection and adjustment.

CAUTION: Tape the battery leads to prevent short circuiting.

a. Remove the regulator cover and inspect the regulator visually for: (1) evidence of burning or abnormal high temperatures at the coils; contacts, insulation, external terminals, or any other points; (2) loose connections resulting from poor soldering; (3) loose nuts on the bottom of the magnet cores; (4) loose screws, NOTE: (All screws must have lockwashers); (5) broken or altered carbon resistor. Repair or replace any of the items mentioned above that may be faulty.

b. Inspect the contacts. If they are dirty or burned, they can be cleaned with a piece of crocus cloth. See figure 249. Do not use sandpaper or a file. After cleaning, the contacts should be cleaned, if possible, with refined carbon tetrachloride, to remove any dirt or grease; after which a piece of clean linen tape or hard paper, such as kraft wrapping paper, should be pulled between the contacts to remove any fine lint or dirt.

(319) Testing and Adjusting Voltage Regulator

The cut-out relay and voltage control unit are checked and adjusted according to the following paragraphs: (See paragraph 311 for specifications.)

(320) Checking Cut-Out Relay

With the contact points held closed, check the air gap between the armature and the center of the core. This gap should be .015". To adjust, loosen the two screws at the back of the relay and raise or lower the armature as required. See figure 250. Tighten screws securely after adjustment.

Measure point opening with points open. The gap should be .020". Adjust by bending the upper armature stop.

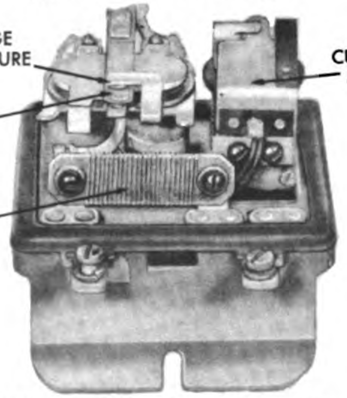


Figure 250. Voltage Regulator (Front).

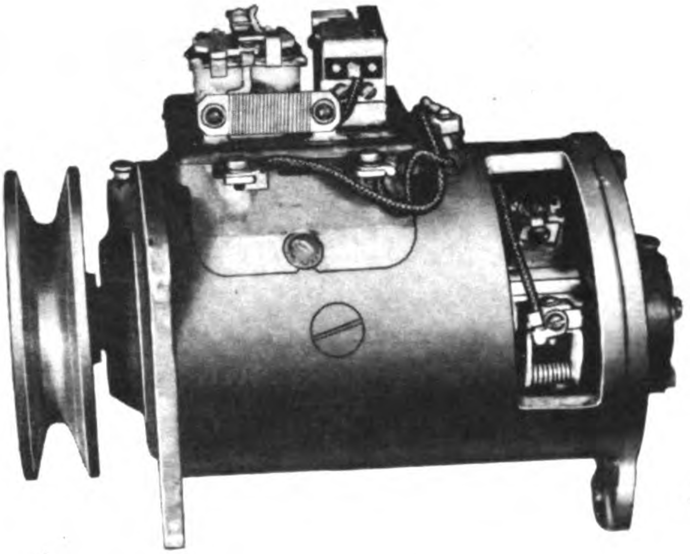


Figure 251. Voltage Regulator (Rear).

Connect voltage control to generator and battery in normal manner to check relay closing voltage. Connect voltmeter from "GEN" terminal to voltage control base. It is not necessary to connect ammeter into circuit at "BAT" terminal unless it is desired to measure generator output. Gradually increase generator speed and note voltage at which relay points close. If the voltmeter does not show a reading of 6.3-6.9 volts, adjust by bending up on the spring post to increase the spring tension and raise the closing voltage. See figure 251. Bend down to lower closing voltage.

The flat contact spring tension is measured at the contacts with the armature up. The pull required to separate the points should be carefully measured. If the tension is not between .5 and 1.1 ounce, adjust by slightly bending the flat spring.

(321) Checking Voltage Control

The voltage control unit air gap is measured with the armature held down against the lower armature stop, between the center of the core and the armature. The gap should be .035". Bend the lower armature stop to adjust. See figures 250 and 251.

Release the armature and gauge the travel between the armature and the lower armature stop. The travel should be .035". Adjust by bending the upper armature stop.

With the armature held down against the lower armature stop, measure the contact point opening, which should be .010". Adjust by bending the contact spring post.

The OPENING VOLTAGE of the contact points is checked by connecting the voltmeter between the "BAT" terminal and base of regulator and the ¼ ohm variable resistance in series in the charging circuit at the "BAT" terminal of regulator. Increase generator speed slowly and note the voltage at which the contact points of the voltage control unit open. VOLTAGE CONTROL MUST BE AT OPERATING TEMPERATURE AND COVER MUST BE IN PLACE. If the battery is low, the voltage control may not operate. To obtain sufficient voltage to cause the voltage control points to open, operate the generator at medium speed and slowly cut in resistance until the voltage control points open. The voltmeter reading should be 6.95 to 7.35 volts at 150° F. To adjust, bend the spiral spring hanger down to increase the opening voltage setting. Bend up to lower the setting.

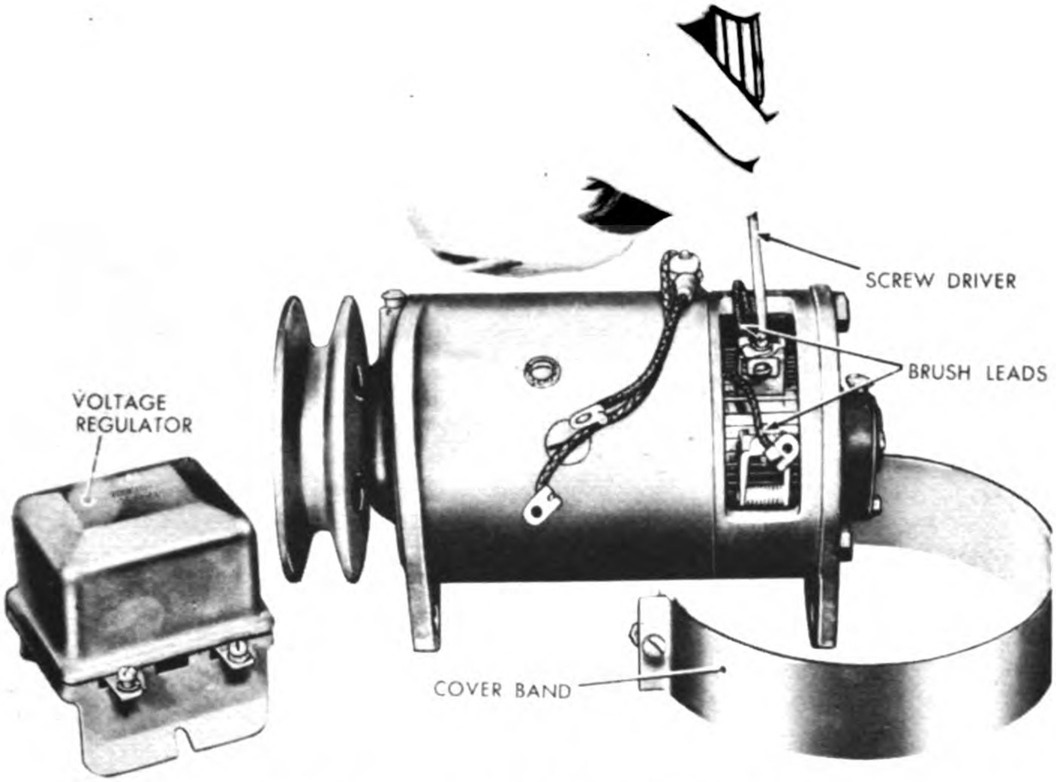


Figure 252. Disconnecting Brush and Field Leads.

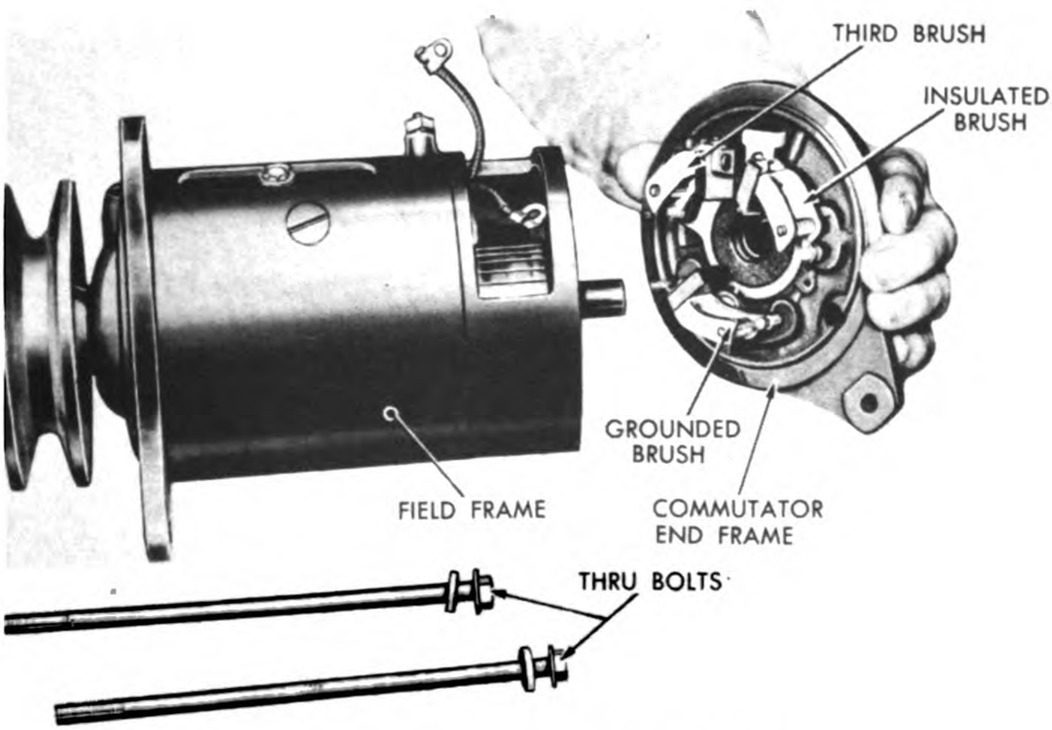


Figure 253. Removing Commutator End Bracket.

The CLOSING VOLTAGE is checked by reducing the generator speed or cutting out resistance so the voltage drops to the value at which the points close. This voltage should be 6.0 maximum at 150° F. Adjust by adjusting the AIR GAP. Increase the air gap to raise the closing voltage. After readjusting the air gap, readjustment of the contact point opening may be required.

(322) 512 Hour Generator Overhaul

After the generator has been removed from the engine, the following procedure is recommended:

a. Disconnect the leads from "F" and "GEN" terminals of the step voltage control by removing the screws and lockwashers. Replace the screws and lockwashers temporarily to avoid misplacing them. Remove the two screws, lockwashers, and washers holding the step voltage control to frame and lift off the step voltage control. See figure 252. Remove the "A" and "F" terminals of the generator, the nuts, lockwashers, and the leads.

b. Remove the cover band and note the relationship of the leads and brushes. Disconnect the screw and lockwasher from the insulated brush holder and one from the third brush holder. See figure 252. This disconnects the lead from "A" terminal stud and the lead from the field winding.

c. Remove the two through bolts and lockwashers and detach the commutator end frame from the field frame. See figure 253. It may be necessary to loosen the commutator end frame with a soft lead hammer.

d. Detach the field frame from the drive end frame again using the lead hammer if necessary. See figure 254.

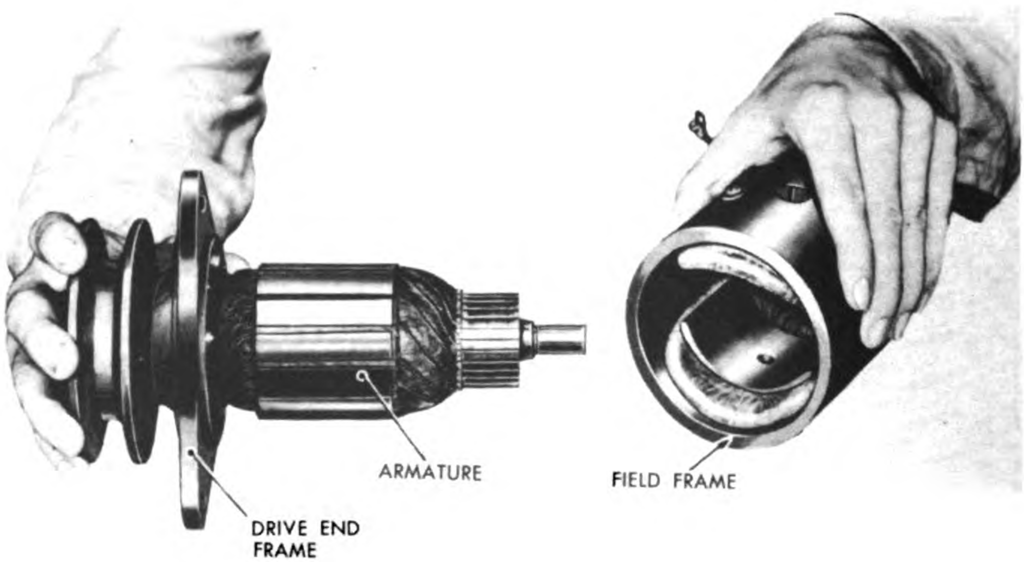


Figure 254. Removing Drive End from Field Frame.

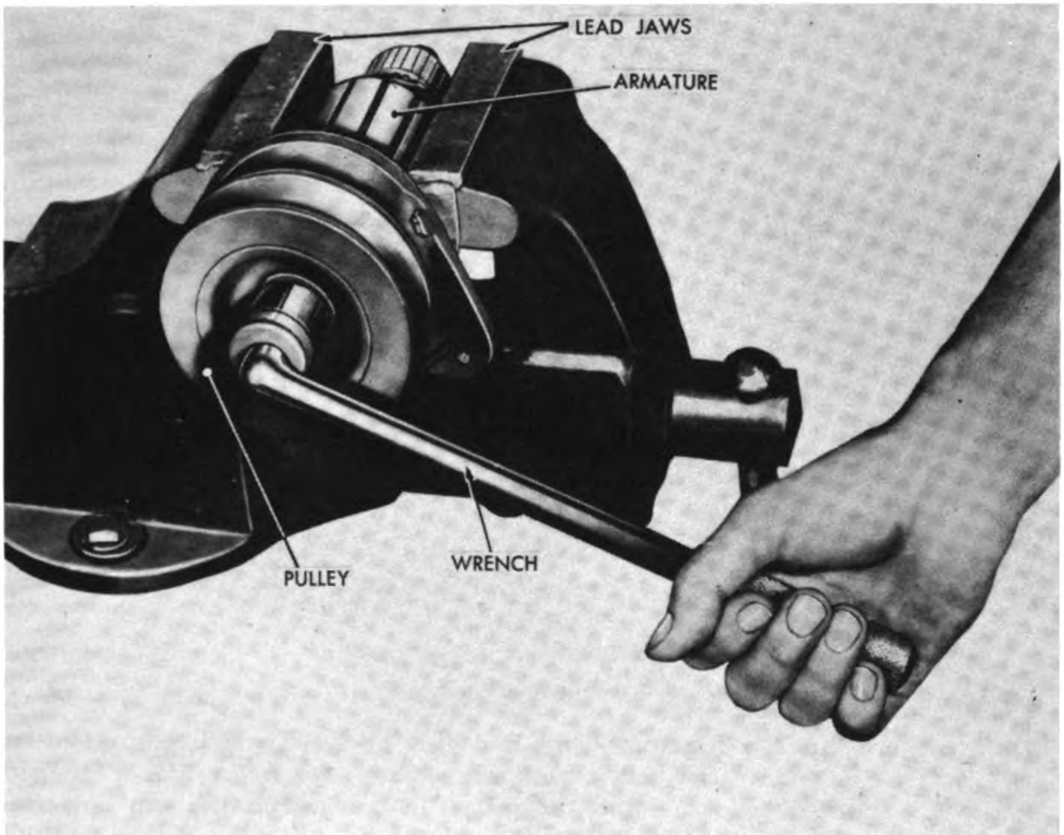


Figure 255. Removing Drive End Pulley Unit.

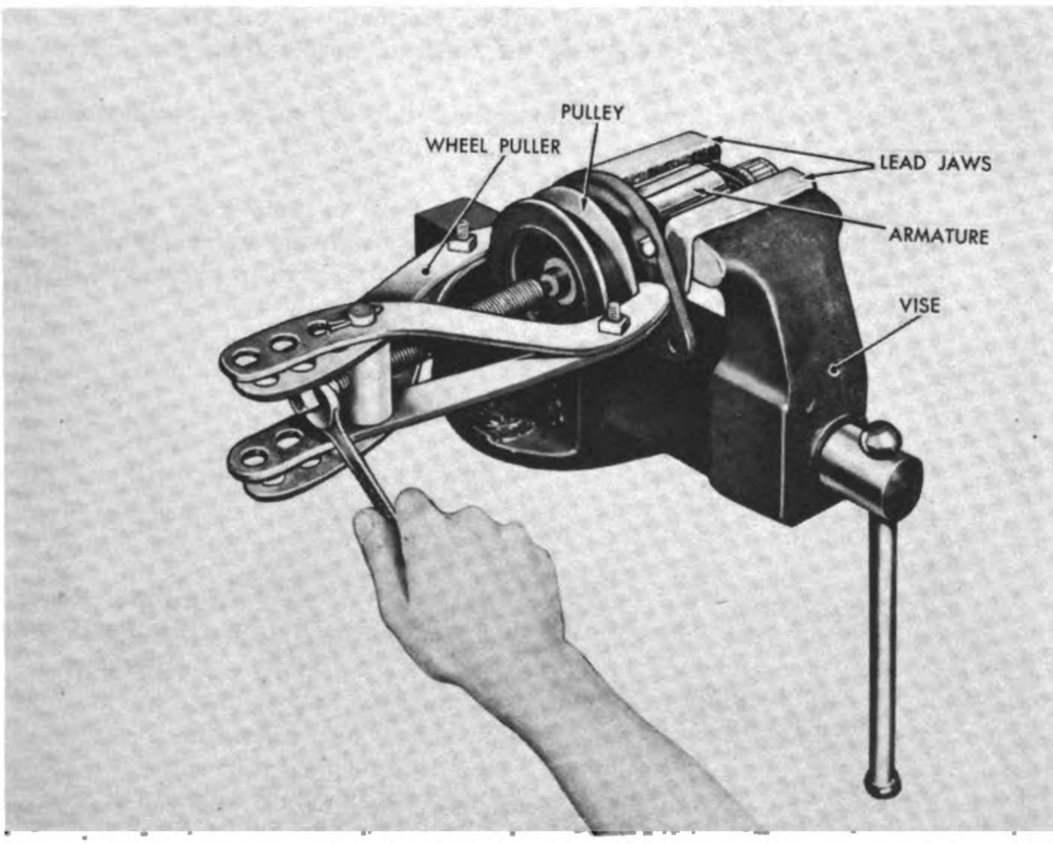


Figure 256. Removing Pulley with Puller.

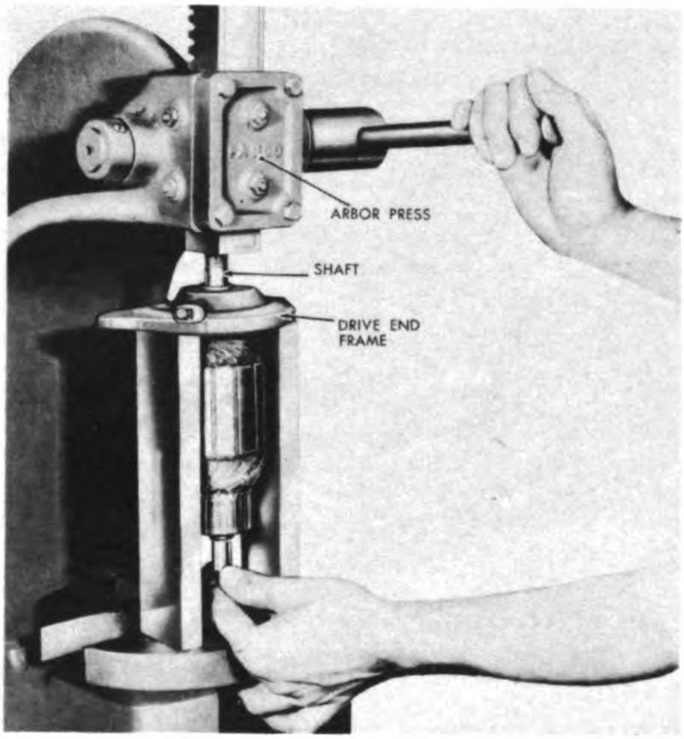


Figure 257. Pressing off Armature Shaft from Drive End Frame.

e. Place the armature in the lead jaws of the vise and use a ¾" wrench to remove the pulley, nut, and washer. See figure 255. Then with a wheel puller, remove the pulley. The woodruff key can be removed with a pair of pliers. See figure 256.

f. To remove the drive end frame from the armature, it may have to be pressed off in an arbor press. Normally, it will slip off very easily. See figure 257. Remove the collar or spacer from the pulley side of the frame.

The generator now is disassembled into its major subassemblies. The disassembly of the subassemblies are as follows:

(323) Disassembling Drive End Frame

Remove the three screws and lockwashers to remove the bearing retainer plate. See figure 258. Remove the bearing from the frame. While this may normally be done with a few light taps, it may have to be pressed out in an arbor press. See figure 259.

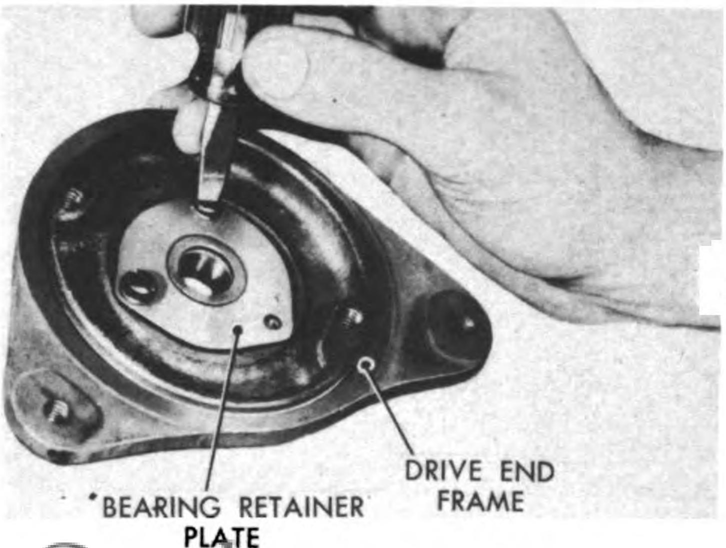


Figure 258. Removing Bearing Retainer Plate Screws.

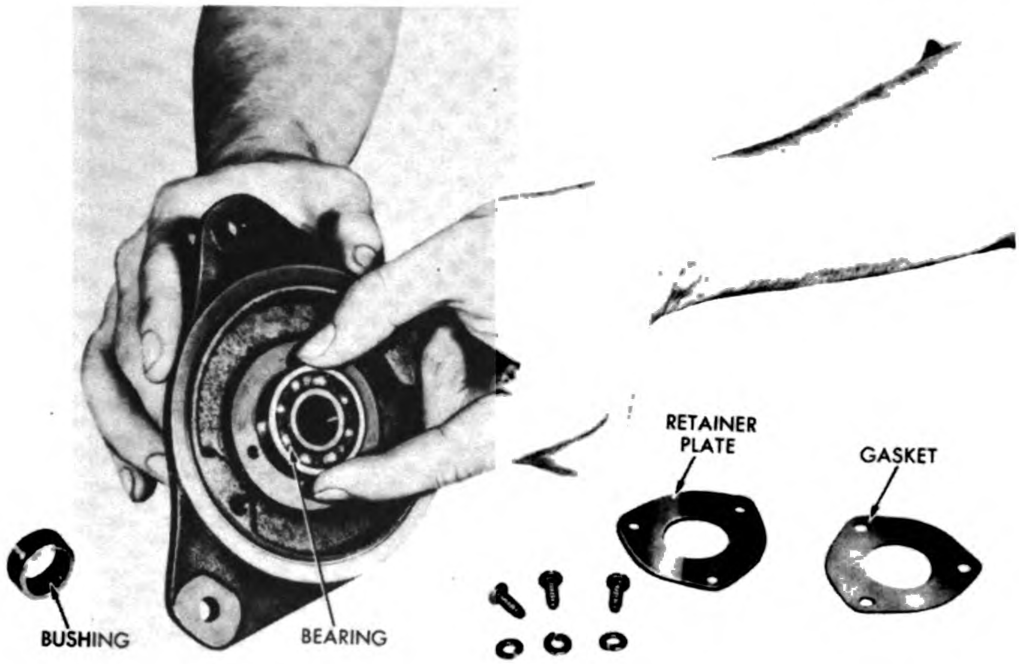


Figure 259. Removing Bearing from Drive End Frame.

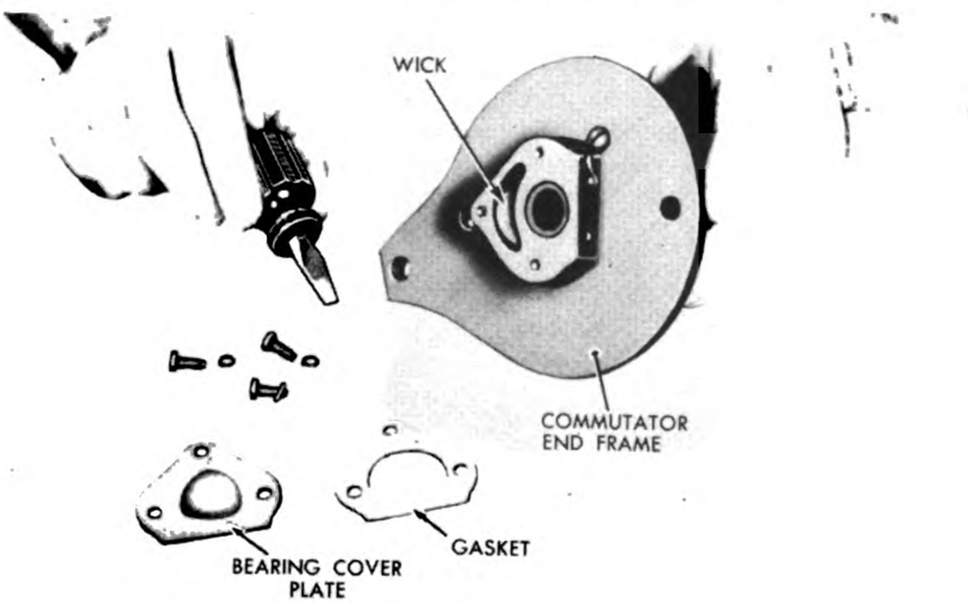


Figure 260. Removing Bearing Cover Plate.

(324) Disassembling Commutator End Frame

a. Remove the bearing cover plate by detaching three screws and a lock-washer. Remove the gasket. See figure 260.

b. If necessary, the bushing may be pressed out in an arbor press, see figure 261, after the following disassemblies have been made c, d, and e.

c. Remove the ground brush lead and lockwasher connecting the ground lead to the brush holder. The brush and brush washer will also come up. See Figure 262.

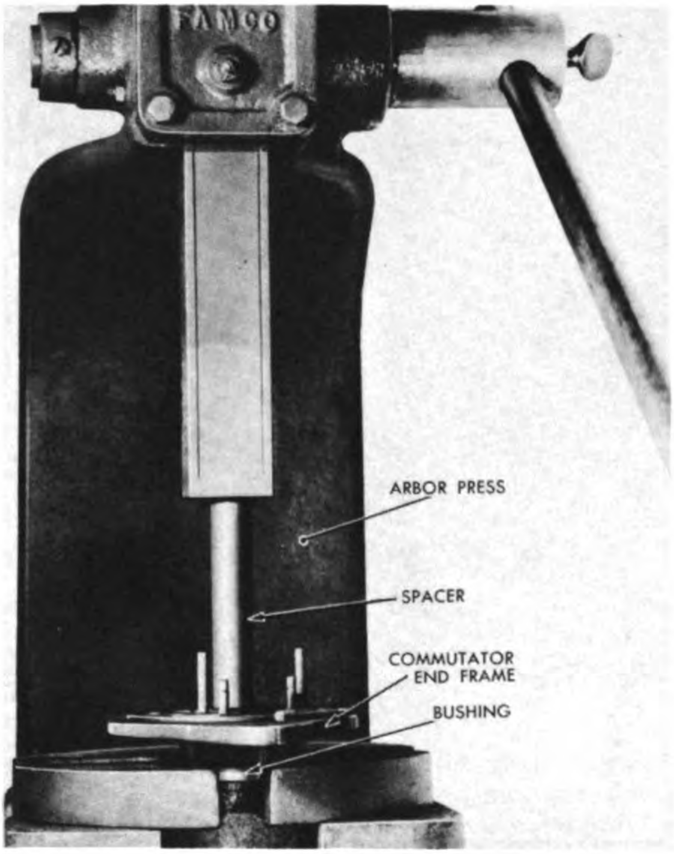


Figure 261. Pressing out Bushing from Commutator End Frame.

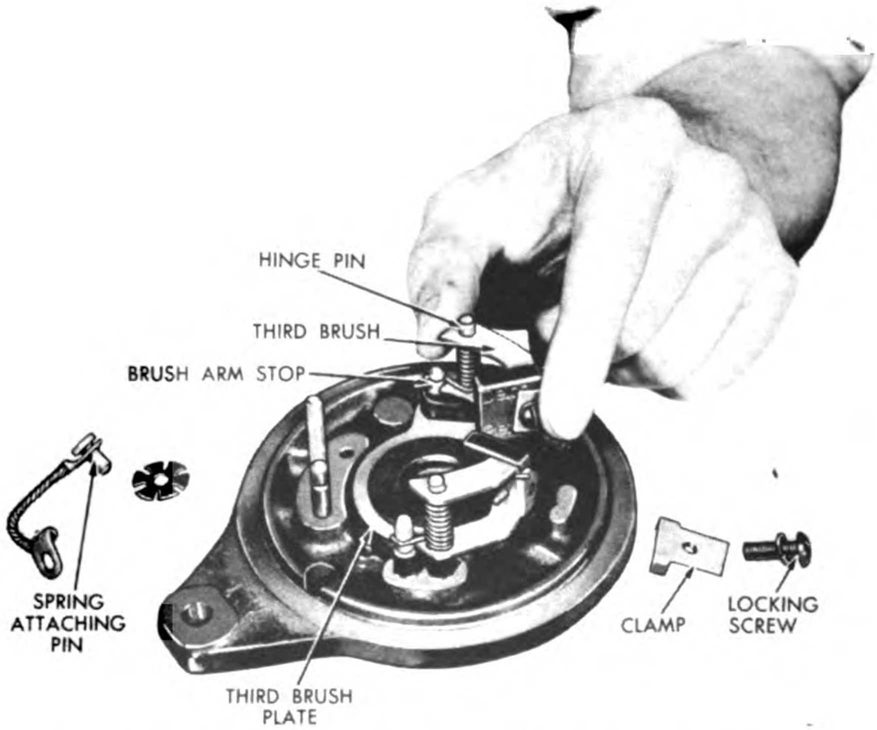


Figure 262. Removing Third Brush and Locating Screw.

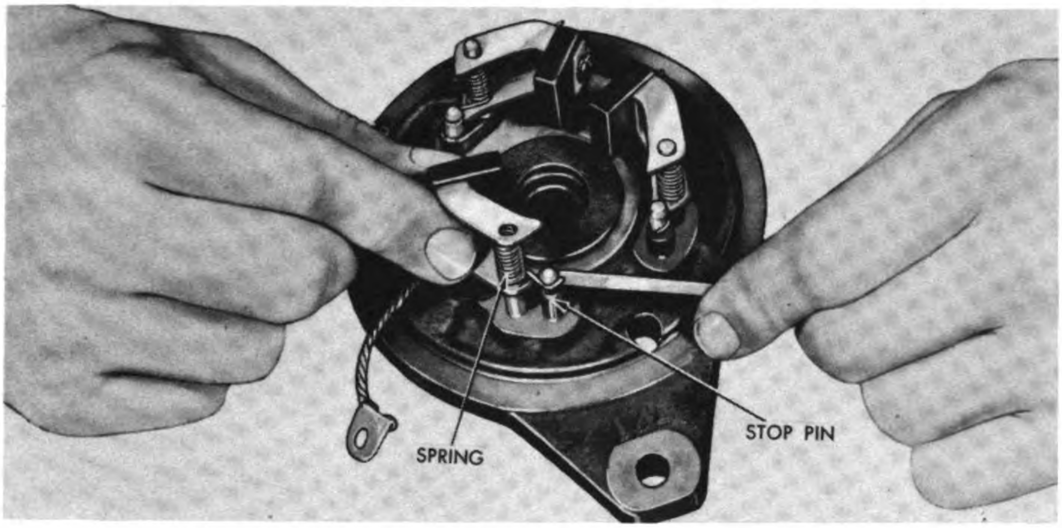


Figure 263. Removing Brush Holder Spring and Arm.

d. To remove the spring and arms of the brush holder, use a plier to catch the hook end of the spring and lift it up over the stop pin. See figure 263. The arm and spring will slide off the pin.

e. To detach the third brush plate, unscrew the third brush locating screw from the outside of the frame and remove the clamp, and with a 1/8" punch, drive out the brush plate spring attaching pin so that the spring, ground lead, and third brush plate may be detached from the frame. See figure 262.

If it is necessary to remove the arm stops and the hinge pins from the frame they can be pressed out on an arbor press.

(325) Disassembling Field Frame

a. With a 7/16" wrench remove from each terminal stud "A" and "F", the nuts, lockwashers, flat washers, and insulators. See figure 264. The "A" terminal stud may be removed from the frame. The "F" terminal stud is soldered to the field winding lead.

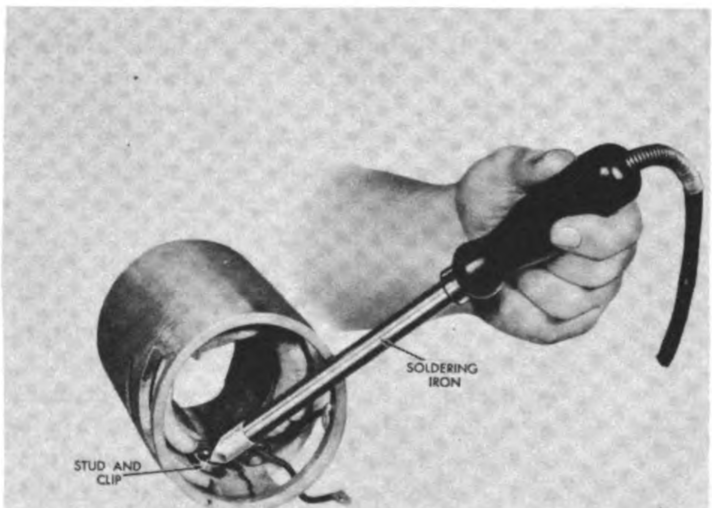


Figure 264. Unsolder "F" Terminal Field Lead.

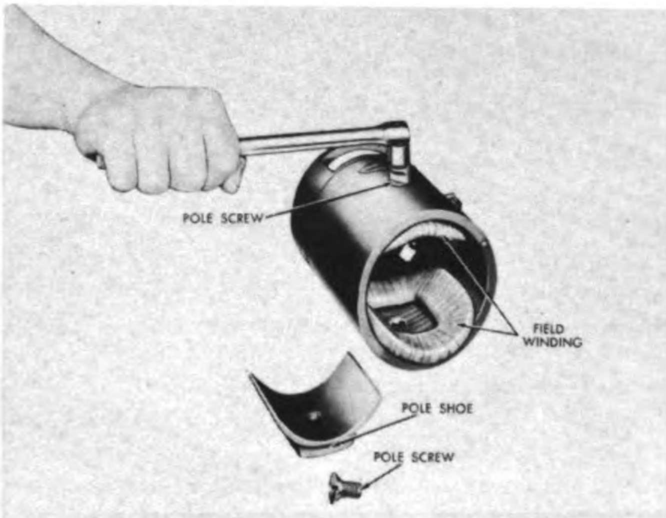


Figure 265. Removing Pole Shoes.

b. Remove the field windings by removing the two pole shoe screws, pole shoes, and windings. See figure 265. Stud and clip on field winding lead may be unsoldered and replaced if required. See figure 264. Be careful in handling field windings to avoid damaging leads or insulation.

(326) Inspection and Repair of Parts

After disassembly, all parts should be cleaned, examined, tested, and defective parts replaced. The procedure for cleaning and inspecting parts is given in the following paragraphs:

(327) Inspecting Armature

a. Do not clean the armature by any degreasing method since this would damage the insulation and might ruin the armature. Rather, wipe the armature with a clean cloth slightly dampened with carbon tetrachloride or a similar solvent. If the commutator is rough, out of round, has high mica, or filled slots, it must be turned down in a lathe. Make the cut no deeper than necessary. The minimum diameter of the commutator should be 1.675". If it is necessary to turn the commutator below this diameter, discard the armature and replace. The mica should be undercut 1/32".

b. Check the armature for grounds. Using a test lamp, place one test point on the commutator segment and the other to the armature shaft or lamination. Check each segment completely around the commutator. If the lamp lights, indicating a ground, and the ground is not readily apparent and repairable, the armature must be replaced. See figure 237.

c. An open circuited armature is easily detectable since this condition produces badly burned bars. The bars connected to the open coils on the armature soon burn, since every time they pass under the brush, 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.

d. A shorted armature may be detected on a growler. See figure 238. A growler is a strong electromagnet connected to a source of electrical current. When a shorted armature is placed on a growler and a hacksaw blade is held above the shorted coils in the armature, the blade will be alternately attracted and repelled from the armature causing the blade to buzz against the armature. Before discarding an armature that indicates that it is shorted, inspect the commutator slots carefully since copper or brush dust sometimes collects in the slots and shorts the adjacent bars.

(328) Inspecting and Replacing the Fields

Clean the fields by wiping with a clean, dry cloth. Do not use any degreasing method because of the resulting damage to the insulation in the windings. Be careful in handling the winding assembly to prevent breakage or weakening of the connecting lead between the two windings. Test the field current draw by connecting a 6-volt battery and an ammeter in series with the two field leads. The current draw should be 4 to 6.1 amperes at 6 volts. Replace windings if they do not meet the specifications.

The field insulation should be in good condition. If bars are worn away so that the wire is exposed, it is sometimes possible to re-wrap the windings with insulating compound. This operation, however, must be executed with care and neatness, since excessive bulkiness will prevent reassembling the windings under the pole shoes in the proper manner. All soldered connections should be made with rosin-flux solder. If the terminal stud or clip is damaged, replace them.

(329) Inspecting the Brushes and Brush Springs

If the brushes are worn down to 7/16" (the original length is ¾") replace the brush. New brushes may be seated with a brush seating stone or No. 000 sandpaper. If using the sandpaper method seating the brushes, see paragraph 316, step d and e. The brush seating stone is an abrasive material which when held against the revolving commutator, disintegrates and carries under the brushes and seats them in a second or two. The brush spring tension should be sufficient to provide 14 to 18 ounces for the main brushes and 16 to 20 ounces for the third brush, after the unit is assembled. This may be checked by assembling the brush springs and arms to the commutator end frame and then checking with a spring gauge the amount of pull required to raise the brush arm. Replace the springs if the tension is not correct. See figure 239.

(330) Inspecting Bearing

If the bearing appears to roll roughly or sloppily, replace it. Otherwise the bearing may be cleaned by rotating it in carbon tetrachloride, drying it with air, and immediately re-lubricating it with ball bearing grease.

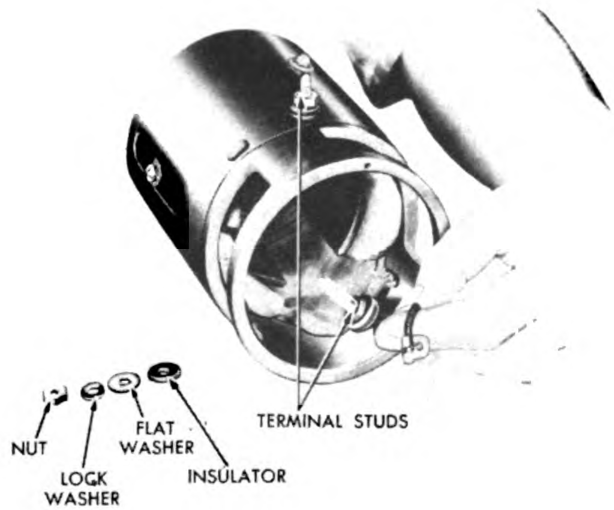


Figure 266. Assembling Terminals to Field Frame.

(331) Miscellaneous Replacements

Any defective insulators, screws, washers, leads, studs, retainers, plates should be replaced. Cracked, bent, battered, worn, or burned insulators and washers defective. Screws or studs which are bent, battered, broken, or have crossed or damaged threads are defective. Leads which have broken strands or badly frayed insulation are defective.

(332) Reassembling Generator

It will be necessary to first assemble each of the sub-assemblies. The procedure for these operations are as follows:

(333) Assembling the Field Frame

Place the field winding assembly with pole shoes in field frame. Insert a pole shoe spreader and tighten the shoes against the frame. Install and tighten the two pole shoe screws with a pole shoe screw driver or a similar tool, as shown in figure 265. The winding with the stud soldered to the lead must be so placed that the stud can be inserted through the hole in the frame, see figure 264.

Insert the stud on the winding lead through the "F" terminal hole in the frame and secure it with the insulator, lockwasher, and nut. See figure 266. Place the stud with the lead attached to "A" terminal hole and secure it with the insulator, lockwasher, and nut.

(334) Assembling Commutator End Frame

a. Install a new bushing, brush arm and stop pins if required, using the arbor press. Finish the bushing to size—a running fit.

b. Before mounting third brush plate, note the relationship of the third brush plate and the frame, and attach the third brush plate with a clamp screw and lockwasher. Fasten the third brush spring and ground lead to the frame with the attaching pin using a hammer and punch. See figure 267.

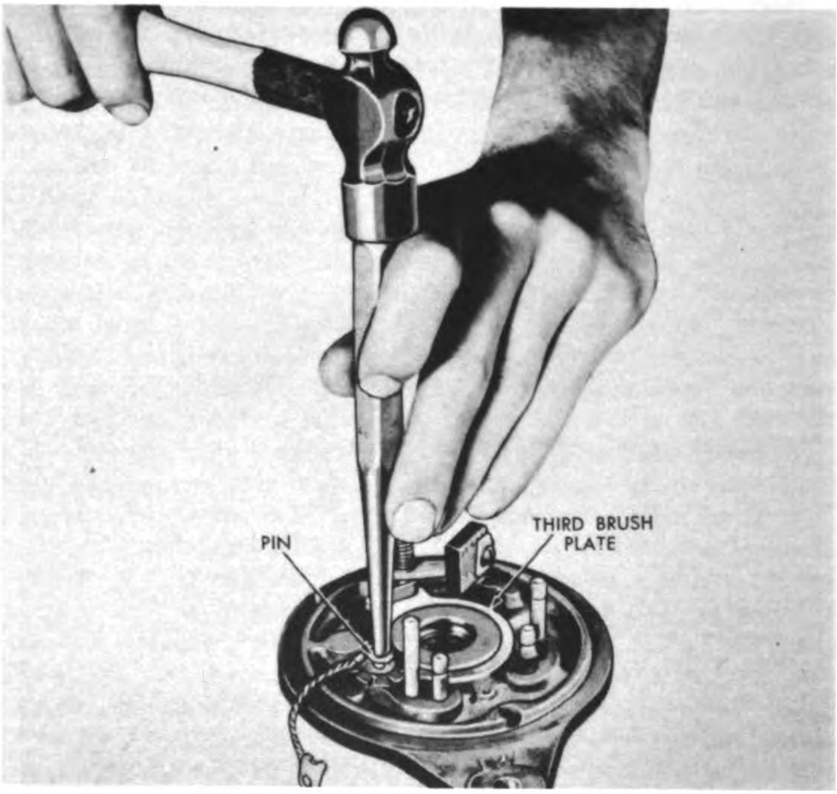


Figure 267. Installing Attaching Pin.

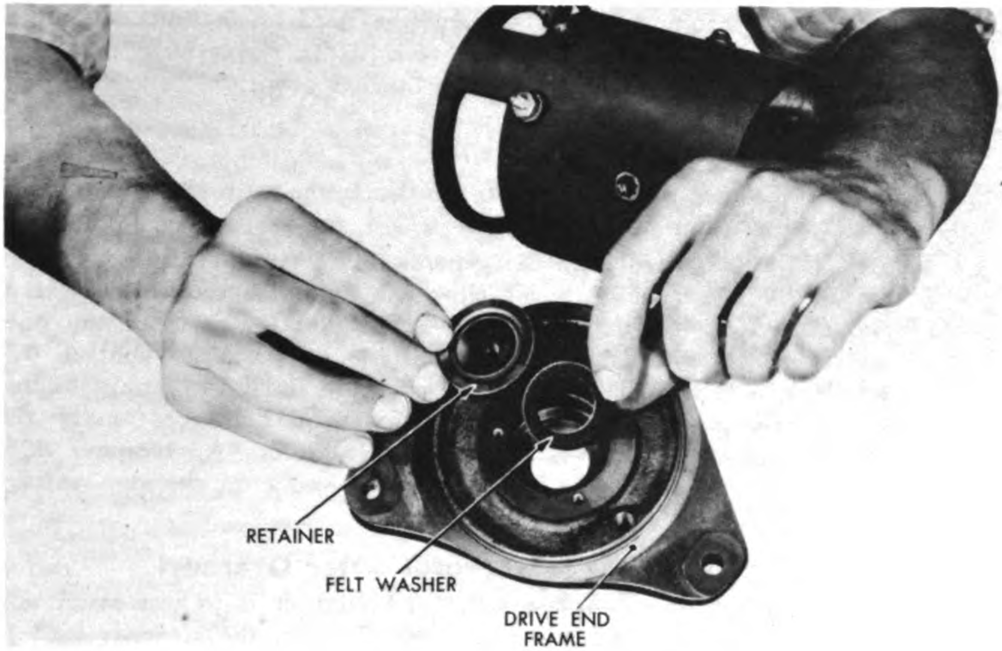


Figure 268. Installing Felt Washer and Retainer.

c. Assemble the brush spring and arms to the hinge pin. The straight end of the spring rests on the back of the brush arm while the bent end of the spring should be hooked with a pliers and hooked over the spring stop. Fasten the brush and ground lead to grounded holder with a screw, lockwasher, and brush washer.

d. Before attaching the end cover plate and gasket with three screws and lockwashers, see figure 260, see that the oil wick is in place.

(335) Assembling Drive End Frame

Install the felt washer, retainer, and the bearing in the frame. See figure 268. NOTE: The cup side of the retainer is away from the bearing so that it does not touch the inner race of the bearing. If the ball bearing does not slip into the frame easily, it may be pressed in with an arbor press. Secure the bearing in place with a retainer plate, three lockwashers and screws. See figure 259.

(336) Assembling the Generator

a. To install the armature in the drive end frame, first place the washer on the armature shaft. Insert shaft and bearing in the drive end frame. Bearing may have to be pressed on with the arbor press. Place the collar on the shaft.

b. To install the pulley on the shaft, place the key in the keyway and place the pulley on the shaft with an arbor press. Then place the armature in the lead jaws of the vise. Install the washer and pulley nut. See figure 255.

c. To attach the field frame, align the dowel and holes and place the field frame in position on the drive end frame, align the dowels. See figure 254.

d. To attach the commutator end frame, align the dowels and dowel holes and place the commutator end frame in position in the drive end frame. See figure 253. The three brush holders may be cocked so that they will be out of the way of the commutator during this assembly procedure. Secure the commutator end frame to the field frame with the two through bolts and lockwashers.

e. Attach the insulated brush lead and the third brush leads to the insulated brush holder and the third brush holder, respectively. The clips go under the lockwashers. Drop the brushes down on the commutator in operating position. See figure 252.

f. Install the cover band.

g. Install the step voltage control on the frame with the two screws, lockwashers, and washer.

h. Attach the long lead from the generator "F" terminal to step voltage control "F" terminal. A round clip goes under the second lockwasher and second nut on the generator "F" terminal. The other clip goes under the lockwasher and screw on the step voltage control "F" terminal. Attach the short lead from the generator "A" terminal to step voltage control "GEN" terminal. The round clip goes under the second lockwasher and second nut on Generator "A" terminal. The other clip goes under the lockwasher and screw on the step voltage control "GEN" terminal.

(337) Testing and Adjusting the Generator After Overhaul

Mount the generator on a test stand and connect it to test stand ammeter and voltmeter. See diagram, figure 243. Connect the ammeter lead to generator "A" terminal and ground the generator "F" terminal with a jumper lead. Operate the generator at the speed at which the maximum cold output is obtained (at 1800 r.p.m.). If the output exceeds 19 to 21 amperes with the generator cold, immediately remove the cover band, loosen the third brush ring locking screw in the commutator end frame and move the third brush away from the main brush to obtain 19 to 21 amperes. The generator output at the specified voltage must be checked at 19 to 21 amperes at 8.35 to 8.5 volts at 1800 r.p.m. If the specified voltage cannot be attained, a ¼ 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 the generator until it reaches operating temperature. This will take about 30 minutes. At the operating temperature, the generator should produce 9 to 12 amperes at 7.35 to 7.65 volts at 2000 r.p.m. A tachometer should be used to obtain the accurate r.p.m. Adjust by moving the third brush toward the main brush to increase output, or away from main brush to lower output. After the adjustment is complete, tighten the locking screw and replace cover band.

CAUTION: Always check the generator output at the specified voltage. Never set the output beyond the specified value. Failure to observe these rules may cause a high setting which will damage the generator.

(338) Installation Caution

After the generator is installed on the engine and reconnected, a jumper lead should be connected momentarily between the generator and the battery terminals ("GEN" and "BAT") BEFORE STARTING THE ENGINE. This allows a momentary surge of battery current to flow into the generator which correctly polarizes it with the battery it is to charge. This should always be done after any check, adjustment, repair or installation of the generator or step voltage control.

Never operate the generator with the field circuit connected and the charging circuit open (open circuit operation) since this will allow a high voltage to build up within the generator which will damage the field and armature.

Ignition System

The ignition system consists of distributor, ignition coil, battery, and spark plugs with the necessary high tension cables between. The ignition is set to occur at 12° before top dead center at 1400 r.p.m. under full load. In the case of defective ignition, it must be first determined where the fault lies. When a cylinder misfires, the fault is usually in the spark plug. See information under Spark Plugs.

Misfiring also may be due to a chafed or broken cable, or loose cable connections. The metal terminals of the cable must not come in contact with any metal parts of the engine other than for which they were designed. Keep the cables and terminals clean and free from dirt, dust, or oil. If cable and plugs are in good condition and the ignition is irregular, the trouble will be found in the distributor, particularly the interrupter points.

(339) Distributor

SPECIFICATIONS:

Cylinders 4
Counter-clockwise rotation viewing driving end
Contact point opening .018 to .024 inch
Contact angle 32 degrees
Contact point pressure 17 to 21 ounces
Centrifugal advance start 0.3° engine at 600 r.p.m.
Intermediate advance 11.5° engine at 1200 r.p.m
Maximum centrifugal advance 28° engine at 3000 r.p.m.
Drive Gear

The purpose of a distributor is to provide current to the primary winding of the ignition coil at the proper time and also to distribute the high tension voltage to the proper spark plug.

The breaker contacts of the distributor are connected in the coil primary circuit so that the rotation of a cam opens the coil circuit at the proper instant to generate a spark. The distributor cap and rotor are arranged so that the high tension voltage is connected to the correct spark plug for firing each cylinder. Figure 269 illustrates the components of the distributor.

The distributor is equipped with a centrifugal governor control of the timing and has the cam connected to the drive shaft through the governor. This is arranged so that as the speed is increased the relationship of the cam to the breaker arm is changed by the centrifugal action of the governor. The rate and amount of spark advance is controlled by the weight springs and the design of the centrifugal governor mechanism.

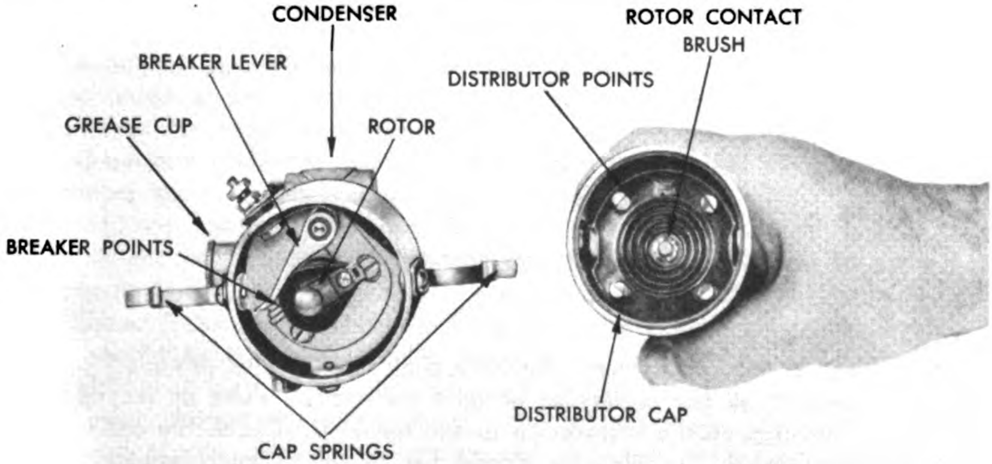


Figure 269. Distributor Cap Removed.

(340) Ignition Coil

The function of an ignition coil is to transform the low voltage energy supplied by the car battery into the high voltage energy necessary to jûmp the spark plug gap.

An ignition coil has two windings, one the primary winding which consists of a comparatively few turns of a very fine wire. The secondary winding is wound on a soft iron core while the primary winding is wound around the outside of both windings and serves to complete the magnetic circuit. Carefully selected and tested insulation is placed between the winding layers, the primary and second windings and between the outside of the primary winding and the outer soft iron shell.

Whenever current is built up and broken in the primary winding a voltage is induced in the secondary winding. The design of a coil is such that the induced current will be sufficiently high to produce a spark at the spark plug.

(341) Lubricating the Distributor

a. Every 64 hours of operation as indicated in the maintenance chart give grease cup one turn.

b. Every 512 hours, add one drop only of light oil to the breaker arm hinge pin and saturate the felt in the top of the cam with light oil. Add one drop of light oil to each governor weight pivot and slot. Do not overlubricate.

c. Apply a light wipe of high melting point non-fibre grease to the breaker cam. Be careful not to get oil or grease on the cap and rotor breaker contacts as oil or dirt materially shorten their life. See figure 269.

(342) 128 Hour Tune-up

After every 128 hours of operation, remove the high tension leads, noting the correct order to be used for reassembling. Remove cap and rotor. The distributor cap should be visually inspected for cracks, carbon runners, evidence of arcing, and corroded high tension terminals. If any of the above conditions are present the cap should be replaced.

(343) Distributor Cap

The distributor cap should also be inspected for incorrect burning of inserts. After a distributor cap has had normal use, the inside of the cap inserts will become slightly burned on the inside tip. If these inserts are badly burned or if they are burned at any other point, the cap should be replaced. If none of the above conditions are found the distributor cap should be thoroughly cleaned and set aside for reassembly.

(344) Rotor

The rotor should be visually inspected for cracks (if cracked, it should be replaced) and evidence of incorrect burning at the end of the metal strip. After a distributor rotor has had normal use, the end of the contact will become burned. If this burning is not excessive and is found only on the end of the metal strip, the rotor need not be replaced. If burning is found on the top of the strip, it indicates the rotor is too short and needs replacing. Usually when this condition is found, the distributor cap inserts will be burned on their horizontal face and the cap will also need replacing. If none of the above conditions are found, thoroughly clean the rotor and set it aside for reassembly.

(345) Condenser

Inspect the condenser. Be sure that it is firmly mounted on the base plate and check the condenser or lead for broken wires or frayed insulation. Clean and tighten the connection to the terminal. Check the condenser on an approved tester. Its capacity should be .20 to .25 microfarads. Replace the condenser if found to be defective.

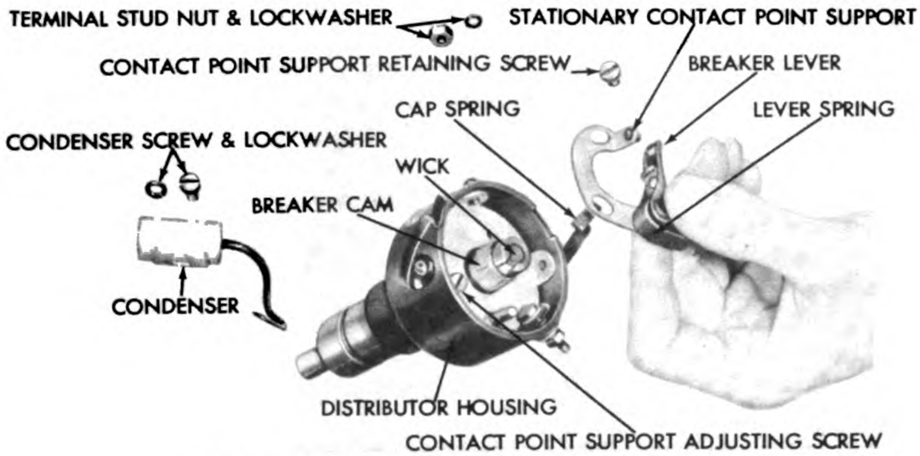


Figure 270. Removing Breaker Lever.

(346) Breaker Contacts

If the contacts are a grayish color and are not burned or pitted, they need not be replaced. Check with a wire feeler gauge and breaker contact gap. This gap should be .020″ plus or minus .002″. Readjust if necessary. See figure 270. After adjusting, retighten the locknut. Then recheck the gap. Check the contact point alignment. The contacts should be aligned so as to make contact near the center of the contact surfaces. Bend the stationary contact bracket to secure proper alignment. Then recheck the maximum gap as just given above.

(347) Circuit Inspection

Inspect the primary circuit to make sure no wires are broken and that the terminals are clean and tight. Turn on the ignition with the engine stopped. If the contacts are closed, the ammeter should show a discharge of approximately 2.5 amperes. Any other reading indicates a grounded, shorted, or open primary circuit. Also check the high tension leads and make sure the wires are clean and that the insulation is not worn or frayed. Inspect the terminals at the coil, distributor, and spark plugs to make sure they are clean and tight.

(348) 256 Hour Tune-up Inspection of the Distributor and Ignition Coil

a. Remove the distributor from the engine after disconnecting the high tension wires from the cap towers and noting the proper order to be used when reassembling, and removing the primary lead from the terminal at the side of the distributor.

b. Snap off the two distributor cap springs and lift the cap off the distributor. Note the position of the rotor in relation to the base. This position should be remembered to facilitate reinstalling and retiming the distributor.

c. Loosen the screw in the advance arm and lift the distributor from the engine.

d. Inspect the cap, rotor, condenser, and contacts described in paragraphs 343, 344, 345 and 346.

e. Check the contact pressure with a spring scale hooked on the breaker arm at the contact and pull on a line perpendicular to the contact face. Take the reading just as the points separate. This pressure should be between 17 to 21 ounces. A low pressure will cause misfiring at high speeds and too high pressure will cause excessive cam wear. Adjust the point pressure by loosening the screw holding the end of the contact arm spring and slide the end of the spring in or out as necessary. Retighten the screw and recheck the pressure.

f. Inspect the governor mechanism for free operation by pulling the distributor shaft and turning the cam to the right as far as it will go and release it. The cam should return immediately to its original position with no drag or restriction. If the governor action is sluggish the distributor should be disassembled and overhauled, as given in paragraphs 349 and 350.

g. Reassemble the rotor and place the distributor in its mounting and turn the base and the rotor to the positions noted when removing the distributor. Push the distributor completely down in the mounting so that the gear engages its drive and fastens the hold down arm.

h. Install the distributor cap making sure the cap springs are firmly in place. Connect the primary lead to the terminal and install the high tension lead in distributor cap. Retime the distributor to the engine as given in paragraph 353.

i. Remove the ignition coil and inspect it on a coil tester. Replace if necessary, and inspect the wiring as described in paragraph 348.

(349) 512 Hour Overhaul of Distributor

a. Remove the distributor from engine as given in paragraph 349. Detach the distributor cap and lift off rotor from breaker cam figure 269.

b. Lift off breaker lever by loosening terminal nut slightly, compress breaker lever spring between thumb and forefingers and lift breaker lever off hinge post. Figure 270.

c. Unscrew adjustment locking screw and lift off stationary contact point support. Drive out the gear pin as shown in figure 271 and with a small wheel puller as shown in figure 272 slide the gear off the shaft.

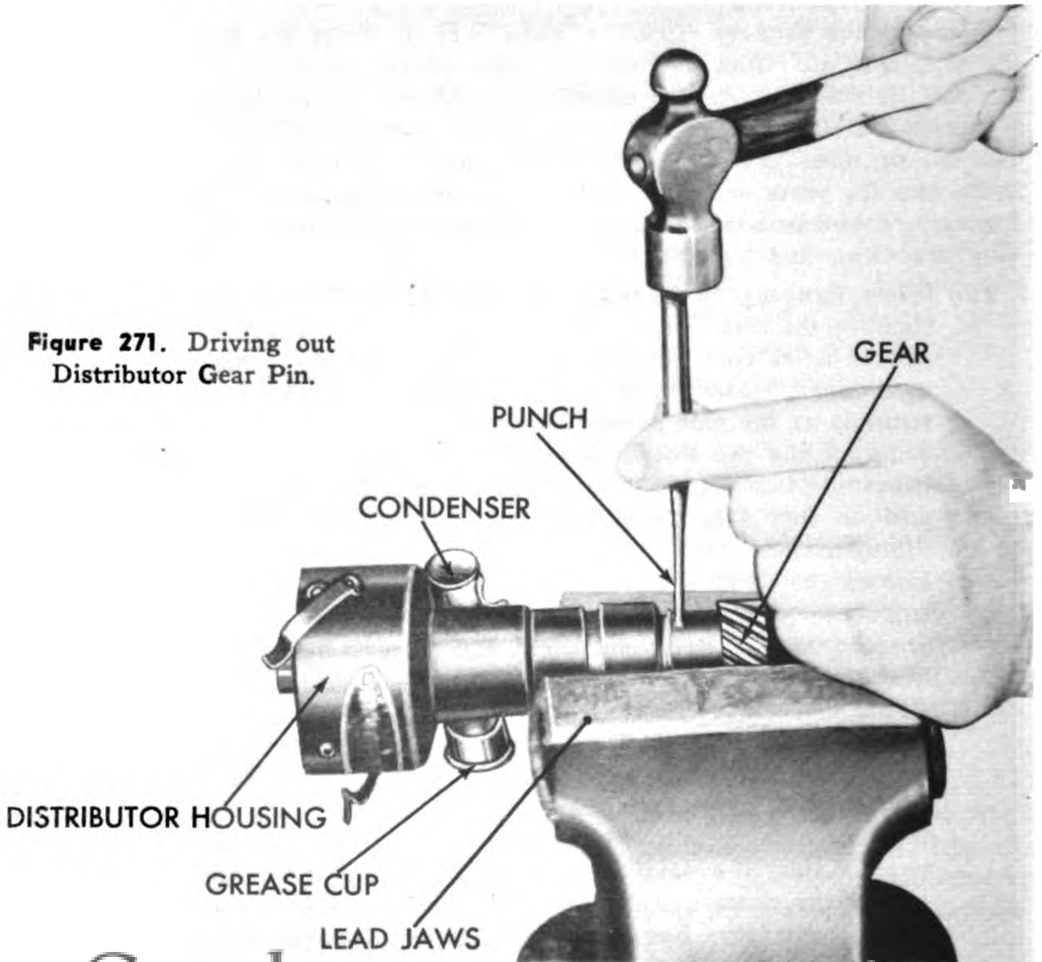


Figure 271. Driving out Distributor Gear Pin.

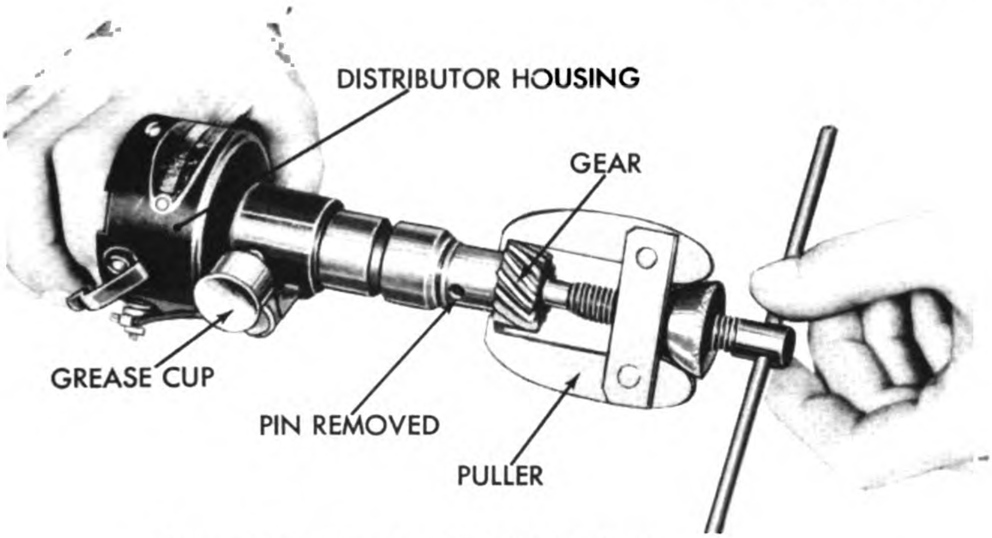


Figure 272. Removing Distributor Gear.

d. Remove terminal stud, first, from inside, remove nut (5/16" wrench) lock washer, and condenser clip. Second, from outside remove the terminals stud in order named: nut, lockwasher, nut, lockwasher, flat washer and insulating washer. Stud can now be removed with bushings and insulating washer. See Fig. 272.

e. Detach condenser and lockwasher by unscrewing attaching screw.

f. Detach breaker plate by removing the two cap spring attaching screws, lockwashers, cap spring supports and cap spring. Removing breaker plate attaching screw, lockwasher and breaker plate. Figure 273.

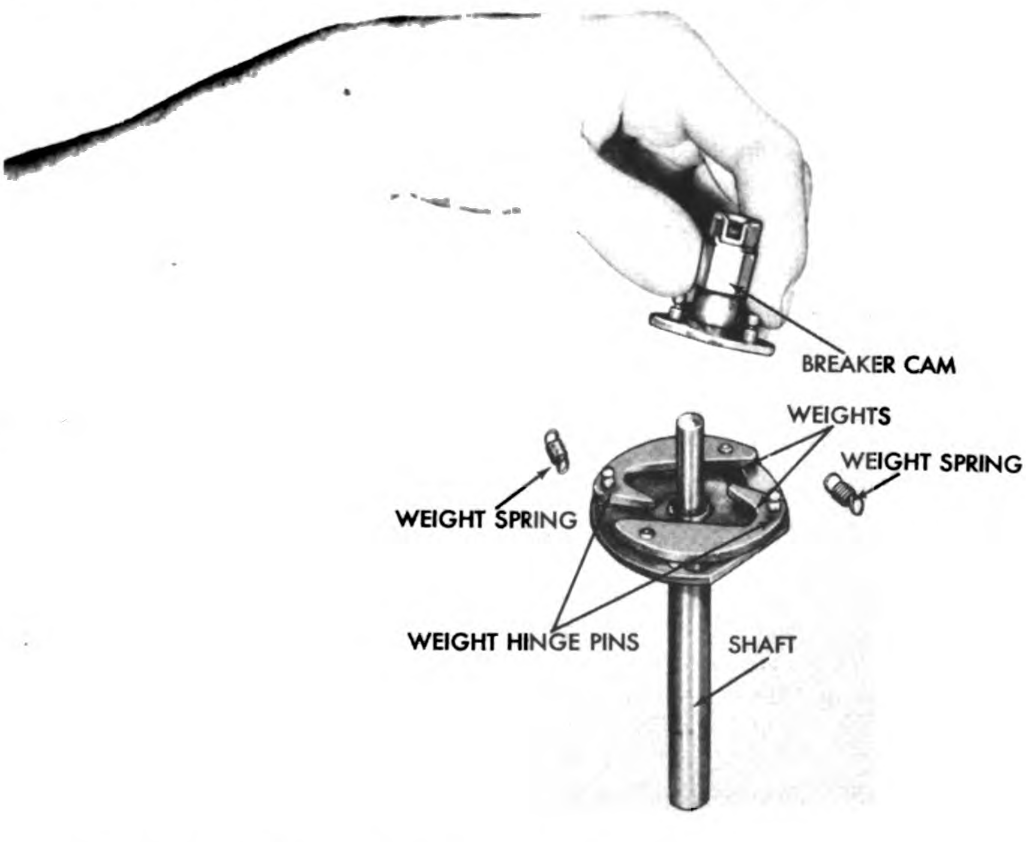


Figure 273. Removing Distributor Breaker Shaft.

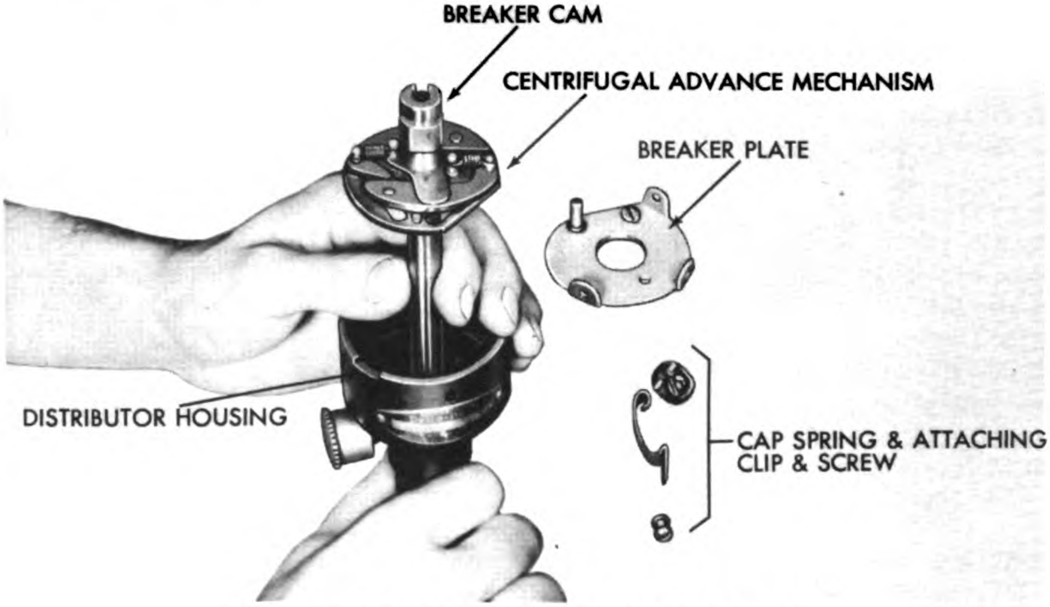


Figure 274. Removing Distributor Main Shaft.

g. Detach main shaft, with centrifugal advance and breaker cam from housing by driving out cotter pins slipping washers and shims off. Remove washer from shaft (under weight base). Figure 274.

h. Disassemble the centrifugal advance mechanism by removing the two weight springs with pliers, taking extreme care to avoid damaging springs. Lift off the centrifugal advance, breaker cam assembly and weights.

i. Remove grease cup from housing, clean and pack with new grease.

(350) Inspection of Distributor Parts

Inspect every part of the now disassambled distributor for wear.

a. Inspect the cap, rotor, condenser, and contacts as given in paragraphs 343, 344, 345 and 346.

b. Check the weight springs. If distorted, replace.

c. Clean the governor base thoroughly and inspect it for cracks and wear; replace the base if cracked. Replace the bearings if worn. (To replace the bearing drive out the old bearing and assemble a new one with the correct arbor.)

d. Clean the breaker plate thoroughly, and inspect the plate pivot and terminal for corrosion. After cleaning, reassemble the contacts and condenser on the plate.

e. Clean the cam and inspect for wear. If cam or the slots are worn excessively, replace.

f. Inspect contact points. Points that are rough, burned, or pitted may be cleaned, if not too bad, with a fine-cut contact file or stone. NEVER USE EMERY CLOTH OR SANDPAPER, since particles will embed and cause the points to burn. It will not be necessary to remove all the high spots nor to file the point surfaces down to the craters. Merely clean off the high spots.

g. Miscellaneous parts like centrifugal advance parts, weights, springs, plate, should be clean, and not show signs of excessive wear. Studs should be tight in the weights and weight base. Insulators, screws, washers, nuts, etc., should be examined and replaced if they are bent, battered, broken, or have crossed threads. Likewise, cracked, bent, worn, burned insulators, and washers, leads that have broken strands, badly frayed insulation, should be replaced.

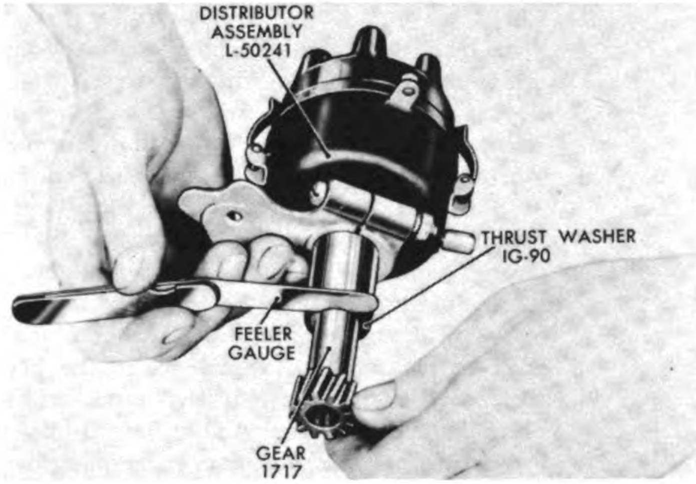


Figure 275. Checking Distributor Shaft End Play.

(351) Reassembly of Distributor

a. Assemble main shaft, centrifugal advance, breaker cam, and grease cup to housing. Place weights on studs and slip breaker and centrifugal advance cam assembly on shaft. Secure with advance springs attached between weight base studs and centrifugal cam studs. (BE SURE WICK IS IN PLACE IN BREAKER CAM.) Now place washer on driving end of main shaft, and slip shaft into housing. Place washers and shims on shaft and slip cotter pin in place and lock.

b. Assemble the gear on the shaft and put rivet in place as shown in figure 271.

c. Check the end play with a feeler gauge by inserting the gauge between the base and lower thrust washer with the shaft pressed to its extreme lower position as shown in figure 275. If end play is not between .003 and .010, remove the gear and install thrust washer between the base and the gear.

d. Put breaker plate in position and secure with three screws and lockwashers. Also attach cap springs and supports to the housing. Mount condenser with screw and lockwasher.

e. Adjust the contact gap by turning the cam so that the rubbing block is on high point. Adjust the stationary contact so that the gap is approximately .020". Turn the cam and check the alignment of the contacts. Bend the stationary contact bracket to secure perfect alignment. Then turn the cam to the maximum point opening and adjust the stationary contact so that gap is .018" to .020" as shown in figure 276. Tighten the locknut and recheck in the gap.

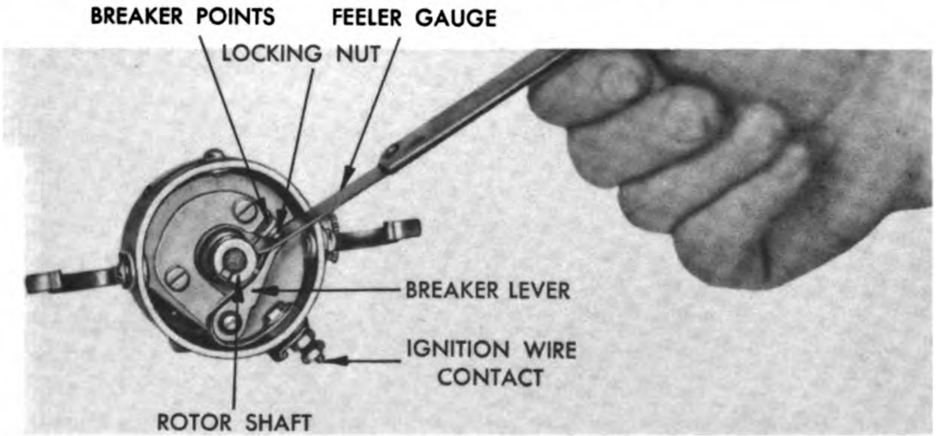


Figure 276. Checking Distributor Contact Gap.

f. Check the contact point pressure as given in paragraph 348.

g. Attach the terminal stud by placing the insulating washer and bushing on terminal stud and insert from inside through hole in housing. Secure with insulating washer, flat washer, condenser lead clip, lockwasher, nut, lockwasher and nut, in order named.

h. Attach contact points by pressing stationary contact point support in place on breaker plate. Compress breaker lever spring between thumb and finger and slip breaker lever on pivot pin with end of spring (where V is cut) on terminal stud. Place adjustment locking screw in breaker plate and run up loosely. Adjust points as outlined in following paragraph. Add a trace of light oil to breaker cam and a drop or two of light engine oil to the breaker lever pivot pin.

i. Put rotor in place on breaker cam making sure that the wick is in place in breaker cam. Add a few drops of light engine oil to wick. Put cap in place on housing, snap the two springs into undercut in cap.

j. Check the governor advance by mounting the distributor on a test fixture that will show distributor R.P.M. and degrees of governor advance. Check the advance both up and down the speed range so that any indication of sluggishness can be observed. Adjust the advance by bending the outer locks on which the governor weights are mounted. The governor advance should be adjusted as follows:

Start advance 0.3° at 600 R.P.M.
Intermediate advance 11.5° at 1200 R.P.M.
Full advance 28° at 3000 R.P.M.

All the figures are distributor degrees and distributor R.P.M.

k. Add one drop only of light oil to the breaker arm hinge pin and saturate the felt in the top of the cam with light oil. Add three to five drops of medium engine oil to the oiler in the outside of the base.

l. Install the distributor on the engine and connect the high tension cables, making sure that the leads to the spark plugs are installed into the correct cap towers.

(352) Timing Distributor to the Engine

Since the distributor is equipped with an automatic spark, only a temporary setting can be made. The final setting can be made when the engine is running under full load. The following steps are necessary to make the temporary setting.

a. Turn the engine in the direction of rotation with a hand crank until the piston in cylinder No. 1 moves upward on the compression stroke. NOTE: The compression stroke can be obtained by cranking the engine until the intake valve opens and closes. The intake valve is the second valve from the fan end. This will necessitate removing the valve cover plate. Carefully continue turning so that the top dead center line (T.D.C.) on the flywheel centers in the timing hole of the flywheel housing. See figure 277.

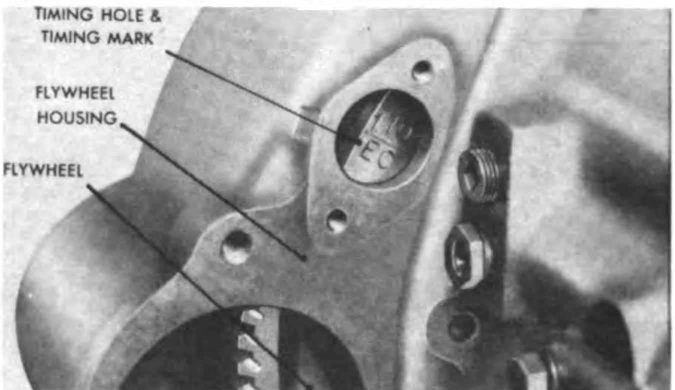


Figure 277. Timing Hole.

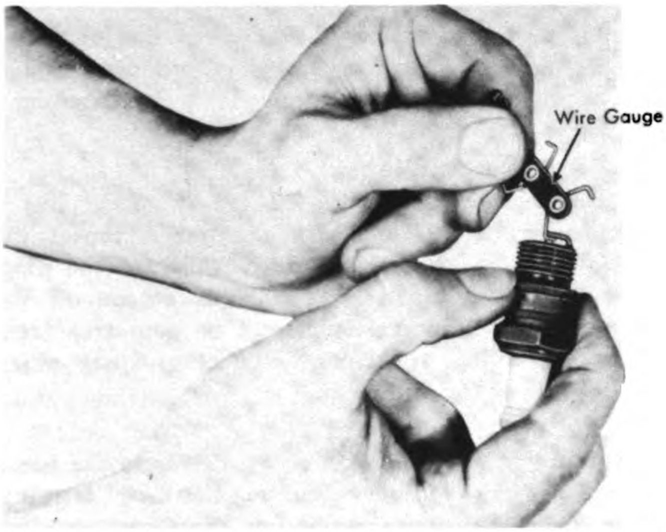


Figure 278. Checking Spark Plug Gap.

b. With a wrench on the crankshaft jaw turn the flywheel in the DIRECTION OF ROTATION 15/32" past the T.D.C. line as measured on the face of the flywheel through the timing hole.
Since a ruler cannot be used in such close quarters, lay the 15/32" past T.D.C. off the flywheel face with a pair of dividers. The 15/32" as measured on the flywheel past the T.D.C. line should be centered in the center of the timing hole before proceeding to the next step.

c. Remove the distributor cap from the distributor.

d. Loosen the clamping screw on the distributor arm so that the distributor can be turned inside the arm.

e. Set the distributor in the distributor mounting hole in the water pump sleeve with the distributor body in such a position that the low tension coil lead connection is toward the front of the engine. In this step pay no attention to the position of the cam. NOTE: If the distributor does not go all the way to the water pump sleeve, turn the cam slightly until the gear teeth mesh.

f. Turn the body of the distributor slightly in the opposite direction of the distributor cam rotation (cam rotation is clockwise) until the points just begin to open. NOTE: To determine the position when the points just open, insert a piece of cigarette paper between the contact points and turn the body of the distributor until the paper can be slipped from between the points with a slight drag.

g. Tighten the clamp screw on the distributor arm with the arm in the advanced position. The arm is in the advanced position when it is pushed toward the rear of the engine.

h. Before installing the distributor cap note the position of the rotor; the contact in the cap coming opposite the rotor will be the No. 1 cylinder terminal connection. Install the cap.

i. Install the high tension cable from the spark plug of the No. 1 cylinder to the No. 1 distributor cap outlet, and install the rest of the cables in their proper order. The firing order is 1-3-2-4. Note that the position of rotor determines which outlet on the distributor cap will become the No. 1 cylinder high tension spark plug connection. The temporary setting has been obtained. NOTE: Since the cam rotates clockwise the distributor cap outlet next to the No. 1 outlet going clockwise around the cap will be for the No. 3 cylinder, next to No. 2, and the outlet for No. 4.

(353) Spark Plugs

The spark plug has two electrodes so arranged that when the high tension electric current passes through the plug a spark is produced which ignites the compressed gas mixture. The center electrode is insulated and the outer electrode is grounded.

(354) Checking and Adjusting the Spark Plugs

The gap between the electrodes should always be set at .025". Use a wire feeler gauge as shown in figure 278 to check the gap. Inspect the porcelain for cracking and chipping if porcelain is damaged, discard the plug. Where possible, use a spark plug sand blaster to clean, or scrape off the carbon with a knife. The outside of the porcelain should be kept free from oil and dirt on which moisture can collect and "short" the plug. Spark plugs should be renewed every 512 hours of operation.

(355) Checking Misfiring Spark Plugs

To find the plug, or plugs, not firing, ground a screw driver to the block (as shown in figure 279) and tilt the screw driver to contact the metal terminal on the cable connecting the spark plug to the distributor. The plugs, or plug, not firing will have no effect on the running of the engine when shorted by the screw driver.

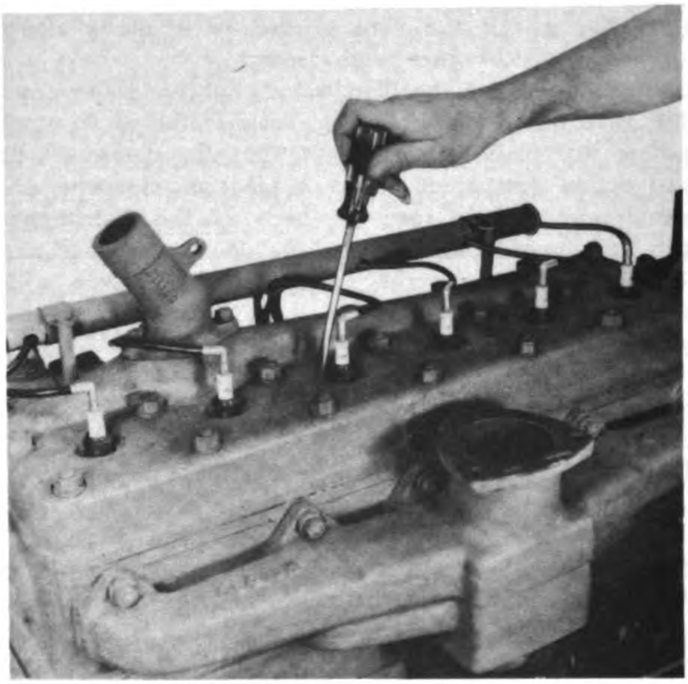


Figure 279. Checking Misfiring Spark Plug.

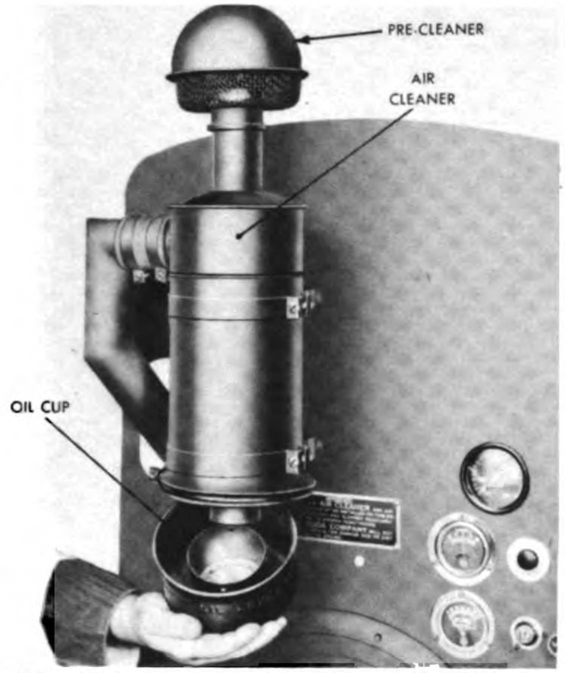


Figure 280. Attaching the Air Cleaner Oil Cup.

Fuel System

The fuel system accessories are: air cleaner, carburetor, fuel pump, governor, the necessary fuel lines and fuel tank.

The gasoline is fed from the fuel tank to the carburetor by a fuel pump and a constant speed governor automatically controls the speed of the engine. Detailed instructions for servicing the accessories are given alphabetically in the following pages.

(356) Air Cleaner

The air cleaner is of the oil bath type. As the air that is drawn in strikes the oil, a fine mist is produced. The mist removes part of the dust and dirt, the balance being removed by the filter element in the main body of the cleaner with the oil mist keeps moist. As the oil mist collects in the cleaning element, drops form and as they drain into the oil cup where the sediment is deposited, these drops of oil wash the filter element. Because abrasive dust is the chief cause of engine wear, it is important that the air cleaner be serviced every eight hours, as recommended in the Maintenance Chart. If the dust and dirt conditions are severe, the cleaner should be serviced every four hours.

(357) Servicing Air Cleaner

Remove the oil cup at the lower end of the cleaner, empty the oil, and scrape out the dirt. Figure 280. Any coating of dirt on the walls of the center tube should be removed by ramming a cloth through the tube with a stick so that the flow of air to the engine will not be restricted. (See figure 281). Refill the oil cup to the oil level, the same grade of oil used in the crank case. Figure 280. Replace the oil cup securely.

NEVER REMOVE THE OIL CUP WHILE THE ENGINE IS RUNNING AND DO NOT RUN THE ENGINE UNLESS THE OIL CUP IS FILLED WITH OIL. Also be sure that the screen on the pre-cleaner is clean and free of leaves and lint. Figure 282.

All connections between the air cleaner and engine MUST BE KEPT AIR TIGHT AT ALL TIMES. Also, the clamps on the hose connections should be kept tight.

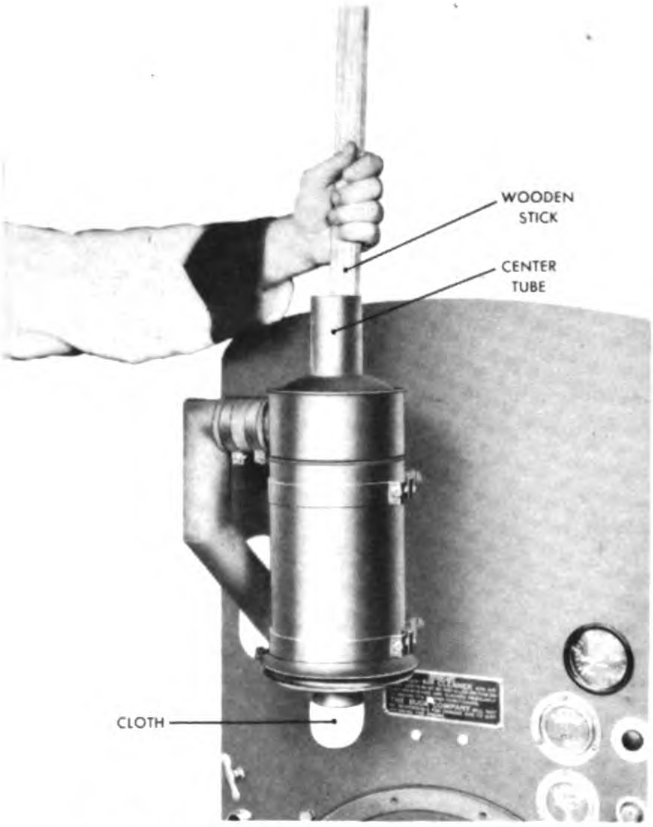


Figure 281. Cleaning Air Cleaner Center Tube.

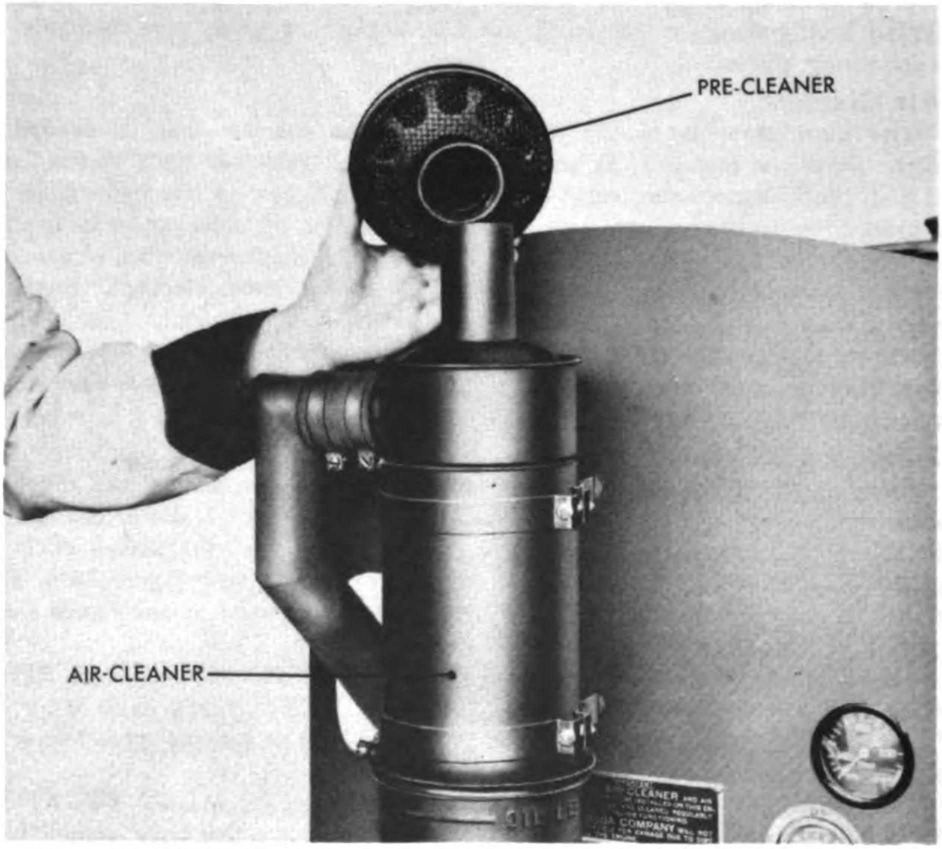


Figure 282. Removing Pre-cleaner Screen.

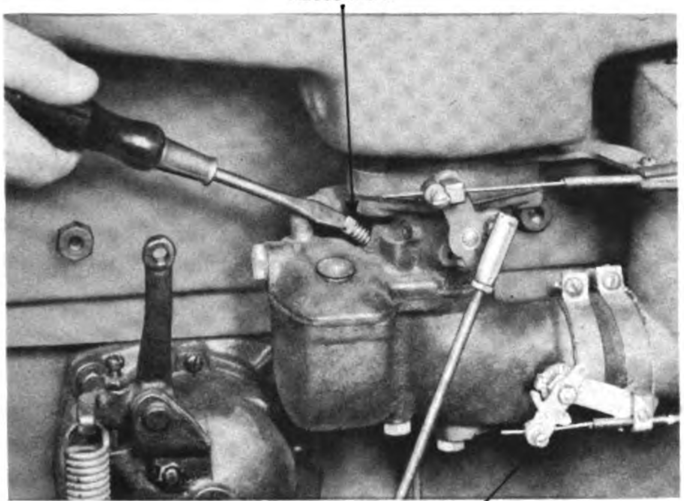


Figure 283. Making Idle Adjustments.

(358) Carbyretor

The Zenith 124 1/2 T.O.X. carburetor is of the double nozzle, single venturi design. It is a balanced carburetor which maintains proper depression ratio between the air intake and fuel bowl.

a. The idling jet measures the fuel for idling speeds with the air for idling being regulated by the idling adjusting nut. The idling system functions only when the throttle plate is almost closed, causing a very strong suction on the priming hole at the edge of the throttle plate.

b. The compensating jet is the source of fuel supply to the idling jet and, as the throttle plate is opened to permit higher engine speeds, the fuel from the compensating jet flows out through the cap jet. This flow is constant even though engine speeds increase, due to the admission of air through ventilation channels. The main jet is the high speed jet and exerts its greatest influence at higher engine speeds. It is a direct suction jet and its flow increased with the flow of air. Its size is determined to give economical operation combining the characteristics of this jet with those of the compensating jet, you obtain a correctly proportioned mixture.

The venturi is the air metering nozzle and determines the maximum volume which may be passed through the carburetor. All mixture adjustments, except idling, are determined by calibration of various jets and can only be changed by disassembling the carburetor and installing a different jet. However, these jets should not be changed unless recommended by the factory's service department.

(359) Adjusting Idling System

Before adjusting the idling mixture, warm up the engine so that the intake manifold is at least warm to the hand (120°F. or higher). To make the mixture richer, turn needle valve IN—to make the mixture leaner, turn the valve OUT. See figure 283. Make all adjustments after the engine is warm, turning the needle valve right or left until the engine runs steadily and as fast as the throttle will permit. After the engine runs smoothly, it may be necessary to change the position of the throttle stop screw.

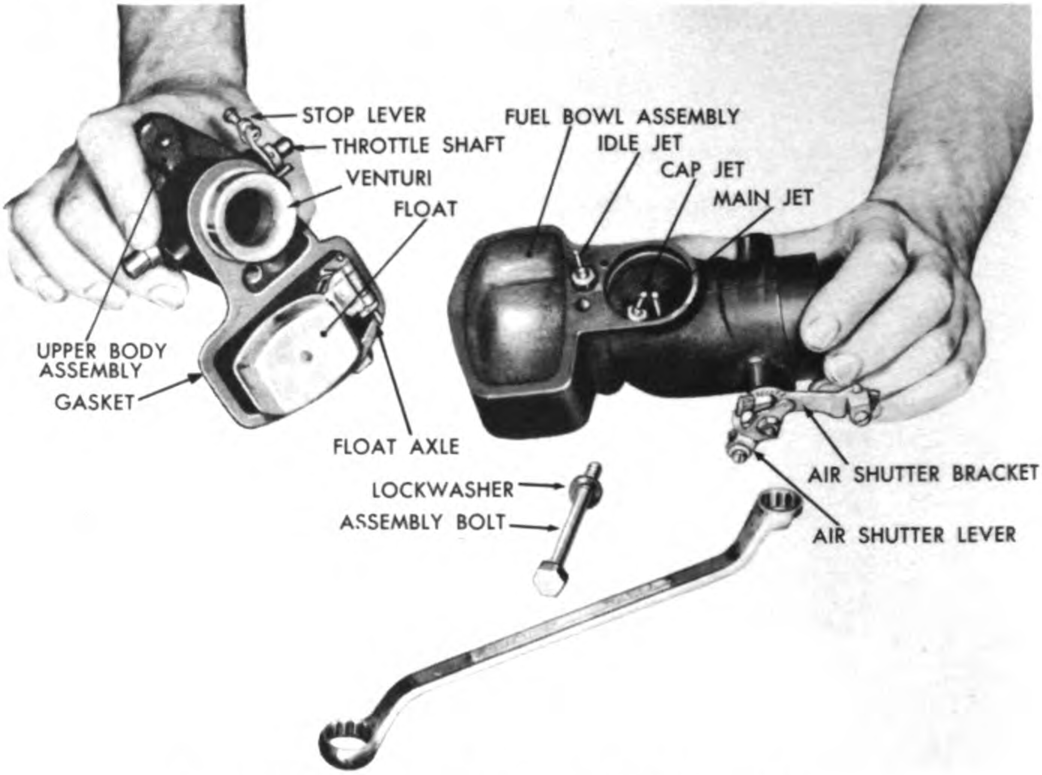


Figure 284. Removing Carburetor Bowl Assembly.

(360) Overhauling the Carburetor

To properly disassemble the Zenith 124 1/2 T.O.X. carburetor, the following procedure is recommended with the accompanying tools:

a. Remove the assembly bolt which holds the bowl assembly to the upper body assembly. (No. 7816S service tool). See figure 284.
b. Lift the upper body clear of the bowl assembly. Be careful not to damage the economizer tube.
c. Remove venturi and bowl to body gasket.
d. Remove the float axle with small pliers. Note carefully the relation of the float spring and float baffle to the float, if these parts are used, and confusion when reassembling will be avoided. See figure 285.
e. Remove throttle plate screws, throttle plate and throttle shaft assembly. (Do not disturb economizer tube or dash adjustment needle housing). See figures 286 and 287.
f. Remove Compensator jet from bowl, using screw driver. See figure 288.
g. Remove fuel valve assembly. (T 30016 service tool). See figure 289.
h. Remove main jet (C161-83 service tool). See figure 290.
i. Remove cap jet (C161-25 or C161-79 service tool). See figure 291.
j. Remove idle jet (C161-9 service tool).
k. Remove lower plug.
l. Remove idle adjusting needle and spring and fuel union body.
m. Remove air shutter shaft. Figure 292.
n. Clean all channels with gasoline or other solvent, but do not boil in caustic solution. Blow through each channel with compressed air.

(361) Parts to Be Replaced

All gaskets, C 181-36 includes all gaskets. Fuel valve and seat assembly No. 45. Float assembly C85-47. Main jet C51-15. Compensator jet C52-3. Cap jet C54-13. Idle jet C54-14. Throttle shaft C23-47. Throttle Plate Screw C136-3 (two needed). Float axle C120-27.

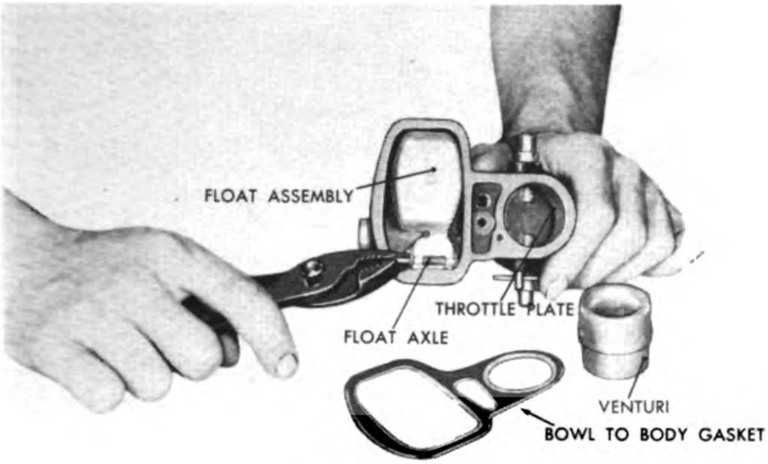


Figure 285. Removing Carburetor Float Axle.

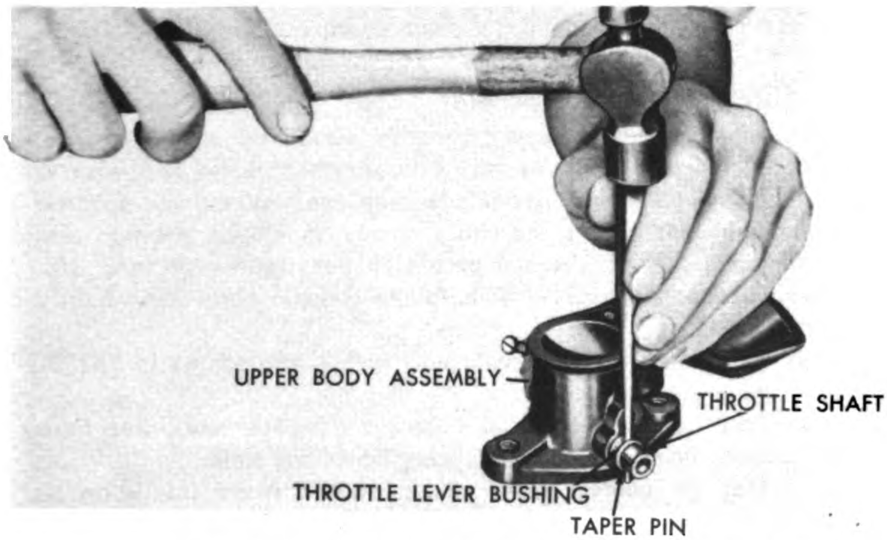


Figure 286. Removing Carburetor Throttle Shaft Pin.

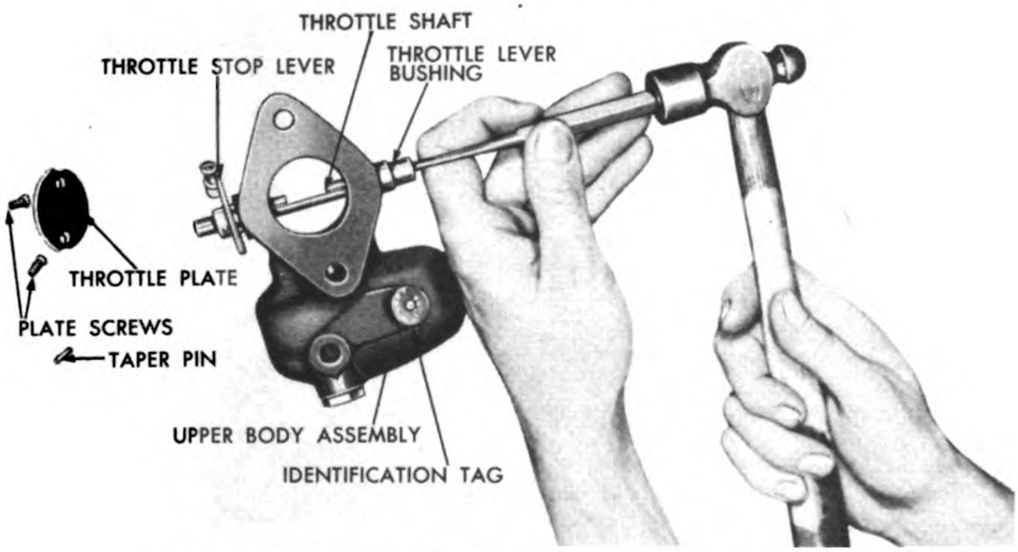


Figure 287. Removing Carburetor Throttle Shaft.

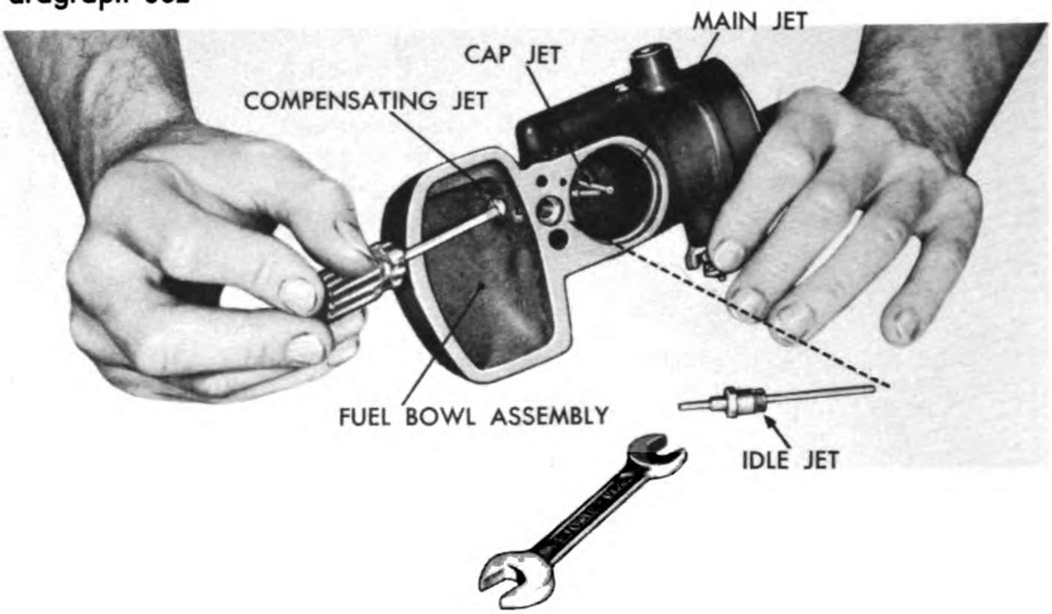


Figure 288. Removing Carburetor Compensating Jet.

(362) Reassembling of the Carburetor

a. Install throttle shaft. Insert throttle plate and make certain it fits closely to the barrel all the way around when closed and with the stop screw backed out away from the stop pin. When the throttle plate has been properly centered, hold firmly in closed position while the throttle screws are tightened securely. See figures 287 and 286.

b. Adjust throttle stop screw to hold the throttle plate just slightly open. See figure 287.

c. Install the idle adjusting needle and spring and adjust to one full turn off the seat. See figure 283.

d. Install fuel valve assembly and gasket (T30016 tool). See figure 289.

e. Install float, float baffle, float spring and float axle.

f. Check float for correct level. Float should move freely on its axle. The dimensions between the top of the bowl and the body when held in an upside down position should be 1-7/32" plus or minus 3/64". See figure 285.

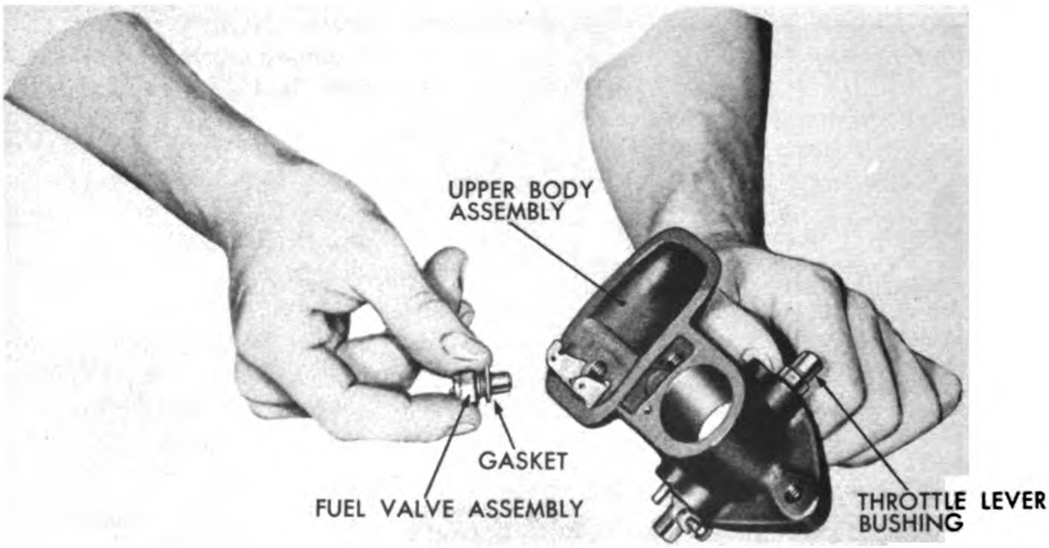


Figure 289. Removing Fuel Valve Assembly.

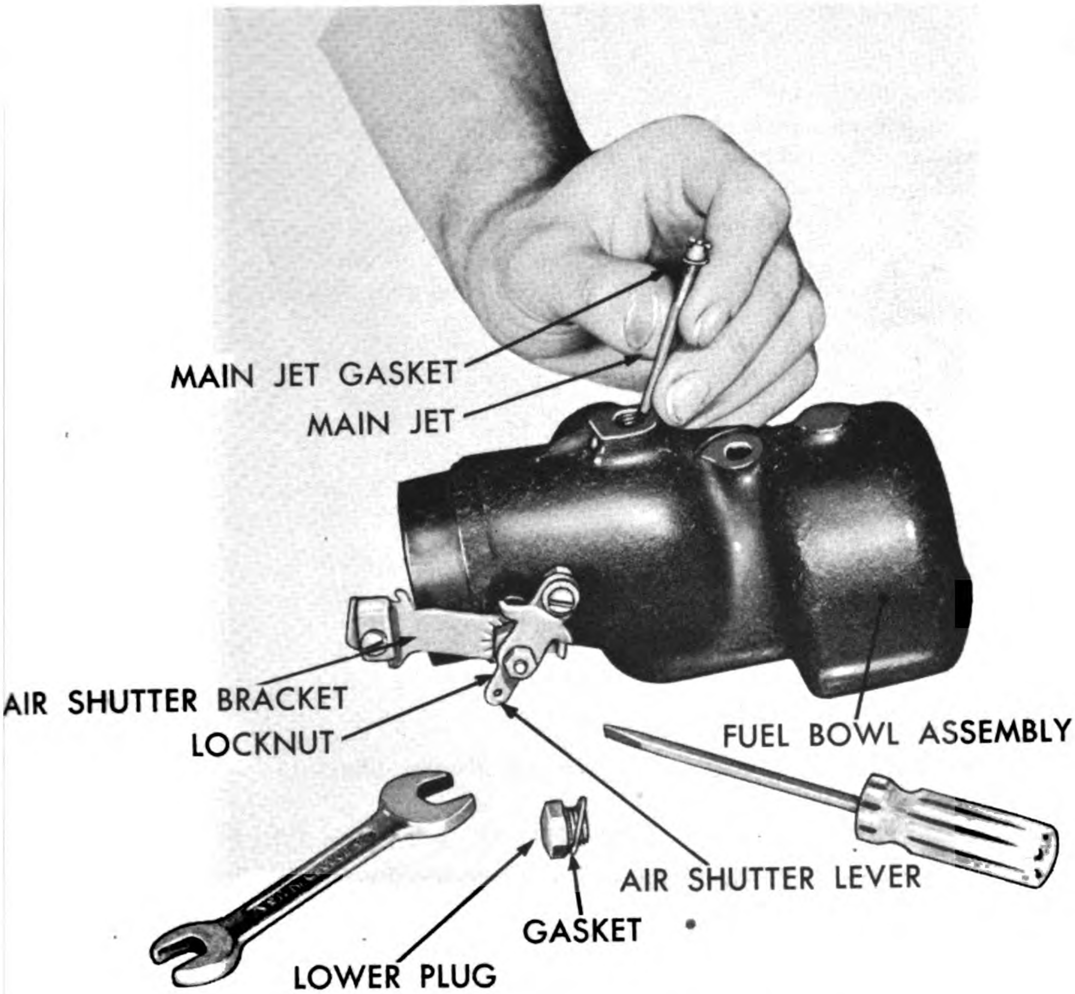


Figure 290. Removing Carburetor Main Jet.

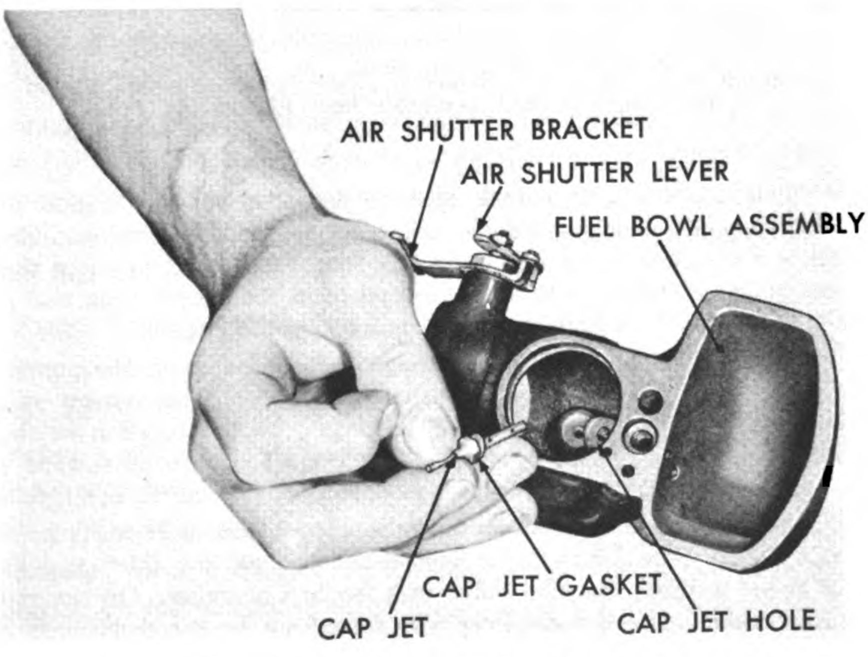


Figure 291. Removing Carburetor Cap Jet.

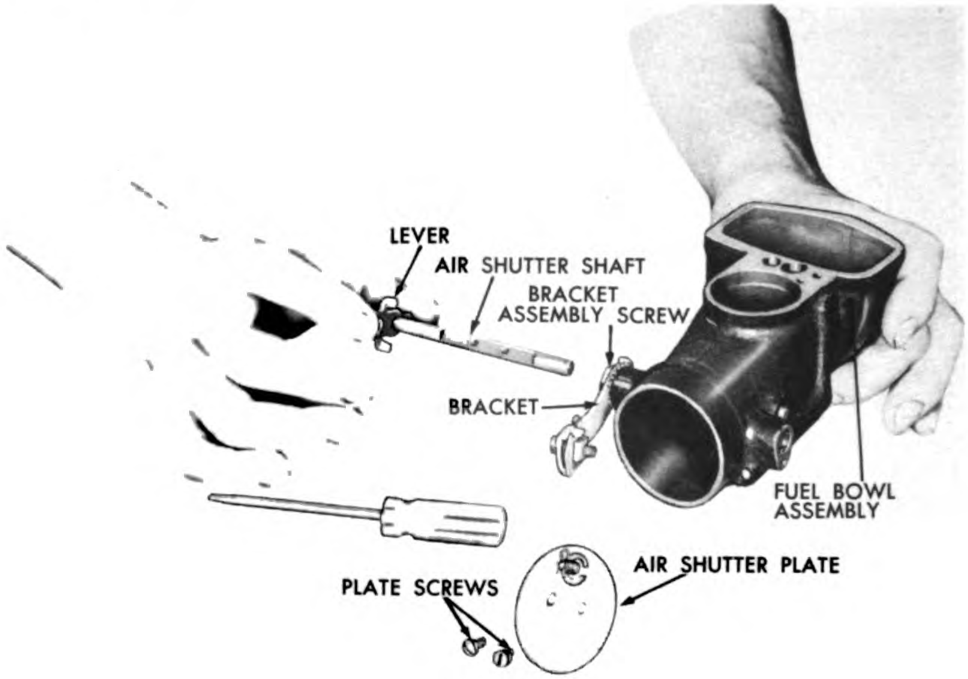


Figure 292. Removing Carburetor Air Shutter Shaft.

g. Install cap jet and gasket (Tool C161-25). See figure 291.

h. Install compensator jet and gasket using screw driver. See figure 290.

i. Install main jet and gasket (C161-83 tool). See figure 290.

j. Install lower plugs.

k. Place the bowl to upper body gasket in position on the upper body assembly and place the venturi in position in the barrel.

l. Assemble the bowl assembly to the upper body assembly by:

1. Hold the upper body assembly upside down.
2. Carefully place the bowl assembly in position on the upper body, avoiding damage to the float, etc.
3. Bolt together with assembly bolt. Figure 284.

(363) Fuel Pump

The AC mechanical fuel pump is installed on the engine next to the carburetor. The suction side is connected to the fuel tank and the discharge side is connected to the carburetor by tubing designed to carry the fuel. The purpose of the pump is to suck the fuel from the supply tank and push it into the carburetor float bowl as it is required by the engine.

Operation is accomplished through a rocker arm on the pump contacting an eccentric on the engine camshaft. Downward movement of the pump diaphragm, or the suction stroke, is caused by the rotation of the eccentric actuating the pump rocker arm, pulling the diaphragm downward against the pressure of the diaphragm spring, producing a vacuum in the fuel chamber.

This vacuum holds the outlet valve closed and pulls the inlet valve open, making fuel flow from the supply tank through the inlet and filter screen and down through the inlet valve into the fuel chamber. On the return stroke of the rocker arm, the diaphragm is forced up by the diaphragm spring, the inlet closes and the outlet valve is forced open, allowing the fuel to flow through the outlet to the carburetor.

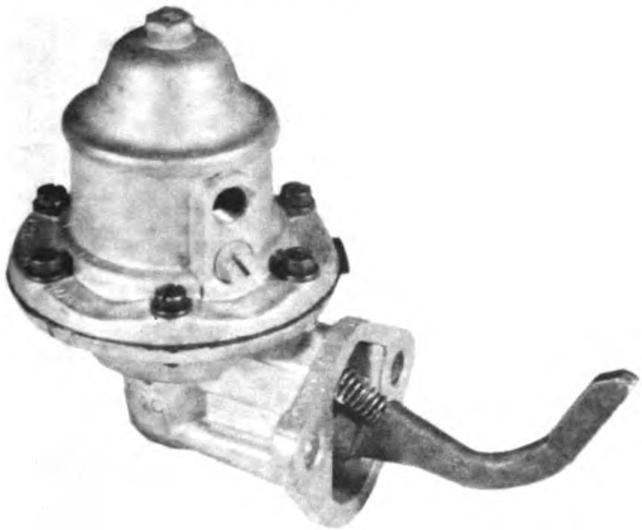


Figure 293. Fuel Pump.

The link is hinged to the rocker arm so that it can be moved down, but cannot be raised, by the rocker arm. The only function of the rocker arm spring is to make the rocker arm follow the cam. The link and diaphragm are moved upward only by the diaphragm spring. The pump, therefore, delivers fuel to the carburetor only when the fuel pressure in the outlet line is less than the pressure maintained by the diaphragm spring. This condition arises when the float needle valve is not seated and the fuel passage from the pump into the carburetor float chamber is open. When the needle valve in the carburetor float chamber is closed, and held in place by the pressure of the fuel on the float, the pump builds up pressure until it overcomes the diaphragm spring. This pressure results in almost a complete stoppage of diaphragm movement until more fuel is needed. Figure 293.

(364) Fuel Pump Trouble Shooting

Trouble in the fuel supply system will usually be caused by:

a. Too little fuel reaching carburetor, evidenced by engine faltering during higher engine speeds, or during low gear range operation uphill with wide open throttle.

b. Too much fuel reaching carburetor, evidenced by excessive fuel consumption, poor engine idling, flooding of carburetor, and by fuel appearing on the outside of carburetor.

c. No fuel reaching carburetor, indicated by engine stalling completely during operation, or failure of engine to start.

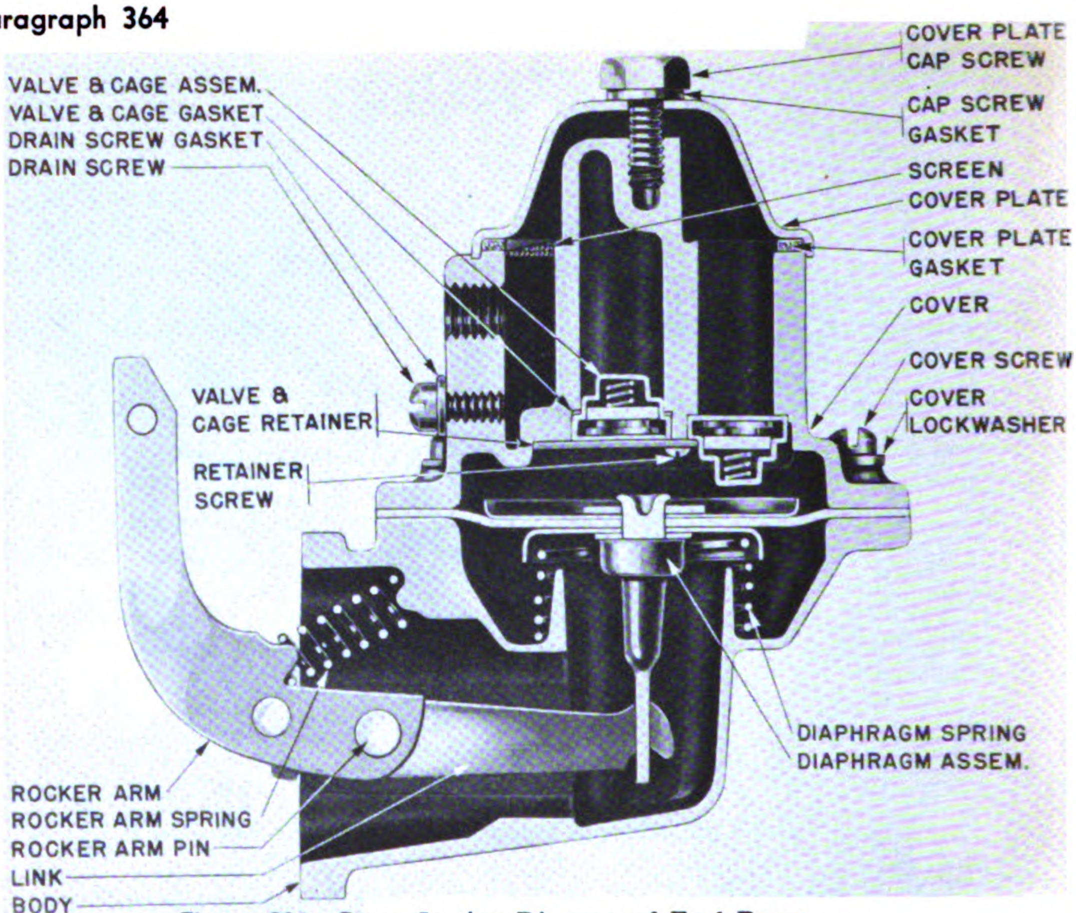


Figure 294. Cross Section Diagram of Fuel Pump.

The following checks should be made to determine which unit in the fuel system is at fault:

a. Be certain that the tank contains fuel.

b. Disconnect the line from fuel pump to carburetor at the carburetor.

c. Turn engine over a few revolutions with starting motor. If no flow of fuel, or if the flow is weak, check system for loose fuel pump mounting capscrews, cover screws, or loose valve plugs clogged with dirt.

1. Loose pump.
2. Pump strainer.
3. Pump bowl gasket leaking, not seated properly.
4. Loose fuel line connections.
5. Broken or flexible fuel lines.
6. Fuel lines punched or chafed.
7. Fuel line filter restricted.
8. Restricted fuel tank vent.
9. Obstruction in fuel tank or in fuel lines from tank to pump.

To check for obstruction, disconnect line from tank to pump, at pump. Blow back through line, and listen for bubbles in the fuel tank. (NOTE: If a filter is in the line, disconnect at filter instead of fuel pump, blowing back as above mentioned.)

If bubbles occur, reconnect the fuel line at pump or filter, turn engine over a few revolutions with starting motor observing fuel discharged at end of disconnected line at carburetor. If there is no improvement in the flow of fuel, the pump should be replaced.

If fuel spurts from the line, the system is functioning although pressure of fuel delivered may not be adequate. Check this with a pressure gauge, Army No. 41G-500, while pump is mounted on the engine. Figure 294.

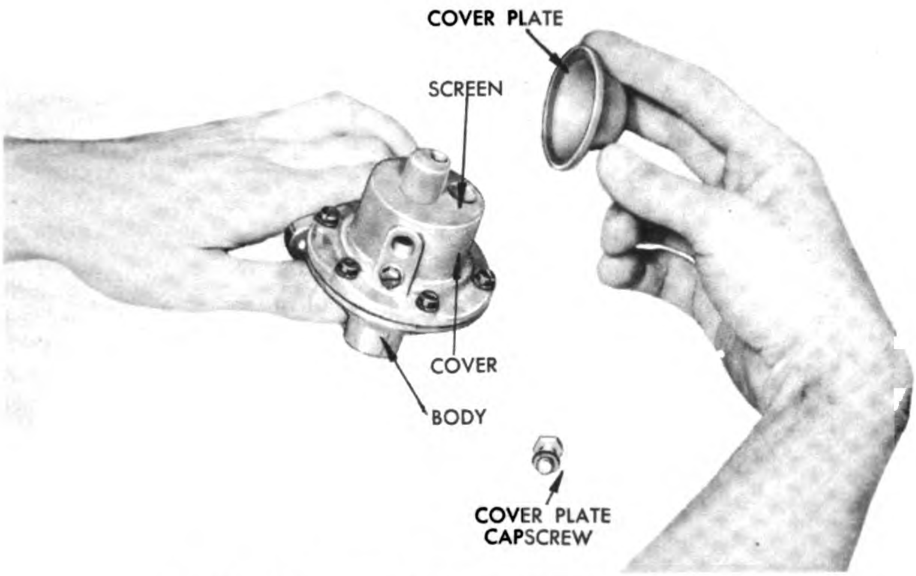


Figure 295. Removing Fuel Pump Top Cover.

(365) Overhauling the Fuel Pump

a. Remove the pump from the engine, wash the outside with cleaning solvent and blow off with compressed air to remove loose grit and grease.

b. Remove top cover plate capscrew and gasket, remove cover plate and gasket. See figure 295.

c. Remove strainer screen, drain plug from side of cover and mark edges of top cover and body with a file. See figure 296. (This is to assure that the parts may be assembled in the same relative position.)

d. Remove top cover screws and washers and separate top cover from body by jarring loose with screwdriver handle. (CAUTION: Do not attempt to pry the body and cover apart as damage may result.) Figure 297.

e. Rest pump body on edge of vise and drive out rocker arm pin with drift punch and hammer. See figure 298. Remove rocker arm. Figure 299. Remove spring, link, and rocker arm bushing. Figure 300.

f. Lay top cover on bench with diaphragm flange up and remove the three screws holding valve and cage retainer. Figure 301.

g. Lift out valve and cage retainer, two valve and cage assemblies and gasket. Figure 302.

(366) Reassembling the Fuel Pump

a. Check top cover and pump body for cracks and breakage. See figure 295. Inspect for diaphragm flange warpage by testing on a smooth flat surface. Examine all threaded holes for stripped or crossed threads. Broken, damaged or severely warped castings must be replaced.

b. Inspect rocker arm for wear or scores at camshaft pad, at point of contact with link and pull rod. Figure 299.

c. Replace the following with new parts—valve and cap assemblies—strainer screen—rocker arm pin and washer—link—rocker arm spring—diaphragm spring—diaphragm and gaskets. (These parts are all in the standard repair kit. Order by mentioning fuel pump number shown on boss above rocker arm.)

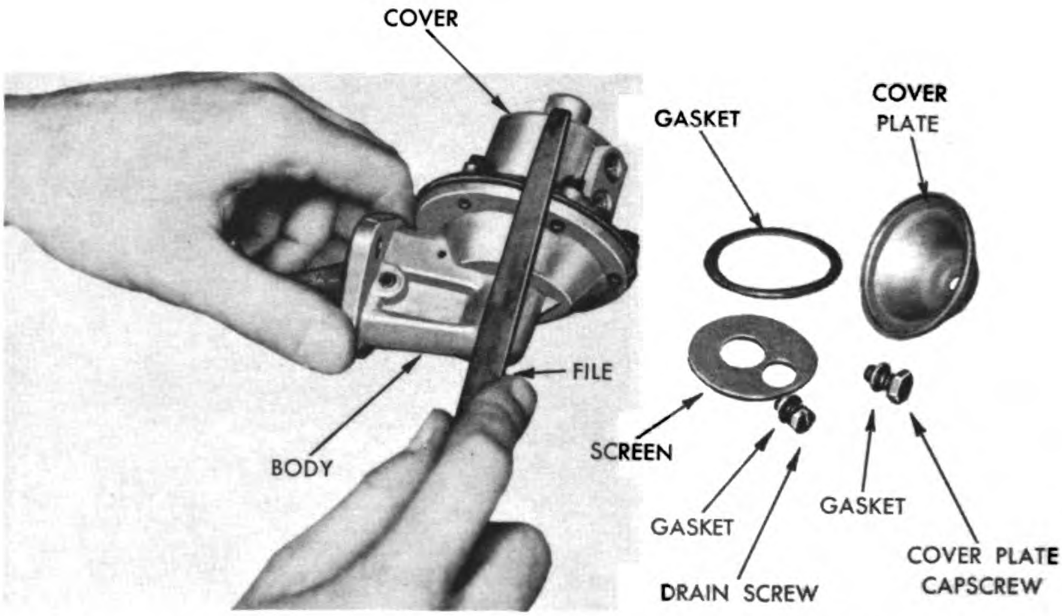


Figure 296. Filing Fuel Pump Cover and Body for Future Reassembly.

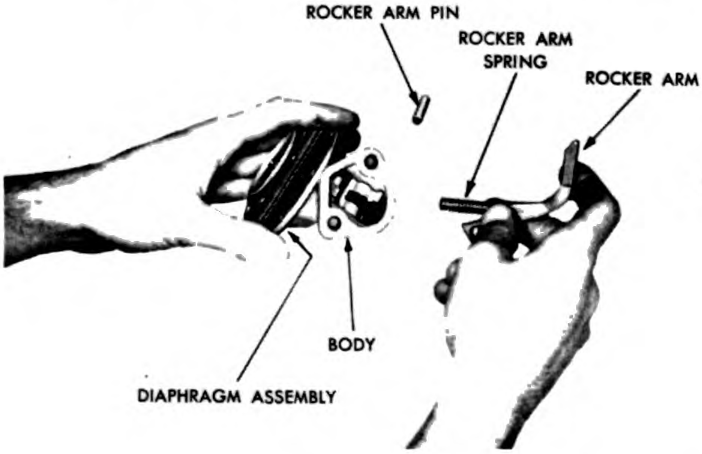


Figure 299. Removing Fuel Pump Rocker Arm.

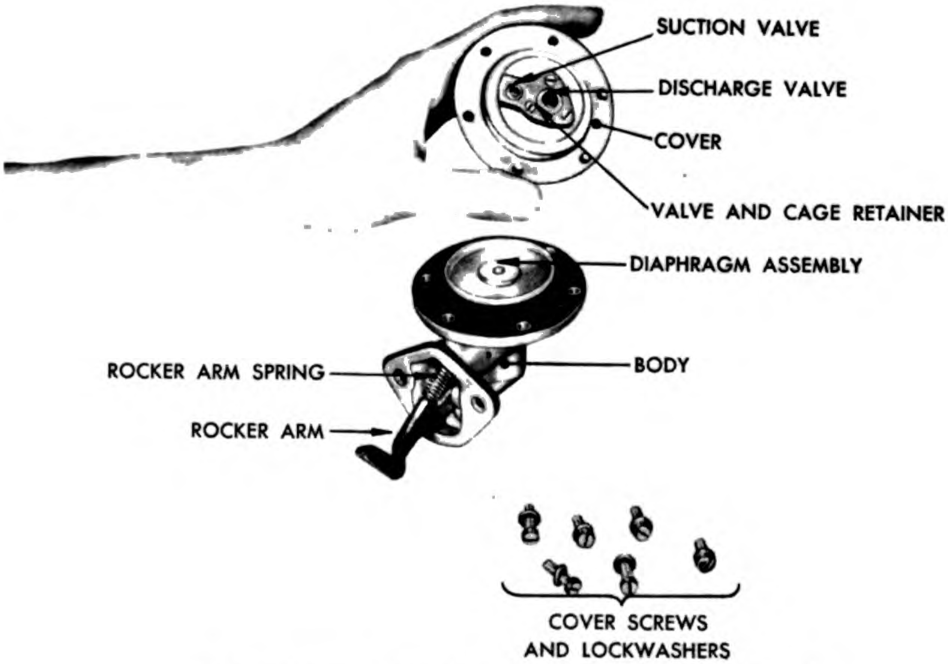


Figure 297. Separating Fuel Pump Body from Cover.

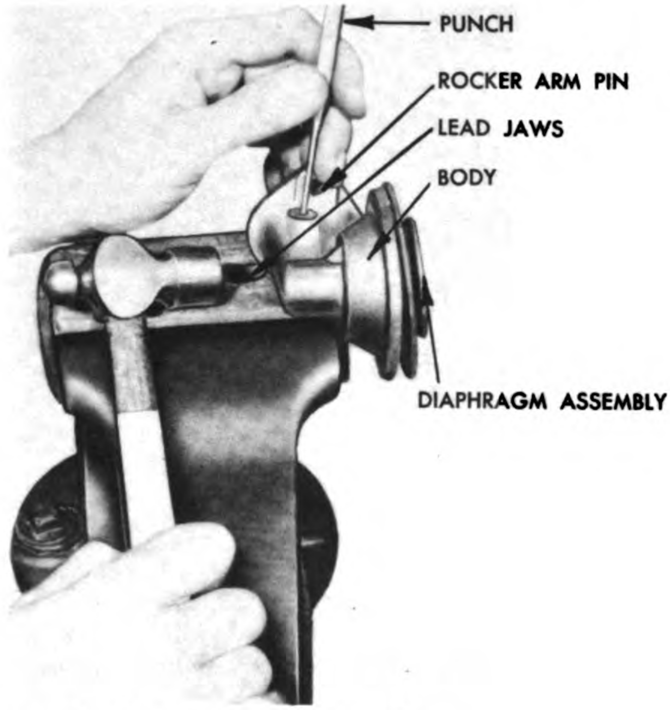


Figure 298. Driving out Fuel Pump Rocker Arm Pin.

d. Soak the new diaphragm assembly figure 300 in clean kerosene while performing the following steps. Fuel oil or gasoline may be used.

e. Assemble link and rocker arm. Place rocker arm and link in body with link hook down. Figure 299. Align rocker arm pin hole with hole in body and drive in the rocker arm pin, figure 298, installing washer on small end of rocker arm pin and spread end of pin.

f. Install lower oil seal retainer, leather oil seal washers, upper oil seal retainer and oil seal retainer on pull rod. Figure 301.

g. Place diaphragm spring over pull rod well and install diaphragm assembly, hooking diaphragm to link by pressing diaphragm against spring. Figure 300.

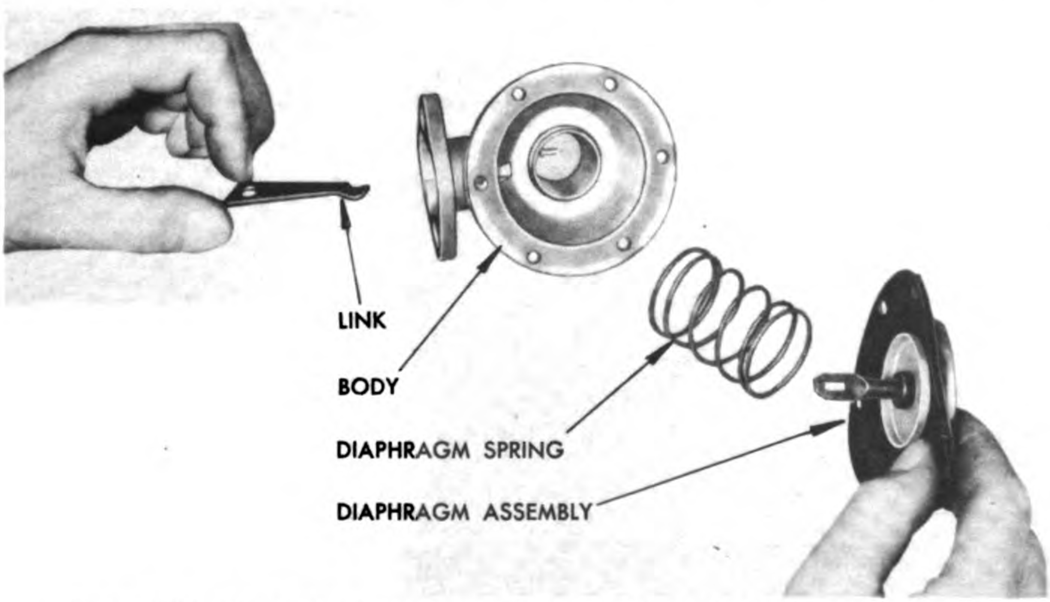


Figure 300. Removing Fuel Pump Spring Link and Diaphragm.

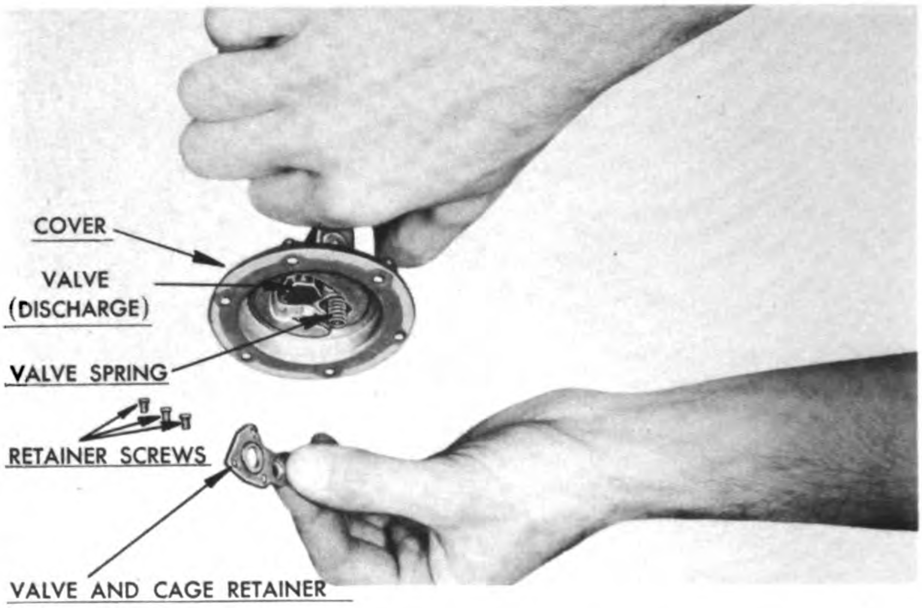


Figure 301. Removing Fuel Pump Valve and Cage Retainer.

h. Place valve retainer gasket in position in cover and insert two valve and cage assemblies. (NOTE: Outer valve should have three-legged spider into cover and inlet valve should have three-legged spider facing out of cover.)

i. Secure valve and cage assemblies by means of valve retainer and two retainer screws. Turn cover so flange rests on bench. Install screen, cover gasket, cover, cover capscrew in the order named.

j. Install drain screw gasket, drain screw, and top cover on pump body being sure to line up the file marks. Figure 296.

k. Install top cover screws and lockwashers loosely until screws just engage lockwashers. Then, push rocker arm in full stroke and hold in this position while tightening screws or pump will deliver too much pressure. See figure 297.

l. Tighten the cover screws and stud alternately and securely, release rocker arm and test operation of pump valves by attaching pressure gauge to outlet and operating rocker arm.

NOTE: Pressure should not fall off rapidly.

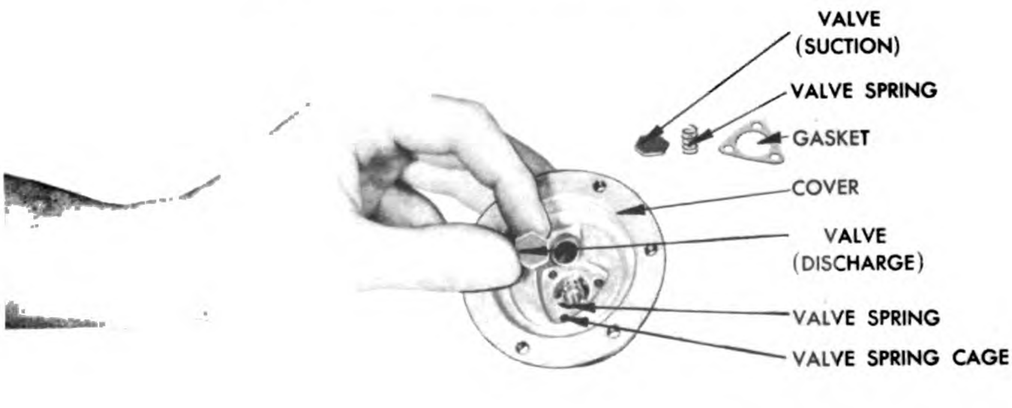


Figure 302. Removing Fuel Pump Valve and Cage Assemblies.

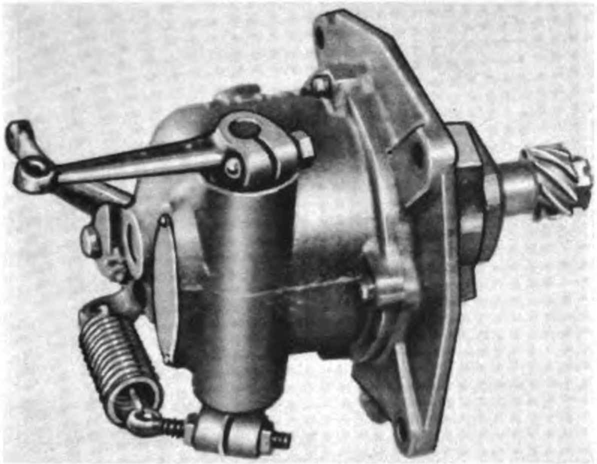


Figure 303. Governor.

(367) Governor

The automatic control of the engine speed is regulated by a Pierce centrifugal governor, horizontal type. See figure 303. The governor is enclosed in a housing. The shaft is gear driven from the camshaft. On the shaft is a weight holder or spider which supports the two governor weights.

As the governor shaft rotates, the centrifugal energy developed in the two weights causes these two weights to swing outward on their pivots. The energy of the weights is counterbalanced by a spring, the tension of which can be regulated. When the centrifugal energy of the weights overcomes the spring tension, a thrust bearing is forced against the rocker yoke to which the governor control lever is attached. The movement of the rocker yoke lever causes the control lever to move, which in turn opens or closes the governor throttle valve in the governor throttle box. The sensitivity or regulation of the governor can be adjusted by the adjusting screw. This setting of this screw should not be altered after the top working speed has been set.

(368) Adjusting Engine Surge

If the engine surge is unstable at top engine speed, running without load or part load, turn the adjusting screw, as shown in figure 304, inward half a turn at a time until the surging stops being sure that you do not raise the speed of the engine by so doing.

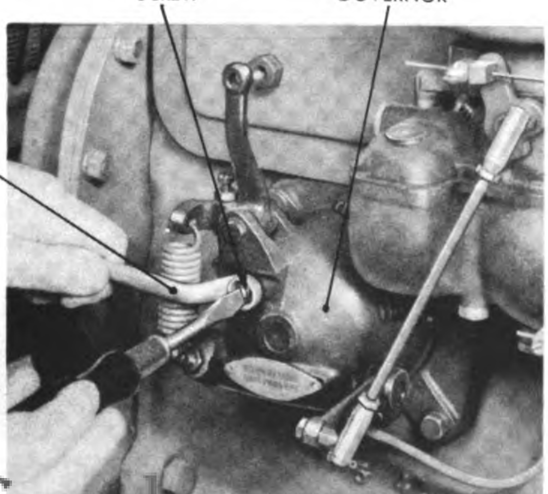


Figure 304. Adjusting Engine Surge.

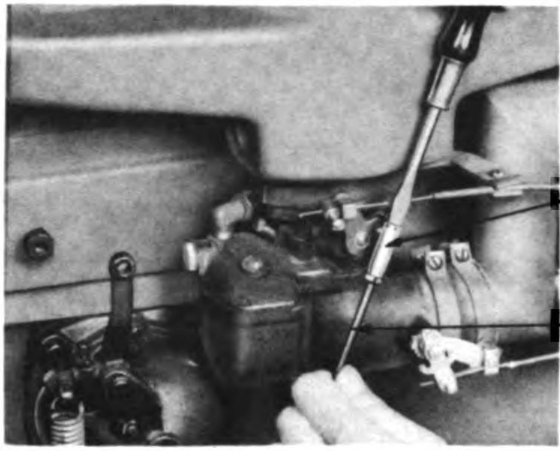


Figure 305. Adjusting Governor Link Rod Ball Joints.

(369) Adjusting Governor Link Ball Joints

The governor link ball joints at both ends of the link rod should be snug but move without friction. In figure 305 the screwdriver is being used to adjust the ball joint adjusting plug and the fingers are testing for friction. A small cotter pin through the screw in the adjusting plug must be removed first to make the adjustment and replaced after the adjusting is made. NEVER BEND THE LINK ROD. The ball joints must be kept lubricated with engine oil.

(370) Adjusting Governor Link Rod

The link of the link rod must be so adjusted that when the engine is stopped, the rod holds the governor throttle box lever slightly short of wide open position. See figure 306. To make this adjustment the engine should not be running. Loosen both of the ball joint locknuts. Remove the ball joints from the governor arm and with the governor throttle in wide open position, adjust the link rod by turning the ball joints either to the right or to the left, depending upon the adjustment required.

(371) Adjusting Governor Speed

The main speed adjustment is correctly set at the factory and normally should not be changed. However, if an overhaul of the governor is necessary, the main speed adjustment will have to be set. Turn the surge adjusting screw out until only three or four threads are engaged. Tighten the locknut and leave in this position for the present. See figure 304. Adjust the governor for the engine speed of 1350 r.p.m. by turning the high speed adjusting screw. See figure 306. Turning in will increase speed. Turning out will decrease speed. Set the governor so that the engine will operate under no load at 1350 r.p.m. with the throttle in wide open position.

Figure 306. Adjusting Governor Link Rod.

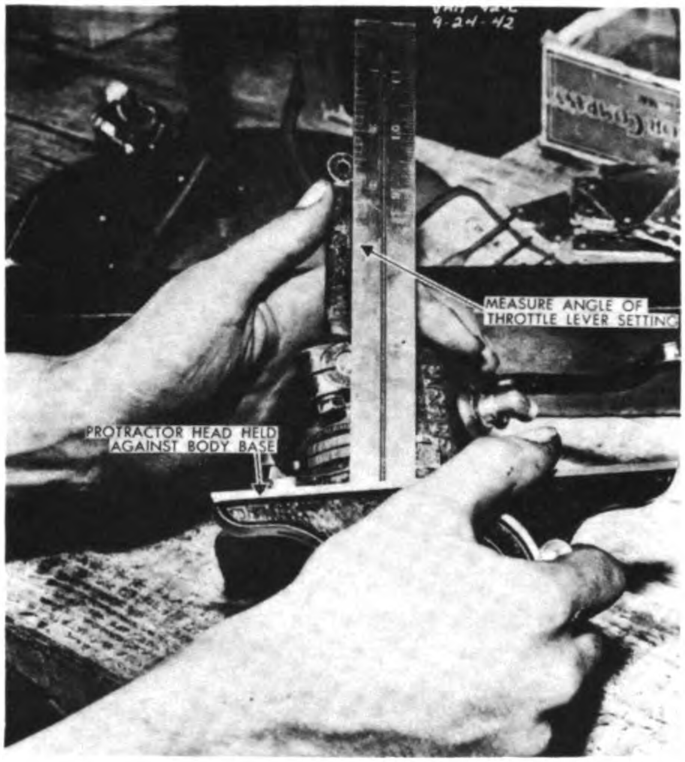


Figure 307. Taking Protractor Reading of Throttle Lever Angle.

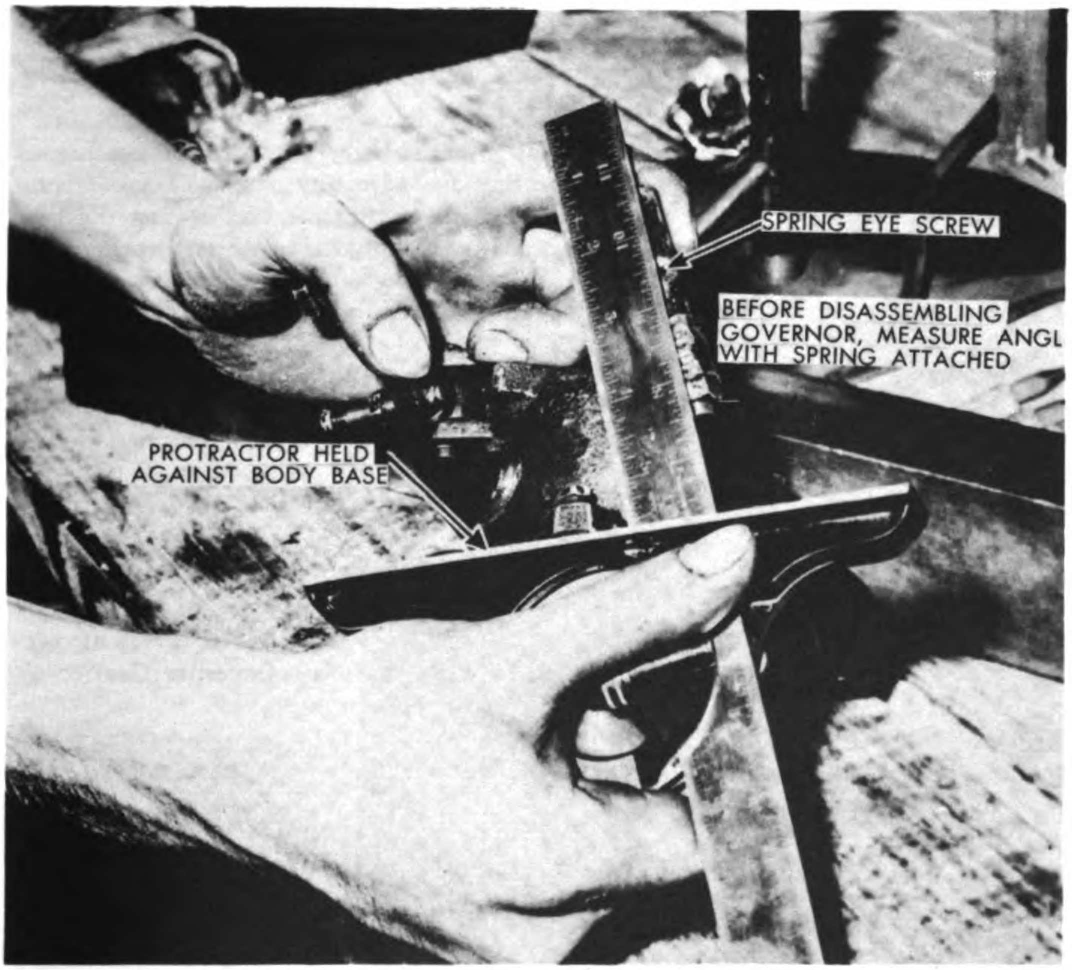


Figure 308. Taking Protractor Reading of Spring Eye Adjusting Screw Angle.

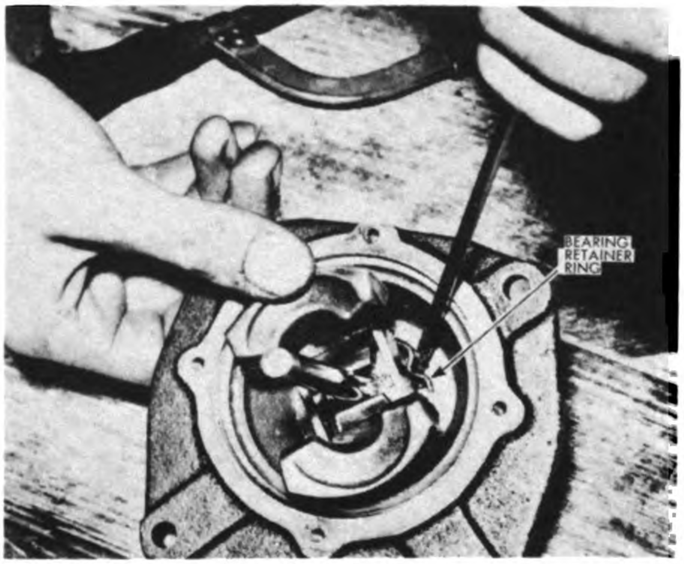


Figure 309. Removing Governor Bearing Ring.

The r.p.m. can be checked by using a hand tachometer inserted in the center of the flywheel or, if the clutch is on the engine, hold the tachometer at the outer end of the clutch shaft with the clutch engaged.

Should the governor surge at no load speed, turn the surge adjusting screw in slowly until the surge is overcome. Do not turn this screw in so far as to increase speed.

NOTE: Should the engine surge under load or part load, turn the spring eye adjusting screw out a few turns at a time until surging stops, and recheck engine speed adjustment. For sensitive regulation, keep this screw in as far as possible without creating load surge.

(372) Overhaul of the Governor

NOTE: Before disassembling the governor, get a protractor reading of the throttle lever angle and of the spring eye adjusting angle. The protractor reading should be taken with the base of the protractor laid against the base of the governor body and with some tension on the governor spring. See figures 307 and 308.

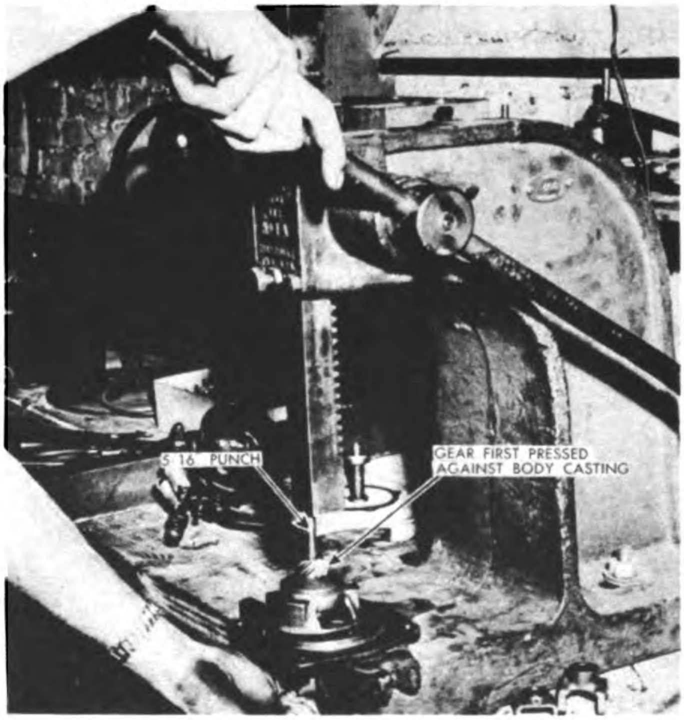


Figure 310. Pressing off Governor Gear.

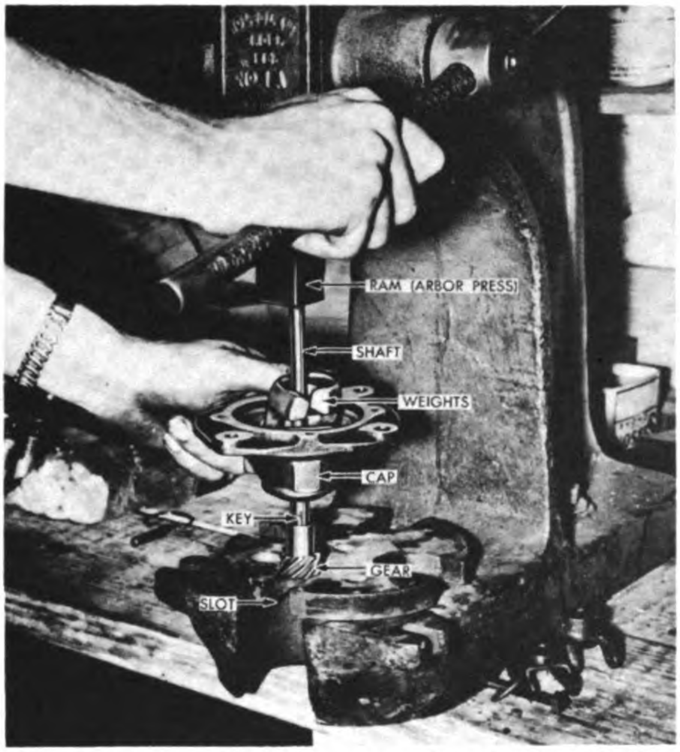


Figure 311. Pressing off Governor Shaft.

Release tension from the governor spring before removing the body bolts. Then disassemble by unscrewing the four body bolts.

(373) Governor Body Cap Disassembly

a. To disassemble governor cap, remove thrust sleeve and thrust bearing drive from drive shaft.

b. Pull out cotter pin and unscrew castle nut holding gear. Remove bearing retainer ring with long screwdriver or hook. See figure 309.

c. Press off gear with arbor press. This is done in two steps. First, press gear so that shoulder rests against body casting. Then use 5/16" punches to force shaft on through gear. Hold weights, spider and shaft assembly with free hand so that they do not fall after gear is pressed loose and mutilate drive shaft. See figure 310. Press bearing from shaft with arbor press and two pieces of flat stock. See figure 311.

d. If necessary to remove weights, grind riveted end of weight pins and then drive out with punch (3/16").

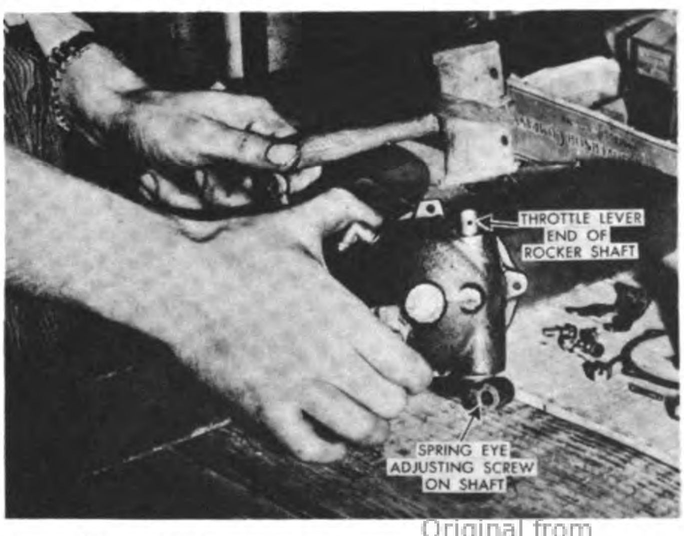


Figure 312. Driving out Governor Rocket Shaft.

(374) Governor Body Disassembly

a. To disassemble body, loosen throttle lever screw (drive ⅛ groove pin from throttle lever, if pinned, using 3/32" punch) and remove throttle lever from rocker shaft.

b. Remove governor spring and spring eye screw and drive out taper pin holding spring eye bracket to rocker shaft. Use 3/32" punch.

c. Remove yoke screws. Drive out rocker shaft with rawhide mallet. See figure 312. Spring eye bracket, bearing retainer, oil seal, felt and one rocker shaft bearing will come with the shaft.

d. Be sure pin has been removed from spring eye bracket and press bracket, bearing retainer, oil seal and bearing from shaft with arbor press. Use ¾" punch. See figure 313. In replacing this part, a new oil seal, and retainer can then be knocked out of body cap with rawhide mallet and ½" diameter punch.

e. To remove welch plug and oilite drive shaft bushing from body cap, drive from inside with 7/16" punch. This will ruin both the welch plug and the oilite bushing, and each will have to be replaced with new material.

(375) Inspection and Replacement of Governor Parts

On disassembling governor body, thoroughly clean all parts, and look for wear in the bearings on the weight noses thrust lead, and the end of the drive shaft which operates in oilite bushing in the body.

The weight noses which bear on the thrust leads have a ground radius at the point of contact, and if there are any flat spots in this radius, repair the worn weights with new material. The thrust sleeve at the point of contact with the weights has been ground to extremely close limits, and any pitting or rough spots in the thrust sleeve calls for the replacement of this part. The bearing on the shaft is a radial bearing and should be replaced if, in rotating with thumb and finger, there seem to be any rough spots or points of friction indicating wear or foreign material in the bearing; or if the bearing races are loose enough to indicate wear. The thrust bearing on the thrust sleeve shows wear by looseness between the top thrust surface and the opposite race. Any sign of wear in bearing parts requires a replacement of these items with new material.

Figure 313. Pressing Bracket, Bearing, Retainer, Oil Seal and Bearing from Shaft.

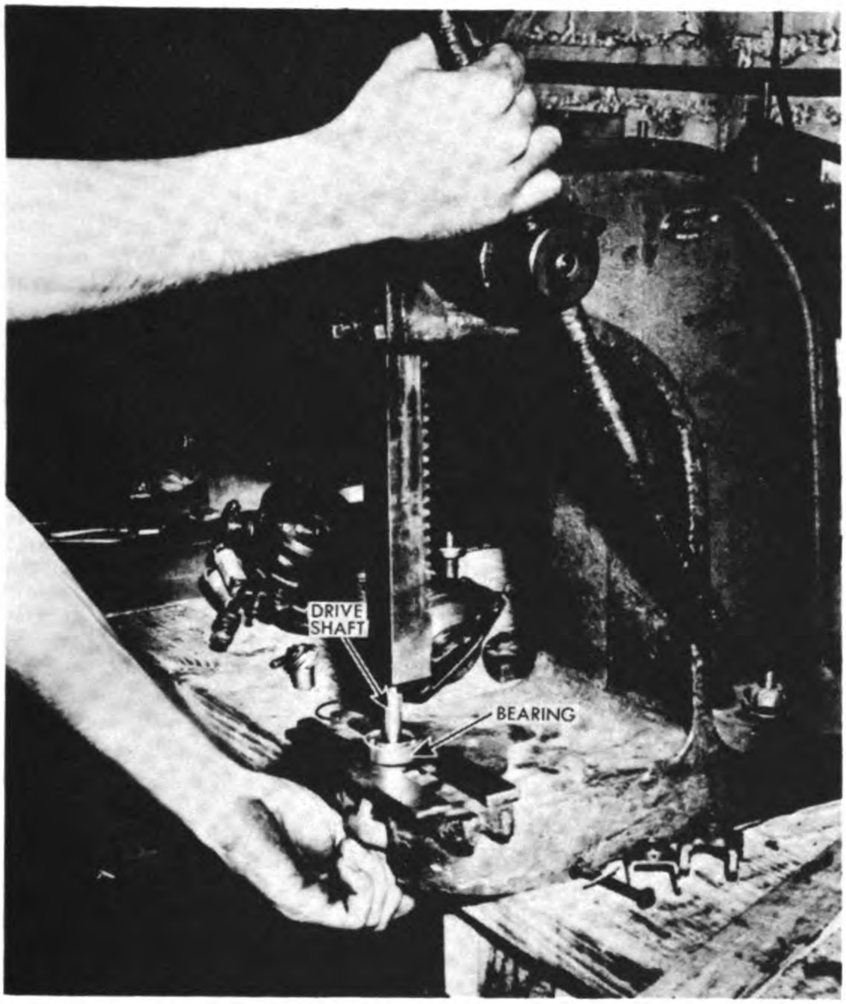


Figure 314. Pressing Governor Shaft into Bearing and Gear.

The oilite bearing in the end of the body should be checked for wear and also the end of the drive shaft where it seats in the oilite bearing.

On reassembling the drive shaft weights and thrust sleeve on the governor body, check to see that there is at least ¼" left on the thrust sleeve when the weights are exploded. Movement from closed to wide open position must have a resultant movement of the thrust sleeve on the shaft of at least ¼". If the sleeve does not have ¼" to travel, grind the weight stop tip that contact the spider until the weight will open far enough to give necessary sleeve travel.

(376) Reassembly of the Governor

A. Body Cap Reassembly

To reassemble the governor body cap, press the bearing into the housing and fasten with the snap ring. Then press the shaft into the bearing and press on the gear with an arbor press. See figure 314. Be sure that there is an adequate hole or slot in the arbor press table so that the shaft can extend through the gear and will not be bent in this operation. The gear is not only held by a press fit and castle nut but is also keyed on with a woodruff key. Be sure that the key way and slot line up before pressing the gear.

NOTE: This shaft is held to plus or minus .001 in manufacture. Careless handling can easily spring it many thousandths of an inch out of line. In pressing the shaft with the arbor press, do not force on with continuous pressure, but use short interrupted strokes to give the shaft a chance to center.

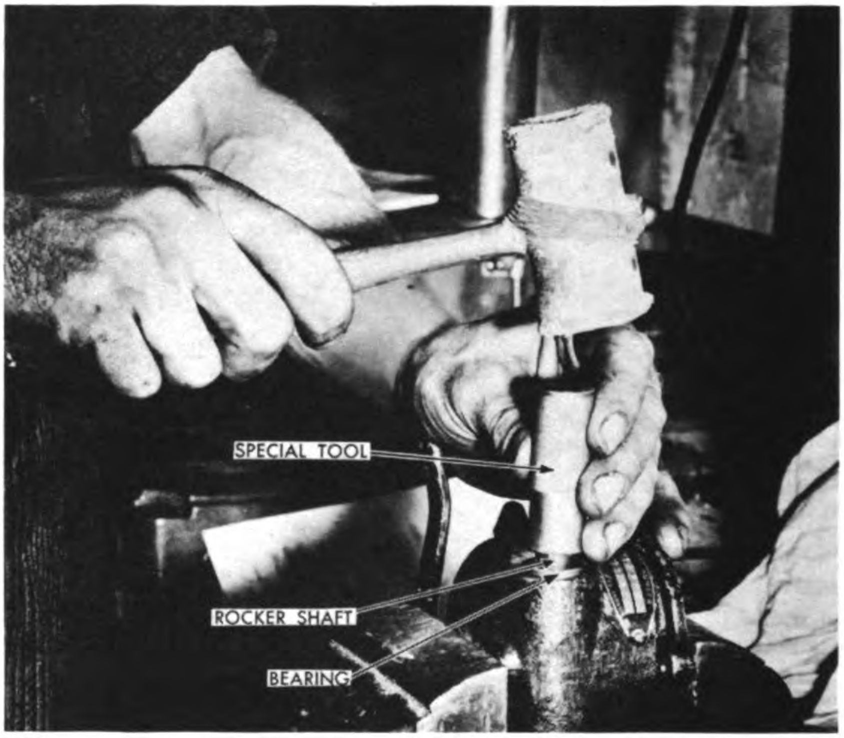


Figure 315. Seating Governor Bearing into Body.

B. Governor Body Reassembly

a. To reassemble the body, install new oilite bushing for the drive shaft. This bushing requires a special tool for installation. Turn one end of a 6″ piece of ½″ round stock to ⅜″ diameter by 11/32″ long, with a square shoulder. Place the bushing on the ⅜″ turned tip and insert into the body hole from the inside. Tap into position with a mallet so that the shoulder of the bearing tool comes flush with the body casting. THIS BEARING MUST LINE UP SO THAT IT DOES NOT BIND THE DRIVE SHAFT.

b. Seat the welch plug with a ½″ dia. punch.

c. Place the snap rings on the rocker shaft and place shaft in the body without the bearings. Assemble the yoke to the shaft. Press the rocker shaft bearings on each end of the shaft by hand with the lettering on the bearing outside. These bearings must be seated against the shoulder in the casting, and this operation requires a simple tool or short piece of tubing. The rocker shaft is approximately 7/16″ in diameter, and the seating tool is made from a piece of ⅞″ OD round stock with 15/32″ hole drilled through the center. The body is placed in a vise, and bearings seated by placing the tool over the shaft and driving with a rawhide mallet. The bearing must not be cocked in the hole and when seated in position, the shoulder in the casting with the bearing retainer will be just above the top of the bearing. See figure 315. Oil seal felt should be placed in the bearing retainer, and the retainer and washer spacer slipped over the rocker shaft and tapped into position with a hammer. The retainer is then seated against the shoulder in the casting with the same tool used for the installation of the bearing. After installation of the rocker shaft, check for excessive friction or misaligned bearing by oscillating the shaft with thumb and finger. If the shaft cannot be turned with the thumb and finger, there is too much friction in the mechanism and this will have to be eliminated.

Figure 316. Adjusting Governor Link Rod.

C. Body and Cap Reassembly

1. Reassemble the body and cap with a new gasket. The drain hole in the body should be down. The oil inlet will appear on the top side of the body. When the body and cap are bolted securely together, rotate gear by hand to check for friction or binding in the shaft. If the shaft does not rotate freely, tap the body cap casting around the oilite bushing with a new rawhide mallet. This will tend to line up drive shaft bushing. All friction must be eliminated before proceeding. Install spring eye screw and eye screw bracket and place it on the rocker shaft. To set it at the correct angle measured by the protractor before disassembling the governor, rotate the spring eye back away from the governor body and then push towards the speed change lever until you can feel the yoke resting on the thrust bearing. Then advance the spring eye screw to the desired setting. See figure 308. The protractor giving the correct angle will be held against the base of the body as originally measured. With the spring eye bracket in this position, drill the bracket and shaft with a No. 27 drill (.1440) and ream with a No. 1 taper reamer. Install the taper pin. After installation of the spring eye bracket, set the throttle lever on the shaft in the same manner as the mounting bracket. Pull the lever away from the governor and push towards the speed change lever so that the yoke is against the thrust bearing and then on forward to the correct setting measured with the protractor. Lock the lever with the screw, and if originally pinned, install a 1/8" groove pin (use 1/8" drill).

(377) Installing the Governor

The governor is lubricated by oil pressure from the engine, and once properly installed and adjusted, no attention is required other than a periodical inspection to see that the bolts and nuts are tight and to lubricate link rod ball joints with a few drops of oil.

When installing the governor on the engine, see that the governor gear is properly meshed with the gear on the camshaft before tightening the bolts on the governor flange, and be sure to connect the oil line to the governor. Install the governor control rod to the throttle lever and the governor arm. The rod should be just long enough that with the engine running and with some tension on the governor spring, the throttle valve will be just short of wide open position. See figure 316. The throttle valve and shaft must move freely and there must be no binding where the rod enters the holes in the two levers. For speed adjustment, see paragraph 444-d under Chapter XXIV on Reassembly of Engine.

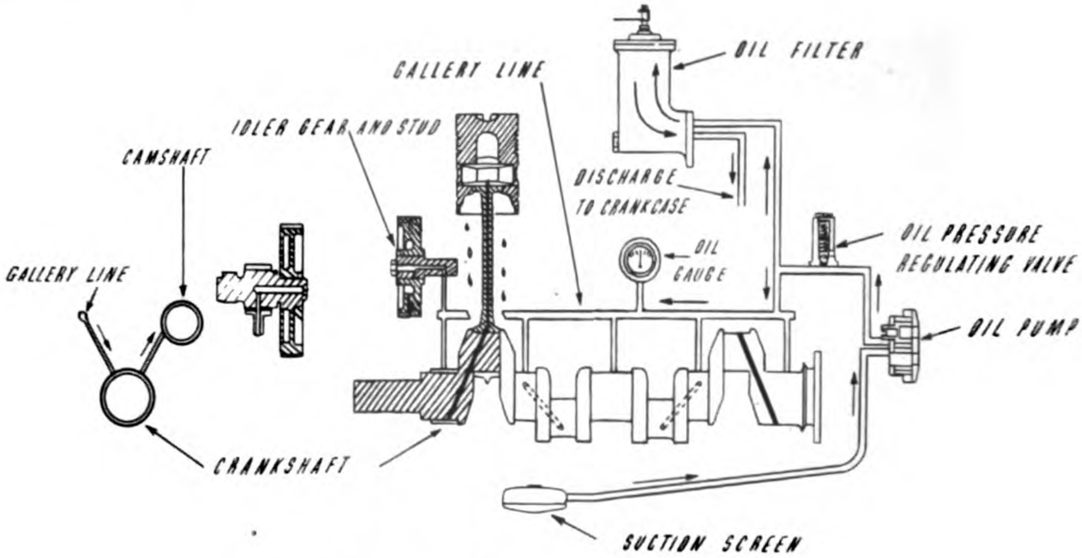


Figure 317. Lubricating System Diagram.

Lubricating System

The lubricating system comprises the following: oil pump, oil pressure relief valve, oil float, oil pressure gauge and oil filter. Figure 317 shows how the oil circulates through the system.

(378) Lubrication Chart

Periods of Operation	Points of Lubrication	Lubricant Required
8 hrs.	1. Air Cleaner—clean, change oil................	OE
	2. Clutch Throw-out collar........................	WB-3
	3. Check crankcase—add if necessary............	OE
64 hrs.	1. Drain and refill crankcase....................	OE—5½ qts.
	2. Water Pump—Oil Cup........................	OE
	3. Distributor—Grease Cup	WB—1 turn
	4. Generator—Oil Cups	OE
	5. Starting Motor—Oil Hole.....................	OE
128 hrs.	1. Change oil filter cartridge and refill crankcase..	OE—6½ qts.
	2. Carburetor throttle shaft, choke, and control cables—flex cables to apply....................	OE
	3. Governor throttle shaft and ball points.........	OE
	4. Distributor Breaker Arm Hinge Pin............	OE—1 drop
	5. Distibutor Cam Felt..........................	OE—5 drops
	6. Distributor Governor Weight Pivot and Slot...	OE—1 drop
512 hrs.	1. Fan—Grease Plug	WB-3

(379) Oil Pump

The oil pump has a hydraulic relief in the casting. The oil which would otherwise be trapped between the teeth is allowed to return through the hydraulic relief to the pressure side of the pump. There are no movable parts in this type of relief. The idler gear and the drive gear have bushings which were machined in the gear blank before the teeth were cut. The gears and bushing should be replaced as a unit. The expansion plug in the oil pump casting is used as an oil seal at the end of the idle shaft. This plug should not be removed from the oil pump body. The oil inlet and oil outlet passages go through the two locating sleeve dowels.

The oil pump assembly fits in a recess in the flywheel end of the crankcase and is driven directly from the rear end of the camshaft. Connection to the pressure and suction passages in the crankcase is made by hollow dowels and sealed against oil leaks by copper asbestos gaskets.

The oil is drawn from the pan through a suction screen to the oil pump. From the pressure side of the pump, it enters a drilled passage in the crankcase casting to the main gallery line and the oil pressure relief valve. Excess oil is by-passed to the oil pan from the oil pressure relief valve. On the way to the oil pressure relief valve a side passage diverts part of the oil to the oil filter. The clean oil from the oil filter is returned to the oil pan. From the main gallery line, side passages are drilled to the main bearings, oil pressure gauge connections and idler gear stud. From the main bearings, the oil is delivered to the connecting rod bearings by means of the drilled crankshaft. The piston pin receives its oil through the rifle-drilled connecting rods. The cylinders are lubricated by oil thrown from the connecting rod bearings.

From the main bearings, side passages lead to the camshaft bearings. A supply of oil is delivered to the idler gear hub through the drilled idler gear shaft. Oil from the hub of this gear is thrown out through drilled holes and is picked up by a groove in the rim of the gears, where it passes through small drilled holes to the gear teeth, spraying the entire gear train.

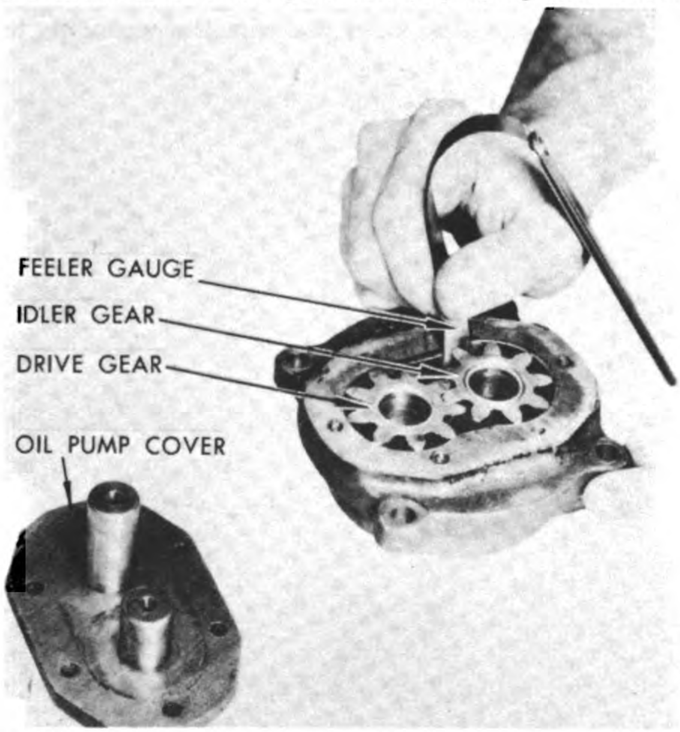


Figure 318. Checking Oil Pump Gear Clearance to Pump Case.

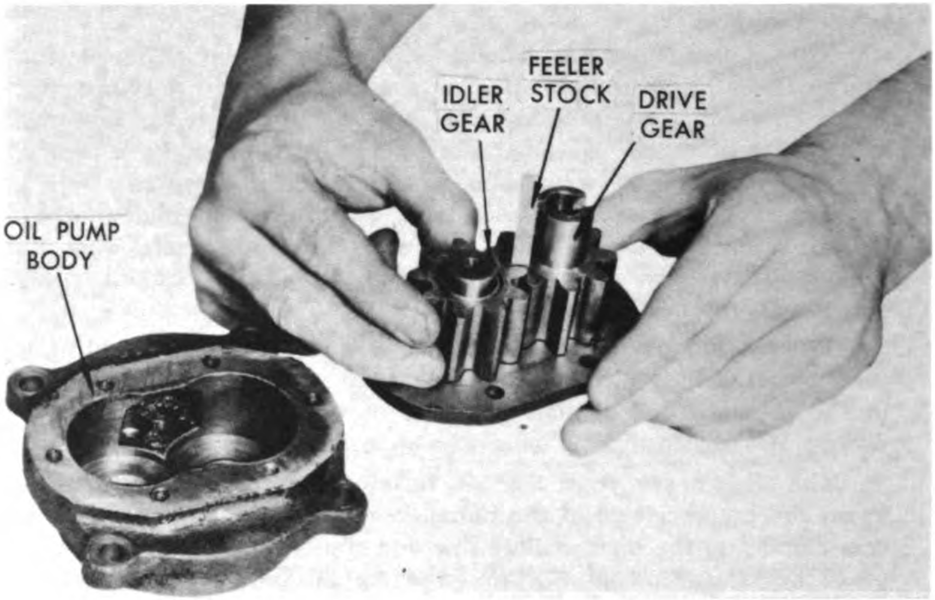


Figure 319. Checking Backlash of Oil Pump Gears.

(380) Disassembling, Inspecting and Replacing Oil Pump Parts

To disassemble the pump, remove the six capscrews and oil pump cover. Check the teeth and the bushings in the gear for wear. If either is worn, both the bushing and the gear must be replaced as a unit. Check the clearance between the teeth and the case. See figure 318. If more than .008", replace with new gears and bushings. NOTE: If the shaft is in place, the clearance should not be more than .004". Check the backlash as shown in figure 319. If more than .005", replace the gears. Also if the ends of the gears are not within .001" flush with the case, replace the gears and bushings.

Examine the studs on which the bushings run. If the studs are worn, replace the studs with new ones. Examine the case for cracks and replace if necessary.

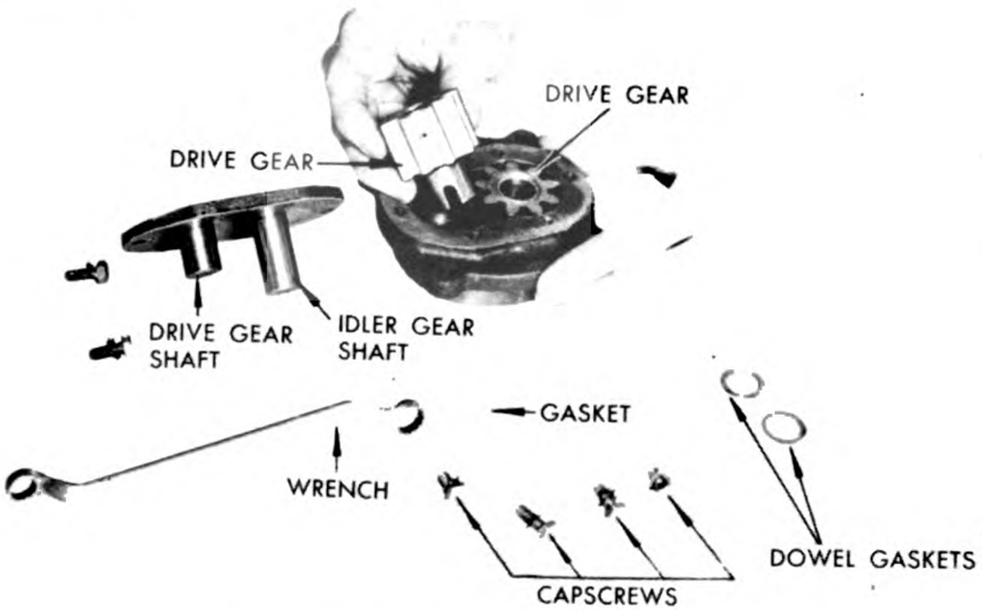


Figure 320. Installing Oil Pump Gears.

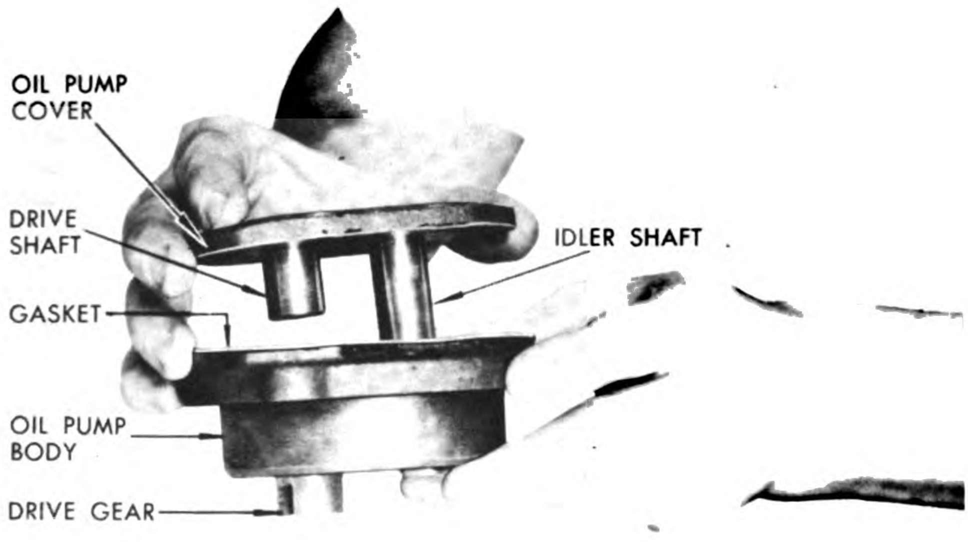


Figure 321. Installing Oil Pump Gear Shaft.

(381) Assembling Oil Pump

Put the drive gear and the idler gear in the housing. Slip the gasket on the housing. See figure 320. Set the cover in place by starting the idler shaft in the idler gear and then the drive gear shaft in the drive gear. See figure 321. Make sure the holes of the gasket are in alignment with the cover and body capscrew holes before installing and tightening the six capscrews. Check pump to be sure gears turn freely. To avoid having to prime the pump after it is installed on the engine, fill the pump with oil before installation. When installing pump be sure to install the dowel gaskets as shown in figure 322.

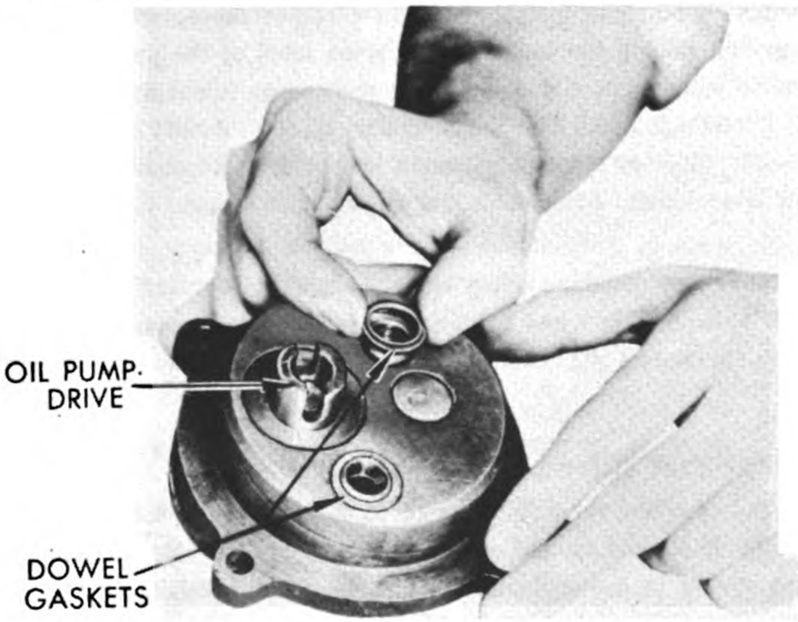


Figure 322. Installing Oil Pump Dowel Gaskets.

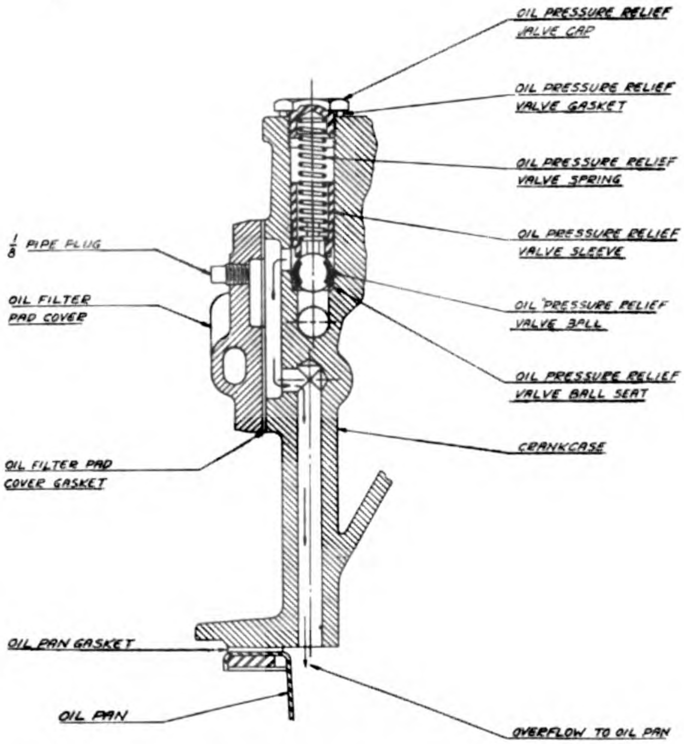


Figure 323. Oil Pressure Relief Valve.

(382) Priming Oil Pump

If it becomes necessary to prime the pump after installation, remove the plug in the side of the crankcase just above the oil pressure gauge connection. See figure 130. This priming must be done while the engine is running and can be most easily done by means of hand oil pump or gun. However, the same results can be obtained by connecting a piece of tubing to the oil priming connection and raising the oil level above the level of the pump, forcing a quantity of oil into the suction passage while the engine is running. DO NOT RUN THE ENGINE MORE THAN ONE MINUTE WITHOUT OID CIRCULATION. The priming hole should be covered as quickly as possible, after pressure is obtained. Afterwards the engine can be shut down, the plug replaced.

If pressure is not obtained after this, examine oil pressure gauge and relief valve. If these are in good condition, remove oil pump and re-examine the drive pin in the end of the camshaft, also the copper gaskets on the sleeve dowels.

(383) Oil Pressure Relief Valve

The oil pressure relief valve is designed to maintain an operating pressure of approximately 30 lbs. at normal speed and temperature. No adjustment is provided. The spring furnished is of the proper weight and length. A temporary adjustment can be made by stretching or compressing the spring. However, a new spring should be obtained as a stretched spring soon loses its tension. See figure 323.

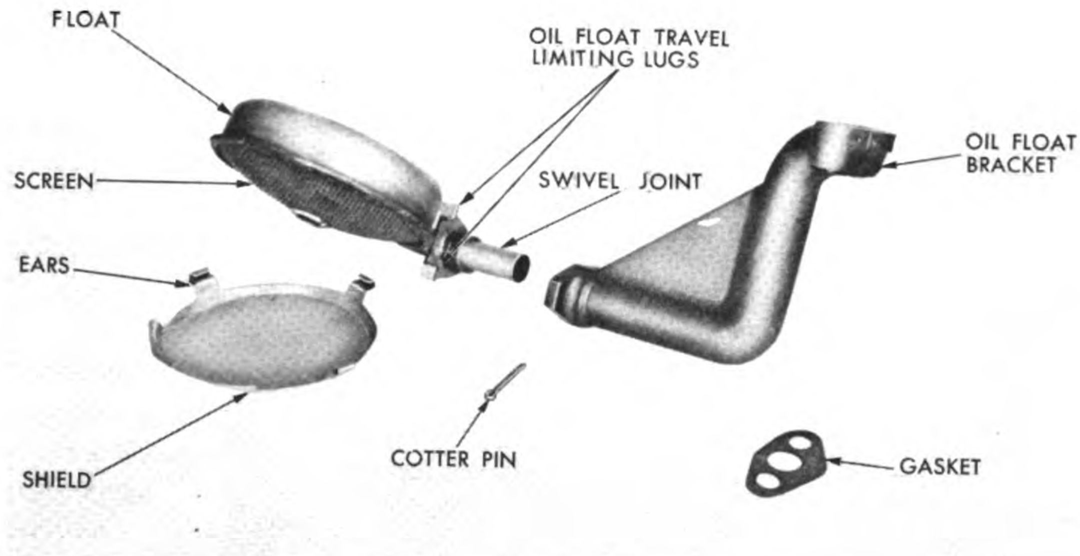


Figure 324. Oil Float Assembly.

(384) Oil Float

The oil float is a floating screen arranged to rise and fall with the oil level in the crankcase so that only the best oil is taken for the bearings. See figure 324.

(385) Checking, Repairing, and Replacing Parts of the Oil Float

First thoroughly clean the float in unleaded gasoline. Blow the screen with compressed air. If the fouling is bad, straighten the ears of the shield, remove the shield and clean the screen with a wire brush. If the mesh is broken or loose from the float and beyond repair, replace the entire float assembly. If the tube is damaged, the entire assembly must be replaced since the tube cannot be removed and replaced. When putting back the shield, it should be carefully positioned and the ears turned over the body flange. Clinch the ears with pliers, not a hammer.

Make certain the float swivel joint is free to move so that the float can "float" on the surface of the oil.

The float is equipped with travel limiting lugs. Make sure they are not bent out of line. The lugs should be at right angles to the plate soldered on the tube.

Check the bracket for cracks. If cracked, it should be replaced.

(386) Oil Filter

The function of the oil filter is to remove dirty particles that are the result of normal engine operation. See figure 325. The filter not only helps to cut down engine wear but also prolongs usefulness of the oil. The filter element should be replaced after every 128 hours of operation or every other crankcase oil change.

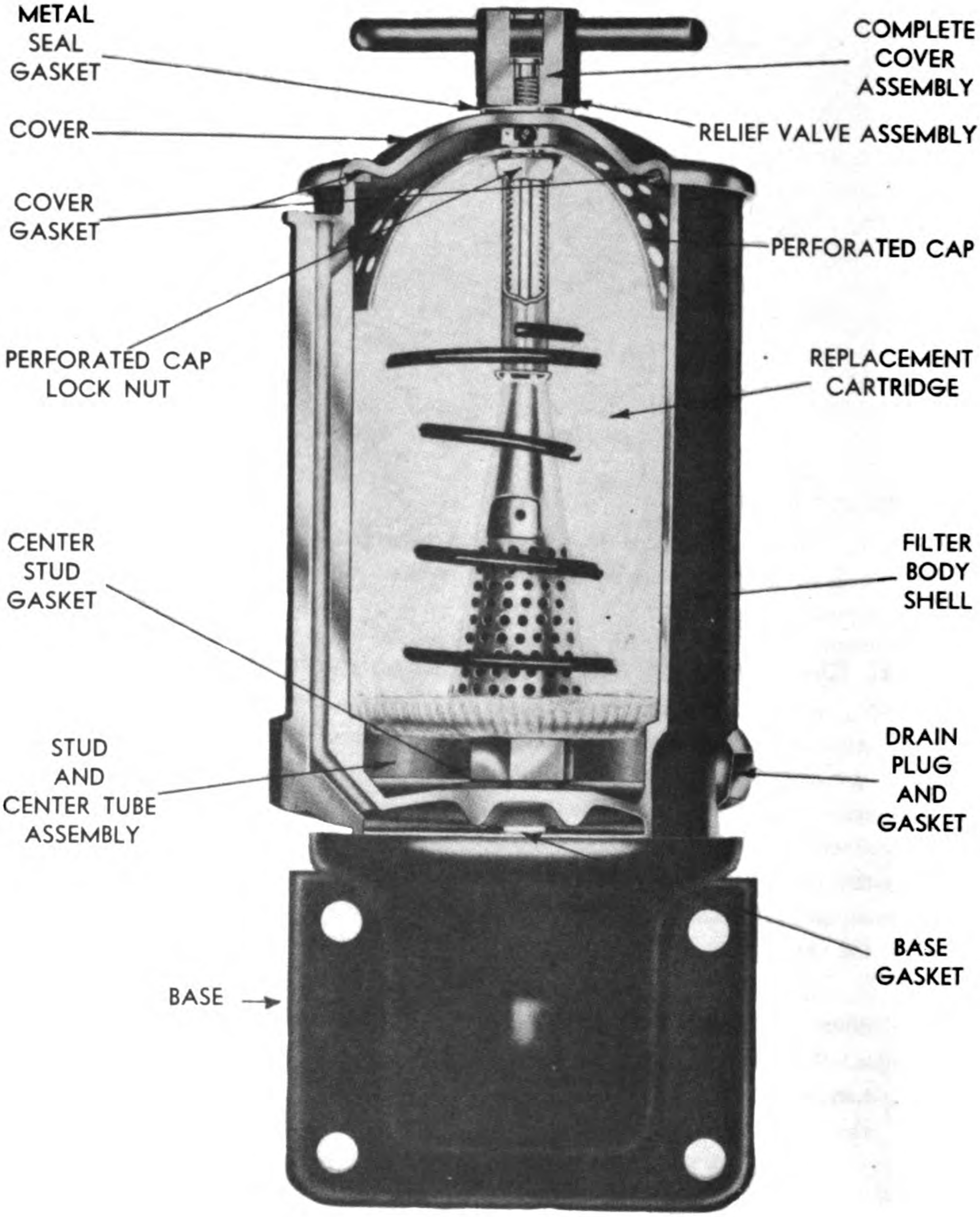


Figure 325. Cross Section of Oil Filter.

Figure 326. Removing Filter Element.

(387) Oil Filter Element

Unscrew the cover assembly by turning the handles at the top of the filter counter-clockwise until the threads are disengaged. Remove the drain plug to remove the accumulation in the sump and to break the vacuum created while removing the element. See figure 326. Remove the dirty element by the wire handles. Flush out the filter housing with kerosene. Inspect the top gasket. If it is "recessed", replace it with a new non-laminated gasket. With the filter completely assembled, check the leakage by running the engine until the filter is warm.

(388) Disassembling and Inspecting Oil Filter

Remove the cover assembly and filter element as described in the foregoing paragraph. The filter body can be taken off the base by unscrewing the center stop. See figure 325. Examine the base for cracks. If cracked, replace the base. Make certain that the upper edge of the filter body shell has no nicks or burrs that interfere with the seating of the gasket. Examine the center stud and cover nut for stripped or damaged threads. Always remove cartridge filter and gasket during the overhaul.

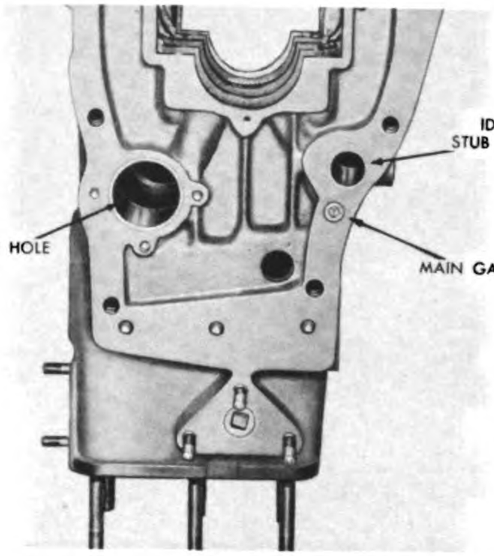


Figure 327. Front Oil Plugs.

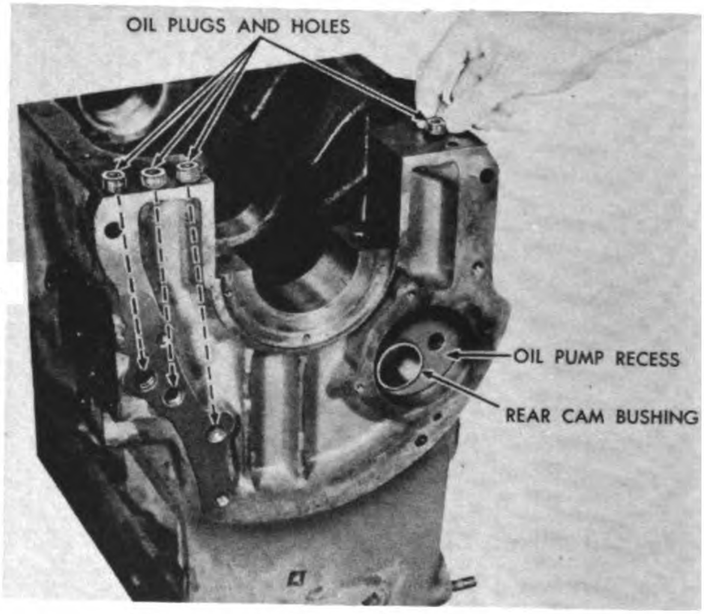


Figure 328. Rear Oil Plugs.

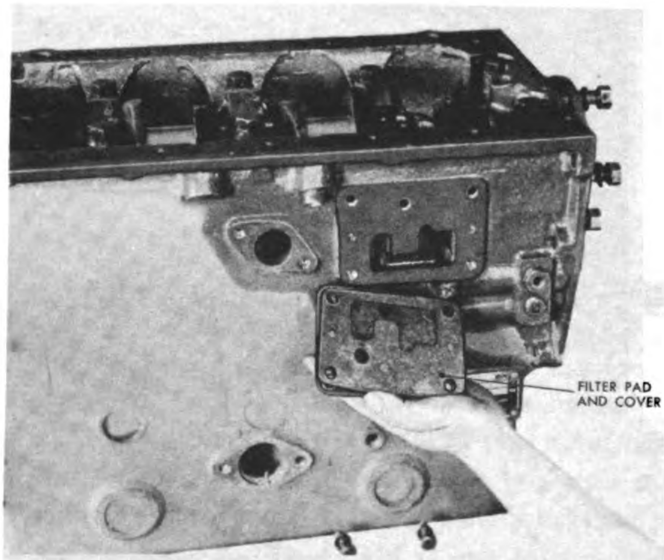


Figure 329. Installing Oil Filter Pad.

Chapter XXIX
Engine Reassembly

At all times during the reassembly of the engine, the mechanic should bear in mind that dirt is the engine's worst enemy. Therefore the parts should be wiped clean and note particularly to remove lint. Do not use waste for wiping; use a lint-free cloth. An air hose can be used to blow off any fine dirt or lint remaining on the parts after wiping. Only clean fresh oil should be used in oiling the parts as they are reassembled. Be sure to replace all the gaskets, oil seals and belts.

The following steps are the recommended sequence of reassembly. Avoid the temptation to add another step of reassembly. Positively follow the sequence.

(389) Inserting Oil Plugs

With the engine setting on its stud, shellac or "permatex" the oil line plugs. Insert one plug in the front end of the main gallery oil line, see figure 327, three at the rear end of the crankcase, see figure 328, one at the bottom side rear and two on the outside of the crankcase. Install the oil filter pad, shown in figure 329. NOTE: The plugs at the front and rear end must be screwed down below the surface of the crankcase so as not to interfere with the surfaces of the flywheel housing and the front support plate.

(390) Dowel Bolts

Insert the two dowel bolts in the front end. Figure 330, and install the bearing retainer screw, see figure 331.

(391) Housing Gasket

Permatex and install the timing gear housing gasket, and install the front plate support. See figure 330.

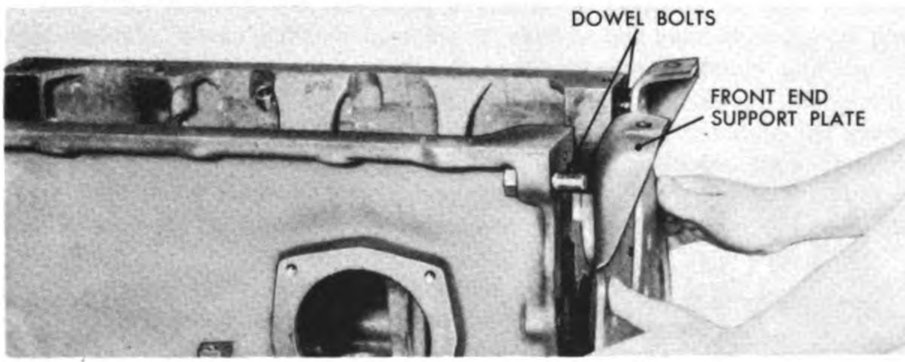


Figure 330. Installing Front Plate Support.

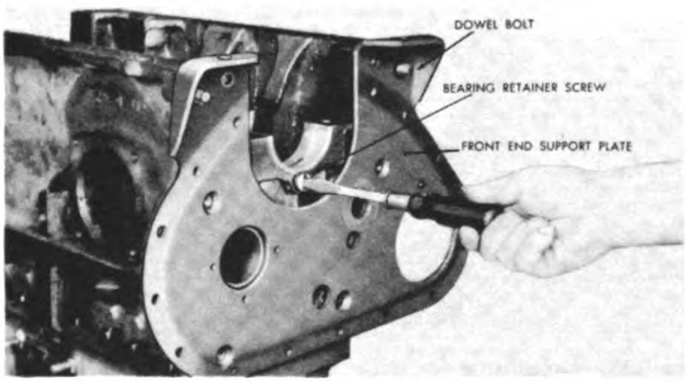


Figure 331. Installing Front Bearing Retainer.

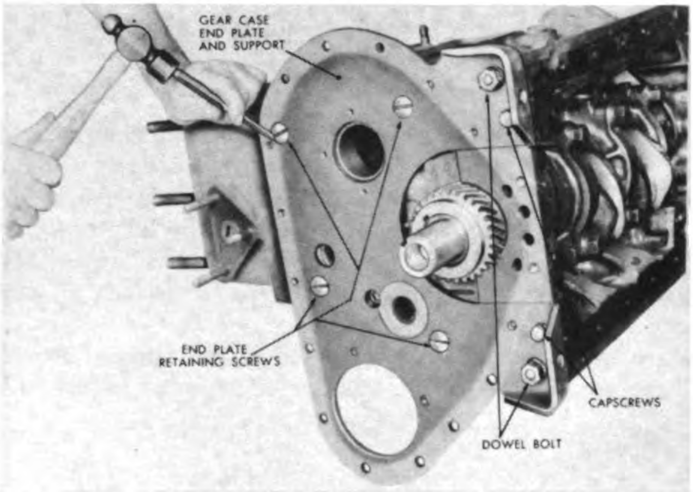


Figure 332. Installing Timing Support Plate.

(392) Locking the Front Support Plate Screws

The four flat headed screws that tighten the front support plate should be locked securely by ball-punching one end of the slot. See figure 332.

(393) Installing Upper Half Bearings

Unless the four intermediate main bearings are new, each must go back in the main support from which it was taken. Their positions in the support must not be reversed. After inserting, thoroughly oil same. See figure 333.

(394) Installing Upper Half of Rear Bearing Oil Seal

Install the upper half of the rear bearing oil seal, see figure 334, but first insert enough gaskets to locate the position of the oil seal HALF WAY between the CRANKSHAFT OIL SLINGER and the flywheel bolt heads. NOTE: The accuracy of this position can only be checked after the crankshaft is in position.

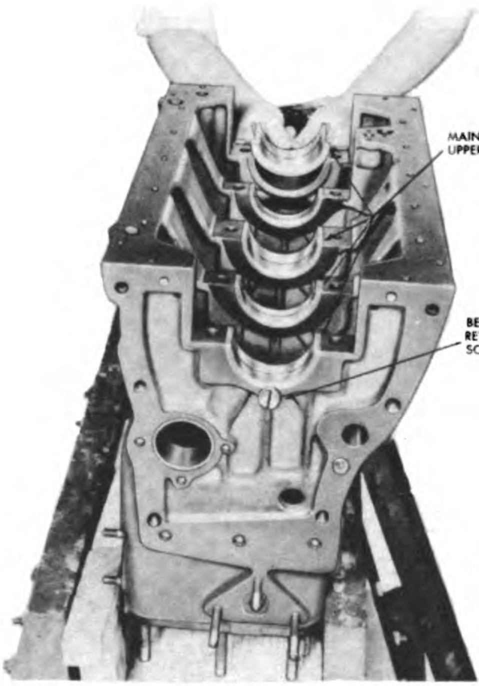


Figure 333. Installing Upper Half Bearings.

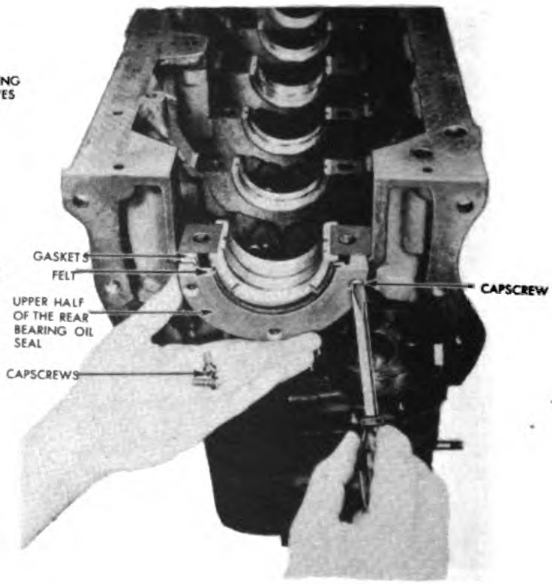


Figure 334. Installing Upper Half Rear Bearing Oil Seal.

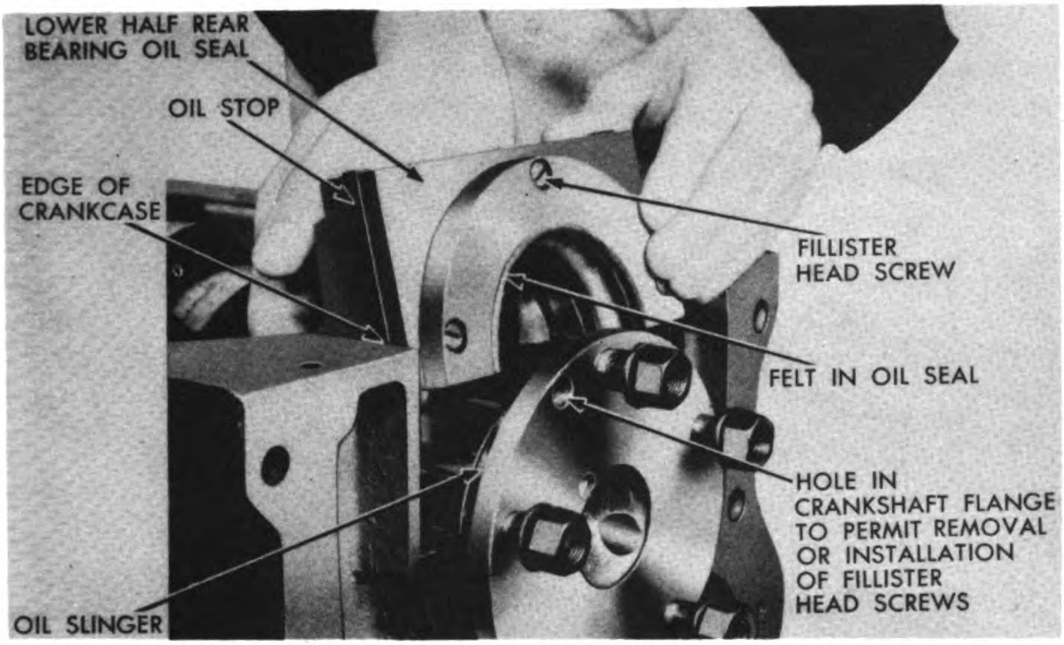


Figure 335. Installing Lower Half Rear Bearing Oil Seal.

(395) Setting Crankshaft in Place

With the five flywheel bolts in place on the crankshaft flange carefully lay the crankshaft in place being sure not to mar the bearings. Note the extra hole on the crankshaft flange, this is for the purpose of silling at the fillister head screws in the rear bearing oil seal in order to remove the seal without having tô take out the crankshaft. See figure 335.

NOTE: If the crankshaft gear was removed and is to be replaced by a new one, the following procedures for installing the crankshaft gear are recommended:

The best method for installing a crankshaft gear is to boil it in oil for approximately fifteen minutes in order to expand the gear as much as possible. At the end of this time, pick up the gear with tongs or pliers and slip it onto the crankshaft. Be sure to align the key seat and the key. This method of heating the gear assures maximum expansion with no injury to the gear.

If the foregoing procedure is not feasible, press on the gear as shown in figure 336. For this procedure a long 7/8" S.A.E. stud, a pipe with the same outside diameter as the gear hub, washers to fit over the stud against the end of the pipe, and a nut to go on the end of the stud are needed.

Now coat the crankshaft with white lead. Place the gear in position on the shaft with the key way and the key in alignment. Screw the stud into shaft. Place the pipe over the shaft with the washer in place and tighten the nut to press on the gear. Watch the key to be sure that it stays in position.

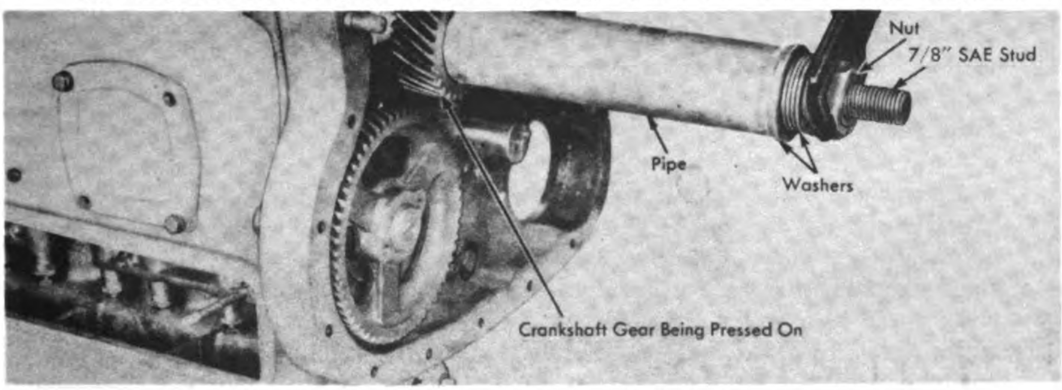


Figure 336. Installing Crankshaft Gear.

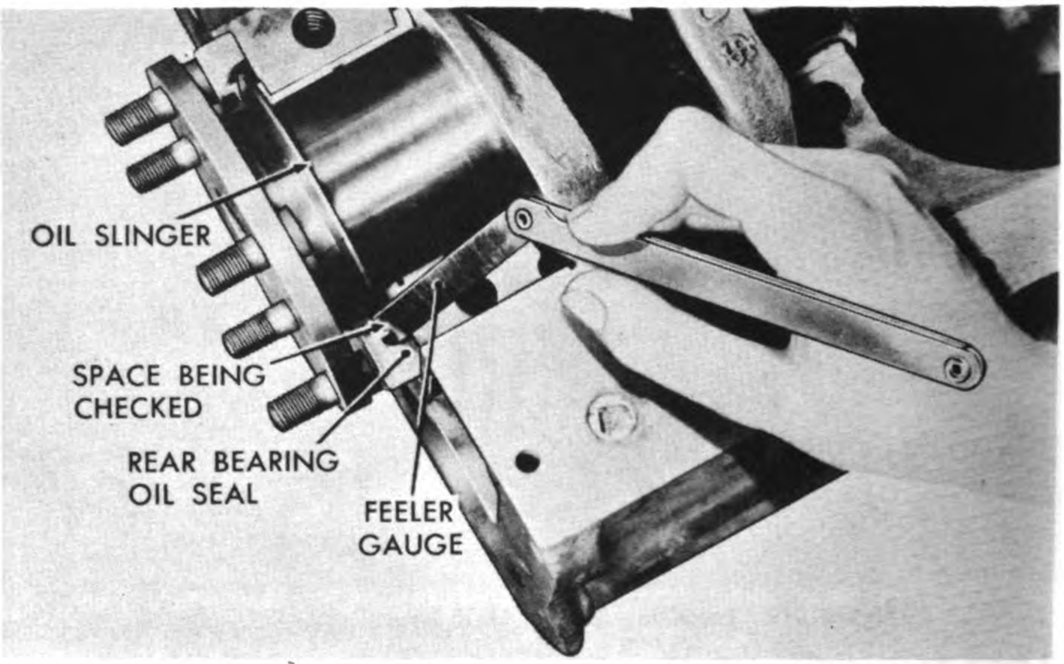


Figure 337. Checking Clearance Between Slinger and Oil Seal.

(396) Checking Clearance Between Oil Slinger Seal

Check the clearance between the slinger and the oil seal as shown in figure 337. The clearance should be .004 and .008. If not correct, lift out the crankshaft and add or remove one or more gaskets whichever is necessary. However, the same number and thickness of gaskets must be used in both upper and lower halves of the oil seal.

(397) Assembling Lower Half Rear Bearing Oil Seal

Assemble the lower half of the oil retainer seal on to the rear bearing cap. Be sure to put the copper gasket on the center fillister head screw. See figure 335. Note: New oil stops should be installed in the cap before installing the cap on the engine. The oil stops seal the sides of the cap to the crankcase and prevent oil leakage. See figure 335.

(398) Install Rear Bearing Cap

Install the rear cap being careful not to tear the oil stop when slipping the cap in place. Use a block of wood and hammer tapping each end evenly. After installation, trim the ends of the oil stop flush.

(399) Installing Bearing Caps

Place the main bearing caps in their respective positions (they are numbered from 1 to 5), being sure that the caps are so placed that one shoulder points to the camshaft side. The cap with two shoulders or projection points opposite. Insert the capscrews making sure that the bolt threads are dry and clean so that the proper tightening results. Tighten the front and rear bearings first, followed by the main or bearing No. 3, then 2 and 4. Finally, tighten all bolts with a torque wrench to a tension of 125 to 135 foot lbs. pressure. Figure 338. Torque each nut to its lowest value and then check to see if the outer pin holes are lined up. If not, continue to a point somewhere between the highest and lowest torque values and again check to see if the cotter pin holes line up. Turn crankshaft by hand to be sure it is free. Before installing the lockwires, check the crankshaft end play. Slip a feeler gauge between the end of the rear main bearing and the crankshaft. See figure 339. Run the feeler gauge clear around the shaft. The proper clearance is .002 to .0042. If more than .012, install a new rear main bearing. Now install the lock wires in the bearing caps, as shown in figure 339.

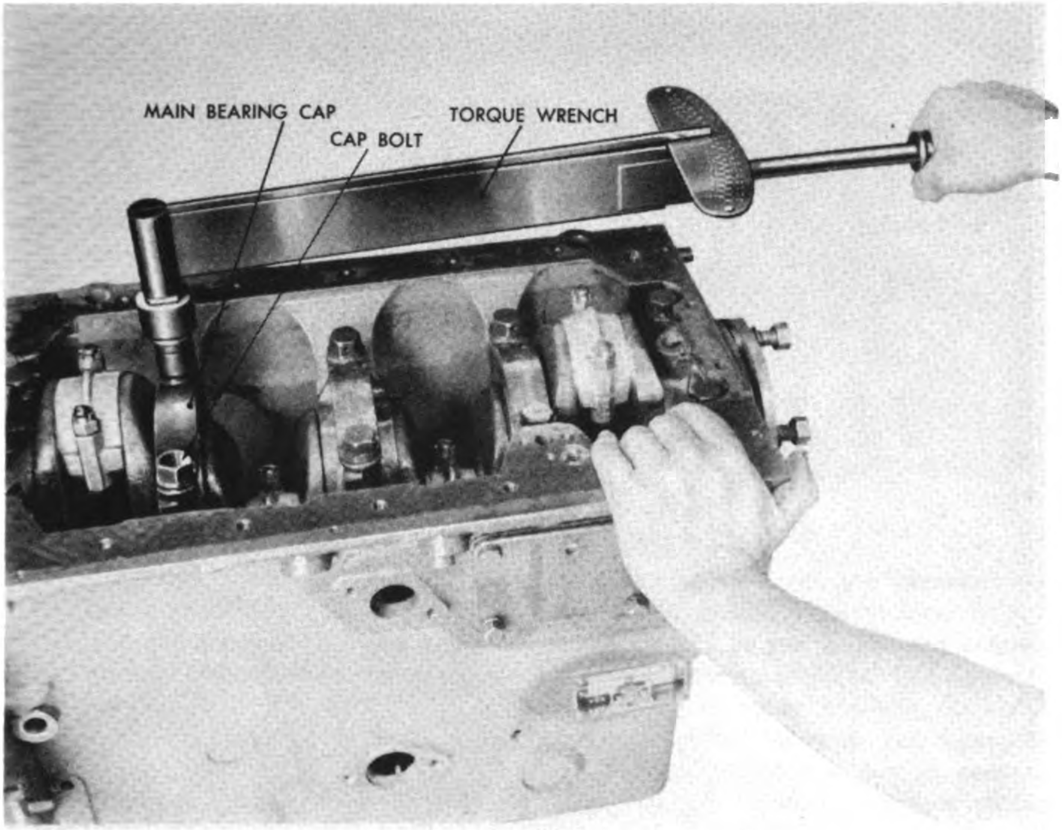


Figure 338. Tightening Main Bearing Caps.

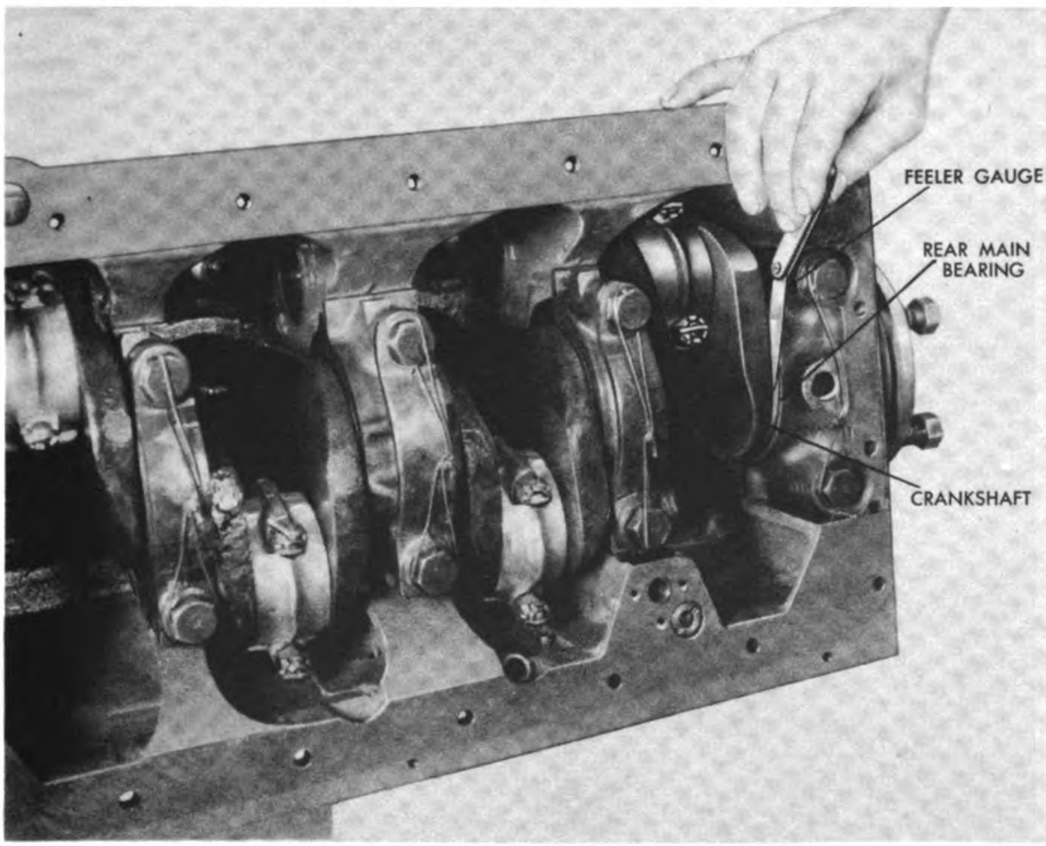


Figure 339. Checking Crankshaft End Play

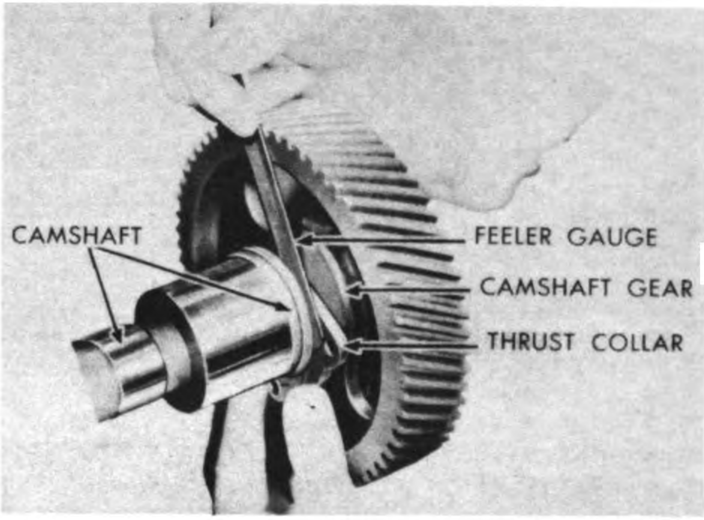


Figure 341. Checking Camshaft End Play.

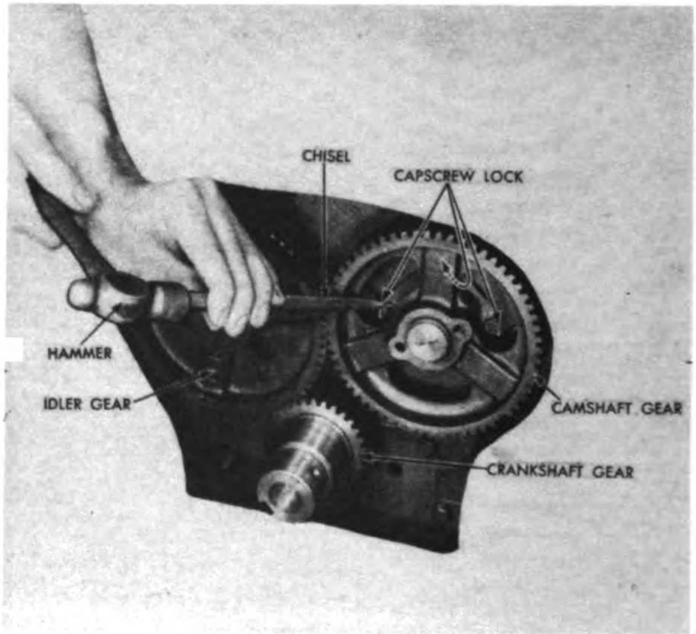


Figure 342. Installing Camshaft Capscrews Lock.

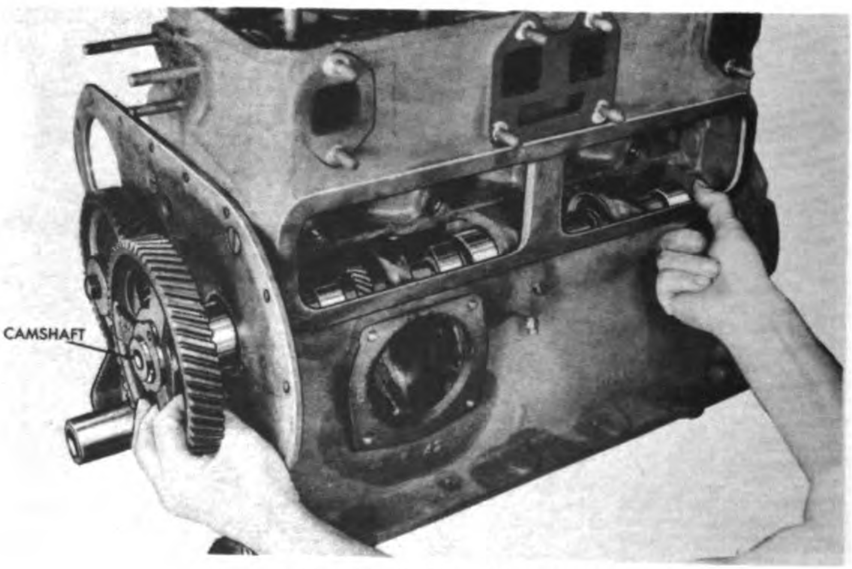


Figure 340. Installing Camshaft.

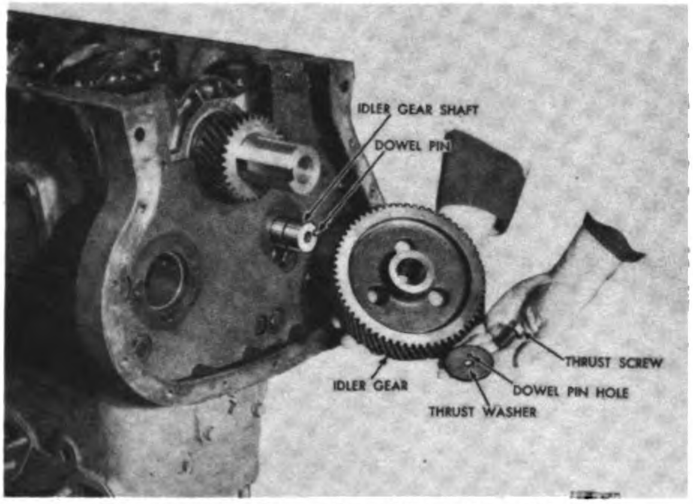


Figure 343. Installing Idler Gear Shaft.

(400) Installing Camshaft

If camshaft gear was removed for replacement, press the camshaft gear onto the camshaft. Make certain to align the key seat with the key. Slip the wire on the retainer ring. Oil the camshaft bearings and install the camshaft into the crankcase being careful not to mar the bearing surfaces. See figure 340.

To check the camshaft end play, measure the space between the hub of the gear and the thrust collar with the shaft pulled forward. See figure 341. This measurement should be .003 to .009. If excessive, this can be corrected by replacing the gear or the plate on the camshaft. Usually the gear replacement will overcome excessive end play. Now install the camshaft thrust washer with the thin capscrew lock. Insert the capscrews and bend the lips of the lock over the sides of the capscrews. See figure 342.

(401) Installing Idler Gear Shaft

Install the idler gear shaft using a block of wood and hammer. Be sure to line up the set screw hole in the shaft with the set screw hole in the crankcase. DO NOT MISTAKE THE OIL PASSAGE HOLE FOR THE SET SCREW HOLE. See figure 343. Install the copper gasket on the set screw on the outside of the block. Install and tighten the acorn lock nut. See figure 344.

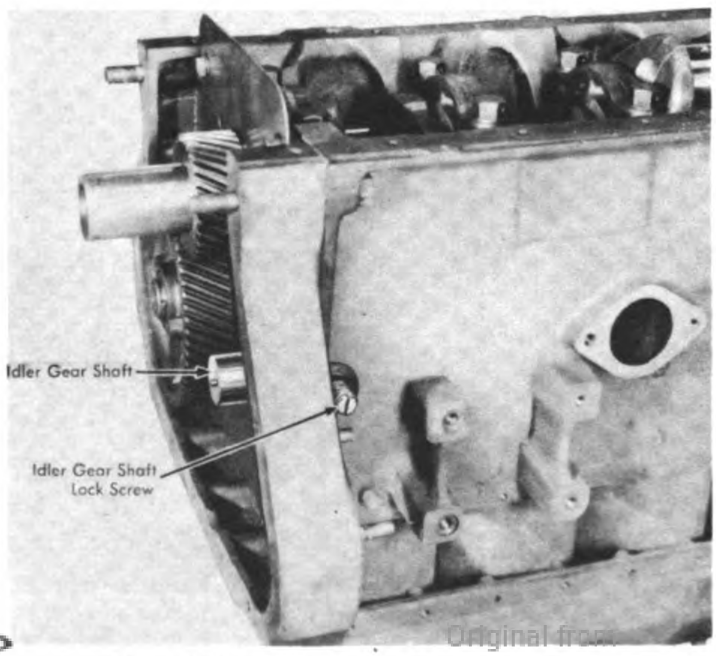


Figure 344. Installing Idler Gear Shaft Lockscrew.

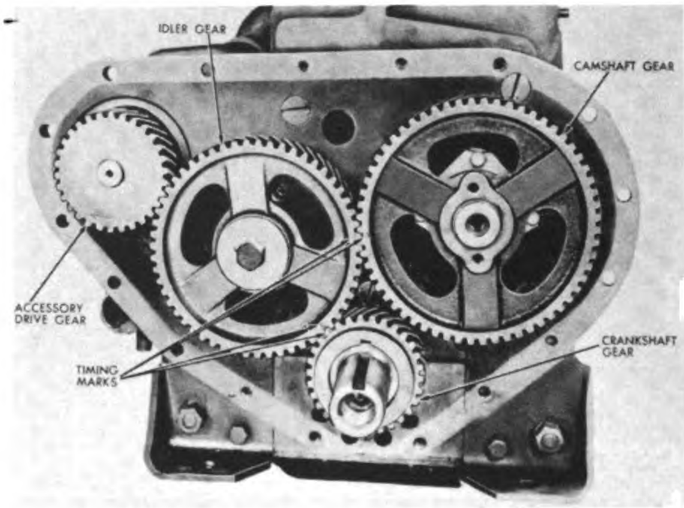


Figure 345. Timing Gears.

(402) Installing Idler Gear

Install the idler gear on the idler gear shaft with the number on the outside so that the oil slinger side of the gear is in toward the crankcase. Be sure to line up the two marks on the idler gear in their respective places; one mark with the mark on the crankshaft gear and the other mark of the idler gear with the mark on the camshaft gear as shown in figure 345. NOTE: If the gears were replaced and the marks were not transferred to the new gears, the timing of the valves cannot be done until the valves are installed. The procedure for timing if this is the case is given in paragraph 416, Chapter XXIV. Install the idler gear retaining washer and install and tighten the screw. This screw has a left hand thread. Be sure the washer is started on the dowel pin correctly.

To check the idler gear end play, which should be .004 to .007 inches, insert a feeler gauge between the idler gear hub and the retaining washer, as shown in figure 346.

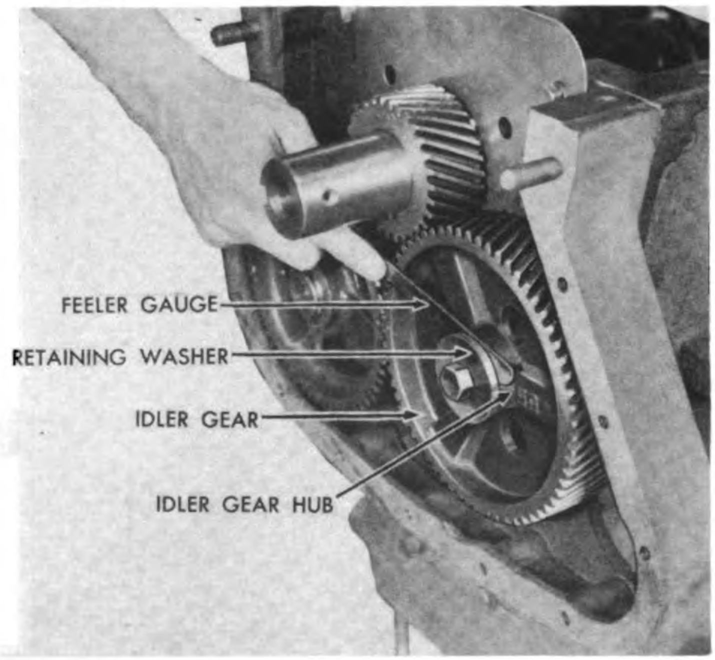


Figure 346. Checking Idler Gear End Play.

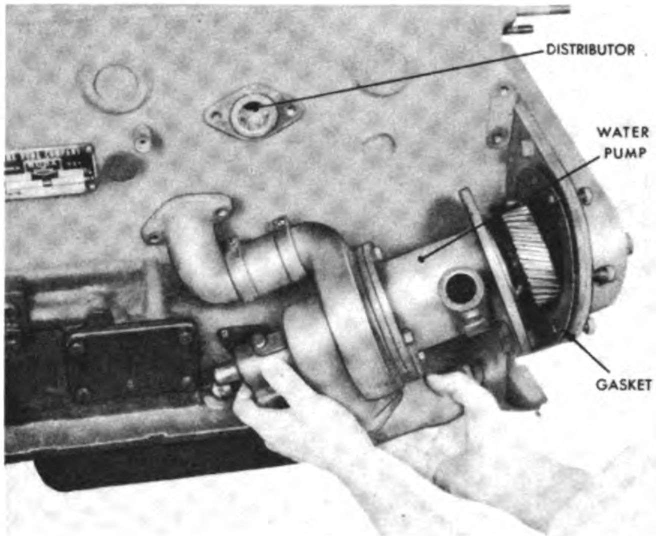


Figure 347. Installing Water Pump and Accessory Drive.

(403) Water Pump and Accessory Drive

Install the water pump and accessory drive and gear figure 347, and check for backlash by inserting a .005" shimstock feeler between the teeth of the gear, see figure 348. If the backlash between the idler gear at all the three points where it meshes with the other gears is more than .005", replace the idler gear with an oversize gear.

NOW LAY THE ENGINE ON ITS RIGHT SIDE.

(404) Installing Oil Pump

Install the oil pump. Be sure to use new copper gaskets in the dowel sleeves, and be sure that they are properly in place. Line up the pin and fork drive and tighten the oil pump in place. See figure 349.

(405) Installing Oil Pressure Relief Valve

Install the oil pressure relief valve which you will see on the bottom of the engine, making sure that the valve seat, ball, and spring are clean. See figure 350.

(406) Installing Oil Filter Pad

This pad is held in place by two screw head caps and two bolts with washers. Figure 351. Tighten all securely.

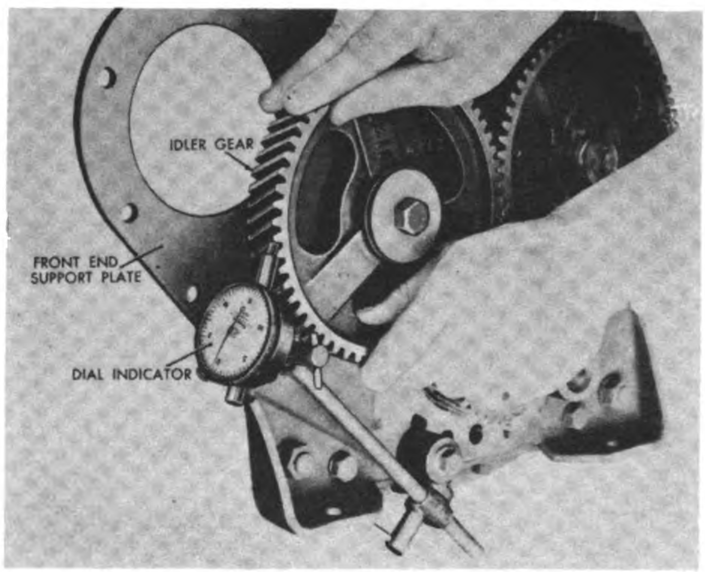


Figure 348. Checking Gear Back Lash.

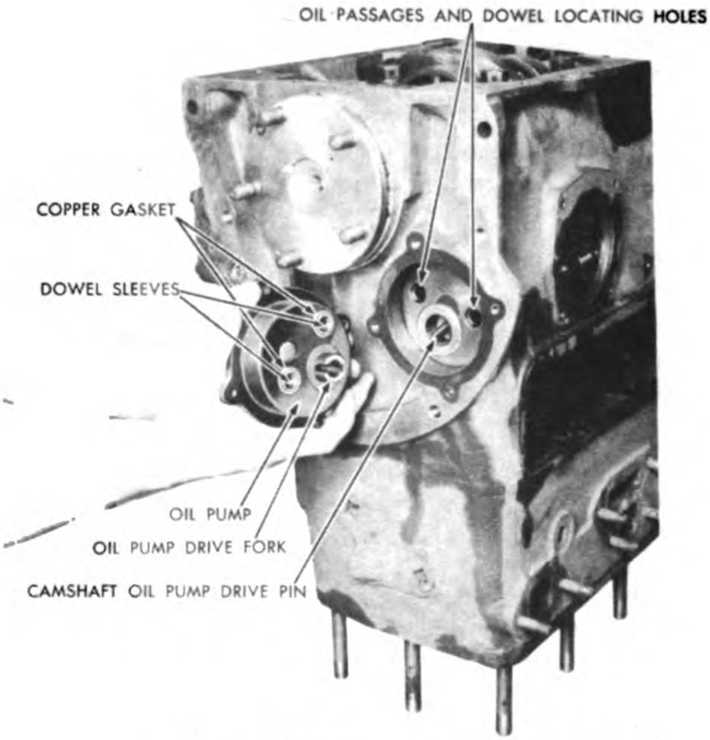


Figure 349. Installing Oil Pump.

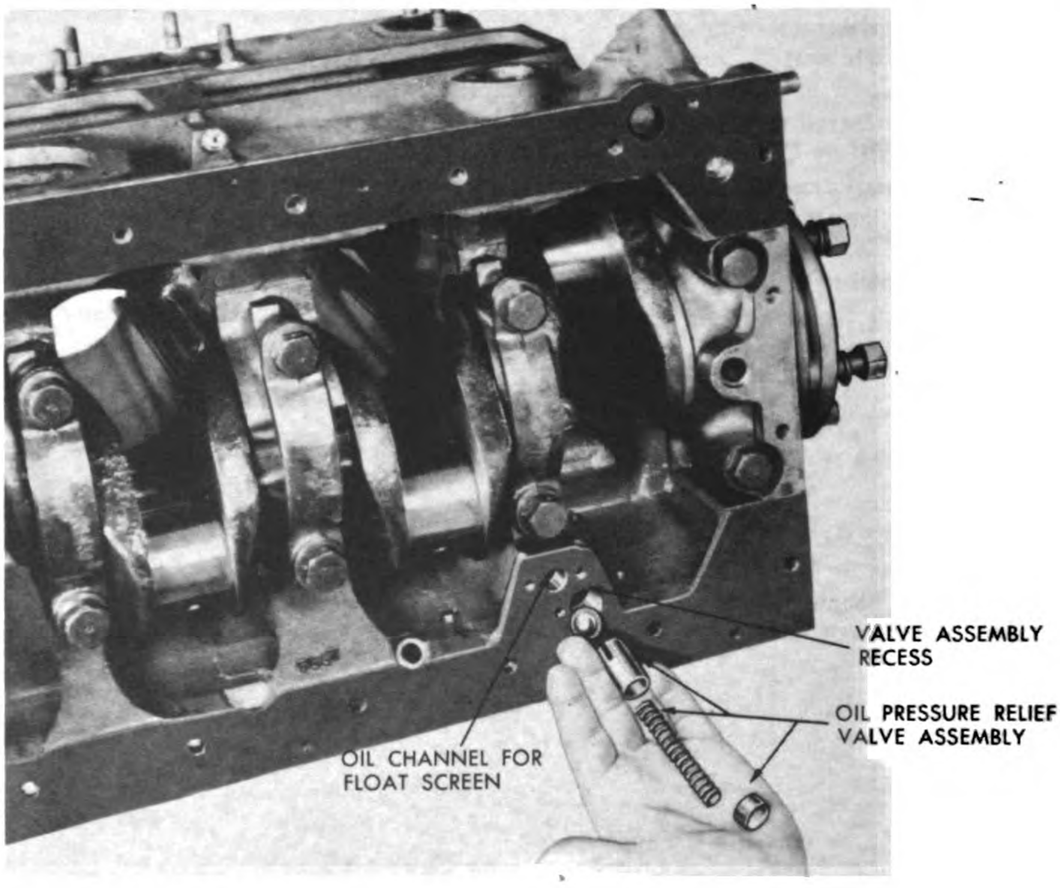


Figure 350. Installing Oil Pump Relief Valve.

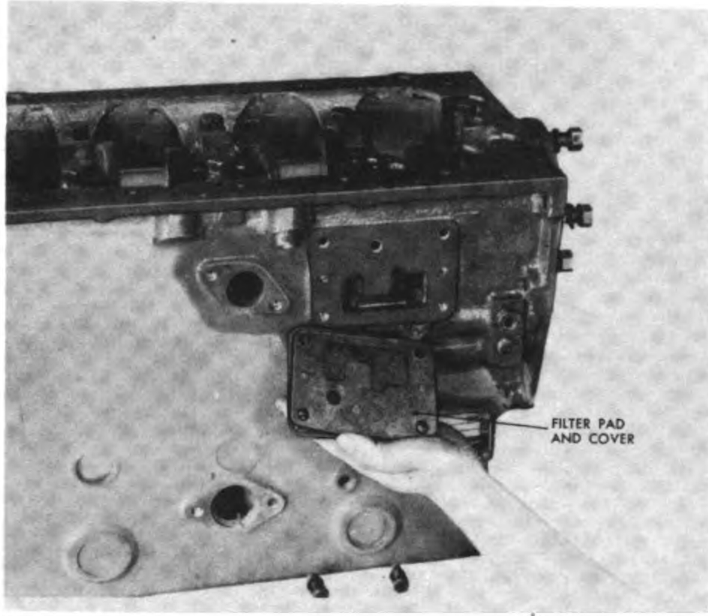


Figure 351. Installing Oil Filter Pad.

(407) Cleaning Piston Grooves

Clamp the piston and connecting rod assembly in a vise with lead jaws to prevent damaging the connecting rod so that the piston seats tightly against the top side of the jaws. With a narrow strip of clean cloth, clean out each ring groove. If the clearance between the ring lands and the ring have not been checked according to the instrucions in Paragraph 260, check to be certain that each ring is free in its respective groove.

(408) Installing Piston Rings

The first ring should be a bigger gap than the second and third rings. The latter two rings must be installed with the plain side up and the undercut side down. Squirt oil on the rings piston skirt. With a special ring tool place the rings into their proper grooves. See figure 352 spacing the gaps ¼ of a circle apart with no gaps over and none in align with the piston pin. The top ring is a plain compression ring; the second and third rings are combination compression and scrapers; the fourth or bottom ring is the slotted oil control ring.

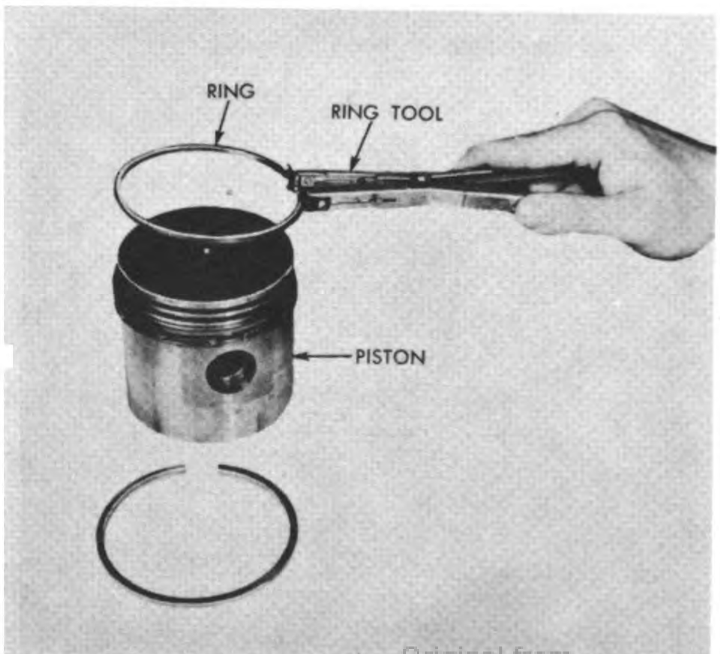


Figure 352. Installing Piston Rings.

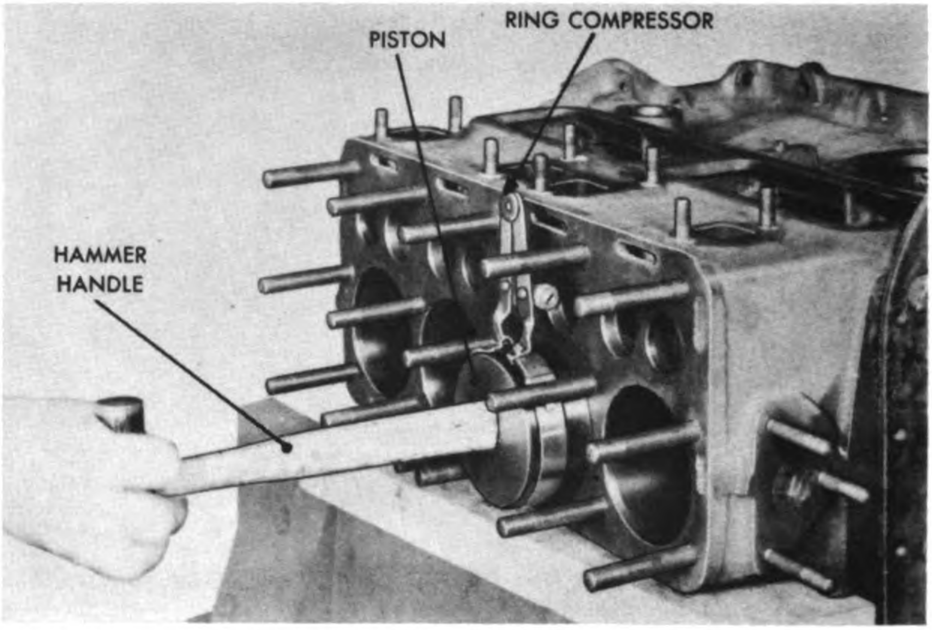


Figure 353. Installing Pistons.

(409) Installing Piston

Place a ring compressor over the rings as shown in figure 352. Make certain that the rings are wholly in their grooves before tightening the compressor. Tighten a little bit at a time—pausing to push the compressor sideways to be certain that the rings are free. Compress as much as possible. NOTE: A good tool for installing the piston is a short wooden handle with a piece of copper tubing fastened to one end. See figure 354. The tubing slips over the bolt and the handle acts as a guide to avoid damaging the bearing surface. CAUTION: Make certain the No. 1 piston is in the No. 1 cylinder with the designating number facing the right side of the engine (opposite of the camshaft) and so forth for each respective piston and cylinder. Lightly tap the piston and connecting rod assembly into place with the handle of the hammer. DO NOT FORCE. If it does not move easily either the rings are not compressed enough or the connecting rod is catching on the inside of the crankshaft.

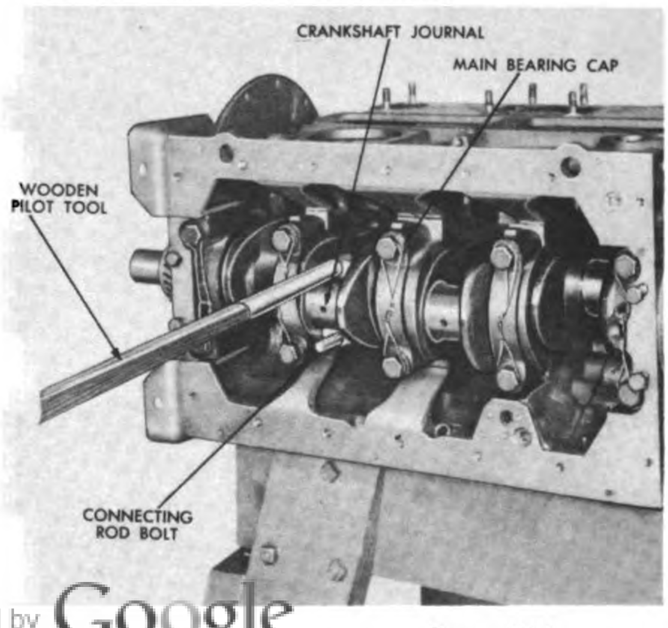


Figure 354. Installing Connecting Rods with Wooden Tool.

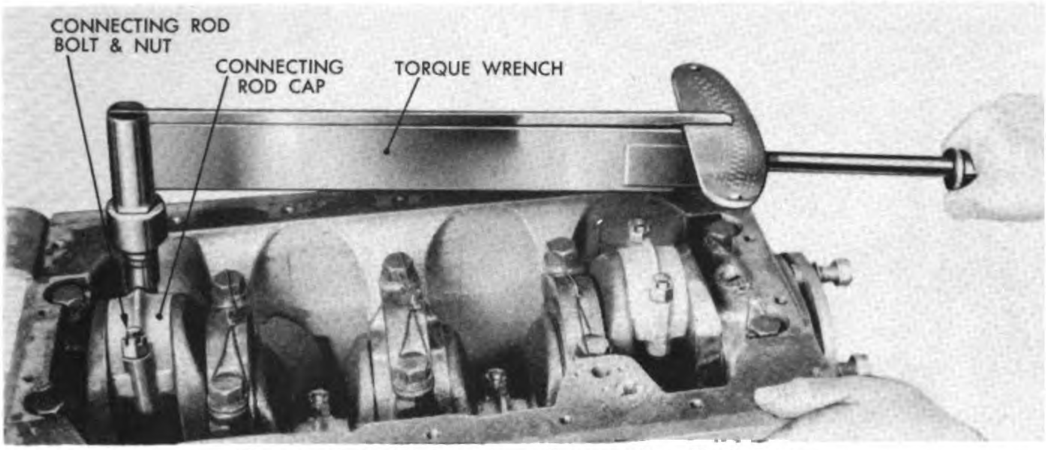


Figure 355. Tightening Connecting Rod Caps.

(410) Installing Connecting Rod Caps

Install the connecting rod cap, oiling it and make sure that the number on the cap corresponds and lines up with the number on the rod. The caps are not interchangeable nor must their position be reversed. Tighten each rod separately and with a torque wrench from 75 to 85 foot pounds. Figure 355. Check the side play of the connecting rods by tapping each cap lightly. See figure 356. This side play should be from .004" to .009". Check with a feeler gauge. If there is no side play, the piston and rod must be removed and checked as follows: Place the connecting rod cap on the crankshaft journal to see if it can be moved sideways; if not, the cap and rod must be filed together. Usually a few strokes are sufficient to provide clearance. If there is side play, but the movement is not free when tapping the cap and rod, there is either dirt on the bearing or the bearing is of improper size.

Line up the cotter pin holes and insert pins of a large enough diameter to make a snug fit in the holes. The cotter pins should extend about ⅜" to ½" to allow enough length for bending. If longer, cut off the excess length.

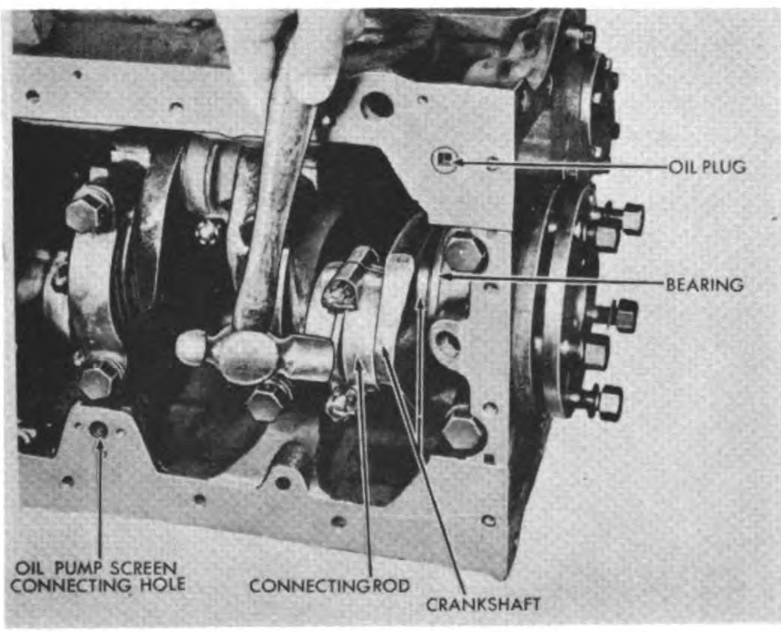


Figure 356. Checking Connecting Rod Side Play.

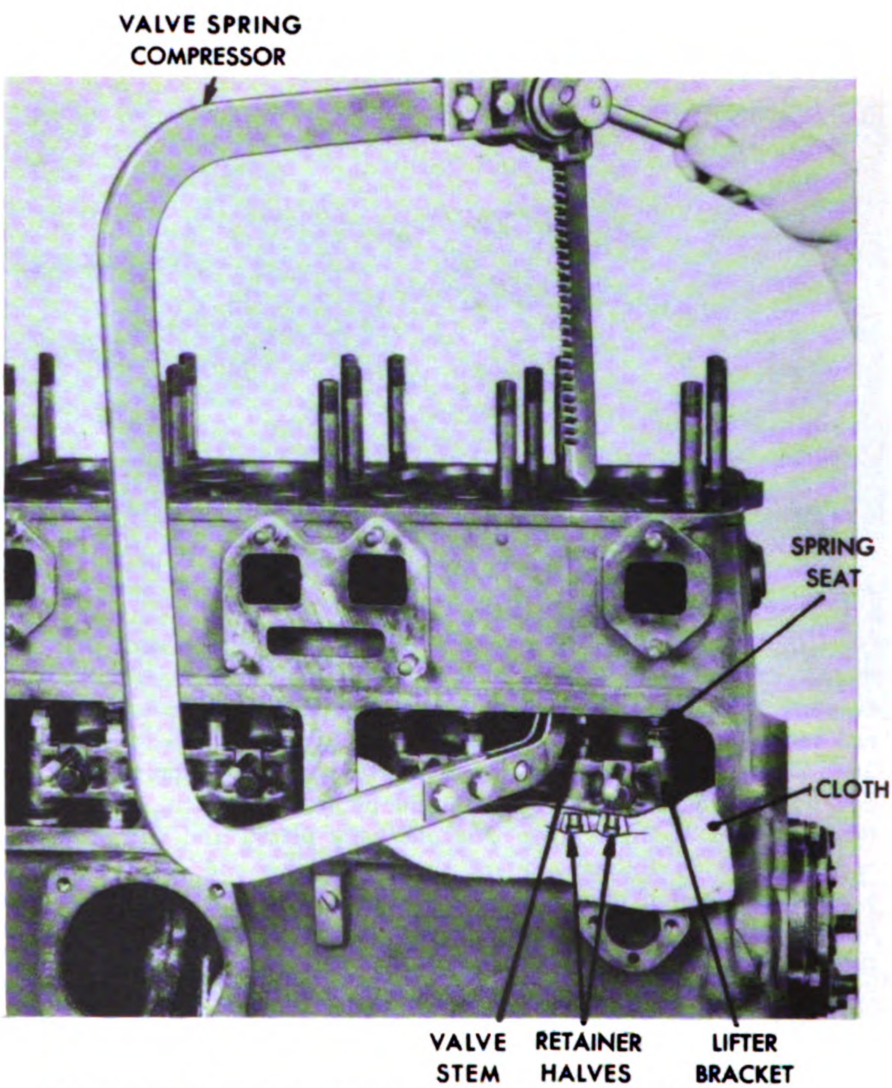


Figure 359. Installing Valves and Springs with Valve Lifter.

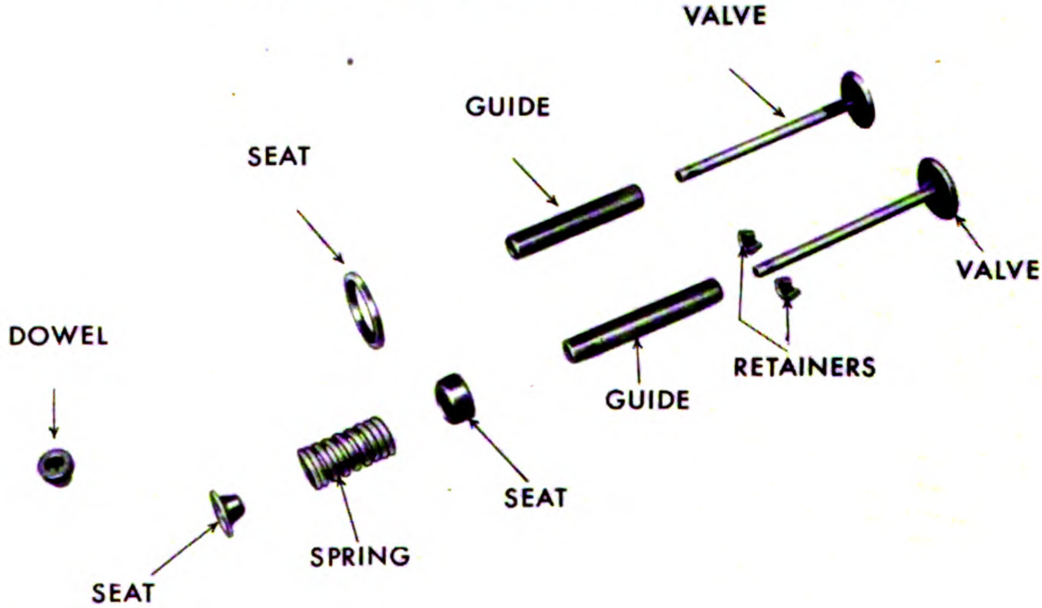


Figure 358. Valve Assembly.

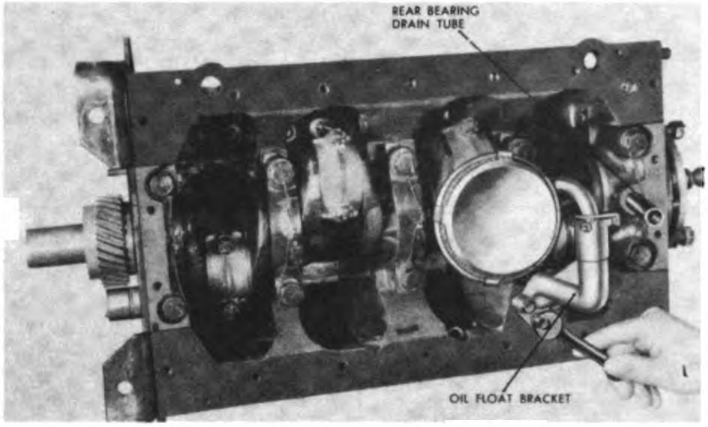


Figure 357. Installing Oil Float and Tube.

(411) Installing Rear Bearing Cap Drain Tube and Oil Float

Install the rear bearing cap drain tube with an adjustable wrench and install the oil float making sure that the gasket is in place. See figure 357.

(412) Installing Oil Pan

Before installing the oil pan make sure that all connecting rod cotter pins and main bearing lock wires are in place. Then permatex the oil pan gasket.

With a chain hoist set the engine upright making sure that both the front and back ends are clear.

(413) Installing Valves

First install cloth in the valve well to prevent parts of the valve assembly from falling down into the crankcase. Be sure that when inserting the valves you get the valve marked inlet and exhaust in their respective holes. Place the valve spring seats and springs in the valve chamber. NOTE: The closest wound and coil should go into the upper valve spring seat. See figure 358. Now with the aid of a valve lifter compress the springs and slip in the retainer halves. See figure 359. NOTE: A coat of grease on the inside of the retainer halves will make them stick to the stems while compressing the springs. Make sure that the retainer halves are firmly seated on the valve stem before releasing the springs.

(414) Installing Valve Lifter and Bracket Assembly

CAUTION: The holes for the screws holding the assembly in place open into the cylinder bore and if, for any reason, any of the capscrews are replaced, ONES OF IDENTICAL LENGTH SHOULD BE USED, 2" LONG, OTHERWISE THEY WILL SCORE THE PISTON.

Now firmly grasp the top of the lifter with the fingers and place the assembly on the camshaft. Figure 360. NOTE: It may be necessary to turn the flywheel over in order to set each lifter under the valve assembly. After the lifters are properly under the valve springs, the bracket can be lined up with the hole and the capscrews inserted and tightened.

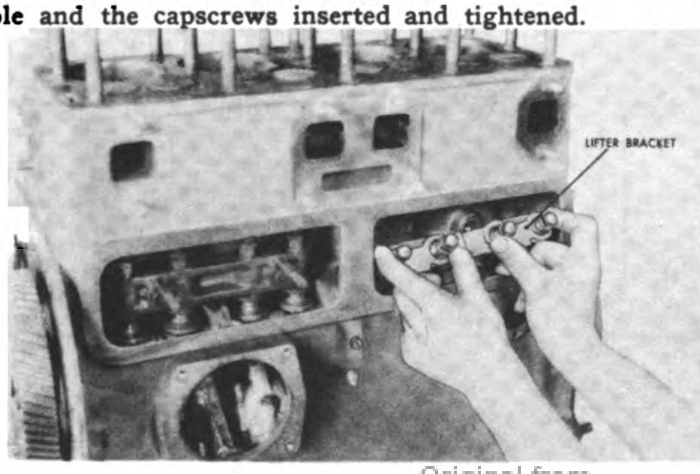


Figure 360. Installing Valve Lifter Assembly.

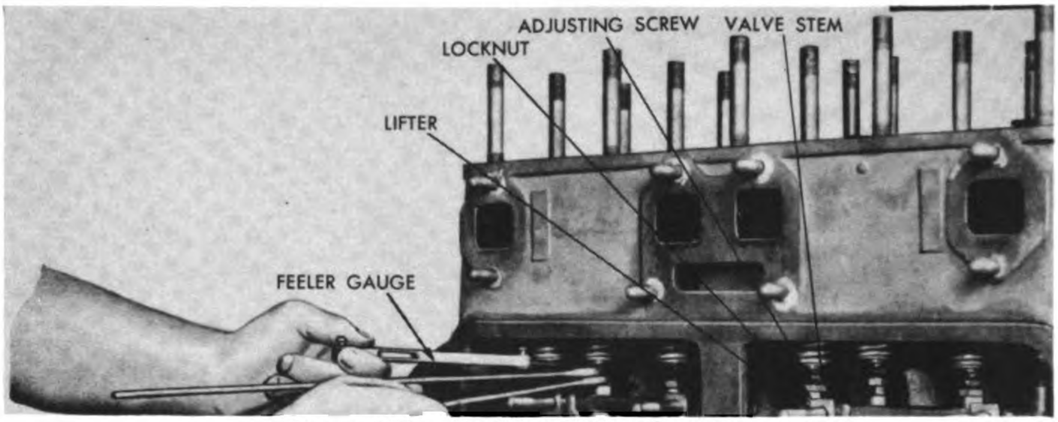


Figure 361. Checking Valve Tappets.

(415) Adjusting Valves

Adjust the valves to their proper clearances: .006" for the intake—.009" for the exhaust. The engine should be at normal operating temperatures when checking tappet clearances. See figure 361. To check this clearance, turn the engine over by hand until the intake valve closes on the particular cylinder you are working on. Continue to turn the engine one-half revolution to be certain that the cam is out from under the lifters. The operation can be simplified by placing a chalk mark on the flywheel and then turning the engine ½ the flywheel circumference. The piston is now approximately at top dead center and both the intake valve and exhaust valve are in position for checking or adjusting.

CAUTION: The position for adjusting and checking is determined by the closing of the intake valve. Therefore, check the ports to be certain that it is the intake valve you are closing to obtain the proper position as shown in figure 362. With a feeler gauge, check the clearance. To adjust, lifter must be held rigid while loosening the middle locknut. Turn the top adjusting screw in either direction, depending upon the adjustment that is needed, until the correct clearance is checked. Tighten the locknut and check to be sure that the adjusting screw has not turned. Repeat this procedure for all the valves and bear in mind that both the intake and exhaust valves can be checked together for that particular cylinder.

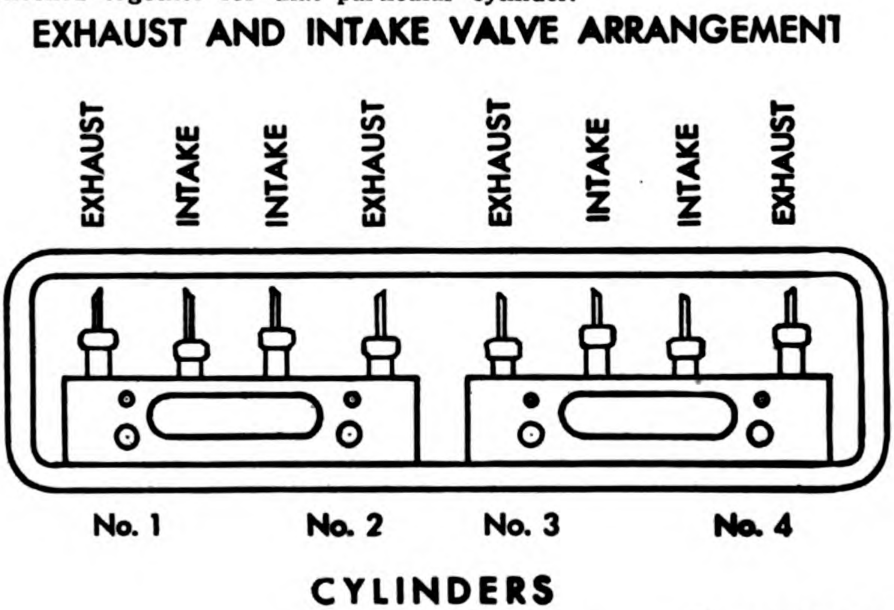


Figure 362. Cylinders.

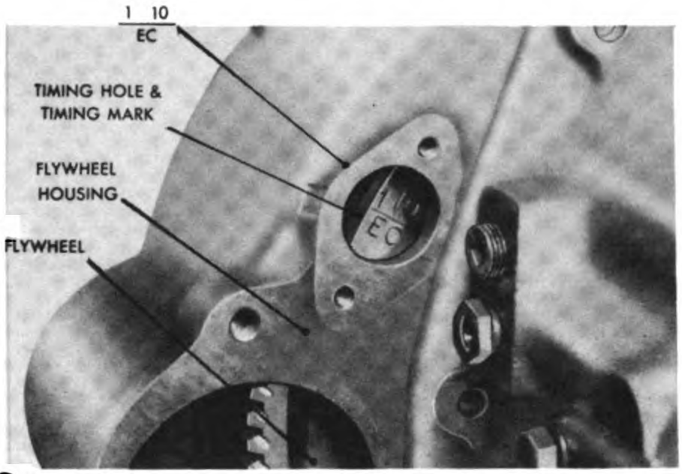


Figure 363. Timing Hole.

(416) Installing New Gears

NOTE: In case the gears have been replaced and the punch marks for the purpose of timing were not transferred, the following procedure for timing the valves is necessary.

a. Be sure that the intake valve lifter No. 1 cylinder (second lifter from the timing gear) is adiusted to the proper clearance of .006" and the idler gear is not in place on the shaft and meshing with the other gears.

b. Turn the crankshaft until the timing mark on the flywheel, No. 1 (cylinder I) (intake open) is in the center of the inspection hole in the flywheel housing. See figure 363.

c. Turn the camshaft in the direction of rotation (same direction as the crankshaft) until the No. 1 cylinder intake valve lifter takes up the slack between the lifter and the valve stem. This point can be determined by rotating the lifter with your fingers. A slight drag indicates the proper point. Slip the idler gear into mesh with the cam and crankshaft gears. Install the camshaft thrust washer and tighten the thrust screw. The ignition can be set externallv. See instructions for Distributor Timing, paragraph 352, chapter XXVIII.

d. To recheck the valve timing, slowly turn the crankshaft almost two revolutions in the direction of its rotation. Toward the latter part of the second revolution, feel the No. 1 cylinder intake tappet. When a slight drag is felt, the timing mark I.O. (intake open) on the flywheel should be in the center of the inspection hole in the flywheel housing.

(417) Installing Oil Baffle Plate and Valve Cover

Place the oil baffle plate on the long stud that extends from the lifter bracket. Figure 364. NOTE: No nuts or washers are necessary here as the plate is held in place by the valve cover which has 4 coneshaped nuts, each containing a copper gasket.

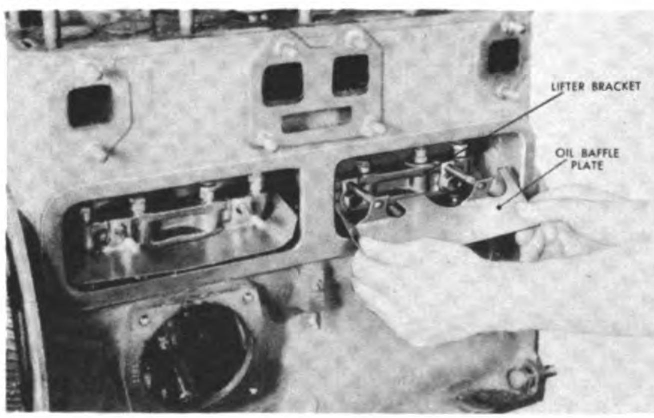


Figure 364. Installing Valve Chamber Baffle Plate and Cover.

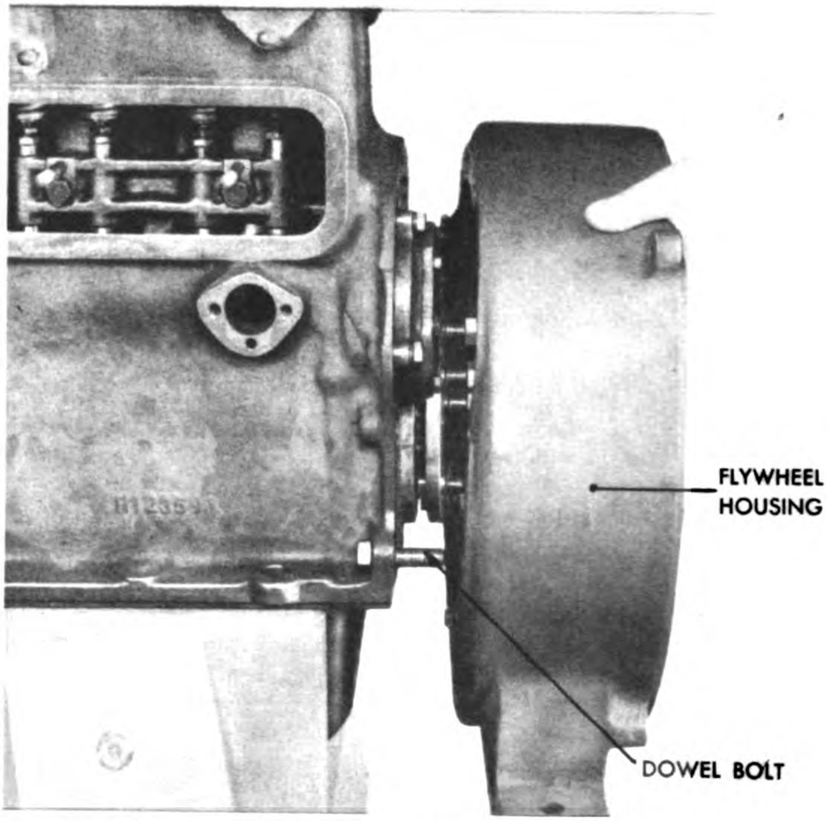


Figure 365. Installing Flywheel Housing.

(418) Installing Flywheel Housing

With the flywheel housing dust plate assembled to it, install the housing by slipping it into place on the two dowel bolts. Figure 365. Tighten the dowel nuts and the four capscrews. See figure 366.

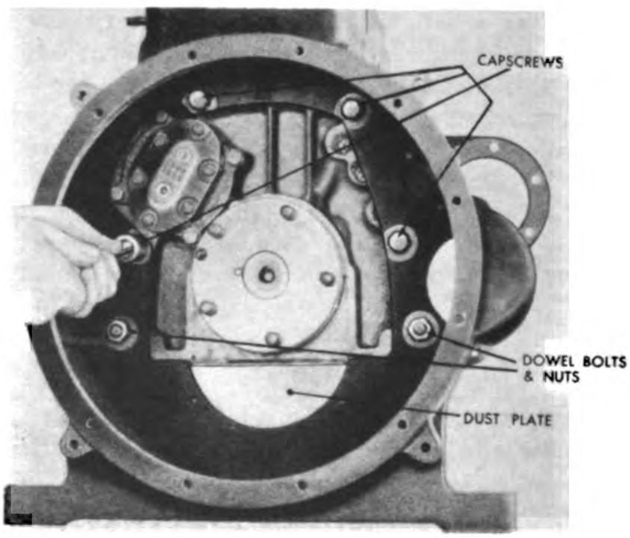


Figure 366. Tightening Flywheel Housing Dowel Nuts and Capscrews.

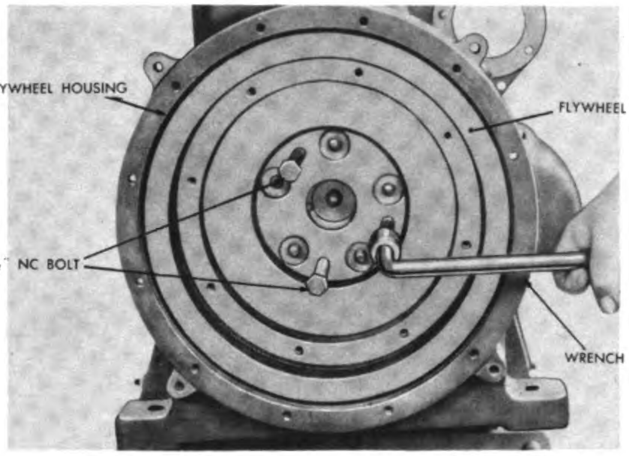


Figure 367. Installing Flywheel.

(419) Installing Flywheel

First, be sure that you have inserted the three 4" capscrews into the ½" holes in the flywheel flange that you used to take the flywheel off. Before installing the flywheel, make certain that all the dirt has been removed from the crankshaft flange, and the crankshaft flange recess in the flywheel. Feel the surfaces for burrs and nicks. See figure 367. To facilitate putting on the flywheel, move No. 1 piston, to top dead center. Line up the timing marks on the flywheel with the timing hole in the housing. Because of an offset bolt, the flywheel goes on in one position only. Check: Lift the flywheel into position on the flywheel bolts. Put on the lockwasher and nuts. Be sure to use the special thin lockwashers provided. Tighten the nuts slowly and evenly by tightening each nut going around several times until the nuts are tightened.

(420) Checking Flywheel Run-out

Check the run-out of the flywheel by marking four positions on the flywheel 90° apart and arranging a fixed measuring point as shown in figure 368. Check the spaces between the fixed point and each of the marked positions. These measurements should not vary more than .008".

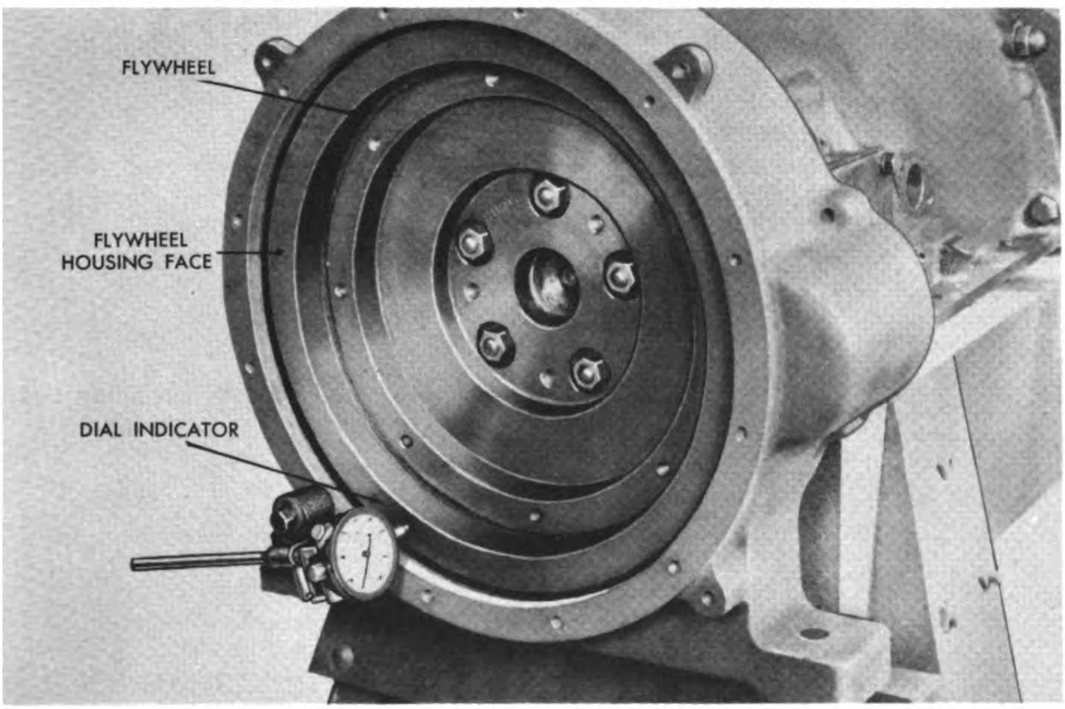


Figure 368. Checking Flywheel Runout.

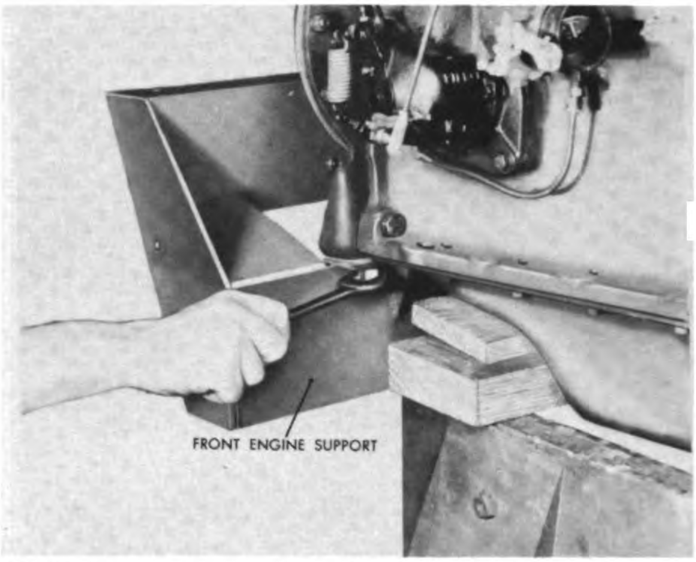


Figure 369. Installing Front Sill.

(421) Front Support and Radiator Mounting Bracket

Install the front sill by inserting the ends into the two vertical bolts that attach it to the front of the engine. CAUTION: Be sure that the rubber gaskets are in place. Tighten the nuts securely. Figure 369.

(422) Installing Timing Gear Cover

Unless the valves have to be timed because the gears were replaced without the timing mark being transferred to the new gears, install the timing gear cover. But first drive the oil seal into the cover as shown in figure 370 and tighten all the capscrews.

(423) Installing Fan Drive Pulley

Drive the pulley key way all the way into the crankshaft recess, being sure that it lines up evenly with the end of the shaft. Now fit the pulley over the key way and drive on with a hammer and block of wood, being sure to drive it as far back as it will go. See figure 371. CAUTION: Do not hit the end of the key with a hammer; otherwise, you will split the end and prevent the pulley from slipping on. Use a ball punch as shown in figure 372.

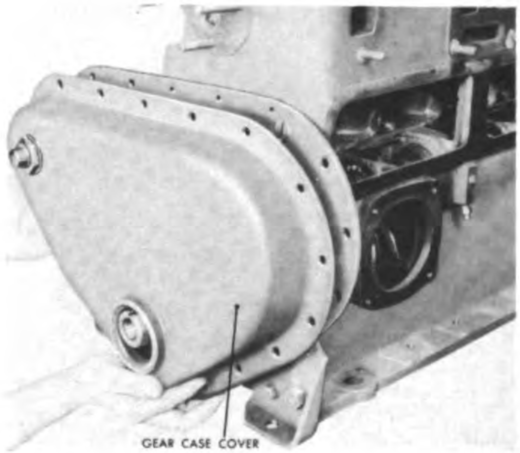


Figure 370. Installing Gear Case Cover.

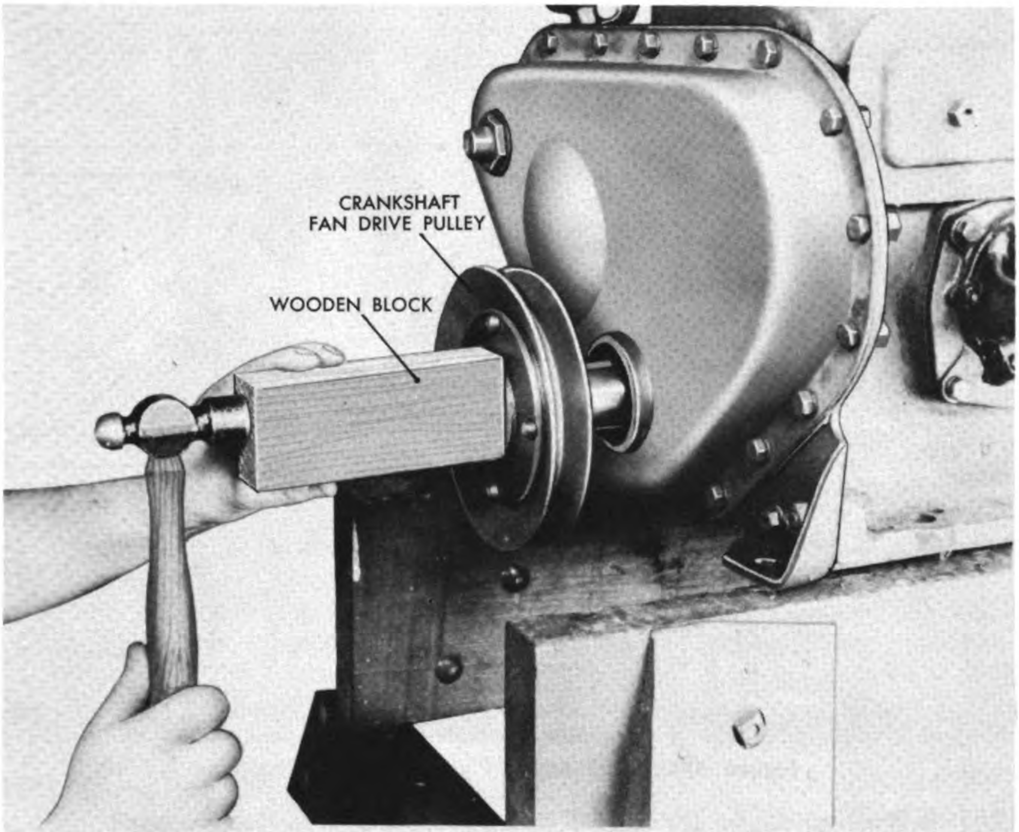


Figure 371. Installing Fan Drive Pulley.

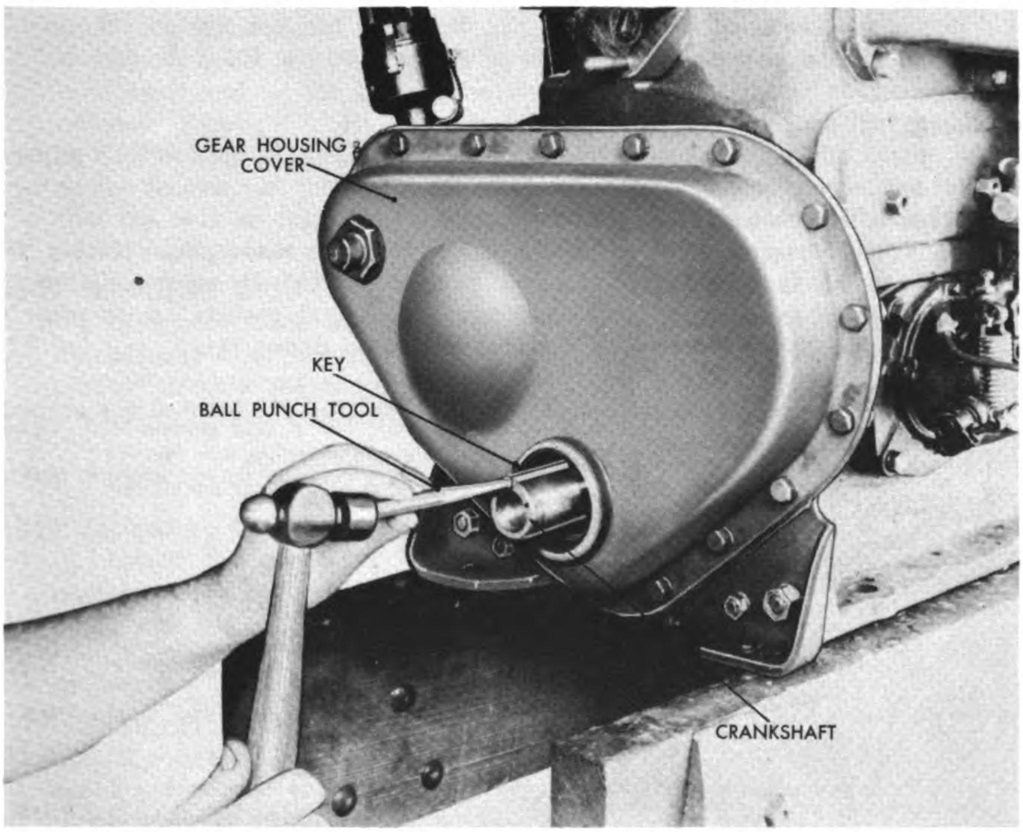


Figure 372. Ball-Punching Fan Drive Pulley Key.

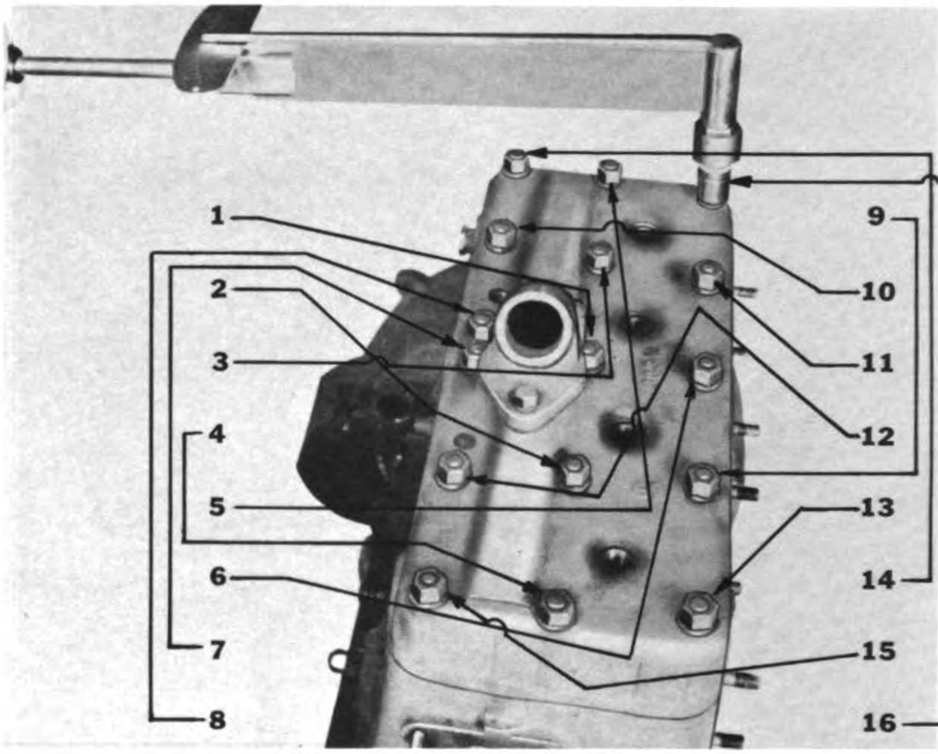


Figure 373. Tightening Cylinder Head Bolts.

(424) Installing Cylinder Head and Gasket

Install the cylinder head and gasket, using a new gasket and tighten according to the diagram shown in figure 373. CAUTION: Be sure and follow the sequence as shown in the diagram. Finally, tighten the cylinder head nuts with a torque wrench of between 95 to 105 foot pounds. See figure 373.

(425) Installing Spark Plugs

It is advisable to use a complete new set of spark plugs correctly adjusted to .025" into the cylinder head.

(426) Installing Manifold and Carburetor

It is advisable here to mount the carburetor with copper tubing that connects to the oil pump attached onto the manifold before placing the manifold on the engine. Make sure that the copper gaskets are in place on the engine before connecting the manifold. See figure 374.

(427) Installing Muffler Pipe

With an adjustable wrench tighten the muffler pipe and elbow securely.

(428) Installing Governor

Tighten the four capscrews that hold the governor to the engine, making sure that the gasket is in place.

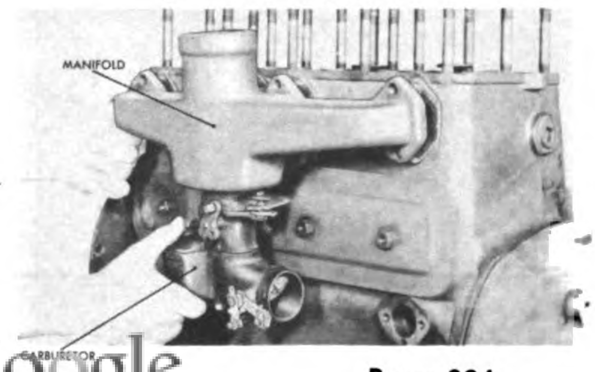


Figure 374. Installing Manifold and Carburetor.

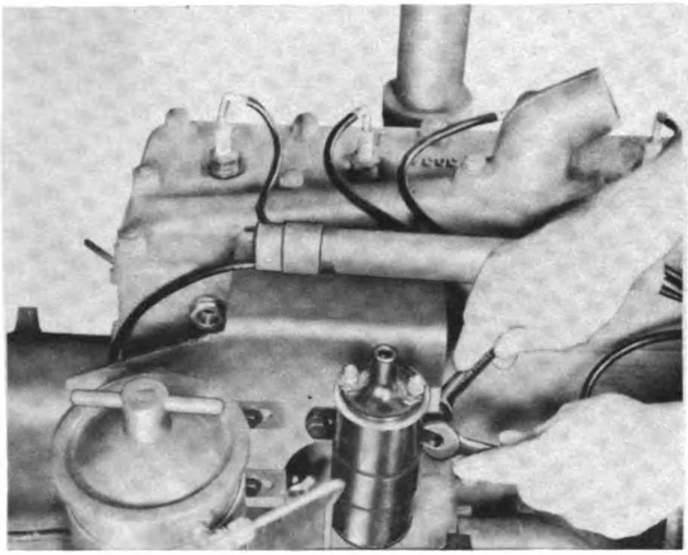


Figure 375. Installing Oil Filter Coil and Bracket Assembly.

(429) Installing Oil Filter and Coil

Before installing the bracket it is advisable to assemble the oil filter and coil to it. Also attach the small steel brace with the small hole attached to the right end nut holding the coil. Now the entire filter, coil and bracket is ready for mounting.

The bracket is held in place at the top by the second and third cylinder head bolts and by the steel brace attached to the left side of the water distributor. Figure 375. However, it will be necessary to tighten the steel brace to the left side of the water distributor and then force the top of the bracket to the second and third cylinder head bolts eliminating the washers. Be sure that the nuts on these two bolts are tightened with a torque wrench from 95 to 125 foot pounds pressure.

(430) Installinq Cable Tubing

This cable tube is held in place by a capscrew with a small spacer to the left and a large spacer to the right. Tighten these capscrews with their spacers onto the engine head.

(431) Installing Oil Breather

Install the oil breather by tightening up the two screws making sure that the screen on the inside has been thoroughly cleaned.

(432) Installing Generator Bracket and Generator

Install the generator bracket by tightening the two capscrews to the engine block. Figure 376. Next, attach the generator to the bracket and install one end of the steel adjusting brace.

(433) Installing Fan Assembly

First, install the fan bracket by tightening the three caps. Loosen the long adjusting screw and slip in the axle and tighten the washers and thin nut. See figure 377. Slip on the belt on the three pulleys and fasten the brace running from the generator to the fan bracket. Tighten the belt by turning down the long adjusting screw and adjusting the nut on the back of the axle pulley so that there will be a slack of ½" to ¾" as shown in figure 378.

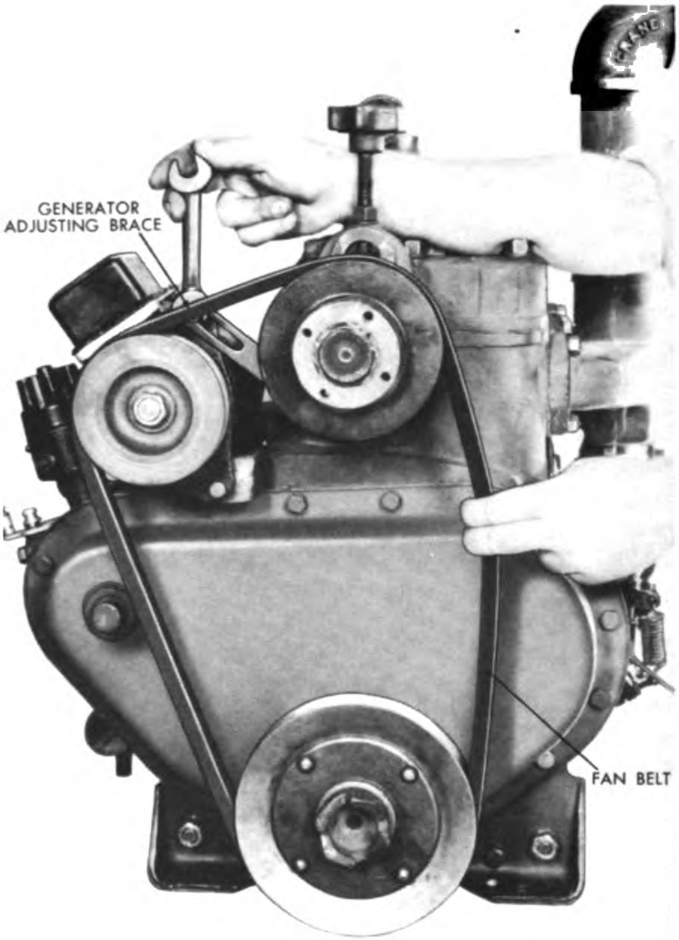


Figure 376. Installing Generator Bracket.

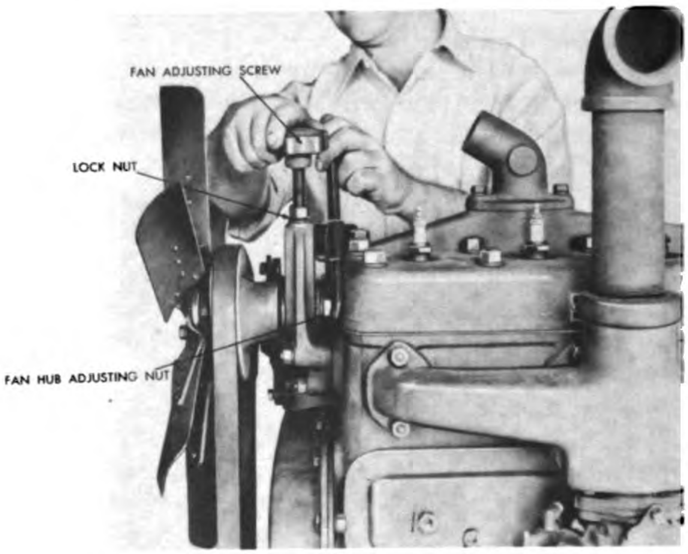


Figure 377. Installing Fan Assembly.

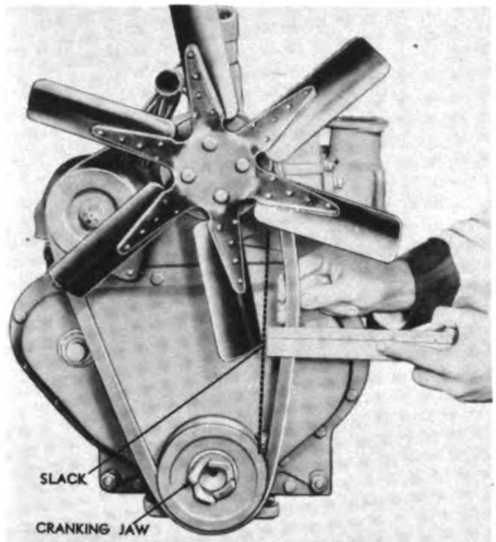


Figure 378. Adjusting Fan Belt.

(434) Installing Distributor

Insert the distributor in the well meshing with the water pump drive shaft gear. Tighten the spark control bracket onto the distributor shaft. Install spark control stop screw into the bracket.

(435) Installing Starter Motor

Install the starter motor so that the gear meshes with the flywheel gear.

(436) Installing Radiator

Attach the radiator to the two bolts that protrude through the front support making sure that the rubber pads are in place. Install and tighten all hose connections, both lower and upper figure 379.

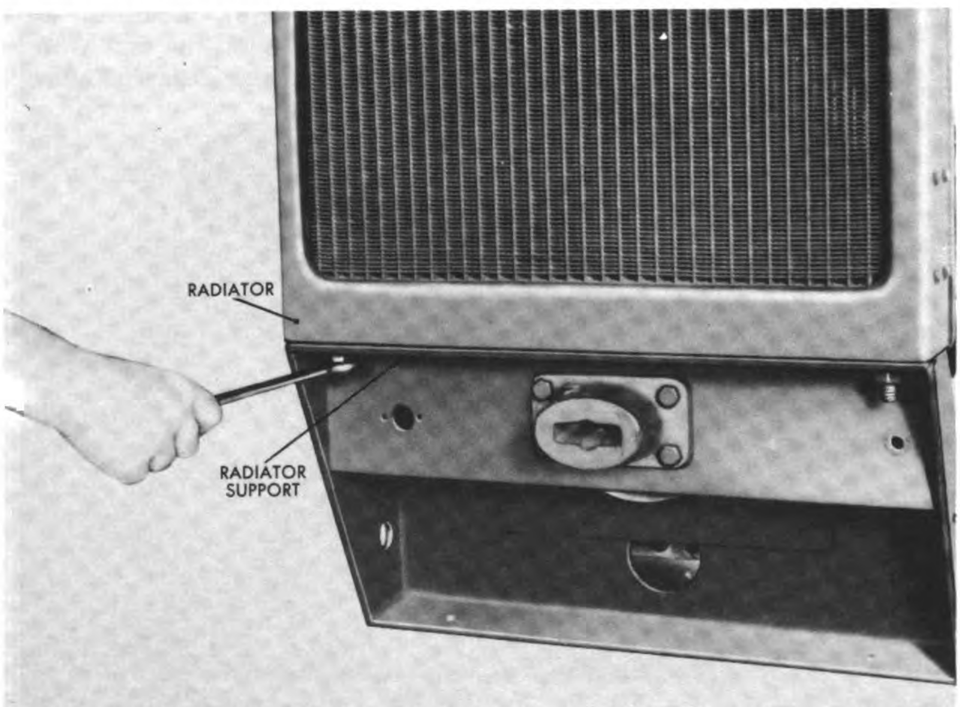


Figure 379. Installing Radiator.

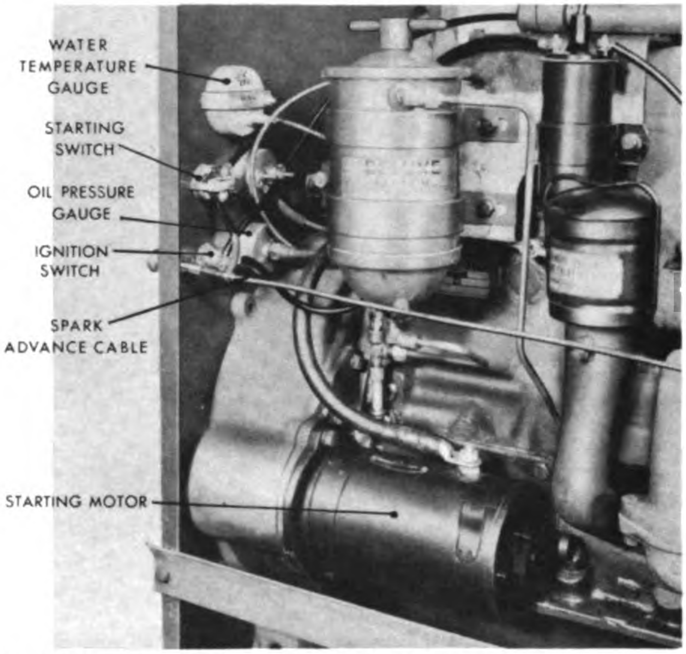


Figure 380. Installing Instrument Panel.

(437) Attaching Hood and Back Panel

First, be sure that all the instruments have been fastened to the back panel; namely, temperature gauge, ammeter, oil pressure gauge, key switch, starter button, spark throttle, and control lever figure 380. Tighten the four bolts that hold the back panel to the flywheel housing and install the hood and gas tank. Next, connect the spark cable to the distributor arm bracket and round brass locking arm being sure to tighten the setscrew thereon. Also the choke wire should be fastened to the carburetor bracket as well as the carburetor control lever.

(438) Installing Air Cleaner

Install the two brackets that hold the air cleaner to the back panel. (Capscrews enter from the rear of the bracket and spacers). Mount the air cleaner body by tightening the adjustable bolt and nuts. Mount the tube with hose on each end, one to the carburetor and the other to the cleaner. Figure 381.

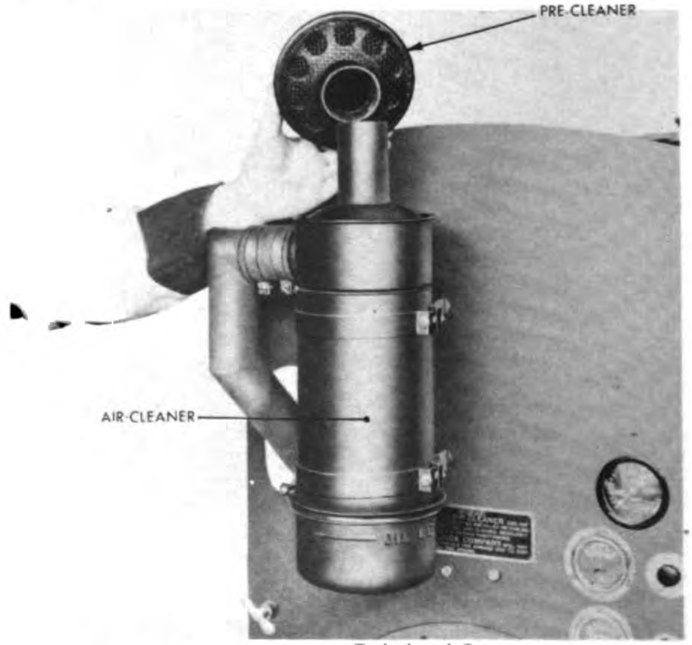


Figure 381. Installing Air Cleaner.

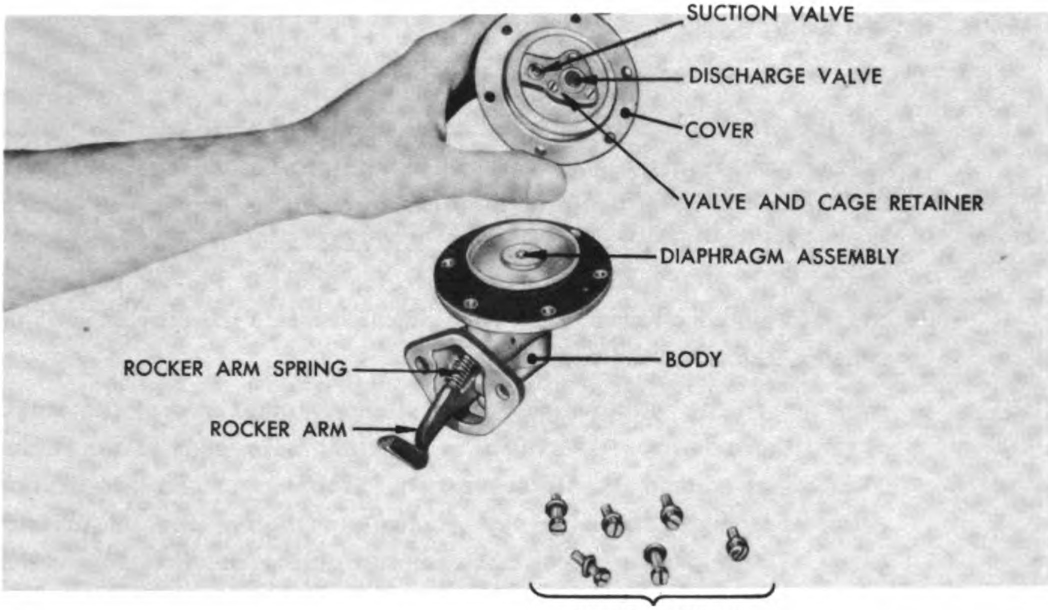


Figure 382. Installing Fuel Pump.

(439) Installing Fuel Pump

Install the fuel pump making sure that the arm extending therefrom properly sets on the camshaft. Figure 382.

(440) Installing Drain Cock

Install the drain cock on the side of the motor and the drain plug at the bottom of the water pump.

(441) Attach the Side Sills

Fasten the two sills that connect the front to the back panel.

(442) Installing Governor

Install governor and hook up the governor link rod at the carburetor and the governor extension arm. Figure 383. For adjustment see Chapter III.

(443) Installing Copper Tubing

Hook up the copper tubing that extends from the carburetor to the oil pump and on the other side of the engine connect elbows and tubing to the oil pressure gauge and oil filter.

Figure 383. Installing Governor Link Rod.

(444) Testing Engine

The engine is now ready for a test run.

a. Fill the crankcase with five and one-half quarts of S.A.E. No. 10 oil. Oil the generator, the governor ball joints, throttle and choke controls, and grease the water pump with special water pump grease, see lubrication chart paragraph 378, Chapter XXVIII and figure 36., also the clutch with No. 3 wheel bearing grease, and fill the air cleaner oil cup with engine oil up to the mark indicated inside the oil cup. .Fill the radiator, and start the engine.

b. Run the engine with no-load from three to eight hours; the length of time depends upon the type of repairs that were made to the engine. The engine should be started slowly, avoiding sudden acceleration. Allow the engine to warm up gradually. Observe the oil pressure gauge. If the pressure does not come up during the first 30 seconds, stop the engine, remove the high pressure oil fitting and prime with oil. If the gauge still indicates no oil pressure, check back on the assembling of the oil pump and lubricating system.

c. An approximate carburetor adjustment should be made after the engine has started, to avoid running with too rich or too lean a mixture. Set the carburetor idle speed and high speed adjustment after the rings have seated, or at the end of the test run. Refer to Carburetor paragraph 358, Chapter XXVIII for the carburetor adjustment. While the engine is running, check for oil, water, and gasoline leaks. CAUTION: If the engine is run indoors, the exhaust gases must be piped outside.

d. Near the end of the run, the governor high speed operation can be adjusted. Refer to figure 304. Turn the surge adjusting screw out until only three or four threads are engaged. Tighten the locknut and leave in this position for the present. Adjust governor for desired speed by turning the high speed adjusting screw. See figure 45. Turning in will increase speed; turning out will decrease speed. Should the engine surge under load or part load, turn the spring eye adjusting screw out a few turns at a time until surging stops. For sensitive regulation, keep this screw in as far as possible without creating load surge.

Should the governor surge at no load speed, turn the surge adjusting screw in slowly until the surge is overcome. Do not turn this screw in so far as to increase speed.

(445) Stopping Engine

Before stopping the engine at the end of the run, de-accelerate it gradually and allow it to idle for a few minutes. This will allow the engine to cool gradually, thus avoiding any damage due to warping because of sudden cooling.

After the engine is stopped, check the tappet clearances according to paragraph 415. Retighten the cylinder head by tightening the stud nuts according to figure 373. Tighten the oil pan, manifold, and gear case cover. Drain the oil and water. Refill the crankcase with oil of recommended viscosity for the prevailing temperature, and refill the radiator.

After the engine has been tested or adjusted, wash and dry it thoroughly and apply a coat of engine paint. The engine is now ready to be installed with the rest of the machinery.

The carburetor and governor may have to be re-adjusted again, after the engine is operated under load with the rest of the machinery. If this necessity occurs, for the governor adjustments refer to paragraph 367, Chapter XXVIII.

Chapter XXX
Engine Tune-up

Results obtained from an Engine Tune-Up are often unsatisfactory, because a "hit and miss" method was used instead of a systematic approach to the job. Too often, mechanics are inclined to guess at the cause of faulty operation, when a complete tune-up is actually in order.

The most common cause of poor performance and excessive operating costs is a combination of maladjustments among the fundamental items of Engine Tune-Up. Therefore, the only logical solution is a complete check following the cycle shown in the accompanying illustration and carrying out each step, as follows:

(446) Spark Plugs

a. Check to be sure that proper make and type are being used.
b. Clean plugs with an abrasive type spark plug cleaner.
c. Inspect porcelain and if cracked or broken replace with new part.
d. Set gap to dimension recommended in "Specifications" at the end of the distributor section, using a round feeler gauge. When regapping is necessary adjust side electrode only, never bend center electrode.
e. Be sure that plug is tight when installing and that the gasket is in good condition.

(447) Ignition Cables

a. Check ground strap — be sure that both terminals are clean and tight.
b. Check the battery to the starter cable — be sure that both terminals are clean and tight.
c. Check the spark plug and other ignition cables. Terminal on each end must be tight and clean if rubber insulation shows evidence of deterioration it should be replaced.

(448) Distributor

a. Check the distributor points for evidence of pitting or burning. Replace if they cannot be cleaned up with point file. Never use emery cloth to clean distributor points.
b. Check the point opening with feeler gauge. Adjust to dimensions shown in "Specifications".
c. Check distributor plate for cracks and replace if cracked or if posts are burned appreciably.
d. Check rotor to be sure the spring contacts secondary terminal, and that point is not burned from arcing.
e. Check condenser for correct condenser capacity.

(449) Ignition Coil

Check ignition coil. See paragraph 348.

(450) Ignition Timing

Check ignition timing to be sure No. 1 cylinder is firing according to flywheel markings.

(451) Valve Clearance

a. Check valve lash against clearance shown in "Nominal Clearances". Engine must be thoroughly warmed up before checking.
b. Make visual inspection of valve springs for broken coils.

(452) Carburetor

a. Clean air cleaner as directed in "Fuel System" section.
b. Check the carburetor flange and intake manifold gasket for leaks.
c. Check the float lever as instructed in "Fuel System" section. Correct the float level height as given in "Specifications."
d. Adjust idling screw until engine runs evenly and steady with leanest possible mixture. The engine should be thoroughly warmed up before adjusting carburetor.

Chapter XXXI
Engine Service Diagnosis

(453) Lack of Power

1. Low or Poor Compression.
2. Ignition System Defective—See "Distributor" Section.
3. Carburetor of Fuel Pump not Functioning Properly—See "Fuel System" Section.
4. Air Cleaner Restricted.
5. Low Octane Fuel.
6. Overheating—See "Cooling System."
7. Improper Grade and Viscosity of Oil.

(454) Poor Compression

1. Incorrect Valve Lash.
2. Valve Stems or Lifters Sticking.
3. Valve Stems or Guides Worn.
4. Valve Springs Weak or Broken.
5. Valve Timing Incorrect.
6. Cylinder Head Gasket Leaking.
7. Piston Rings Broken, Worn or Stuck.
8. Pistons or Rings Improperly Fitted.
9. Piston Ring Grooves Worn.
10. Cylinder Scored or Worn Excessively.

(455) Excessive Cylinder and Piston Wear

1. Improper Grade and Viscosity of Oil.
2. Lack of Oil.
3. Dirty Oil.
4. Overheating—See "Cooling System."
5. Piston Improperly Installed and Fitted.
6. Piston Rings not Properly Fitted to Piston Groove and Cylinder Wall.
7. Piston Rings Stuck in Piston Grooves or Broken.
8. Air Cleaner not Clean, Allowing Dirt to Enter Combustion Chamber.
9. Carburetor Fuel Mixture too Rich.

(456) Crankshaft Bearing Failure

1. Crankshaft Bearing Journal Out-of-Round.
2. Crankshaft Bearing Journal Round.
3. Crankshaft Oil Passage Restricted.
4. Bearings Loose.
5. Bearings Improperly Fitted.
6. Bearings Loose in Crankcase.
7. Crankshaft or Bearings Out-of-Alignment.
8. Lack of Oil.
9. Low Oil Pressure.
10. Improper Grade and Viscosity of Oil.

(457) Connecting Rod Bearing Failure

1. Crankshaft Surface Rough.
2. Restricted Oil Passage.
3. Bearings Loose.
4. Improperly Fitted.
5. Loose in Connecting Rod.
6. Lack of Oil.
7. Bent Connecting Rod.
8. Low Oil Pressure.
9. Improper Grade and Viscosity of Oil.

(458) Burned Valves and Seats

1. Improper Valve Lash.
2. Weak Valve Springs.
3. Improper Valve Timing.
4. Excessive Carbon Deposits Around Seat and Valve Head.
5. Valves Sticking in Guides.
6. Improper Type Valve—Use Genuine Parts.
7. Valve Head too Thin Causing Hot Sections.
8. Valve Seats too Narrow.
9. Fuel Mixture Flow Restricted.
10. Overheating—See "Cooling System."
11. Rocker Arm Stuck, Holding Valve Open.

(459) Valves Sticking

1. Incorrect Valve Lash.
2. Insufficient Clearance between Valve Stem and Guide.
3. Valve Spring Weak or Broken.
4. Valve Stems Scored or Dirty.
5. Valve Lifters Sticking.
6. Use of Fuel with High Gum Content.

(460) Overheating

1. See "Cooling System."
2. Improper Grade and Viscosity of Oil.
3. Fuel Mixture too Lean.
4. Air Cleaner Restricted.
5. Ignition System Defective—See "Distributor" Section.
6. Valve Timing too Early.

(461) Excessive Oil Consumption

1. Piston Rings Broken, Worn or Stuck.
2. Piston Rings Improperly Fitted.
3. Piston Ring Slots Clogged with Carbon.
4. Cylinder Bore Out-of-Round or Excessive Taper.
5. Cylinder Bore Scored or Badly Worn.
6. Crankshaft and Connecting Rod Bearings Worn or Excessive End Play.
7. Overheating—See "Cooling System."
8. Improper Grade and Viscosity of Oil.
9. Excessive Oil Pressure.
10. Oil Level Too High.
11. Oil Leaks at Gaskets and Seals.

(462) Low Oil Pressure

1. Improper Grade and Viscosity of Oil.
2. Oil Pressure Relief Valve Stuck.
3. Oil Pump Screen Clogged.
4. Excessive Crankshaft and Connecting Rod Bearing Clearance.
5. Oil Pump Gear to Housing Clearance Excessive.
6. Oil Pump Worn Excessively.

(463) Popping, Spitting, and Spark Knock

1. Defective Ignition System—See "Distributor" Section.
2. Carburetor not Properly Adjusted—See "Fuel System" Section.

Index by Paragraphs to MAINTENANCE SECTION of MODEL 38D with BUCKET ELEVATOR ATTACHMENT

Index by Paragraphs to Maintenance Section of Model 38D with Bucket Elevator Attachment.

Maintenance of Bucket Loader Attachment Footshaft and Spiral Assembly ¶ 464.

Chapter XXXII
38 D Bucket Elevator Attachment

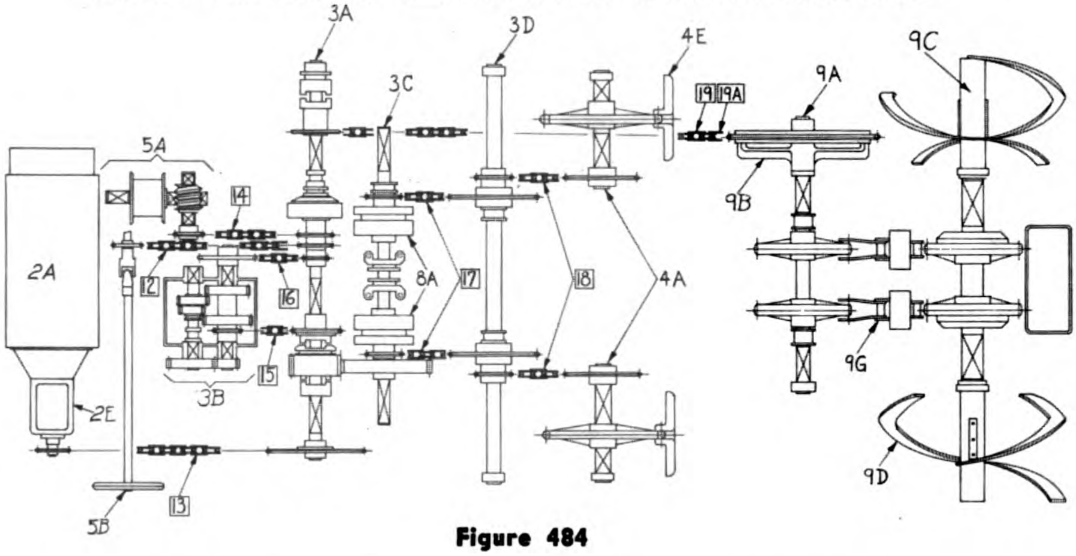


Figure 484

Power Transmission Chart
Shafting Identification and Speeds

Ref. No.		R.P.M.
2A	Engine................................	1400
2E	1. Transmission	1st 2nd 3rd 350 700 1400
5B	2. Hoist Hand Wheel Shaft...............	
5A	3. Hoist Drum Shaft.......................	
	Hoist Drive Shaft.......................	Varies
3B	4. Gear Box Idler Shaft....................	
	5. Gear Box Drive Shaft..................	
3A	6. Main Jack Shaft.........................	1st 2nd 3rd 140 280 560
3C	7. Crawler Clutch Shaft....................	
3D	8. Crawler Oscillating Shaft................	Varies
4A	9. Crawler Drive Shaft.....................	
9A.	10. Elevator Headshaft	42.0
9C.	11. Elevator Foot Shaft and Spiral........	42.0
9G.	Bucket Line Speed......................	168.0 F.P.M.
4E	Crawler Speed...........................	

(See "Determing Crawler Speed" in Operating Section)

Drive Chain Identification

12. Hoist Hand Wheel Chain................
13. Main Jack Shaft Drive Chain.............
14. Hoist Drive Chain.......................
15. Jackshaft Pinion Drive Chain.............
16. Gear Box Drive Chain....................
17. Oscillating Shaft Drive Chain............
18. Crawler Drive Chain.....................
19. Bucket Line Drive Chain................

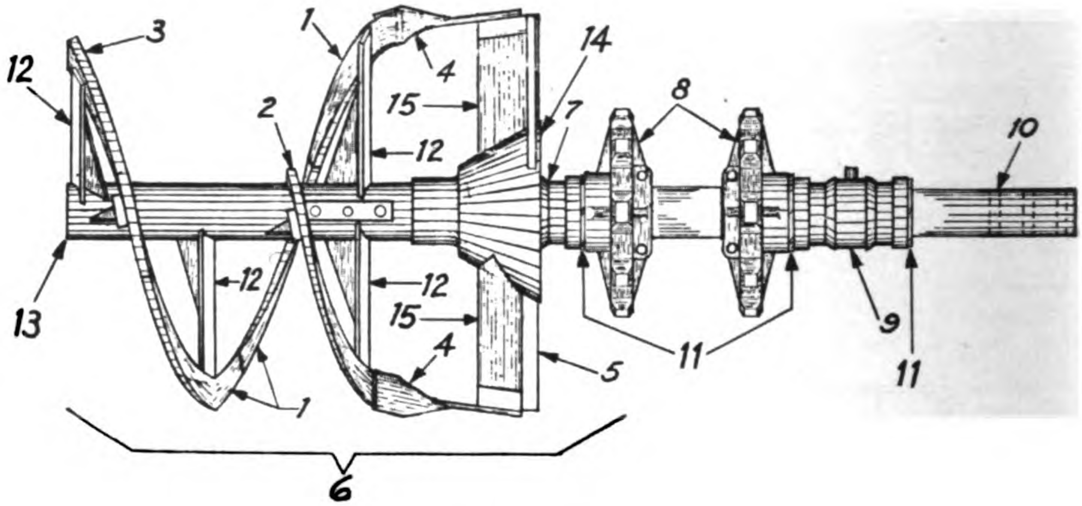


Figure 485

(464) Footshaft and Spiral Assembly

PARTIAL REPAIR

Certain repairs may be made to the Footshaft and Spiral assembly 9C and D, figure 484 without removing the footshaft (10), figure 485.

All wearing faces (1) (2) (3) (4) of the spiral, outside spacer washers and both foot shaft sprocket (8) fall into this category.

The foot shaft sprockets (8) may be interchanged if the teeth are worn excessively. To remove the foot shaft sprockets proceed as follows:

(a) Loosen bucket line chain.

(b) Disconnect bucket line chain.

(c) Remove bolts from each sprocket. Keep sprocket in pairs as removed from shaft.

(d) Sprocket halves may be removed from shaft.

The spiral frames may be pulled from the foot shaft after removing the three bolts which secure the frame to the foot shaft. When the frames are removed the outside bronze spacer washer may be replaced.

GENERAL OVERHAUL

To remove foot shaft proceed as follows:

(a) Loosen the bucket line chain.

(b) Disconnect bucket line chain.

(c) Remove foot shaft sprockets (8) and keys.

(d) Remove one or both of spiral frames (6).

(e) Footshaft may be pulled out of bearings (9).

(f) Remove bolts in bearing caps.

(g) Bearings (9) may now be removed. Note: The footshaft may be left in the bearings and removed with the bearings if desired.

INSPECTION FOR REPLACEMENT

The bearings should be rebushed and the shaft replaced if worn excessively.

The four bronze washers one each side both bearings prevent end play and aid in keeping dirt out of the foot shaft bearings, therefore, if worn or damaged, they should be replaced.

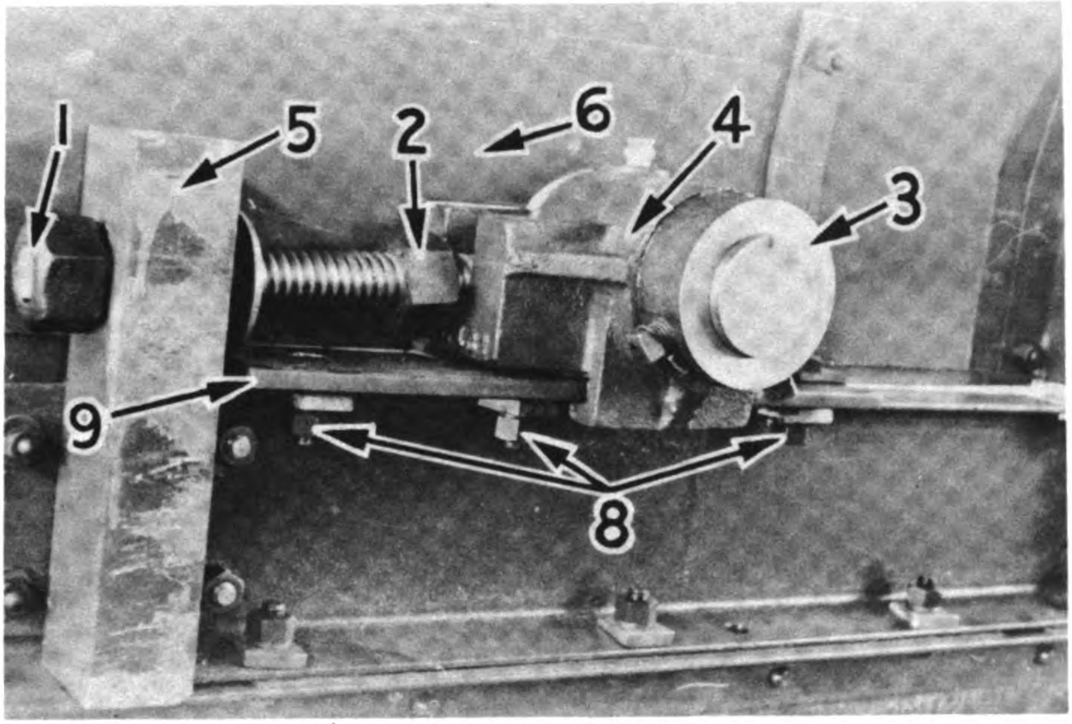


Figure 486

ADJUSTMENT

Bucket Line Chain

Take up of this chain is accomplished by means of two adjusting bolts (1) figure 486 at the elevator headshaft. To tighten the chain loosen lock nuts (2) as shown and take up on bolts till the chain is in proper adjustment. Then tighten lock nuts against bar (5). Each bolt should be taken up an equal amount to maintain proper sprocket and chain alignment. This chain is properly adjusted when the clearance between the return bucket line chain and the cross brace on the chassis superstructure is from 4" to 6". At no time should the chain be allowed so much slack that the bucket lips on the return line scrape the return pans at any point as the pans will wear through very quickly if this condition exists. CAUTION: When the bucket line chain is tightened, the bucket line drive chain is also tightened. This should be checked for proper tension.

Bucket Line Drive Chain

This chain (19) figure 489 is in proper adjustment when the amount of sag in the chain from the take-up sprocket to the headshaft is not less than 1" or more than 3". The adjustment of this chain is accomplished by lifting the lock plates (10) away from the heads of the adjusting bolts (8). Take up on the bolts until the chain is in proper adjustment. Each bolt should be taken up an equal amount to maintain proper sprocket and chain alignment. Replace the lock plates (10) after adjusting.

LUBRICATION

Lubricate the bearings thoroughly before the machine is put into operation.

(465) Bucket Line and Buckets

PARTIAL REPAIRS

Any bucket may be removed from the bucket line (9G) figure 484 or any link may be replaced without complete disassembly of the bucket line.

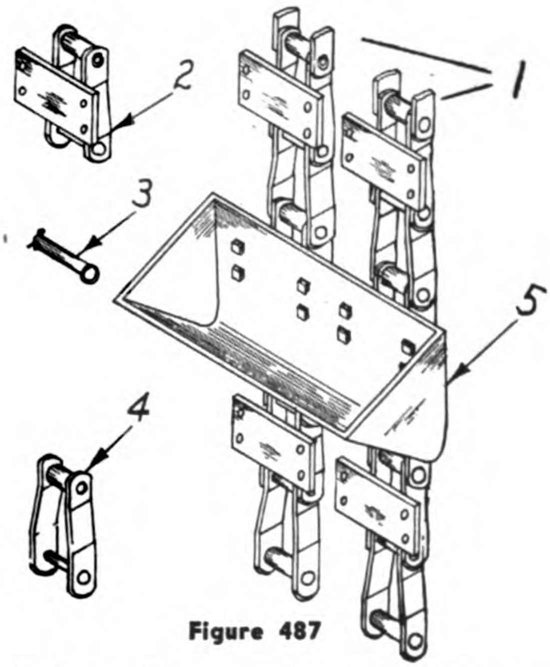


Figure 487

A bucket (5) figure 487 or number of buckets may be unbolted and removed from the chain.

The chain links (2), (4) may be replaced by slacking off the take up. Lash the chain ends so they will not fall, uncouple the bucket chains and remove the link or links to be replaced.

GENERAL OVERHAUL

The bucket line may be removed by several methods. One method is as follows: Remove the buckets from the chain. Tie a rope to each chain on down run side at the head sprocket. Slack off both take-up bolts. Uncouple the chain on discharge side of the head sprockets. Run the bucket line in idling speed and direct chain so it will travel down the swivel spout to the ground. When the end of the chain reaches the foot sprockets the ropes may be removed. Continue running bucket line until all the chain has run off the elevator. Inspection for replacement.

The bucket line may be inspected anytime so does not have to be disassembled for this purpose.

The bucket lips will wear more rapidly in abrasive materials. If the lips are badly worn they may be built up by welding with Stellite or equivalent.

The chain should be examined for excessive wear in the chain rollers, bushings and pins. Any links worn excessively or with rollers missing should be replaced at once.

ASSEMBLY

There are several methods used to install the bucket line. One method is to put chains over head sprockets first, then as sections of chain are added run the bucket line in idling speed and guide the down run side through the return dust pans until chains may be connected together at the foot sprockets.

ADJUSTMENT

See adjustment under the FOOT SHAFT AND SPIRAL ASSEMBLY.

LUBRICATION

None unless machine is to be stored, then refer to Chapter XXI, operator's manual.

BOOM IDLER SHAFT

(B/M 82-211-A)

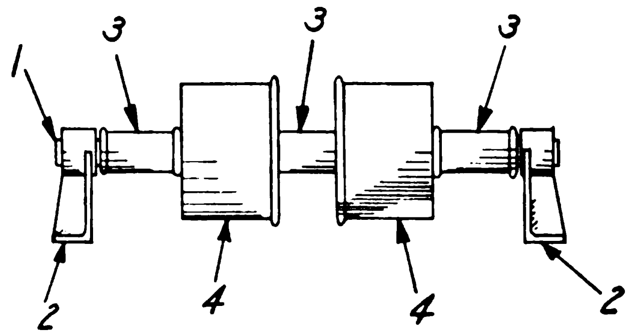


Figure 488

(466) Bucket Line Idlers

PARTIAL REPAIRS—None

GENERAL OVERHAUL

The bucket line idlers may be removed as follows:

(a) Block bucket off idler assembly which is to be removed.

(b) Remove grease pipe fittings which extend through skirt boards.

(c) Remove bolts from brackets (2) figure 488.

(d) Assembly may now be removed from elevator frame.

(e) Remove set screws which hold shaft (1) in brackets (2).

(f) Brackets (2) and shaft (1) may now be removed freeing flanged rollers (4) and spacers (3).

INSPECTION FOR REPLACEMENT

When the bore of the rollers or the shaft is worn excessively, replace. Particular attention should be given the grease rifling. Rollers with broken flanges should not be used again.

Spacers should be replaced if the length is decreased by wear as these determine the spacing of the rollers and prevent end play.

ASSEMBLY

The assembly is the reverse of the disassembly operation.

LUBRICATION

Grease thoroughly so the rifling is filled and the rollers are receiving lubricant before the machine is put into operation.

(467) Elevator Pivot Shaft

PARTIAL REPAIRS

The sprockets (5) figure 489, (6) shaft (7) and take up bolts (8) may be removed for replacement without removing the pivot shaft (1).

To remove these parts proceed as follows:

(a) Disconnect elevator drive chain (19).

(b) Take off collar (4).

(c) Remove bolts holding take up bracket (9) to elevator frame.

(d) Take up frame may now be removed releasing sprocket (5).

(e) Remove take up bolts (8) shaft (7) may be pulled out releasing sprocket (6).

Note: Sprocket (6), shaft (7) and take up bolts (8) may be removed without removing bracket.

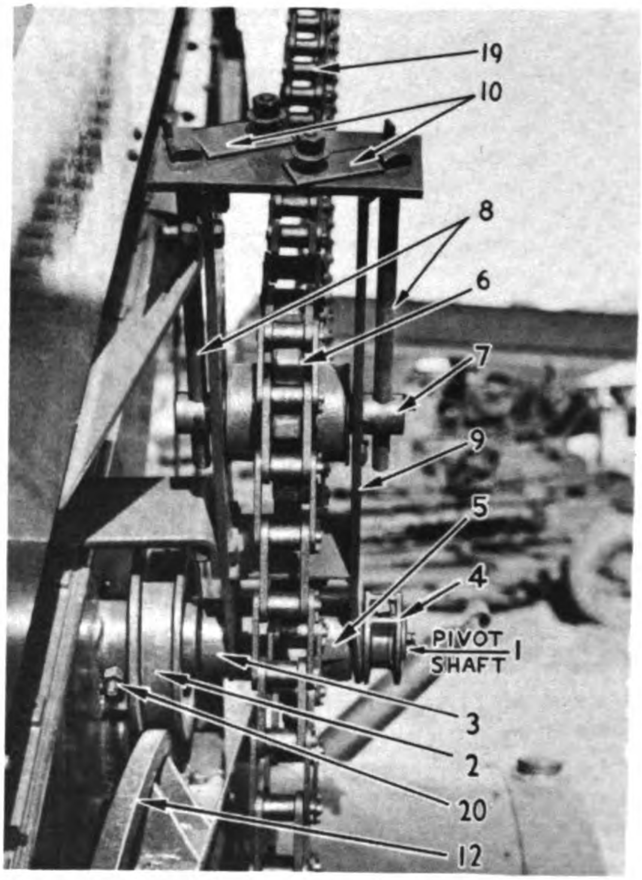


Figure 489

GENERAL OVERHAUL

To remove the pivot shaft proceed as follows:

(a) Lower spiral feed end of elevator to rest on 8″ high blocking on the ground and provide slack in hoist cables.

(b) Uncouple elevator drive chain (19), figure 489.

(c) Secure hoist sling around headshaft (8) figure 490 between sprockets (5) and collars (3). Hoist the head end up until the elevator rollers (2) figure 489 are clear of the curved track (12), on the superstructure frame. The elevator is now supported on the spiral end and by the sling at the head shaft and the Pivot Shaft (1) is free for removal.

(d) Remove set collar (4), and swivel spout control bracket, figure 492.

(e) Remove chain adjusting bracket (9) figure 489 releasing sprocket (5). The bracket which bolts to the elevator frame may be removed at this point, if desired, although the shaft (1) will slide out with this in place.

(f) Remove bolt (20) in hub of structural boom bracket and shaft will slide out, releasing boom rollers (2), collar (3) and bushed sprocket (5).

INSPECTION FOR REPLACEMENT

Rollers (2) should be replaced if the bore is worn excessively or the flanges are damaged.

Sprockets (5) and (6) may be rebushed and may be turned around if the teeth are worn.

Threads in shaft (7) should be examined. Spacer washers for sprocket (6) should be replaced if worn so thin that sprocket has excessive end play.

Shaft (1) should be replaced if worn excessively, particular attention should be given the grease rifling in this shaft.

ASSEMBLY

The assembly is the reverse of the disassembly operation.

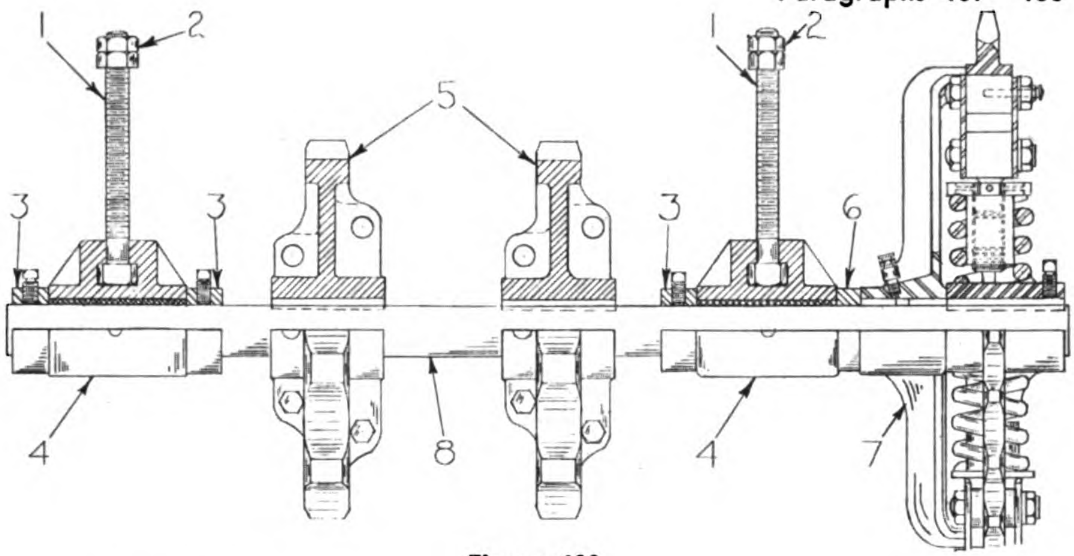


Figure 490

ADJUSTMENT

After assembly work is complete, adjust the bucket line drive chain as instructed under adjustments, "Footshaft and Spiral Assembly."

LUBRICATION

Lubricate sprocket (6). Be certain sprocket (5) is lubricated as grease rifling will have to be filled before sprocket (5) receives lubricant.

(468) Elevator Headshaft

PARTIAL REPAIRS

Certain repairs may be made to the head shaft assembly (9A) figure 484 without removing it from the elevator frame.

The overload release sprocket (7) figure 490, head sprockets (5), take up bearings (4) and bolts (1) fall into this category.

These parts may be removed for partial repairs as follows:

(a) Repairs to the headshaft assembly may be made with elevator in either working or horizontal position.

(b) Remove bucket line drive chain (19) figure 489.

(c) Loosen set screws and pull gib key (7) figure 491 from overload release sprocket hub (8).

(d) Release tension of springs (5) of overload release sprocket. Hub and sprocket (7) figure 490 may be pulled off shaft.

While overload release sprocket is removed the take up bearings (4) may be taken off by the following additional steps:

(e) Loosen take up bolts allowing headshaft to lower to the mimimum position.

(f) Remove take up bolts (1).

(g) Take out bolts (8) figure 486, bars (9), also collars (3) figure 490 and (6).

(h) Bearings (4) may be removed.

The bucket line sprockets (5) may be renewed or if the teeth are worn and sprockets are otherwise O. K. they may be interchanged without removing headshaft.

The sprockets may be removed as follows:

(i) Loosen take up bolts (1) figure 490 allowing headshaft (8) to lower to the minimum position.

(j) If work is to be done while boom is in working position, lash bucket line so when it is parted ends will not fall.

(k) Disconnect bucket line.

(l) Remove bolts in sprockets (5). The sprocket halves may now be removed. Keep sprockets as removed from shaft.

Assembly of these parts are the reverse of the disassembly operation.

GENERAL OVERHAUL

To remove the shaft assembly proceed as follows:

Refer to operation, (a), (b), (e), (f), (j), and (k).

(a) Take out bolts (8) and bars (9) figure 486.

(b) Remove plates (6) from both sides of headshaft.

The shaft may now be lifted from the elevator frame. If it is desired to make the headshaft assembly as light as possible the overload release sprocket, bearings and headshaft sprockets may be removed as directed under "Partial repairs," before removing the shaft from the elevator frame.

INSPECTION FOR REPLACEMENT

The bearings and shaft should be replaced if worn excessively. The threads of the take up bolts and nuts should be in good condition. The bucket line head sprockets may be interchanged or replaced if the teeth are hooked or worn to a point where they may interfere with the back of the bucket.

ASSEMBLY

The assembly is the reverse of the disassembly operation.

ADJUSTMENT

Adjust the bucket line chain and the bucket line drive chain as instructed under adjustment, "Footshaft and Spiral Assembly."

LUBRICATION

Lubricate the bearings and spring release sprocket thoroughly before the loader is put into operation.

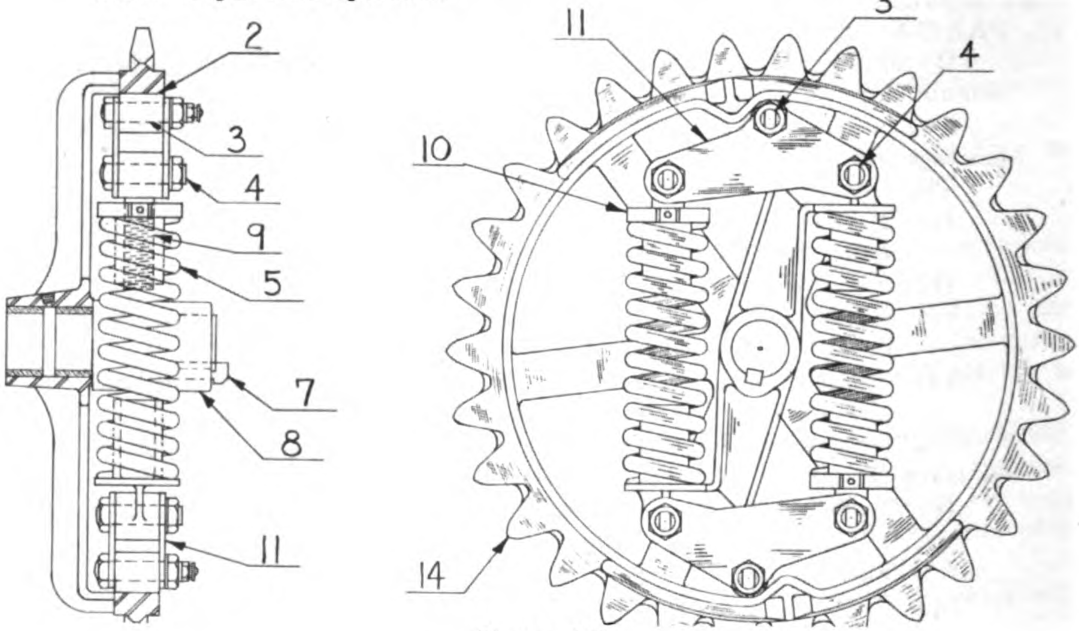


Figure 491

(469) Overload Release Sprocket

PARTIAL REPAIRS

The overload release sprocket (9B) figure 484 may be disassembled while on the headshaft or when the headshaft is removed. The disassembly and assembly are the same in either case.

GENERAL OVERHAUL

(a) Remove nuts from pivot pins (3) and (4) figure 491, roller plate assembly (11) and springs (5) will come off the carrier.

(b) Roller assembly may be taken apart by removing nut of roller pins (3) and pins (4) which hold pins to plates (11).

(c) Adjusting nut (10) threads on to eyebolt (9).

INSPECTION FOR REPLACEMENT

Sprocket (14) should be replaced if the teeth or cams, in the roller track, are worn excessively. The sprocket bushings are replaceable, if necessary.

Rollers (2), pins (3) and (4) should also be examined for excessive wear. The grease rifling should be unobstructed in the pins (3). The plates (11) must not be bent.

ASSEMBLY

The assembly is the reverse of the disassembly operation, but follow the adjustment section for the setting of the adjusting nuts.

ADJUSTMENT

Adjust the overload release sprocket as follows: Turn the nuts (10) down so that the springs (5) are snug, and set up the tension further by testing the loader on material. These springs should be set up equally, to the point at which the bucket line will handle its maximum load of material without the springs releasing the rollers from the cams inside the sprocket due to overload. NEVER set the springs so tight that the engine will kill roller track. If set up too tight, the loader loses its protection from damage when the machine is overloaded.

LUBRICATION

The sprocket and two pins of the overload release sprocket should be well lubricated before the machine is put into operation.

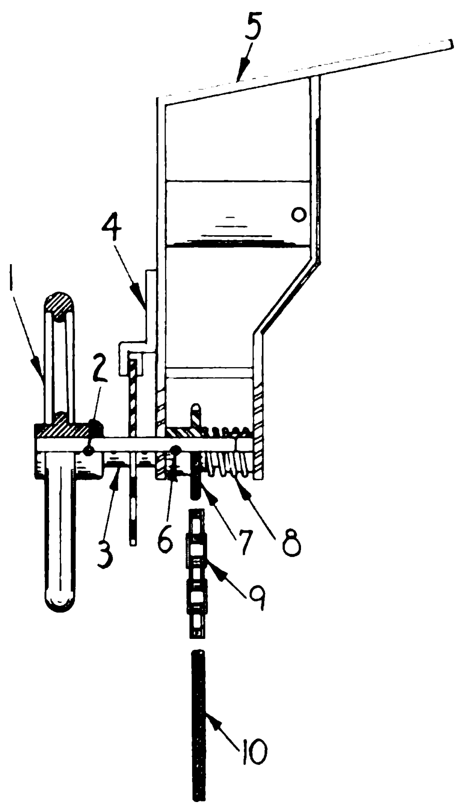


Figure 492

(470) Swivel Spout Control

PARTIAL REPAIRS

The chain (9) figure 492 and cable (10) may be removed without disassembly of the control unit.

Disconnect the cable clamps and loosen the U-bolts in the swivel spout sheave. The cable may now be taken off the sprocket of control assembly.

GENERAL OVERHAUL

Follow the above instructions then drive out pin (6). Remove handwheel catch (4). Handwheel with shaft may be pulled out releasing sprocket (7) and spring (8). Remove pin (2) and handwheel (1) may be removed from shaft (3).

INSPECTION FOR REPAIRS

Excessively worn parts should be replaced. If the shaft or ratchet is worn they both must be replaced, as the two make up a welded unit.

ASSEMBLY

The assembly is the reverse of the disassembly operation. Be certain both pins (2) and (6) are riveted. Have the swivel spout in the straight back position and chain in equal amount around sprocket (7) before U-bolts in the swivel spout sheave are tightened.

ADJUSTMENT

Adjust the cable taut with the turnbuckle. Lock the nuts on each end of the turnbuckle after the adjustment is completed.

LUBRICATION

Apply oil to each frame bearing which holds shaft (3).

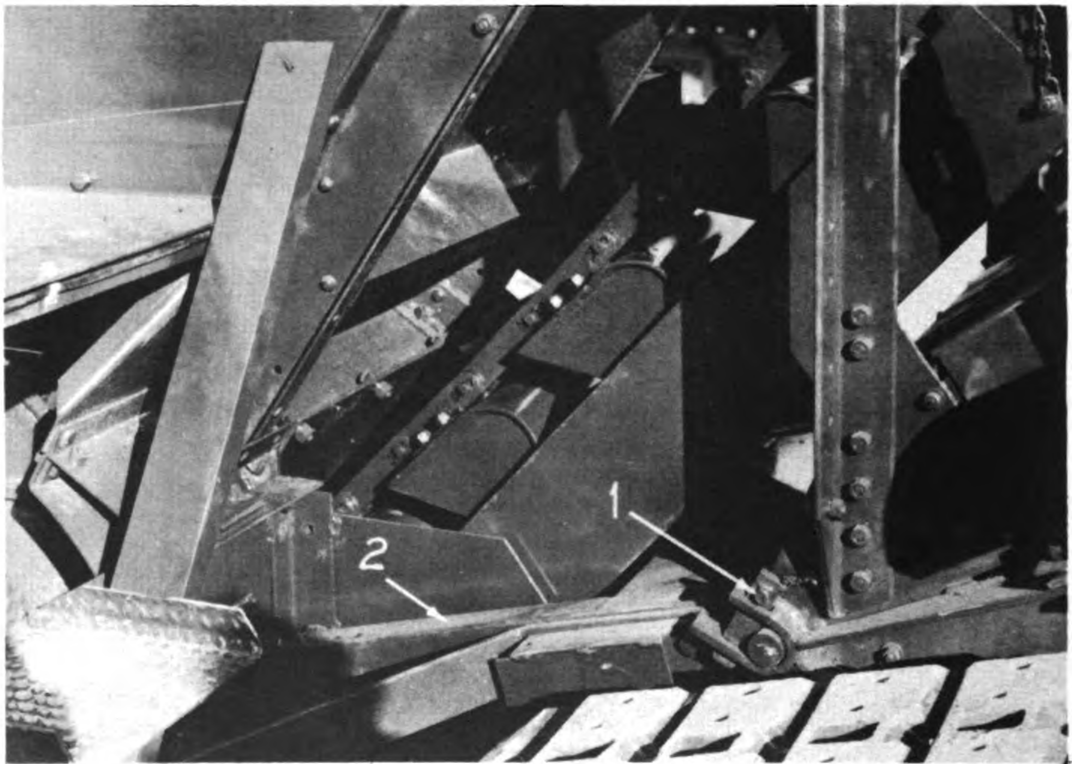


Figure 493

(471) Removal of Bucket Elevator

To facilitate extensive work on the chassis it may be desirable to remove the elevator. This may be accomplished by following the procedure outlined below:

(a) Follow the instructions (a), (b) and (c) "General Overhaul" (see Elevator Pivot Shaft), but do not remove the shaft.

(b) Uncouple the ends of the hoist cable on the superstructure (9) figure 494, and remove the cable from the sheaves (7) and (5) on the elevator.

(c) Remove pins (1) which secure push arms (2) figure 493 in "U" shaped brackets.

(d) Remove brace across front angles of superstructure.

(e) Now start the engine, and with master clutch disengaged shift the transmission to reverse. Shift the gear box to low speed and engage both crawler levers. With engine warmed up, set throttle to idling position. Engage the master clutch and the chassis may be run out and away from the elevator.

CAUTION: Be sure that the elevator has been hoisted high enough so pivot shaft rollers and swivel spout bracket will clear.

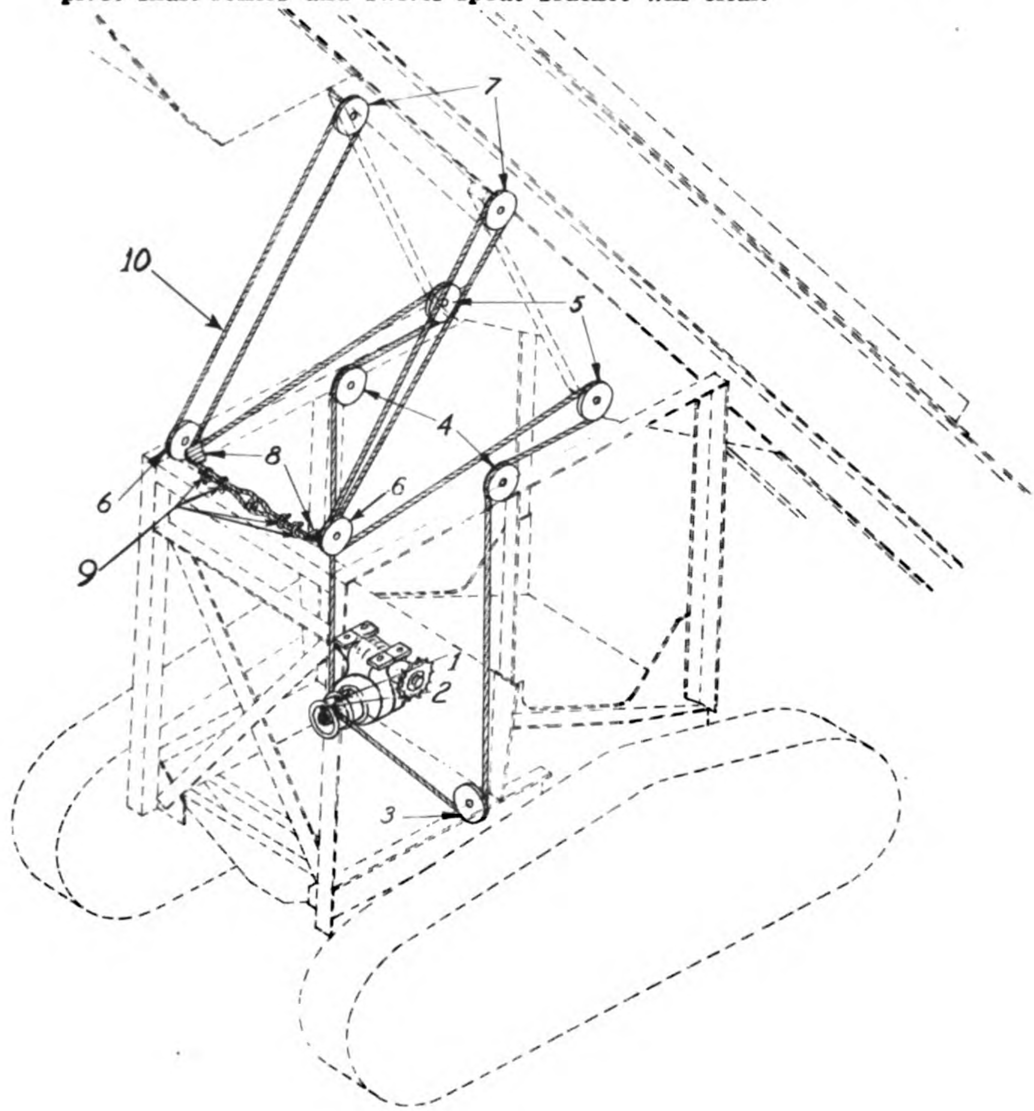


Figure 494

(472) Installing Hoist Cables

The double cable drum for the hoist is mounted between the engine and the front of the superstructure housing. The cable for the loader is furnished in one strand and is mounted in the following manner, with the elevator lowered to operating position:

(a) Run one end of the cable through the hole next to the inner flange (1) figure 494 in the hoist drum, then through inside the drum and out hole (2) next to the outer flange. Pull the cable across to sheave (3) on the superstructure frame on the side opposite the drum and run the cable under this sheave.

(b) Grasp cable near hole (2) and loop it over and around drum so that it leads from the top of drum to sheave (3). Run other end of cable so that it runs from hole (1) around the drum to be run up from the under side of the drum over sheave (4) on the superstructure frame above the drum. Run other cable end up from sheave (3) and over sheave (4). Now pull the ends of cable out from sheave (4) so that there is an equal amount of cable for each side of elevator.

(c) Each cable end is now reeved in the same manner on its respective side, from sheave (4), under and around sheave (5) on boom pivot bracket, under and up from sheave (6) on the top front of the superstructure frame, over and down from sheave (7) on the loader elevator, through holes at (8) along side sheave (6) and across the frame so that the ends meet and overlap about eighteen inches. Clamp ends securely together with two clamps (9).

(d) Now guide the cables, manually, so that they run evenly onto the drums, to remove the slack, as the hoist is operated. Adjust cable ends with clamps, as required, so that the cable to each side pulls the elevator up evenly.

PARTS CATALOG

for Barber-Greene Model 38D Snow Loader including Bucket Loader Elevator Attachment

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.

Machine Number

The machine number described below is located on the Main Frame above the operator's platform. This number helps the manufacturer to identify parts used in manufacturing any particular machine, and provides an accurate method of indicating any design changes that have been made.

Sample Machine Number Plate

The first number, 38D, indicates the Machine model. The last number, 38, indicates the schedule of manufacture in which the machine was built. The middle number, 1, indicates the number of the machine in that schedule of manufacture. The sample above is Model 38D and is the first machine manufactured in the 38th schedule. The next machine built will have machine number 38D-2-38. The next schedule will be 39 and the number of the first machine in that schedule will be 38D-1-39.

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 of authority, and date delivery is required, immediately below description of machine.

g. Group parts required under group headings as shown in manufacturer's parts catalogs.

h. State manufacturers' parts numbers and nomenclature descriptions accurately and completely. Do not use abbreviations.

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.

PREPARATION OF REQUISITIONS

Sample Copy for Use in the Preparation of Requisitions

Revision in QMC Form 400 for requisitioning spare parts are connned to new column headings. Until new forms are available all organizations are to continue using the present form and either type or write in corrections indicated in column headings.

Under revised heading "Nomenclature and Unit" list the article and the unit (ea for each: lb for pound, etc.). Under heading "Authorized or Maximum Level" list the authorized depot stock levels or organizational allowances given in Part III of the 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. For "Initial" and "Replenishment" requisitions, the sum of "Required", "Due In", and "On Hand", should equal the "Authorized or Maximum Level."

On this page is shown a sample 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. Additional information on this subject is contained in section AA-1 of Part III Engineers Supply Catalog, available from the Engineer Field Maintenance Office, P. O. Box 1679, Columbus, O.

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.

Give complete shipping instructions. Special instructions for packing, marking, routing, etc., should be given at the end of the requisition.

State proper nomenclature of machine, also make, model, machine serial number and U. S. A. registration number.

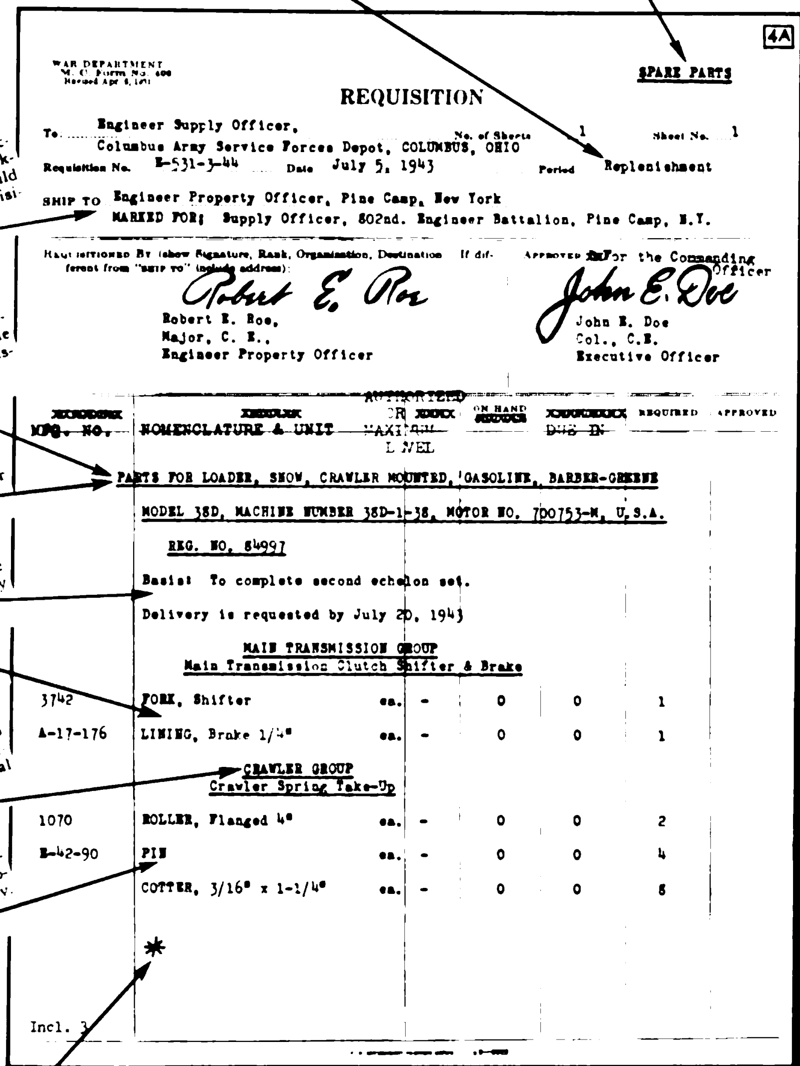
Prepare a separate requisition for each different machine

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 manufacturers' parts numbers and nomenclature descriptions accurately and completely. Do not use abbreviations.



WAR DEPARTMENT
Q. M. C. Form No. 400

4A

SPARE PARTS

REQUISITION

To: Engineer Supply Officer, Columbus Army Service Forces Depot, COLUMBUS, OHIO — No. of Sheets 1 — Sheet No. 1

Requisition No. E-531-3-44 — Date July 5, 1943 — Period Replenishment

SHIP TO Engineer Property Officer, Pine Camp, New York
MARKED FOR: Supply Officer, 802nd. Engineer Battalion, Pine Camp, N.Y.

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

Approved By: For the Commanding Officer
John E. Doe
John E. Doe
Col., C.E.,
Executive Officer

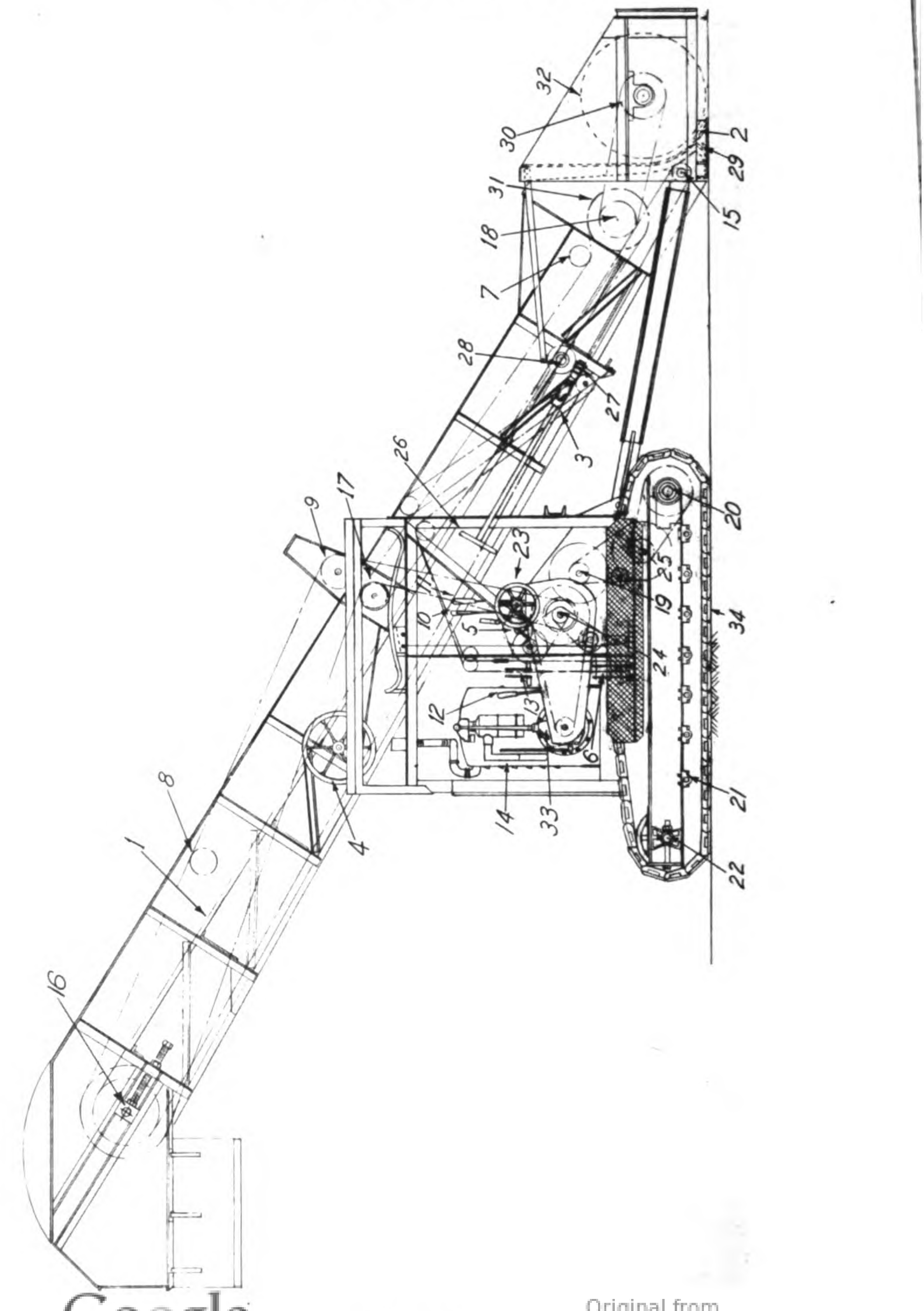
MFG. NO.	NOMENCLATURE & UNIT		AUTHORIZED OR MAXIMUM LEVEL	ON HAND	DUE IN	REQUIRED	APPROVED
	PARTS FOR LOADER, SNOW, CRAWLER MOUNTED, GASOLINE, BARBER-GREENE						
	MODEL 38D, MACHINE NUMBER 38D-1-38, MOTOR NO. 700753-M, U.S.A.						
	REG. NO. 84997						
	Basis: To complete second echelon set.						
	Delivery is requested by July 20, 1943						
	MAIN TRANSMISSION GROUP Main Transmission Clutch Shifter & Brake						
3742	FORK, Shifter	ea.	-	0	0	1	
A-17-176	LINING, Brake 1/4"	ea.	-	0	0	1	
	CRAWLER GROUP Crawler Spring Take-Up						
1070	ROLLER, Flanged 4"	ea.	-	0	0	2	
E-42-90	PIN	ea.	-	0	0	4	
	COTTER, 3/16" x 1-1/4"	ea.	-	0	0	8	
	*						

Incl. 3

*Nonexpendable items such as tools must be accounted for, when requisitioned, by a statement that they have been placed on RECORD OF SURVEY or STATEMENT OF CHARGES.

Emergency requisitions sent by telephone, telegraph or radio must always be confirmed immediately with requisition marked: "Confirming (state identifying data)."

Barber-Greene Model 38 Snow Loader
GRAPHIC CONTENTS



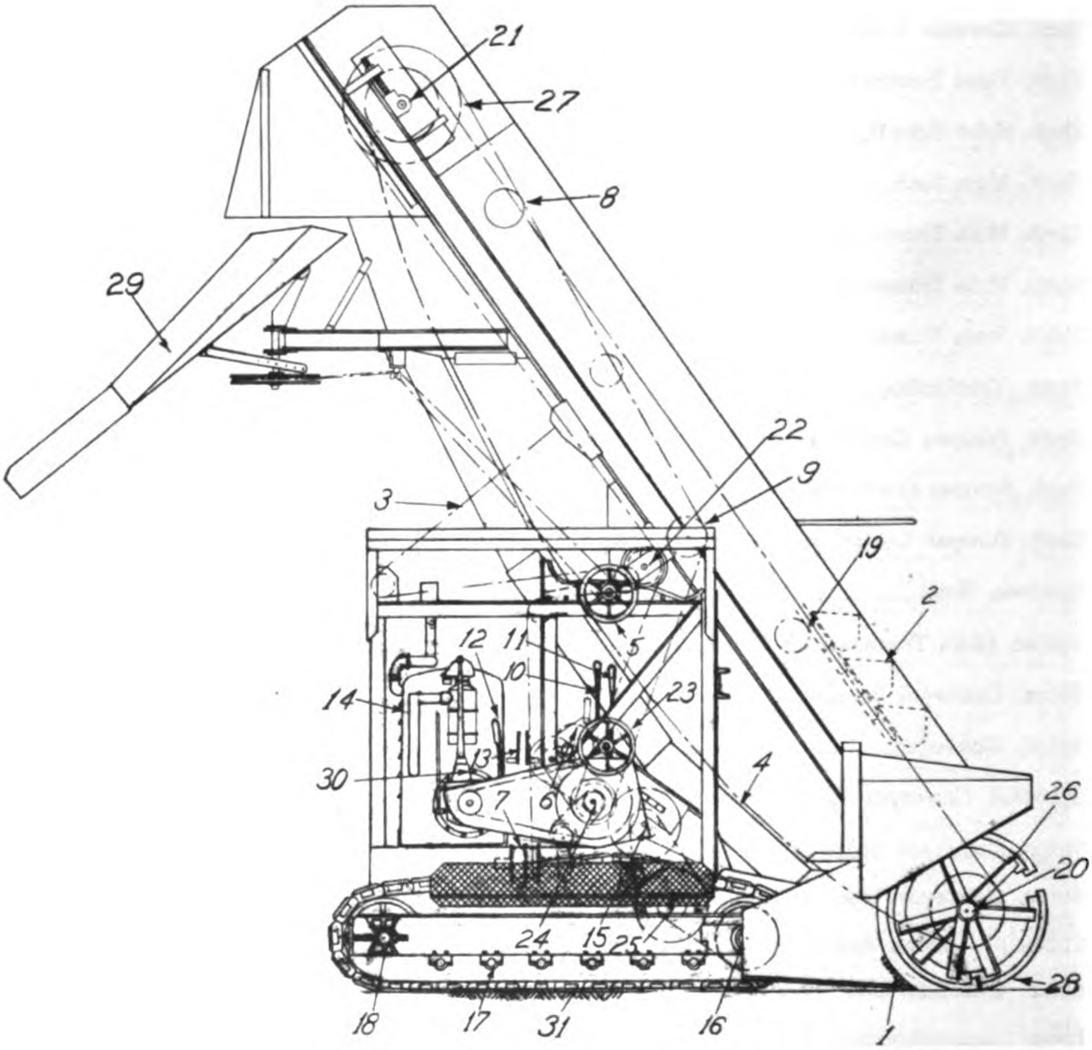
Alphabetical Index to Parts Section
38D Snow Loader

Alphabetical Index to Parts Section (cont'd)
38D Snow Loader

ENGINE (cont'd)

Alphabetical Index to Parts Section (cont'd)
38D Snow Loader

BARBER-GREENE MODEL 38D SNOW LOADER WITH BUCKET ELEVATOR ATTACHMENT OPERATING AS A BUCKET LOADER

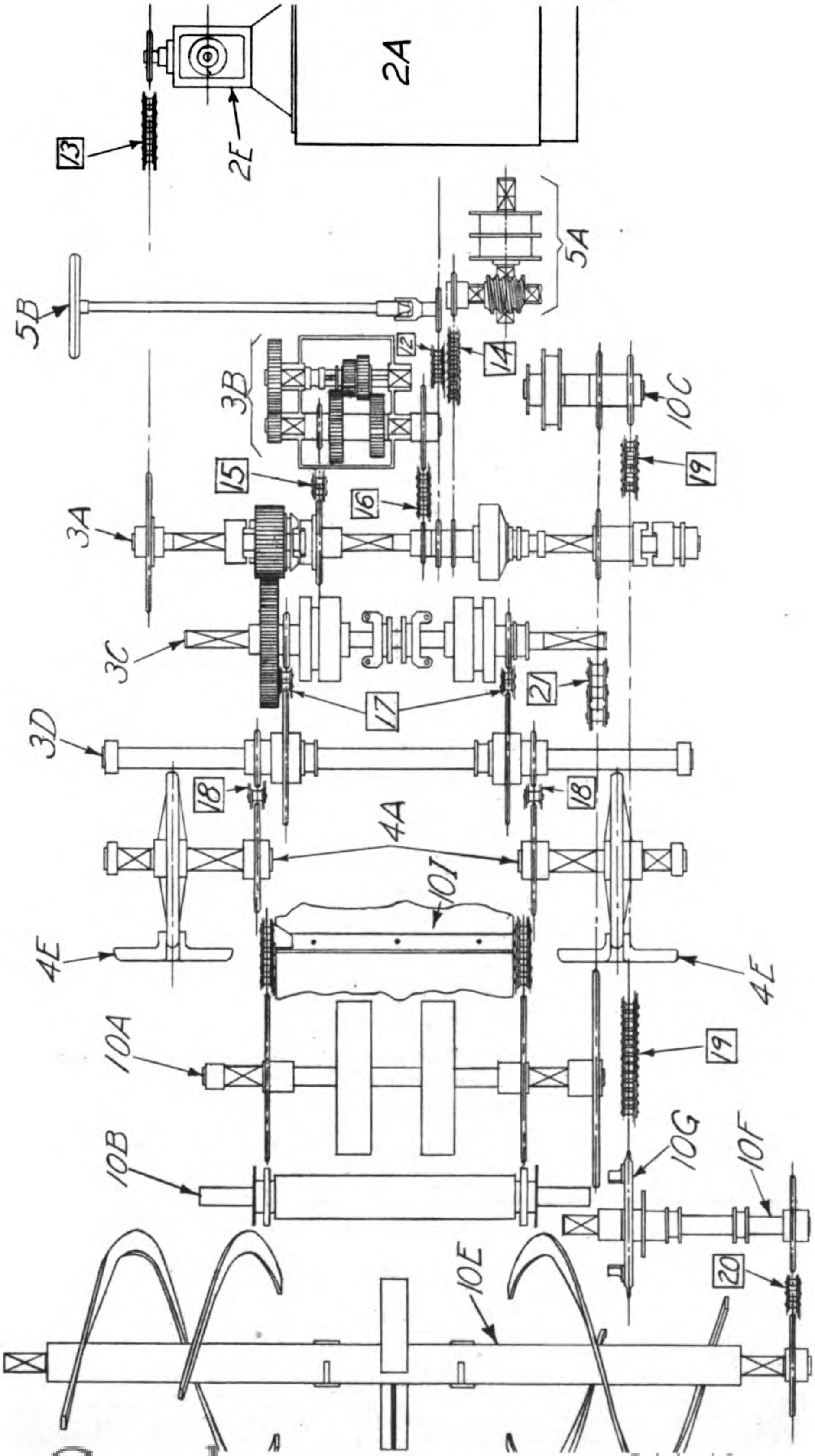


Alphabetical Index to Parts Section 38D Snow Loader with Bucket Elevator Attachment Operating as a Bucket Loader

Alphabetical Index to Parts Section
38D Snow Loader with Bucket Elevator Attachment Operating as a Bucket Loader

BARBER-GREENE MODEL 38D SNOW LOADER

Power Transmission Machinery



ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

SNOW LOADER DRIVE CHAINS

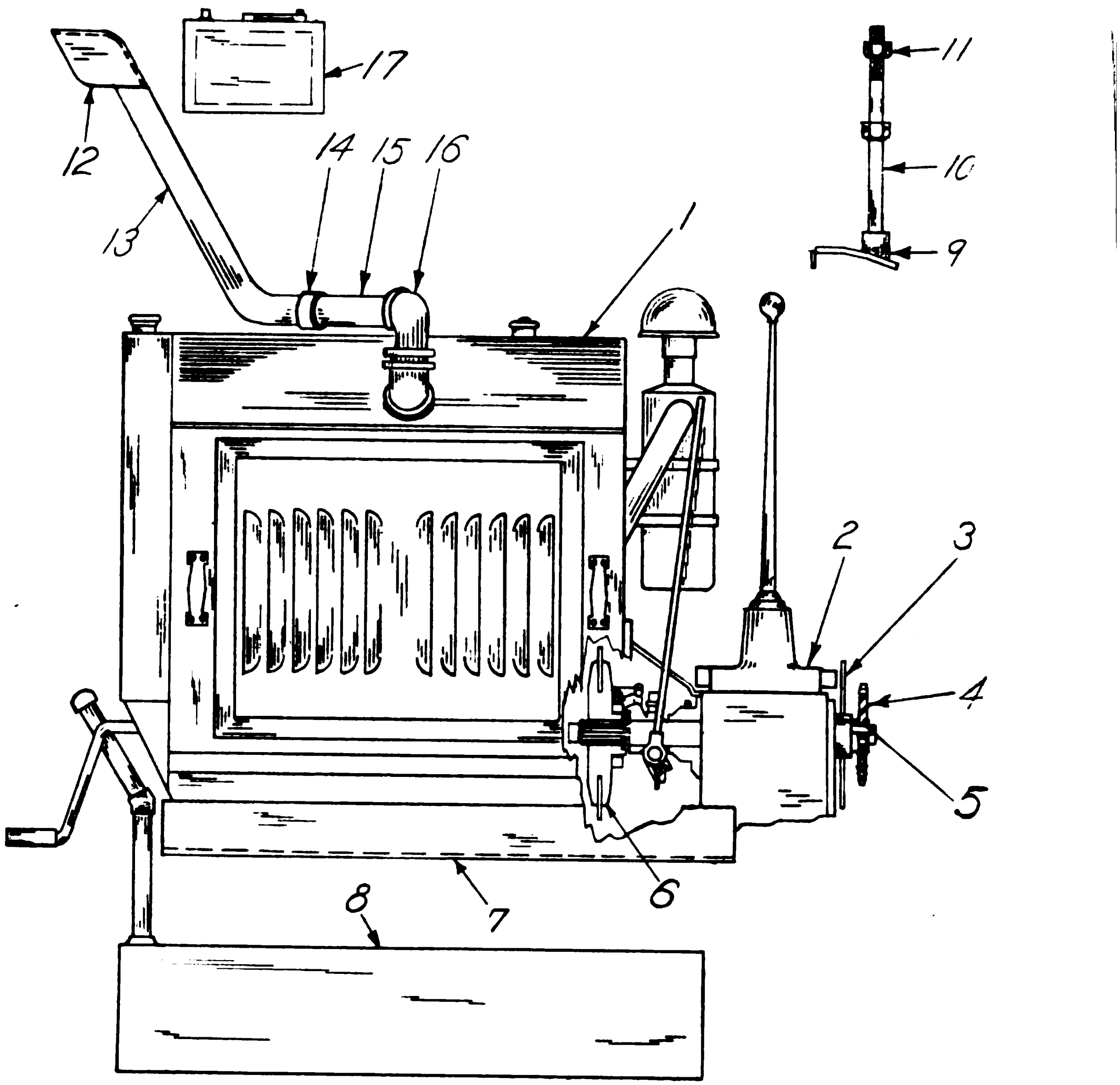
38-214-A5

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
12	AA-6-58C	1	Strand of Diamond #434 Chain, 1" Pitch, 26 Links and 1 Offset	
	A-6-58	13	Roller Link, Diamond #434 Chain, 1" Pitch	AA-6-58C
	B-6-58	13	Connecting Link, Diamond #434 Chain, 1" Pitch	AA-6-58C
	C-6-58	1	Offset Link, Diamond #434 Chain, 1" Pitch	AA-6-58C
13	BA-6-64C	1	Strand of Diamond #470 Chain, 1¼" Pitch, 76 Links	
	A-6-64	38	Roller Link, Diamond #470 Chain, 1¼" Pitch	BA-6-64C
	B-6-64	38	Connecting Link, Diamond #470 Chain, 1¼" Pitch	BA-6-64C
	C-6-64	1	Offset Link, Diamond #470 Chain, 1¼" Pitch	
14	KK-6-58C	1	Strand of Diamond #434 Chain, 1" Pitch, 36 Links & 1 Offset	
	A-6-58	18	Roller Link, Diamond #434, 1" Pitch	KK-6-58C
	B-6-58	18	Connecting Link, Diamond #434 Chain, 1" Pitch	KK-6-58C
	C-6-58	1	Offset Link, Diamond #434 Chain, 1" Pitch	KK-6-58C
15	KK-6-64C	1	Strand of Diamond #470 Chain, 1¼" Pitch, 36 Links & 1 Offset	
	A-6-64	18	Roller Link, Diamond #470 Chain, 1¼" Pitch	KK-6-64C
	B-6-64	18	Connecting Link, Diamond #470 Chain, 1¼" Pitch	KK-6-64C
	C-6-64	1	Offset Link, Diamond #470 Chain, 1¼" Pitch	KK-6-64C
16	XX-6-58C	1	Strand of Diamond #434 Chain, 1" Pitch, 48 Links	
	A-6-58	24	Roller Link, Diamond #434 Chain, 1" Pitch	XX-6-58C
	B-6-58	24	Connecting Link, Diamond #434 Chain, 1" Pitch	XX-6-58C
	C-6-58	1	Offset Link, Diamond #434 Chain, 1" Pitch	
17	AH-6-64C	2	Strand of Diamond #470 Chain, 1¼" Pitch, 56 Links & 1 Offset	

(continued on next page)

Snow Loader Drive Chains—(Cont'd)

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
	A-6-64	56	Roller Link, Diamond #470 Chain, 1¼" Pitch	AH-6-64C
	B-6-64	56	Connecting Link, Diamond #470 Chain, 1¼" Pitch	AH-6-64C
	C-6-64	2	Offset Link, Diamond #470 Chain, 1¼" Pitch	AH-6-64C
18	GG-6-91C	2	Strand of Diamond #478 Chain, 2" Pitch, 32 Links & 1 Offset	
	A-6-91	32	Roller Link, Diamond #478 Chain, 2" Pitch	GG-6-91C
	B-6-91	32	Connecting Link, Diamond #478 Chain, 2" Pitch	GG-6-91C
	C-6-91	2	Offset Link, Diamond #478 Chain, 2" Pitch	
19	JK-6-58C	1	Strand of Diamond #434 Chain, 1" Pitch, 284 Links & 1 Offset	
	A-6-58	142	Roller Link Diamond #434 Chain, 1" Pitch	JK-6-58C
	B-6-58	142	Connecting Link, Diamond #434 Chain, 1" Pitch	JK-6-58C
	C-6-58	1	Offset Link, Diamond #434 Chain, 1" Pitch	JK-6-58C
20	BH-6-64C	1	Strand of Diamond #470 Chain, 1¼" Pitch, 82 Links	
	A-6-64	41	Roller Link, Diamond #470 Chain, 1¼" Pitch	BH-6-64C
	B-6-64	41	Connecting Link, Diamond #470 Chain, 1¼" Pitch	BH-6-64C
	C-6-64	1	Offset Link, Diamond #470 Chain, 1¼" Pitch	
21	FG-6-116C	1	Strand of Baldwin #0508 Chain, 2.62" Pitch, 180 Links & 1 Offset	
	A-6-116	90	Roller Links, Baldwin #0508 Chain, 2.62" Pitch	FG-6-116C
	B-6-116	90	Connectig Links, Baldwin #0508 Chain, 2.62" Pitch	FG-6-116C
	C-6-116	1	Offset Link, Baldwin #0508 Chain, 2.62" Pitch	FG-6-116C



POWER UNIT

From 552-71-A, 82-192-Q
82-192-K, 82-192-M

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	EN-B-A9	1	Engine, Buda, HP-217 (For details see "Engine")	
	R1-456	2	Flat Head Cap Screw, Nut, & Lock Washer, 5/8" x 2½"	
	R1-453	2	Flat Head Cap Screw, Nut, & Lock Washer, 5/8" x 1¾"	
2	53-153-A	1	Transmission, Main, Fuller SU (For details, see "Main Transmission")	
	R1-494	12	Hex. Head Cap Screw, Lockwasher 3/8" x 1"	
3	D1-82-125	1	Seal	
	O-82-125	1	Seal	

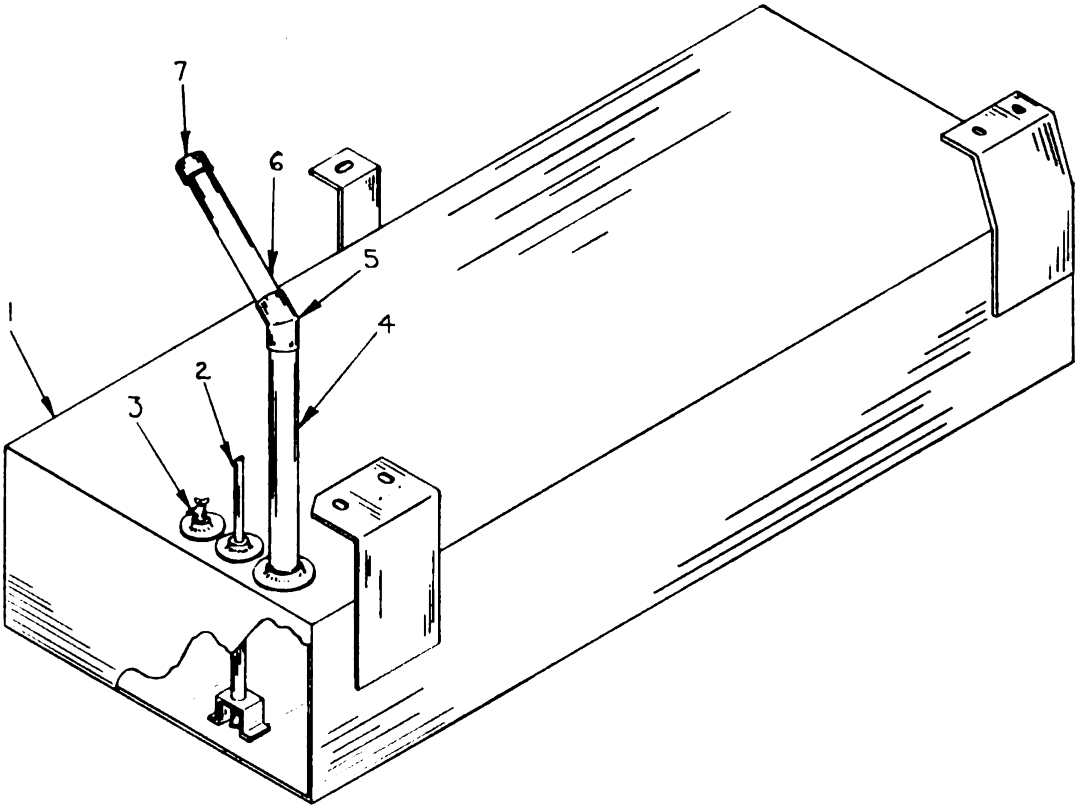
(continued on next page)

POWER UNIT—(concluded)

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No
4	A-19-725	1	Sprocket, 16-Tooth	
5	A-17-32	1	Key	
6	CL-TD-A3	1	Clutch, Master Twin Disc Model CS-110 (For details, see "Master Clutch")	
	R1-494	8	Hex. Head Cap Screw and Lock-washer, ⅜" x 1"	
	J-82-193W	1	Lever	
	U-17-30	1	Key	
	A(R)-82-193	1	Sill (Far Side)	
7	A(L)-82-193	1	Sill (Near Side)	
	R1-290	4	Machine Bolt, Nut, Lock Washer, & 2 Cut Washer, ⅝" x 1¾"	
8	F-82-218W	1	Tank, Gasoline	
9	E-82-193W	1	Pad, Take-Up	
10	G-82-193W	1	Screw, Take-Up	
11	R1-794	1	Hex. Nut, 1"	
12	A-552-71W	1	Hood, Exhaust	
	R1-124	2	Machine Bolt, Nut, & Lock Washer, ½" x 1¼"	
	E-552-71	1	Clamp	
	R1-214	2	Machine Bolt, Nut, Lock Washer, & Cut Washer, ⅜" x 1¼"	
13	HO-PD-G1	1	Hose, Flexible	
14	D-552-71	1	Clamp	
	R1-104	1	Machine Bolt, Nut, & Lock Washer, ⅜" x 1½"	
15	M-17-126	1	Pipe	
16	R1-726	1	Elbow, Street, 1½"	
	R1-350	1	Bushing, Reducer, 2" to 1½"	
	R1-727	1	Elbow, Street, 2" x 90°	

BATTERY
From 82-197-D or 82-197-F

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
	R1-593	1	Conduit, Flexible, EL-CE-A1, ½" x 10'-0"	
	R1-403	1	Cable, Starting, #0 x 10½"	
	EL-WT-C2	1	Terminal, Negative Battery	
	EL-WT-BO	2	Lug, Copper Cable, #0	
	R1-404	1	Cable, Starting, #0 x 11'-0"	
	EL-WT-C1	1	Terminal, Positive Battery	
17	EL-BA-C1	1	Battery, 6V-17 Plate	



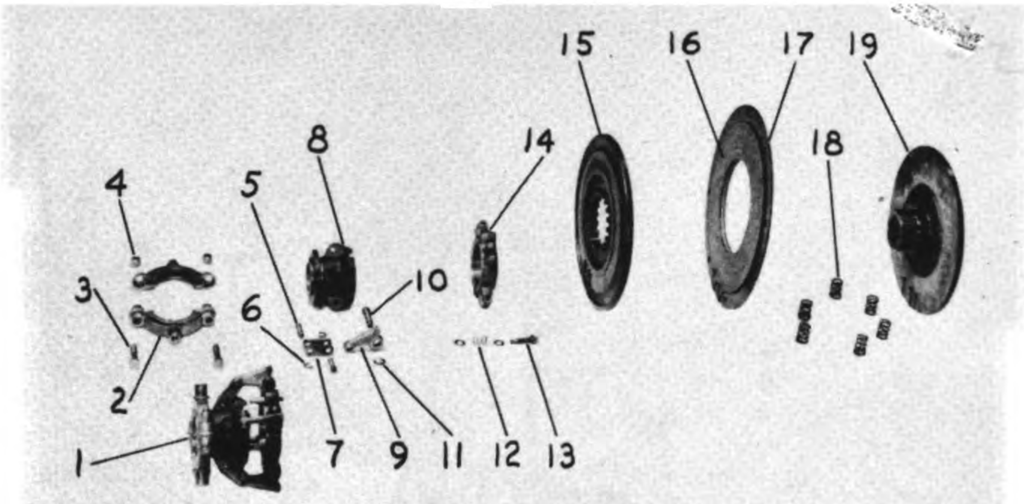
GASOLINE TANK
82-218-D

Ref. No	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	F-82-218W	1	Tank, Gasoline	
	R1-717	1	Elbow, Street, ⅛" x 90°	
2	R1-1092	1	Tubing, Steel, Copper Coated, 5/16" x 6'-6"	
3	R1-826	1	Pet Cock, ¼"	
4	GG-17-125	1	Pipe	
5	F-17-202W	1	Elbow	
6	J-17-125	1	Pipe	
7	D-17-45	1	Cap, Gasoline	
	C-46-100S	1	Coupling, Utility	
	R1-718	1	Elbow, Street, ¼" x 90°	
	R1-871	1	Plug, Pipe, 1¼"	
	69-F	1	Elbow, 5/16"	
	G-82-218	2	Strap, 24 Ga.	
	R1-124	2	Machine Bolt, Nut & Lock Washer, ½" x 1¼"	
	R1-223	3	Machine Bolt, Nut, Lock Washer, Cut Washer, ½" x 1¼"	

MASTER CLUTCH

Twin Disc Type X5738—Model CS-110

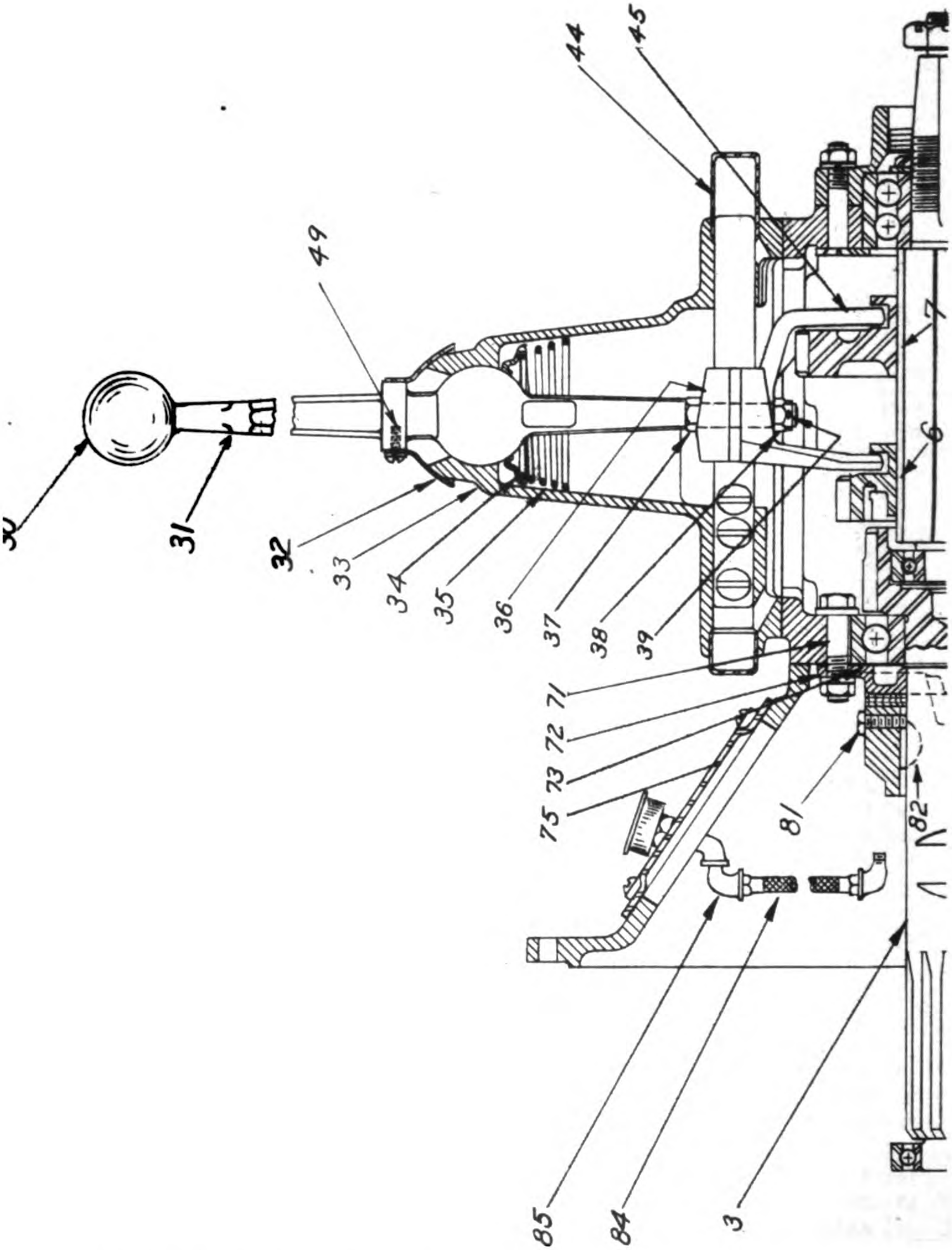
Specification No. 15308
Barber-Greene Specification, CL-TD-A3



*These are Twin Disc Clutch Company part numbers.

Ref. No.	*Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	S-390	1	Sliding Sleeve Assembly	
2	117-C-8-S	1	Cone Collar	S-390
3	M649	2	Bolt	117-C-8-S
4	M645	2	Nut	117-C-8-S
	120-C-8	2	Shim	117-C-8-S
5	1968A	4	Lever Link Pin	S-390
	1871A	4	Lever Link Pin	S-390
6	M642	8	Snap Ring	S-390
	1395	8	Washers	S-390
7	2611	8	Lever Link	S-390
8	2137B	1	Sliding Sleeve	S-390
	A-60	1	Adjusting Yoke Assembly	
9	103F	4	Finger Lever	A-60
10	106A	4	Finger Lever Pin	A-60
11	M641	4	Snap Ring	A-60
12	115	1	Adjusting Lock Pin Spring	A-60
13	2245	1	Adjusting Lock Pin	A-60
14	1990	1	Adjusting Yoke	A-60
15	5752	1	Floating Plate	
	0116B-10	1	Driving Plate Assembly	
16	112B-10	2	Friction Discs	O116B-10
	M115	12	Tubular Rivets	O116B-10
17	116B-10	1	Driving Plate	O116B-10
18	A1069	6	Release Springs	
19	Z5747E	1	Hub and Back Plate	
	A1706	1	Instruction Plate	
	M422	4	Drive Pins	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



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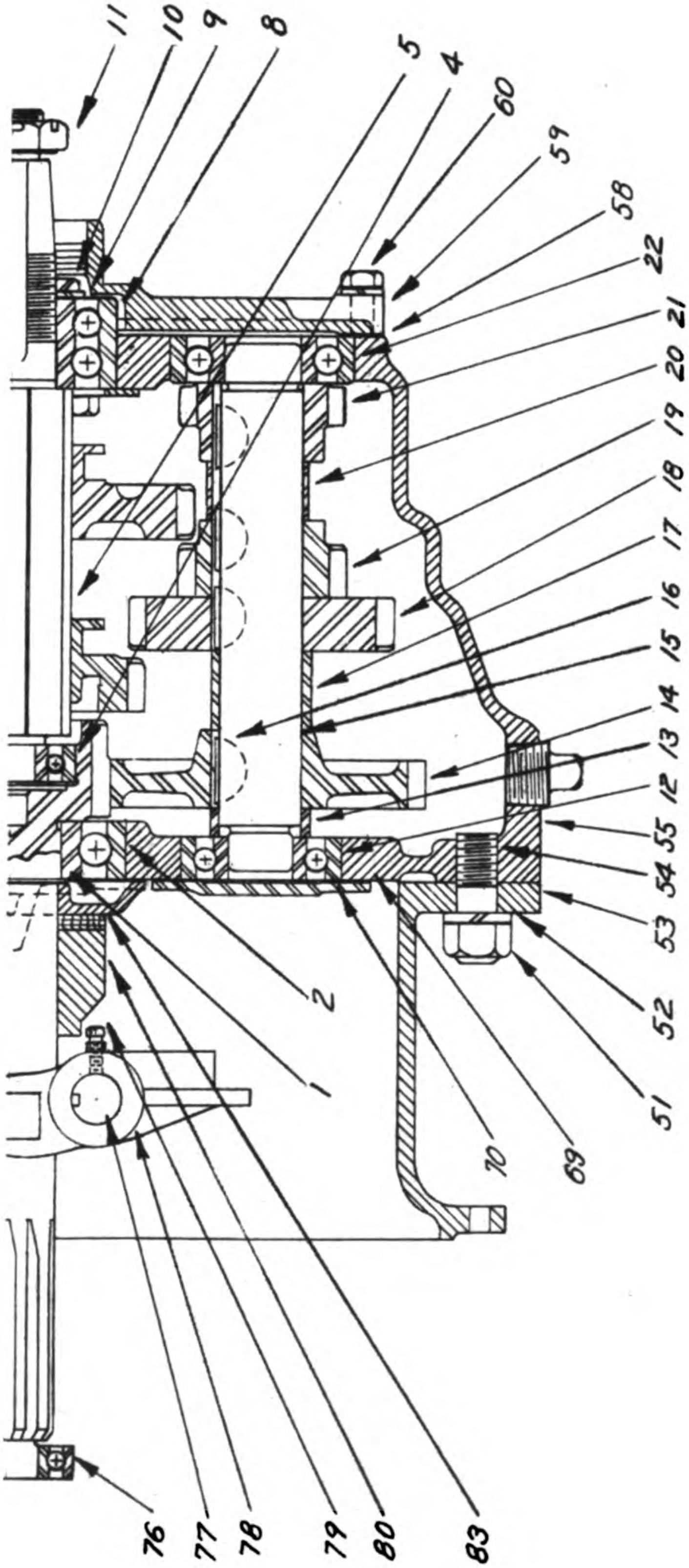

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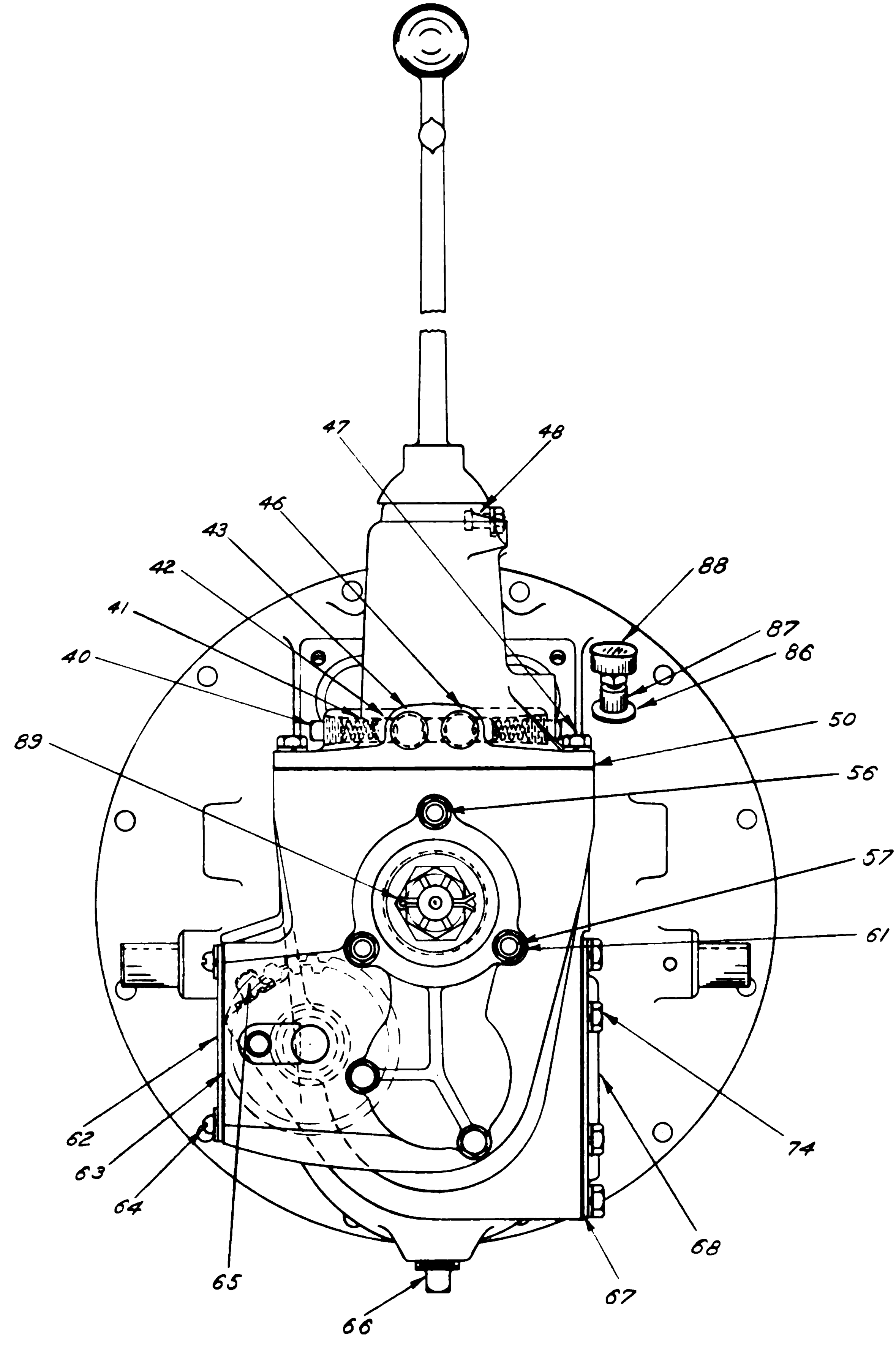

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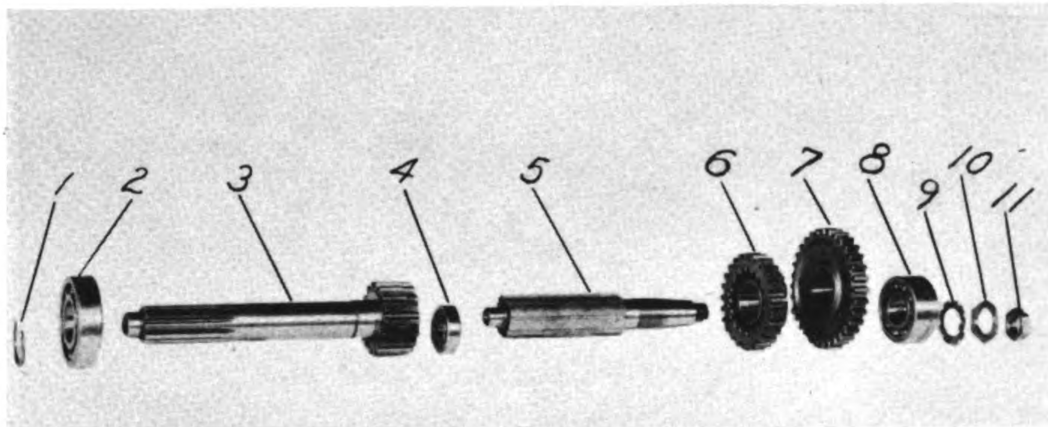
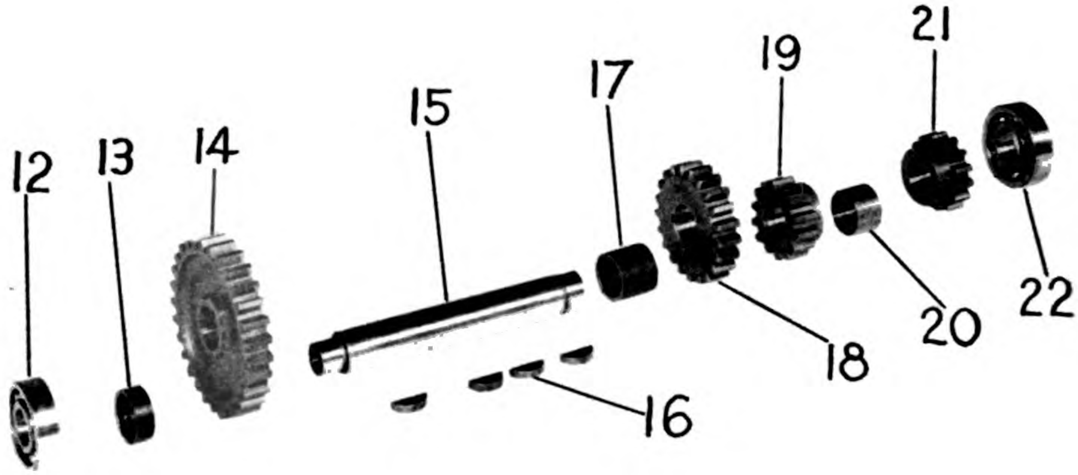


MAIN TRANSMISSION MAIN SHAFT
From 53-153-A

*These are Fuller & Sons Mfg. Company part numbers.

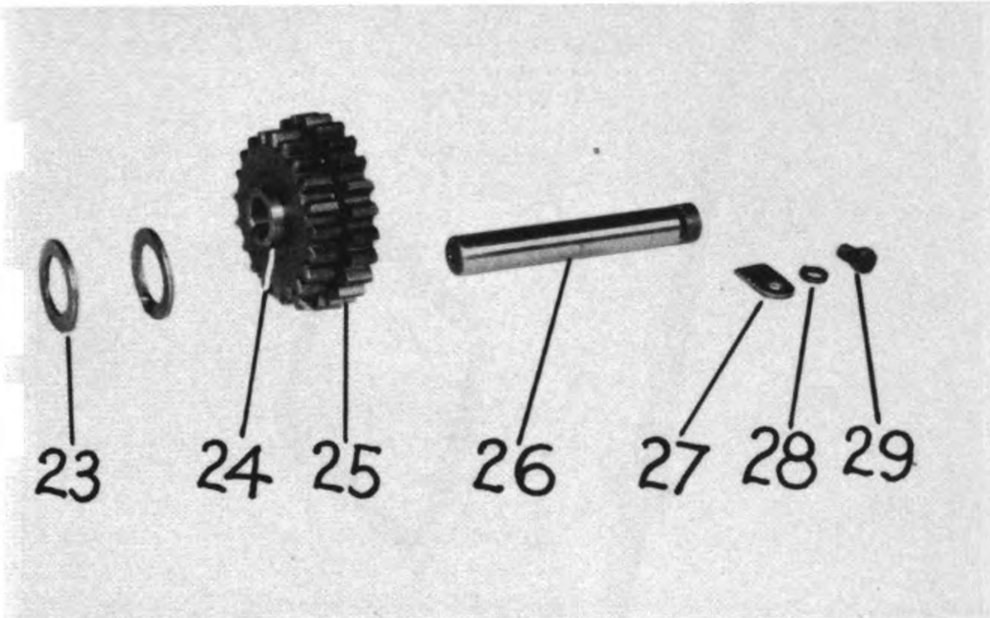
Ref. No.	*Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	2765	1	Drive Gear Bearing Snap Ring	
2	308SF	1	Drive Gear Ball Bearing	
3	6389	1	Drive Gear & Clutch Shaft	
4	304M	1	Mainshaft Pilot Ball Bearing	
5	2407	1	Splined Main Shaft	
6	2026	1	High Speed Sliding Gear	
7	1734	1	Low & Reverse Mainshaft Sliding Gear	
8	5307	1	Mainshaft Rear Double Row Ball Bearing	
9	2409	1	Lock Nut Clip	
10	2408	1	Lock Nut	
11	1846	1	Main Shaft Castle Nut	



MAIN TRANSMISSION COUNTER SHAFT
From 53-153-A

*These are Fuller & Sons Mfg. Company part numbers.

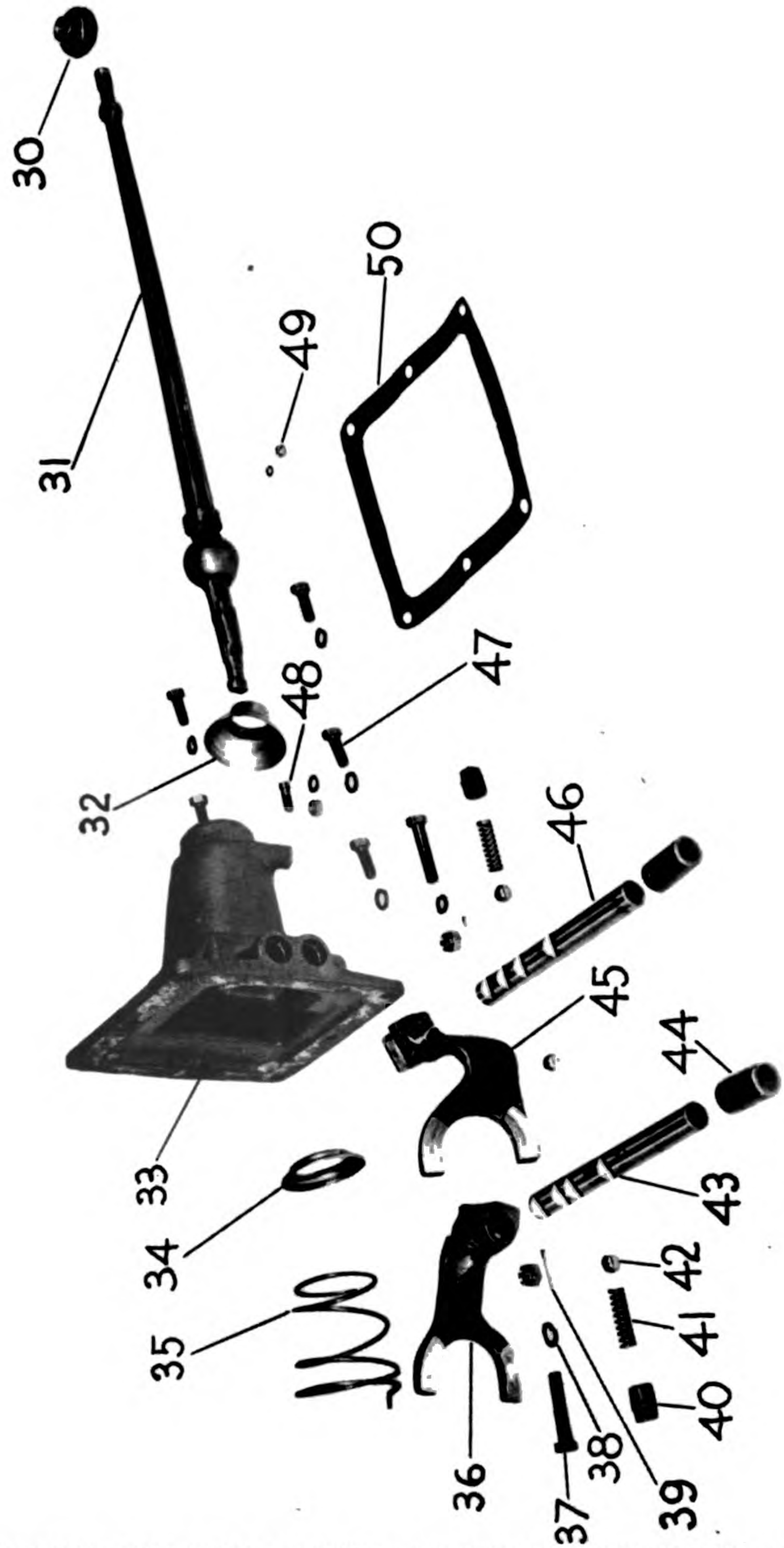
Ref. No.	*Part Number	Number Required	DESCRIPTION	Part of Assem. No.
12	305M	1	Countershaft Front Ball Bearing	
13	1738	1	Countershaft Bearing Spacer	
14	1045	1	Countershaft Drive Gear	
15	1157	1	Counter Shaft	
16	X-6-18	4	#18 Woodruff Key	
17	1018	1	Countershaft Drive & 2nd Speed Gear Spacer	
18	2027	1	Countershaft 2nd Speed Gear	
19	1042	1	Countershaft Low Speed Gear	
20	2002	1	Low & Reverse Gear Spacer	
21	2001	1	Countershaft Reverse Speed Gear	
22	306S	1	Countershaft Rear Ball Bearing	



MAIN TRANSMISSION IDLER SHAFT
From 53-153-A

*These are Fuller & Sons Mfg. Company part numbers.

Ref. No.	*Part Number	Number Required		DESCRIPTION	Part of Assem. No.
23	1059	2		Reverse Idler Shaft Thrust Washer	
	A-241	1		Reverse Gear & Bushing Assembly	
24	1184		1	Reverse Gear Bushing	A-241
25	2000		1	Reverse Idler Gear	A-241
26	1641	1		Reverse Idler Shaft	
27	1638	1		Reverse Idler Shaft Lock	
28	X-3-600	1		Lock Washer, 3/8"	
29	X-8-600	1		Hex. Head Cap Screw, 3/8"—16 x 1"	

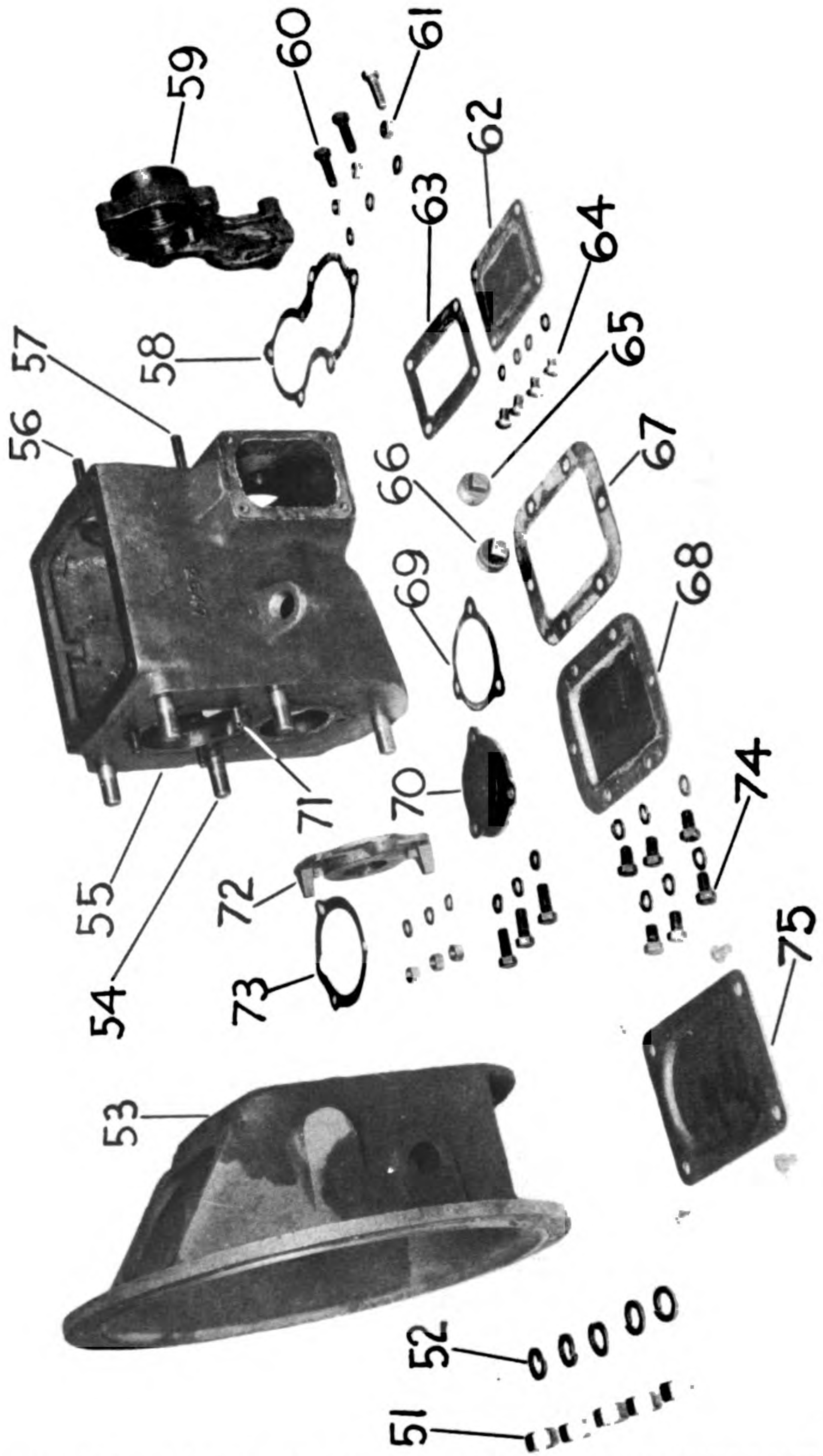


ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

MAIN TRANSMISSION GEARSHIFT LEVER
From 53-153-A

*These are Fuller & Sons Mfg. Company part numbers.

Ref. No.	*Part Number	Number Required	DESCRIPTION	Part of Assem. No
30	1075	1	Gearshift Lever Ball	
31	1392	1	Gearshift Lever	
32	2962	1	Gearshift Lever Bell	
	2401	1	Brake Shaft Hole Plug	
33	2534	1	Center Control Cover	
34	2538	1	Gearshift Lever Washer	
35	2536	1	Gearshift Lever Spring	
36	1280	1	High Speed Shifting Yoke	
37	X-7-601	2	Hex. Head Bolt, 3/8"– 24 x 3/4"	
	X-2-600	2	S.A.E. Castle Nut, 3/8"—24	
38	X-3-600	8	Lock Washer, 3/8"	
39	X-4-306	2	Cotter Pin, 3/32" x 1 3/4'	
40	X-12-601	2	Pipe Plug, 3/8"	
41	1064	2	Position Finder Spring	
42	X-14-800	3	Steel Ball, 1/2"	
43	1257	1	High Speed Yoke Bar	
44	2947	2	Long Thimble for Yoke Bar Hole	
	2939	2	Short Thimble for Yoke Bar Hole	
45	1999	1	Low & Reverse Speed Shifting Yoke	
46	2004	1	Low & Reverse Yoke Bar	
47	X-8-600	6	Hex. Head Cap Screw, 3/8"—16 x 1"	
48	2271	1	Gearshift Lever Pivot Pin	
	X-3-500	1	Lock Washer, 5/16"	
	X-1-500	1	S.A.E. Nut, 5/16"—24	
	X-3-302	1	Lock, Washer, #12	
49	X-8-251	1	Round Head Machine Screw, #12—24 x 1/2"	
50	1251	1	Center Control Cover Gasket	

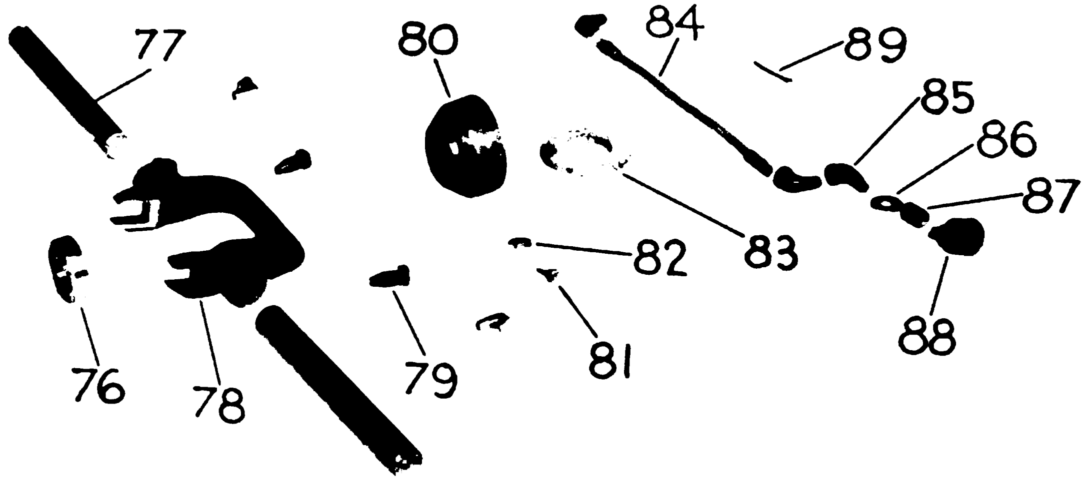


ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

MAIN TRANSMISSION CASE AND CLUTCH HOUSING
From 53-153-A

*These are Fuller & Sons Mfg. Company part numbers.

Ref. No.	*Part Number	Number Required	DESCRIPTION	Part of Assem. No.
	A-303	1	Case & Clutch Housing Assembly	
51	X-1-1000	5	S.A.E. Nut, ⅝"—18	A-303
52	X-3-1000	5	Lockwasher, ⅝"	A-303
53	3426	1	Clutch Housing, #4 Flange	A-303
54	1632	5	Clutch Housing Stud	A-303
55	2547	1	Transmission Case	A-303
56	X-7-616	1	Flat Head Bolt, ⅜"—24 x 2⅝"	
57	X-7-613	2	Hex. Head Bolt, ⅜"—24 x 2¾"	
	1633	3	Bearing Retainer Washer	
58	2212	1	Rear Bearing Cover Gasket	
59	6161	1	Rear Bearing Cover	
60	X-8-602	2	Hex. Head Cap Screw, ⅜"—16 x 1½"	
61	X-1-600	6	S.A.E. Nut, ⅜"—24	
	X-3-600	15	Lock Washer, ⅜"	
62	1512	1	Reverse Idler Cover	
63	1513	1	Reverse Idler Cover Gasket	
	X-3-500	4	Lock Washer, 5/16"	
64	X-8-509	8	Fillister Head Cap Screw, 5/16"—18 x ½" U.S.S.	
65	X-12-1201	1	Pipe Plug, ¾" (Filler)	
66	X-12-1202	1	Pipe Plug, ¾" Special (Drain)	
67	1684	1	P.T.O. Cover Gasket	
68	2840	1	P.T.O. Opening Cover	
69	1051	1	Countershaft Front Bearing Cover Gasket	
70	1149	1	Countershaft Front Bearing Cover	
71	X-7-610	3	Hex. Head Bolt, ⅜"—24 x 1¾"—K.B.	
	2720	1	Mainshaft Rear Bearing Retainer Plate	
72	2356	1	Front Bearing Cover & Clutch Stop	
73	2381	1	Front Bearing Cover Gasket	
74	X-8-606	6	Hex Head Cap Screw, ⅜"-16 x ⅝"	
	X-8-600	3	Hex Head Cap Screw, ⅜"-16 x 1"	
75	1565	1	Clutch Hand Hole Cover	
	1956	1	Name & Number Plate	
	X-13-206	2	"Z" Type Self-Tapping Screw, #7 x 5/16"	
	1819	1	Locking Wire for Yoke Screw	

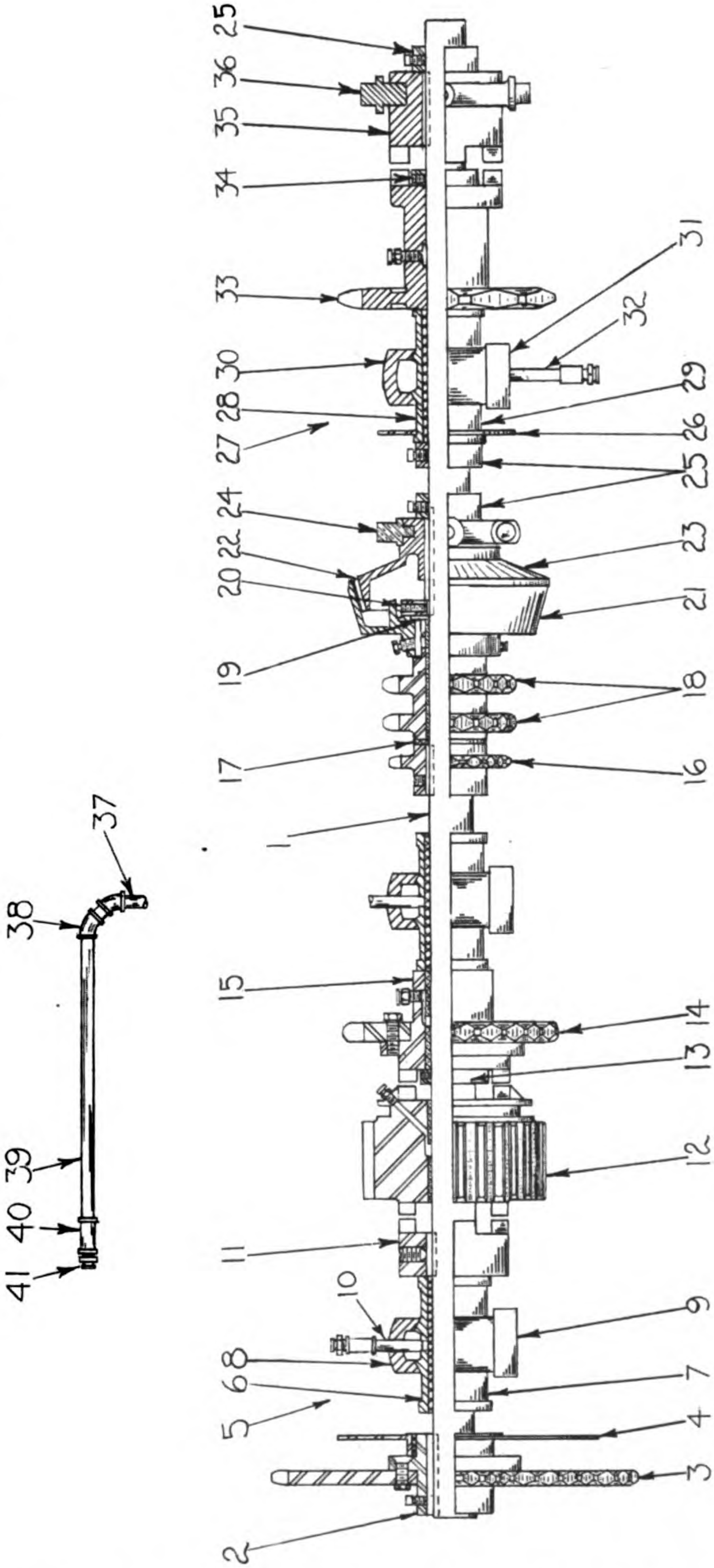


MAIN TRANSMISSION CLUTCH SHIFTER AND BRAKE
From 53-153-A

*These are Fuller & Sons Mfg. Company part numbers.

Ref. No.	Part Number	Number Required		DESCRIPTION	Part of Assem. No.
76	BR-N-A1	1		Bearing, Pilot, New Departure, #7505	
77	A-53-65	2		Shaft	
78	3742	1		Fork, Shifter	
79	R1-970		2	Set Screws, Warner Gear Co. #5573	3742
	OI-GT-B	2		Gitts Oil Cup #L-1207	
80	*3572	1		Sleeve, Brake	
81	R1-474		1	Hex. Head Cap Screw, ¼" x ¾"	3572
82	*E-3-1131	1		Key	
83	*A-17-176	1		Lining, Brake, ¼"	
84	46-50-A	1		Tube, Flexible	
85	R1-717	3		Elbow, Street, ⅛"	
86	R1-1179	1		Lock Washer, ⅜"	
87	R1-648	1		Coupling, ⅛"	
88	R1-680	1		Cup, Grease #00	
89	R1-607	1		Cotter, ⅛" x 1½"	

MAIN JACK SHAFT



ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

MAIN JACK SHAFT
82-162-A5

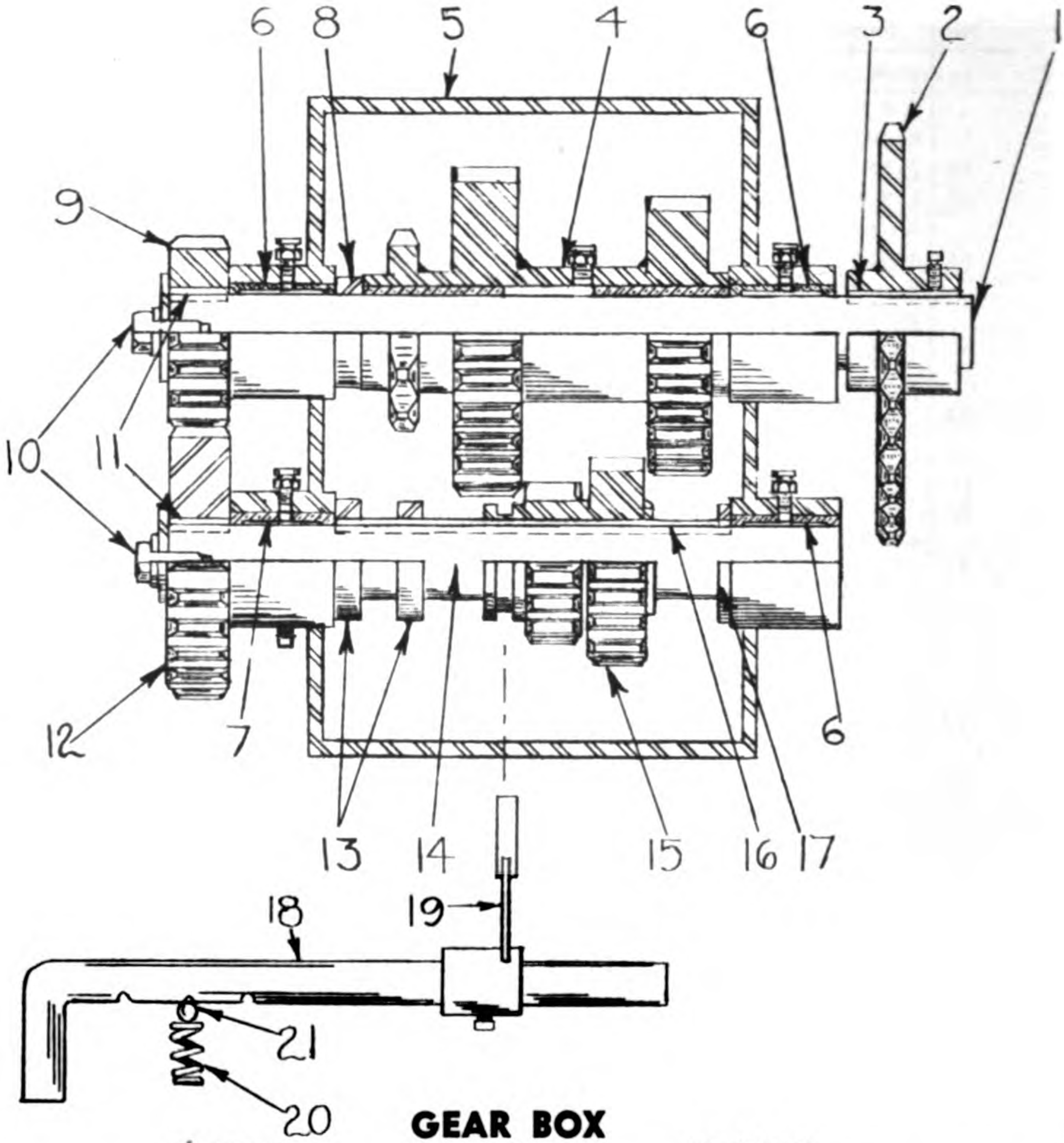
Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	A-82-161	1	Shaft	
2	D-3-887	1	Hub, Sprocket	
	R1-950	1	Set Screw, 5/8" x 1 1/4"	D-3-887
	R1-948	1	Set Screw, 5/8" x 3/4"	D-3-887
3	Q-19-558	1	Sprocket, 40-Tooth	
	R1-443	6	Flat Head Cap Screw, Nut & Lock Washer, 1/2" x 2"	
4	Q-82-125WB	1	Guard	
	AG-17-33	1	Key	
5	13-213-H	2	Bearing	
6	1462D	2	Upper Half	13-213-H
7	1462A	2	Lower Half	13-213-H
8	822B	2	Cap	13-213-H
9	821	2	Base	13-213-H
	R1-81	4	Machine Bolt, Nut & Jam Nut, 5/8" x 6"	13-213-H
10	E-17-43	2	Pipe	
	R1-649	1	Coupling, 1/4"	
	R1-12	1	Alemite, Button Head, Male, 1/4"	
	R1-245	6	Machine Bolt, Nut, Lock Washer & Cut Washer, 5/8" x 2 1/2"	
11	A-3-1001	1	Clutch, Jaw	
	R1-1032	1	Set Screw, Safety, 5/8" x 1 1/4"	A-3-1001
	R1-1033	1	Set Screw, Safety, 5/8" x 1 1/2"	A-3-1001
	PP-17-33	2	Key	
12	A-18-234	1	Gear, 31-Tooth	
	H-8-75	2	Bushing	A-18-234
	R1-11	1	Alemite, Button Head, Male, 1/8"	
13	E-3-941	1	Collar	
	R1-1012	2	Set Screw, Safety, 3/8" x 1/2"	E-3-941
14	T-19-543	1	Sprocket, 22-Tooth	
	R1-503	6	Hex. Head Cap Screw & Lock Washer, 1/2" x 1 1/2"	
15	B-3-1001	1	Clutch, 3 Jaw Square	
	R1-11	2	Alemite, Button Head, Male 1/8"	
	R1-1033	1	Set Screw, Safety, 5/8" x 1 1/2"	B-3-1001
	H-8-75	2	Bushing	B-3-1001
16	A-19-689	1	Sprocket, 14-Tooth	
	R1-1022	1	Set Screw, Safety, 1/2" x 1/2"	A-19-689
	R1-1024	1	Set Screw, Safety, 1/2" x 3/4"	A-19-689
	AM-17-33	1	Key	
17	D-17-92	1	Washer	

(continued on next page)

Main Jack Shaft—(Cont'd)

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
18	B-19-498	2	Sprocket, 15-Tooth	
	A-8-75	1	Bushing	B-19-498
	M-8-75	1	Bushing	B-19-498
19	A-17-75	1	Washer	
20	U-3-941	1	Collar	
	R1-1016	2	Set Screw, Safety, 3/8" x 1 1/4"	U-3-941
21	3509A	1	Cone, Female Half	
	AA-17-32	1	Key	
	R1-944	1	Set Screw, 1/2" x 1 1/2"	3509A
	R1-943	1	Set Screw, 1/2" x 1 1/4"	3509A
	R1-11	1	Alemite, Button Head, Male 1/8"	
22	A-3-1077	1	Lining	
	R1-33	8	Flat Head Stove Bolt, Hex. Nut & Lock Washer, 3/16" x 3/4"	
23	2680D	1	Cone, Male Half	
	GG-17-106	1	Key, Feather	
24	3605	1	Yoke, Shifter	
	R1-107	2	Machine Bolt, Nut & Lock Washer, 3/8" x 2 1/4"	3605
	BE-17-9	2	Washer, 12 Ga.	3605
	R1-11	1	Alemite, Button Head, Male, 1/8"	
25	J-3-941	3	Collar	
	R1-935	6	Set Screw, 3/8" x 1"	J-3-941
26	O-82-173	1	Guard, 10 Ga.	
27	13-213-J	1	Bearing	
28	1462A	1	Upper Half	13-213-J
29	1462D	1	Lower Half	13-213-J
30	822	1	Cap	13-213-J
31	821A	1	Base	13-213-J
	R1-81	2	Machine Bolt, Nut & Jam Nut, 5/8" x 6"	13-213-J
32	J-17-43	1	Pipe	
	R1-649	1	Coupling, 1/4"	
	R1-12	1	Alemite, Button Head, Male, 1/4"	
	R1-74	2	Machine Bolt, Nut & Cut Washer 5/8" x 2 1/2"	
33	3493	1	Sprocket, 9-tooth	
	R1-12	1	Alemite, Button Head, Male, 1/4"	
34	Q-3-941	1	Collar	
	R1-1012	1	Set Screw, Safety, 3/8" x 1/2"	Q-3-941
35	3494	1	Clutch, Jaw	
	ZZ-17-106	1	Key	
36	599A	1	Ring, Shifter	
	R1-11	1	Alemite, Button Head, Male, 1/8"	
	R1-110	2	Machine Bolt, Nut & Lock Washer 3/8" x 3"	
37	AF-17-43	1	Pipe	
38	R1-682	2	Elbow, 1/4" x 45°	
	D-17-43	1	Pipe	
39	N-17-43	1	Pipe	
40	R1-649	1	Coupling, 1/4"	
41	R1-12	1	Alemite, Button Head, Male, 1/4"	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



GEAR BOX

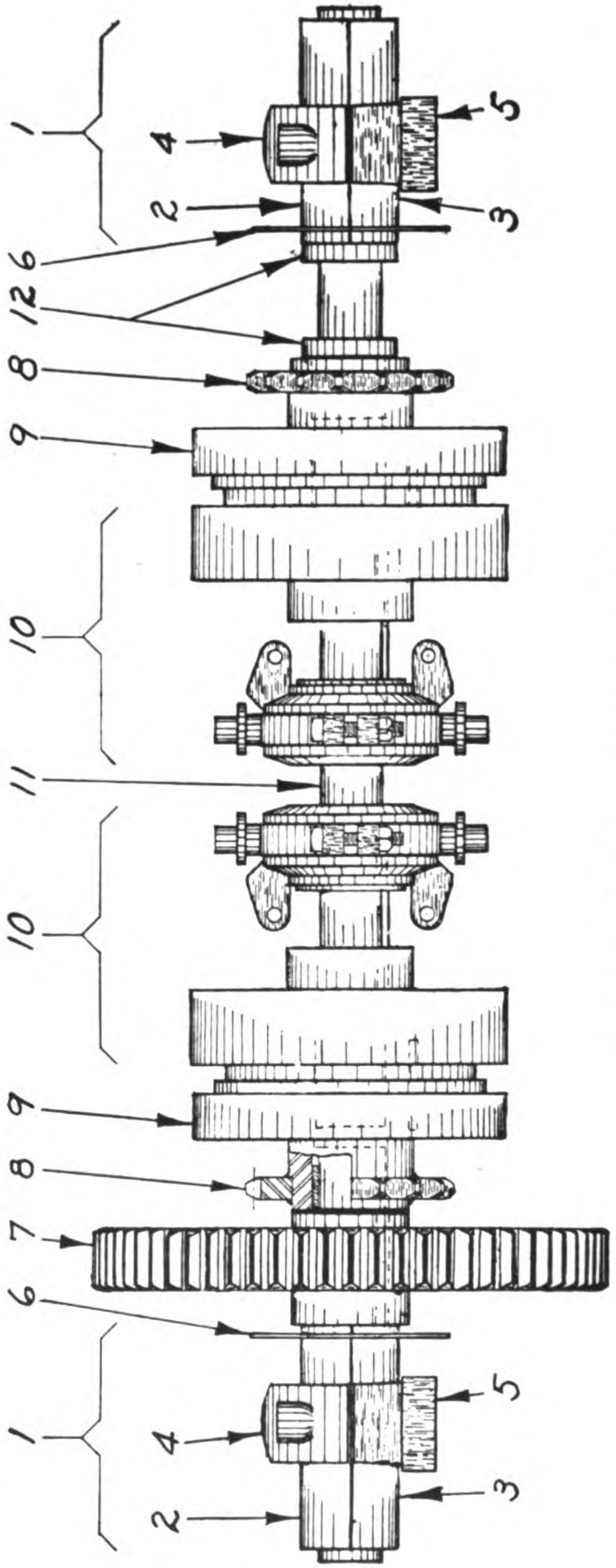
53-101-B2 53-101-C 53-101-E

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	A-53-104	1	Shaft	
2	19-474-0	1	Sprocket, 31-tooth	
	R1-940	1	Set Screw, ½" x ¾"	19-474-0
	R1-942	1	Set Screw, ½" x 1"	19-474-0
3	AF-17-32	1	Key	
4	A-18-245W	1	Gear Cluster, 23-tooth, 31-tooth & 11-tooth Sprocket	
	P-8-55	2	Bushing	A-18-245W
	R1-12	2	Alemite, Button Head, Male, ¼"	
5	A-53-103WM	1	Gear Box	
	C-3-23	1	Dog Point Set Screw, ⅜" x ⅝"	A-53-103WM
6	G-8-52	3	Bushing	A-53-103WM
			(continued on next page)	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

Gear Box—(Cont'd)

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
7	B1-8-57	1	Bushing	A-53-103WM
	N-53-103RW	1	Cover	
	EC-17-25	1	Pin, Clevis	
	R1-606	2	Cotter, 1/8" x 1 1/4"	
	AA-53-103	2	Shim, 20 Ga.	
	BB-53-103	2	Shim, 20 Ga.	
	T-53-103	2	Shim, 16 Ga.	
	W-53-103	2	Shim, 16 Ga.	
	Q-53-103	2	Shim, 10 Ga.	
	V-53-103	2	Shim, 10 Ga.	
	U-53-103	2	Shim, 1/4 Ga.	
	P-53-103	2	Shim, 1/4 Ga.	
8	P-3-938	1	Collar	
9	A-18-232	1	Gear, 13-tooth	
10	R1-501	2	Hex Head Cap Screw & Lock Washer, 1/2" x 1"	
	OO-17-9	2	Washer	
11	C-17-30	4	Key	
12	C-18-233	1	Gear, 32-tooth	
13	A-3-1002	2	Collar	
	R1-935	2	Set Screw, 3/8" x 1"	A-3-1002
14	B-53-104	1	Shaft	
15	C-18-244W	1	Gear Cluster, 22-tooth, 14-tooth	
16	P-17-108	2	Key	
17	AA-17-9	1	Washer	
18	C-53-104	1	Rod, Shifter	
19	A-3-1003W	1	Yoke, Shifter	
	R1-933	1	Set Screw, 3/8" x 3/4"	A-3-1003W
20	C-46-55	1	Spring	
21	R1-19	1	Ball, Steel, 7/16"	
	J-17-43	4	Pipe	
	R1-11	2	Alemite, Button Head, Male, 1/8"	
	R1-12	5	Alemite, Button Head, Male, 1/4"	
	R1-649	5	Coupling, 1/4"	
	D-17-43	1	Pipe	
	C-18-232	1	Gear, 21-tooth } Interchangeable with A-18-232 & C-18-233	
	B-18-232	1	Gear, 17-tooth } Interchangeable with A-18-232 & C-18-233	
	B-18-233	1	Gear, 28-tooth } Interchangeable with A-18-232 & C-18-233	
	A-18-233	1	Gear, 24-tooth } Interchangeable with A-18-232 & C-18-233	



CRAWLER CLUTCH SHAFT

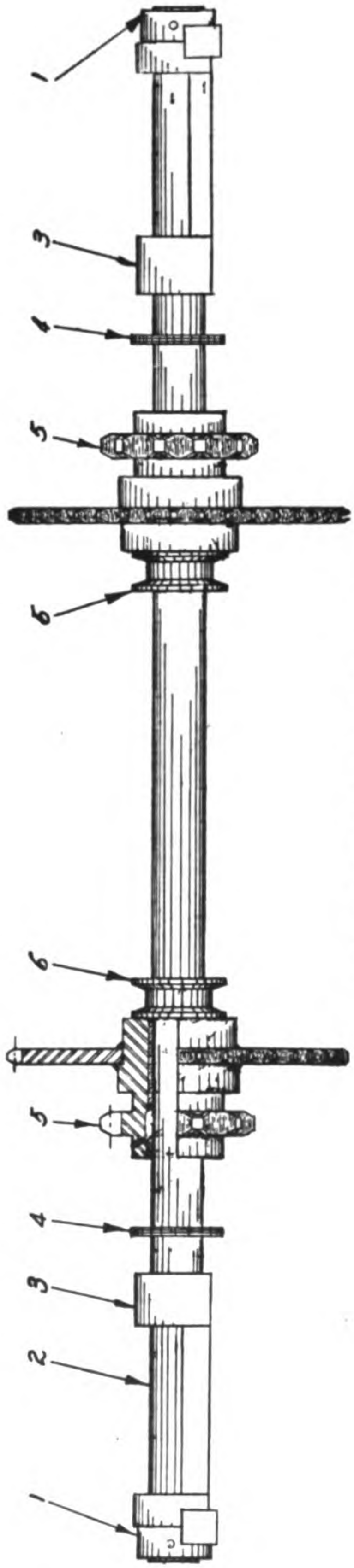
ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

CRAWLER CLUTCH SHAFT

(82-200-A2)

(See illustration on preceding page)

Ref. No.	No. Req.	Part No.	Description
1.	2	13-214-G	Ball & Socket Bearing (Complete)
	4	R1-81	Machine Bolt, Nut, & Jam Nut, 5/8" x 6"
2.	2	825 B	Bearing, Upper Half
	2	E-17-43	Pipe, 1/4" x 1 1/2"
	2	R1-649	Pipe Coupling, 1/4"
	2	R1-12	1/4" Button Head Alemite, Male
3.	2	825 A	Bearing, Lower Half
4.	2	822 B	Bearing Cap
5.	2	821	Bearing Base
	1	B-17-136	Shim, 3/8"
	1	A-17-136	Shim, 3/8"
	6	A-17-110	Shim, 14 Ga.
	2	N-17-71	Bearing Stop, 1/4"
	2	R1-124	Machine Bolt, Nut, & Lock Washer, 1/2" x 1 1/4"
	4	R1-247	Machine Bolt, Nut, & Lock Washer, & Cut Washer, 5/8" x 3"
6.	2	N-82-173	Patch Plate
7.	1	3435	Spur Gear, 64-Tooth
	1	R1-949	Set Screw, 5/8" x 1"
	1	R1-950	Set Screw, 5/8" x 1 1/4"
	1	E-17-33	Key, 1/2" x 1/2" x 3 1/2"
8.	2	C-19-680 WM	Sprocket, 15-Tooth
	2	H-8-75	Bronze Bushing
	2	O-8-75	Bronze Bushing
	4	R1-12	1/4" Button Head Alemite, Male
9.	2	3511	Clutch Hub, 8"
	2	ZZ-17-33	Key, 1/2" x 1/2" x 2 3/8"
10.	2	3-1007-A	Barber-Greene 8" Friction Clutch (For Details See "Clutch")
	2	AT-17-33	Key, 1/2" x 1/2" x 6 3/4"
	2	R1-11	1/8" Button Head Alemite, Male
11.	1	A-82-200	Shaft, 1 15/16" x 4' 1 1/2", S.A.E. 4140
12.	2	M-3-941	Collar
	4	R1-933	Set Screw, 3/8" x 3/4"



OSCILLATING SHAFT

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

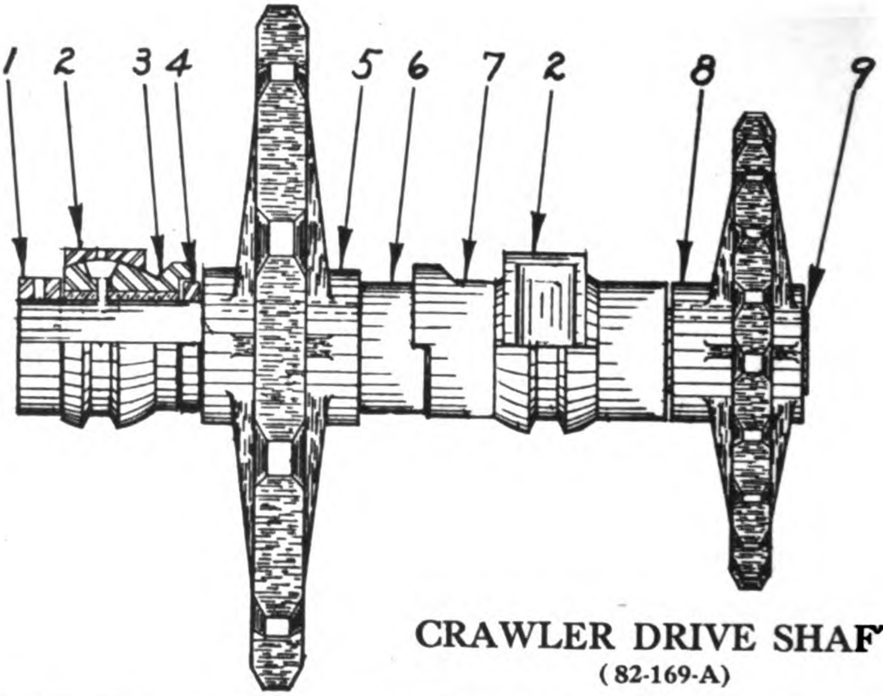
OSCILLATING SHAFT

(82 66-C)

(82-169-A)

(See illustration on preceding page)

Ref. No.	No. Req.	Part No.	Description
1.	2	F-3-949	Collar
	2	R1-137	Machine Bolt, Nut, & Lock Washer, ½" x 4½"
	6	OC-17-9	Washers
2.	1	B-82-66	Shaft, 2$\frac{7}{16}$" x 6' 2", S.A.E. #3140
3.	2	2387	Bearing
	8	R1-295	Machine Bolt, Nut, & Lock Washer, & two Cut Washers, ⅝" x 3¼"
	8	R1-1162	Bevel Washer, ⅝"
	38	A-17-111	Shim, #10
	4	KK-17-111	Shim, #16
	4	G-24-85	Keeper
4.	6	JI-17-9	Washer
5.	2	19-656-A	Sprocket, 10-Tooth & 39-Tooth
	2	BB-8-95	Bronze Bushing
	2	CC-8-95	Bronze Bushing
	4	R1-682	Elbow, ¼" x 45°
	4	F-17-43	Pipe, ¼" x 2"
	4	R1-12	¼" Button Head Alemite, Male
6.	2	R1-591	Standard Collar, 2$\frac{7}{16}$"

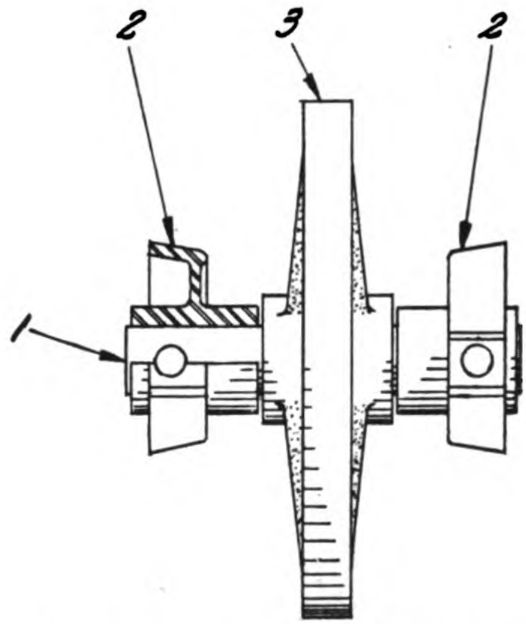


CRAWLER DRIVE SHAFT

(82-169-A)

Ref. No.	No. Req.	Part No.	Description
1.	2	B-3-949	Collar
	2	R1-138	Machine Bolt, Nut, & Lock Washer, ½" x 4¾"
2.	4	2483	Bearing Cap
	6	R1-165	Machine Bolt, Nut, & Lock Washer, ⅝" x 7½"
	2	R1-164	Machine Bolt, Nut, & Lock Washer, ⅝" x 7"
3.	2	2485	Bearing
	2	AA-8-92	Bronze Bushing
	2	R1-866	Pipe Plug, ¼"
	2	C-17-43	Pipe, ¼" x ⅞"
	2	R1-649	Pipe Coupling, ¼"
	2	R1-12	¼" Button Head Alemite, Male
4.	2	F-3-948	Collar
5.	2	1506 C	Sprocket, 10-Tooth
	4	R1-950	Set Screw, ⅝" x 1¼"
	2	R1-951	Set Screw, ⅝" x 1½"
	4	W-17-34	Key, ⅝" x ⅝" x 4½"
6.	2	G-3-948	Collar
7.	2	2482 A	Bearing
	4	JJ-8-94	Bronze Bushing
	2	R1-866	Pipe Plug, ¼"
	2	C-17-43	Pipe, ¼" x ⅞"
	2	R1-649	Pipe Coupling, ¼"
	2	R1-12	¼" Button Head Alemite, Male
8.	2	2975	Sprocket, 21-Tooth
	4	R1-949	Set Screw, ⅝" x 1"
	2	R1-950	Set Screw, ⅝" x 1¼"
	4	Y-17-34	Key, ⅝" x ⅝" x 4"
9.	2	C-82-77	Shaft, 2 7/16" x 1' 11 3/16", S.A.E. 3140

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

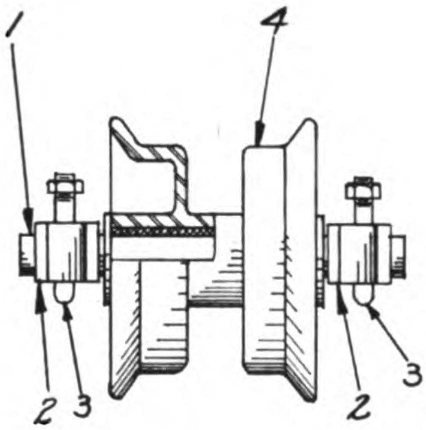


CRAWLER TAKE-UP SHAFT

(82-169-A)

Ref. No.	No. Req.	Part No.	Description
1.	2	A-82-77	Shaft, $2\frac{7}{16}''$ x 1′ 1¾″, S.A.E. #1020
	2	R1-12	¼″ Button Head Alemite, Male
2.	4	3372	Take-Up Bearing
	4	R1-160	Machine Bolt, Nut, & Lock Washer, ⅝″x5″
	4	C-17-102	Bolt, 1″ x 12″, S.A.E. #2330 Heat Treated (4 Acme threads per inch)
	4	M-17-24	1″ Square Nut (4 Acme threads per inch)
	8	KI-17-9	Washer
3.	2	362 B	Traction Wheel
	4	FF-8-95	Bushing

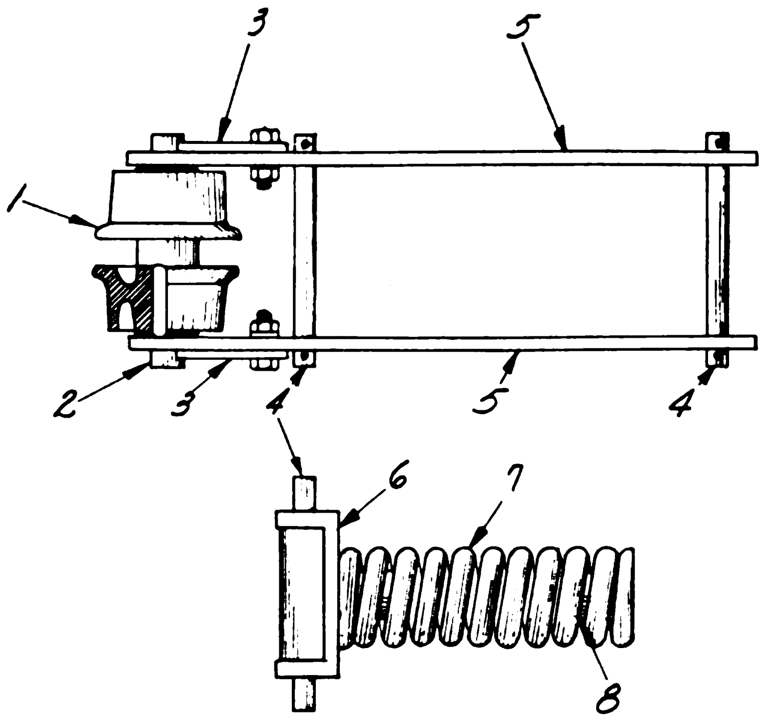
ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



CRAWLER ROLLER SHAFT

(82-169-A)

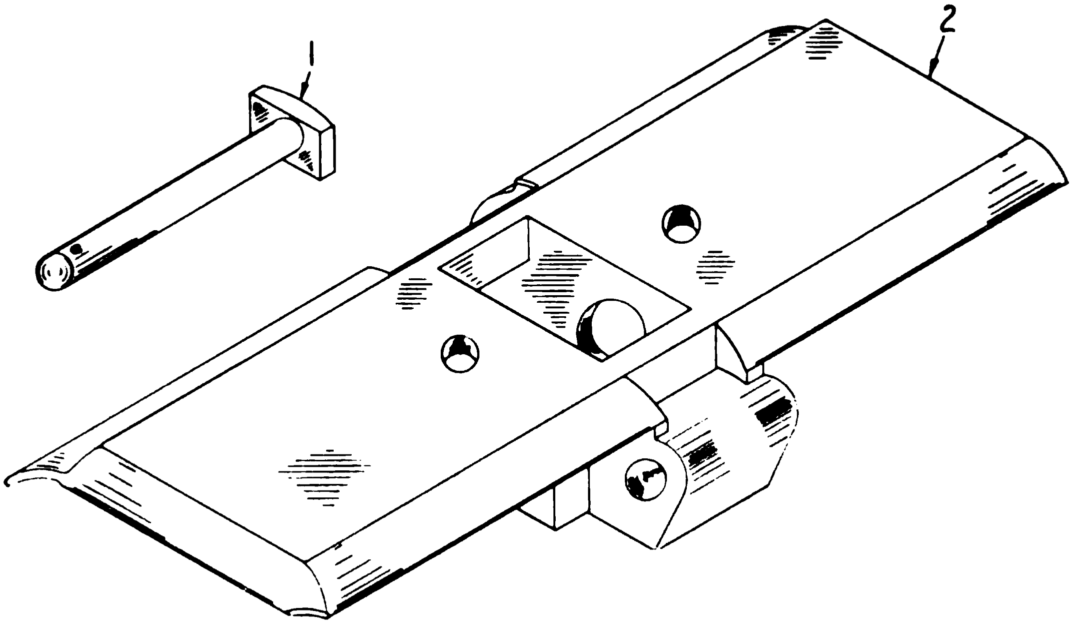
Ref. No.	No. Req.	Part No.	Description
1.	14	A-62-21	Shaft, $1\frac{11}{16}$" x 1' 0½", S.A.E. #1020
	14	R1-12	¼" Button Head Alemite, Male
2.	28	1300	Keeper
3.	28	A-3-172	U-Bolt, ⅝"
	56	R1-812	Hex Nut, & Lock Washer, ⅝"
	56	R1-1162	Bevel Washer, ⅝"
4.	14	3430	Flanged Roller
	28	AQ-17-9	Washer



CRAWLER SPRING TAKE-UP

(82-169-A)

Ref. No.	No. Req.	Part No.	Description
1.	2	1070	Flanged Roller, 4"
2.	2	S-42-90	Shaft, 1 3/16" x 8¼", S.A.E. #1020
	2	R1-12	¼" Button Head Alemite, Male
3.	4	J-42-90	Keeper
	4	R1-125	Machine Bolt, Nut, & Lock Washer, ½" x 1½"
4.	4	E-42-90	Pin
	8	R1-614	Cotter, 3/16" x 1¼"
5.	4	H-42-90	Take-Up Arm
6.	2	667	Spring Seat
7.	2	B-46-45	Coil Spring
8.	2	668	Spring Retainer
	2	R1-133	½" x 3½" Machine Bolt, Nut, & Lock Washer

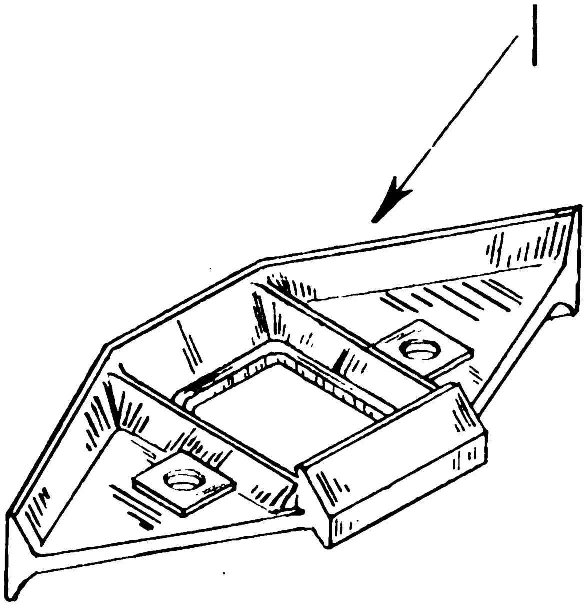


CRAWLER TREAD

(82-169-D)

Ref. No.	No. Req.	Part No.	Description
1.	82	A-38-17	T-Head Pin
	82	R1-630	Cotter, 5/16" x 1¼"
2.	82	1048	Crawler Link

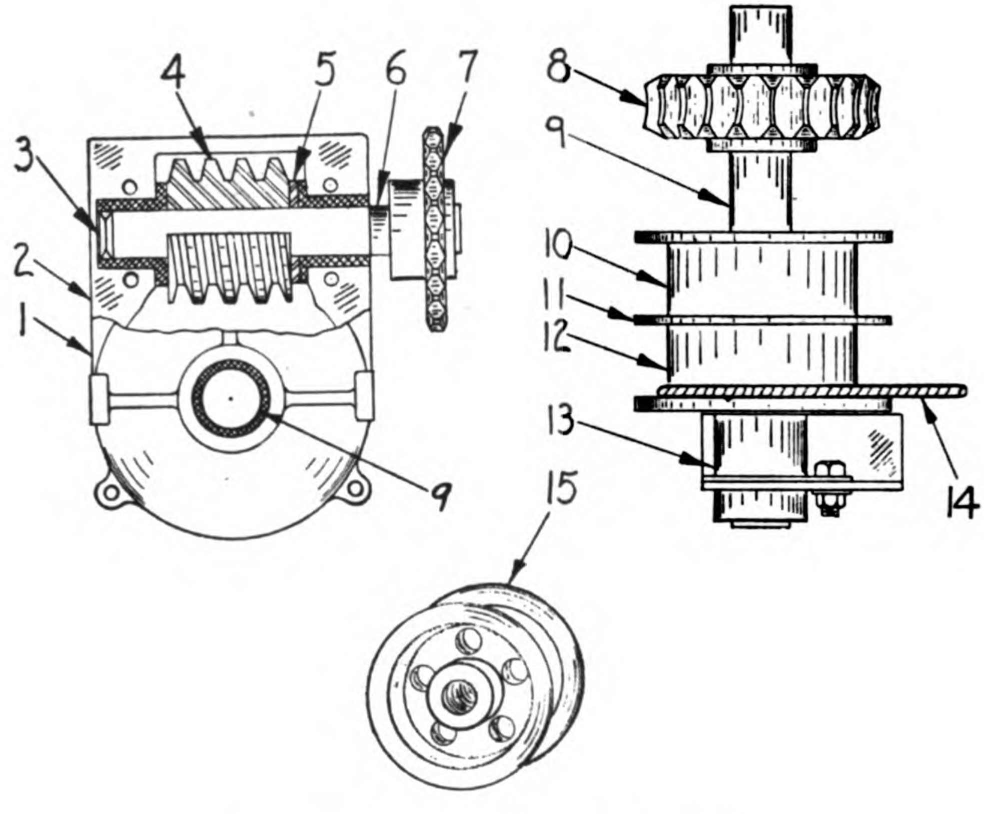
ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



CRAWLER GROUSER
82-169-E

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	1295	82	Grouser	
	R1-146	164	Machine Bolt, Nut & Lock Washer 5/8" x 1½"	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



HOIST, SHEAVES & CABLE

(82-118-A1)
(82-93-A3)

Ref. No.	No. Req.	Part No.	Description
1.	1	N-82-61 WB	Worm Gear Housing
	4	BB-17-43	Pipe, ¼" x 4½"
	4	R1-683	Elbow, ¼" x 90°
	5	R1-649	Pipe Coupling, ¼"
	5	R1-12	¼" Button Head Alemite, Male
	1	CU-17-43	Pipe, ¾" x 7"
	2	B-17-123	Pipe, ¾" x 2"
	2	R1-408	Pipe Cap, ¾"
	2	R1-688	Elbow, ¾" x 90°
	2	R1-127	Machine Bolt, Nut, & Lock Washer, ½" x 2"
	1	R1-504	Cap Screw, & Lock Washer, ½" x 1¾"
	2	AF-17-43	Pipe, ¼" x 2½"
	2	C-17-43	Pipe, ¼" x ⅞"
	1	X-17-43	Pipe, ¼" x 7"
	1	R1-826	Pet Cock, ¼"
	1	CT-17-43	Pipe, ¾" x 5"

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

Hoist, Sheaves & Cable (continued)

Ref. No.	No. Req.	Part No.	Description
2.	1	A-3-224	Gasket
	2	R1-124	Machine Bolt, Nut, & Lock Washer, ½″ x 1¼″
	4	R1-133	Machine Bolt, Nut, & Lock Washer, ½″ x 3½″
	2	R1-126	Machine Bolt, Nut, & Lock Washer, ½″ x 1¾″
	1	R1-125	Machine Bolt, Nut, & Lock Washer, ½″ x 1½″
	4	R1-1168	Cut Washer, ½″
3.	2	C-18-49	Thrust Button
4.	1	E-18-68	Worm, Right Hand, Single Thread
	1	A-17-65	Taper Key, ⅜″ x ⅜″ x 3 13/16″
5.	1	D-17-63	Washer
6.	1	A-82-109	Shaft, 1 11/16″ x 11¼″, S.A.E. 1020
7.	1	C-19-498	Sprocket, 19-Tooth
	1	R1-940	Set Screw, ½″ x ¾″
	1	R1-942	Set Screw, ½″ x 1″
	1	E-17-32	Key, ⅜″ x ⅜″ x 2¼″
8.	1	1639	Worm Gear, Right Hand, 21-Tooth
	1	Z-17-33	Key, ½″ x ½″ x 2⅝″
	2	R1-935	Set Screw, ⅜″ x 1″
9.	1	C-82-61	Shaft, 1 15/16″ x 1′ 4⅝″, S.A.E. 1020
10.	1	1630	Drum
	2	R1-1029	Allen Cup Point Safety Set Screw, ⅝″x⅝″
11.	1	C-3-265	Drum Plate
12.	1	1630 A	Drum
	2	R1-1029	Allen Cup Point Safety Set Screw, ⅝″x⅝″
	1	AY-17-33	Key, ½″ x ½″ x 5¾″
13.	1	13-192-A	1 15/16″ Bearing
	2	E-13-192	Shim, ¼″
	5	F-13-192	Shim, 16 Ga.
	3	R1-128	Machine Bolt, Nut, & Lock Washer, ½″ x 2¼″
	1	Y-17-43	Grease Pipe, ¼″ x 3½″
	1	R1-649	Pipe Coupling, ¼″
	1	R1-12	¼″ Button Head Alemite, Male
14.	1	R1-911	Cable, ⅜″ x 56′-0″, 6 x 19
	4	R1-570	Cable Clamp, ⅜″
	2	R1-1089	Cable Thimble, ⅜″
15.	9	868 A	Sheave
	9	K-17-14	Bushing
	3	R1-176	Machine Bolt, Nut, & Lock Washer, ¾″ x 2¾″
	4	R1-177	Machine Bolt, Nut, & Lock Washer, ¾″x3″
	2	R1-459	Flat Head Cap Screw, Nut, & Lock Washer, ¾″ x 3½″

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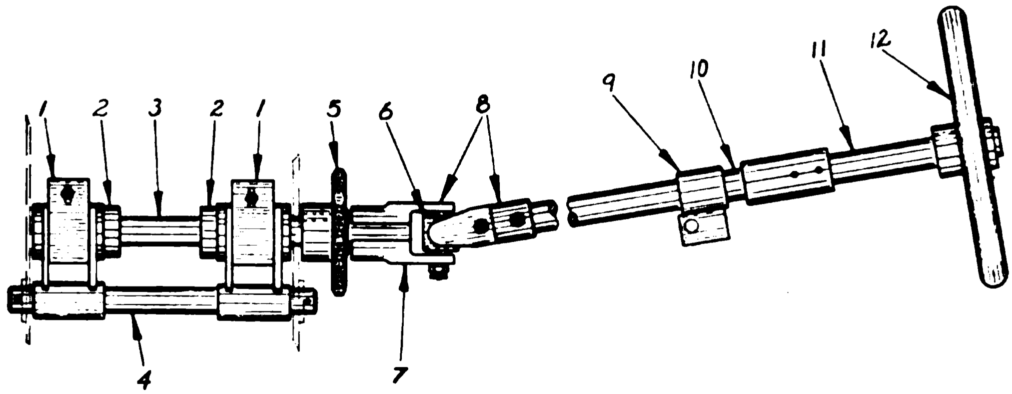

HOIST HAND WHEEL AND TAKE-UP PIVOT SHAFT

(82-97-B1) (82-93-A3)

Ref. No.	No. Req.	Part No.	Description
1.	2	E-82-97 WB	Hoist Bracket
	2	BK-17-24	Take-Up Bolt, ½" x 3¼"
	5	R1-801	Half Nut, ½"
	3	R1-1168	Standard Cut Washer, ½"
	2	R1-11	⅛" Button Head Alemite, Male
2.	2	O-3-932	Collar
	2	R1-1009	Allen Cup Point Safety Set Screw, ⅜"x¼"
3.	1	C-82-96	Hoist Idler Shaft, 1$\frac{7}{16}$" x 1' 3$\frac{11}{16}$", S.A.E. #1020
4.	1	D-82-97	Take-Up Pivot Shaft, 1" x 1' 0-¾", S.A.E. #1020
	2	R1-623	Cotter, ¼" x 1½"
5.	1	19-475-A	Sprocket, 15-Tooth
	1	R1-932	Set Screw, ⅜" x ⅝"
	1	R1-934	Set Screw, ⅜" x ⅞"
	1	E-17-30	Key, ¼" x ¼" x 2"
6.	1	A-3-897	Universal Joint Connector
7.	1	3317-A	Universal Fork Half
	1	R1-11	⅛" Button Head Alemite, Male
	1	R1-131	Machine Bolt, Nut, & Lock Washer, ½"x3"
	1	R1-132	Machine Bolt, Nut, & Lock Washer, ½" x 3¼"
8.	3	3317	Universal Fork Half
	1	R1-131	Machine Bolt, Nut, & Lock Washer, ½"x3"
	1	R1-132	Machine Bolt, Nut, & Lock Washer, ½" x 3¼"
9.	1	J-82-96 W	Hand Wheel Shaft Bracket
10.	1	K-82-96 W	Hand Wheel Shaft, 1$\frac{7}{16}$" x 2'0⅝", S.A.E. #1020
	2	R1-107	Machine Bolt, Nut, & Lock Washer, ⅜" x 2¼"
11.	1	H1-82-96	Hand Wheel Shaft, 1$\frac{7}{16}$" x 1' 1¾", S.A.E. #1020
12.	1	1392-A	Hand Wheel
	1	H-17-30	Key, ¼" x ¼" x 2½"
	2	R1-1011	Allen Cup Point Safety Set Screw, ⅜"x⅜"

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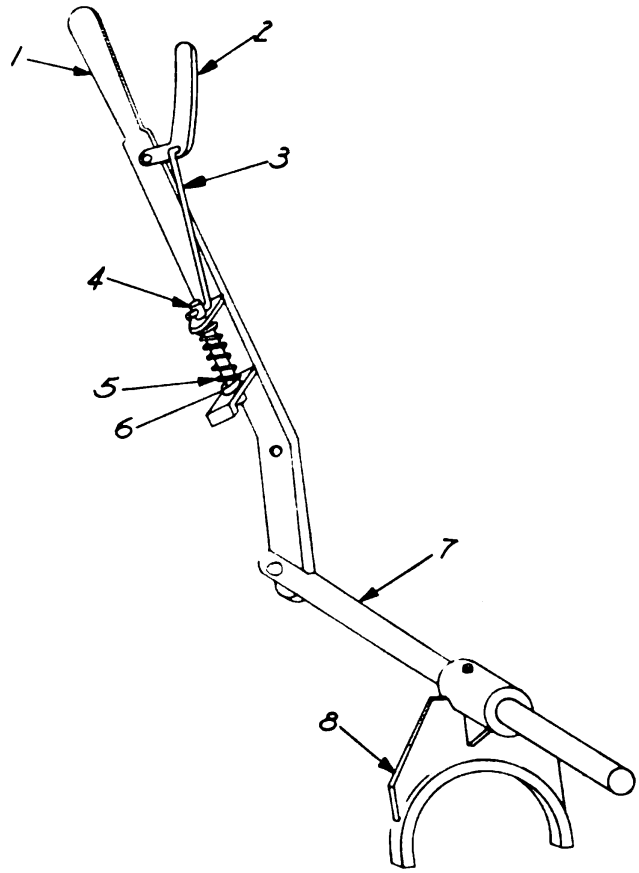
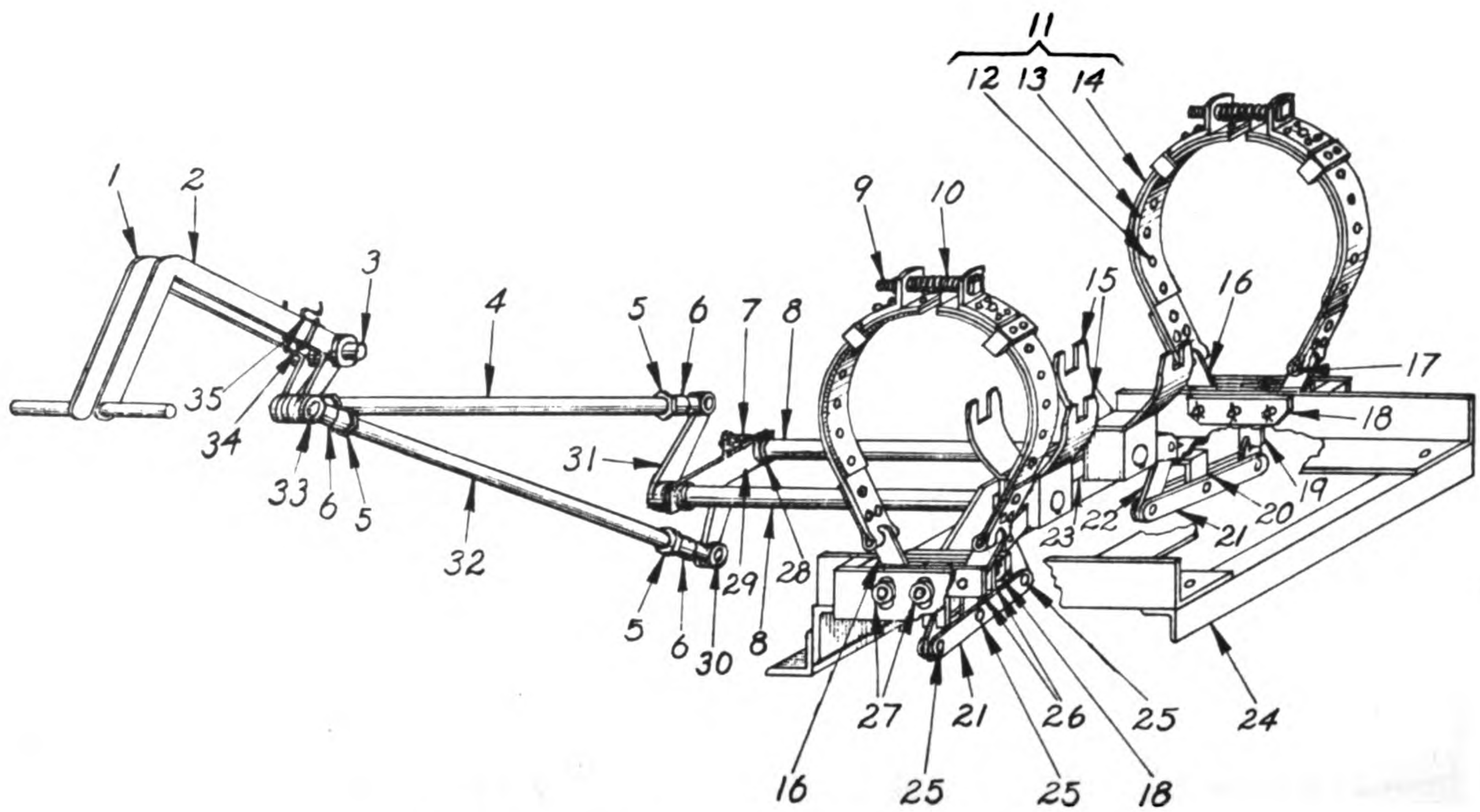


HIGH-LOW SPEED LEVER

(82-179-A)

Ref. No.	No. Req.	Part No.	Description
1.	1	C-82-178 W	Lever
	1	O-17-23	Rivet, ½" x 1¼"
	1	KK-17-23	Rivet, ⅜" x 1¼"
	2	R1-604	Cotter, ⅛" x ¾"
2.	1	G-62-33	Grip Latch
	1	DC-17-23	Rivet, ¼" x 1⅛"
3.	1	N-82-45	Rod
	2	R1-601	Cotter, $\frac{3}{32}$" x 1"
4.	1	N-62-33	Dog, ½" x 4⅝", S.A.E. 1020
5.	1	H-42-47	Spring
6.	1	J-62-33	Collar
	1	AA-17-26	Pin
7.	1	B-82-178	Shaft, 1" x 1' 5", S.A.E. 1020
8.	1	K-3-1003 W	Shifter Fork
	1	R1-933	Set Screw, ⅜" x ¾"

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



STEERING LEVERS AND BRAKES

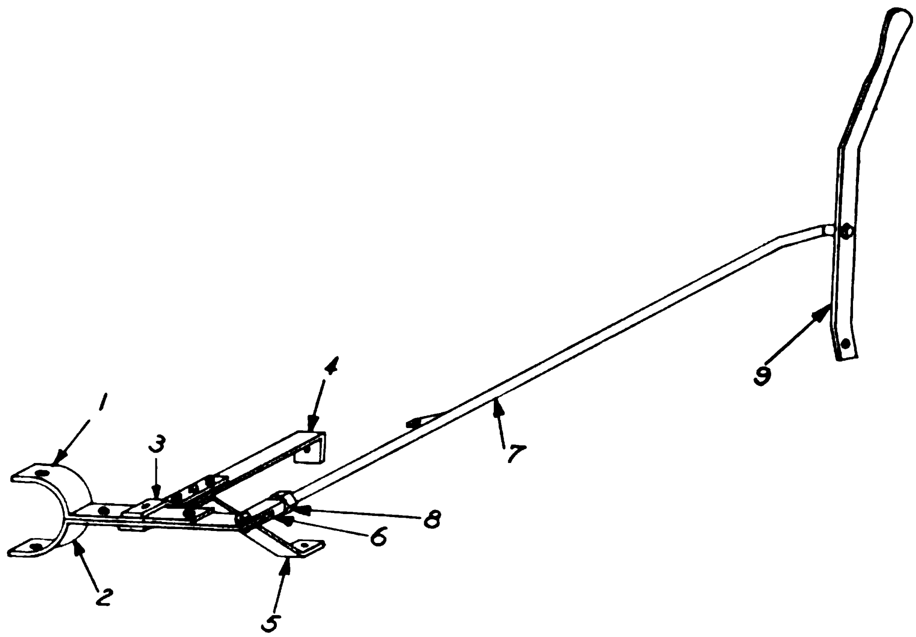
STEERING LEVERS AND BRAKES

(82-106-A2)

Ref. No.	No. Req.	Part No.	Description
1.	1	J (R) 82-43-W	Steering Lever
2.	1	J (L) 82-43-W	Steering Lever
3.	1	GG-17-25	Steering Lever Shaft
	2	R1-624	Cotter, ¼" x 1¾"
4.	1	C-82-43	Link Rod, ¾" x 2' 2$\frac{13}{16}$"
5.	4	R1-792	Hex Nut, ¾"
6.	4	B-3-149	Yoke
7.	1	1715 A	Lever Arm
	1	C-17-30	Key, ¼" x ¼" x 1½"
	1	R1-129	Machine Bolt, Nut, & Lock Washer, ½" x 2½"
8.	2	A-82-43	Shifter Shaft, 1$\frac{3}{16}$" x 2' 0$\frac{9}{16}$"
9.	2	AZ-17-24	Machine Bolt, Nut, & Lock Washer, ½" x 6"
10.	2	H-42-47	Coil Spring
11.	4	C-82-206 R	Brake Band Half
12.	28	R1-892	Tubular Brass Rivets, #10 x $\frac{7}{16}$"
13.	4	B-82-206	Brake Lining
14.	4	A-82-206	Brake Shoe
15.	2	G-3-395 W	Clutch Shifter Yoke
	4	R1-933	Set Screw, ⅜" x ¾"
	2	FZ-17-25	Yoke Pin, ½" x 2"
	4	R1-614	Cotter, $\frac{3}{16}$" x 1¼"
	2	H-17-30	Key, ¼" x ¼" x 2½"
16.	4	K-82-202	Brake Link
17.	4	CZ-17-23	Button Head Rivet, ⅝" x 1¾"
	4	R1-605	Cotter, ⅛" x 1"
18.	2	Q-82-202	Retainer Bar
19.	2	C1-3-1057 W	Link
20.	2	M1-82-202	Lever Hanger
	2	R1-225	Machine Bolt, Nut, Lock Washer, & Cut Washer, ½" x 1¾"
	2	R1-226	Machine Bolt, Nut, Lock Washer, & Cut Washer, ½" x 2"
	2	Q-17-139	Shim, 16 Ga.
	2	S-17-139	Shim, 12 Ga.
	2	VV-17-139	Shim, 14 Ga.
	2	WW-17-139	Shim, 24 Ga.
21.	4	P-82-202	Lever Arm
22.	2	J1-82-202	Yoke to Lever Arm Link
23.	1	N-82-202	Spacer Bar
	2	R1-440	Flat Head Cap Screw, Nut, & Lock Washer, ½" x 1¼"
24.	1	H1-82-202 W	Lever Support
	6	R1-278	Machine Bolt, Nut, Lock Washer, & Two Cut Washers. ½" x 1½"

Steering Levers and Brakes (continued)

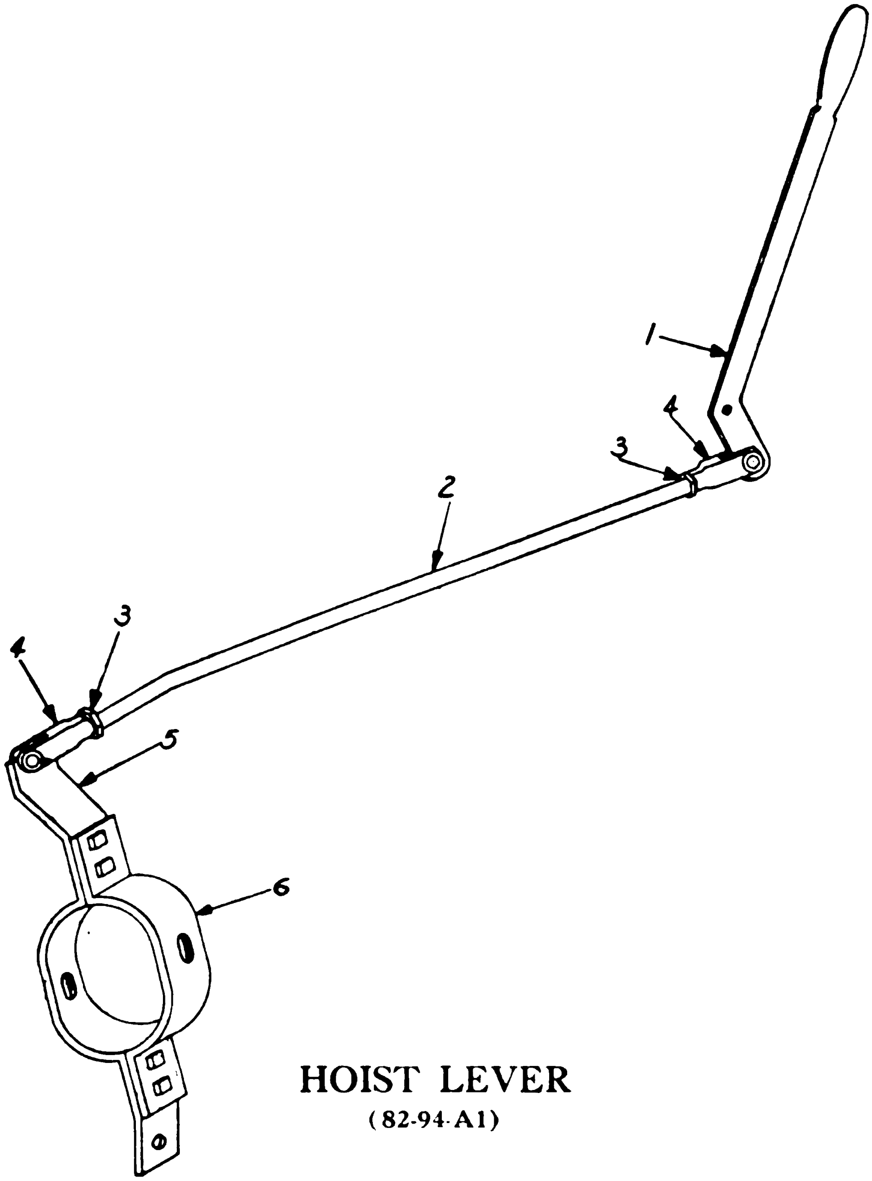
Ref. No.	No. Req.	Part No.	Description
25.	6	FY-17-25	Lever Pin, 1/2" x 1 5/8"
	12	R1-614	Cotter, 3/16" x 1 1/4"
26.	4	O-82-202	Equalizer Lever Arm
27.	6	D-3-1057 W	Link Pin
	6	R1-614	Cotter, 3/16" x 1 1/4"
28.	2	T-3-932	Collar
	2	R1-933	Set Screw, 3/8" x 3/4"
29.	1	N-82-44	Bearing Bar
	2	R1-124	Machine Bolt, Nut, & Lock Washer, 1/2" x 1 1/4"
30.	2	C-17-23	Button Head Rivet, 1/2" x 1 3/4"
	2	R1-605	Cotter, 1/8" x 1"
31.	1	1715 C	Lever Arm
	1	C-17-30	Key, 1/4" x 1/4" x 1 1/2"
	1	R1-129	Machine Bolt, Nut, & Lock Washer, 1/2" x 2 1/2"
32.	1	D-82-43	Link Rod, 3/4" x 2' 0"
33.	2	A-17-27	Lever Pin, 1/2" x 1 1/2"
	2	R1-609	Cotter, 1/8" x 2"
34.	2	B-46-268	U-Bolt, 1/4"
	4	R1-787	Hex Nut, 1/4"
35.	2	A-46-268	Steering Lever Spring



LOADING LEVER
82-219-A1 and 82-219-B1

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	J-82-41	1	Yoke Half (Upper)	
2	H-82-41	1	Yoke Half (Lower)	
	R1-125	2	Machine Bolt, Nut & Lock Washer, ½" x 1½"	
3	F1-82-219	1	Bar, Pivot	
	R1-125	1	Machine Bolt Nut, & Lock Washer, ½" x 1½"	
	R1-127	1	Machine Bolt, Nut & Lock Washer, ½" x 2"	
	R1-441	1	Flat Head Cap Screw, Nut & Lock Washer, ½" x 1½"	
	F-17-23	1	Rivet	
	R1-605	1	Cotter, ⅛" x 1"	
4	N1-82-219	1	Support, Pivot	
	R1-125	2	Machine Bolt, Nut & Lock Washer, ½" x 1½"	
5	G1-82-219	1	Brace	
	R1-125	2	Machine Bolt, Nut & Lock Washer, ½" x 1½"	
6	B-3-149	1	Yoke End	
	C-17-23	1	Rivet	
	R1-605	1	Cotter, ⅛" x 1"	
7	J1-82-219W	1	Rod	
	G-42-47	1	Spring	
	R1-605	1	Cotter, ⅛" x 1"	
8	R1-792	1	Hex Nut, ¾"	
9	S-82-41W	1	Lever	
	Z-17-23	1	Rivet	
	R1-615	1	Cotter, 3/16" x 1½"	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

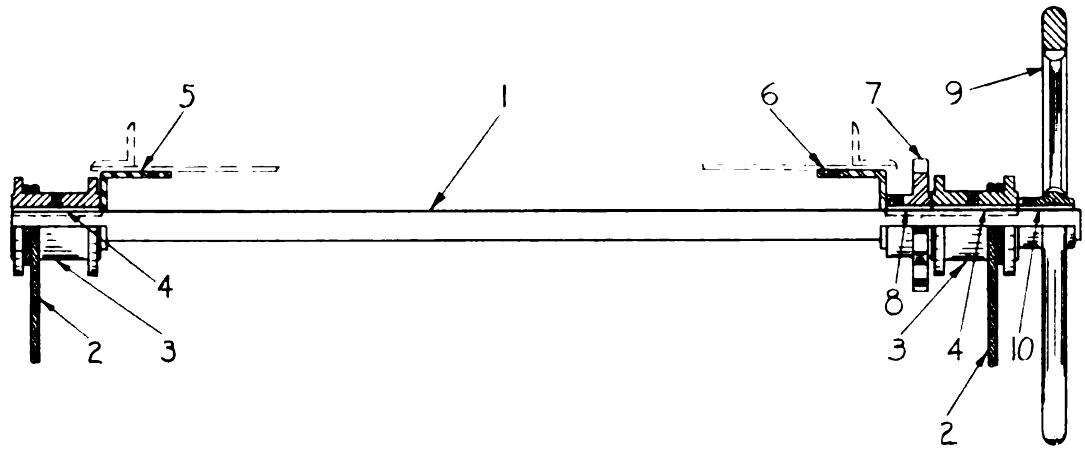


HOIST LEVER

(82-94-A1)

Ref. No.	No. Req.	Part No.	Description
1.	1	E-82-94 W	Lever
	1	V-17-27	Shaft, ⅝" x 3¼", S.A.E. 1020
	1	R1-615	Cotter, 1/16" x 1½"
	1	XX-17-11	Spacer
2.	1	B1-82-94	Rod, ¾" x 2' 8¼"
3.	2	R1-803	Half Nut, ¾"
4.	2	B-3-149	Yoke End
	2	R1-604	Cotter, ⅛" x ¾"
	2	UU-17-23	Rivet
5.	1	D-82-94	Yoke Half (With Pivot)
6.	1	C-82-45	Yoke Half
	3	R1-125	Machine Bolt, Nut, & Lock Washer, ½" x 1½"
	1	R1-126	Machine Bolt, Nut, & Lock Washer, ½" x 1¾"
	1	R1-441	Flat Head Cap Screw, Nut, & Lock Washer, ½" x 1½"
	1	B-17-10	Spacer

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

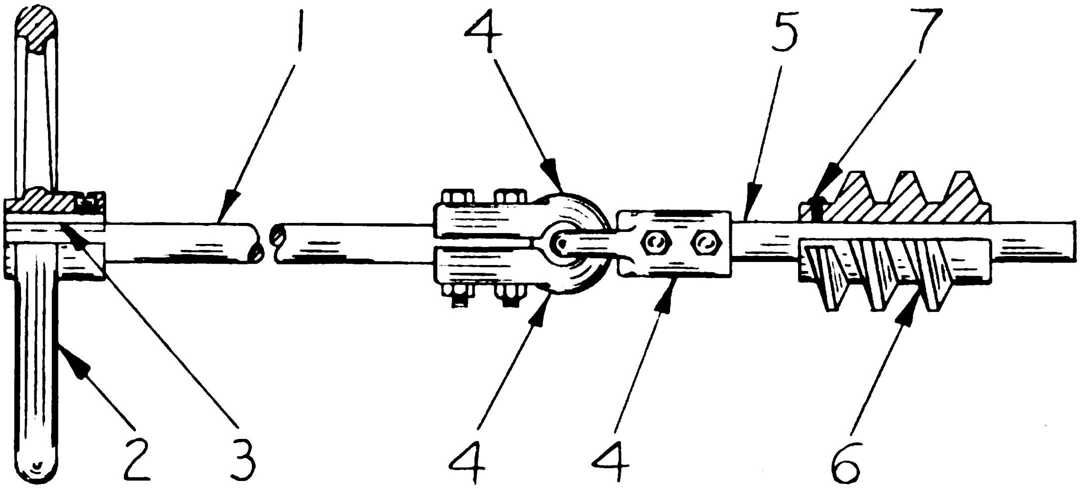


CONVEYOR DISCHARGE BAFFLE CONTROL

From 38-199-A2

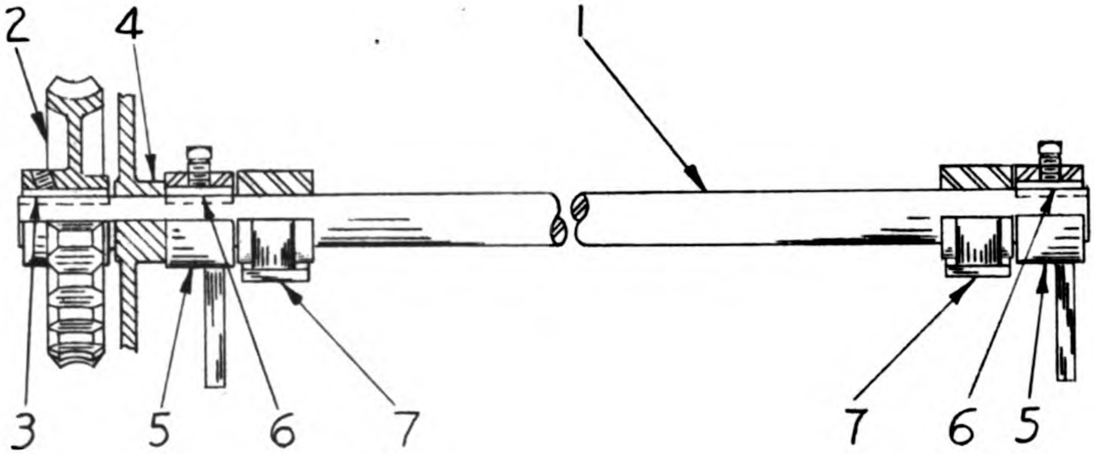
Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	A-38-199	1	Shaft	
2	R1-905	2	Rope, Wire, Crucible Cast Steel, 5/16" x 16'-0" (8 x 19)	
	R1-1116	2	U-Bolt, 2 Hex Nut & 2 Lock Washer 1/4"	
	R1-569	4	Clamp, Cable 5/16"	
	R1-1088	2	Thimble, Cable 5/16"	
	R1-884	2	Pulley Swivel Pole, No. 334987M1	
	P-17-23	2	Rivet	
	R1-605	2	Cotter, 1/8" x 1"	
	R1-20	2	Block, Fast Eye, #9	
	R1-101	2	Machine Bolt, Nut & Lock Washer 3/8" x 3/4"	
3	111E	2	Drum	
	R1-1014	2	Set Screw, Safety, 3/8" x 3/4"	111E
4	N-17-30	2	Key	
5	C1R-38-199	1	Bracket	
	R1-124	4	Machine Bolt, Nut & Lock Washer, 1/2" x 1 1/4"	
6	EL-38-199W	1	Bracket	
7	612B	1	Ratchet Wheel	
	R1-1014	2	Set Screw, Safety, 3/8" x 3/4"	612B
8	E-17-30	1	Key	
9	735C	1	Hand Wheel	
	R1-1011	2	Set Screw, Safety, 3/8" x 3/8"	735C
10	H-17-30	1	Key	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



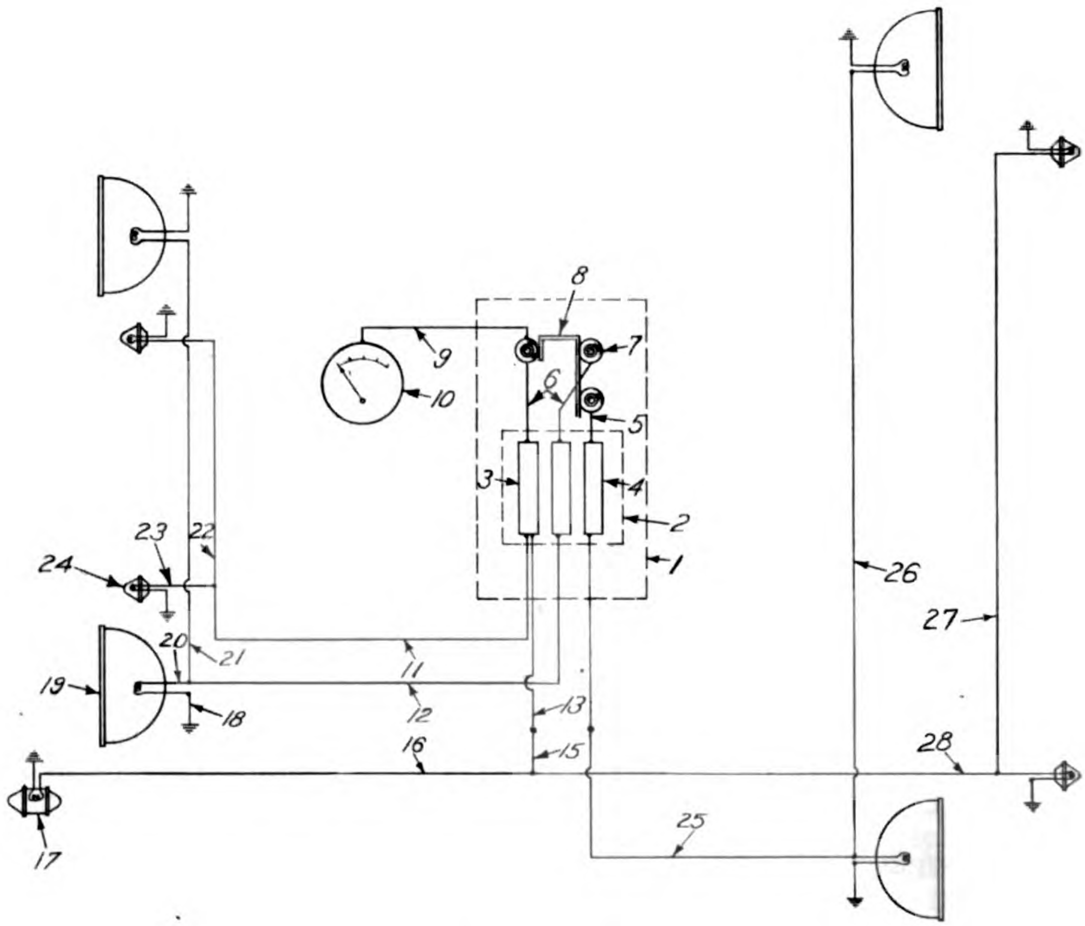
SCRAPER CONTROL HAND WHEEL
SHAFT AND WORM SHAFT
From 38-192-A2

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	F-38-192	1	Shaft	
2	1392	1	Hand Wheel	
	R1-930	2	Set Screw, Safety, 3/8" x 3/8"	1392
3	H-17-30	1	Key	
4	1052	4	Joint, Universal	
	R1-107	4	Machine Bolt, Nut & Lock Washer, 3/8" x 2 1/4"	
5	U-38-67	1	Shaft	
6	806	1	Worm	
7	C-17-26	2	Pin	



SCRAPER CONTROL WORM GEAR SHAFT
From 38-192-A2

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	A-38-192	1	Shaft	
2	805	1	Worm Wheel, 24-tooth	
	R1-940	2	Set Screw, ½" x ¾"	805
3	H-17-32	1	Key	
4	340	1	Housing	
	R1-147	2	Machine Bolt, Nut & Lock Washer, ⅝" x 1¾"	
5	J-38-192W	2	Arm	
	R1-940	2	Set Screw, ½" x ¾"	J-38-192W
	R1-942	2	Set Screw, ½" x 1"	J-38-192W
6	B-17-32	2	Key	
7	1383A	2	Bearing	
	R1-132	4	Machine Bolt, Nut & Lock Washer, ½" x 3¼"	



LIGHTS

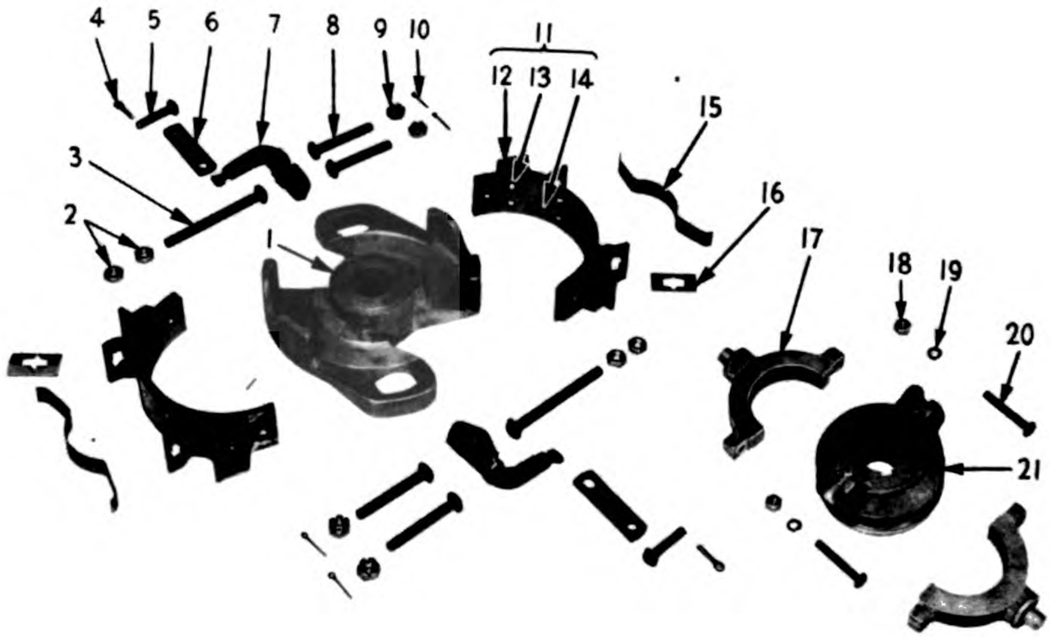
38-292-A, 38-292-B, and 82-286-A

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	EL-SB-A	1	Box, Switch	
2	EL-FB-A	1	Block, Four Pole Fuse	
	R1-32	2	Flat Head Stove Bolt, 3/16" x 3/4"	
3	EL-FS-A6	1	Fuse, 6-Ampere	
4	EL-FS-A15	2	Fuse, 15-Ampere	
5	R1-362	1	L. C. Cable, 16 Ga. 0'-6"	
6	R1-363	2	L. C. Cable, 16 Ga. 1'-0"	
7	EL-SW-A	3	Switch, Push-Pull	
8	Q-38-230	1	Buss Bar	
9	R1-396	1	L. C. Cable, 10 Ga. 4'-0"	
10			Ammeter (on Engine)	
11	R1-368	1	L. C. Cable, 16 Ga. 5'-0"	
12	R1-367	1	L. C. Cable, 16 Ga. 4'-6"	
13	R1-366	2	L. C. Cable, 16 Ga. 4'-0"	
15	R1-365	1	L. C. Cable, 16 Ga. 3'-0"	
16	R1-372	1	L. C. Cable, 16 Ga. 18'-6"	

(continued on next page)

Lights—(continued)

17	EL-LA-J1	1		Lamp, Red Clearance	
	EL-BU-E		1	Bulb	EL-LA-J1
18	R1-364	4		L. C. Cable, 16 Ga. 2′-6″	
19	EL-LA-A	4		Lamp, Dietz Flood	
	EL-BU-D	4		Bulb, 6-Volt	
20	R1-364	2		L. C. Cable, 16 Ga. 2′-6″	
21	R1-368	1		L. C. Cable, 16 Ga. 5′-0″	
22	R1-366	1		L. C. Cable, 16 Ga. 4′-0″	
23	R1-363	1		L. C. Cable, 16 Ga. 1′-0″	
24	EL-LA-K1	4		Lamp, Red Clearance	
	EL-BU-E		4	Bulb	EL-LA-K1
25	R1-371	1		L. C. Cable, 16 Ga. 14′-0″	
26	R1-369	1		L. C. Cable, 16 Ga. 5′-6″	
27	R1-370	1		L. C. Cable, 16 Ga. 8′-0″	
28	R1-373	1		L. C. Cable, 16 Ga. 22′-0″	
	EL-WT-A16	23		Terminal, Wire, 16 Ga.	
	EL-WT-A10	2		Terminal, Wire, 10 Ga.	
	EL-CF-C	1		Extension, Panel Connector	



B-G 8" FRICTION CLUTCH

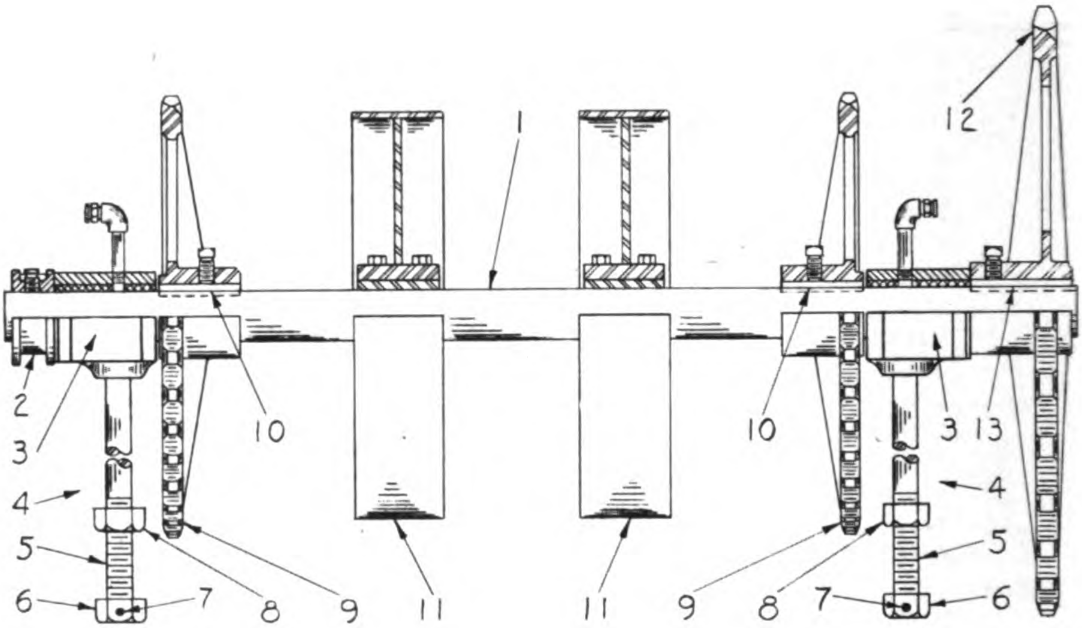
Ref. No.	No. Req.	Part No.	Description
1.	1	3436	Clutch Carrier
2.	4	R1-801	Half Nut, ½"
3.	2	C-46-208	Machine Bolt, ½" x 5¾"
4.	2	R1-605	Cotter, ⅛" x 1"
5.	2	C-3-1011	Toggle Pin
6.	2	A-3-1011	Toggle Link
7.	2	A-3-1010	Clutch Lever
8.	4	B-46-208	Machine Bolt, ½" x 3½"
9.	4	D-46-208	Slotted Nut, ½"
10.	4	R1-606	Cotter, ⅛" x 1¼"
11.	2	A-3-1008 WR	Clutch Band Half (Complete)
13.	24	R1-892	Rivet, Tubular #10 x $\frac{7}{16}$"
14.	2	F-3-1008	Clutch Lining
15.	2	B-3-1011	Spring
16.	1	A-3-1007	Shim, 10 Ga.
16.	1	C-3-1007	Shim, 14 Ga.
17.	1	897	Shifter Yoke
18.	2	R1-789	Hex Nut, ⅜"
19.	2	R1-1179	Lock Washer, ⅜"
20.	2	R1-36	Machine Bolt, ⅜" x 2¼"
21.	1	3438	Shifter Collar

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

TOOLS

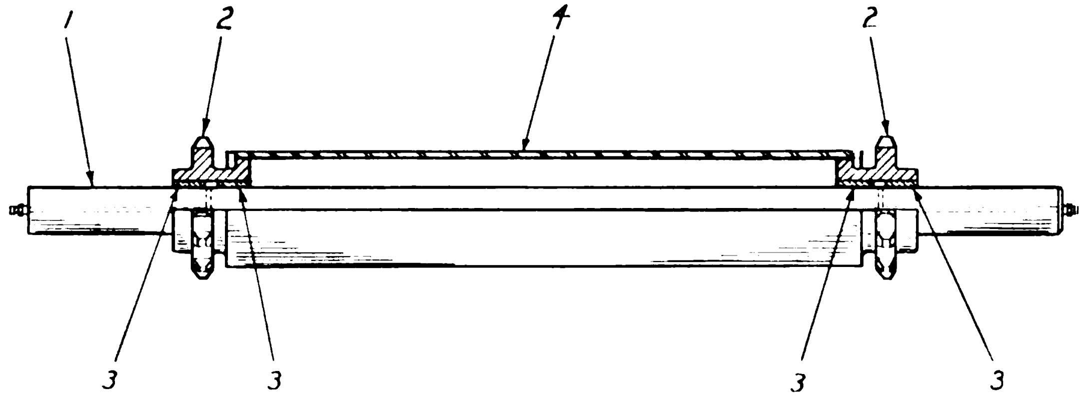
82-285-A and 82-285-B

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
	J-46-20	1	Chisel, $\frac{3}{4}''$	
	EE-46-20	1	Drift, $\frac{3}{4}''$	
	AN-46-20	1	Gun, Alemite Gat	
	AH-46-20	1	Hose, Heavy Duty	
	A-46-20	1	Hammer, Ball Peen, $1\frac{3}{4}$ lbs.	
	N-46-20	1	Pliers, 8"	
	P-46-20	1	Screwdriver, 6"	
	MM-46-20	1	Wrench, Adjustable, 12"	
	M-46-20	1	Wrench, Safety Set Screw, $\frac{3}{8}''$	
	HH-46-20	1	Wrench, Safety Set Screw, $\frac{5}{8}''$	
	ZZ-46-20	1	Wrench, Check Nut	
	E-46-20	1	Wrench, Construction, 1"	
	G-46-219	1	Wrench, Crank Case Plug, $\frac{5}{8}''$ x $\frac{5}{8}''$ x 4"	
	F-46-20	1	Wrench, Construction, $1\frac{1}{4}''$	
	WW-46-20	1	Wrench, Engineer, $\frac{5}{8}''$ x $\frac{3}{4}''$	
	BB-46-20	1	Oil Can	
	B-46-20	1	Wrench, Engineer, $\frac{3}{8}''$ x $\frac{1}{2}''$	
From 82-285-B For Snow Loader Only.				
	B-38-265W	1	Hoe, Snow	



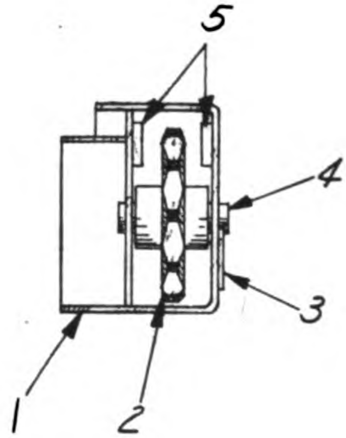
CONVEYOR HEAD SHAFT
38-283-A1

Ref No.	Part Number	Number Required		DESCRIPTION	Part of Assem. No.
1	A-38-283	1		Shaft	
2	136A	1		Collar	
	R1-989		1	Set Screw, Low Head, ⅝" x ¾"	136A
3	838B	2		Bearing, Take-Up	
	R1-12	2		Alemite, Button Head, Male, ¼"	
	R1-683	2		Elbow, ¼" x 90°	
	I-17-43	2		Pipe	
4	46-198-A	2		Bolt, Take-Up	
5	C-46-198		2	Bolt, 1"	46-198-A
6	D-46-198		2	Hex Nut, 1"	46-198-A
7	DA-17-26	2		Pin	
8	K-17-24	2		Hex Nut, 1"	
9	2992	2		Sprocket, 37-tooth	
	R1-950		2	Set Screw, ⅝" x 1¼"	2992
	R1-949		2	Set Screw, ⅝" x 1"	2992
10	HH-17-33	2		Key	
11	PL-D-M1	2		Pulley	
12	3620	1		Sprocket, 30-tooth	
	R1-950		2	Set Screw, ⅝" x 1¼"	3620
13	K-17-33	1		Key	



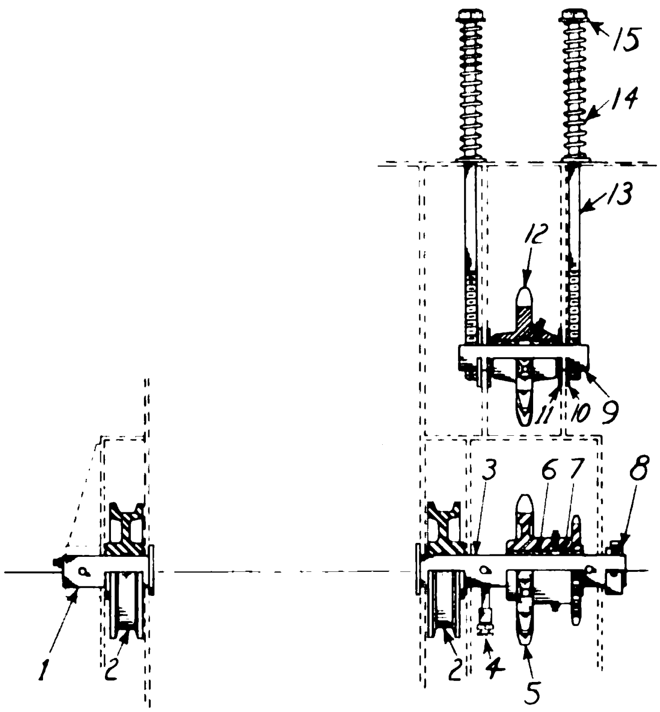
CONVEYOR FOOT SHAFT
38-287-A

Ref. No.	Part Number	Number Required		DESCRIPTION	Part of Assem. No.
1	A-38-193	1		Shaft	
	R1-12	2		Alemite, Button Head, Male, ¼"	
2	2993	2		Sprocket, 12-tooth	
3	C-8-75		4	Bushing	2993
4	A-38-287	1		Pulley	



CONVEYOR DRIVE IDLER
ELEVATOR DRIVE IDLER
38-245-A2

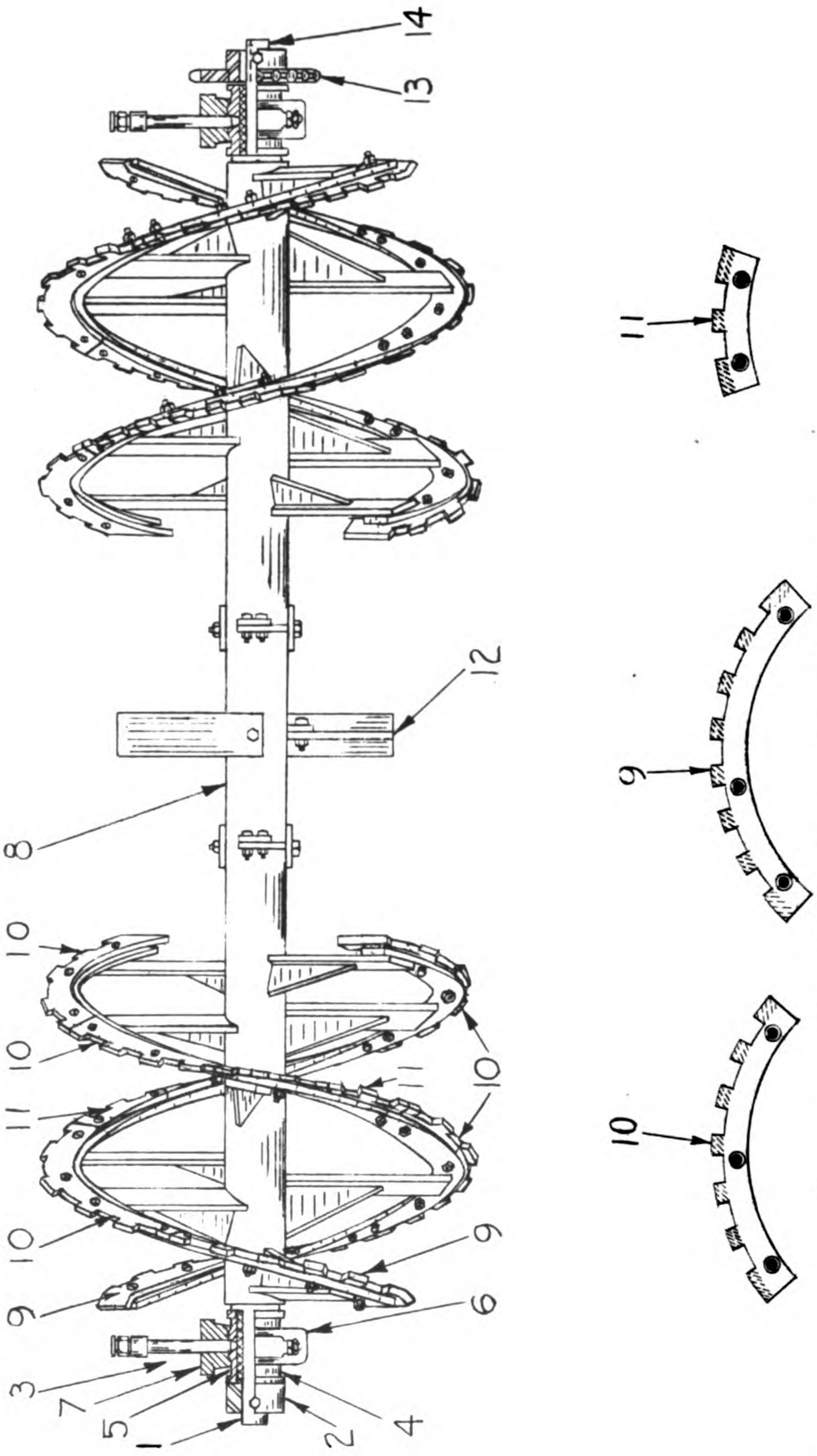
Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	H-38-245W	1	Bracket	
	R1-124	3	Machine Bolt, Nut & Lock Washer, ½" x 1¼"	
2	2991B	1	Sprocket, 9-tooth	
	G-8-54	2	Bushing	2991B
3	E-38-245	1	Keeper	
	R1-103	2	Machine Bolt, Nut & Lock Washer, ⅜" x 1¼"	
4	G1-38-245	1	Shaft	
	R1-11	1	Alemite, Button Head, Male, ⅛"	
5	C-38-245	2	Guide, Chain	
	D-38-245	2	Guide, Chain	
	R1-442	2	Flat Head Cap Screw, Nut & Lock Washer, ½" x 1¾"	



CONVEYOR PIVOT SHAFT AND CONVEYOR DRIVE TAKE-UP IDLER

38-198-A2

Ref. No.	Part Number	Number Required		DESCRIPTION	Part of Assem. No.
1	F-38-198W	1		Shaft	
	R1-11	1		Alemite, Button Head, Male, ⅛"	
	R1-136	1		Machine Bolt, Nut & Lock Washer, ½" x 4¼"	
2	694A	2		Wheel	
3	E-38-198W	1		Shaft	
4	WW-17-43	1		Pipe	
4	R1-648	1		Coupling, ⅛"	
4	R1-11	1		Alemite, Button Head, Male, ⅛"	
	R1-136	1		Machine Bolt, Nut & Lock Washer, ½" x 4¼"	
	CX-17-23	1		Rivet	
	R1-605	1		Cotter, ⅛" x 1"	
5	19-662-B	1		Sprocket, 10 & 23-tooth	
6	C-8-95		1	Bushing	19-662-B
7	G-8-95		1	Bushing	19-662-B
	R1-12	2		Alemite, Button Head, Male, ¼"	
8	B-3-944	1		Collar	
	R1-948		2	Set Screw, ⅝" x ¾"	B-3-944
9	E-42-76	1		Shaft	
10	AD-17-9	2		Washer	
11	P-17-9	2		Washer	
12	2991	1		Sprocket, 9-tooth	
	G-8-54		2	Bushing	2991
	R1-12	1		Alemite, Button Head, Male, ¼"	
13	BB-17-24	2		Bolt, Take-Up	
14	K-24-42	2		Spring	
15	R1-1170	4		Cut Washer, ¾"	



CONVEYOR SPIRAL AND WEARING STRIPS

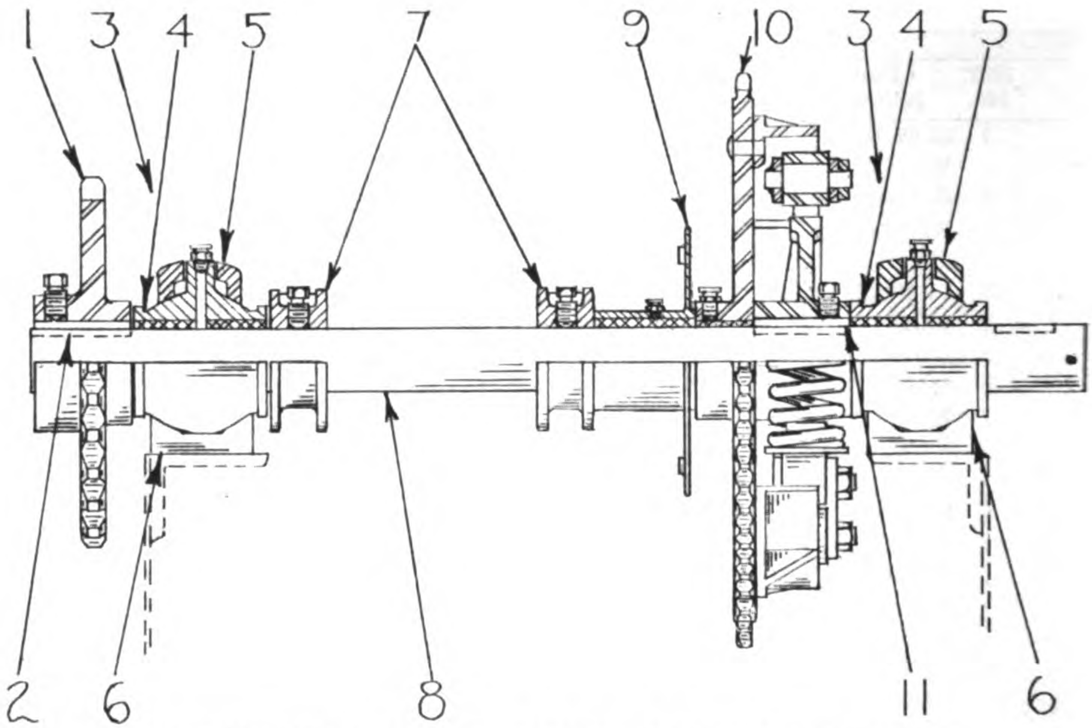
ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

CONVEYOR SPIRAL AND WEARING STRIPS

38-191-A

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	H-38-187	1	Shaft	
	X-17-33	1	Key	
2	E-3-946	1	Collar	
	R1-185	1	Machine Bolt, Nut & Lock Washer, ¾" x 5"	
3	13-216-D	2	Bearing	
4	1082	2	Upper	13-216-D
5	1082A	2	Lower	13-216-D
6	961	2	Cap	13-216-D
7	960	2	Base	13-216-D
	R1-81	4	Machine Bolt, Nut & Jam Nut, ⅝" x 6"	13-216-D
	R1-248	4	Machine Bolt, Nut, Lock Washer & Cut Washer, ⅝" x 3¼"	
	Z-17-43	2	Pipe	
	R1-649	2	Coupling, ¼"	
	R1-12	2	Alemite, Button Head, Male, ¼"	
8	A-38-186W	1	Spiral	
	R1-976	2	Set Screw and Jam Nut, ⅝" x 1¾"	
	A(R)38-189	2	Wearing Strip (Opposite Operator's Side)	
	R1-455	6	Flat Head Cap Screw, Nut & Lock Washer, ⅝" x 2¼"	
9	A(L)38-189	2	Wearing Strip (Operator's Side)	
	R1-455	6	Flat Head Cap Screw, Nut & Lock Washer, ⅝" x 2¼"	
	B(R)38-189	6	Wearing Strip (Opposite Operator's Side)	
	R1-455	18	Flat Head Cap Screw, Nut & Lock Washer, ⅝" x 2¼"	
10	B(L)38-189	6	Wearing Strip (Operator's Side)	
	R1-455	18	Flat Head Cap Screw, Nut & Lock Washer, ⅝" x 2¼"	
	C(R)38-189	2	Wearing Strip (Opposite Operator's Side)	
	R1-455	4	Flat Head Cap Screw, Nut, & Lock Washer, ⅝" x 2¼"	
11	C(L)38-189	2	Wearing Srtip (Operator's Side)	
	R1-455	4	Flat Head Cap Screw, Nut & Lock Washer, ⅝" x 2¼"	
12	J-38-187W	6	Paddle	
	R1-125	12	Machine Bolt, Nut & Lock Washer ½" x 1½"	
	R1-187	3	Machine Bolt, Nut & Lock Washer, ¾" x 6"	
13	A-19-816W	1	Sprocket, 22-tooth	
	R1-949	2	Set Screw, ⅝" x 1"	A-19-816W
	GG-17-33	2	Key	
	R1-185	1	Machine Bolt, Nut & Lock Washer, ¾" x 5"	
14	F-38-187	1	Shaft	
	X-17-33	1	Key	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

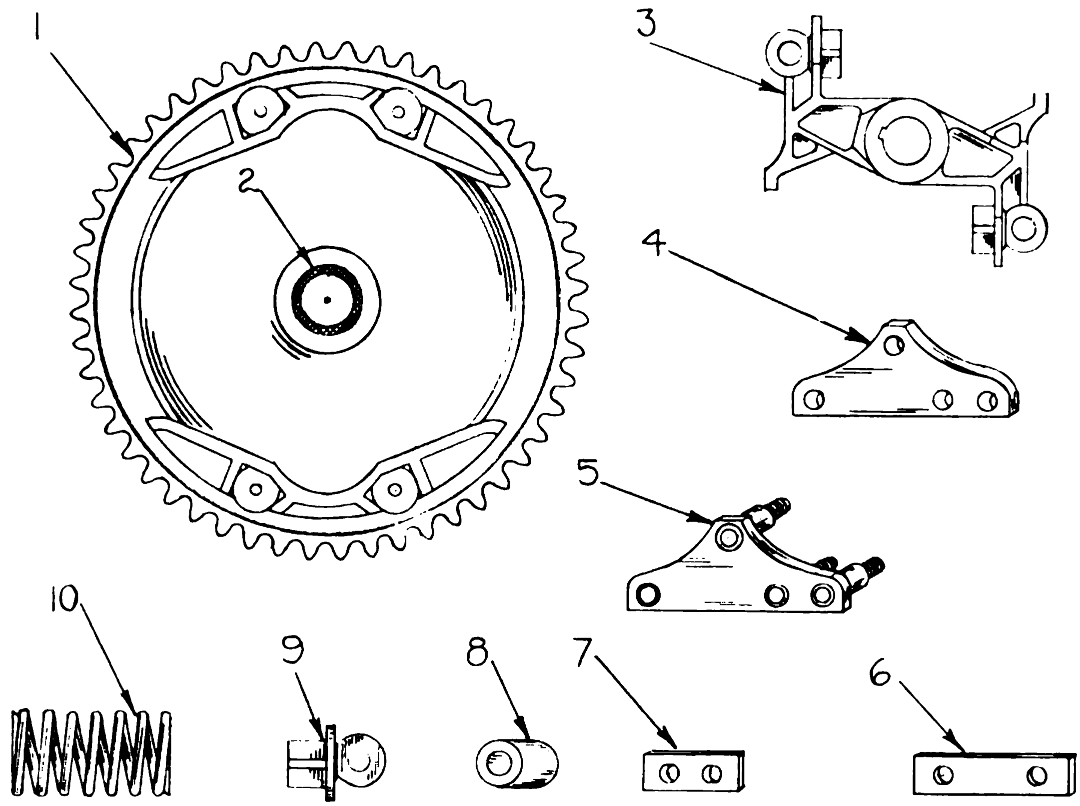


CONVEYOR SPIRAL DRIVE COUNTER SHAFT

38-194-A4

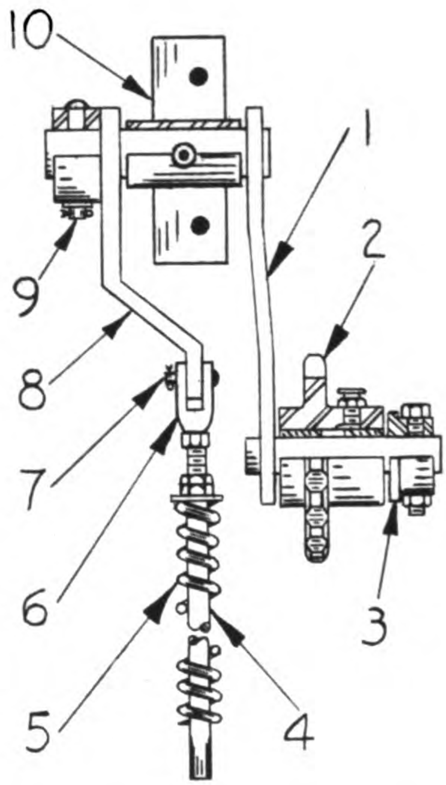
Ref. No	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	19-601-X	1	Sprocket, 29-tooth	
	R1-990	1	Low Head Set Screw, ⅝" x 1"	19-601-X
	R1-991	1	Low Head Set Screw, ⅝" x 1¼"	19-601-X
2	S-17-33	1	Key	
3	13-213-C	2	Bearing	
4	2419 A	2	Bearing	13-213-C
5	822 B	2	Cap	13-213-C
6	821	2	Base	13-213-C
	R1-81	4	Machine Bolt, Nut & Jam Nut, ⅝" x 6"	13-213-C
	R1-11	2	Alemite, Button Head, Male, ⅛"	
	R1-245	4	Machine Bolt, Nut, Lock Washer & Cut Washer, ⅝" x 2½"	
	M-17-28	4	Blocking	
	R1-124	4	Machine Bolt, Nut & Lock Washer, ½" x 1¼"	
7	136	2	Collar	
	R1-990	2	Low Head Set Screw, ⅝" x 1"	136
8	C-38-194	1	Shaft	
9	F-38-212WB	1	Bearing Patch	
	R1-11	1	Alemite, Button Head, Male, ⅛"	
	R1-102	4	Machine Bolt, Nut & Lock Washer, ⅜" x 1"	
10	19-675-A2	1	Spring Release Sprocket, 52-tooth. (For Details see "Conveyor Spring Release Sprocket")	
11	AH-17-33	1	Key	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



CONVEYOR SPRING RELEASE SPROCKET
19-675-A2

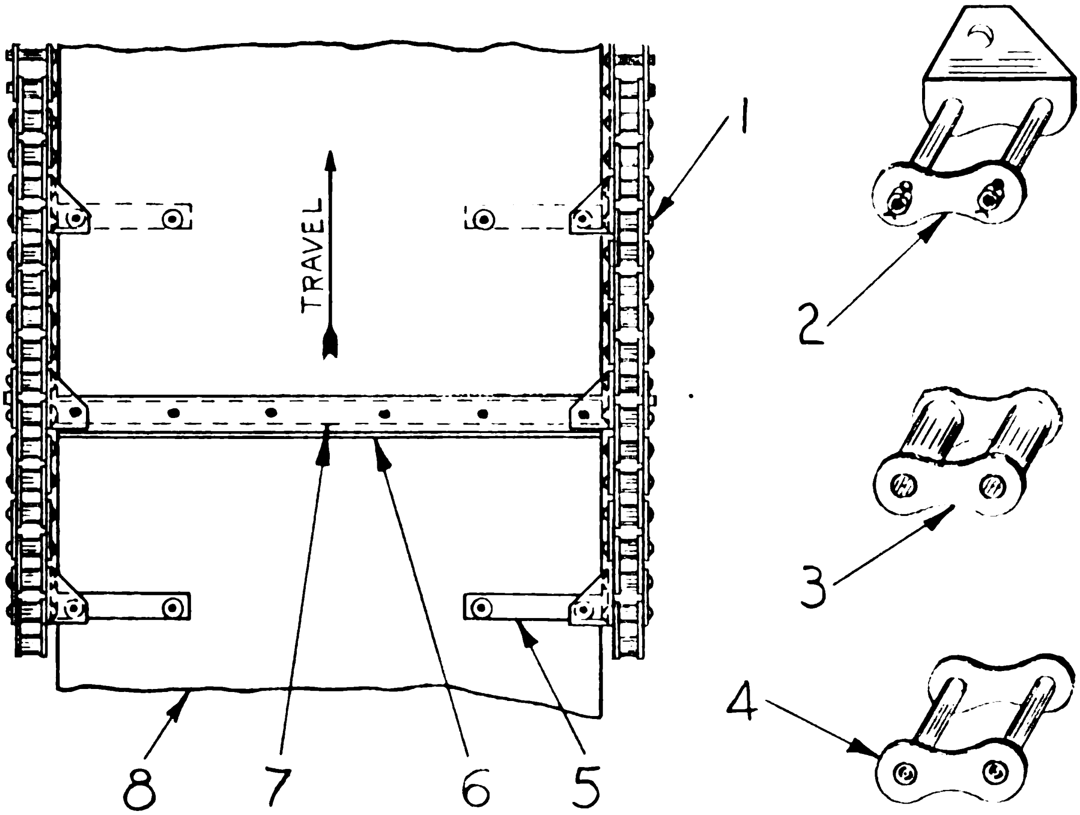
Ref. No.	Part Number	Number Required		DESCRIPTION	Part of Assem. No.
1	A-19-699WMR	1		Sprocket, 52-tooth	
2	P-8-72		1	Bushing	A-19-699WMR
	R1-11	1		Alemite Button Head, Male, ⅛"	
3	1932 A	1		Hub	
	P-17-51		1	Set Screw	1932 A
	R1-948		1	Set Screw, ⅝" x ¾"	1932 A
	R1-11	2		Alemite, Button Head, Male, ⅛"	
4	A-19-674	2		Plate, Roller	
	R1-803	2		Hex Half-Nut, ¾"	
5	G-19-674W	2		Bar, Side	
6	E-19-674	2		Shim, 16 Ga.	
7	F-19-674	2		Shim, 16 Ga.	
8	A-19-212	2		Roller	
9	1933	2		Retainer, Spring	
10	B1-46-270	2		Spring	



CONVEYOR COUNTER SHAFT IDLER
From 38-212-A5

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	C-38-212W	1	Bracket	
2	B-19-250	1	Sprocket, 16-tooth	
	A-8-11	2	Bushing	B-19-250
	R1-12	1	Alemite, Button Head, Male, ¼″	
3	H-38-212W	1	Arm	
	R1-108	1	Machine Bolt, Nut & Lock Washer, ⅜″ x 2½″	
	AG-17-10	1	Pipe	
	R1-114	1	Machine Bolt, Nut & Lock Washer, ⅜″ x 4″	
4	A-46-270	1	Spring	
5	N2-38-213	1	Rod	
	R1-1170	1	Cut Washer, ¾″	
	R1-803	2	Half Nut, ¾″	
	R1-792	1	Hex Nut, ¾″	
6	B-3-149	1	Yoke End	
7	D-17-23	1	Rivet	
	R1-612	1	Cotter, 3/16″ x 1″	
8	E1-38-212W	1	Arm, Lever	
9	H-17-23	1	Rivet	
	CS-17-9	1	Washer	
	R1-605	1	Cotter, ⅛″ x 1″	
10	B-38-212WB	1	Bearing	
	R1-12	1	Alemite, Button Head, Male, ¼″	
	R1-102	2	Machine Bolt, Nut & Lock Washer, ⅜″ x 1″	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



CONVEYOR BELT
38-284-A

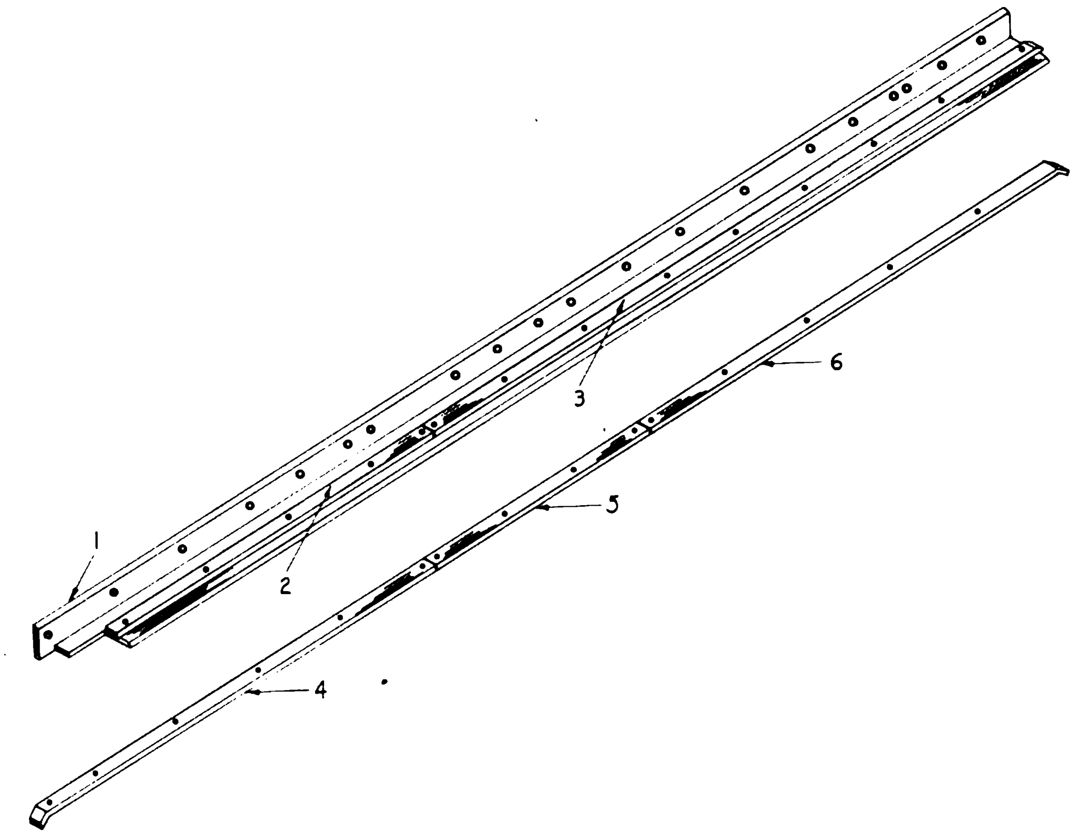
Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
	38-284-A	1	Belt Assembly with Chain & Flights	
1	F(R)38-284R	1	Chain Assembly, 374 Links (Opposite Operator's Side)	
2	C(R)6-8A	62	Attachment (Opposite Operator's Side)	F(R)38-284R
	R1-441	62	Flat Head Cap Screw, Nut & Lock Washer, ½" x 1½"	
3	A-6-83	1	Roller Link	F(R)38-284R
	E-6-83	62	Strand #SS-378 Chain, 5 Link, 1.654" P.	F(R)38-284R
	F(L)38-284R	1	Chain Assembly, 374 Links (Operator Side)	
	C(L)6-8A	62	Attachment (Opperator's Side)	F(L)38-284R
	R1-441	62	Flat Head Cap Screw, Nut & Lock Washer, ½" x 1½"	
	A-6-83	1	Roller Link	F(L)38-284R
	E-6-83	62	Strand #SS-378 Chain, 5 Link, 1.654" P.	F(L)38-284R
4	B-6-83	2	Connecting Link	
5	D(R)38-284	31	Attachment Bar	
	D(L)38-284	31	Attachment Bar	
	E-38-284	62	Attachment Bar	
	R1-335	62	Round Head Stove Bolt, Nut, Lock Washer & Cut Washer, ⅜" x 1¼"	
6	B-38-284	31	Flight	
	R1-330	124	Round Head Stove Bolt, Nut & Lock Washer, ⅜" x 1¼"	

(continued on next page)

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

Conveyor Belt—(continued)
38-284A

7	C-38-284	31		Flight Bar	
8	A-38-284	1		Conveyor Belt, 28" +.00" or − 1/8" 4 Ply, 28 Ounce, 1/16" Rubber Cover, 1/32" Bottom, 51'-6 3/16" Complete With Lacing & Pins	
	R1-746		2	Lacing, Alligator Belt, #35, 28"	A-38-284
	R1-830		2	Pin, Alligator Rocker, #35, 28"	A-38-284

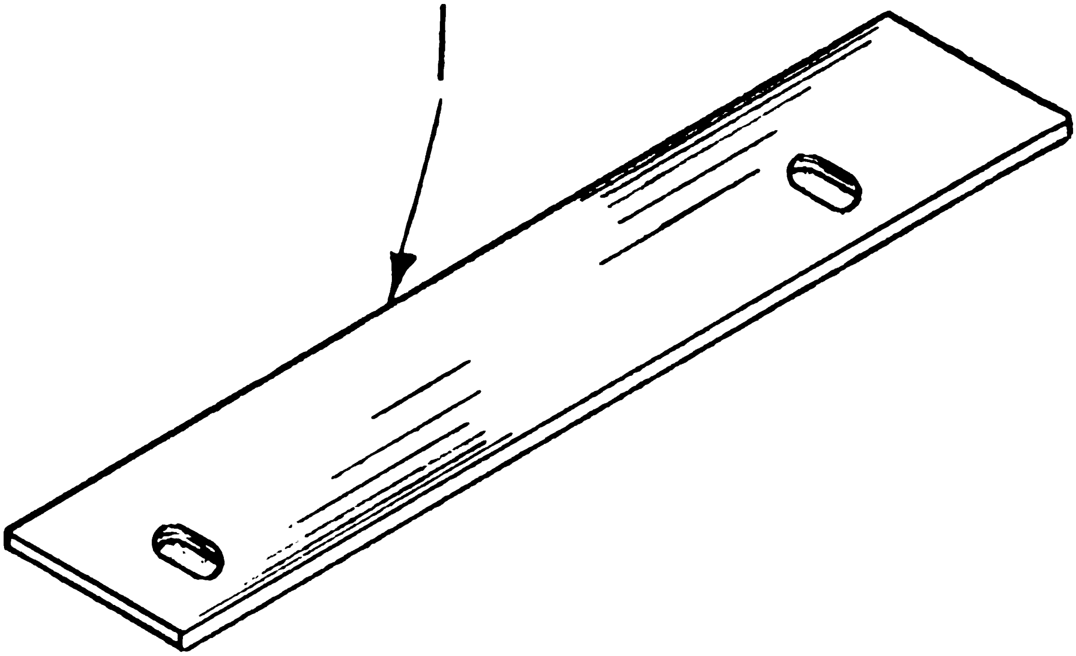


CONVEYOR WEARING STRIPS

38-267-E2

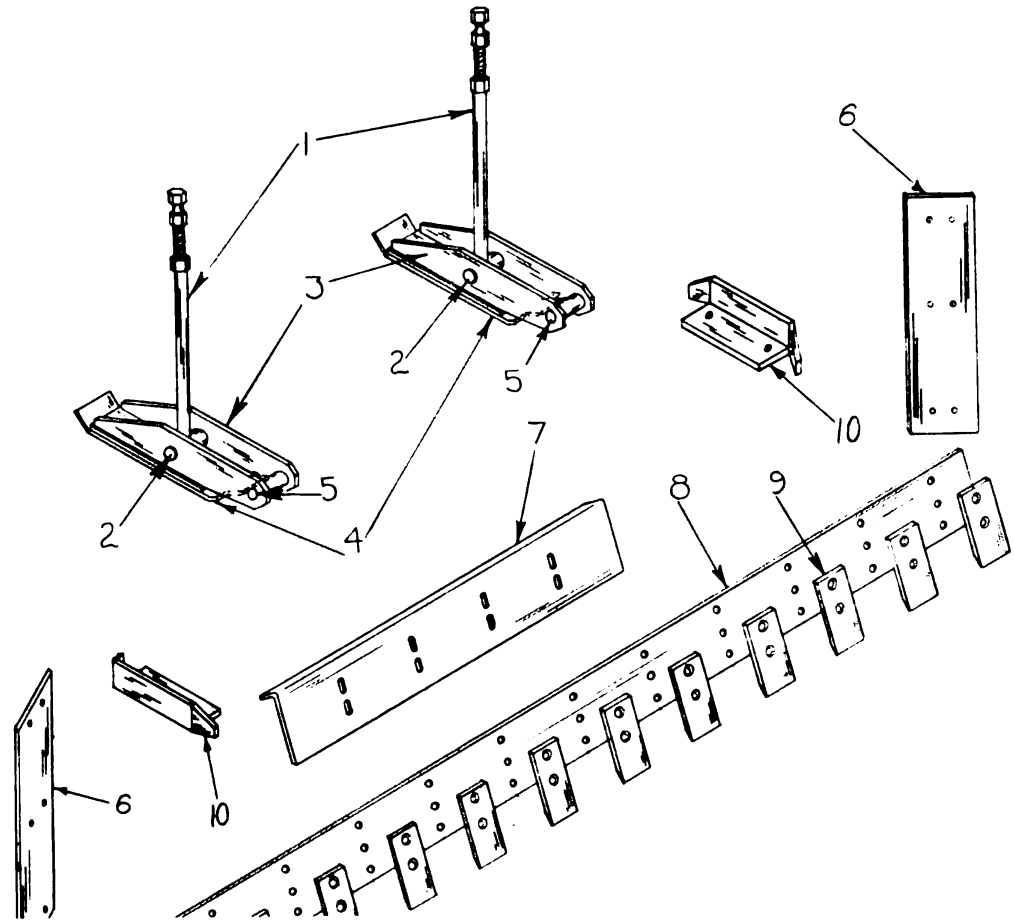
Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
	B1(R)38-286	1	Track Angle	
1	B1(L)38-286	1	Track Angle	
	R1-441	4	Flat Head Cap Screw, Nut & Lock Washer, ½" x 1½"	
	R1-442	2	Flat Head Cap Screw, Nut & Lock Washer, ½" x 1¾"	
	R1-439	28	Flat Head Cap Screw, Nut & Lock Washer, ½" x 1"	
	R1-440	6	Flat Head Cap Screw, Nut & Washer, ½" x 1¼"	
2	F-38-285	2	Wearing Strip	
3	E-38-285	2	Wearing Strip	
4	G-38-285	2	Wearing Strip	
5	H1-38-285	2	Wearing Strip	
6	J-38-285	2	Wearing Strip	
	R1-461	60	Flat Head Cap Screw, Nut, Lock Washer & Cut Washer, ¼" x 1"	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



CONVEYOR BELT SCRAPER
38-267-A3

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	M1-38-207	2	Scraper	
	R1-541	4	Hex Head Cap Screw, Nut & Lock Washer, ½" x 1"	

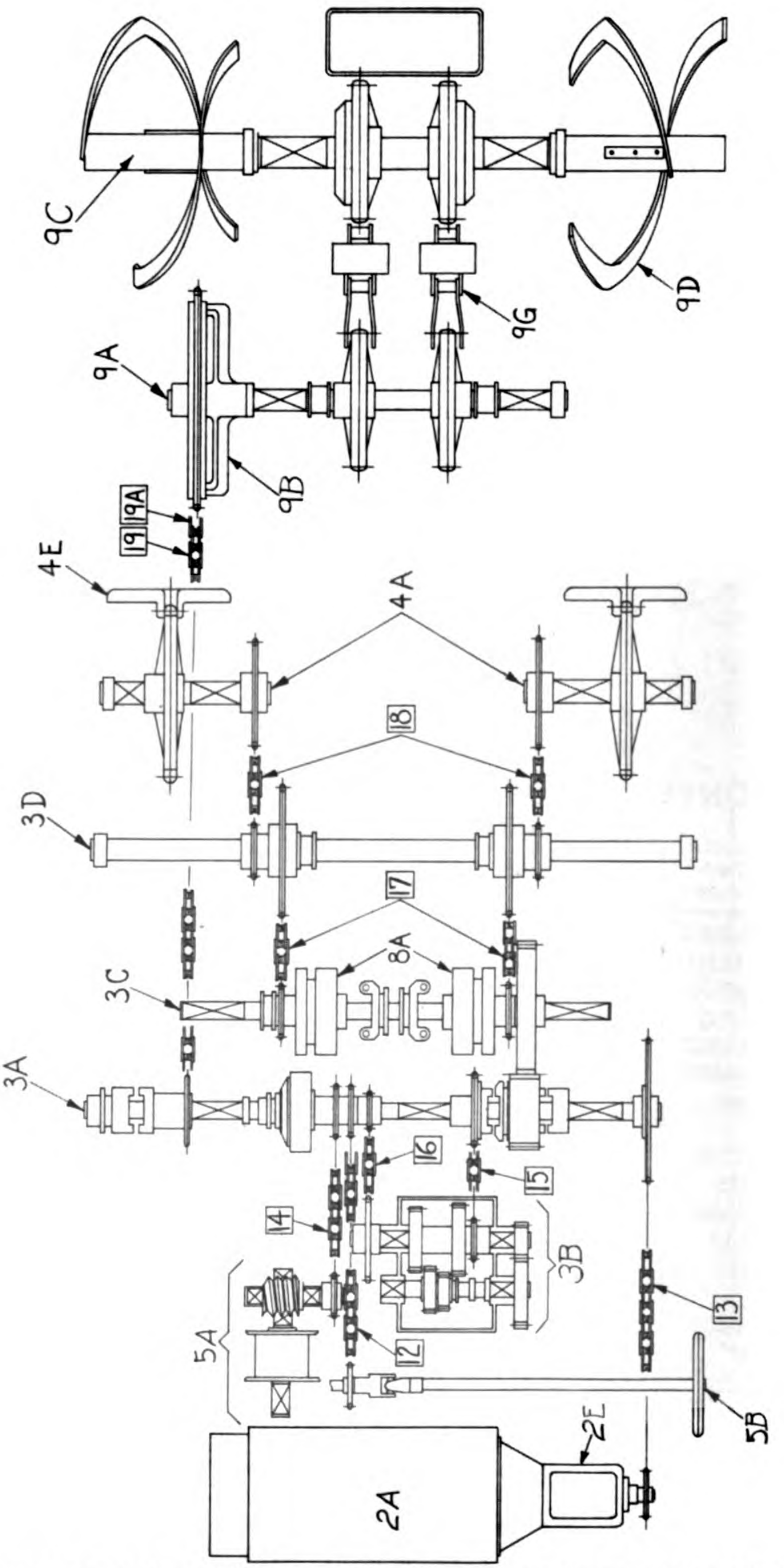


CONVEYOR SCRAPER SHOES AND BLADES
38-288-A and 38-236-A2

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	B-38-288W	2	Arm, Shoe Adjusting	
	C-3-1137M	2	Screw, Adjusting	
	BU-17-26	4	Pin	
2	FF-17-27	2	Shaft	
3	E-38-288W	2	Bracket, Shoe	
4	F-38-288W	2	Shoe	
	R1-306	4	Plow Bolt, Nut & Lock Washer, #3 Head, ½" x 1½"	
5	NN-17-25	2	Shaft	
	R1-625	4	Cotter, ¼" x 2"	
	G-38-288	2	Stop Bar	
	E-17-10	2	Spacer	
	R1-226	2	Machine Bolt, Nut, Lock Washer & Cut Washer, ½" x 2"	
6	S1-38-239	2	Blade	
	R1-67	6	Machine Bolt, Lock Washer, & Half Nut, ⅝" a 1¼"	
7	D1-38-239	1	Center Plate, Adjustable	
8	C1-38-239	1	Blade	
9	C-3-202	12	Tooth	
	R1-444	24	Flat Head Cap Screw, Nut & Lock Washer, ½" x 2¼"	
10	D1-38-237	4	Shoe	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

POWER TRANSMISSION MACHINERY



BUCKET LOADER DRIVE CHAINS
82-105-A9, 82-105-C1, and 82-105-F

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
12	AA-6-58C	1	Strand of Diamond #434 Chain, 1" Pitch, 26 Links & 1 Offset	
	A-6-58	13	Roller Link, Diamond #434 Chain, 1" Pitch	AA-6-58C
	B-6-58	13	Connecting Link, Diamond #434 Chain, 1" Pitch	AA-6-58C
	C-6-58	1	Offset Link, Diamond #434 Chain 1" Pitch	AA-6-58C
13	BA-6-64C	1	Strand of Diamond #470 Chain, 1¼" Pitch, 76 Links	
	A-6-64	38	Roller Link, Diamond #470 Chain, 1¼" Pitch	BA-6-64C
	B-6-64	38	Connecting Link, Diamond #470 Chain, 1¼" Pitch	BA-6-64C
	C-6-64	1	Offset Link Diamond #470 Chain, 1¼" Pitch	
14	KK-6-58C	1	Strand of Diamond #434 Chain, 1" Pitch, 36 Links & 1 Offset	
	A-6-58	18	Roller Link, Diamond #434, 1" Pitch	KK-6-58C
	B-6-58	18	Connecting Link, Diamond #434 Chain, 1" Pitch	KK-6-58C
	C-6-58	1	Offset Link, Diamond #434 Chain, 1" Pitch	KK-6-58C
15	KK-6-64C	1	Strand of Diamond #470 Chain, 1¼" Pitch, 36 Links & 1 Offset	
	A-6-64	24	Roller Link, Diamond #470 Chain, 1¼" Pitch	KK-6-64C
	B-6-64	24	Connecting Link, Diamond #470 Chain, 1¼" Pitch	KK-6-64C
	C-6-64	1	Offset Link, Diamond #470 Chain, 1¼" Pitch	KK-6-64C
16	XX-6-58C	1	Strand of Dimaond #434 Chain, 1" Pitch, 48 Links	
	A-6-58	24	Roller Link, Diamond #434 Chain, 1" Pitch	XX-6-58C
	B-6-58	24	Connecting Link, Diamond #434 Chain, 1" Pitch	XX-6-58C
	C-6-58	1	Offset Link Diamond #434 Chain, 1" Pitch	
17	AH-6-64C	2	Strand of Diamond #470 Chain, 1¼" Pitch, 56 Links & 1 Offset	
	A-6-64C	56	Roller Link, Diamond #470 Chain, 1¼" Pitch	AH-6-64C
	B-6-64C	56	Connecting Link, Diamond #470 Chain, 1¼" Pitch	AH-6-64C
	C-6-64	2	Offset Link, Diamond #470 Chain, 1¼" Pitch	AH-6-64C

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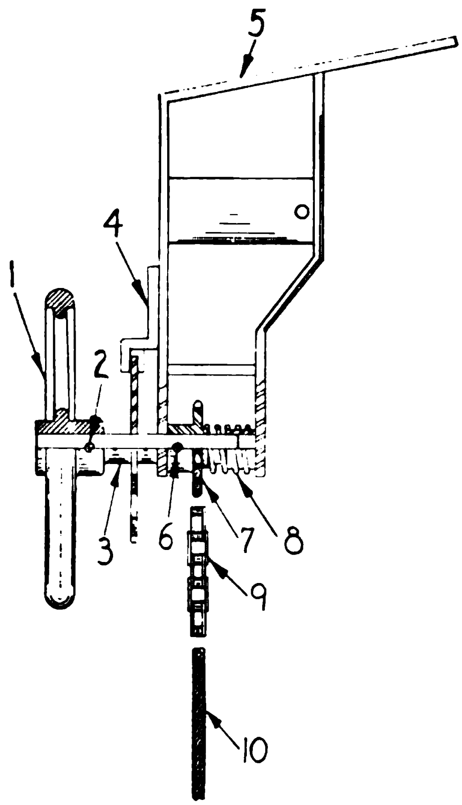
Bucket Loader Drive Chains—(Cont'd)

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
18	GG-6-91C	2	Strand of Diamond #478 Chain, 2" Pitch, 32 Links & 1 Offset	
	A-6-91	32	Roller Link, Diamond #478 Chain, 2" Pitch	GG-6-91C
	B-6-91	32	Connecting Link, Diamond #478 Chain 2" Pitch	GG-6-91C
	C-6-91	2	Offset Link, Diamond #478 Chain, 2" Pitch	GG-6-91C
19	DY-6-116C	1	Strand of Baldwin #0508 Chain, 2.62" Pitch, 148 Links & 1 Offset	
	A-6-116	74	Roller Link, Baldwin #0508 Chain, 2.62" Pitch	DY-6-116C
	B-6-116	74	Connecting Link, Baldwin #0508 Chain, 2.62" Pitch	DY-6-116C
	C-6-116	1	Offset Link, Baldwin #0508 Chain, 2.62" Pitch	DY-6-116C

82-105-C1—For 18" Elevator Extension Only

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
19a	N-6-116C	1	Strand of Baldwin #0508 Chain, 2.62" Pitch, 14 Links	
	A-6-116	7	Roller Link, Baldwin #0508 Chain 2.62" Pitch	N-6-116C
	B-6-116	7	Connecting Link, Baldwin #0508 Chain, 2.62" Pitch	N-6-116C
	C-6-116	1	Offset Link, Baldwin #0508 Chain, Chain, 2.62" Pitch	

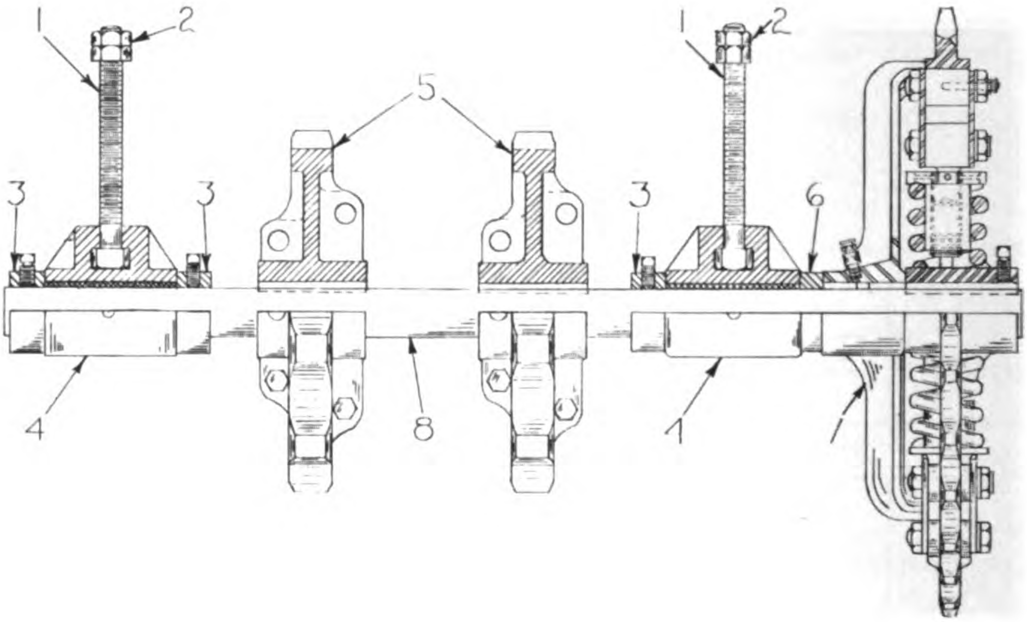


ELEVATOR SWIVEL SPOUT CONTROL

82-40-A2or 82-40-B or 82-40-E

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	1392 D	1	Hand Wheel	
2	P-17-26	1	Pin	
3	DD1-82-39W	1	Shaft	
4	EE1-82-39W	1	Catch	
	R1-124	2	Machine Bolt, Nut & Lock Washer, ½" x 1¼"	
5	CC-82-39W	1	Bracket	
	AY-17-25	1	Pin	
	R1-612	2	Cotter, 3/16" x 1"	
6	FH-17-26	1	Pin	
7	F-19-411	1	Sprocket, 13-tooth	
8	C-46-173	1	Spring	
9	AO-6-51R	1	Strand Diamond #433 Chain, 64 Link, ¾" Pitch	
	A-6-51	32	Roller Link, Diamond #433 Chain, ¾" Pitch	AO-6-51
	B-6-51	32	Connecting Link, Diamond #433 Chain, ¾" Pitch	AO-6-51
	R1-1087	1	Thimble, Cable, ¼"	
	R1-568	4	Clamp, Cable, ¼"	
	R1-1108	1	Turnbuckle, ⅜"	
	R1-897	1	Rope, Wire, Crucible Cast Steel ¼" x 18'-4" (8 x 19)	
	R1-20	2	Block, Fast Eye, #9	
	R1-1114	2	U-Bolt & 4 Nut, 5/16"	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

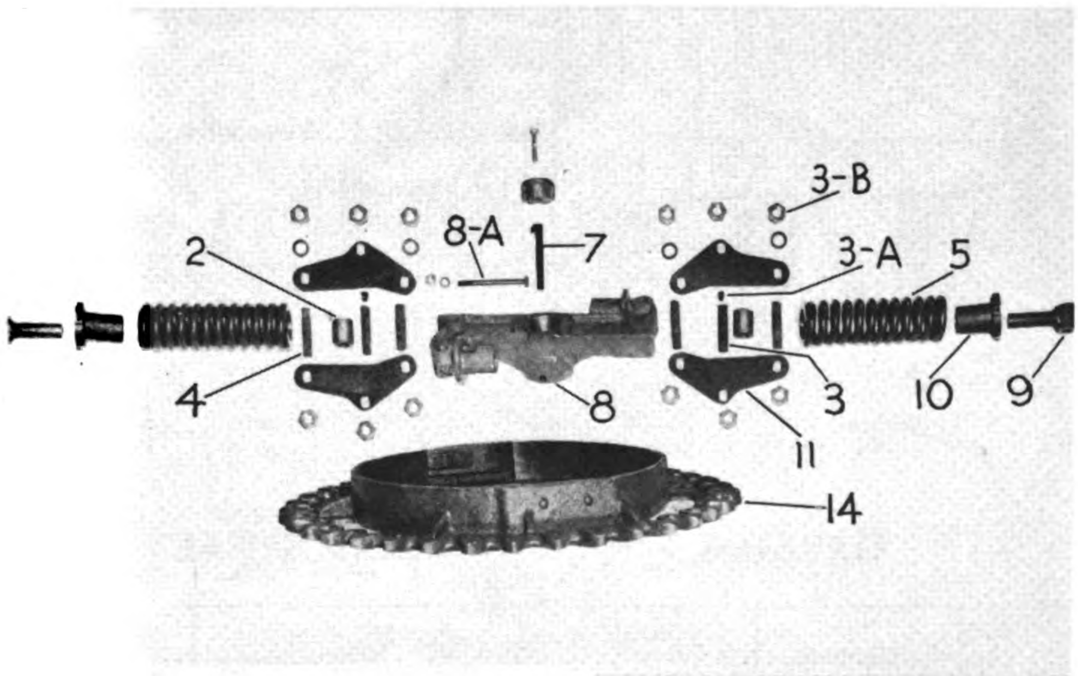


ELEVATOR HEAD SHAFT

82-151-B1

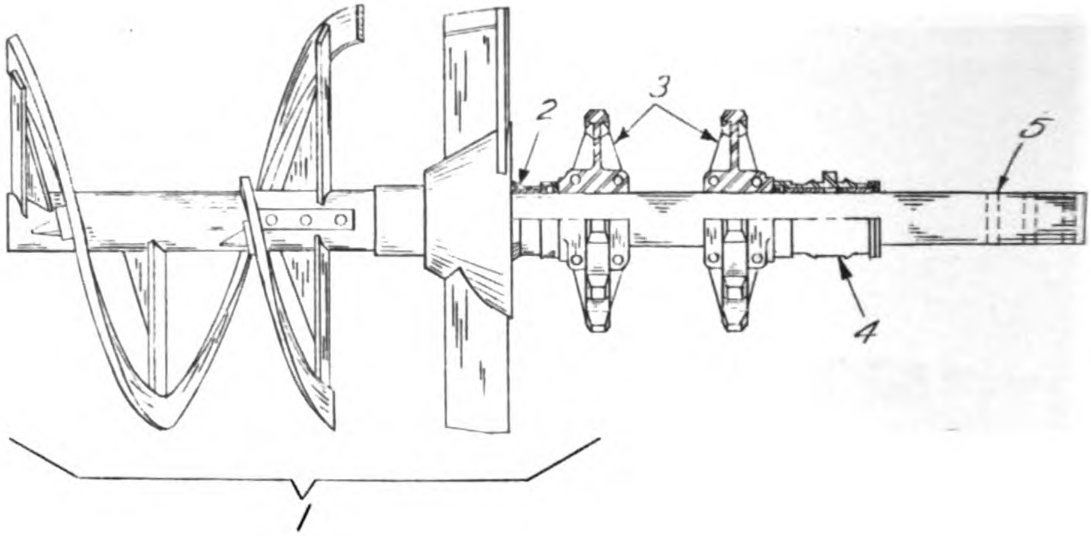
Ref. No.	Part Number	Number Required		DESCRIPTION	Part of Assem. No.
1	A-46-208	2		Bolt, Take-Up	
2	BU-17-24	4		Hex Nut	
	R1-1172	2		Cut Washer, 1¼″	
3	K-3-947	3		Collar	
	R1-949		6	Set Screw, ⅝″ x 1″	K-3-947
4	3431 A	2		Bearing	
	R1-12	2		Alemite, Button Head, Male, ¼″	
5	2994 B	2		Sprocket, 8-tooth	
	R1-950		2	Set Screw, ⅝″ x 1¼″	2994 B
	R1-548		8	Hex Head Cap Screw, Nut & Lock Washer, ⅞″ x 3½″	2994 B
	M-17-34	2		Key	
6	H-3-948	1		Spacer	
7	19-203-D	1		Sprocket, Spring, Release 30-tooth, (For Details See "Elevator Spring Release Sprocket")	
	C-17-43	1		Pipe	
	R1-649	1		Coupling, ¼″	
8	A2-82-151	1		Shaft	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



ELEVATOR SPRING RELEASE SPROCKET
19-203-D

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
2	B-19-51	2	Roller	
3	B-19-106	2	Pin	
3A	R1-11	2	Alemite, Button Head, Male, 1/8"	
3B	A-19-105	2	Hex Half-Nut	
	R1-804	10	Hex Half-Nut, 7/8"	
	R1-1183	6	Lock Washer, 7/8"	
4	A-19-106	4	Pin	
5	A-46-39	2	Spring	
7	I-17-34	1	Key	
8	2256 B	1	Hub	
	F-17-51	2	Set Screw	2256 B
9	C-3-656W	2	Eye-Bolt, Adjustment	
10	1158	2	Retainer, Spring	
	A-19-103	2	Wire, #14 Ga. x 10"	
11	A-19-51	4	Plate, Roller	
14	1579B	1	Sprocket, 30-tooth	
	EE-8-94	2	Bushing	1579 B
	R1-12	1	Alemite, Button Head, 1/4"	

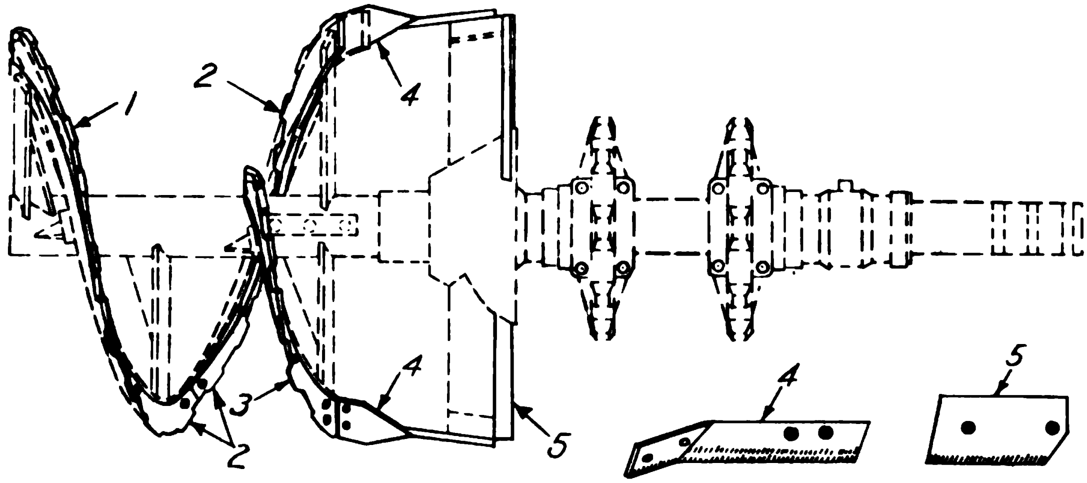


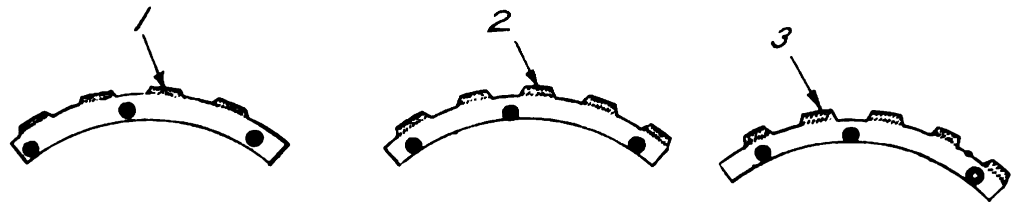
ELEVATOR FOOT SHAFT AND SPIRAL

82-11-A7

Ref. No.	Part Number	Number Required		DESCRIPTION	Part of Assem. No.
1	F2(R)-82-142W	1		Spiral (Operator Side)	
	F2(L)-82-142W	1		Spiral (Opposite Operator Side)	
	R1-187	6		Machine Bolt, Nut & Lock Washer, ¾" x 6"	
2	3550	1		Bearing	
	MM-8-115		2	Bushing	3550
3	2915	2		Sprocket, 8-tooth	
	R1-950		4	Set Screw, ⅝" x 1¼"	2915
	R1-185		8	Machine Bolt, Nut & Lock Washer, ¾" x 5"	2915
	HH-17-34	4		Key	
	C-17-103	2		Washer	
	D-17-164	2		Washer	
4	3550 A	1		Bearing	
	MM-8-115		2	Bushing	3550 A
5	A-82-11	1		Shaft	
	R1-12	2		Alemite, Button Head, Male, ¼"	

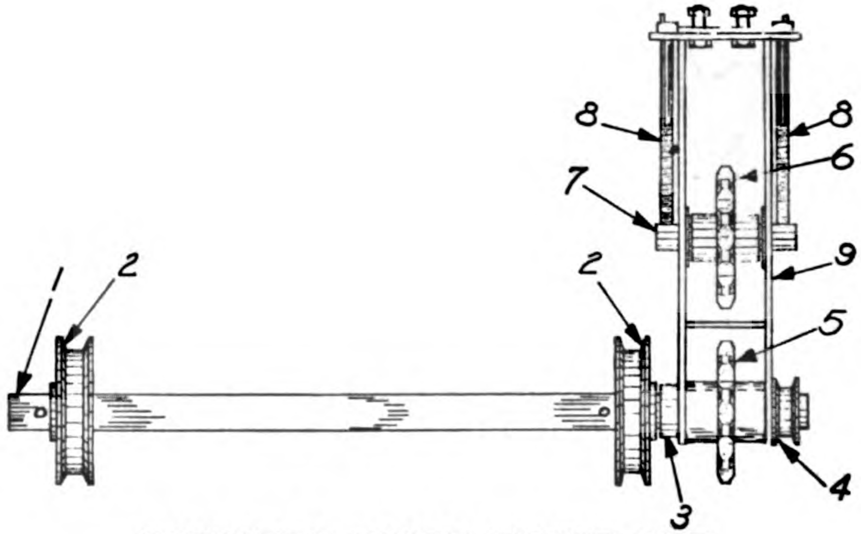
ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.





ELEVATOR SPIRAL WEARING STRIPS
82-143-D
(Notched Tube Borium)

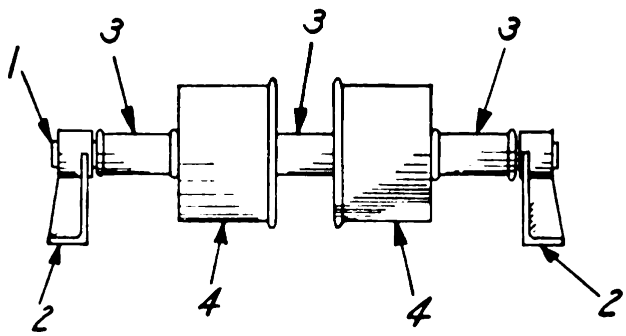
Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	C(R)-82-209	1	Strip, Wearing (Operator Side)	
	C(L)-82-209	1	Strip, Wearing (Opposite Operator Side)	
	R1-454	6	Flat Head Cap Screw, Nut & Lock Washer, ⅝" x 2"	
2	A(R)-82-209	3	Strip, Wearing, (Operator Side)	
	A(L)-82-209	3	Strip, Wearing, (Opposite Operator Side)	
	R1-454	18	Flat Head Cap Screw, Nut & Lock Washer, ⅝" x 2"	
3	B(R)-82-209	1	Strip, Wearing, (Operator Side)	
	B(L)-82-209	1	Strip, Wearing (Opposite Operator Side)	
	R1-454	6	Flat Head Cap Screw, Nut, & Lock Washer, ⅝" x 2"	
4	N(R)-82-142	2	Cutter, Spiral (Operator Side)	
	N(L)-82-142	2	Cutter, Spiral (Opposite Operator Side)	
	R1-454	16	Flat Head Cap Screw, Nut & Lock Washer, ⅝" x 2"	
5	O(R)-82-142	2	Cutter, Spiral (Operator Side)	
	O(L)-82-142	2	Cutter, Spiral (Opposite Operator Side)	
	R1-453	8	Flat Head Cap Screw, Nut & Lock Washer, ⅝" x 1¾"	



ELEVATOR PIVOT SHAFT AND ELEVATOR DRIVE TAKE-UP IDLER
82-166-B2

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	A1-82-166	1	Shaft	
	R1-11	2	Alemite, Button Head, Male, 1/8"	
2	694	2	Wheel, Double Flanged	
3	G-3-945	1	Collar	
4	136A	1	Collar	
	R1-989	1	Low Head Set Screw, 5/8" x 3/4"	136A
5	2991B	1	Sprocket, 9-tooth	
	G-8-54	2	Bushing	2991B
6	2990 A	1	Sprocket, 9-tooth	
	B-8-95	2	Bushing	2990 A
7	F-82-166	1	Shaft	
	P-17-9	2	Washer	
8	A-17-24	2	Bolt, Take-Up	
	T-(R)82-165	1	Latch, Take-Up Bolt	
	T-(L)82-165	1	Latch, Take-Up Bolt	
	R1-227	2	Machine Bolt, Nut, Lock Washer & Cut Washer, 1/2" x 2 1/4"	
	AQ-17-10	2	Spacer	
	R1-127	2	Machine Bolt, Nut & Lock Washer, 1/2" x 2"	
9	M-82-165 W	1	Frame, Pivot Take-Up Support	
	N-82-165	1	Brace	
	R1-125	2	Machine Bolt, Nut & Lock Washer, 1/2" x 1 1/2"	
	R1-124	2	Machine Bolt, Nut & Lock Washer, 1/2" x 1 1/4"	
	O-82-165	1	Brace	
	R1-1161	4	Bevel Washer, 1/2"	
	R1-125	4	Machine Bolt, Nut & Lock Washer, 1/2" x 1 1/2"	
	R1-124	2	Machine Bolt, Nut & Lock Washer, 1/2" x 1 1/4"	

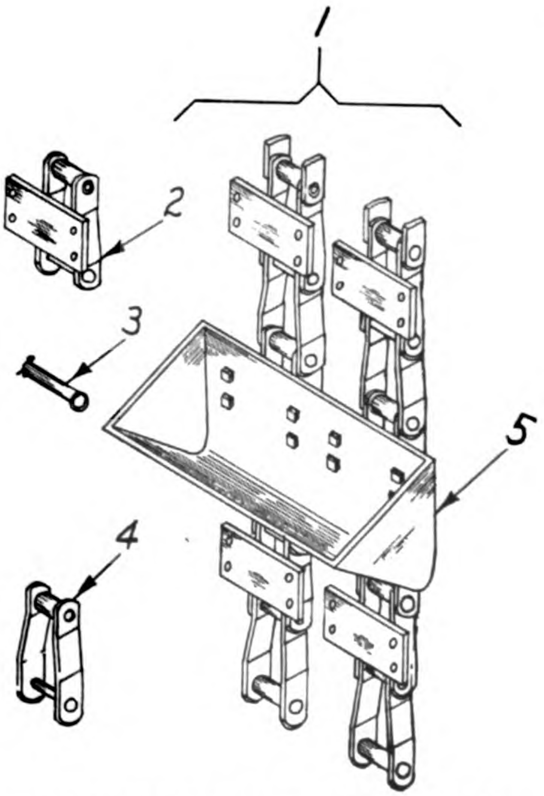
ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



ELEVATOR BUCKET LINE IDLER SHAFT

(82-211-A)

Ref. No.	No. Req.	Part No.	Description
1.	2	A-82-211	Shaft, $1\frac{7}{16}$" x 2' 5½", S.A.E. 1020
	4	R1-12	¼" Button Head Alemite, Male
	4	R1-339	⅜" x ¼" Reducing Bushing
	4	C-17-121	Pipe, ⅜" x 2"
2.	4	699	Idler Shaft Support
	8	R1-127	Machine Bolt, Nut, & Lock Washer, ½" x 2"
	8	R1-1161	Bevel Washer, ½"
	4	R1-942	Set Screw, ½" x 1"
3.	6	722	Spacer
4.	4	679-A	Roller



ELEVATOR BUCKET LINE

82-37-A1

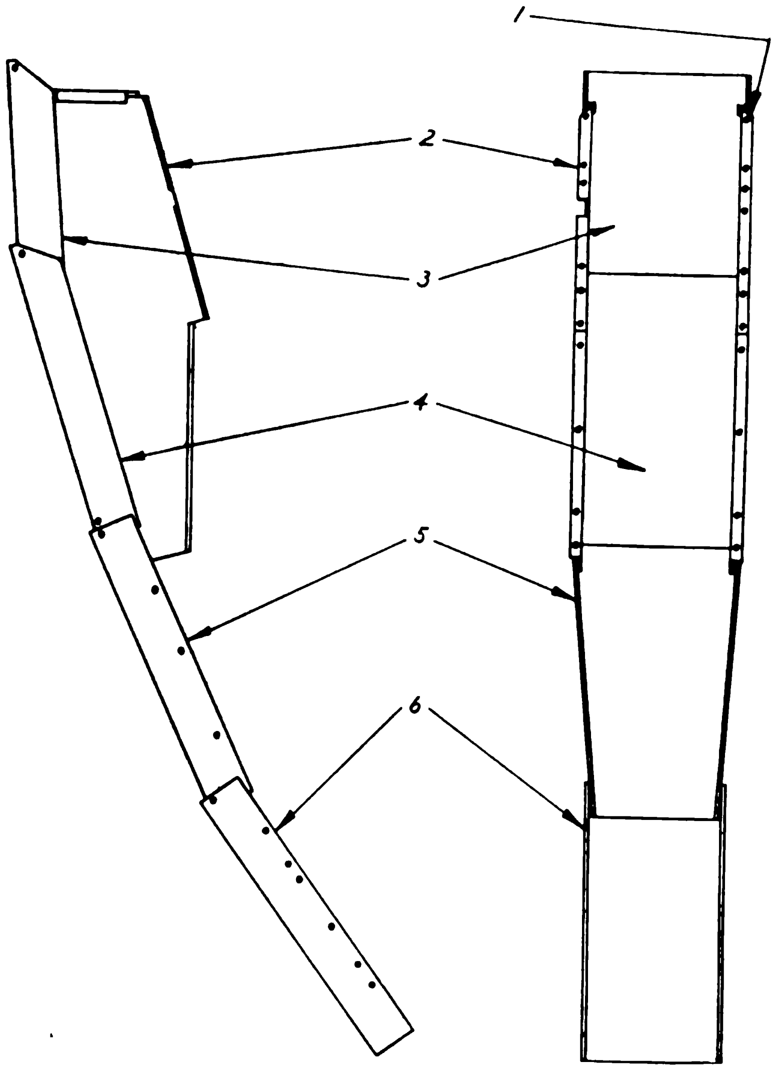
Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	BC-6-146C	2	Strand of Chabelco, #A-2842, Chain 6.048" Pitch, 77 Links, with K22 Attachment B-6-25W Every Second Link	
2	B-6-25W	76	Attachment Link	BC-6-146C
3	HH-26-F	154	Pin	BC-6-146C
	R1-621	154	Cotter, ¼" x 1⅛"	BC-6-146C
4	C-6-146C	78	Offset Link of Chabelco, #A-2842, Chain	BC-6-146C
5	25-46-A	38	Bucket	
	R1-124	304	Machine Bolt, Nut & Lock Washer, ½" x 1¼"	

82-37-D1—For 18" Elevator Extension

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	F-6-146C	2	Strand of Chabelco #A-2842, Chain, 6 Links With K22 Attachment B-6-25W Every Second Link	
2	B-6-25W	6	Attachment Link	F-6-146C
3	HH-26-F	12	Pin	F-6-146C
	R1-621	12	Cotter, ¼" x 1⅛"	F-6-146C
4	C-6-146C	6	Offset Link of Chabelco, #A-2842, Chain	F-6-146C
5	25-46-A	3	Bucket	
	R1-124	24	Machine Bolt, Nut & Lock Washer ½" x 1¼"	

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

ELEVATOR DUST CHUTE
82-21-A2 82-185-A1

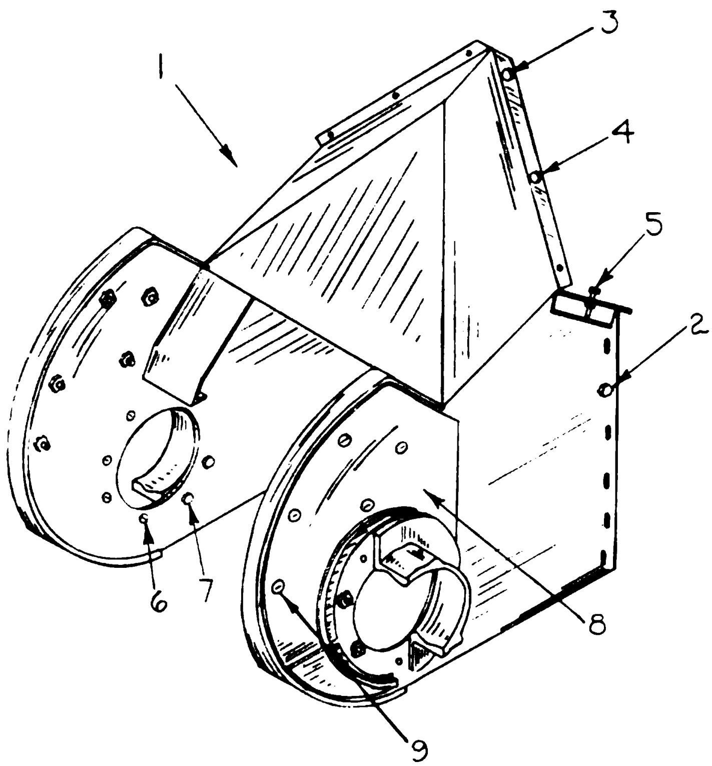


ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

ELEVATOR DUST CHUTE

82-21-A2   82-185-A1

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No
1	F(R)82-257W	1	Chute Side Plate	
2	F(L)82-257W	1	Chute Side Plate	
	R1-224	4	Machine Bolt, Nut, Lock Washer & Cut Washer, ½" x 1½"	
3	J-82-184	1	Pan, Dust Chute	
	R1-102	2	Machine Bolt, Nut & Lock Washer, ⅜" x 1"	
	R1-1161	4	Bevel Washer, ½"	
	R1-223	6	Machine Bolt, Nut, Lock Washer & Cut Washer, ½" x 1¼"	
	R1-748	8	Trace Repair Link, 3/16"	
	R1-224	2	Machine Bolt, Nut, Lock Washer & Cut Washer, ½" x 1½"	
4	A-82-21	1	Pan, Dust Chute	
	R1-563	2	Chain, Twisted, 3/16" x 32"	
	R1-102	2	Machine Bolt, Nut & Lock Washer, ⅜" x 1"	
	R1-213	2	Machine Bolt, Nut, Lock Washer & Cut Washer, ⅜" x 1"	
	R1-102	2	Machine Bolt, Nut & Lock Washer, ⅜" x 1"	
5	B-82-21	1	Pan, Dust Chute	
	R1-562	2	Chain, Twisted, 3/16" x 28"	
	R1-563	2	Chain, Twisted, 3/16" x 32"	
	R1-102	2	Machine Bolt, Nut & Lock Washer, ⅜" x 1"	
6	C-82-21	1	Pan, Dust Chute	
	R1-215	2	Machine Bolt, Nut, Lock Washer & Cut Washer, ⅜" x 1½"	
	R1-562	2	Chain, Twisted, 3/16 x 28"	
	R1-213	2	Machine Bolt, Nut, Lock Washer & Cut Washer, ⅜" x 1"	



ELEVATOR LOWER END FRAME
82-148-A2

Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	F2-82-147W	1	Frame, Elevator Lower End	
2	R1-291	12	Machine Bolt, Nut, Lock Washer & 2 Cut Washer, 5/8" x 2"	
3	R1-148	4	Machine Bolt, Nut & Lock Washer, 5/8" x 2"	
4	R1-146	2	Machine Bolt, Nut & Lock Washer, 5/8" x 1½"	
5	R1-148	6	Machine Bolt, Nut & Lock Washer, 5/8" x 2"	
	R1-147	3	Machine Bolt, Nut & Lock Washer, 5/8" x 1¾"	
	R1-1162	7	Bevel Washer, 5/8"	
	3361	2	Bracket, Bearing	
6	R1-148	8	Machine Bolt, Nut & Lock Washer, 5/8" x 2"	
7	R1-187	4	Machine Bolt, Nut & Lock Washer, ¾" x 6"	
8	H(R)-82-148W	1	Liner	
	H(L)-82-148W	1	Liner	
9	R1-425	10	Flat Head Cap Screw, Half Nut & Lock Washer, 5/8" x 1½"	

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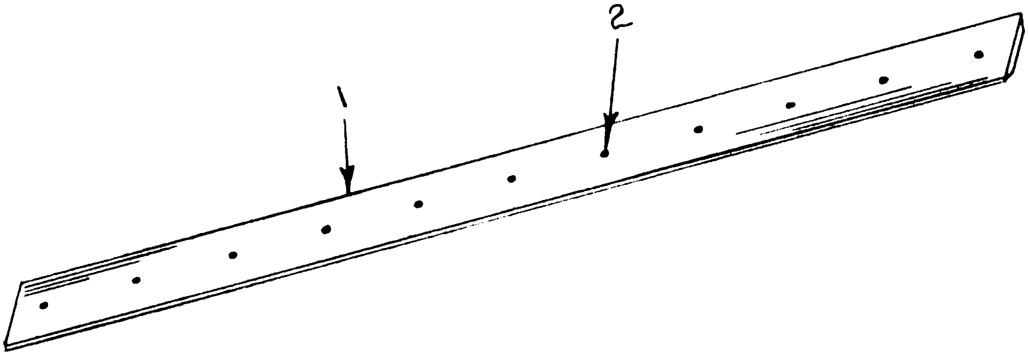
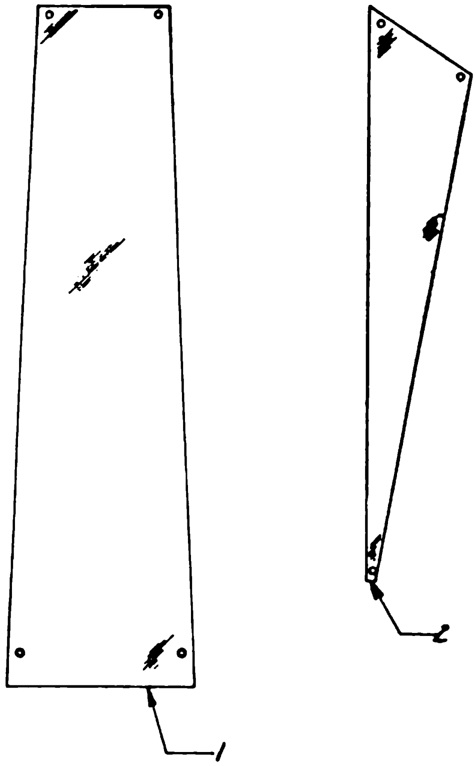


ELEVATOR SCRAPER BLADE
From 82-145A

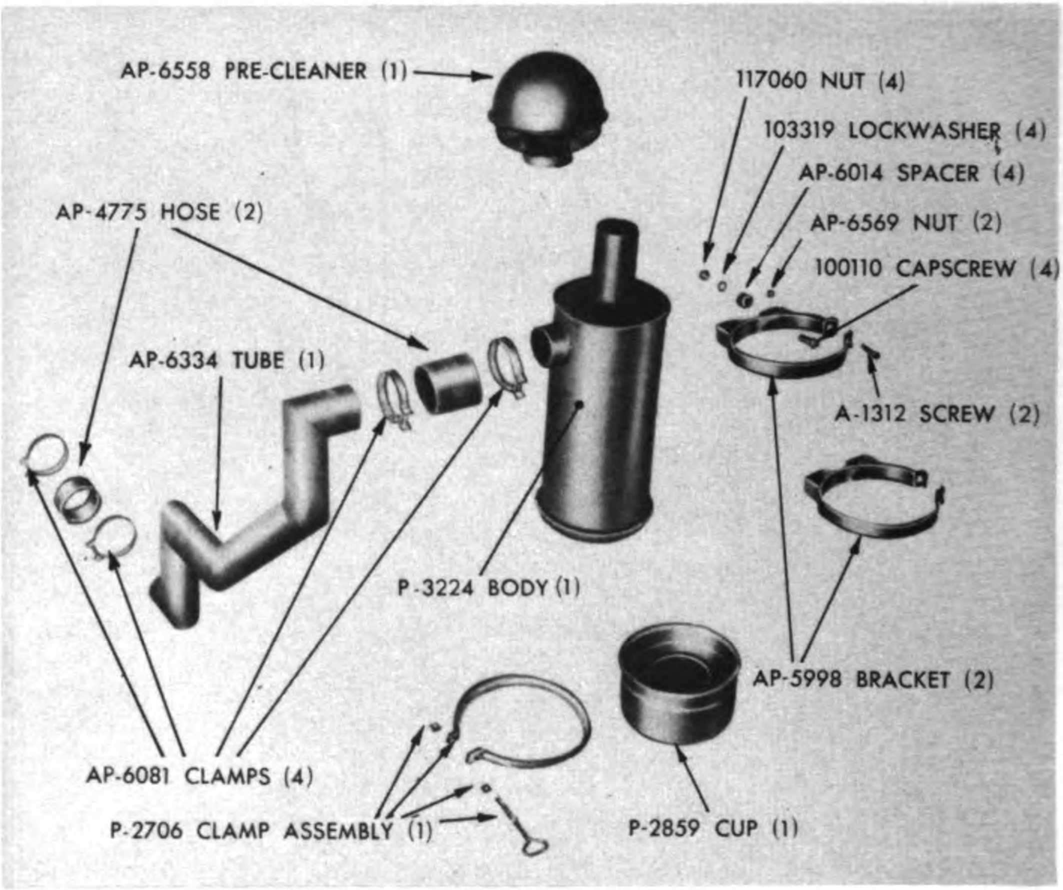
Ref. No.	Part Number	Number Required	DESCRIPTION	Part of Assem. No.
1	O-82-146	1	Blade	
2	R1-453	11	Flat Head Cap Screw, Nut & Lock Washer, 5/8" x 1¾"	



ELEVATOR SWIVEL SPOUT AND LINERS

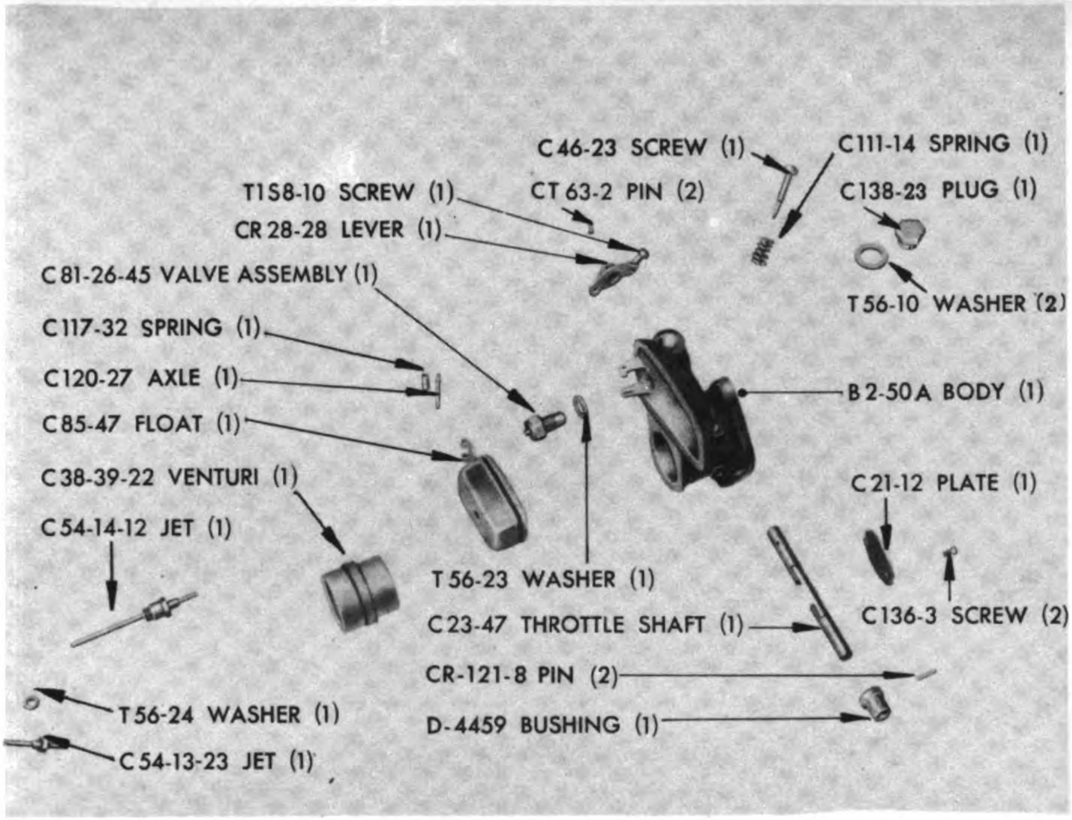
(82-38-A1)

Ref. No.	No. Req.	Part No.	Description
	1	82-38-A1	Swivel Spout Complete with Support Frame, Control Sheave, Spout Yoke and Spout
1.	1	N-42-43	Bottom Liner Plate
	2	R1-101	Machine Bolt, Nut, & Lock Washer, 3/8" x 3/4"
	2	R1-434	Flat Head Cap Screw, Nut, & Lock Washer, 3/8" x 1"
2.	2	M-42-43	Side Liner Plate
	6	R1-101	Machine Bolt, Nut, & Lock Washer, 3/8" x 3/4"



AIR CLEANER

Buda Part No.	No. Rqd.	Name Description
AP-6563	1	Air cleaner assembly
AP-6558	1	Pre-cleaner
AP-4775	2	Hose, air cleaner 2" x 2¼"
AP-6334	1	Tube, air cleaner
AP-6081	4	Clamp, air cleaner hose
P-3224	1	Body, air cleaner
P-2706	1	Clamp assembly
P-2859	1	Cup, air cleaner oil
117060	4	Nut ¼" clamp
103319	4	Lockwasher ¼"-clamp
100110	4	Capscrew ¼"—20 x 1"
AP-6569	2	Nut, air cleaner wing
A-1312	2	Screw, air bracket
AP-5998	2	Bracket, air cleaner
AP-6014	4	Spacer, air cleaner bracket



CARBURETOR

Buda Part No.	No. Rqd.	Name Description
H-11385	1	Carburetor assy. (not illustrated)
C-181-36	1	Gasket, assy. (not illustrated)
B2-50A	1	Throttle Body
C-54-14-12	1	Jet, idling
T-56-24	3	Washer, cap jet
C-54-13-23	1	Jet, cap
C-117-32	1	Spring, float axle
C-120-27	1	Axle, float
C-81-26-45	1	Valve assy. Carburetor
T-56-23	1	Washer, fuel valve
C-85-47	1	Float, carburetor
C-38-39-22	1	Venturi carburetor
CR-28-28	1	Lever, throttle stop
T1S8-10	2	Screw, throttle stop and tube clamp
CT-63-2	2	Pin, throttle stop
C-46-23	1	Screw, Idling adjusting
C-111-14	1	Spring, idling adjusting
C-138-42	1	Plug, gas connection
T-56-10	3	Washer, gas connection plug
C-21-12	1	Plate assy. throttle
C-136-3	2	Screw, throttle plate
C-23-47	1	Shaft, throttle
D-4459	1	Bushing, throttle lever
C-52-3-22	1	Jet, compensating
CT-91-1	1	Plug, Bowl Drain
T-56-23	2	Washer, fuel valve and lower plug
C-142-27	1	Gasket, bowl and body
C-101-2	1	Plate, assy. air shutter
T-43-6	2	Washer, air shutter retaining screw

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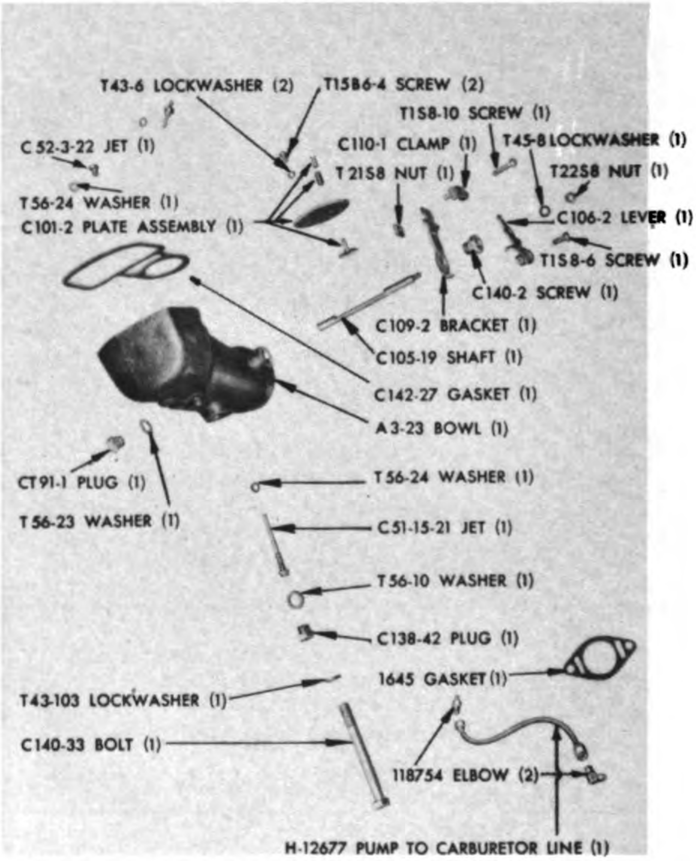

CARBURETOR—(Continued)

Buda Part No.	No. Rqd.	Name Description
T-15B6-4	2	Screw, air shutter retaining
T-21S8	1	Nut, clamp screw
C-110-1	1	Clamp, bracket tube
T-22S8	1	Nut
T-45-8	1	Lockwasher, air shutter shaft nut
T-1-S-8-6	1	Screw, swivel
C-105-19	1	Shaft, air shutter
C-106-2	1	Lever, air shutter
C-109-2	1	Bracket, air shutter
C-140-2	1	Screw, bracket assy.
A-3-23	1	Bowl, carburetor fuel
C-51-15-21	1	Jet, main carburetor
C-138-23	1	Plug, gas connection
T-43-103	1	Lockwasher, assy. bolt
1645	1	Gasket, engine to carburetor
C-140-33	1	Bolt, assy.
118754	2	Elbow
H-12677	1	Pump to carburetor copper tubing assy.
CR-121-8	2	Pin, throttle stop

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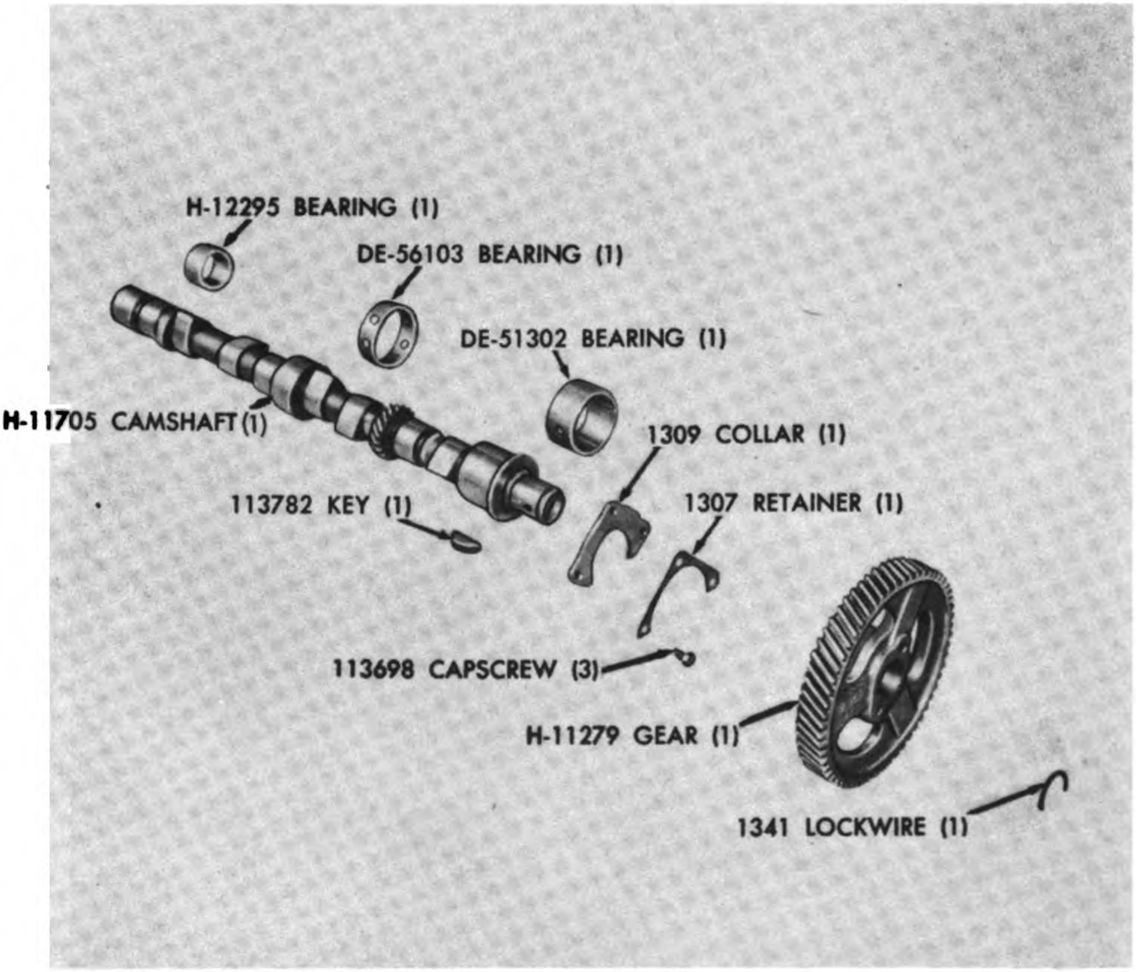
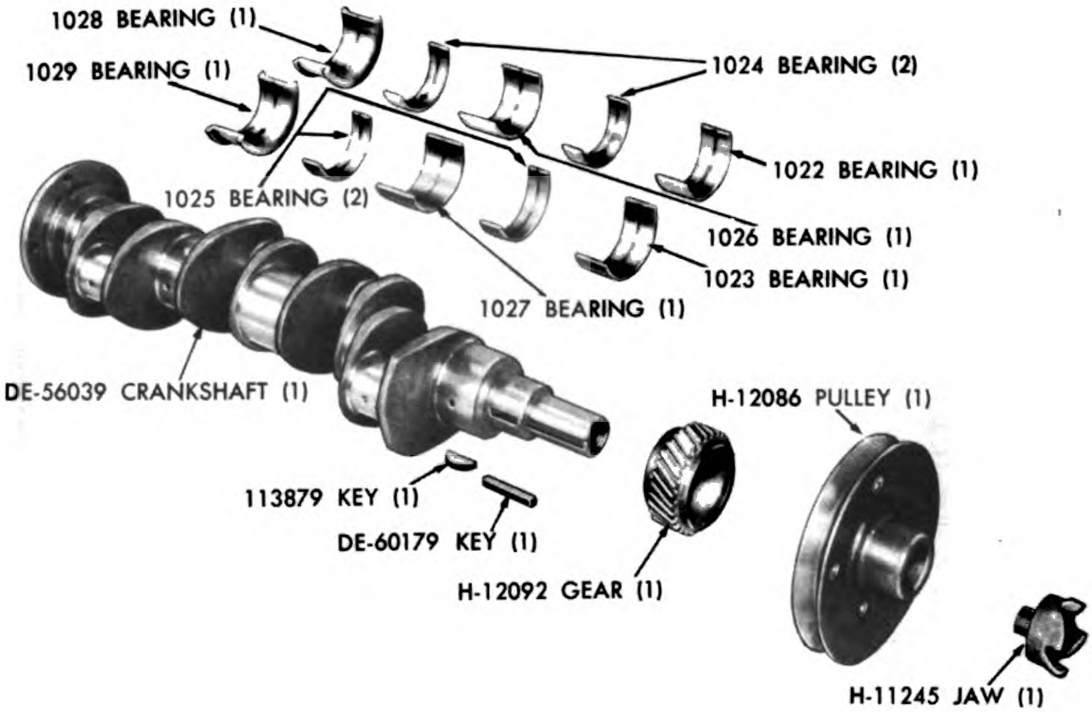


CAMSHAFT ASSEMBLY

Buda Part No.	No. Rqd.	Name Description
H-12295	1	Bearing, camshaft rear
DE-56103	1	Bearing, camshaft intermediate
DE-51302	1	Bearing, camshaft front
1307	1	Retainer, camshaft gear
H11279	1	Gear, camshaft
H11705	1	Camshaft
113782	1	Woodruff key, camshaft
1309	1	Collar, camshaft thrust
113698	3	Capscrews ¼" 28 x ½"
1341	1	Lockwire, camshaft gear



CRANKSHAFT

Buda Part No.	No. Rqd.	Name Description
1029	1	Bearing, crankshaft, rear lower
1028	1	Bearing, crankshaft, rear upper
1027	1	Bearing, crankshaft, lower center
1026	1	Bearing, crankshaft, upper center
1024	2	Bearing, crankshaft, upper intermediate
1025	2	Bearing, crankshaft, lower intermediate
1022	1	Bearing, crankshaft, front upper
1023	1	Bearing, crankshaft, front lower
H-12086	1	Pulley, crankshaft
H-11245	1	Jaw, crankshaft
DE-60179	1	Key, $\frac{5}{16}$ x $\frac{5}{16}$ x 2, crankshaft
DE-56039	1	Crankshaft
113879	1	Key, crankshaft pulley
H-12092	1	Gear, crankshaft

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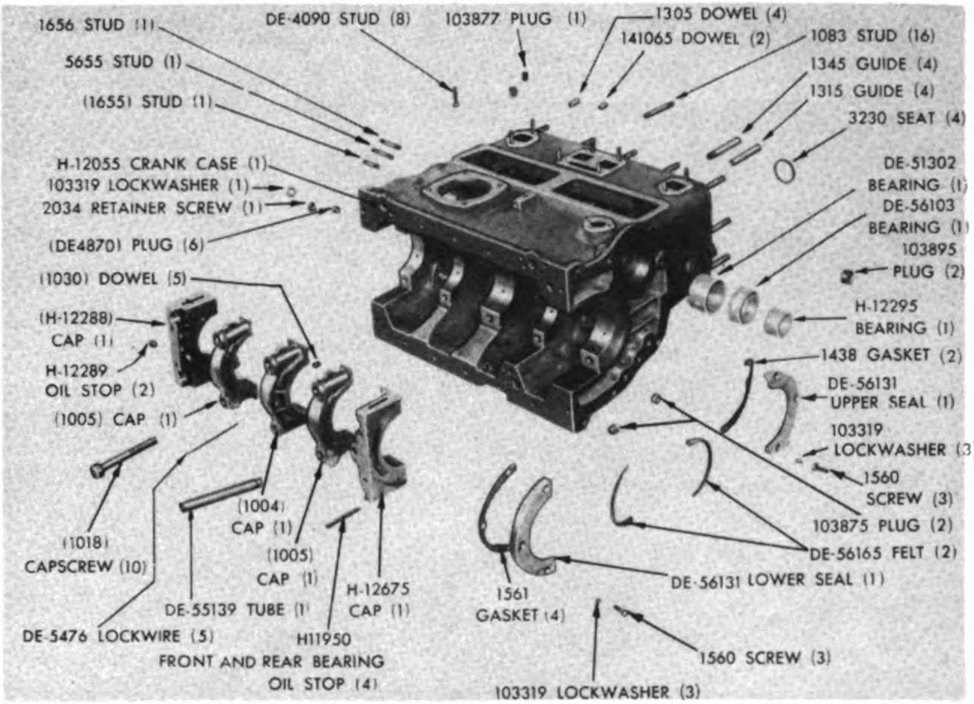


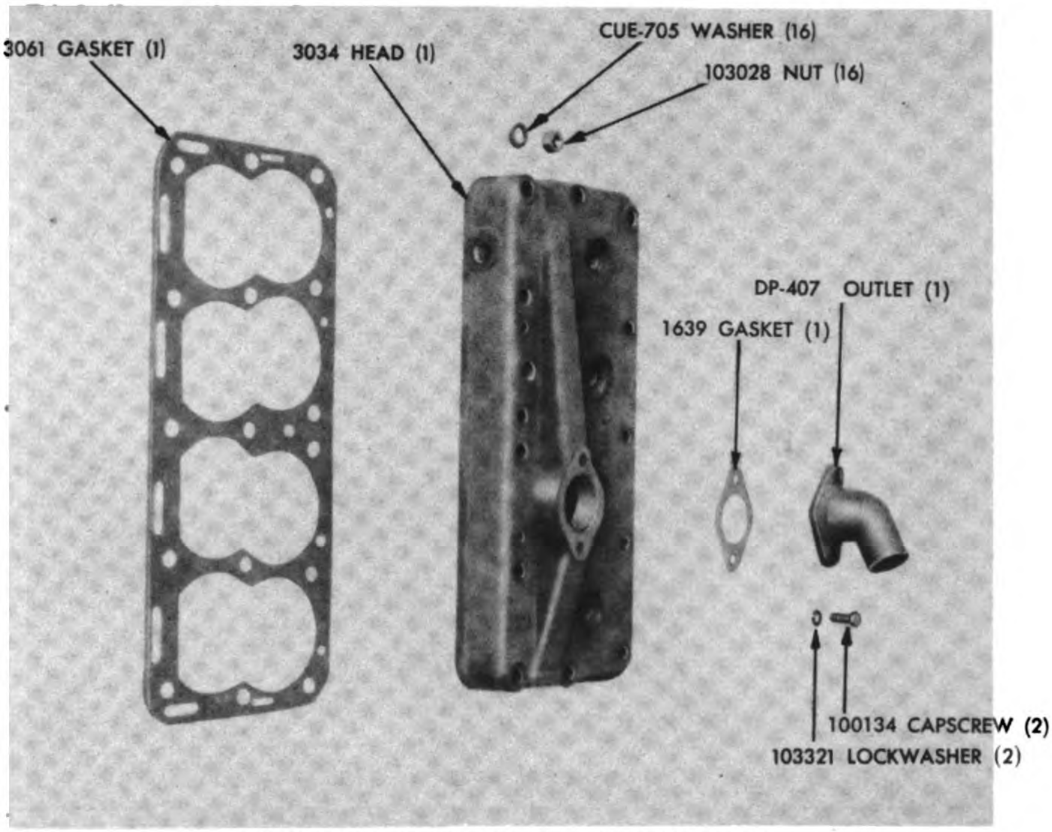
CYLINDER BLOCK AND CRANKCASE ASSEMBLY

Buda Part No.	No. Rqd.	Name Description
H12055	1	Crankcase
1656	1	Stud, crankcase
5655	1	Stud, crankcase
1655	1	Stud, crankcase
2034	1	Screw, front support retainer
DE-4870	6	Plug, oil
103319	7	Lockwasher, for oil seal and retainer screw ¼"
141065	2	Dowel, pin 5/32" x 3/8"
1030	5	Dowel
H12675	1	Cap, rear bearing
DE5476	5	Lockwire
1018	10	Capscrew, bearing
1005	2	Cap, intermediate bearing
1004	1	Cap, center bearing
DE55139	1	Tube, oil
H11950	4	Stop, front & rear bearing oil (long)
H12289	2	Stop, front bearing oil (short)
H12288	1	Cap, front bearing
1305	4	Dowel, valve lifter
DE4090	8	Stud, crankcase
103877	1	Plug, crankcase oil
1083	16	Studs, cylinder block
1345	4	Guide, valve
1315	4	Guide, valve
3230	4	Seat, exhaust valve
103895	2	Plug, safety expansion
103896	1	Plug, safety expansion (not illustrated)
103875	2	Plug, oil
H12295	1	Bearing, camshaft rear

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.

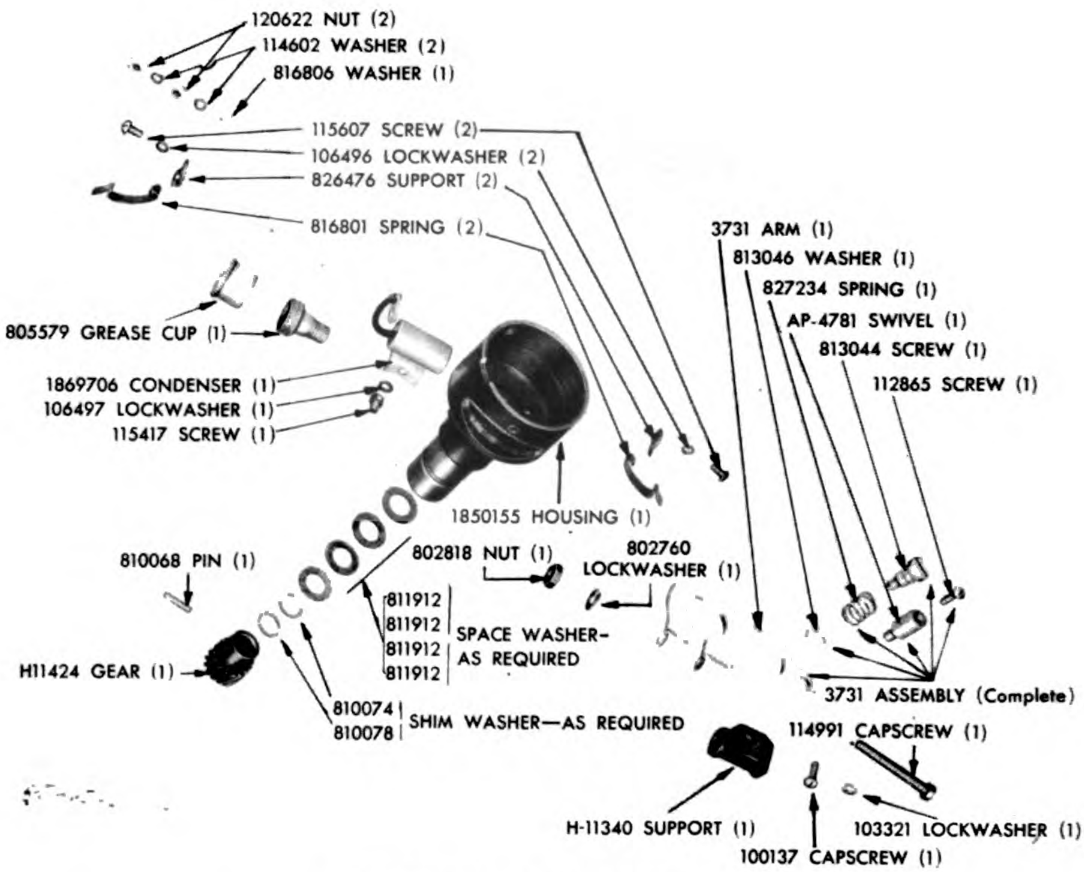
CYLINDER BLOCK AND CRANKCASE ASSEMBLY —Continued

Buda Part No.	No. Rqd.	Name Description
DE-56103	1	Bearing, camshaft center
DE-51302	1	Bearing, camshaft front
1438	2	Gasket, rear bearing oil seal
DE-56131	2	Seal, rear bearing oil, upper and lower
1560	6	Capscrew, rear bearing oil seal
DE-56165	2	Felt, rear bearing oil seal
1561	4	Gasket, rear bearing oil seal



CYLINDER HEAD ASSEMBLY

Buda Part No.	No. Rqd.	Name Description
3061	1	Gasket, cylinder
3034	1	Head, cylinder
CUE-705	16	Lockwasher ½″
103028	16	Nut, ½″—20
1639	1	Gasket, outlet pipe
100134	2	Capscrew, ⅜-16-1″
103321	2	Lockwasher, ⅜″
DP-407	1	Outlet, cylinder head



DISTRIBUTOR ASSEMBLY

Buda Part No.	No. Rqd.	Name Description
3884	1	Distributor assy.
120622	2	Nut, terminal
114602	2	Washer, terminal nut
816806	1	Washer, insulation
115607	2	Capscrew, breaker plate
106496	2	Lockwasher, breaker plate capscrew
826476	2	Support, cap spring
816801	2	Cap spring, distributor
1850155	1	Housing, distributor
811912	12	Lockwasher
810074	12	Shimwasher
H-11424	1	Gear, distributor
810068	1	Pin, gear
1869706	1	Condenser, distributor
106497	1	Lockwasher, distributor condenser capscrew
115417	1	Capscrew distributor condenser
805579	1	Grease cup, distributor shaft
813046	1	Washer, part of 3731 assy.
827234	1	Spring, part of 3731 assy.
813044	1	Screw, part of 3731 assy.
AP-4781	1	Swivel
112865	1	Screw
114991	1	Capscrew

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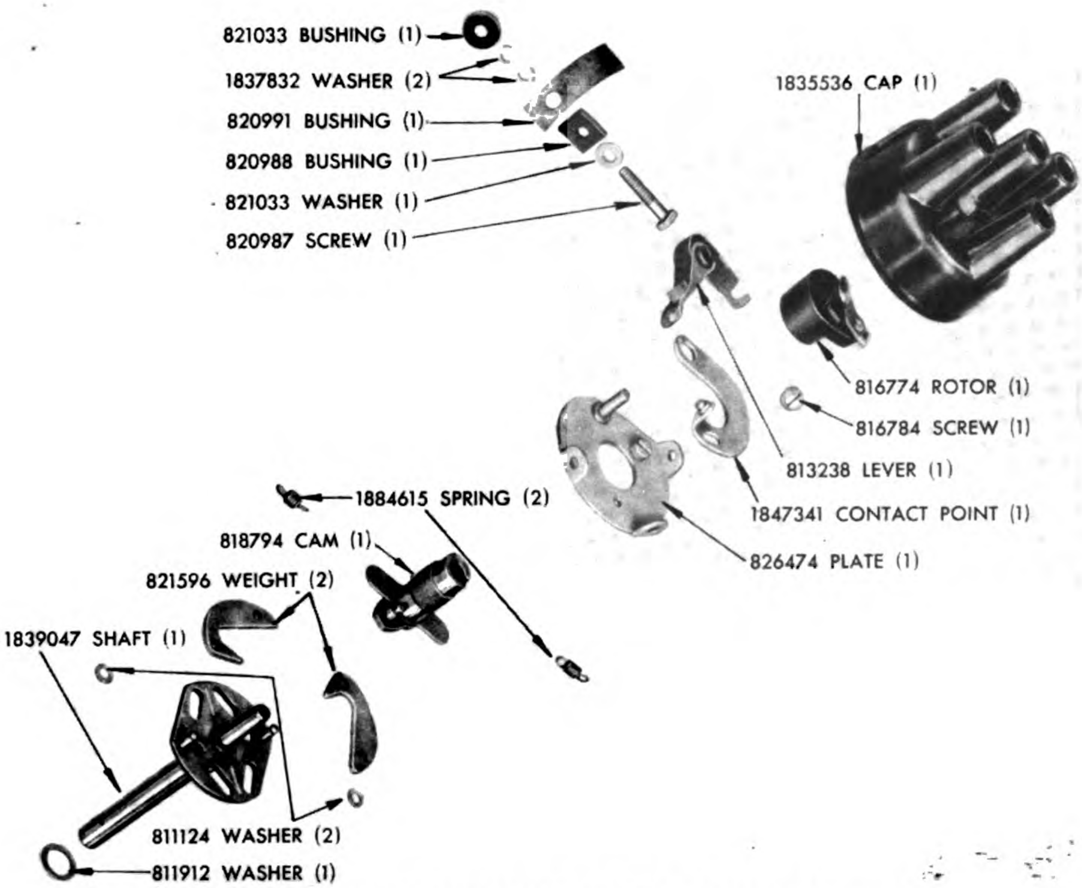
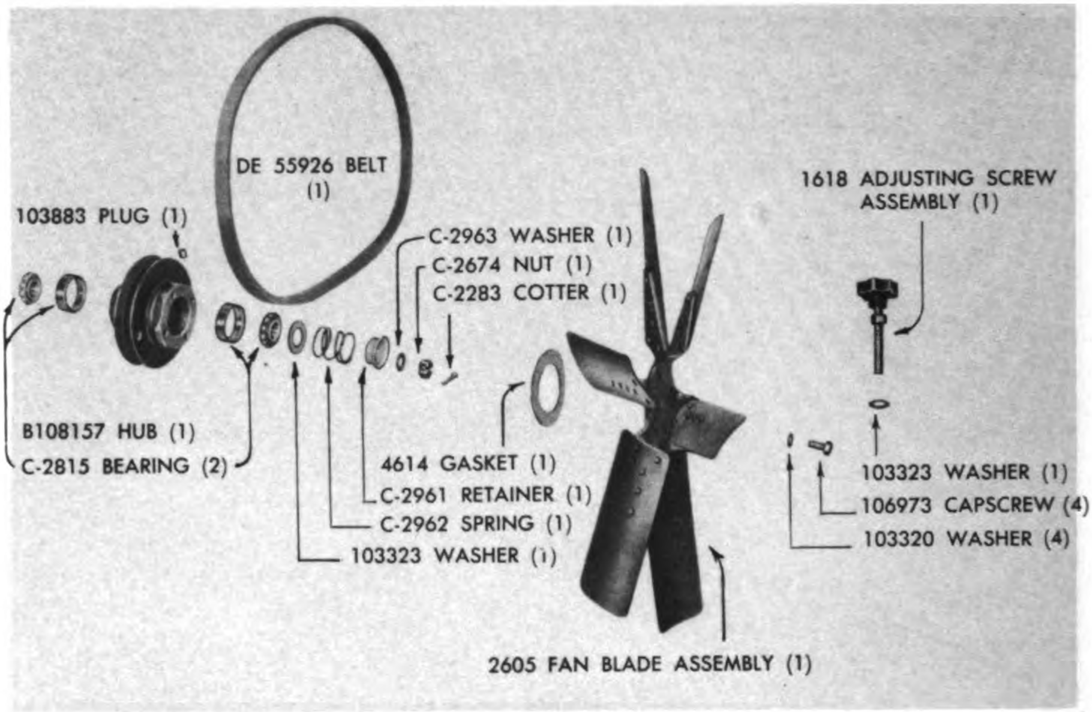


DISTRIBUTOR ASSEMBLY—(Continued)

Buda Part No.	No. Rqd.	Name Description
100137	1	Capscrew ⅜-16-1¼
1835536	1	Cap, distributor
816774	1	Rotor, distributor
816784	1	Capscrew, adjusting
813238	1	Lever, breaker
1847341	1	Contact point, distributor
826474	1	Plate, breaker
1884615	2	Spring, weight
818794	1	Cam, distributor
811124	2	Lockwasher, weight
821596	2	Weights, distributor
1839047	1	Shaft, distributor
811912	1	Lockwasher, shaft
820987	1	Capscrew, terminal
821033	2	Washer, terminal capscrew
820988	1	Bushing
820991	1	Bushing
1837832	2	Lockwasher, stud
802760	1	Lockwasher
802818	1	Nut
3731	1	Arm assembly distributor
H-11340	1	Support adjustable arm
103321	1	Lockwasher ⅜″



FAN ASSEMBLY

Buda Part No.	No. Rqd.	Name Description
H-12101	1	Fan assembly (not illustrated)
2605	1	Fan blade assy.
B-108157	1	Hub, fan
103883	1	Oil plug, fan
1622	1	Spindle
122403	1	Nut, fan spindle
103326	1	Lockwasher, fan spindle
1620	1	Lockwasher, fan spindle clamp (rear)
1628	1	Lockwasher, fan spindle clamp (front)
C-4832	1	Wire, fan spindle oil retain cork
C-3159	1	Retainer, fan spindle oil retain cork
C-3158	1	Cork, fan spindle
C-3157	1	Washer, fan spindle cork retainer
C-3837	1	Gasket, fan spindle bearing
1617	1	Bracket, fan
103026	3	Nut, fan bracket
103321	3	Lockwasher, fan bracket 3/8"
106973	4	Capscrew, fan blade
103320	4	Lockwasher, fan blade 5/16"
4614	1	Gasket, fan blade
1618	1	Screw, assy. fan adjusting
103323	2	Lockwasher, fan adjusting 1/2"
C-2815	2	Bearing, fan hub
C-2961	1	Retainer, fan hub bearing
C-2962	1	Spring, fan hub bearing
C-2963	1	Washer, fan hub bearing
C-2674	1	Nut, fan spindle
C-2283	1	Cotter, fan spindle
DE-55926	1	Belt, fan

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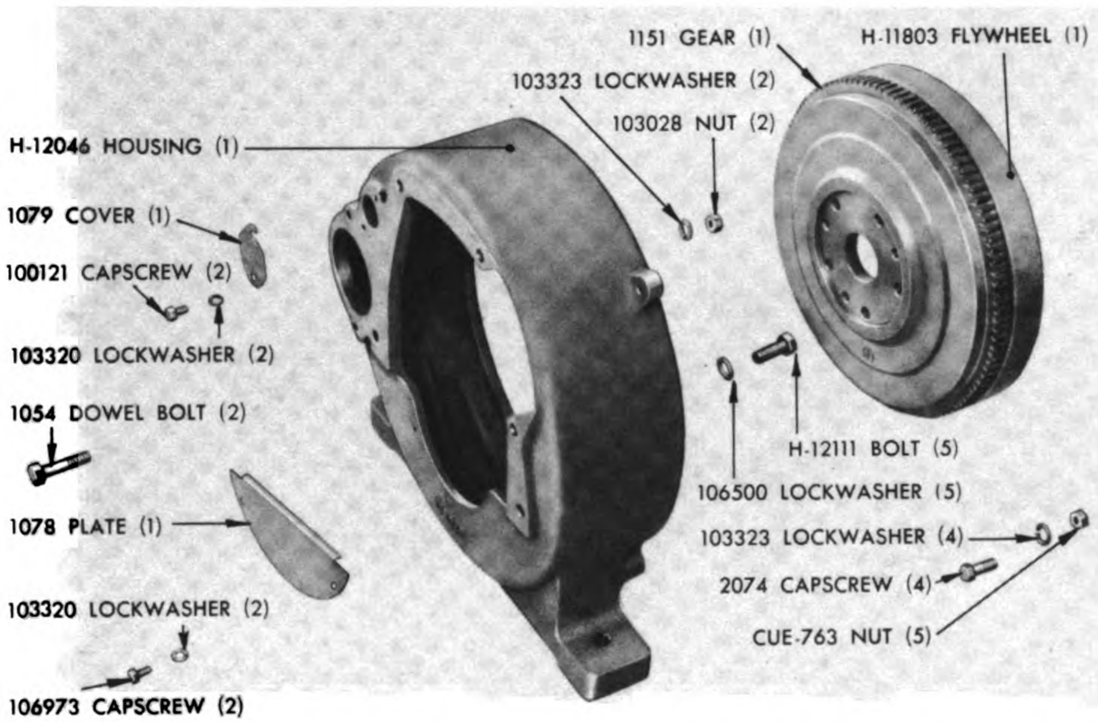
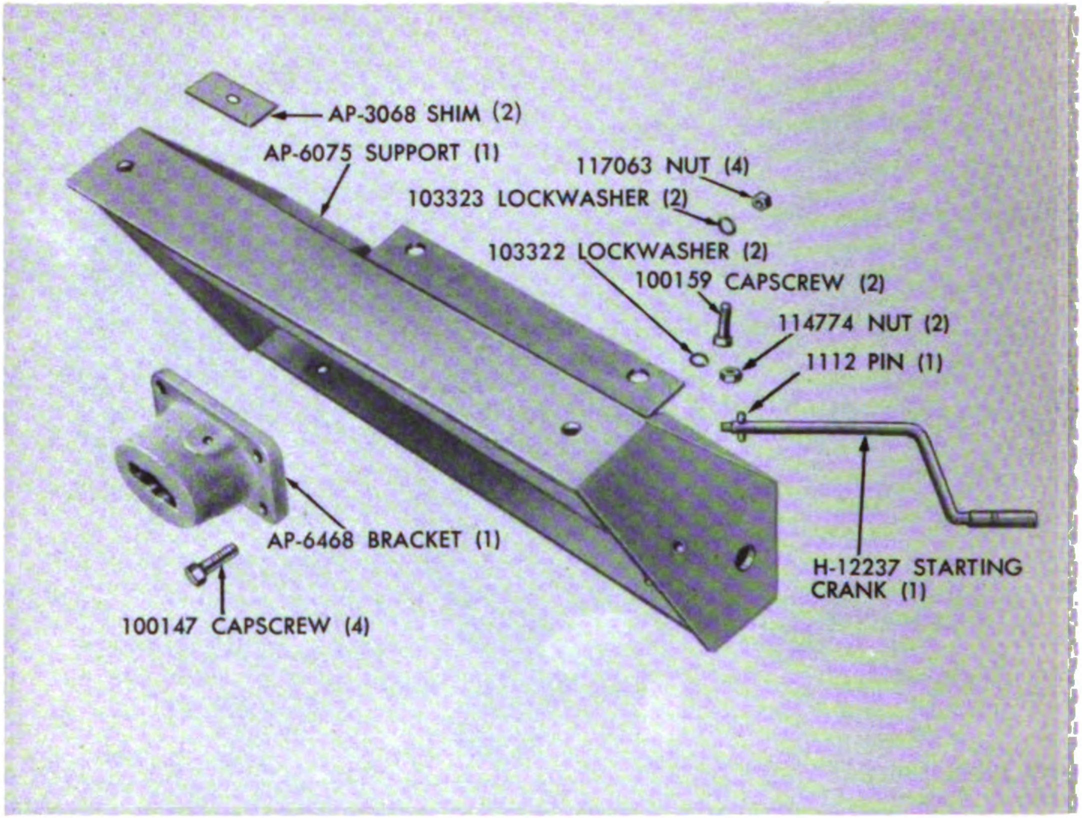


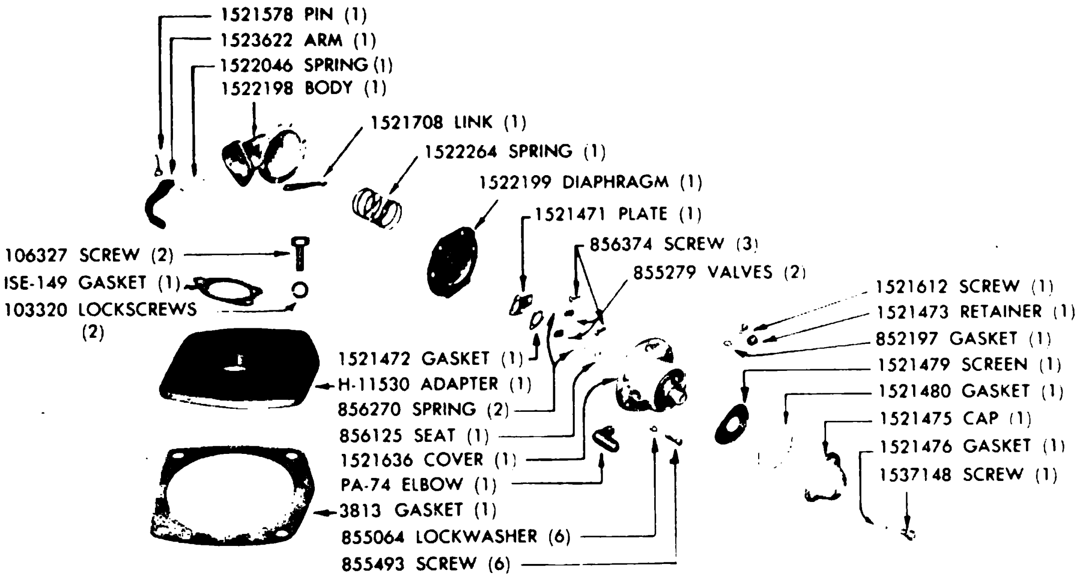
FLYWHEEL AND FLYWHEEL ASSEMBLY

Buda Part No.	No. Rqd.	Name Description
1054	2	Dowel bolt, flywheel housing
100121	2	Capscrew, 5/16-18-3/4"
103320	4	Lockwasher 5/16"
1079	1	Cover, flywheel housing
H-12046	1	Housing, flywheel
103323	6	Lockwasher 1/2"
103028	2	Nut, 1/2-20
1151	1	Gear, flywheel
H-11803	1	Flywheel
106973	2	Capscrew 5/16-18 x 1 1/2"
2074	4	Capscrew 1/2 x 1 1/4"
H-12111	5	Bolt
106500	5	Lockwasher 1/2"
CUE-763	5	Nut, 1/2"
1078	1	Plate



FRONT SUPPORT AND CRANK

Buda Part No.	No. Rqd.	Name Description
AP-6468	1	Bracket, starting crank guide
100147	4	Capscrews 7/16-14-1 1/4
103322	4	Lockwasher 7/16"
117063	4	Nuts, 7/16-14
AP-6075	1	Support front engine
AP-3068	2	Shim, front engine support
114774	2	Nut, Cylinder front support
100159	2	Capscrew 1/2-13-1 1/2"
103323	2	Lockwasher 1/2"
H-12237	1	Starting crank
1112	1	Pin, starting crank



FUEL PUMP

Buda Part No.	No. Rqd.	Name Description
H-12170	1	Fuel pump assembly
1521578	1	Pin, fuel pump rocker arm
1522046	1	Spring, fuel pump rocker arm
1522198	1	Body, fuel pump
1521708	1	Link fuel pump
1522264	1	Spring, diaphragm
1522199	1	Diaphragm, fuel pump
1523622	1	Arm, fuel pump rocker
1521471	1	Plate, fuel pump stop
1521472	1	Gasket, fuel pump stop plate
855279	2	Valves, fuel pump
856374	3	Screw, fuel pump valve plate
856125	1	Seat, fuel pump inlet valve
856270	2	Spring, fuel pump valve
1521636	1	Cover, fuel pump
1537148	1	Screw, fuel pump cover
1521612	1	Screw, fuel pump drain
852197	1	Gasket, fuel pump drain screw
1521479	1	Screen, fuel pump drain
1521480	1	Gasket, fuel pump cover
1521475	1	Cap, fuel pump
1521476	1	Gasket, fuel pump cap
855493	6	Screw, fuel pump cover
855064	6	Lockwasher, fuel pump cap screw
1521473	1	Retainer, fuel pump valve
1521288	1	Washer, fuel pump rocker (not illustrated)
H-11530	1	Adapter, fuel pump
3813	1	Gasket, fuel pump
103320	2	Lockwasher 5/16
106327	2	Capscrews 5/16-18 x 1 3/8
1-SE-149	1	Gasket, adapter fuel pump
PA-74	1	Elbow, fuel pump to carburetor

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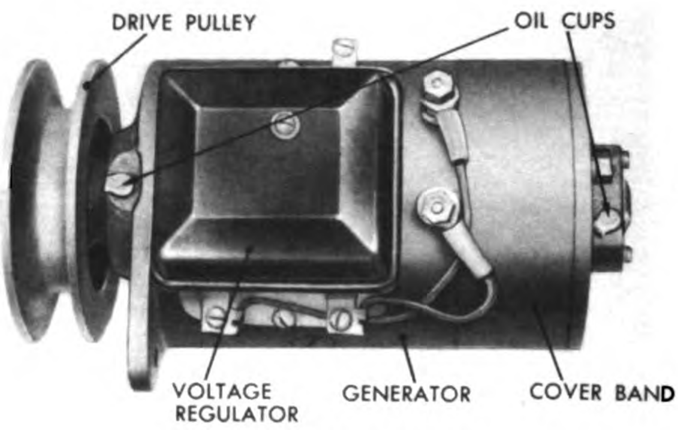

GENERATOR

Buda Part No.	No. Rqd.	Name Description
H-12175	1	Generator
DR-5864	1	Voltage regulator
817216	1	Commutator end frame and pin assembly
809644	2	Brush spring, 3rd and Ground
809658	1	Brush spring, insulated main
806915	1	Nut, shaft
804000	1	Lockwasher, shaft nut
H-12117	1	Pulley, generator shaft
817224	1	Collar, generator shaft
1838678	1	Drive end frame
809945	1	Washer, drive end frame
903203	1	Ball bearing, drive end
1855702	1	Plate, drive end
1855701	1	Gasket, drive end
802731	3	Washer, drive end
1866970	3	Screw, drive end
819104	1	Plate, felt washer retainer
124545	1	Key, woodruff drive end
817807	1	Armature, generator
1873937	1	Lead, (F terminal)
1850025	1	Lead, (A terminal)
815018	2	Bolt (Through)
108579	2	Washer, (Through bolt)
132900	2	Screw, control mounting
138479	2	Washer, control mounting screw
1856056	2	Washer, control mounting screw, plain
1872638	1	Band, generator cover
132923	1	Screw, generator cover band
103088	1	Nut, generator cover band
809961	1	Washer, generator shaft

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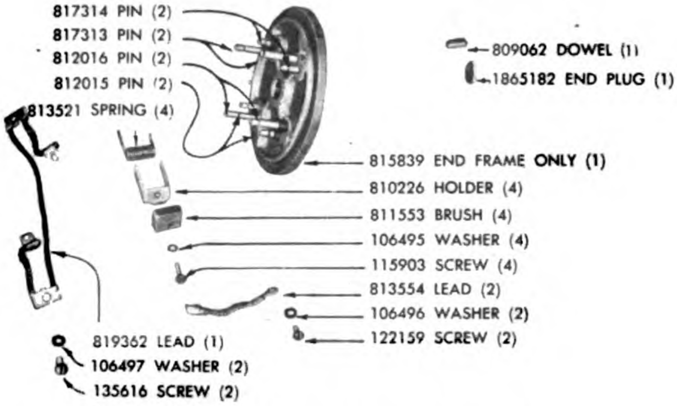
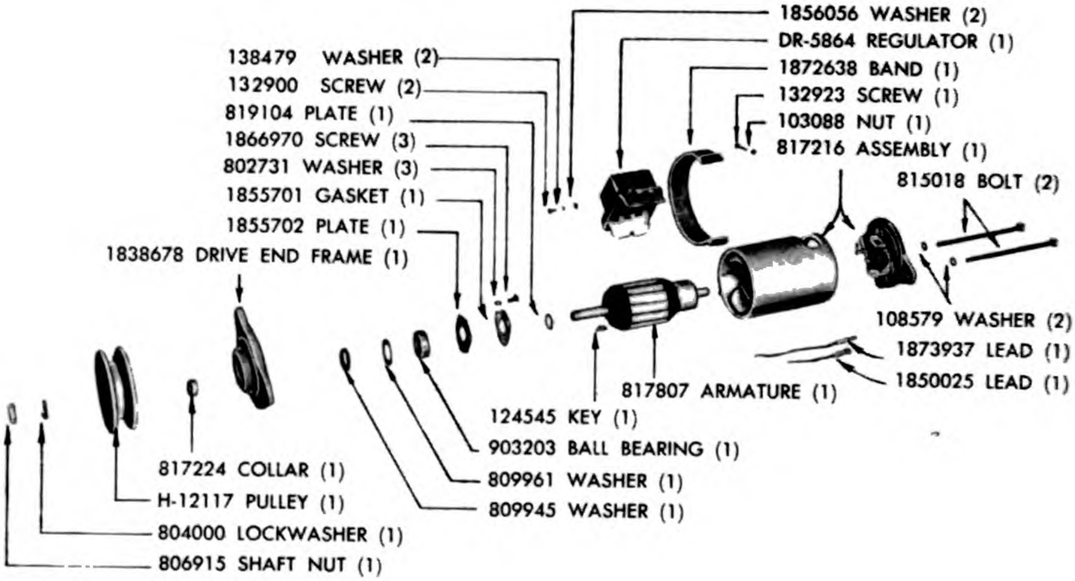


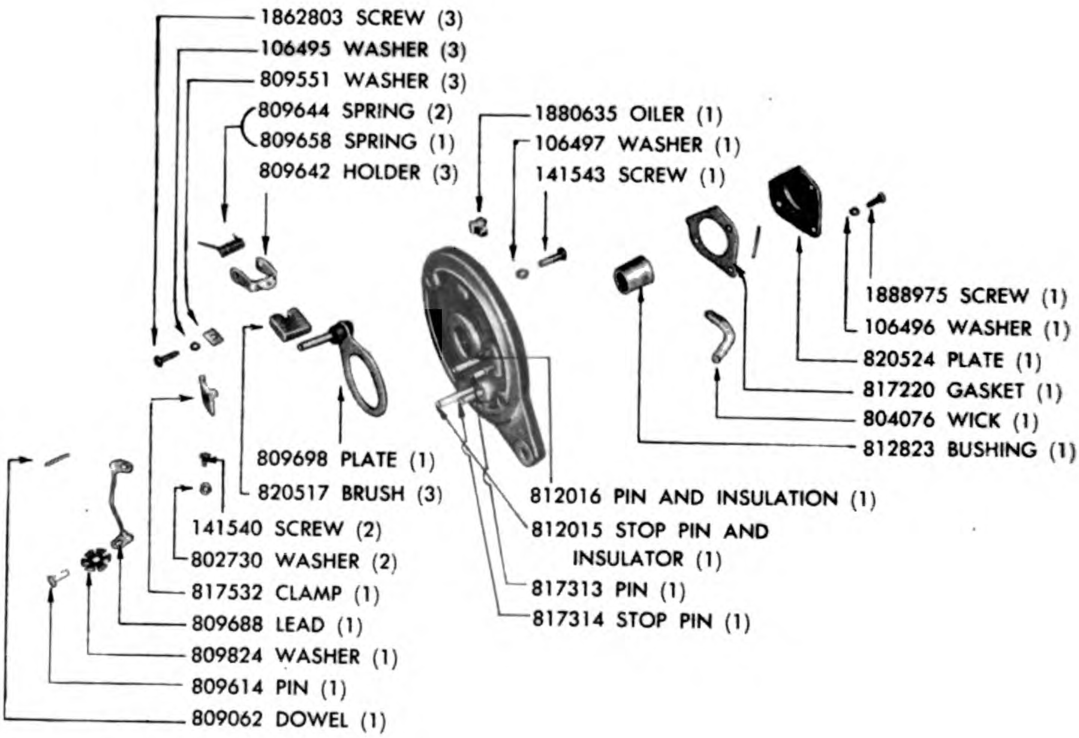
GENERATOR—(Continued)

Buda Part No.	No. Rqd.	Name Description
1862803	3	Screw, brush attaching
106495	3	Washer, brush attaching screw
809551	3	Washer, brush attaching screw plain
809642	3	Holder, brush
820517	3	Brush, generator
809698	1	Plate, generator brush
1880635	1	Oiler
106497	1	Washer, third brush plate screw
141543	1	Screw, third brush plate
809062	1	Dowel, commutator end
809614	1	Pin, commutator end
809824	1	Washer, commutator end pin
809688	1	Lead, brush ground
141540	2	Screw, brush ground lead
802730	2	Washer, brush ground lead screw
817532	1	Clamp, third brush
812016	1	Pin and insulation
812015	1	Stop pin and insulation
817313	1	Pin, brush holder hinge
817314	1	Stop pin brush holder
812823	1	Bushing, commutator end
817220	1	Gasket, end cover
804076	1	Wick
820524	1	Plate, commutator end
106496	1	Washer, commutator end plate
1888975	1	Screw, commutator end plate
814978	1	Coil field
1863510	1	Coil, field
828675	2	Screw, pole shoe
813496	2	Pole, shoe
1858749	1	Stud, terminal
1858753	2	Washer, terminal stud
1858752	2	Washer, stud plain
802757	4	Washer, terminal stud
121743	4	Nut, stud

(continued on next page)

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.





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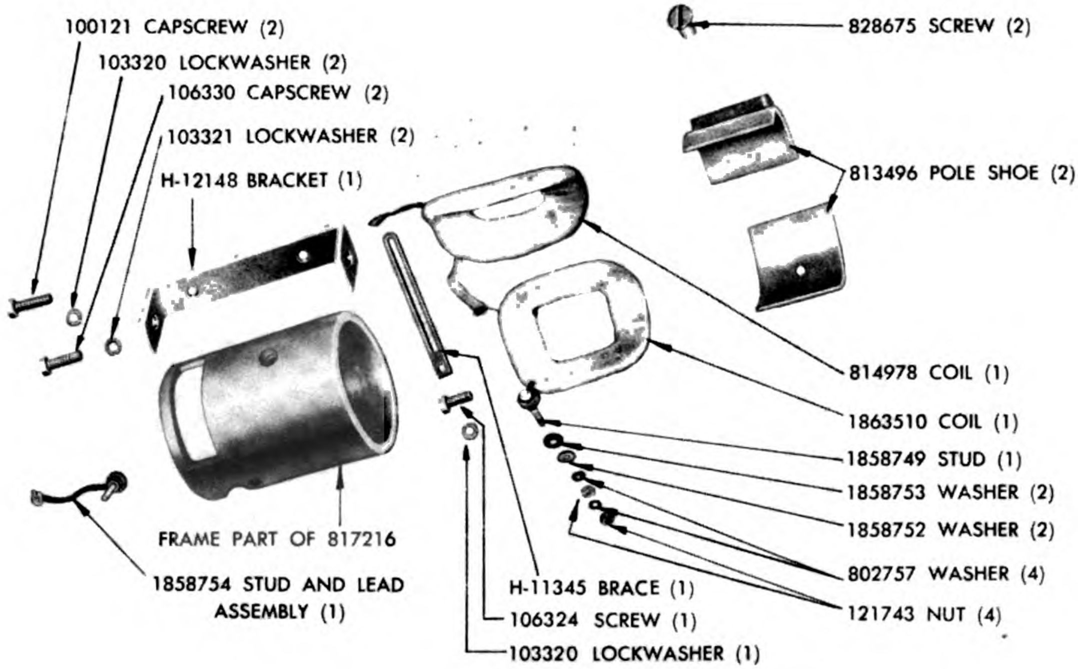
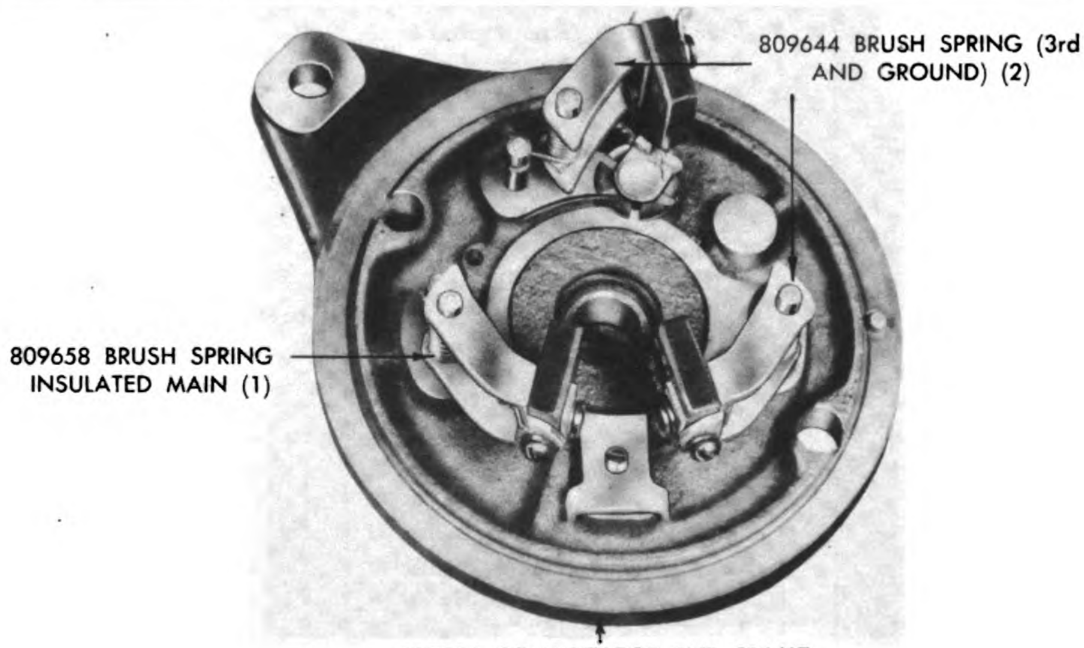


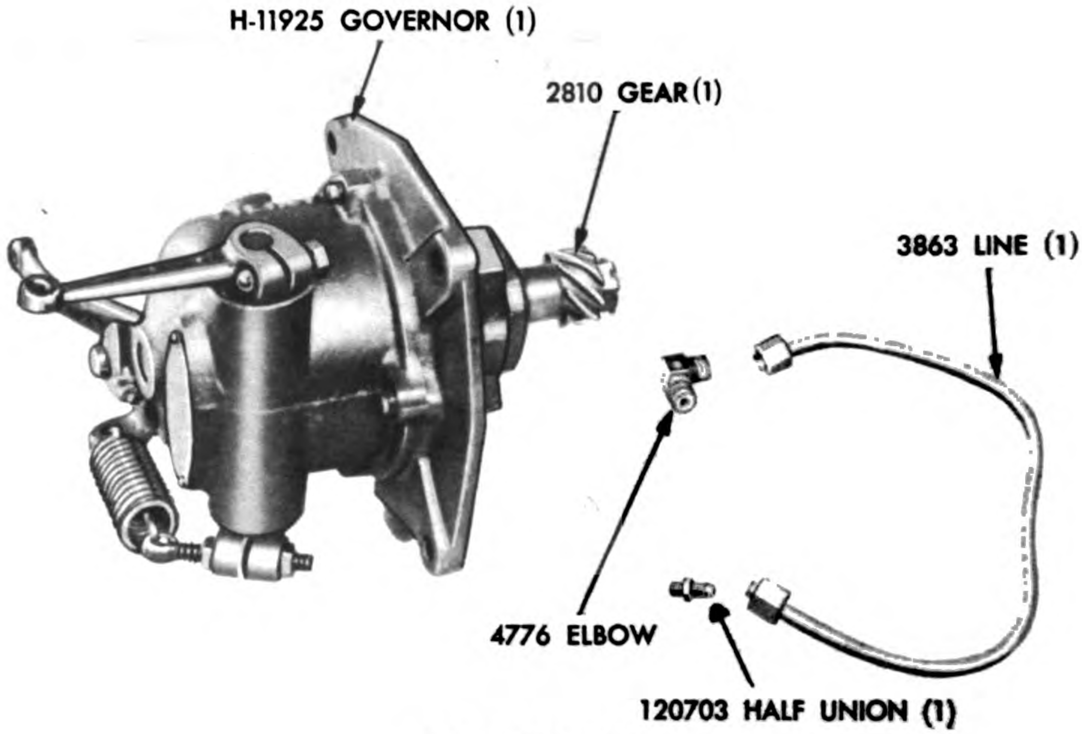
GENERATOR—(Continued)

Buda Part No.	No. Rqd.	Name Description
1858754	1	Stud, head assembly
H11345	1	Brace, generator bracket to fan bracket
106324	1	Capscrew 5/16"-18-5/8"
103320	3	Lockwasher 5/16"
H12148	1	Bracket, generator
106330	2	Capscrew 3/8-16-7/8"
103321	2	Lockwasher 3/8"
100121	2	Capscrew 5/16-18-3/4"



817216 COMMUTATOR END FRAME
AND PIN ASSEMBLY (1)

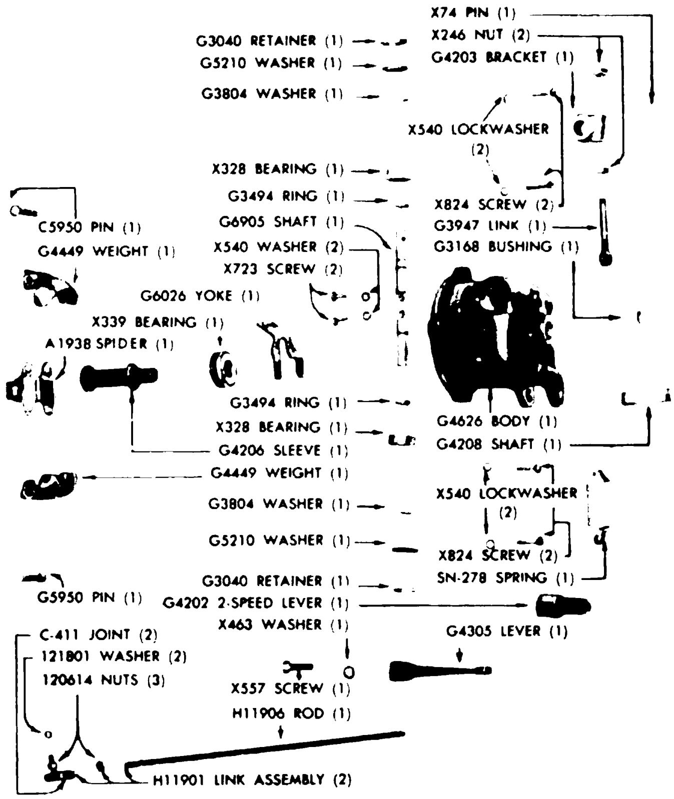
ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



GOVERNOR

Buda Part No.	No. Rqd.	Name Description
H-11925	1	Governor, assembly (includes gear)
C-5950	2	Pin, governor weight
G-4449	2	Weights, governor
A-1938	1	Spider, governor
X-540	6	Lockwasher, #10
X-723	2	Capscrew 10-32-7/16"
G-6026	1	Yoke, governor
X-339	1	Bearing, governor thrust
G-4206	1	Sleeve, governor thrust
X-328	2	Bearing, governor
G-3804	2	Lockwasher
G-5210	2	Lockwasher, governor oil retaining
G-3040	2	Retainer, governor bearing
X-246	2	Nut, 5/16"
X-74	1	Pin, governor tapered
X-824	4	Capscrew, 10-24 x 3/4"
G-4203	1	Bracket, Governor adjusting screw bracket
G-3494	2	Ring, governor snap
G-6905	1	Shaft, governor
G-3947	1	Link, governor spring eye
G-3168	1	Bushing, governor drive shaft
G-4626	1	Body, governor
G-4208	1	Shaft, governor lever
SN-278	1	Spring, governor
G-4202	1	Lever, governor two speed
G-4305	1	Lever, governor throttle
X-463	1	Lockwasher, 1/4"
X-557	1	Capscrew, 1/4-28-7/8"
H-11906	1	Rod, governor throttle

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



GOVERNOR—(Continued)

Buda Part No.	No. Rqd.	Name Description
H-11901	2	Link, assembly
C-411	2	Joint, governor throttle ball
120614	3	Nut, governor throttle rod ball joint #10 x 32
121801	2	Lockwasher, governor throttle rod ball joint #10
1811	1	Gasket, governor
X-425	1	Cotter Pin 3/32 x 3/4
X-763	1	Nut, governor spider shaft 3/8"
2810	1	Gear, governor shaft
X-461	1	Key, governor shaft gear
G-4200	1	Cap, governor
G-4209	1	Gasket, governor cap
X-310	1	Bearing, governor shaft
G-4159	1	Spring, governor shaft
X-935	1	Pin, governor spider to shaft 1/8 x 7/8
G-4205	1	Shaft, governor spider
103320	4	Lockwasher 5/16"
100121	4	Capscrews 5/16-18-3/4"
4776	1	Elbow, governor oil line
3863	1	Oil line, governor
120703	1	Half union, oil line
X-454	1	Welch plug
G-3494	2	Ring, snap
SN-266	1	Spring, bumper
G-5113	1	Screw, bumper
X-217	1	Nut

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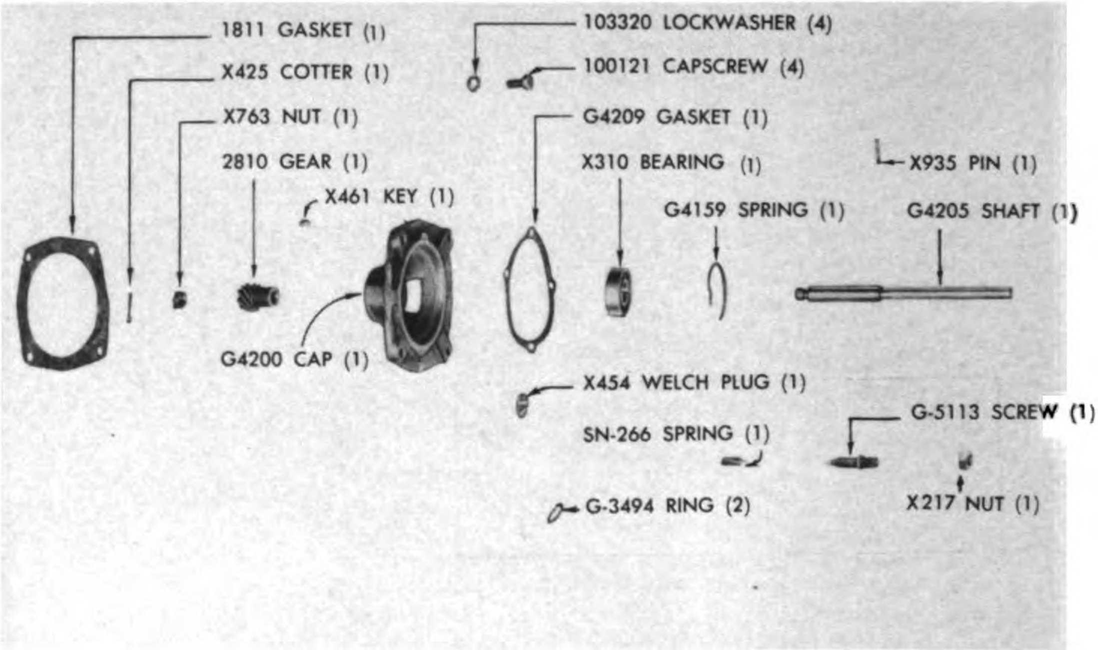

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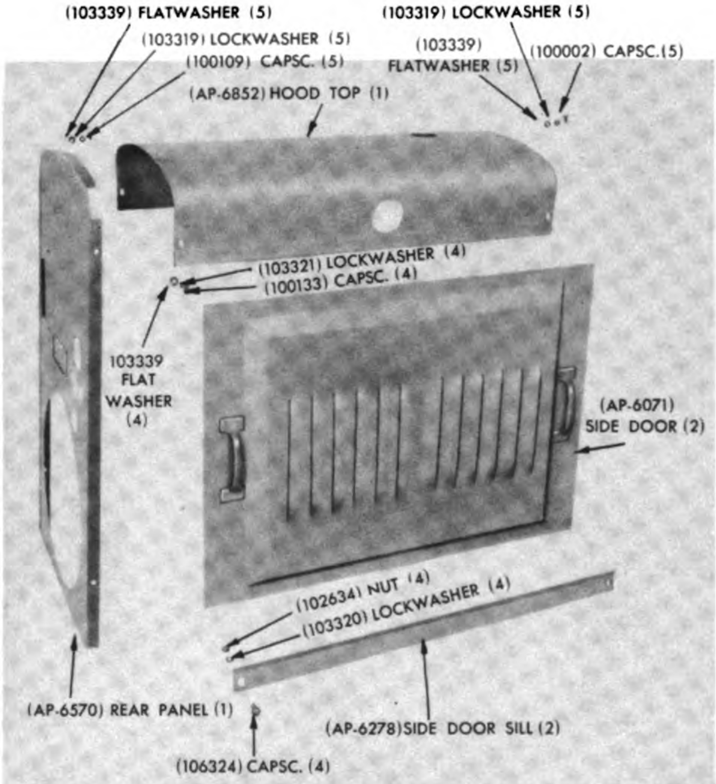
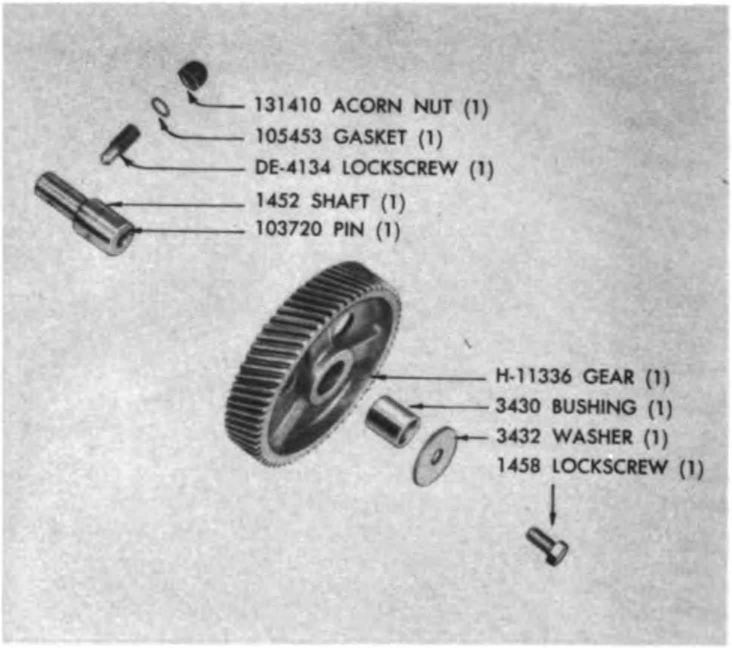


HOOD, SIDE DOORS, SILL AND REAR PANEL

Buda Part No.	No. Rqd.	Name Description
103339	14	Lockwasher, Hood flat
103319	10	Lockwasher, ¼"
100109	5	Capscrew, hood ¼"
103321	4	Lockwasher, ⅜"
100133	4	Capscrew, ⅜"
102634	4	Nut, sill 5/16"
103320	4	Lockwasher, sill nut 5/16"
AP-6278	2	Sill, side door
106324	4	Capscrew 5/16"
AP-6852	1	Hood top
AP-6570	1	Rear panel
100002	5	Capscrews, hood 5/16-18 x ¾"
AP-6071	2	Side doors

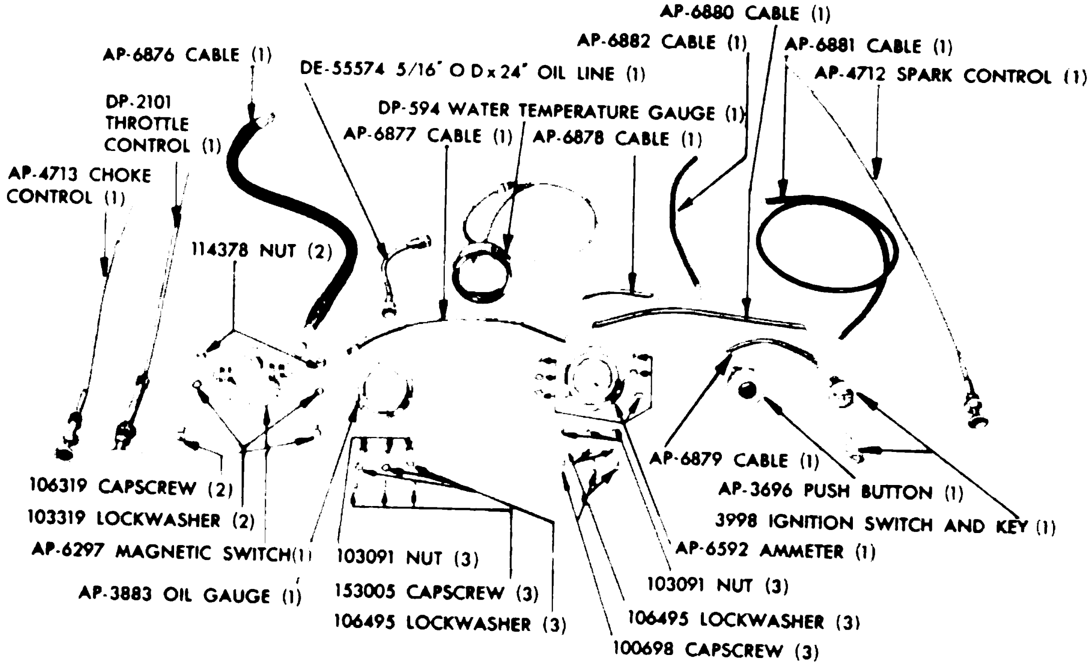


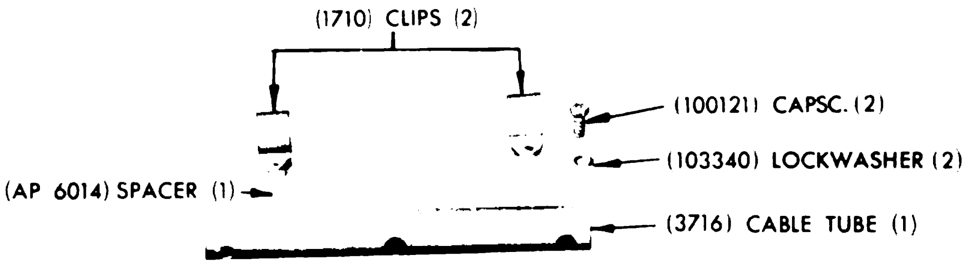
IDLER GEAR ASSEMBLY

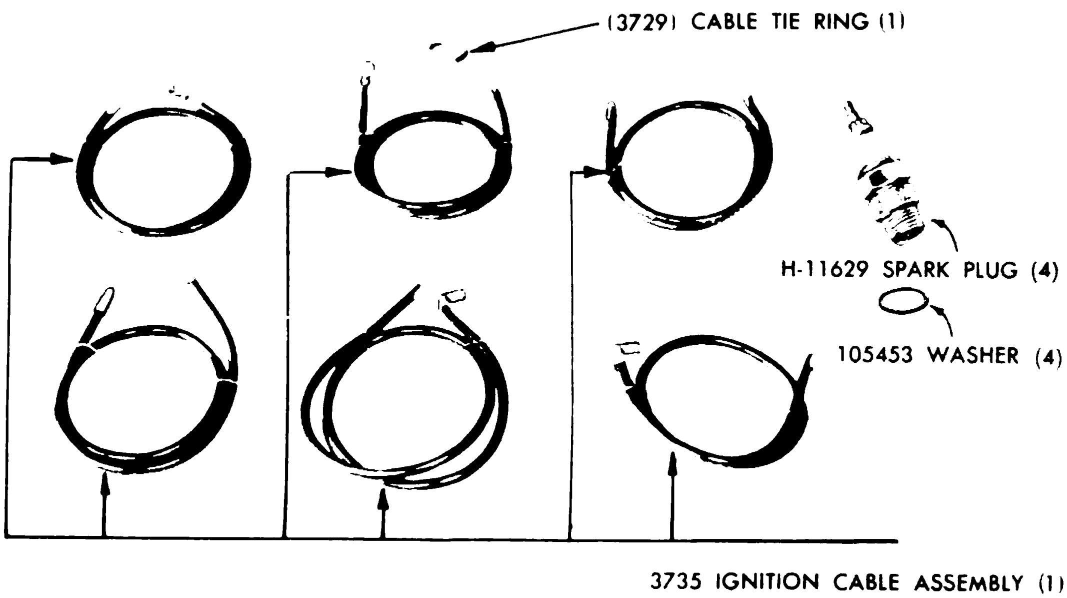
Buda Part No.	No. Rqd.	Name Description
H-11336	1	Gear, Idler
1452	1	Shaft, Idler Gear
103720	1	Pin, Idler gear shaft
3432	1	Thrust washer, idler gear
1458	1	Lockscrew, idler gear thrust washer
DE-4134	1	Lockscrew, idler gear shaft
131410	1	Acorn nut, 5/8-11
105453	1	Gasket, 5/8"
3430	1	Bushing, idler gear

IGNITION ACCESSORIES

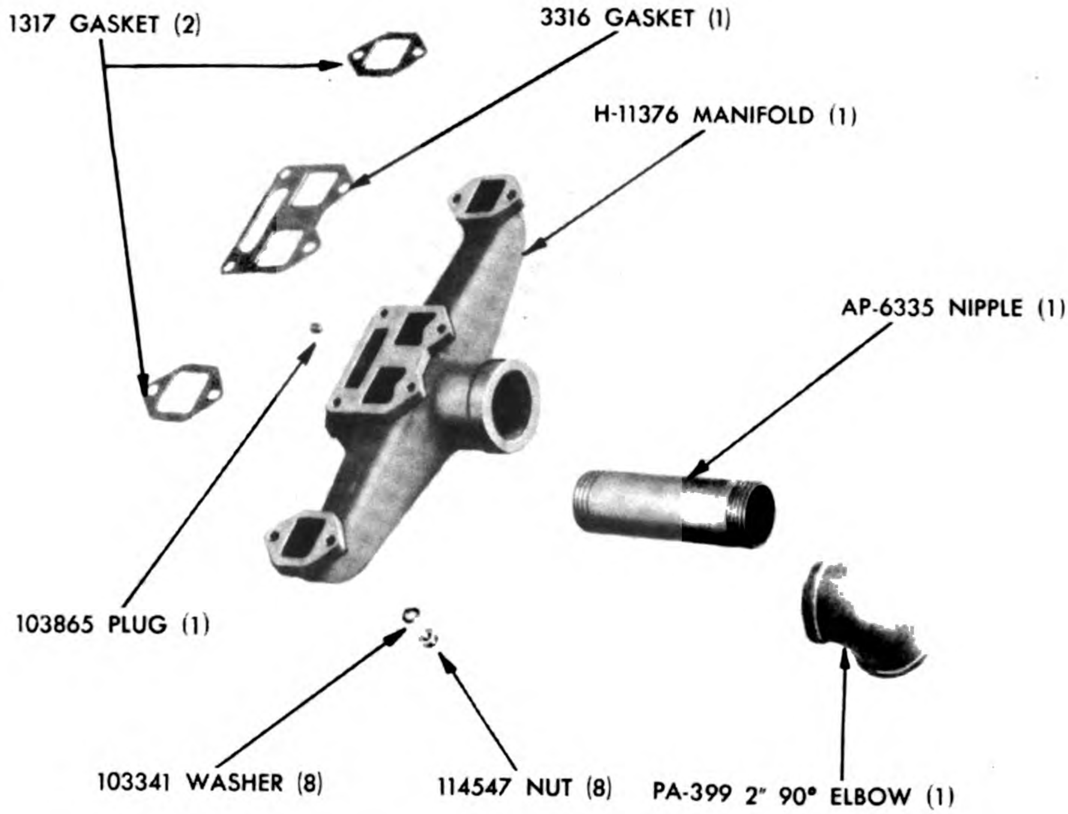
Buda Part No.	No. Rqd.	Name Description
AP-4713	1	Choke control
DP-2101	1	Throttle control
DE-55574	1	5/16" OD x 24 oil line
DP-594	1	Gauge, water temperature
AP-4712	1	Spark, control
AP-6876	1	Cable, magnetic switch to starter
AP-6877	1	Cable, magnetic switch to ammeter
AP-6879	1	Cable, ammeter to ignition switch
AP-6880	1	Cable, ammeter to coil
AP-6881	1	Cable, ammeter to volt regulator
AP-6878	1	Cable, starter button to ignition switch
AP-6882	1	Cable, ignition switch to coil
AP-6297	1	Magnetic switch
114378	2	Nut, magnetic switch
103319	2	Lockwasher, magnetic switch 1/4
106319	2	Capscrew, magnetic switch 1/4"-20 x 5/8"
AP-3883	1	Oil gauge
103091	6	Nut, oil gauge and ammeter
106495	6	Lockwasher, oil gauge and ammeter
153005	3	Capscrew, oil gauge
AP-3696	1	Push button
AP-6592	1	Ammeter
3998	1	Ignition switch and key
100698	3	Capscrews, ammeter
1710	2	Clips, cable
AP-6014	1	Spacer, cable tube
3716	1	Cable, tube
100121	2	Capscrew, cable tube 5/16"-18 x 3/4"
103340	2	Lockwasher, cable tube 5/16"
3729	1	Tie ring, cable
3735	1	Ignition cable assembly
H-11629	4	Spark plug
105453	4	Washer, spark plug





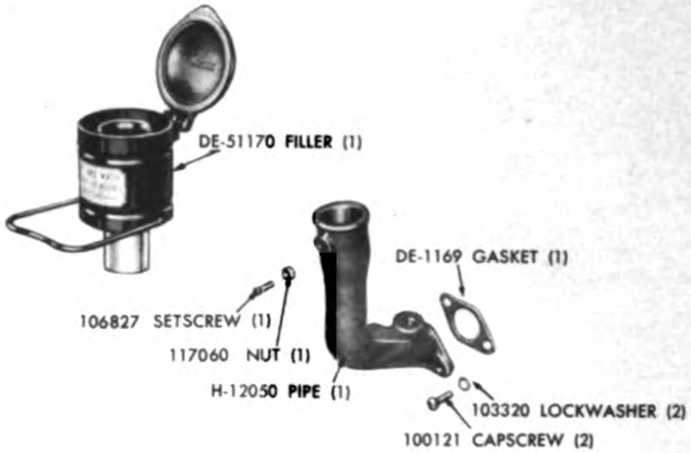


ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



INTAKE AND EXHAUST MANIFOLD ASSEMBLY

Buda Part No.	No. Rqd.	Name Description
1317	2	Gasket, exhaust port
3316	1	Gasket, intake and exhaust
H-11376	1	Manifold, intake and exhaust
114547	8	Nut, 3/8-24
103341	8	Lockwasher 3/8"
AP-6335	1	Muffler pipe nipple
PA-399	1	Elbow 2" -90°
103865	1	Plug, pipe 1/8 sq. hd.



OIL FILLER AND BREATHER

Buda Part No.	No. Rqd.	Name Description
DE-51170	1	Breather, oil filler assy.
H-12050	1	Filler pipe, oil
DE-1169	1	Gasket, oil filler pipe
100121	2	Capscrew 5/16-18 x 1
103320	2	Lockwasher 5/16
106827	1	Set screw 1/4 x 1/2
117060	1	Nut, 1/4

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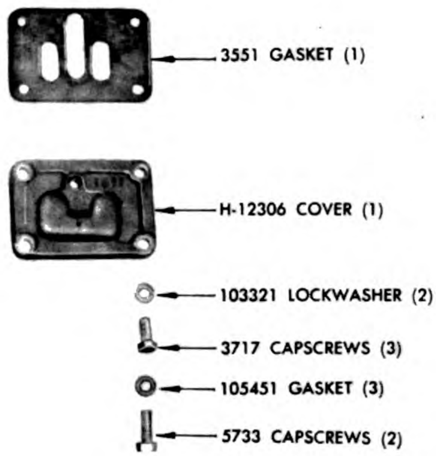
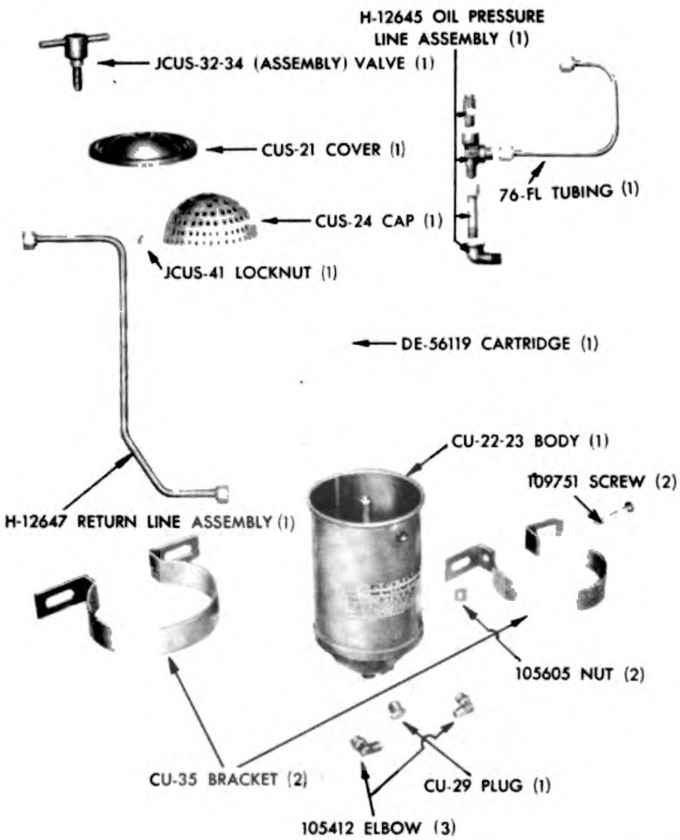


FILTER PAD AND COVER

Buda Part No.	No. Rqd.	Name Description
H-12306	1	Cover, oil filter
3551	1	Gasket, oil filter cover
3717	3	Capscrews, (slotted) oil filter cover
5733	2	Capscrews, (regular) oil filter cover
103321	2	Lockwashers, ⅜"
105451	3	Gasket, copper asbestos ⅜"



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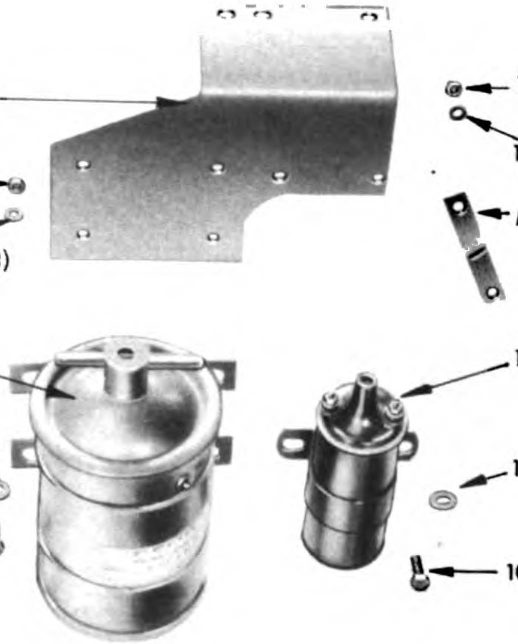

OIL FILTER, IGNITION COIL, FILTER OIL LINE AND BRACKET ASSEMBLY

Buda Part No.	No. Rqd.	Name Description
MC-14276	1	Bracket, oil filter and coil
117062	4	Nut, ⅜″
110730	8	Lockwasher ⅜″
100133	4	Capscrew, ⅜-16-¾
MC-12952	1	Brace, oil filter bracket
112723	2	Lockwasher 5/16
117061	2	Nut, 5/16
103343	2	Lockwasher, plain 5/16″
100121	2	Capscrew 5/16-18-¾
1755	1	Ignition coil
H-11676	1	Oil filter
JCUS-32-34	1	Valve assy. oil filter
CUS-21	1	Cover, oil filter
JCUS-41	1	Locknut, cover
CUS-24	1	Cap, oil filter
DE-56119	1	Cartridge, oil filter
CU-22-23	1	Body, oil filter
CU-35	2	Bracket, oil filter body
CU-29	1	Plug, oil filter body oil
105412	3	Elbow, ⅛ x ¼ brass
H-12645	1	Oil pressure line assy.
H-12647	1	Oil pressure return line assy.
76-FL	1	Tubing, ⅛ x 5/16
109751	2	Capscrews, 5/16″
105605	2	Nut, 5/16″

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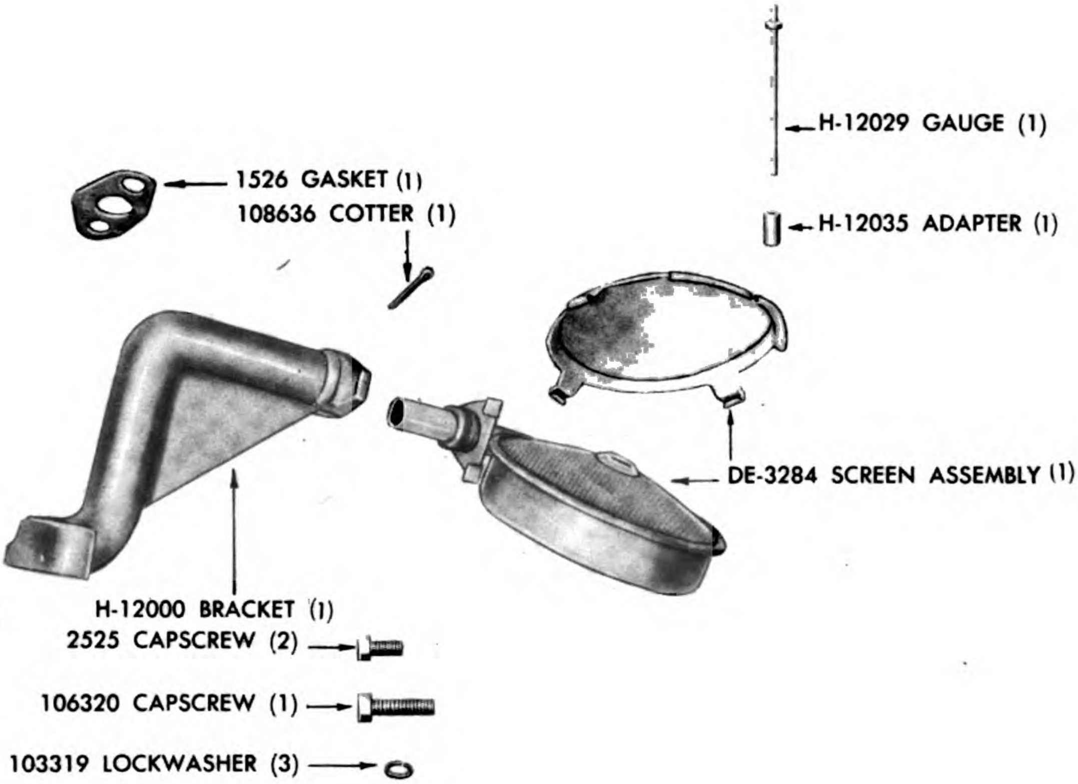

OIL PAN, FLOAT SCREEN AND GAUGE

Buda Part No.	No. Rqd.	Name Description
3531	1	Pan, oil
H-12178	1	Plug, oil pan drain
106330	18	Capscrew 3/8-16-7/8
103321	18	Lockwasher 3/8"
3539	2	Gasket, oil pan side
1540	1	Gasket, oil pan front
1541	1	Gasket, oil pan rear
DE-3284	1	Screen assembly
H-12000	1	Bracket, oil screen
1526	1	Gasket, oil screen bracket
2525	2	Capscrew, 1/4 x 1 1/4
106320	1	Capscrew, 1/4 x 7/8"
103319	3	Lockwasher 1/4"
H-12029	1	Gauge, oil level
H-12035	1	Adaptor
108636	1	Cotter, oil float

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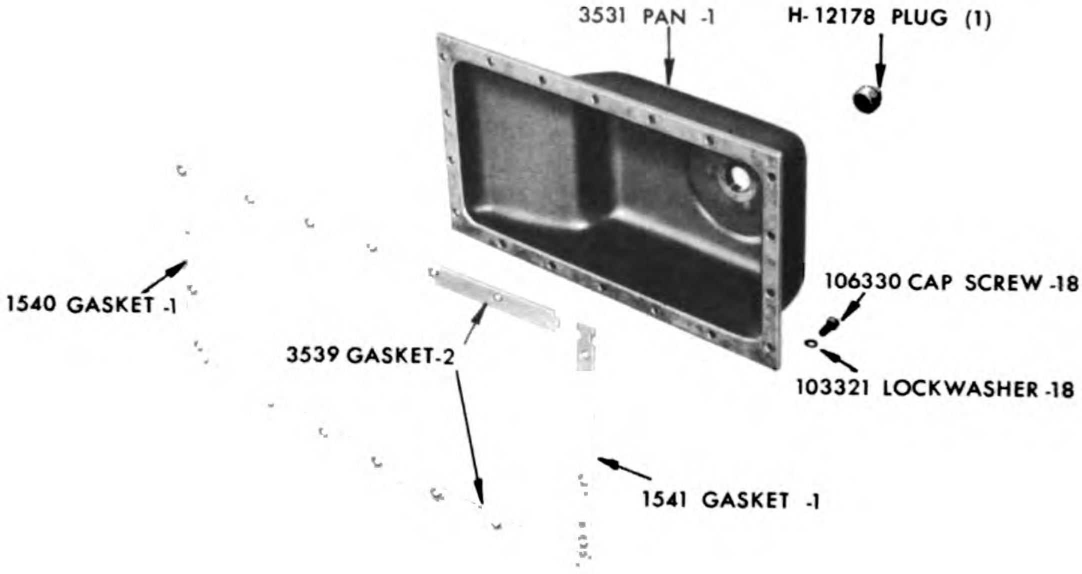
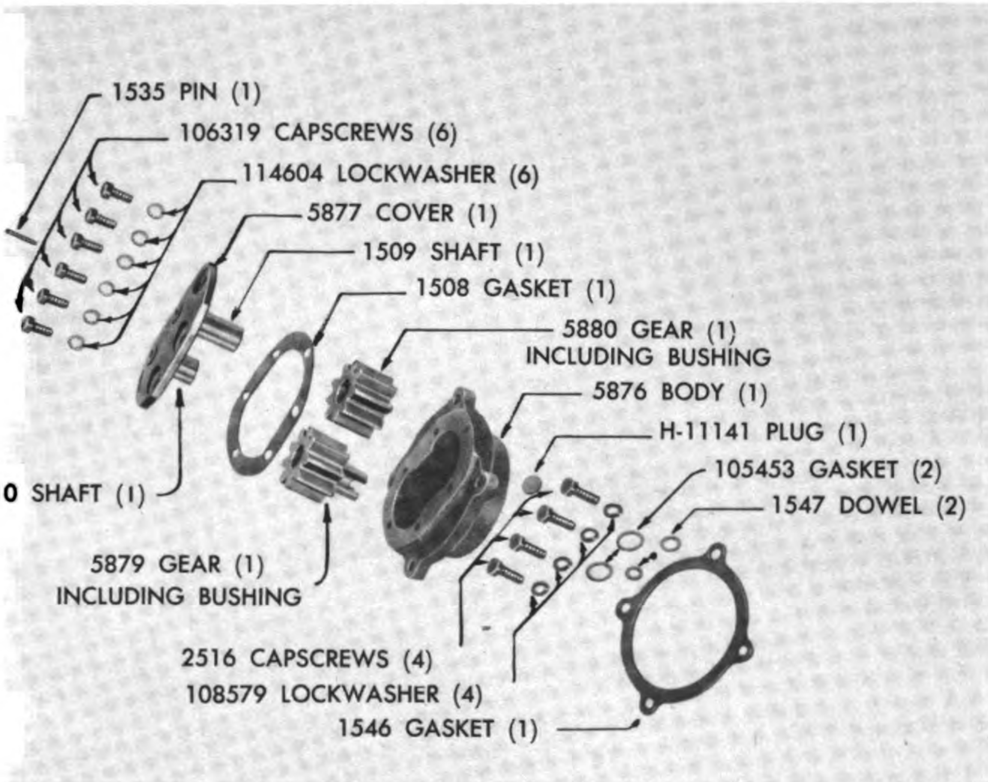
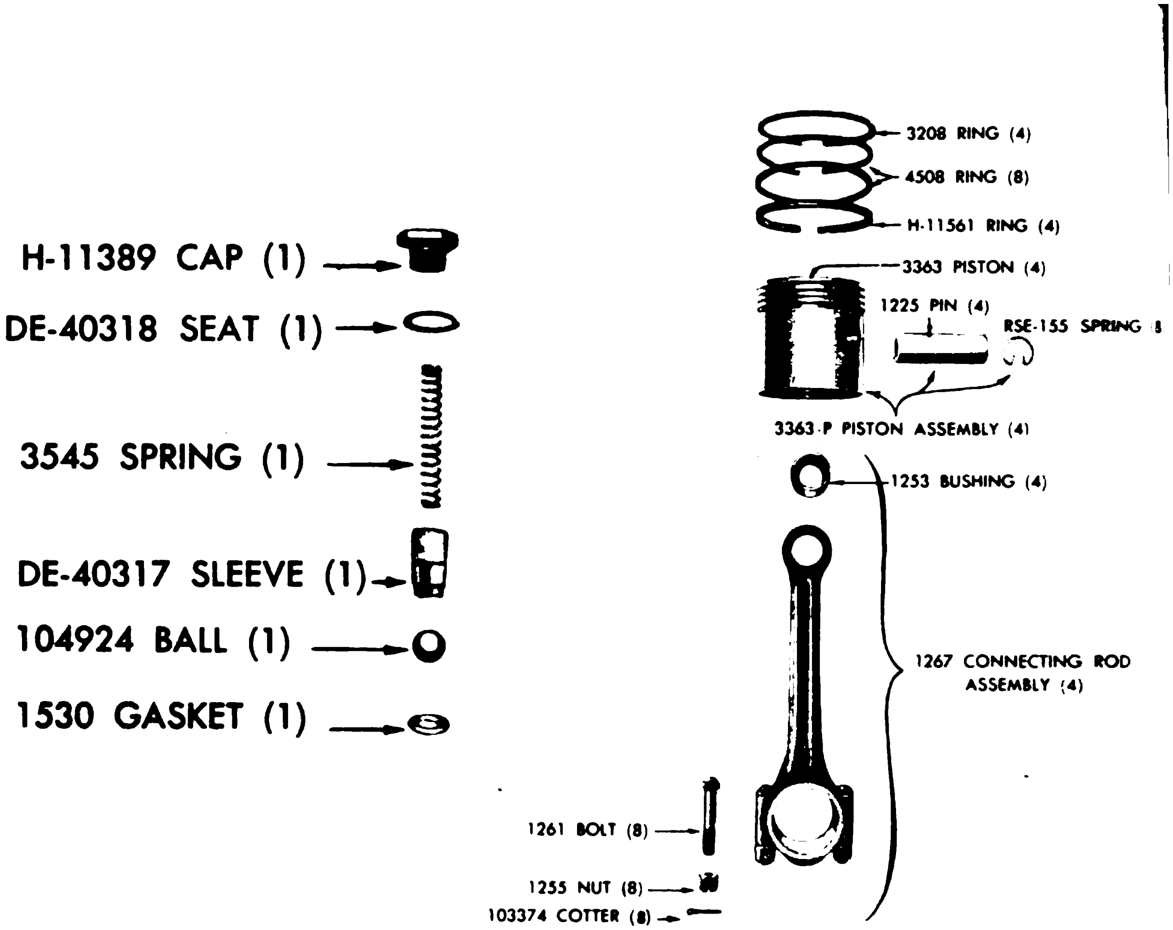

3531 PAN -1
H-12178 PLUG (1)
1540 GASKET -1
106330 CAP SCREW -18
3539 GASKET-2
103321 LOCKWASHER -18
1541 GASKET -1



OIL PUMP

Buda Part No.	No. Rqd.	Name Description
5875	1	Oil pump assembly (not illustrated)
1535	1	Pin, camshaft drive
106319	6	Capscrews ¼"-20 x ⅝"
114604	6	Lockwasher ¼
5877	1	Cover, oil pump body
1509	1	Shaft, oil pump drive
1510	1	Shaft, oil pump idler
1508	1	Gasket, oil pump body
5880	1	Gear, oil pump idler (includes bushings)
5879	1	Gear, oil pump drive (includes bushings)
5876	1	Body, oil pump
H11141	1	Plug, welch
2516	4	Capscrews 5/16 x 1"
108579	4	Lockwasher 5/16"
105453	2	Gasket, copper 5/16"
1547	2	Dowel, oil pump body
1546	1	Gasket, oil pump body to crankcase



OIL RELIEF VALVE PISTON AND CONNECTING ROD ASSEMBLY

OIL RELIEF VALVE ASSEMBLY

Buda Part No.	No. Rqd.	Name Description
H-11389	1	Cap, oil pressure relief valve
DE-40318	1	Seat, oil pressure relief valve
3545	1	Spring, oil pressure relief valve
DE-40317	1	Sleeve, oil pressure relief valve
104924	1	Ball, oil pressure relief valve
1530	1	Gasket, oil pressure relief valve
		PISTONS ASSEMBLY
H-11561	4	Piston ring, top
4508	8	Piston ring, 2nd. and 3rd.
3208	4	Piston ring, bottom
3363-P	4	Assembly, piston pin and spring
1225	4	Pin, piston
RSE-155	8	Spring, piston pin
		CONNECTING ROD ASSEMBLY
1267	4	Connecting rod assembly
1253	4	Bushing
1261	8	Bolt, connecting rod
1255	8	Nut,
103374	8	Cotter 3/32" x 1"

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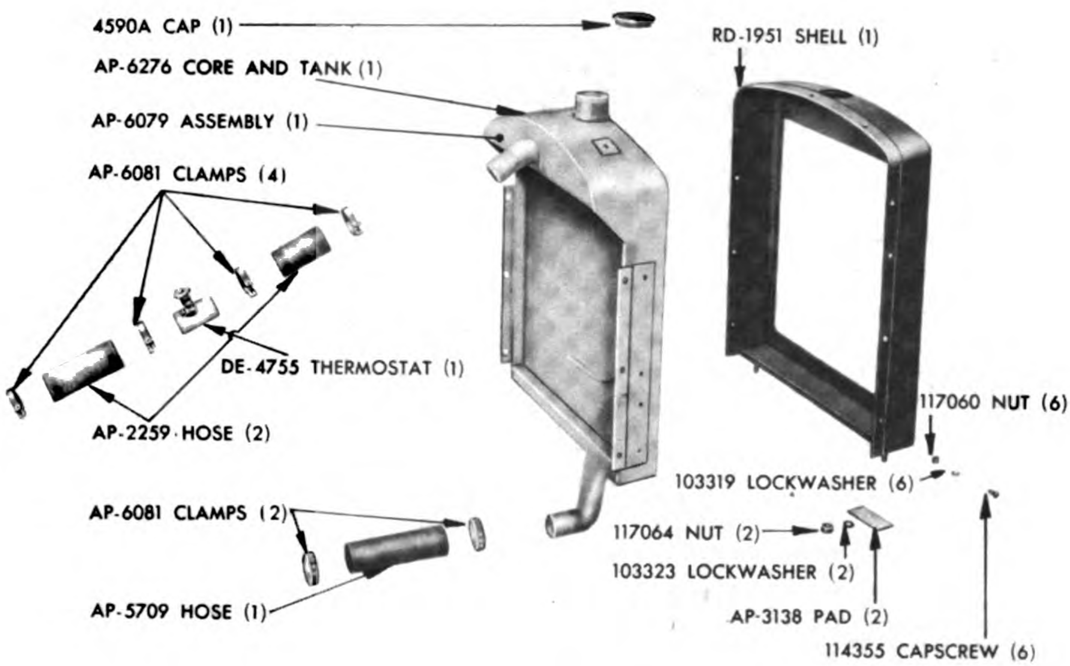
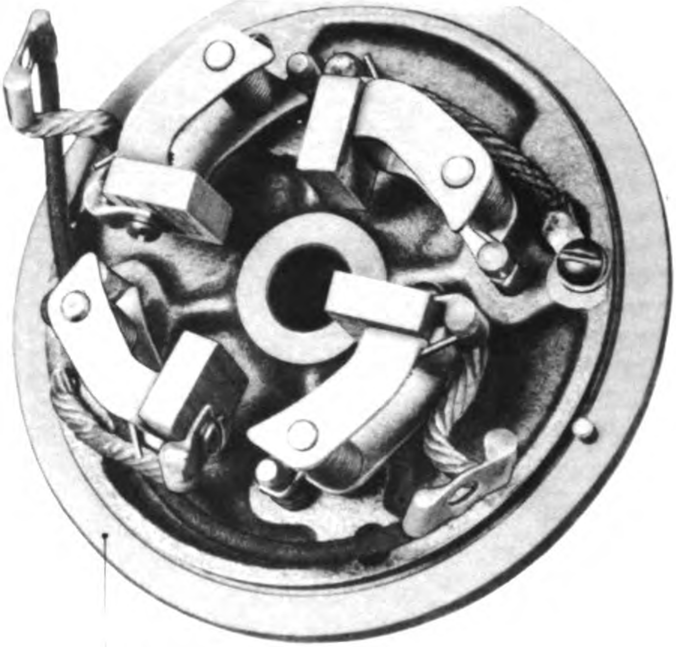


RADIATOR AND THERMOSTAT

Buda Part No.	No. Rqd.	Name Description
AP-6079	1	Radiator assembly
DE-4755	1	Thermostat
AP-2259	2	Hose, radiator
AP-6081	6	Clamp, radiator hose
AP-5709	1	Hose, radiator, bottom
AP-6276	1	Core and tank, radiator
4590A	1	Cap, radiator
RD-1951-	1	Shell, radiator
117060	6	Nut, radiator shell to core ¼"
103319	6	Lockwashers ¼"
114355	6	Capscrew, radiator shell to core ¼" x 9/16"
AP-3138	2	Pad, radiator
117064	2	Nut, radiator bottom ½"
103323	2	Lockwashers, radiator bottom nut



815839 COMMUTATOR END FRAME AND PIN ASSEMBLY (1)

STARTING MOTOR

Buda Part No.	No. Rqd.	Name Description
2734	1	Starting motor
124546	1	Key, woodruff
811559	2	Support
805057	2	Lockwasher
1850810	1	Screw
1850811	1	Screw
1841543	1	Housing, motor drive
103322	3	Lockwashers, 7/16"
100147	3	Capscrews, 7/16-14-1 1/4
1849774	1	Washer, space .626 x 1 1/16 x 3/32"
809815	1	Washer, space .626 x 1 1/16
833602	1	Washer, space .563 x 63/64" x 1/16
1887893	1	Assembly, Bendix gear and shaft
1850812	1	Spring, motor
1848530	1	Sleeve, motor
818002	1	Armature, starting motor
833602	1	Space washer
815839	1	Commutator end frame and pin assembly
817114	1	Cover band
809053	2	Through bolt
103319	2	Lockwasher, through bolt
1880642	1	Oiler
802691	1	Wick
810601	4	Shoe pole
828675	4	Screw, pole shoe
810627	1	Coil, upper field
810626	1	Coil, lower field

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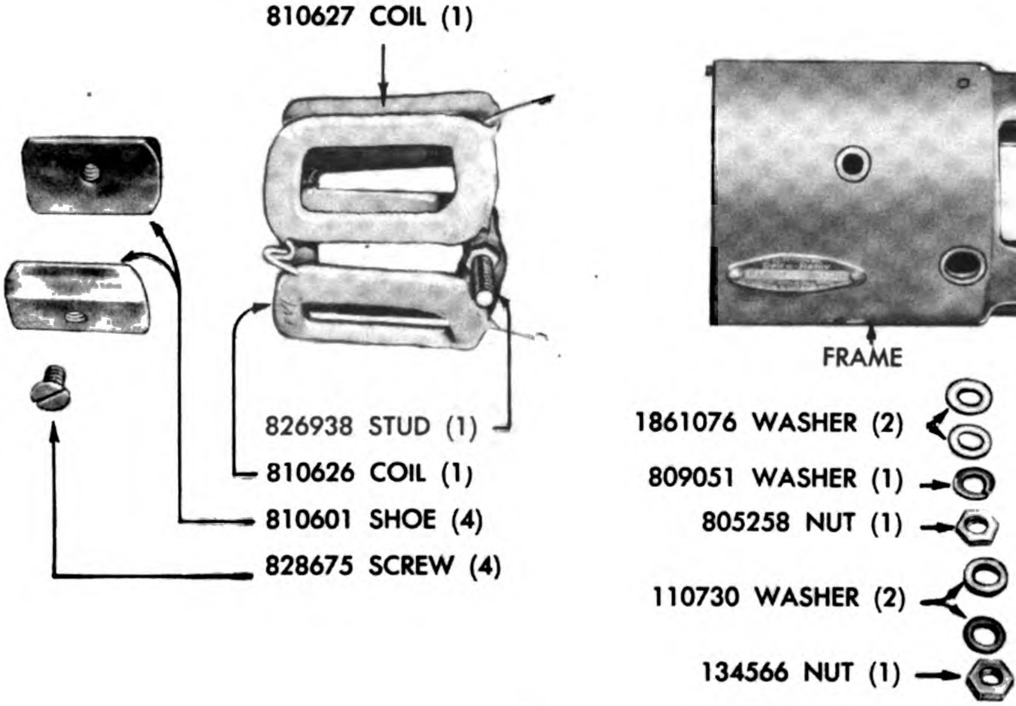

STARTING MOTOR—(Continued)

Buda Part No.	No. Rqd.	Name Description
826938	1	Stud, terminal
1861076	2	Washer, insulator (¾ OD)
809051	1	Washer, insulator (9⁄16 OD)
110730	2	Lockwasher
805258	1	Nut, (5⁄32 thick)
134566	1	Nut, (¼ thick)
809062	1	Dowel pin
1865182	1	End plug
813521	4	Spring
810226	4	Holder
811553	4	Brush
106495	4	Washer
115903	4	Screw
813554	2	Lead, ground
122159	2	Screw, ground lead
106496	2	Lockwasher, ground lead screw
819362	1	Lead, brush and field connector
135616	2	Screw, brush and field connector lead
106497	2	Lockwasher, brush and field connector field screw
817313	2	Pin, brush holder hinge
817314	2	Pin, brush holder stop
812016	2	Pin, brush holder hinge
812015	2	Pin, brush holder stop

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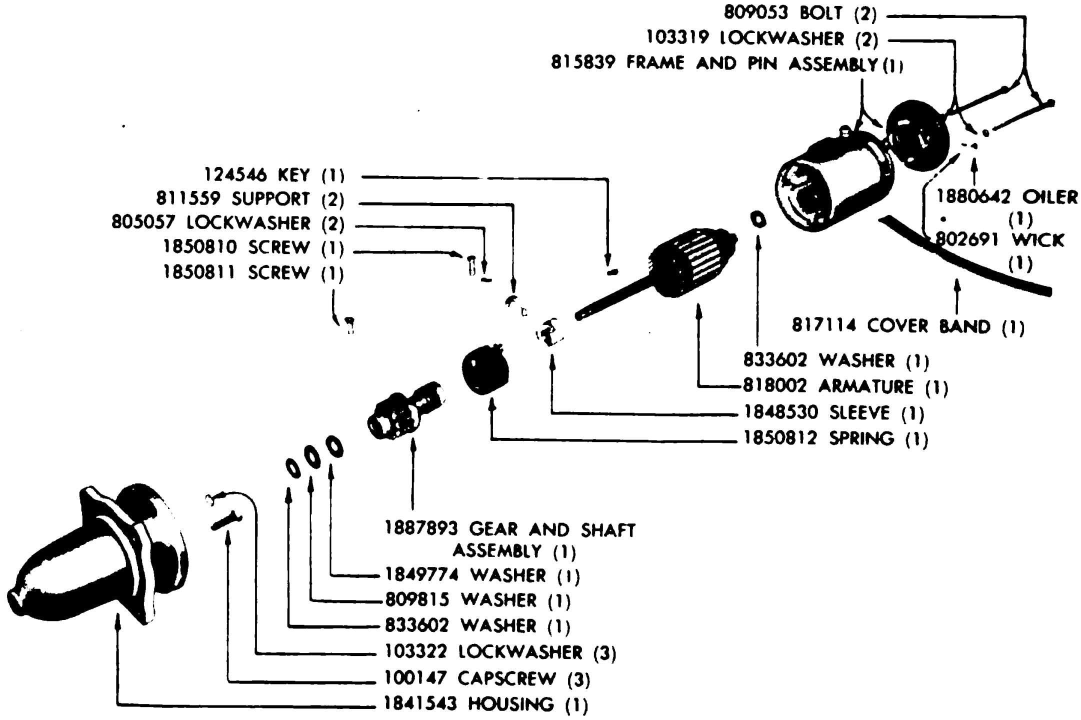

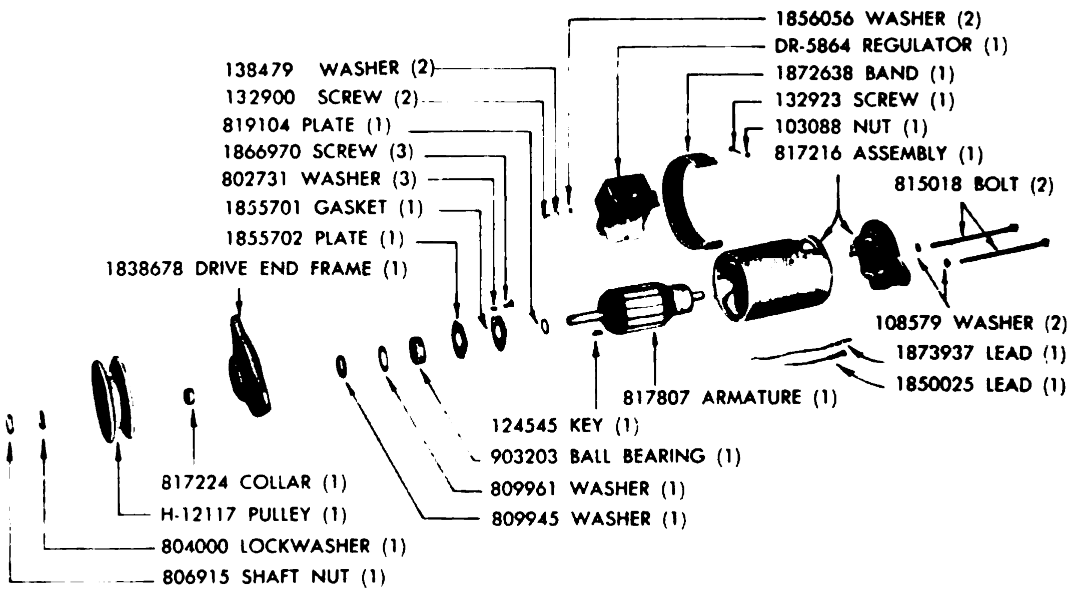

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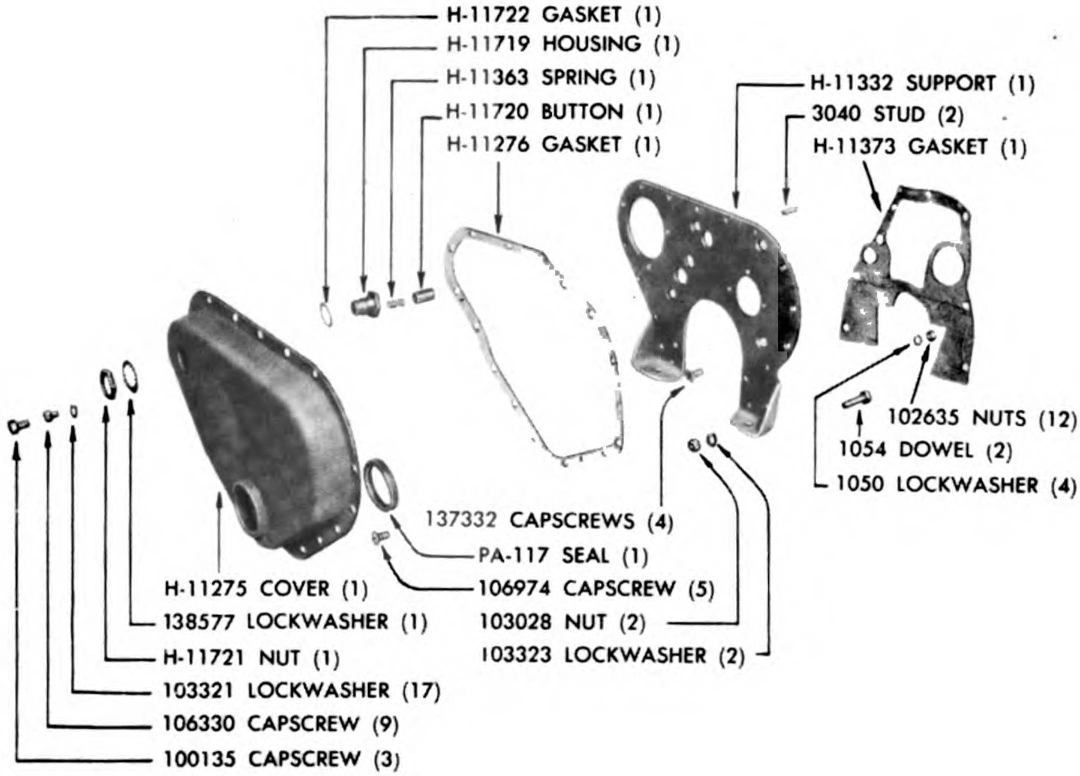
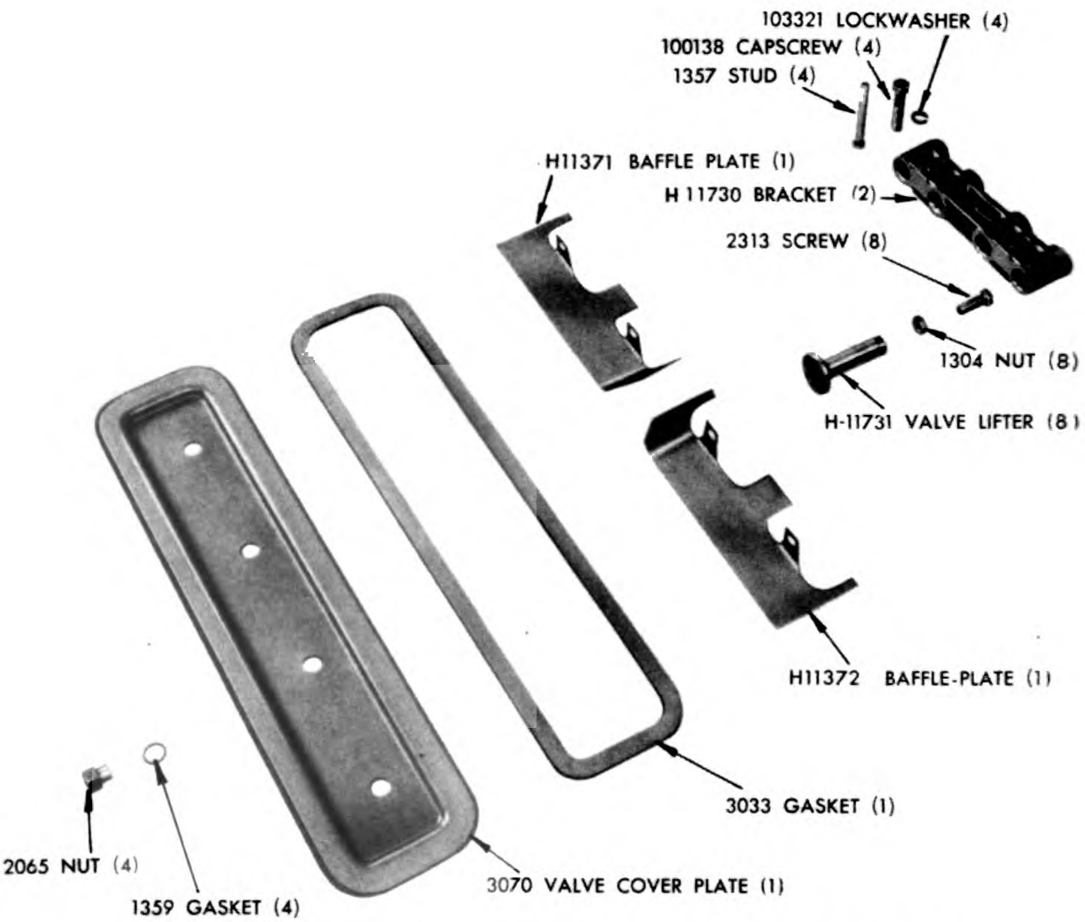


TIMING GEAR HOUSING AND COVER

Buda Part No.	No. Rqd.	Name Description
H-11275	1	Cover, front end
103321	17	Lockwasher, 3/8"
106330	9	Capscrew, 3/8-16 x 7/8"
100135	3	Capscrew, 3/8-16 x 1 1/4"
106974	5	Capscrew, 3/8-16 x 1/2"
102635	12	Nuts, 3/8" x 16
PA-117	1	Seal, front cover oil
137332	4	Capscrew, 1/2-13 x 1" flat head
1050	4	Lockwasher, 1/2" Shakeproof
H-11332	1	Support, cylinder front
3040	2	Stud, cylinder support
H-11373	1	Gasket, cylinder support
1054	2	Dowel, front support
103323	2	Lockwasher, 1/2"
103028	2	Nut, 1/2" x 20
H-11721	1	Nut, water pump shaft thrust bearing
H-11722	1	Gasket, water pump shaft thrust bearing
H-11719	1	Housing, water pump shaft thrust bearing
H-11363	1	Spring, water pump shaft thrust bearing
H-11720	1	Button, water pump shaft thrust bearing
H-11276	1	Gasket, front end cover
138577	1	Lockwasher, 1 1/8"

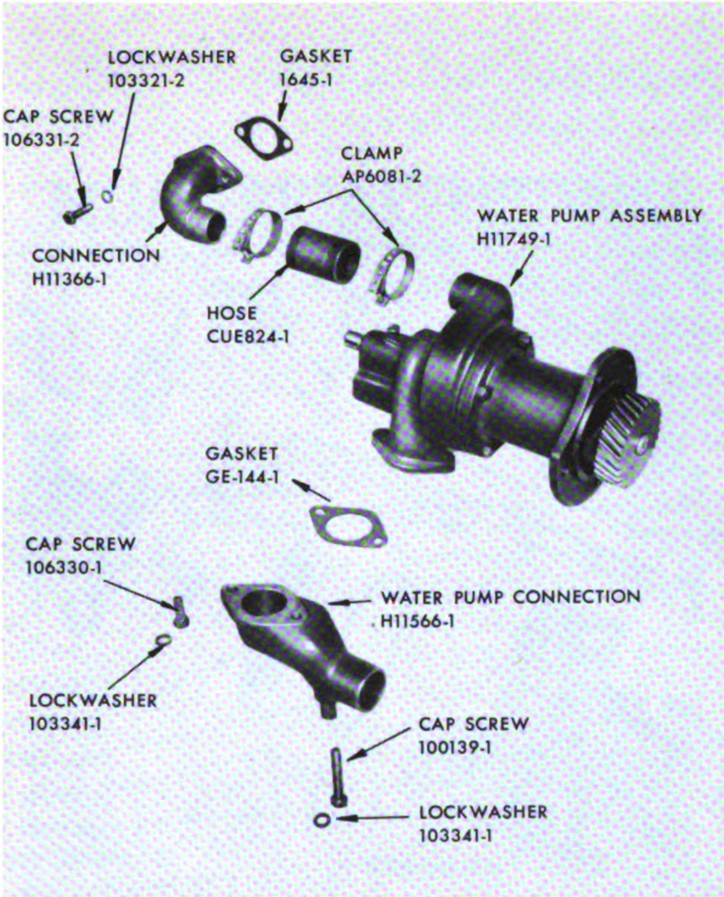
ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



VALVE BRACKET AND COVER ASSEMBLY

Buda Part No.	No. Rqd.	Name Description
3312	4	Valve, exhaust
1310	4	Valve, inlet
H12280	8 prs.	Retainer, valve
1345	4	Guide, valve
1315	4	Guide, valve
H11805	8	Seat, upper valve
3230	4	Seat valve
H12329	8	Spring, valve
H11807	8	Seat, lower valve
H1305	4	Dowel, valve lifter bracket
H-11730	2	Bracket, valve lifter
100138	4	Capscrew 3/8-16 x 1 3/4
103321	4	Lockwasher 3/8
H11731	8	Lifter valve
1304	8	Nut, valve lifter adj. screw check
2313	8	Screw, valve lifter adj.
H11371	1	Baffle plate, valve chamber
H11372	1	Baffle plate, valve chamber
3070	1	Cover, valve chamber
3033	1	Gasket, valve chamber cover
1359	4	Gasket, copper asbestos
2065	4	Nut, valve chamber cover
1357	4	Stud, valve cover plate

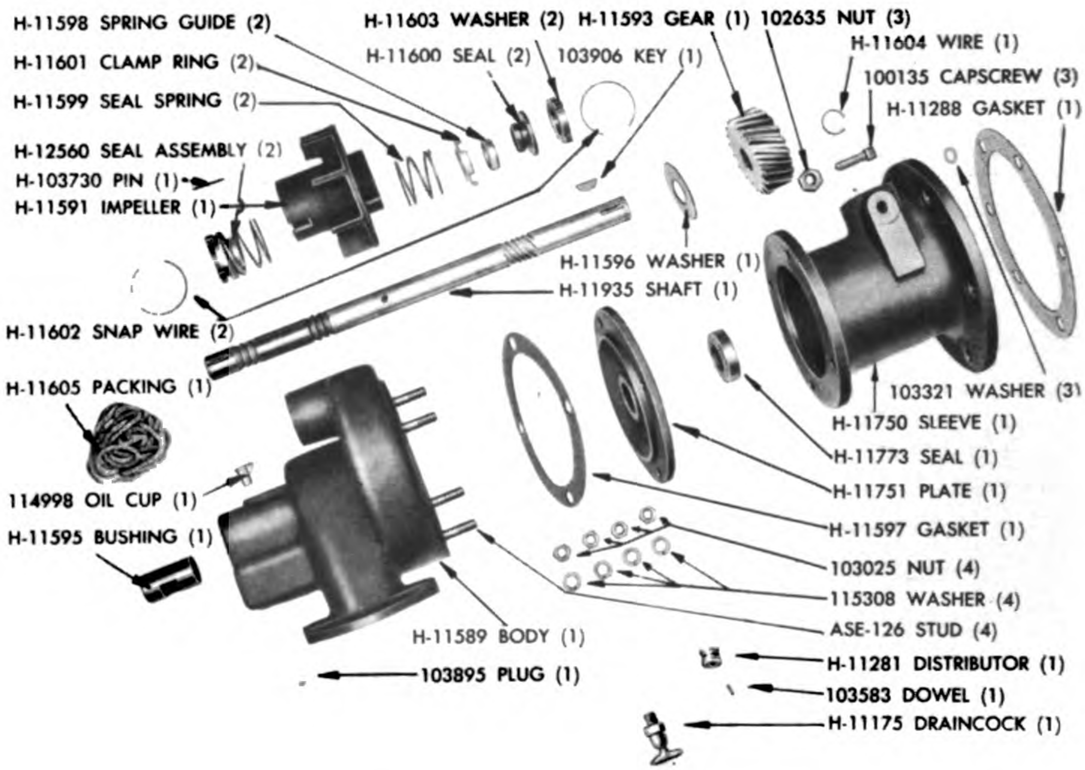
ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS



WATER PUMP

Buda Part No.	No. Rqd.	Name Description
H-11749	1	Water pump assembly (gear not included)
H-11366	1	Connection water pump to cylinder
1645	1	Gasket, water pump to cylinder connection
106331	2	Capscrew, water pump to cylinder
103321	2	Lockwasher, water pump to cylinder capscrew
CUE-824	1	Hose, water pump connection
AP-6081	2	Clamp, water pump connection
H-11566	1	Connection, water pump inlet
GE-144	1	Gasket, water pump inlet
106330	1	Capscrew, water pump inlet
103341	2	Lockwasher, water pump inlet
100139	1	Capscrew, water pump inlet
H-12560	2	Water pump seal assembly (includes 6 items marked with*)
*H-11602	2	Snap wire, water pump retainer
*H-11599	2	Spring, water pump seal
*H-11601	2	Ring, water pump seal
*H-11598	2	Guide, water pump seal spring
*H-11600	2	Seal, water pump flexible
*H-11603	2	Washer, water pump seal
H-11591	1	Impeller, water pump
103730	1	Pin, water pump impeller
103906	1	Key, water pump drive
H-11596	1	Washer, water pump thrust

ALWAYS GIVE MACHINE NUMBER, PART NUMBER, AND DESCRIPTION WHEN ORDERING PARTS.



WATER PUMP—(Continued)

H-11593	1	Gear, water pump
H-11604	1	Wire, water pump drive gear snap
114998	1	Oil cup, water pump body
H-11595	1	Bushing, water pump body
H-11589	1	Body, water pump
103895	1	Plug, water pump body expansion
H-11605	1	Packing, water pump body wool
H-11750	1	Sleeve, water pump drive bearing
H-11773	1	Seal, water pump drive oil
H-11935	1	Shaft, water pump drive
H-11281	1	Distributor, cylinder water
103583	1	Dowel, cylinder water
H-11751	1	Plate, water pump seal
H-11597	1	Gasket, water pump body to drive
115308	4	Washer, water pump body to drive
103025	4	Nut, water pump body to drive
ASE-126	4	Stud, water pump body to drive
H-11175	1	Drain cock cylinder water
H-11288	1	Gasket, water pump flange
100135	3	Capscrew, water pump to cover
103321	3	Lockwashers, water pump to cover
102635	3	Nut, water pump to cover

NUMERICAL LISTING OF PARTS

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price	Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
R1-11	378				R1-103	410	2	.2	.02
	379				R1-104	363	1	.2	.02
	381				R1-107	379			
	383					394			
	394					402	8	.2	.03
	410				R1-108	416	1	.2	.03
	411				R1-110	379	2	.2	.03
	414				R1-114	416	1	.2	.03
	415				R1-124	363			
	427					364			
	430	26		.12		383			
R1-12	378					393			
	379					398			
	380					401			
	381					410			
	383					414			
	385					425			
	386					430			
	387					432	355	.4	.04
	388				R1-125	389			
	389					393			
	392					399			
	393					400			
	408					413			
	409					430	33	.4	.04
	411				R1-126	393			
	413					400	3	.4	.04
	416				R1-127	392			
	426					399			
	427					430			
	428					431	13	.4	.04
	431	69	.1	.14	R1-128	393	3	.4	.04
R1-19	381	1		.04	R1-129	397			
R1-20	401					398	2	.4	.04
	425	4	.4	.25	R1-131	394	2	.4	.05
R1-32	404	2		.01	R1-132	394			
R1-33	379	8		.01		403	6	.4	.05
R1-36	406	2	.1	.03	R1-133	389			
R1-67	421	6	.5	.07		393	6	.4	.05
R1-74	379	2	.4	.08	R1-136	411	2	.4	.05
R1-81	378				R1-137	385	2	.4	.05
	379				R1-138	386	2	.4	.05
	383				R1-146	391			
	413					435	66	.5	.06
	414	18	.8	.09	R1-147	403			
R1-101	401					435	5	.5	.07
	437	10	.2	.02	R1-148	435	18	.5	.07
R1-102	414				R1-160	387	4	.8	.09
	416				R1-164	386	2	.8	.10
	434	14	.2	.02	R1-165	386	6	.8	.10

NUMERICAL LISTING OF PARTS (Continued)

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
R1-176	393	3	.8	.10
R1-177	393	4	.8	.10
R1-185	413			
	428	10	1.0	.12
R1-187	413			
	428			
	435	13	1.4	.13
R1-213	434	4	.2	.02
R1-214	363	2	.2	.02
R1-215	434	2	.2	.02
R1-223	364			
	434	9	.4	.04
R1-224	434	6	.4	.04
R1-225	397	2	.4	.04
R1-226	397			
	421	4	.4	.05
R1-227	430	2	.4	.05
R1-245	414			
	378	10	.5	.08
R1-247	383	4	.8	.08
R1-248	413	4	.8	.08
R1-278	397	6	.4	.08
R1-290	363	4	.5	.08
R1-291	435	12	.5	.09
R1-295	385	8	.8	.08
R1-306	421	4	.3	.05
R1-330	417	124	.2	.02
R1-335	417	62	.2	.03
R1-339	431	4	.1	.04
R1-350	363	1	.6	.14
R1-362	404	1		.01
R1-363	404			
	405	3		.02
R1-364	405	6		.05
R1-365	404	1		.06
R1-366	404			
	405	3		.08
R1-367	404	1	.1	.10
R1-368	404			
	405	2	.1	.11
R1-369	405	1	.1	.13
R1-370	405	1	.1	.14
R1-371	405	1	.2	.34
R1-372	404	1	.2	.40
R1-373	405	1	.2	.46
R1-396	404	1	.1	.20
R1-403	363	1	.4	.31
R1-404	363	1	4.7	3.85
R1-408	392	2	.3	.10
R1-425	435	10	.4	.15
R1-434	437	2	.1	.06
R1-439	419	28	.2	.09
R1-440	397			
	419	8	.2	.10
R1-441	399			
	400			
	417			
	419	130	.2	.10
R1-442	410			
	419	4	.2	.11
R1-443	378	6	.2	.11
R1-444	421	24	.2	.12
R1-453	362			
	429			
	436	21	.4	.16
R1-454	429	46	.4	.16
R1-455	413	56	.4	.17

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
R1-456	362	2	.4	.18
R1-459	393	2	.8	.39
R1-461	419	60	.1	.04
R1-474	376	1	.1	.01
R1-494	362			
	363	20	.1	.03
R1-501	381	2	.1	.05
R1-503	378	6	.2	.06
R1-504	392	1	.2	.06
R1-541	420	4	.2	.05
R1-548	426	8	.7	.26
R1-562	434	4	1.0	.25
R1-563	434	4	1.2	.29
R1-568	425	4	.1	.04
R1-569	401	4	.2	.05
R1-570	393	4	.2	05
R1-591	385	2	2.6	.96
R1-593	363	1	4.4	.82
R1-601	395	2		.00
R1-604	395			
	400	4		.00
R1-605	397			
	398			
	399			
	401			
	406			
	411			
	416	15		.00
R1-606	381			
	406	6		.00
R1-607	376	1		.00
R1-609	398	2		.00
R1-612	416			
	425	3		.00
R1-614	389			
	397			
	398	30		.00
R1-615	399			
	400	2		.00
R1-621	432	166		.00
R1-623	394	2		.01
R1-624	397	2		.01
R1-625	421	4		.01
R1-630	390	82		.01
R1-648	376			
	411	2		.06
R1-649	378			
	379			
	381			
	383			
	386			
	392			
	393			
	413			
	426	23	.1	.06
R1-680	376	1	.1	.11
R1-682	379			
	385	6	.1	.09
R1-683	392			
	408	6	.1	.08
R1-688	392	2	.4	.09
R1-717	364			
	376	4	.1	.09
R1-718	364	1	.2	.09
R1-726	363	1	1.5	.35
R1-727	363	1	2.3	.56
R1-746	418	2	.7	.42

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
R1-748	434	8	.1	.02
R1-787	398	4		.01
R1-789	406	2		.01
R1-792	397			
	399			
	416	6	.2	.03
R1-794	363	1	.4	.05
R1-801	394			
	406	9	.1	.01
R1-803	400			
	415			
	416	6	.2	.03
R1-804	427	10	.2	.05
R1-812	388	56	.2	.02
R1-826	364			
	392	2	.2	.32
R1-830	418	2		.00
R1-866	386	4	.1	.02
R1-871	364	1	.4	.05
R1-884	401	2	3.1	2.20
R1-892	397			
	406	52		.01
R1-897	425	1	1.7	1.78
R1-905	401	2	2.2	1.60
R1-911	393	1	12.9	5.21
R1-930	402	2		.03
R1-932	394	1		.03
R1-933	381			
	383			
	395			
	397			
	398	12		.03
R1-934	394	1		.03
R1-935	379			
	381			
	393	10		.03
R1-940	380			
	393			
	403	6	.1	.04
R1-942	380			
	393			
	403			
	431	8	.1	.04
R1-943	379	1	.1	.05
R1-944	379	1	.1	.05
R1-948	378			
	411			
	415	4	.1	.07
R1-949	383			
	386			
	408			
	413			
	426	15	.1	.06
R1-950	378			
	383			
	386			
	408			
	426			
	428	18	.1	.07
R1-951	386	2	.2	.09
R1-970	376	2	.1	.18
R1-976	413	2	.3	.10
R1-989	408			
	430	2	.1	.09
R1-990	414	3	.1	.06
R1-991	414	1	.1	.07
R1-1009	394	2		.05

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
R1-1011	394			
	401	4		.05
R1-1012	378			
	379	3		.05
R1-1014	401	4		.03
R1-1016	379	2		.09
R1-1022	378	1		.08
R1-1024	378	1		.04
R1-1029	393	4		.10
R1-1032	378	1	.1	.16
R1-1033	378	2	.1	.09
R1-1087	425	1	.1	.05
R1-1088	401	2	.1	.05
R1-1089	393	2	.2	.06
R1-1092	364	1	.7	.72
R1-1108	425	1	.8	.48
R1-1114	425	2	.1	.07
R1-1116	401	2	.1	.05
R1-1161	430			
	431			
	434	16	.1	.03
R1-1162	385			
	388			
	435	71	.2	.04
R1-1168	393			
	394	7	.1	.01
R1-1170	411			
	416	5		.01
R1-1172	426	2		.03
R1-1179	376			
	406	3		.00
R1-1183	427	6	.1	.02
T-1-S-8-10	439	2		.05
T-1-S-8-6	440	1		.05
X-1-500	373	1		.04
X-1-600	375	6		.04
X-1-1000	375	5		.06
X-2-600	373	2		.08
A-3-23	440	1		3.50
C-3-23	380	1	.0	.03
B-3-149	397			
	399			
	400			
	416	8	.5	.36
A-3-172	388	28	.8	.18
C-3-202	421	12	2.6	1.56
A-3-224	393	1	.1	.40
C-3-265	393	1	3.6	.45
X-3-302	373	1		.02
G-3-395W	397	2	9.2	6.45
X-3-500	373			
	375	5		.02
X-3-600	371			
	373			
	375	24		.02
C-3-656W	427	2	2.3	2.34
D-3-887	378	1	9.0	10.80
A-3-897	394	1	.6	1.18
O-3-932	394	2	.3	.73
T-3-932	398	2	.4	.65
P-3-938	381	1	.5	.70
E-3-941	378	1	.6	1.08
J-3-941	379	3	2.1	1.74
M-3-941	383	2	.7	1.14
Q-3-941	379	1	.9	1.38
U-3-941	379	1	2.3	1.26
B-3-944	411	1	1.8	2.08

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
G-3-945	430	1	.8	1.04
E-3-946	413	1	5.5	3.83
K-3-947	426	3	2.8	1.65
F-3-948	386	2	1.2	1.53
G-3-948	386	2	3.5	1.98
H-3-948	426	1	.9	.87
B-3-949	386	2	2.8	1.62
F-3-949	385	2	2.0	1.56
X-3-1000	375	5		.04
A-3-1001	378	1	9.6	17.88
B-3-1001	378	1	15.6	31.02
A-3-1002	381	2	.9	1.13
A-3-1003W	381	1	1.9	5.50
K-3-1003W	395	1	3.2	5.67
3-1007-A	383	2	46.5	39.00
A-3-1007	406	1	.1	.06
C-3-1007	406	1	.1	.06
A-3-1008WR	406	2	3.6	3.88
F-3-1008	406	2	.4	.89
A-3-1010	406	2	1.3	.97
A-3-1011	406	2	.2	.54
B-3-1011	406	2	.1	.18
C-3-1011	406	2	.1	.15
C1-3-1057W	397	2	.8	.60
D-3-1057W	398	6	.3	.33
A-3-1077	379	1	.7	2.40
E-3-1131	376	1	.1	.08
C-3-1137M	421	2	1.8	1.01
X-4-306	373	2		.02
C-R-6-8A	417	62		.35
C-L-6-8A	417	62		.35
X-6-18	370	4		.08
B-6-25W	432	82	5.3	2.08
A-6-51	425	32	.1	.09
B-6-51	425	32	.1	.09
AO-6-51R	425	1	8.8	3.24
A-6-58	360			
	361			
	423	252	.2	.13
B-6-58	360			
	361			
	423	252	.1	.14
C-6-58	360			
	361			
	423	7	.2	.47
AA-6-58C	360			
	423	2	3.8	3.79
JK-6-58C	361	1	39.9	36.68
KK-6-58C	360			
	423	2	5.1	5.06
XX-6-58C	360			
	423	2	6.8	6.12
A-6-64	360			
	361			
	423	215	.3	.27
A-6-64C	423	56	15.0	11.10
B-6-64	360			
	361			
	423	215	.3	.19
B-6-64C	423	56	15.0	11.10
C-6-64	360			
	361			
	423	9	.3	.61
AH-6-64C	360			
	423	4	15.1	11.10
BA-6-64C	360			
	423	2	20.0	14.23
BH-6-64C	361	1	21.6	15.36
KK-6-64C	360			
	423	2	9.8	7.35
A-6-83	417	2	.5	.25
B-6-83	417	2	.4	.25
E-6-83	417	124	2.3	1.25
A-6-91	361			
	424	64	1.3	.81
B-6-91	361			
	424	64	.9	.54
C-6-91	361			
	424	4	1.1	.90
GG-6-91C	361			
	424	4	35.7	18.18
A-6-116	361			
	424	171		.61
B-6-116	361			
	424	171	.7	.43
C-6-116	361			
	424	3	.8	1.13
N-6-116C	424	1	10.8	5.32
DY-6-116C	424	1	115.2	57.37
FG-6-116C	361	1	139.9	69.53
C-6-146C	432	84	3.2	.85
F-6-146C	432	2	25.3	8.76
BC-6-146C	432	2	323.4	112.42
X-7-601	373	2		.11
X-7-610	375	3		.11
X-7-613	375	2		.11
X-7-616	375	1		.15
A-8-11	416	2	5.4	1.38
G-8-52	380	3	.8	1.99
G-8-54	410			
	411			
	430	6		1.69
P-8-55	380	2		1.44
B1-8-57	381	1	.8	1.68
P-8-72	415	1		2.52
A-8-75	379	1		1.62
C-8-75	409	4		1.26
H-8-75	378			
	383	6	1.1	1.05
M-8-75	379	1	1.0	1.10
O-8-75	383	2		1.98
AA-8-92	386	2		2.70
EE-8-94	427	2		2.52
JJ-8-94	386	4		2.70
B-8-95	430	2		2.01
C-8-95	411	1		3.12
G-8-95	411	1		1.19
BB-8-95	385	2		2.70
CC-8-95	385	2	1.1	1.69
FF-8-95	387	4		2.88
MM-8-115	428	4		5.47
X-8-251	373	1		.03
X-8-509	375	8		.05
X-8-600	371			
	373			
	375	10		.08
X-8-602	375	2		.08
X-8-606	375	6		.06
X-12-601	373	2		.04
X-12-1201	375	1		.06
X-12-1202	375	1		.20
13-192-A	393	1	4.3	6.36
E-13-192	393	2	.9	.06
F-13-192	393	5	.2	.06

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
X-13-206	375	2		.02
13-213-C	414	2	19.6	7.98
13-213-H	378	2	21.0	6.84
13-213-J	379	1	20.9	6.95
13-214-G	383	2	22.9	7.10
13-216-D	413	2	30.8	8.47
X-14-800	373	3		.06
T-15-B-6-4	440	2		.05
P-17-9	411			
	430	4	.3	.06
AA-17-9	381	1	.2	.08
AD-17-9	411	2	.3	.06
AQ-17-9	388	28	.3	.06
BE-17-9	379	2	.3	.03
CS-17-9	416	1	.3	.06
JI-17-9	385	6	.8	.08
KI-17-9	387	8	.3	.06
OC-17-9	385	6	.1	.06
OO-17-9	381	2	.2	.06
B-17-10	400	1	.1	.11
E-17-10	421	2	.1	.10
AG-17-10	416	1	.1	.10
AQ-17-10	430	2	.1	.12
XX-17-11	400	1	.1	.12
K-17-14	393	9	.1	.18
C-17-23	398			
	399	3	.2	.06
D-17-23	416	1	.2	.07
F-17-23	399	1	.1	.06
H-17-23	416	1	.2	.07
O-17-23	395	1	.3	.06
P-17-23	401	2	.2	.08
Z-17-23	399	1	.1	.06
CX-17-23	411	1	.2	.07
CZ-17-23	397	4	.2	.08
DC-17-23	395	1	.1	.06
KK-17-23	395	1	.1	.08
UU-17-23	400	2	.1	.08
A-17-24	430	2	1.6	.52
K-17-24	408	2	.5	.12
M-17-24	387	4	.5	.12
AZ-17-24	397	2	.3	.34
BB-17-24	411	2	3.2	.52
BK-17-24	394	2	.3	.16
BU-17-24	426	4	.7	.24
AY-17-25	425	1	.2	.17
EC-17-25	381	1	.6	.25
FY-17-25	398	6	.1	.20
FZ-17-25	397	2	.1	.20
GG-17-25	397	1	1.2	.53
NN-17-25	421	2	.7	.44
C-17-26	402	2	.1	.17
P-17-26	425	1	.1	.18
AA-17-26	395	1	.1	.09
BU-17-26	421	4	.1	.03
DA-17-26	408	2		.14
FH-17-26	425	1	.1	.10
A-17-27	398	2	.2	.12
V-17-27	400	1	.3	.29
FF-17-27	421	2	.8	.24
M-17-28	414	4	.3	.06
C-17-30	381			
	397			
	398	6	.1	.08
E- 17-30	394			
	401	2	.1	.09
H- 17-30	394			
	397			
	401			
	402	5	.1	.09
N-17-30	401	2	.1	.11
U-17-30	363	1	.1	.09
A-17-32	363	1	.1	.10
B-17-32	403	2	.1	.10
E-17-32	393	1	.1	.12
H-17-32	403	1	.1	.15
AA-17-32	379	1	.1	.15
AF-17-32	380	1	.1	.12
E-17-33	383	1	.2	.18
K-17-33	408	1	.1	.19
S-17-33	414	1	.1	.20
X-17-33	413	2	.1	.20
Z-17-33	393	1	.2	.16
AG-17-33	378	1	.1	.15
AH-17-33	414	1	.1	.18
AM-17-33	378	1	.1	.15
AT-17-33	383	2	.1	.24
AY-17-33	393	1	.4	.22
GG-17-33	413	2	.1	.13
HH-17-33	408	2	.1	.15
PP-17-33	378	2	.1	.14
ZZ-17-33	383	2	.1	.18
I-17-34	427	1	.2	.32
M-17-34	426	2	.1	.29
W-17-34	386	4	.5	.15
Y-17-34	386	4	.1	.18
HH-17-34	428	4	.6	.32
C-17-43	386			
	392			
	426	7	.1	.11
D-17-43	379			
	381	2	.2	.04
E-17-43	378			
	383	4	.2	.04
F-17-43	385	4	.1	.07
I-17-43	408	2	.1	.07
J-17-43	379			
	381	5	.1	.08
N-17-43	379	1	.5	.18
X-17-43	392	1	.2	.09
Y-17-43	393	1	.1	.07
Z-17-43	413	2	.2	.07
AF-17-43	379			
	392	3	.2	.07
BB-17-43	392	4	.2	.05
CT-17-43	392	1	.4	.14
CU-17-43	392	1	.6	.04
WW-17-43	411	1	.1	.05
D-17-45	364	1	.3	.30
F-17-51	427	2		.02
P-17-51	415	1		.02
D-17-63	393	1	.5	.81
A-17-65	393	1	.2	.10
N-17-71	383	2	.3	.06
A-17-75	379	1		.27
D-17-92	378	1	.4	.99
C-17-102	387	4	2.6	1.50
C-17-103	428	2	.7	1.10
GG-17-106	379	1	.1	.36
ZZ-17-106	379	1	.4	.30
P-17-108	381	2	.1	.34
A-17-110	383	6	.5	.06
A-17-111	385	38	.1	.06

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
KK-17-111	385	4	.1	.06
C-17-121	431	4	.1	.05
B-17-123	392	2	.1	.07
J-17-125	364	1	1.4	.23
GG-17-125	364	1	2.8	.40
M-17-126	363	1	1.8	.28
A-17-136	383	1	4.1	.79
B-17-136	383	1	3.9	.70
Q-17-139	397	2	.3	.06
S-17-139	397	2	.3	.06
VV-17-139	397	2	.1	.06
WW-17-139	397	2	.1	.06
D-17-164	428	2	1.3	1.90
A-17-176	376	1	.1	.27
F-17-202W	364	1	1.1	1.43
C-18-49	393	2	.1	.84
E-18-68	393	1	11.8	10.05
A-18-232	381	1	2.3	6.75
B-18-232	381	1	4.8	8.28
C-18-232	381	1	7.8	8.25
A-18-233	381	1	10.8	10.98
B-18-233	381	1	14.8	12.24
C-18-233	381	1	19.9	14.85
A-18-234	378	1	53.4	58.80
C-18-244W	381	1	10.2	25.83
A-18-245W	380	1	43.0	52.85
A-19-51	427	4	1.5	.60
B-19-51	427	2	.8	1.50
A-19-103	427	2	.1	.06
A-19-105	427	2	.1	.27
A-19-106	427	4	.5	2.22
B-19-106	427	2	.5	2.22
19-203-D	426	1	145.6	115.20
A-19-212	415	2	.5	.90
B-19-250	416	1	5.4	13.86
F-19-411	425	1	1.2	3.55
19-474-O	380	1	15.0	11.25
19-475-A	394	1	3.6	7.58
B-19-498	379	2	11.4	34.31
C-19-498	393	1	6.2	10.44
T-19-543	378	1	8.5	9.31
Q-19-558	378	1	35.6	12.06
19-601-X	414	1	24.8	15.20
19-656-A	385	2	64.5	54.27
19-662-B	411	1	26.0	27.90
A-19-674	415	2	1.1	.48
E-19-674	415	2	.1	.06
F-19-674	415	2	.1	.06
G-19-674W	415	2	2.5	7.62
19-675A2	414	1	75.6	69.12
C-19-680WM	383	2	17.1	17.88
A-19-689	378	1	4.6	7.98
A-19-699WMR	415	1	47.4	41.34
A-19-725	363	1	6.5	12.18
A-19-816W	413	1	14.3	14.00
CUS-21	466	1		1.00
T-21-S-8	440	1		.05
C-21-12	439	1		.85
T-22-S-8	440	1		.05
CU-22-23	466	1	2.0	6.00
C-23-47	439	1		.60
CUS-24	466	1		1.00
K-24-42	411	2	.2	.42
G-24-85	385	4	.4	.29
25-46-A	432	41	28.5	6.00
HH-26-F	432	166	.5	.27
CR-28-28	439	1		.40
CU-29	466	1		.25
JCUS-32-34	466	1		1.50
CU-35	466	2	.8	.30
A-38-17	390	82	.8	.30
C-38-39-22	439	1		1.60
U-38-67	402		2.4	1.45
A-38-186W	413	1	540.0	188.10
F-38-187	413	1	10.5	5.50
H-38-187	413	1	10.8	4.25
J-38-187W	413	6	5.5	1.47
A-R-38-189	413	2	6.3	3.81
A-L-38-189	413	2	6.3	3.81
B-R-38-189	413	6	6.0	3.69
B-L-38-189	413	6	6.0	3.69
C-R-38-189	413	2	3.0	1.98
C-L-38-189	413	2	3.0	1.98
A-38-192	403	1	12.0	3.75
F-38-192	402	1	8.5	2.85
J-38-192W	403	2	3.8	3.50
A-38-193	409	1	36.7	7.10
C-38-194	414	1	25.9	8.31
E-38-198W	411	1	15.4	7.32
F-38-198W	411	1	6.5	4.15
A-38-199	401	1	15.0	4.00
C1R-38-199	401	1	2.5	.38
EL-38-199W	401	1	3.	1.02
M1-38-207	420	2	1.4	.22
B-38-212WB	416	1	1.5	3.20
C-38-212W	416	1	7.0	1.82
E1-38-212W	416	1	2.5	2.13
F-38-212WB	414	1	6.4	4.25
H-38-212W	416	1	1.3	1.32
N2-38-213	416	1	.7	1.38
Q-38-230	404	1	.0	.07
D1-38-237	421	4	4.3	.68
C1-38-239	421	1	5.0	12.33
D1-38-239	421	1	14.5	2.25
S1-38-239	421	2	12.0	2.40
C-38-245	410	2	.9	.34
D-38-245	410	2	.5	.29
E-38-245	410	1	.5	.29
G1-38-245	410	1	3.8	1.38
H-38-245W	410	1	14.5	2.99
B-38-265W	407	1	6.0	1.20
A-38-283	408	1	49.8	15.10
38-284-A	417	1	357.0	495.97
A-38-284	418	1	213.2	144.33
B-38-284	417	31	5.2	.81
C-38-284	418	31	2.4	.38
D-R-38-284	417	31	.6	.15
D-L-38-284	417	31	.6	.15
E-38-284	417	62	.4	.06
F-R-38-284R	417	1	178.5	101.00
F-L-38-284R	417	1	178.5	101.00
E-38-285	419	2	12.5	1.94
F-38-285	419	2	5.7	.88
G-38-285	419	2	7.4	1.15
H1-38-285	419	2	4.0	.63
J-38-285	419	2	7.8	1.22
B1L-38-286	419	1	73.0	11.35
B1R-38-286	419	1	73.0	11.35
A-38-287	409	1	31.4	7.13
B-38-288W	421	2	3.8	2.90
E-38-288W	421	2	12.5	3.75
F-38-288W	421	2	6.5	1.13
G-38-288	421	2	3.5	.54
JCUS-41	466	1		.10

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
M-42-43	437	2	9.5	1.55
N-42-43	437	1	36.4	4.02
G-42-47	399	1	.3	.20
H-42-47	395			
	397	3	.1	.06
E-42-76	411	1	5.2	1.68
E-42-90	389	4	1.0	.32
H-42-90	389	4	7.7	1.15
J-42-90	389	4	.3	.29
S-42-90	389	2	2.3	1.50
T-43-6	439	2		.05
T-43-103	440	1		.05
T-45-8	440	1		.05
A-46-20	407	1	1.8	1.00
B-46-20	407	1	1.3	.42
E-46-20	407	1	4.4	3.78
F-46-20	407	1	6.0	2.95
J-46-20	407	1	3.0	.80
M-46-20	407	1	.4	.06
N-46-20	407	1	1.0	.27
P-46-20	407	1	.1	.62
AH-46-20	407	1	1.8	7.25
AN-46-20	407	1	3.4	5.75
BB-46-20	407	1	.3	.18
EE-46-20	407	1	1.0	.54
HH-46-20	407	1	.1	.12
MM-46-20	407	1	2.0	1.68
WW-46-20	407	1	2.3	1.20
ZZ-46-20	407	1	.9	.78
C-46-23	439	1		.25
A-46-39	427	2	8.5	1.98
B-46-45	389	2	10.5	2.30
46-50-A	376	1	.1	2.40
C-46-55	381	1	.1	.06
C-46-100S	364	1	.2	.65
C-46-173	425	1	.1	.15
46-198-A	408	2	4.7	1.86
C-46-198	408	2	1.7	1.68
D-46-198	408	2	.4	.05
A-46-208	426	2	3.3	1.68
B-46-208	406	4	.3	.18
C-46-208	406	2	.4	.12
D-46-208	406	4	.1	.08
G-46-219	407	1	.4	.28
A-46-268	398	2	.1	.36
B-46-268	398	2	.0	.41
A-46-270	416	1	.8	.24
B1-46-270	415	2	3.1	1.22
B2-50-A	439	1		3.00
C-51-15-21	440	1		.75
C-52-3-22	439	1		.45
A-53-65	376	2	1.9	1.17
A-53-103WM	380	1	74.3	41.00
N-53-103RW	381	1	6.5	3.38
P-53-103	381	2	1.5	.42
Q-53-103	381	2	.8	.33
T-53-103	381	2	.3	.29
U-53-103	381	2	1.5	.42
V-53-103	381	2	.8	.34
W-53-103	381	2	.4	.27
AA-53-103	381	2	.2	.06
BB-53-103	381	2	.2	.06
A-53-104	380	1	12.5	5.20
B-53-104	381	1	10.4	5.64
C-53-105	381	1	3.5	1.50
53-153-A	362	1	144.0	113.71
C-54-13-23	439	1		.40
C-54-14-12	439	1		.60
T-56-10	439	3		.05
T-56-23	439	3		.05
T-56-24	439	3		.05
A-60	365	1		7.10
A-62-21	388	14	7.3	2.18
G-62-33	395	1	.2	.39
J-62-33	395	1	.1	.23
N-62-33	395	1	.3	.29
CT-63-2	439	2		.05
69-F	364	1	.1	.14
X-74	456	1		.07
PA-74	451	1	.1	.20
76-FL	466	1	.1	.55
C-81-26-45	439	1	.3	.75
A-82-11	428	1	150.9	26.70
A-82-21	434	1	66.5	8.88
B-82-21	434	1	63.0	8.88
C-82-21	434	1	48.9	5.34
82-38-A1	437	1	307.8	50.33
CC-82-39W	425	1	25.7	6.32
DD1-82-39W	425	1	3.2	.95
EE1-82-39W	425	1	.6	.61
H-82-41	399	1	4.0	.57
J-82-41	399	1	3.2	.66
S-82-41W	399	1	6.2	1.15
A-82-43	397	2	7.5	1.56
C-82-43	397	1	3.0	1.20
D-82-43	398	1	2.8	.92
J-R-82-43W	397	1	5.9	2.91
J-L-82-43W	397	1	5.9	2.91
N-82-44	398	1	1.8	.43
C-82-45	400	1	3.0	1.05
N-82-45	395	1	.1	.36
C-82-61	393	1	13.4	3.06
N-82-61WB	392	1	48.2	39.54
B-82-66	385	1	97.0	18.99
A-82-77	387	2	15.9	4.26
C-82-77	386	2	29.2	11.16
B1-82-94	400	1	3.9	.98
D-82-94	400	1	5.0	.95
E-82-94W	400	1	4.3	1.19
C-82-96	394	1	4.8	1.53
H1-82-96	394	1	4.1	1.50
J-82-96W	394	1	.5	.69
K-82-96W	394	1	8.3	3.65
D-82-97	394	1	2.7	.82
E-82-97WB	394	2	4.3	4.70
A-82-109	393	1	7.0	1.80
D1-82-125	362	1	2.8	.43
O-82-125	362	1	.9	.15
Q-82-125WB	378	1	18.0	6.45
F2R-82-142W	428	1	242.0	74.90
F2L-82-142W	428	1	242.0	74.90
N-R-82-142	429	2	8.0	5.31
N-L-82-142	429	2	8.0	5.31
O-R-82-142	429	2	3.0	.65
O-L-82-142	429	2	3.0	.65
O-82-146	436	1	51.0	8.07
F2-82-147W	435	1	305.0	66.42
H-R-82-148W	435	1	13.0	4.29
H-L-82-148W	435	1	13.0	4.29
A2-82-151	426	1	60.0	14.76
A-82-161	378	1	55.0	15.72
M-82-165W	430	1	2.3	3.90
N-82-165	430	1	4.6	.81
O-82-165	430	1	2.5	.54

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price	Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
T-L-82-165	430	1	.2	.24	BG 136-A	408			
T-R-82-165	430	1	.2	.24		430	2	2.4	1.20
A1-82-166	430	1	53.6	7.17	BU C-136-3	439	2		.05
F-82-166	430	1	5.3	4.19	BU C-138-23	440	1		.35
N-82-173	383	2	1.4	.38	BU C-138-42	439	1		.25
O-82-173	379	1	1.1	.17	BU C-140-2	440	1		.05
B-82-178	395	1	3.5	2.08	BU C-140-33	440	1		.20
C-82-178W	395	1	4.4	1.73	BU C-142-27	439	1		.10
J-82-184	434	1	29.3	3.39	BU GE-144	477	1		.08
AR-82-193	363	1	36.0	5.58	BU ISE-149	451	1		.05
AL-82-193	363	1	36.0	5.58	BU RSE-155	470	8		.08
E-82-193W	363	1	2.0	1.78	BU C-181-36	439	1	.03	.40
G-82-193W	363	1	3.3	1.38	BU X-217	457	1		.06
J-82-193W	363	1	3.0	2.31	FU A-241	371	1		5.51
A-82-200	383	1	40.3	11.85	BU X-246	456	2		.06
H1-82-202W	397	1	54.6	10.84	BU SN-266	457	1		.15
J1-82-202	397	2	.1	.27	BU SN-278	456	1		.60
K-82-202	397	4	.5	.29	FU A-303	375	1		45.86
M1-82-202	397	2	1.1	.36	FU 304-M	369	1		2.10
N-82-202	397	1	1.8	.43	FU 305-M	370	1		2.48
O-82-202	398	4	.5	.30	FU 306-S	370	1		2.93
P-82-202	397	4	.8	.33	FU 308-SF	369	1		3.94
Q-82-202	397	2	.4	.27	BU X-310	457	1		1.80
A-82-206	397	4	.8	.34	BU X-328	456	2		.50
B-82-206	397	4	.2	.27	BU X-339-9	456	1		.90
C-82-206R	397	4	1.5	1.68	BG 340	403	1	13.0	5.10
A-R-82-209	429	3	6.8	6.36	BG 362-B	387	2	71.6	23.88
A-L-82-209	429	3	6.8	6.36	TD S-390	365	1		10.40
B-R-82-209	429	1	5.0	6.54	BU PA-399	463	1	.3	2.65
B-L-82-209	429	1	5.0	6.54	BU DP-407	445	1		1.00
C-R-82-209	429	1	5.9	6.32	BU C-411	457	2		.60
C-L-82-209	429	1	5.9	6.32	TD M-422	365	4		.01
A-82-211	431	2	12.5	3.30	BU X-425	457	1		.03
F-82-218W	363				BU X-454	457	1		.06
	364	2	85.0	24.25	BU X-461	457	1		.12
G-82-218	364	2		.00	BU X-463	456	1		.06
F1-82-219	399	1	1.5	.35	BU X-540	456	6		.04
G1-82-219	399	1	4.0	.72	BG A-552-71W	363	1	3.0	1.00
J1-82-219W	399	1	6.5	1.98	BG D-552-71	363	1	.5	.38
N1-82-219	399	1	5.0	.68	BG E-552-71	363	1	.4	.61
F-R-82-257W	434	1	49.3	8.00	BU X-557	456	1		.20
F-L-82-257W	434	1	49.3	8.00	BU DP-594	461	1		6.00
BU C-85-47	439	1	.2	.50	BG 599-A	379	1	3.4	3.36
BU CT-91-1	439	1		.10	BG 612-B	401	1	6.4	4.62
BU C-101-2	439	1	.2	.75	TD M-641	365	4		.11
TD 103-F	365	4		.55	TD M-642	365	8		.22
BU C-105-19	440	1		.50	TD M-645	365	2		.03
TD 106-A	365	4		.12	TD M-649	365	2		.04
BU C-106-2	440	1		.35	BG 667	389	2	6.0	1.08
BU C-109-2	440	1		.35	BG 668	389	2	1.1	.45
BU C-110-1	440	1		.05	BG 679A	431	4	33.0	8.28
BG 111-E	401	2	8.1	3.85	BG 694	430	2	20.0	9.68
BU C-111-14	439	1		.10	BG 694-A	411	2	20.4	9.10
TD 112-B-10	365	2		1.20	BG 699	431	4	6.6	2.16
TD-115	365	1		.06	BU CUE-705	445	16		.04
TD M-115	365	12		.01	BG 722	431	6	2.3	.60
TD 0116-B-10	365	1		5.20	BU X-723-3	456	2		.05
TD 116-B-10	365	1		2.90	BG 735-C	401	1	22.6	6.06
BU PA-117	475	1		.85	BU X-763	457	1		.10
TD 117-C-8S	365	1		3.30	BU CUE-763	449	5		.05
BU C-117-32	439	1		.05	BG 805	403	1	9.4	5.22
TD 120-C8	365	2		.20	BG 806	402	1	5.9	4.02
					BG 821	378			
BU C-120-27	439	1		.10		383			
BU CR-121-8	440	2		.05		416	6	8.0	1.50
BU ASE-126	478	4		.12	BG 821-A	379	1	7.9	2.52
BG 136	414	2	3.0	1.38	BG 822	379	1	3.4	.72

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price	Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
BG 822-B	378				BU 1341	441	1		.03
	383				BU 1345	443			
	414	6	3.4	1.08		476	8		.40
BU X-824	456	4		.06	BU 1357	476	4		.06
BU CUE-824	477	1		.18	BU 1359	476	4		.02
BG 825-A	383	2	4.8	1.95	BG 1383A	403	2	3.7	2.42
BG 825-B	383	2	5.1	2.28	FU 1392	373	1		4.88
BG 838-B	408	2	16.2	7.02	BG 1392	402	1	13.6	4.80
BG 868-A	393	9	3.6	1.08	BG 1392A	394	1	13.2	3.99
BG 897	406	1	4.9	3.75	BG 1392D	425	1	13.5	3.35
BU X-935	457	1		.10	TD 1395	365	8		.02
BG 960	413	2	14.8	3.42	BU 1438	444	2		.04
BG 961	413	2	5.2	1.32	BU 1452	460	1		2.50
BU 1004	443	1		2.00	BU 1458	460	1		.10
BU 1005	443	2		1.75	BG 1462A	378			
FU 1018	370	1		.19		379	3	4.0	1.68
BU 1018	443	10		.34	BG 1462D	378			
BU 1022-23	442	1	8.3	3.75		379	3	4.0	1.68
BU 1024-25	442	2	4.5	3.30	BG 1506C	386	2	65.3	35.98
BU 1026-27	442	1	13.5	4.60	BU 1508	469	1		.05
BU 1028-29	442	1	13.5	6.60	BU 1509	469	1		.65
BU 1030	443	5		.04	BU 1510	469	1		.65
FU 1042	370	1		2.18	FU 1512	375	1		.41
FU 1045	370	1		4.84	FU 1513	375	1		.02
BG 1048	390	82	20.0	5.65	BU 1526	467	1		.04
BU 1050	475	4		.04	BU 1530	470	1		.06
FU 1051	375	1		.02	BU 1535	469	1		.04
BG 1052	402	4	.8	.43	BU 1540	467	1		.06
BU 1054	449				BU 1541	467	1		.06
	475	4		.15	BU 1546	469	1		.04
FU 1059	371	2		.08	BU 1547	469	2		.06
FU 1064	373	2		.05	BU 1560	444	6		.04
TD A-1069	365	6		.11	BU 1561	444	4		.04
BG 1070	389	2	11.4	4.02	FU 1565	375	1		.30
FU 1075	373	1		.26	BG 1579B	427	1	80.5	47.40
BU 1078	449	1		.20	BU 1617	448	1		4.00
BU 1079	449	1		.10	BU 1618	448	1		1.60
BG 1082	413	2	4.5	2.46	BU 1620	448	1		.16
BG 1082A	413	2	4.3	2.82	BU 1622	448	1		4.30
BU 1083	443	16		.15	BU 1628	448	1		.16
BU 1112	450	1		.12	BG 1630	393	1	13.4	5.52
FU 1149	375	1		.39	BG 1630A	393	1	13.4	5.52
BU 1151	449	1		3.30	FU 1632	375	5		.08
FU 1157	370	1		3.75	FU 1633	375	3		.05
BG 1158	427	2	3.0	3.48	FU 1638	371	1		.08
BU DE-1169	464	1		.10	BG 1639	393	1	14.6	16.38
FU 1184	371	1		.83	BU 1639	445	1		.04
BU 1225	470	4		.95	FU 1641	371	1		1.50
FU 1251	373	1		.05	BU 1645	440			
BU 1253	470	4		.38		477	2		.04
BU 1255	470	8		.08	BU 1655	443	1		.06
FU 1257	373	1		1.50	BU 1656	443	1		.06
BU 1261	470	8		.20	FU 1684	375	1		.04
BU 1267	470	4	2.8	11.50	TD A-1706	365	1		.28
FU 1280	373	1		3.00	BU 1710	461	2		.15
BG 1295	391	82	4.0	2.34	BG 1715A	397	1	2.0	2.45
BG 1300	388	28	2.0	1.00	BG 1715C	398	1	2.0	2.45
BU 1304	476	8		.04	FU 1734	369	1		5.14
BU 1305	443	4		.08	FU 1738	370	1		.15
BU H-1305	476	4		.08	BU 1755	466	1		3.50
BU 1307	441	1		.04	BU 1811	457	1		.10
BU 1309	441	1		.55	FU 1819	375	1		.04
BU 1310	476	4		.90	FU 1846	369	1		.15
BU A-1312	438	2		.04	TD 1871A	365	4		.18
BU 1315	443				BG 1932A	415	1	8.8	13.20
	476	8		.40	BG 1933	415	2	1.2	1.74
BU 1317	463	2		.10	BU A-1938	456	1		1.80

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
BU RD-1951	471	1	36.0	25.00
FU 1956	375	1		.00
TD 1968A	365	4		.12
TD 1990	365	1		3.63
FU 1999	373	1		2.81
FU 2000	371	1		5.88
FU 2001	370	1		2.59
FU 2002	370	1		.15
FU 2004	373	1		1.50
FU 2026	369	1		5.06
FU 2027	370	1		2.66
BU 2034	443	1		.10
BU 2065	476	4		.08
BU 2074	449	4		.08
BU DP-2101	461	1		3.00
TD 2137B	365	1		4.25
FU 2212	375	1		.04
TD 2245	365	1		.24
BG 2256B	427	1	22.7	25.68
BU AP-2259	471	2	.3	.60
FU 2271	373	1		.08
BU C-2283	448	1		.02
BU 2313	476	8		.28
FU 2356	375	1		1.39
FU 2381	375	1		.04
BG 2387	385	2	17.0	5.58
FU 2401	373	1		.15
FU 2407	369	1		9.38
FU 2408	369	1		.45
FU 2409	369	1		.15
BG 2419A	414	2	6.8	4.56
BG 2482A	386	2	20.1	15.70
BG 2483	386	4	4.9	2.37
BG 2485	386	2	11.0	10.34
BU 2516	469	4		.06
BU 2525	467	2		.04
FU 2534	373	1		6.75
FU 2536	373	1		.11
FU 2538	373	1		.08
FU 2547	375	1		26.25
BU 2605	448	1		6.25
TD 2611	365	8		.11
BU C-2674	448	1		.16
BG 2680D	379	1	10.7	11.19
BU P-2706	438	1	.1	.50
FU 2720	375	1		1.35
BU 2734	472	1		24.00
FU 2765	369	1		.11
BU 2810	457	1		2.00
BU C-2815	448	2		3.30
FU 2840	375	1		.26
BU P-2859	438	1	1.0	1.25
BG 2915	428	2	58.8	41.71
FU 2939	373	2		.11
FU 2947	373	2		.11
BU C-2961	448	1		.40
FU 2962	373	1		.23
BU C-2962	448	1		.40
BU C-2963	448	1		.20
BG 2975	386	2	35.4	29.02
BG 2990A	430	1	18.7	11.82
BG 2991	411	1	16.0	9.06
BG 2991B	410			
	430	2	17.0	8.52
BG 2992	408	2	35.1	34.92
BG 2993	409	2	10.1	7.89
BG 2994B	426	2	66.8	23.16

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
BU 3033	476	1		.16
BU 3034	445	1		22.00
BU 3040	475	2		.06
BU G-3040	456	2		.30
BU 3061	445	1		1.75
BU AP-3068	450	2		.30
BU 3070	476	1		1.00
BU AP-3138	471	2		.20
BU C-3157	448	1		.24
BU C-3158	448	1		.16
BU C-3159	448	1		.40
BU G-3168	456	1		.26
BU 3208	470	4		.50
BU P-3224	438	1	4.5	.22
BU 3230	443			
	467	8		1.00
BU DE-3284	476	1		1.30
BU 3312	476	4		1.40
BU 3316	463	1		.28
BG 3317	394	3	.9	.78
BG 3317A	394	1	.9	1.44
BG 3361	435	2	13.4	6.87
BU 3363P	470	4		5.35
BG 3372	387	4	13.9	5.82
FU 3426	375	1		18.75
BG 3430	388	14	61.4	18.36
BU 3430	460	1		.20
BG 3431A	426	2	23.8	9.51
BU 3432	460	1		.30
BG 3435	383	1	45.8	44.79
BG 3436	406	1	17.5	9.96
BG 3438	406	1	10.8	8.80
BG 3493	379	1	21.5	13.17
BG 3494	379	1	13.0	15.72
BU G-3494	456			
	457	4		.06
BG 3509A	379	1	167.5	11.40
BG 3511	383	2	35.5	13.74
BU 3531	467	1		7.50
BU 3539	467	2		.08
BU 3545	470	1		.05
BG 3550	428	1	26.0	31.56
BG 3550A	428	1	26.0	31.56
BU 3551	465	1		.06
BG 3572	376	1	1.8	1.32
BG 3605	379	1	2.8	7.08
BG 3620	408	1	66.8	30.21
BU AP-3696	461	1		2.50
BU 3716	461	1		3.00
BU 3717	465	3		.08
BU 3729	461	1		.05
BU 3731	446	1		.50
BU 3735	461	1		2.25
BG 3742	376	1	2.6	7.47
BU G-3804	456	2		.30
BU 3813	451	1		.10
BU C-3837	448	1		.15
BU 3863	457	1		1.25
BU AP-3883	461	1		2.25
BU 3884	446	1		7.50
BU G-3947	456	1		.50
BU 3998	461	1		1.00
BU DE-4090	443	8		.15
BU DE-4134	460	1		.20
BU G-4159	457	1		.25
BU G-4200	457	1		4.50
BU G-4202	456	1		1.10

NUMERICAL LISTING OF PARTS (Continued)

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
BU G-4203	456	1		2.40
BU G-4205	457	1		1.80
BU G-4206	456	1		1.80
BU G-4208	456	1		1.20
BU G-4209	457	1		.05
BU G-4305	456	1		.90
BU G-4449	456	2		.60
BU D-4459	439	1	.2	.15
BU 4508	470	8		.20
BU 4590A	471	1	.3	.75
BU 4614	448	1		.15
BU G-4626	456	1	3.5	6.90
BU AP-4712	461	1		.75
BU AP-4713	461	1		1.25
BU DE-4755	471	1		11.00
BU AP-4775	438	2	.1	.24
BU 4776	457	1		.35
BU AP-4781	446	1		.15
BU C-4832	448	1		.08
BU DE-4870	443	6		.06
G-5113	457	1		.10
G-5210	456	2		.10
5307	369	1		.98
DE-5476	443	5		.02
5655	443	1	.1	.16
AP-5709	471	1		1.50
5733	465	2		.30
Z-5747E	365	1		16.45
5752	365	1		5.40
DR-5864	452	1	1.1	4.75
5875	469	1		14.50
5876	469	1		4.75
5877	469	1		2.79
5879	469	1		2.50
5880	469	1		2.50
C-5950	456	2		.16
AP-5998	438	2	2.0	.70
AP-6014	438			
	461	5		.20
G-6026	456	1		1.80
AP-6071	459	2		6.25
AP-6075	450	1	38.0	15.00
AP-6079	471	1		50.00
AP-6081	438			
	471			
	477	12		.05
6161	375	1		5.06
AP-6276	471	1		35.00
AP-6278	459	2		.85
AP-6297	461	1		3.25
AP-6334	438	1	.5	8.50
AP-6335	463	1	3.0	1.35
6389	369	1		15.00
AP-6468	450	1		3.50
AP-6558	438	1		2.92
AP-6563	438	1		18.33
AP-6569	438	2		.01
AP-6570	459	1	12.0	6.75
AP-6592	404			
	461	1	.3	1.50
AP-6852	459	1	17.0	4.00
AP-6876	461	1	.3	2.50
AP-6877	461	1	.1	1.90
AP-6878	461	1		1.25
AP-6879	461	1		1.90
AP-6880	461	1	.3	1.90
AP-6881	461	1	.1	2.50

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
AP-6882	461	1	.1	1.75
G-6905	456	1		.60
H-11141	469	1		.10
H-11175	478	1		.40
H-11245	442	1		12.50
H-11275	475	1		6.50
H-11276	475	1		.35
H-11279	441	1		5.75
H-11281	478	1		1.20
H-11288	478	1		.08
H-11332	475	1		10.00
H-11336	460	1		5.90
H-11340	446	1		.65
H-11345	455	1		.40
H-11363	475	1		.04
H-11366	477	1		.90
H-11371	476	1		.12
H-11372	476	1		.12
H-11373	475	1		.15
H-11376	463	1		16.50
H-11385	439	1		10.50
H-11389	470	1		.12
H-11424	446	1		1.65
H-11530	451	1		1.50
H-11561	470	4		.20
H-11566	477	1		1.65
H-11589	478	1		6.60
H-11591	477	1		2.25
H-11593	478	1		5.75
H-11595	478	1		.60
H-11596	477	1		.25
H-11597	478	1		.12
H-11598	477	2		.08
H-11599	477	2		.20
H-11600	477	2		.35
H-11601	477	2		.08
H-11602	477	2		.05
H-11603	477	2		.35
H-11604	478	1		.05
H-11605	478	1		.12
H-11629	461	4		.65
H-11676	466	1		12.00
H-11705	441	1		18.00
H-11719	475	1		.65
H-11720	475	1		.50
H-11721	475	1		.15
H-11722	475	1		.04
H-11730	476	2		3.40
H-11731	476	8		1.00
H-11749	477	1		29.00
H-11750	478	1		9.50
H-11751	478	1		3.85
H-11773	478	1		1.50
H-11803	449	1	57.0	26.50
H-11805	476	8		.10
H-11807	476	8		.06
H-11901	457	2		1.35
H-11906	456	1		.25
H-11925	456	1		25.40
H-11935	478	1		6. 0
H-11950	443	4		.15
H-12000	467	1		2.85
H-12029	467	1		.50
H-12035	467	1		.35
H-12046	449	1		26.00
H-12050	464	1		1.75
H-12055	443	1		165.00

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
H-12086	442	1		6.00
H-12092	442	1		4.40
H-12101	448	1		15.00
H-12111	449	5		.16
H-12117	452	1		2.50
H-12148	455	1		2.50
H-12170	451	1		7.00
H-12175	452	1		25.00
H-12178	467	1		.75
H-12237	450	1		3.50
H-12280	476	8		.08
H-12288	443	1		3.85
H-12289	443	2		.05
H-12295	441			
	443	2		.70
H-12306	465	1	.8	2.00
H-12329	476	8		.40
H-12560	477	2		1.35
H-12645	466	1	.3	1.50
H-12647	466	1	.5	1.60
H-12675	443	1		3.85
H-12677	440	1	.3	2.00
MC-12952	466	1	.1	.30
MC-14276	466	1	4.3	3.50
DE-40317	470	1		.28
DE-40318	470	1		.35
DE-51170	464	1		4.00
DE-51302	441			
	444	2		.60
DE- 55139	443	1		.12
DE- 55574	461	1		2.00
DE- 55926	448	1		2.20
DE- 56039	442	1		60.00
DE- 56103	441			
	444	2		.55
DE-56119	466	1		1.05
DE-56131	444	2		1.25
DE-56165	444	2		.08
DE-60179	442	1		.15
100002	459	5		.03
100109	459	5		.04
100110	438	4		.04
100121	449			
	455			
	457			
	461			
	464			
	466	14		.04
100133	459			
	466	8		.04
100134	445	2		.04
100135	475			
	478	6		.04
100137	447	1		.06
100138	476	4		.06
100139	477	1		.06
100147	450			
	472	7		.04
100159	450	2		.06
100698	461	3		.02
102634	459	4		.02
102635	475			
	478	15		.02
103025	478	4		.02
103026	448	3		.02
103028	445			
	449			
	475	20		.04
103088	452	1		.02
103091	461	6		.01
103319	438			
	443			
	459			
	461			
	467			
	471			
	472	34		.01
103320	448			
	449			
	451			
	455			
	457			
	459			
	464	23		.01
103321	445			
	446			
	448			
	455			
	459			
	465			
	467			
	475			
	476			
	477			
	478	58		.01
103322	450			
	472	7		.01
103323	448			
	449			
	450			
	471			
	475	14		.01
103326	448	1		.02
103339	459	14		.02
103340	461	2		.02
103341	463			
	477	10		.01
103343	466	2		.04
103374	470	8		.01
103583	478	1		.02
103720	460	1		.04
103730	477	1		.04
103865	463	1		.04
103875	443	2		.10
103877	443	1		.04
103883	448	1		.02
103895	443			
	478	3		.04
103896	443	1		.06
103906	477	1		.04
104924	470	1		.06
105412	466	3		.12
105451	465	3		.04
105453	460			
	461			
	469	7		.04
105605	466	2		.01
106319	461			
	469	8		.04
106320	467	1		.04
106324	455			
	459	5		.04

NUMERICAL LISTING OF PARTS (Continued)

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
106327	451	2		.04
106330	455			
	467			
	475			
	477	30		.04
106331	477	2		.04
106495	453			
	461			
	473	13		.01
106496	446			
	453			
	473	5		.01
106497	446			
	453			
	473	4		.01
106500	449	5		.02
106827	464	1		.08
106973	448			
	449	6		.04
106974	475	5		.04
B-108157	448	1		4.50
108579	452			
	469	6		.02
108636	467	1		.01
109751	466	2		.05
110730	466			
	473	10		.01
112723	466	2		.01
112865	446	1		.01
113698	441	3		.04
113782	441	1		.04
113879	442	1		.04
114355	471	6		.06
114378	461	2		.01
114547	463	8		.08
114602	446	2		.01
114604	469	6		.01
114774	450	2		.04
114991	446	1	.1	.03
114998	478	1		.30
115308	478	4		.04
115417	446	1		.04
115607	446	2		.01
115903	473	4		.01
117060	438			
	464			
	471	11		.05
117061	466	2		.02
117062	466	4		.02
117063	450	4		.04
117064	471	2		.04
118754	440	2		.12
120614	457	3		.02
120622	446	2		.02
120703	457	1		.08
121743	453	4		.02
121801	457	2		.01
122159	473	2		.01
122403	448	1		.06
124545	452	1		.04
124546	472	1		.02
131410	460	1		.04
132900	452	2		.01
132923	452	1		.03
134566	473	1		.04
135616	473	2		.01
137332	475	4		.20

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
138479	452	2		.10
138577	475	1		.05
141065	443	2		.05
141540	453	2		.01
141543	453	1		.01
153005	461	3		.02
802691	472	1		.05
802730	453	2		.01
802731	452	3		.01
802757	453	4		.01
802760	446	1		.01
802818	446	1		.05
804000	452	1		.05
804076	453	1		.05
805057	472	2		.01
805258	473	1		.05
805579	446	1		.20
806915	452	1		.10
809051	473	1		.05
809053	472	2		.10
809062	453			
	473	2		.05
809551	453	3		.05
809614	453	1		.05
809642	453	3		.10
809644	452	2		.05
809658	452	1		.05
809688	453	1		.10
809698	453	1		.30
809815	472	1		.05
809824	453	1		.02
809945	452	1		.05
809961	452	1		.05
810068	446	1		.05
810074	446	12		.02
810226	473	4		.10
810601	472	4		.50
810626	472	1		1.80
810627	472	1		1.80
811124	447	2		.01
811553	473	4		.05
811559	472	2		.07
811912	446			
	447	13		.05
812015	453			
	473	3		.10
812016	453			
	473	3		.10
812823	453	1		.20
813044	446	1		.05
813046	446	1		.05
813238	447	1		.50
813496	453	2		.50
813521	473	4		.05
813554	473	2		.10
814978	453	1		1.00
815018	452	2		.10
815839	472	1		1.50
816774	447	1		.25
816784	447	1		.05
816801	446	2		.05
816806	446	1		.05
817114	472	1		.10
817216	452	1		1.25
817220	453	1		.05
817224	452	1		.10

Part Number	Page No.	No. Req.	Lbs. Each	Unit Price	Part Number	Page No.	No. Req.	Lbs. Each	Unit Price
817313	453				1839047	447	1	.5	1.50
	473	3		.05	1841543	472	1	5.3	4.50
817314	453				1847341	447	1		.30
	473	3		.05	1848530	472	1	.1	.40
817532	453	1		.05	1849774	472	1		.05
817807	452	1		7.50	1850025	452	1		.10
818794	447	1	.1	1.00	1850155	446	1	1.1	2.00
819002	472	1		5.00	1850810	472	1		.07
819104	452	1		.05	1850811	472	1		.08
819362	473	1		.15	1850812	472	1	.5	.55
820517	453	3		.10	1855701	452	1		.05
820524	453	1		.05	1855702	452	1		.10
820987	447	1		.03	1856056	452	2		.01
820988	447	1		.05	1858749	453	1		.01
820991	447	1		.05	1858752	453	2		.01
821033	447	2		.05	1858753	453	2		.02
821596	447	2		.10	1858754	455	1		.10
826474	447	1	.1	.30	1861076	473	2		.01
826476	446	2		.05	1862803	453	3		.01
826938	473	1		.10	1863510	453	1		1.00
827234	446	1		.05	1865182	473	1		.05
828675	453				1866970	452	3		.01
	472	6		.05	1869706	446	1	.1	.45
833602	472	2		.05	1872638	452	1		.50
852197	451	1		.01	1873937	452	1		.15
855064	451	6		.01	1880635	453	1		.05
855279	451	2		.03	1880642	472	1		.05
855493	451	6	.1	.01	1884615	447	2		.10
856125	451	1		.10	1887893	472	1	1.0	3.90
856270	451	2		.50	1888975	453	1		.01
856374	451	3		.01	BR-N-A1	376	1	.3	1.70
903203	452	1		1.15	CL-TD-A3	363	1	29.3	34.44
1521288	451	1		.02	EL-BA-C1	363	1	55.0	22.18
1521471	451	1		.20	EL-BU-D	405	4	.1	.21
1521472	451	1		.02	EL-BU-E	405	5	.1	.12
1521473	451	1		.02	EL-CF-C	405	1	.2	.24
1521475	451	1	.1	.10	EL-FB-A	404	1	.2	.91
1521476	451	1	.1	.01	EL-FS-A15	404	2	.2	.04
1521479	451	1		.10	EL-FS-A6	404	1	.1	.05
1521480	451	1		.02	EL-LA-A	405	4	5.0	9.80
1521578	451	1	.1	.15	EL-LA-J1	405	1	.6	.48
1521612	451	1		.01	EL-LA-K1	405	4	.3	.27
1521636	451	1		.11	EL-SB-A	404	1	3.0	1.45
1521708	451	1		.10	EL-SW-A	404	3	.1	.37
1522046	451	1		.02	EL-WT-A10	405	2		.09
1522198	451	1	.6	.80	EL-WT-A16	405	23		.05
1522199	451	1	.1	.50	EL-WT-BO	363	2		.16
1522264	451	1		.05	EL-WT-C1	363	1	.2	.21
1523622	451	1	.1	3.40	EL-WT-C2	363	1	.3	.25
1537148	451	1		.02	EN-B-A9	362	1	865.0	485.00
1835536	447	1	.2	.75	HO-PD-G1	363	1	1.7	.96
1837832	447	2		.05	OI-GT-B	376	2		.20
1838678	452	1		2.00	PL-D-M1	408	2	30.0	9.45