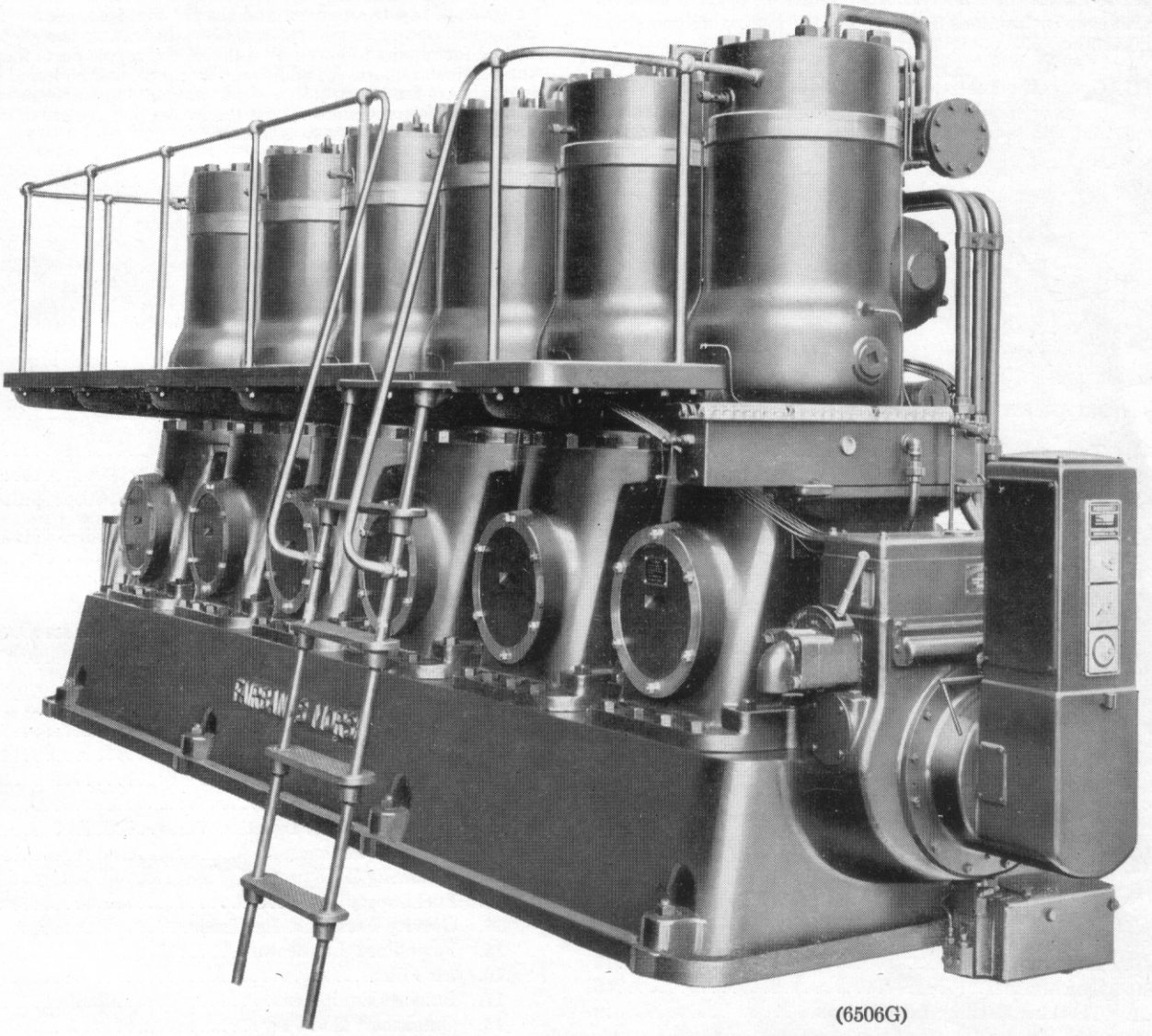
Instructions No. 3200E

Fairbanks-Morse

Stationary Diesel Engines
Models 32E12 and 32E14



(6506G)

6 Cyl. Model 32E14 Stationary Diesel Engine with Direct Connected Alternator

ENGINES COVERED

This instruction book covers the Model 32E12 Stationary Diesel Engines in 2 and 3 cylinders, and the Model 32E14 Stationary Diesel Engines in 2, 3, 4, 5 and 6 cylinders.

READ THE INSTRUCTIONS

Before attempting to operate the engine, read the instructions carefully. Familiarity with the engine and a thorough knowledge of the manner in which it operates is necessary to insure satisfactory and dependable operation.

Fourth Edition—June, 1954
Supersedes Third Edition—Dec., 1948
217253-045701M-B.L.P.

Printed in U.S.A.

INTRODUCTION

The material in this instruction book has been arranged into sections to make ready reference possible and to provide an organization of material which will suit the demands of the various persons interested in the engine.

I. Description and Operation. Pages 3 to 6, inclusive.
This section is indespensable to an operator who is interested in obtaining a thorough knowledge of the engine, and will be found valuable to others desiring a general knowledge of the engine and the manner in which it operates.

II. Installation Instructions. Pages 7 to 19, inclusive.
Complete instructions for installing the engine are contained in this section.

III. Operating Instructions. Pages 19 and 20.
The operator should study this section thoroughly as it will provide him with the necessary information to operate the engine.

IV. Inspection Routine. Page 21.
Both the owner and operator should read this section, and they should cooperate in establishing a suitable inspection routine for the particular installation.

V. Servicing Instructions. Pages 22 to 27, inclusive.
This section contains instructions which will enable the operator to perform minor adjustments and servicing.

VI. Repair Charts and List. Pages 28 to 68, inclusive.
This section contains an explanation of the repair list; instructions for ordering repair parts; an index of list divisions; an index of repair numbers; and the list divisions, each of which comprises one or more repair charts illustrating the parts furnished for repairs followed by a list of the repair parts found on the particular chart. In addition, the charts will be found useful in studying the construction of the engine. Repair numbers on charts that are underscored with a dotted line are numbers that are referred to in the instruction text.

TABLE OF CONTENTS

I. DESCRIPTION AND OPERATION

This section covers the description and operation of the several systems which make up the engine and complete installation.

1. Type and Cycle

Type and Cycle—These engines are of the valveless, airless fuel injection type, and are designed to use a wide variety of fuels. They operate on the two cycle principle in which two strokes of the piston (one complete revolution of the crankshaft), are necessary to complete the cycle.

Compression—The cycle begins with the upward movement of the piston from its lower dead center. After the piston has covered the exhaust ports, the air in the cylinder is compressed, and during the same upward movement of the piston, air is drawn into the crankcase through automatic suction valves.

Combustion and Expansion—As the piston nears upper dead center, fuel is injected into the combustion space where it burns and expands, forcing the piston downward. Expansion of the hot gases forms the greater part of the power stroke, and continues nearly to the end of the stroke. During this stroke, the air in the crankcase is slightly compressed.

Exhaust and Scavenging—Toward the end of the expansion or power stroke, the piston uncovers the exhaust ports, allowing the burned gases to escape to the atmosphere through the exhaust system. Immediately after the exhaust ports have been uncovered, when the pressure in the cylinder has dropped to atmospheric, the air inlet ports are uncovered by the piston, and the compressed air in the crankcase rushes through the air transfer passages into the cylinder, sweeping the exhaust gases out of the cylinder through the exhaust ports and filling the cylinder with fresh air for the next compression stroke.

2. Fuel Supply System

Supply System—The fuel system consists of the supply and injection systems. The supply system includes the fuel storage tank, suction and overflow pipes with the necessary fittings and valves, fuel supply pump, suction filter, and reservoir. When the fuel tank must be located above the level of the fuel reservoir, a gravity feed fuel regulator must be included.

Gravity Feed Fuel Regulator—The regulator consists of a water jacketed reservoir containing a float mechanism, see Fig. 10. This float operates a valve which controls the supply of fuel admitted to the regulator reservoir. The regulator is provided with an air vent in the cover which maintains atmospheric pressure on the fuel and indicates, by fuel leakage, that the float is inoperative. This air vent is arranged so that any fuel leakage flows into an open funnel and then into a vented tank outside of the building. With the open funnel, the operator can readily detect any leakage, and with the tank placed outside of the building, the fire hazard is greatly reduced.

Operation of Fuel Supply System—The supply pump draws fuel from the fuel storage tank or gravity feed fuel regulator through the suction filter and delivers it to the fuel reservoir where it is ready to be taken up by the individual injection pumps. Any excess fuel in this reservoir drains through the overflow pipe to the storage tank or gravity feed fuel regulator.

3. Fuel Injection System

Index to Diagrams—The following parts are indicated on Figs. 1 and 2 to illustrate the discussion of the fuel injection and governing system.

(A) Fuel pipe leading to the injection nozzle.
(B) Injection pump plunger.
(C) Discharge valve.
(D) Injection pump roller.
(E) High point of injection cam.
(F) Injection cam (in fixed relation to the crankshaft).
(G) Crankshaft (shown in two sections).
(H) Governor cam (loose on the crankshaft).
(J) An increase in load will turn the governor cam H in the direction J, closing the suction valve P earlier, thus causing a greater amount of fuel to be injected into the cylinder.
(K) A decrease in load will turn the governor cam H in the direction K, closing the suction valve P later, thus causing a lesser amount of fuel to be injected into the cylinder.
(L) Leading high point of governor cam for reverse rotation
(M) Leading high point of governor cam for standard rotation.
(N) Suction valve adjusting screw.
(O) Suction valve adjusting screw nut.
(P) Suction valve.
(Q) Injection pump suction lower push rod.

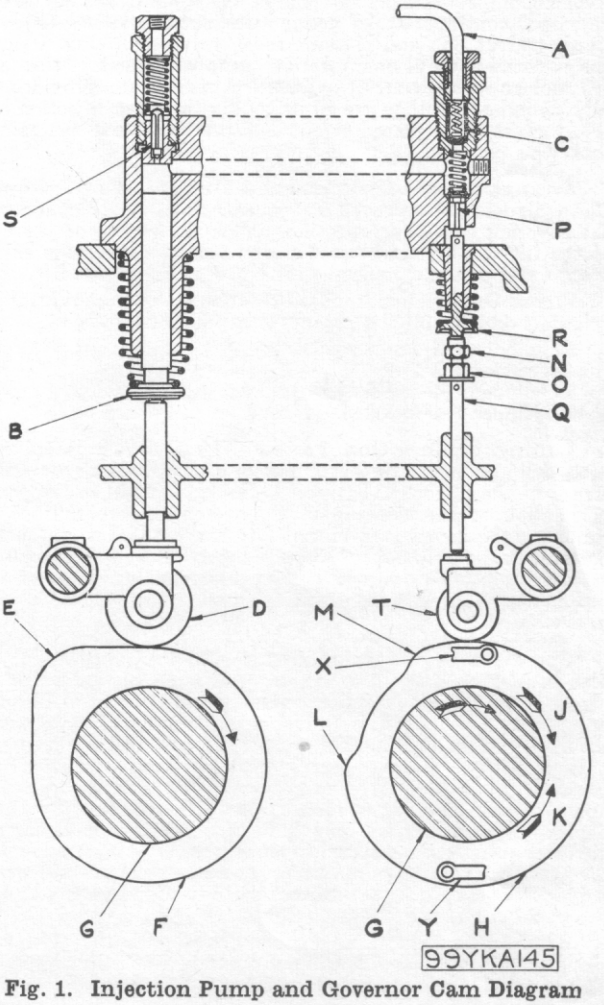


Fig. 1. Injection Pump and Governor Cam Diagram

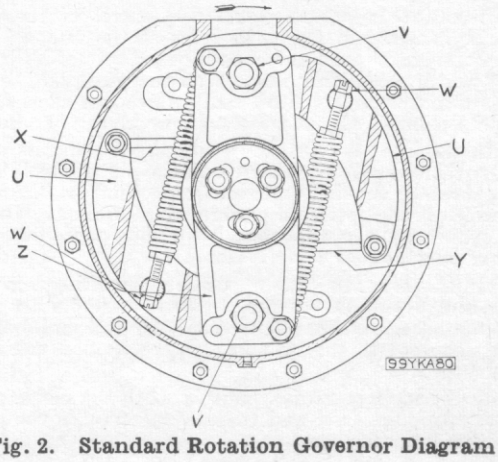


Fig. 2. Standard Rotation Governor Diagram

(R) Injection pump suction upper push rod stem.
(S) Relief valve.
(T) Governor cam roller.
(U) Governor weight; centrifugal force throws the weight out.
(V) Pivot of the governor weight.
(W) Governor spring adjusting screw; tighten to increase the speed and loosen to decrease the speed.
(X) & (Y) Governor weight to governor cam links.
(Z) Governor spider, with governor weights, clamped in fixed relation to the crankshaft.

Fuel Injection System—The fuel injection system includes the individual injection pumps, fuel tubes, and differential fuel injection valves for each cylinder, also the driving and control mechanism for operating the pumps. The pumps are of the cam operated, constant stroke design with suction valves (P), discharge valves (C), and pressure relief valves (S). Fig. 1 shows the essential parts of one injection pump with the injection cam (F) and governor cam (H). Identical pumps are provided for each cylinder, but they are all driven by the same injection cam (F), rockers being placed at equal distances around the cam to make this possible.

Arrangement of Cylinders and Fuel Injection Pumps—The cylinders are arranged in sequence with No. 1 cylinder at the governor end. The injection pumps are located on the floor of the fuel supply reservoir and are arranged the same as the firing order of the cylinders, with No. 1 pump at the left.

Firing Order—For standard rotation the firing order of the cylinders on the different engines is as follows:

3 Cylinder 1–3–2.
4 Cylinder 1–3–2–4.
5 Cylinder 1–4–3–2–5.
6 Cylinder 1–4–5–2–3–6.

Timing of Injection Period—The fuel is injected into each cylinder near the beginning of the downward or power stroke of the piston. The proper timing of the injection period in relation to the position of the piston is accomplished by clamping the governor spider (Z) to the crankshaft in such a position that the injection pump plunger (B) is at high point a certain number of degrees before the corresponding piston reaches top center. This is fully explained under "Injection Timing," in Section V.

Operation of Injection Pump—As the plunger (B) descends, fuel is drawn into the pump through suction valve (P) which is held open by the governor cam (H). When the high point of injection cam (E) moves under the roller (D) and pivots the rocker, thus moving the plunger (B) up, fuel is discharged back into the suction passages until the suction valve (P) is closed. The suction valves are controlled by governor cam (H), and are closed only when the cam roller (T) is in contact with the depressed portion of the cam L to M. Injection cam (F) and governor cam (H) are placed in such relation to each other that the plunger (B) always starts its movement before the suction valve is closed; thus, the beginning of injection is controlled by the position of the governor weights.

With the suction valve P closed, and with the plunger B rising, a pressure is built up in the pump which forces the discharge valve C off its seat. Fuel is then discharged through the injection tube A to the injection nozzle where it is thoroughly atomized and forced into the combustion space.

Control of Injection System—Control of the injection system is centered in the hand lever at the right of the fuel pump housing. It has three positions, "Prime," "Run," and "Stop" which are plainly marked on the quadrant. The hand lever is attached to a control shaft which has cams for lifting the pump plungers (B) and the suction valves (P). See Fig. 3.

With the lever in "Prime" position, the plungers are being lifted by the control shaft cams; thus the plunger can be worked up and down by moving the lever from "Run" to "Prime" positions which is the operation performed in priming. When priming a cylinder, the piston must be in such a position that the corresponding suction valve is closed.

When the lever is in "Stop" position, the lifting cam has been moved away from the pump plungers, and another cam has raised the suction valve off its seat. In this position, no fuel can be delivered to the cylinder, for the suction valve is open continuously.

With the lever in "Run" position, both the plunger and the suction valves are free, and the fuel injection is controlled by the governor mechanism.

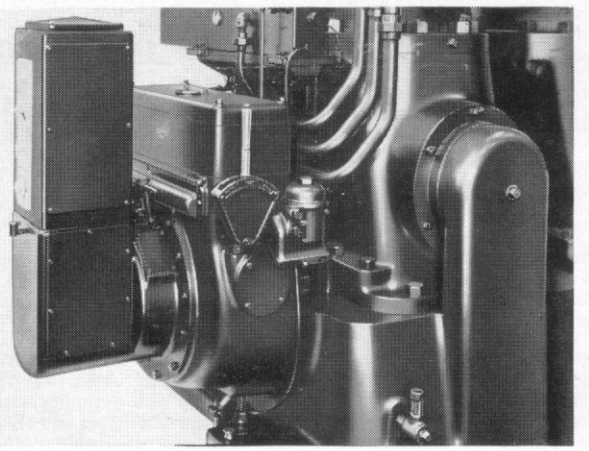


Fig. 3. Fuel Control Mechanism (6509G)

4. Governing System

Governing System—The governing system includes the governor, injection cam (F), and governor cam (H). The governor is of the flyball type, and has two spring regulated weights (U) which pivot about points (V). The injection cam (F) is keyed to the governor spider (Z). The governor cam (H) is mounted on the governor spider too, but is free to rotate within certain limits, being held in position by the two links (X) and (Y) which are connected to the free ends of the governor weights.

The entire governing mechanism is clamped on the end of the crankshaft by means of three clamp nuts through the governor spider (Z). Slotted holes in the spider allow the shifting of the governor mechanism in relation to the crankshaft.

Operation of Governing System—With the crankshaft rotating, centrifugal force acts on the governor weights (U). With a decrease in load, the engine speed increases, and the governor weights swing out farther. Through links (X) and (Y), this movement is transmitted to the governor cam (H), which is retarded in relation to the injection cam (F). This causes the suction valves (P) to close later, and less fuel is delivered to the cylinders. With an increase in load the opposite is true; thus, the governor automatically controls the amount of fuel delivered between certain limits.

Description of Woodward Governor—The governor consists of a rectangular case approximately 1′ square and 2½′ high, containing the complete mechanism, including the oil pump, the relay cylinder for operating the fuel control equipment, flyballs for timing, and link mechanism, etc. This unit is mounted in the same place normally occupied by the standard stationary governor and is driven from the end of the crankshaft through a short splined shaft and a pair of bevel gears.

In the conventional (direct acting) Diesel engine governor, the flyballs do not only indicate speed, but also serve as a source of energy to move the engine fuel pump cam and suction valve and all intervening connections. Therefore, to make a corrective fuel change requires quite a sizeable frequency or speed change in order to produce the force required to overcome the friction of the governor head, fuel cam, suction valve and other connecting parts.

In the Woodward Diesel engine governor, the flyballs are very small by comparison with the conventional type and serve only to indicate speed. The flyballs transmit the speed indication to a small valve that is in perfect hydraulic balance, and it is this valve that controls the oil under pressure to move these mechanical parts required to relocate the fuel setting. Speed changes of less than 1/100 of one per cent will cause corrective movement of the fuel control mechanism.

The Woodward governor is stable, that is, it does not hunt when the load is added or taken off, which, in cases where accurate speed control is required, is very desirable. Tests show the governor capable of accepting full load from no load with a maximum speed reduction of 4% and returning to normal speed in approximately three seconds time. The same results are attained in the rejection of load from full load to no load.

This type of governor can be used on an engine, where there is only one engine in a plant, or where there are a number of engines in the same plant operating in parallel. Where there are several units operating in parallel, with one engine of sufficient capacity to handle the load changes, equipped with a Woodward governor, and all the other units equipped with a conven-

tional governor, the engine equipped with the Woodward governor will control the speed of all the other engines to check with that maintained by the engine equipped with the Woodward governor. For instructions on the operation of the Woodward governor see Woodward Bulletin W-2 for IC Type Governor.

5. Lubricating System

Automatic Lubrication—Each engine is equipped with an automatic lubrication and circulation system which requires no attention other than to keep an adequate supply of oil in the storage tank.

Main Part of System—The main parts of the system are the force feed lubricator, pressure type oil filter mounted on the clean oil storage tank, clean oil and used oil sumps each fitted with a reciprocating pump and strainer, oil rings and wells for each main bearing, oil reservoir in the governor case, and the connecting tubes and piping.

Lubrication of Pistons, Piston Pins, and Crankpin—In operation, the clean oil pump draws filtered oil through a strainer and delivers it to the force feed lubricator which supplies lubrication to the pistons piston pins, and crankpin. Referring to Fig. 11 it will be noted that two of the lubricator feeds deliver to oil collectors located in the piston at each end of the piston pin. These collectors furnish lubrication to the piston pin. A third lubricator feed leads into the front or scavenge air transfer side of each cylinder for the lubrication of the piston, and the fourth feed supplies lubrication to the crankpin bearing by means of a ring oil collector bolted to the crank web. This collector is connected to a drilled passage in the crank web and pin which leads to the bearing. Each feed to the engine is an individual feed from the lubricator.

Used Oil Filtered and Returned to Tank—The used oil from the pistons, piston pins and crankpin bearings drains to the bottom of the respective crankcases and is drained through pipes to the used oil sump at the governor end of the engine. The used oil pump transfers this oil to the oil filter where it is thoroughly cleansed, and then delivers it to the clean oil storage tank where it is again ready for circulation. **Under no circumstances should oil ever be allowed to accumulate in the crankcases.**

Commercial lubricating oil filters may be used when connected and operated as directed by the filter manufacturer.

Lubrication of Governor Mechanism—The clean oil pump delivers more oil than is required by the force feed lubricator, so the excess oil overflows to the governor case, lubricating the lubricator drive eccentric and rocker bearings. The 1, 2 and 3 cylinder engines, having fewer cylinders and bearings to lubricate, have a larger quantity of oil overflowing from the lubricator. This overflow is more than is required for the rocker bearings and lubricator drive eccentric so on the 1, 2 and 3 cylinder engines an overflow bypass is provided to return a portion of the oil directly to the clean oil sump. The oil level in the governor case is maintained at such a height that the splash created by the dipping of the governor spider thoroughly lubricates the governor mechanism, injection cam, push rods, etc. An overflow pipe permits any excess oil to flow back to the clean oil sump.

Lubrication of Main Bearings—The oil level in each of the crankshaft main bearing oil wells is automatically maintained by means of a cored passage between the governor case and the governor-end main bearing oil well and an equalizing pipe connecting this oil well to each of the other wells. Lubrication is supplied to the main bearings by means of oil rings which dip into the oil wells beneath. Operation of these rings can be observed and checked by opening the cover provided in the top of each bearing cap.

Oil Level Sight Gauges—All engines are equipped with a glass sight gauge at the governor end of the oil equalizer pipe for checking the oil level in the governor case and oil wells. The 4, 5 and 6 cylinder engines are provided with an additional gauge at the flywheel end of the equalizer pipe.

Floating Dredge Service—When the engine is to be used for floating dredge service where the crankshaft is not perfectly horizontal at all times, the main bearing oil well equalizing pipe must be omitted and an oil sight gauge be provided for each oil well. Also the cored passage between the governor case and the governor end main bearing must be plugged. When an order specifies that the engine is to be used for floating dredge service, this special oil well piping will be installed at the factory without extra charge.

The main bearing oil rings will function satisfactorily in this service as experience has shown that the engine may be slightly tilted end-wise without interfering with the action of the rings.

If the engine is to be direct connected to a direct current generator or magnetic clutch, brass oil rings must be used, as a magnetic attraction is sometimes encountered which tends to make the steel rings stick. Brass oil rings will be furnished for special direct current installations without extra charge.

6. Cooling Water System

General—An adequate supply of soft water is essential to the satisfactory operation of an internal combustion engine. Only clean soft water or water which is free from scale forming ingredients, should be used in the cooling system. Even a thin layer of scale or dirt on the cylinder jacket walls will act as an insulator and cause overheating and possible breakage. If clean rain water is available, it is suitable for cooling purposes without previous treatment. Salt water should not be used for cooling, as it may cause corrosion in the water jackets. Any hard water containing lime or magnesia is almost certain to cause scale and must be treated. To prevent scale deposit, the cooling system recommended, is the closed system using only soft water in the engine jackets.

Cooling System—The cooling water system on these engines consists of the cooling water passages in the cylinders and heads, and the necessary equipment for circulating and cooling the water, such as pumps and heat exchangers.

The presence of combustion products in the cooling system, due to defective or loose cylinder head gaskets will form acids which will attack the metal surfaces. Gaskets must, therefore, be kept tight and in good repair. Pump glands should be well packed and tight to prevent infiltration of air and, wherever possible, positive pressure should be placed on the suction side of the pump.

7. Air Starting System

Air Starting System—Compressed air is used to start these engines. The air starting system consists of an air start mechanism on the engine for distributing and admitting the compressed air to the cylinders, an auxiliary air compressor, steel tanks for storing the compressed air, and the necessary piping and fittings.

Starting Mechanism—Fastened to the left side of the pump case housing is the air lever which controls the air start mechanism. See Fig. 4. This lever is attached to a control shaft which has cams for raising or lowering the air valves and to which is fastened the disc shut off valve. The air lever has two positions "Start" and "Run." These are plainly marked on the quadrant.

Each cylinder head on those cylinders which receive starting air is provided with an air starting check valve No. 854B. This valve is so arranged that it is opened by the compressed air during its admission into the cylinder, but is closed at all other times.

Operation of System—When the lever is moved to the "Start" position, the disc shut off valve is opened admitting compressed air to the distributor. At the same time the cams under the air starting valves are moved out of position, and the valves are lowered to their respective seats and brought into contact with the air starting cam. As the engine revolves, the air starting cam lifts the valves in the proper order, and air is admitted to the corresponding power cylinder during a portion of the downward stroke of the piston.

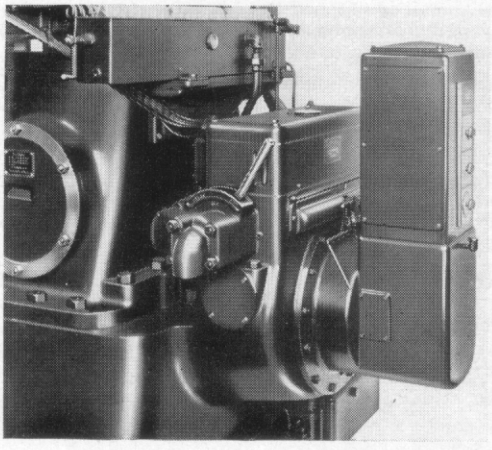


Fig. 4. Air Control Mechanism (6510G)

When the engine has started, the air lever is moved to the "Run" position. In this position, the disc valve is closed, thus stopping the admission of air from the starting tanks, and the air starting valves are lifted off their seats. With this arrangement, the cam rollers do not come in contact with the cam while the

engine is in operation. The disc valve and the lifting cams are interlocked in such a manner that air cannot be admitted to the distributor while the starting valves are off their seats.

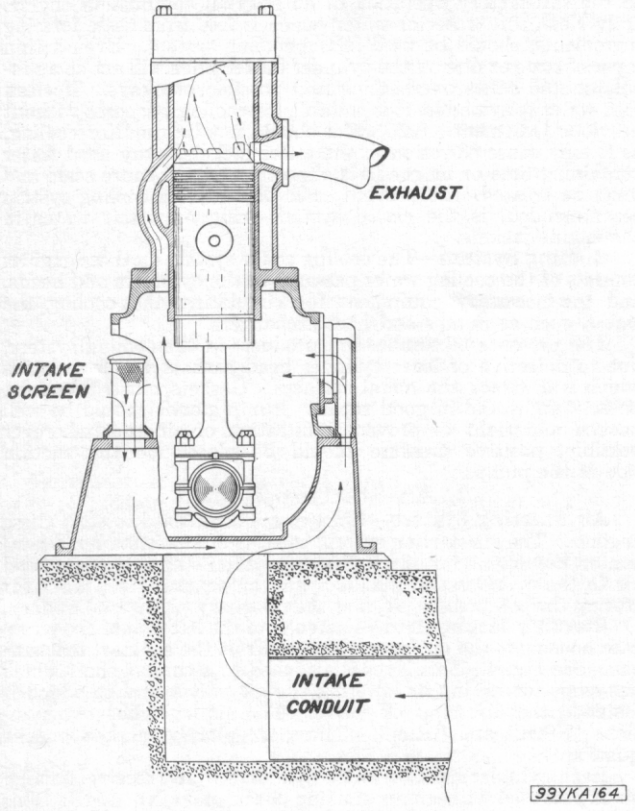


Fig. 5. Scavenging Diagram

8. Scavenging Air System

The scavenging air is supplied by the piston acting as a pump. During the upstroke of the piston, air is drawn into the engine in one of the following ways. (a) From outside the engine room through an underground conduit into the engine base. (b) From the engine room through a screen located on top of the engine base at the flywheel end.

When the air is supplied to the engine by method (a), which is the preferred arrangement, the intake opening on top of the base is shut off with a blind flange.

When the air is supplied to the engine by method (b), one intake screen is furnished on 1, 2 and 3 cylinder engines, and two on the 4, 5 and 6 cylinder engines.

After entering the engine base, the air is drawn into the crankcase through an automatic air valve during the upstroke of the piston, and is compressed on the downstroke. Arrows on Fig. 5 indicate the flow of scavenging air through the engine.

Air Filters—Many installations are made under conditions which require that the air supply be filtered before it enters the engine. Cement mill, flour mill, and rock crusher installations are examples.

The self cleaning panel type or oil bath filter is recommended; however, the fixed panel type filter can be used if required for a particular installation.

9. Exhaust System

General—In the discussion under "Type and Cycle," the manner in which the exhaust gases are expelled from the cylinders is explained. Since the satisfactory operation of any Diesel engine depends a great deal upon the arrangement for conducting these gases to the atmosphere, it is highly essential that the exhaust system conform to one of the approved arrangements as outlined under "Installation Instructions." If any departure from these arrangements seems necessary, approval must be obtained from Fairbanks, Morse & Co.

Exhaust Temperature—Under normal full load operating conditions with the engine in good condition and proper adjustment and with an approved exhaust arrangement, the exhaust temperature should be approximately 390°F. to 420°F.

This should be determined for each individual installation. The temperature will vary to some extent with the temperature of the incoming air.

Exhaust Arrangements—In conducting the exhaust gases from the engine to the atmosphere, there are four approved arrangements as follows:

(a) **Underground Conduit**—This arrangement, as shown in Fig. 16, is preferred. It provides especially favorable exhaust and scavenging conditions under practically all field applications, and results in the most satisfactory engine operation together with the best appearance of the installation.

This arrangement consists of a reinforced concrete conduit extending lengthwise of and adjacent to the foundation. Individual pipes from each cylinder lead through expansion joints into this conduit which in turn is vented to the atmosphere through a stack. It is very important that the exhaust inlet and outlet connections to the conduit be at the extreme ends so that no dead spaces will exist, since under certain conditions such "dead ends" will seriously interfere with the engine exhaust.

The conduit must be provided with a drain connection, preferably so arranged that a fixed level of water can be maintained in the bottom. This will effectively quench all sparks brought in with the exhaust gases.

(b) **Exhaust Pot Arrangement**—This arrangement, shown in Figs. 19 and 20, is satisfactory for installations of 2 or 3 cylinders where it is permissible to run an exhaust pipe through a side wall or through the roof, or where the installation of an underground conduit is undesirable.

For multiple installations it is essential that individual exhaust stacks be installed with each exhaust pot, and where exhaust washing or silencing is required, an individual washer or silencer for each stack. This arrangement however, is not recommended for 4, 5 or 6 cylinder engines.

(c) **Exhaust Manifold Arrangement**—This arrangement is used for engines with two or more cylinders where a single stack is necessary or desirable. An exhaust silencer may be installed if desired.

(d) **Dredge Individual Elbow Exhaust Arrangement**—This arrangement, shown in Fig. 21, is suitable only for dredge, drag line, and shovel installations where space requirements and weight must be kept to a minimum and where the noise of the exhaust is not particularly objectionable.

10. Synchronizer

The synchronizer is furnished as special equipment and may be installed on the engine in the field. For instructions on installing the synchronizer in the field, see "10. Synchronizer" in Section II.

Purpose—When the engine is to be used in driving an alternator in parallel with other synchronous machinery, the no load speed must first be reduced to normal full load speed value before the alternator can be paralleled. This can be accomplished by means of a synchronizer as described below.

Description—The synchronizer consists of a mechanism which includes two coiled springs attached to the governor weights in such a manner that they oppose the action of the governor springs. A handwheel is provided by means of which the tension in the synchronizer springs can be varied. An indicator dial on the side of the synchronizer shows the position of the control at all times. The handwheel can be locked in any position by means of a knurled pin. The no load speed of the engine can be reduced approximately 25 r.p.m. by means of the standard synchronizer springs.

II. INSTALLATION INSTRUCTIONS

1. Layout of Plant

Floor Plan—Lay out the entire floor plan, carefully locating the exhaust and cooling water arrangements, foundations for auxiliaries, etc., before erecting the engine. Locate all auxiliary equipment so that the piping will be as short as possible. Leave plenty of space around the engine and auxiliaries, and provide for development and future extensions.

Engine Rotation—The standard rotation of the engine is clockwise, when facing the engine at the governor end. When specially ordered, the engine can be furnished for reversed rotation. Fig. 22 shows the engine with standard and reversed rotations.

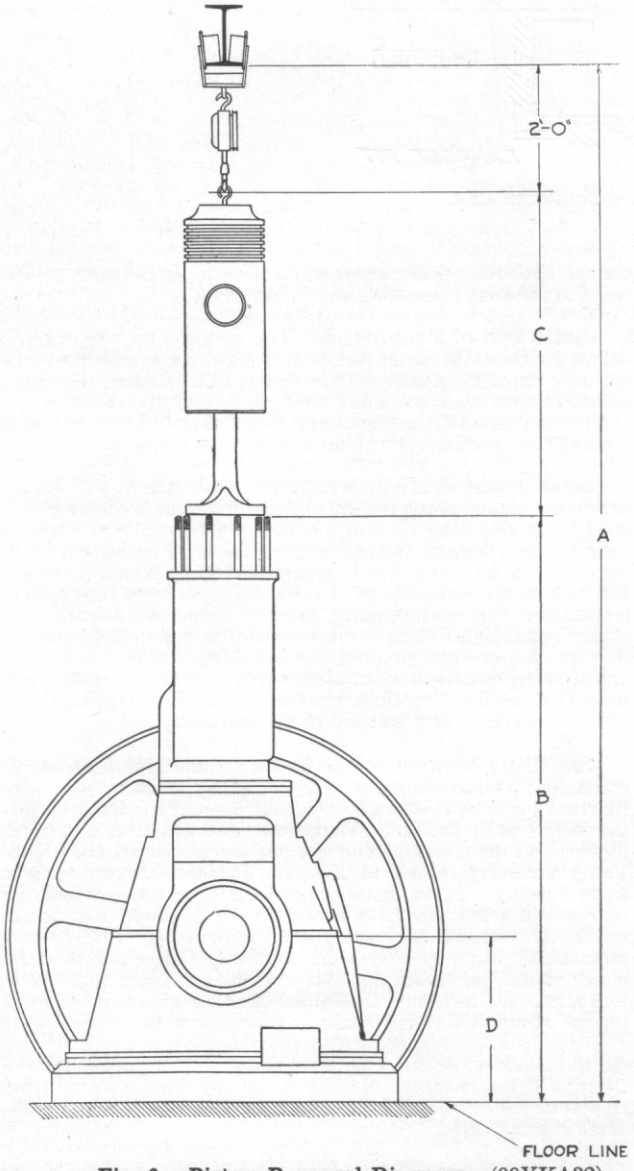


Fig. 6. Piston Removal Diagram (99YKA32)

HEAD ROOM REQUIRED FOR REMOVING PISTONS
STANDARD LOW MOUNTED ENGINES

ENGINE SIZE	A	B	C	D
12"x15"	13'-8"	7'-5½"	4'-2½"	22"
14"x17"	15'-2"	8'-6⅝"	4'-7⅜"	2'-3"

SPECIAL HIGH MOUNTED ENGINES

12"x15"	15'-1"	8'-10½"	4'-2½"	3'-3"
14"x17"	16'-5"	9'-9⅝"	4'-7⅜"	3'-6"

Cylinder Position—The standard position of the cylinder is with the exhaust ports on the right-hand side when facing the engine at the governor end. See Fig. 22. When specially ordered, the engine can be furnished with the exhaust connections at the left-hand side.

Completely Reversed Engine—When specially ordered, the engine can be furnished with both reversed rotation and reversed cylinders.

Overhead Clearance for Removing Pistons—When laying out the plant it is important to provide a convenient means for removing the cylinder head, piston, etc., in order to facilitate cleaning or making repairs on these parts. Provide a suitable overhead hoist as illustrated in Fig. 6, keeping in mind that the hoist should travel, at least in the direction parallel with the axis of the engine crankshaft, and if possible, transversely as well. The overhead clearance required for removing the piston and connecting rod is shown in the table accompanying the diagram. The dimension given in the cut for the space occupied by the hoist is 2'-0", but this can be reduced several inches by the use of an army type hoist.

Size of Hoist—The following table indicates the size of hoist required when removing various parts of the engine. For general servicing work, a hoist of sufficient capacity to remove the cylinders will be suitable. For removing the crankshaft or flywheel, the size must be increased accordingly.

SIZE OF HOIST (TONS) REQUIRED TO REMOVE THE FOLLOWING PARTS

Engine Bore & Stroke	12"x15"			14"x17"					
No. of Cylinders	1	2	3	1	2	3	4	5	6
Cylinders	1	1	1	1	1	1	1	1	1
Crankshaft	1	1½	2	1	2	3	3	3	4
Flywheel (Belted Commercial)	1½	1	2	2	2	2	4	4	4
Flywheel (Belted Electric)	3	1½	3	4	3	3	4	4	4
Flywheel (Dir. Con. Electric)	4	2	2	5	4	4	4	4	4

Piping—To improve the general appearance of the plant, lay the fuel, water, and air pipes below the floor level wherever possible. Make a channel in the floor, to receive the pipes, and cover it with floor plates, or pack the channel with sand and cover the top with a thin layer of cement. If necessary to remove or repair the pipes, the thin layer of cement can be broken easily, the pipes repaired, and the cement readily replaced. It is not advisable to cement any pipe solidly into a wall or floor.

Lighting—Provide an abundance of light on all sides of the engine at all times. This is important from the standpoint of safety as well as economical operation. A well lighted engine room makes it possible for the operator to detect promptly, any slight irregularity of operation and to make the necessary adjustments before any serious results develop.

2. Foundation

Standard Mounting of Engine—The standard mounting for any 14"x17" engine is that in which the engine base is set upon a concrete foundation, projecting 7 inches above the floor line. On a 12"x15" engine, the foundation projects 4 inches above the floor line. For either size of engine, a pit must be provided for the flywheel and belt pulley, as shown on the foundation plan furnished for each engine. Drains should be provided for all pits.

Special Mounting of Engine—When specially ordered, a foundation plan will be prepared showing the engine mounted on a higher foundation with the flywheel and pulley above the floor line. With this mounting, no pit is required.

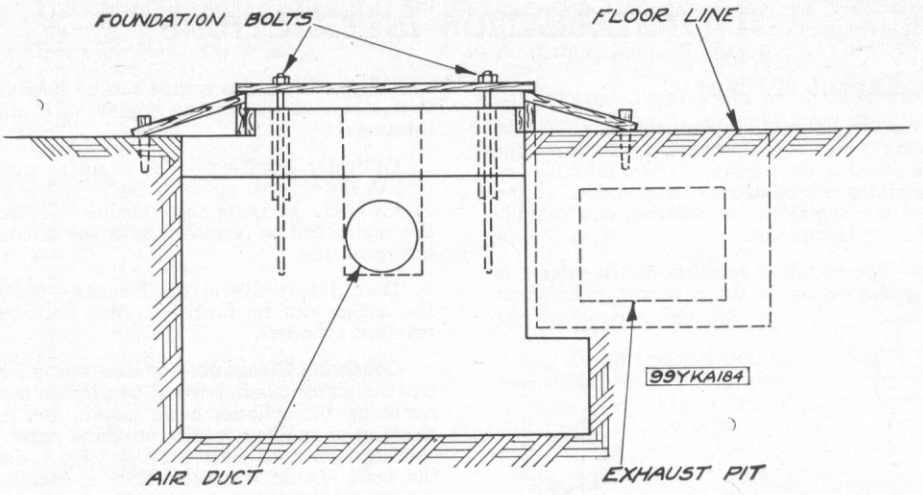


Fig. 7. Foundation from Governor End

Generator Mounting—On a direct connected outfit, the engine foundation is extended to support the generator, as shown on the foundation plan furnished for each engine.

Foundation Plan—Prepare the foundation in accordance with the foundation plan furnished for each engine. This plan gives the location of the foundation bolts, driving belt, exhaust equipment, and all outside dimensions. Follow the dimensions carefully.

Extend the foundation deep enough into the ground to secure a solid footing; that is, one that will not settle when the engine is mounted. The foundation plan shows a depth that is sufficient for solid ground, but Fairbanks, Morse & Company will not be responsible for the failure or inadequacy of a foundation. Provide a space of at least three feet all around the engine for easy access by the attendant.

Foundation Isolation—In all installations where engine vibrations are undesirable, such as in or near hotels, residences, offices, etc., it is recommended that the foundation be properly isolated. For information regarding such isolation, refer to the Manufacturing Division.

Isolate Exhaust Conduit—When an exhaust conduit is used, it should be isolated from the engine foundation. The usual practice is to place an inch board between the engine foundation and the exhaust conduit, and to leave this board in position after the remainder of the form is removed.

Foundation Bolts—Set the foundation bolts in tubes or boxes, extending from the top of the foundation well down into the concrete, with the ends of the foundation bolts extending above the foundation, the distance shown on the foundation plan. The object in using the tubes is to allow the foundation bolts to be sprung slightly, so as to enter the holes in the engine base. It is therefore important to exclude all concrete from the tubes while pouring the foundation, as the bolts cannot be sprung if imbedded in the concrete. Fill the tubes with a thin, rich grout at the time the finish grouting is poured.

Reinforcing Rods—The foundation may be strengthened by the addition of reinforcing rods, but their use is not considered necessary if the foundation is properly constructed.

3. Installing the Engine and Drive Equipment

Erector's Level—The erector should use a good level. It should be at least as accurate as the L. S. Starett No. 98 machinists' level and have a cross level in the base. Check it for each job by trying it on a smooth surface and noting the position of the bubble with respect to the graduations on the bubble tube. Reverse the level and again note the position of the bubble. If any variation exists, correct the error before attempting to level the engine. An 8 inch level is the longest that can be used on certain parts of the engine.

Examine Drain Pipes—Before the engine is set on the foundation, examine the drain pipes from the crankcase to the sump box to see that they have not been loosened or damaged in transit. Also check the inter-connection pipes between bearing wells to see that these have not loosened.

Clean Top of Foundation—The air used by the engine is drawn in from the space below the crank case and above the concrete capstone portion of the foundation. Before the engine is set, remove all dust, chips, dirt, etc., from the under side of the lower base and the top of the foundation. If dirt in the air reaches the cylinders, it will cut the working surfaces.

Installation Procedure may be Modified—The following procedure for installing the engine and driven unit covers general conditions, and may require modification to apply to a specific installation. Some erectors may wish to level and grout in the engine first, and the drive equipment later, which procedure will be entirely satisfactory. Leveling and aligning the complete installation first and grouting later is suggested, because it is thought that by so doing any errors may be more easily rectified. Any procedure must produce the same final results; that is, all crankshaft journals must be dead level, and the extension shaft must be aligned so that there is no distortion of the crank adjacent to the flywheel in any position of the crankshaft.

Installing Flywheel—The flywheel should be placed on the crankshaft **before** setting the engine on the foundation, unless the flywheel pit is wide enough to permit placing the flywheel after the engine is in position. Wedge the hub apart, and place the flywheel on the crankshaft in the position shown on the foundation plan, being careful to align the flywheel keyway with the shaft keyway. In an installation using an extension shaft and outboard bearing, when the flywheel is in its proper location the crankshaft extends through the hub about ¾ inch. On an installation using an overhung flywheel, the wheel is moved closer to the main bearing and the shaft extends through the hub about 2¾ inches on the Model 32E12 engine and 2½ inches on the Model 32E14 engines. Remove the wedges, and tighten the clamp bolts temporarily so that the flywheel will be tight on the shaft while the engine is being set on the foundation. Fit and drive the key. Lining up of the hub faces and final tightening of the clamp bolts should be done when the extension shaft is being fitted.

Set the Engine—The engine should now be placed on the foundation. Support it with leveling screws and steel bearing plates, allowing clearance for grouting according to the foundation plan furnished with the engine. The leveling screws should consist of ¾ inch by 5 inch, cup point, square head set screws. The steel bearing plates should be of such size and shape as to afford a suitable bearing surface and be installed in such a manner that they can be left in the grouting.

Level the Base—The base should be leveled first. On each side of every main bearing, scrape sufficient paint from the top of the lower base to provide a smooth bearing for the level. Place the level on each of the surfaces and adjust the leveling screws until an accurate crosswise and lengthwise level is obtained. In some cases, when leveling a base, it may be necessary to draw down on one or two of the foundation bolts.

Flywheel—If the flywheel has not been placed on the crankshaft, install it now.

Installing Bearing Pedestal, Sole Plate and Outboard Bearing—Before installing the outboard bearing, make certain that the lower shell is scraped to a good bearing surface throughout the entire length. In cases where it will not be necessary to remove the extension shaft after it is fitted, the bearing pedestal, sole plate and lower half of the outboard bearing should be placed in position before the shaft is bolted to the flywheel. The bearing should be placed low enough temporarily so that it will not interfere while the extension shaft is being fitted. Where there is sufficient clearance at the end of the shaft, the lower half of the bearing may be installed after the shaft is fitted, by sliding it lengthwise along the shaft.

Fitting Shaft Extension—The shaft extension should now be fitted to the engine. Loosen the flywheel hub clamp bolts and drive in a wedge lightly. Then bolt the shaft extension to the hub. This will line up the faces of the hub by pulling them up against the flange of the extension shaft. Remove the flywheel wedge and tighten the clamp bolts. It is essential to fit the hub faces accurately to a good contact over the entire bearing surface and so that the extension shaft will run true. Mark the flange and hub so that if the extension shaft must be removed it can be replaced in the original position.

Fitting Flexible Couplings—If the extension shaft is connected to the engine by means of a flexible coupling, instead of by a rigid flanged coupling, **use the same care in aligning the flexibly coupled shaft as would be used in the case of a rigidly coupled shaft.** Then the flexible coupling takes care of any misalignment due to expansion or to wear of the parts. The flywheels used with installations having a flexible coupling are so light that the bending effect on the crankshaft can be disregarded.

Aligning Outboard Bearing—When the extension shaft has been fitted, the outboard bearing should be aligned. All parts such as pulley or rotor and stator should first be in position. Then, with several shims between the bearing and sole plate, so that vertical adjustment can be made in both directions, adjust the position of the bearing to make the following conditions true. The journal next to the flywheel should be dead level, and the distance between the last two crank webs should be exactly the same when the crank is in the top and bottom positions. Measurements should be taken with an inside micrometer or an instrument equally accurate, preferably a Starrett #696 Crankshaft Distortion Gauge.

See Fig. 8 which illustrates incorrect and correct alignment. The two upper figures show the distortion of the crank next to the flywheel when the outboard bearing is placed on the same level as the main bearings. Dimensions "A" and "B" indicate the difference in the measurements for the two vertical positions of the crank. The lower figure shows the correct alignment. Dimension "C" will be the same for all positions of the crank.

Horizontal position of the outboard bearing may be checked by measuring the distance between the last two crank webs when the crank is in the two horizontal positions.

After the outboard bearing is installed and the extension shaft is fitted to the engine, place the distortion gauge between the cheeks of the cranks of all the cylinders. The distortion gauge should read very close to zero at all points. A deviation from a zero reading will indicate that the shaft is not bearing properly in the main bearing. Adjustment of the engine base leveling screws should be made until the deviation is corrected.

Filling Rail Jack Cutouts—After the engine is set fill the rail jack cutouts with ordinary concrete and allow to set before the grouting is poured.

Finishing Grouting—Re-check the alignment of the engine and extension shaft, then pour the finishing grouting. The foundation plan calls for finish grouting to be poured after the engine is carefully leveled and blocked in place. Grouting should also be poured under the outboard bearing sole plate and the generator stator foundation (if used). Make this finishing grouting from one part of cement and two parts of sand, with sufficient water added to make it flow freely. Build a board form around the top of the foundation to retain the grouting. Extend the grouting ¾ to 1 inch up on the base. When the grouting has

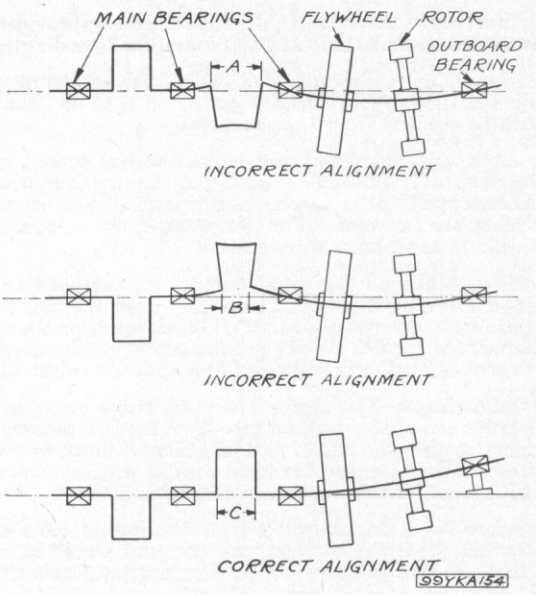


Fig. 8. Alignment Diagram
(This diagram is greatly exaggerated for illustrative purposes.)

set slightly, remove the form and cut away the excess grouting outside of the base. Pack the grouting in under the edge of the base, and finish the edge with a bevel. The grouting should flow over the whole surface of the foundation. To improve the appearance of the foundation above the floor, plaster it with a rich mixture of cement and sand.

After the grouting is hard, remove the leveling screws and make sure that the anchor bolt nuts are tight. Place a cork in each leveling screw hole and trim it flush before painting.

Final Check of Alignment—When all work as outlined above has been completed, make a final alignment check of the entire installation before starting the engine.

4. Fuel Supply System

Since the fuel tank and the suction and overflow pipes (and the gravity feed fuel regulator, when used), are the only parts of the fuel supply system that are not incorporated in the engine, these parts are the only ones that need be considered under the installation of the system.

(a) Installation of System without Gravity Feed Fuel Regulator.

Fuel Tank Location—A galvanized steel fuel supply tank is required for each engine. Connect it to the engine with the suction pipe and overflow pipe as shown in Fig. 9. Locate the fuel tank outside of the building in a covered pit accessible for filling, and place it in a horizontal position so that the suction lift can never be greater than 10 feet. This applies when light fuels are used; for heavy fuels, use heaters, larger pipes or less suction lift

Place unions close to the regulator, in all pipe lines entering it. Extend the pipe, connecting the overhead tank, with the regulator reservoir, about six inches into the tank to permit any sediment in the fuel to settle in the bottom of the tank so as to prevent any foreign matter from entering the fuel regulator. It is advisable to provide a gauge glass on the overhead tank to indicate the amount of oil in the tank and also to show any water that may accumulate in the bottom of the tank. This water should be drained off before it reaches the level of the top of the fuel outlet pipe.

Piping—When the tank is furnished by Fairbanks, Morse & Co., the proper connections for suction and overflow pipes are included. Use the size of pipe to fit these connections. In connecting the fuel tank with the engine, wash out every piece of pipe or joint with gasoline or kerosene to remove all scale and loose matter, which, if left in the pipes, would interfere with the

proper working of the valves. All tanks should be provided with drains for removing residue and water and for periodic cleaning.

When the piping is installed, three-way cocks should be placed in both the suction and overflow piping so that fuel consumption can be checked from time to time.

A check valve must be provided in the fuel suction line to prevent the fuel from draining back into the fuel tank when the engine is stopped. It is very necessary that all fuel be strained when filling the fuel tank. For this purpose, use a 12 in. funnel fitted with 40-mesh brass wire screen.

Joints—Make all fuel pipe connections carefully and use shellac to insure tight joints. Thoroughly clean the pipe threads with gasoline to remove all trace of oil before applying the shellac. Shellac will not stick to an oily surface, consequently an oil tight joint cannot be made unless the shellac is applied to clean threads.

Overflow Pipe—The engine is shipped with a union attached to the lower end of the overflow pipe from the fuel reservoir. To this union connect the return pipe and carry it down to the floor or through the floor as required, and back to the fuel tank with a gradual descent for the free return of surplus fuel.

Storage Tank Capacity—It is advisable to install a storage tank having the capacity of a tank car, and placed at such a level that the fuel will flow by gravity into the smaller supply tank.

(b) Installation of System with Gravity Feed Fuel Regulator.

Gravity Feed Fuel Regulator—The gravity feed fuel regulator is special equipment and is necessary in installations where the fuel storage tank is located above the level of the injection pump. The function of the regulator is (1) to control the amount of fuel supplied to the auxiliary fuel pump, (2) to provide for the overflow from the auxiliary fuel reservoir, (3) to provide for the overflow from the fuel pumps, and (4) to provide for the preheating of the fuel by means of the outlet water from the engine water jacket. Preheating is necessary only when the fuel is a very heavy oil or when it is exposed to low temperatures.

Clean Pipes and Connections—In connecting the regulator to the engine, carefully wash with gasoline or kerosene, each pipe and fitting used in order to remove all dirt or scale, which, if left in the piping, would seriously interfere with the operation of the valves.

Pipe Connections—All water and fuel pipe connections must be absolutely tight. Use shellac on fuel pipe joints and white lead on water pipe joints.

Checking Fuel Consumption—A three-way cock can be installed in the fuel suction line (Fig. 9) to afford a means of checking fuel consumption.

Arrangement of Equipment—Fig. 10 shows a typical arrangement of the regulator and piping. The regulator may be placed on a low bracket on the wall, on the floor, or in a pit below the floor level. Make dimension A about nine inches deep. In any case, the regulator must be placed below the fuel connections on the engine. Connect the overhead fuel tank to the regulator reservoir through the lower hole, tapped for ¾ inch pipe. Place a shut-off valve in this line and keep it closed when the engine is not operating. Connect the fuel overflow pipe of the engine to the upper hole, tapped for ¾ inch pipe, in the regulator reservoir. Connect the fuel suction pipe on the engine to the middle hole, tapped for ½ inch pipe, in the regulator reservoir.

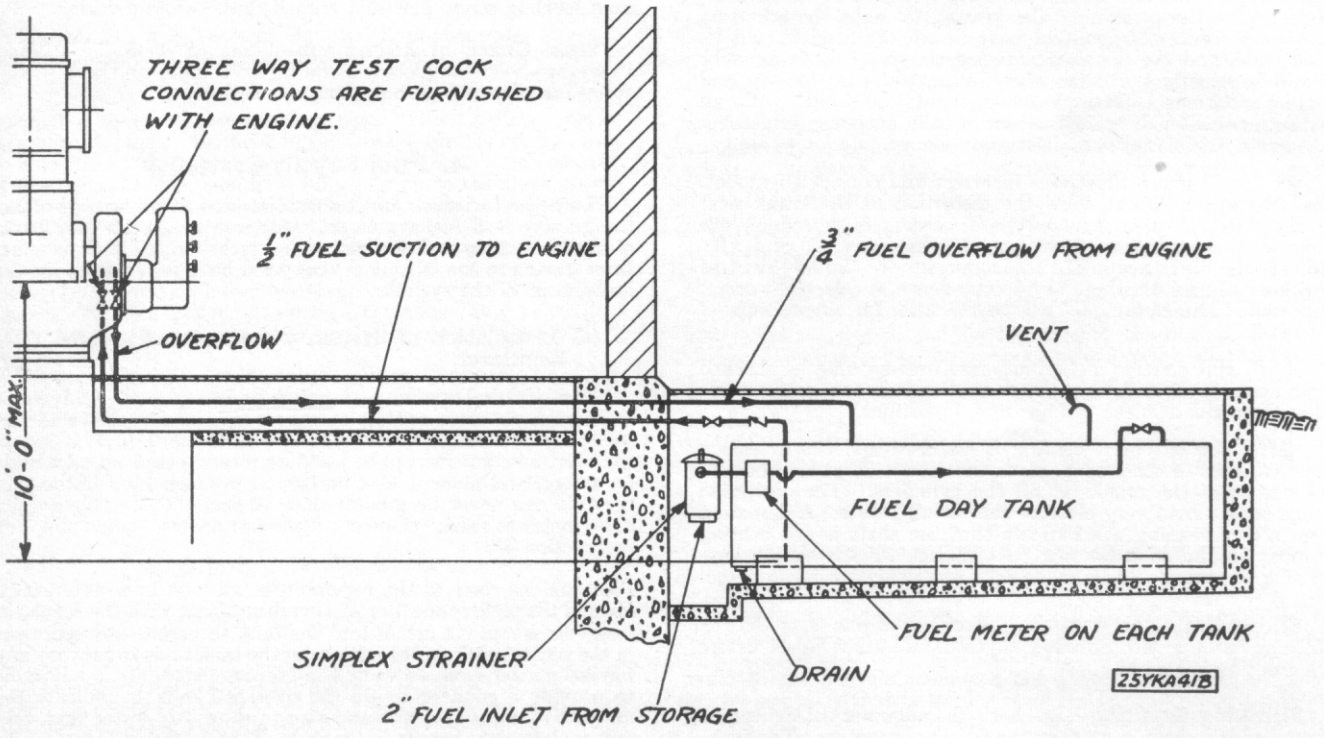


Fig. 9. **Fuel Piping Diagram**

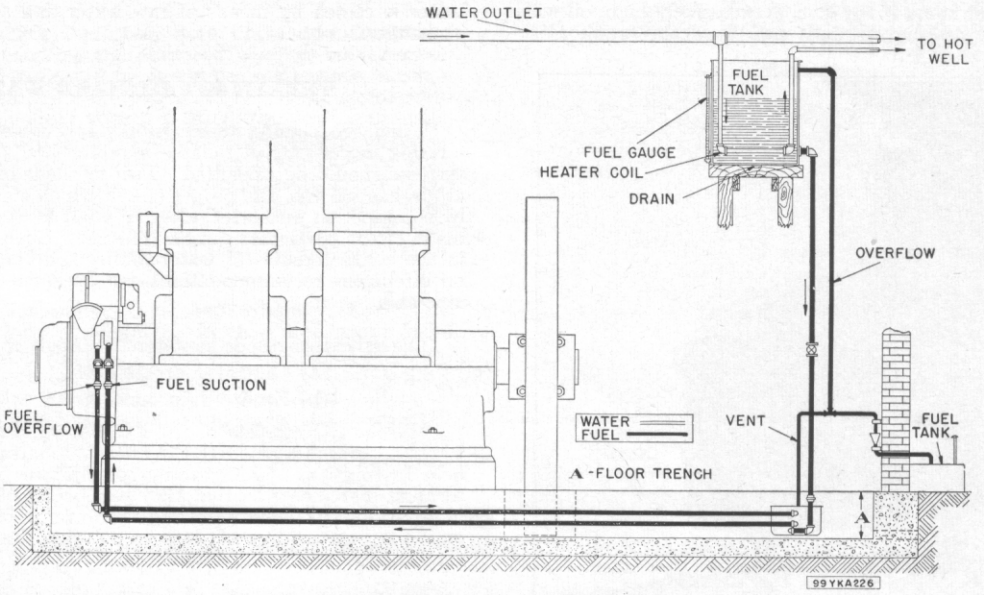


Fig. 10. Gravity Feed Fuel Regulator Diagram

5. Lubricating System

The pressure type oil filter and clean oil storage tank are mounted near the engine and connected to the clean and used oil sumps as shown in Figs. 11 and 12. All other parts are either attached to or incorporated in the engine itself; so installation work on the lubricating system requires only the proper setting and connecting of the filter and storage tank.

Necessity for Proper Oil Levels—As previously explained under the operation of the lubricating system, the oil in the governor case and each of the main bearing oil wells is maintained at a common level by means of equalizing connections. The level is maintained by the clean oil circulating pump, and is determined by the vertical overflow pipe leading to the clean oil sump. For best operation, the oil level in the governor case should coincide with the upper end of the overflow pipe. If the level in the engine is allowed to drop because of an insufficient

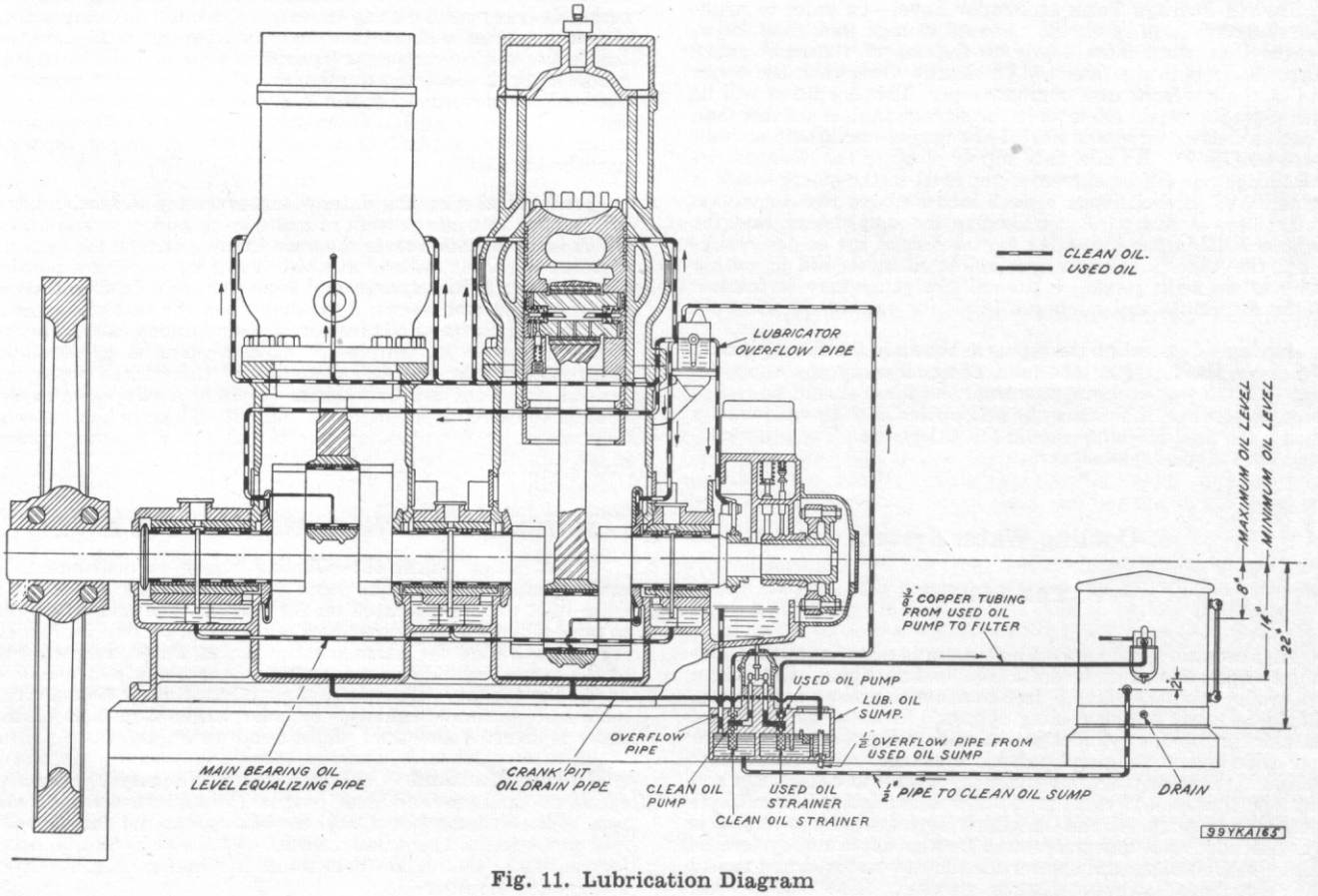


Fig. 11. Lubrication Diagram

supply to the clean oil pump, the governor spider and main bearing oil rings will swing clear of the oil and lubrication will cease. On the other hand, if the level is excessively high, oil will overflow from the bearing oil wells and flood the crankcases.

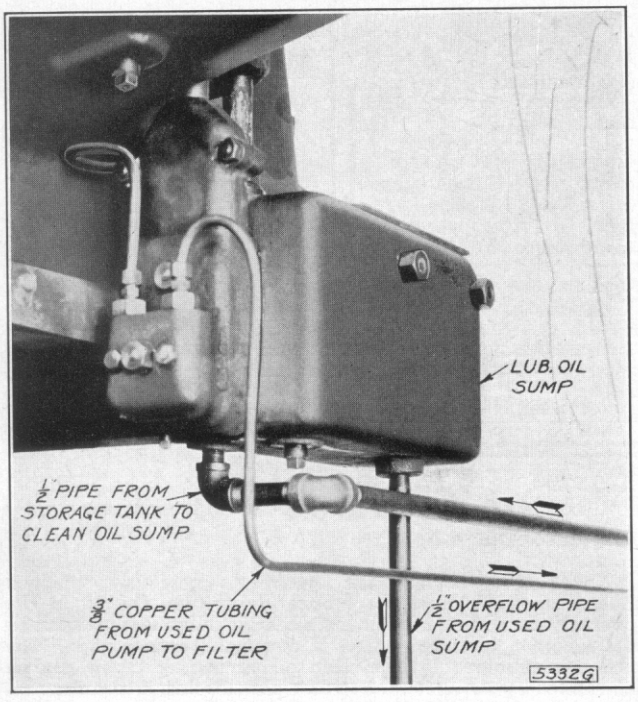


Fig. 12. Piping at Lubricating Oil Sump

Install Storage Tank at Proper Level—In order to maintain the correct oil level, the clean oil storage tank must be so located that when filled nearly to the top of the sight gauge glass, the level in the tank will be slightly lower than the upper end of the governor case overflow pipe. This condition will be met when the maximum level in the storage tank is not less than 8 inches below the center line of the engine crankshaft as indicated in Fig. 11. An adequate supply of oil to the clean oil circulating pump will be assured if the level in the storage tank is not allowed to drop lower than 2 inches above the connection to the clean oil sump. By so locating the storage tank that the bottom is 22 inches below the center line of the engine crankshaft, the upper and lower permissible oil levels will be within range of the sight gauge. If desired, the gauge may be marked at the maximum and minimum levels for ease in checking.

Piping—Connect up the piping as shown in the two diagrams. Details of the piping at the lubricating oil sump, are shown in Fig. 12. The ½" overflow pipe from the sump should be run to some point where the oil may be collected. Oil will overflow only in case the used oil pump should fail to operate. The other connections are self-explanatory.

6. Cooling Water System

WATER SUPPLY

An adequate supply of cool soft water is essential to the satisfactory operation of an internal combustion engine. Only clean soft water or water which is free from scale forming ingredients, should be used in the cooling system. Even a thin layer of scale or dirt on the cylinder jacket walls will act as an insulator and cause overheating and possible breakage. Any hard water containing lime or magnesia is almost certain to cause scale and must be treated. If clean rain water is available, it is suitable for the soft water circuit in closed systems. However, it is recommended that any water used for the soft water system be treated. Do not use rain water for the raw water circuit unless it is treated to prevent fungus growths. The only system recommended is a closed system in which only soft water is circulated through the cylinder jackets and in which the soft water is cooled by means of raw water and some form of heat exchanger.

TREATMENT OF HARD WATER

When the cooling water supply is known to contain scale forming ingredients, a reliable manufacturer of water softening systems should be consulted. Two methods of water treatment are in general use, the proper one of which should be prescribed by a competent authority, after an analysis and survey has been made of the particular case in question. Such a diversity exists in the characteristics of water found in different localities that no intelligent recommendations can be given until all data are available.

The general methods of water treatment are:

(**a**) Chemical Treatment.

(**b**) Zeolite Treatment.

Method (**a**) consists of the addition of certain chemicals to the water which react with the salts, sulphates, carbonates, etc., held in solution. This reaction precipitates most of the scale forming ingredients so that they can be removed by settlement in separate tanks before putting the water in the cooling system, or it may leave some of them in solution, but so change them that no scale will be deposited.

Method (**b**) consists of forcing the water to be softened through a bed of "Zeolite" sand. This mineral, commonly known as the green sands of New Jersey, has the property of removing calcium and magnesium elements from the water and replacing them with sodium, or, in other words, changing the scale forming lime and magnesia salts to sodium salts, which are not scale forming. By properly regulating the flow of water through the "Zeolite" sand scale forming salts can be removed. After a certain amount of water has been treated, the active sodium in the Zeolite becomes so far exhausted that the water is no longer properly softened. The Zeolite is then rejuvenated by passing brine (made from common salt), through it. During this process, the lime and magnesia elements held by the Zeolite are exchanged for the sodium element in the salt, the lime and magnesia being carried away to waste as calcium and magnesium chlorides. After a short time, usually from 10 to 25 minutes, the Zeolite will have resumed its original state and the treatment can be stopped. Salt consumption and the frequency of regeneration will be governed by the hardness of the water and the amount to be treated. If uninterrupted service is required, either a duplicate plant or a storage tank of proper capacity must be installed.

Treated jacket cooling water which is recooled and recirculated will require a certain percent of make-up to replace evaporation, which tends to concentrate the scale forming salts in the system. Concentration can be held at a safe value by wasting a portion of the water in the system and replacing with freshly treated water, the amount wasted depending upon the rate of evaporation and the degree of elimination of scale forming salts from the treated water. As permissible concentration is governed in every case by the chemical character of the treated water, no general statement can be made as to either a safe value or the method to be employed in determining it. These points must be determined by the manufacturer of the water treating system in use and recommendations made accordingly.

WATER CIRCULATION THROUGH THE ENGINE

Main Inlet Manifold—Cooling water is distributed to each cylinder and cylinder head water jacket by means of a main inlet manifold located on the exhaust side and connected to each cylinder at the lowest part of the water jacket. Individual regulating valves for balancing the jacket water temperatures of the several cylinders are installed in the main inlet manifold on earlier engines. By means of pipe connections between the main inlet manifold and the cylinder heads a portion of the water is diverted into the cylinder head water jackets.

Outlet Manifold—Cooling water is discharged from the cylinders through individual overflow pipes connected at the tops of the cylinder heads, and then flows into the outlet manifold connected to the cylinder heads. Provision should be made for venting at the highest point of each cylinder. Fig. 13 shows a suggested method.

COOLING WATER CIRCULATION RATES

In determining the correct rate of water circulation for the proper cooling of a Diesel engine, consideration must be given to three fundamental factors as here outlined.

(a) Sufficient water at correct inlet and outlet temperatures must be circulated in order to maintain workable operating temperatures of cylinders and pistons through the dissipation of excess heat. This is governed by the power rate of the engine engine or "load", desired operating temperature and temperature of the water entering the jackets.

(b) A certain minimum rate of circulation must be maintained in order to avoid sluggishness in any part of the system. Should this rate be materially reduced, steam pockets with consequent "hot spots" and possible local overheating of parts will result.

Refer to the piping diagram in Fig. 14 for soft and raw water flow rates.

(c) The difference between the circulating water inlet and outlet temperatures must be restricted to a maximum allowable value of 10° F. in order to avoid mechanical distortion and excessive expansion strains.

The recommended operating soft water outlet temperature is 130° – 135° Fahrenheit with a maximum permissable, temperature of 140° Fahrenheit.

CIRCULATING PUMPS

Centrifugal Pumps—Centrifugal pumps are recommended for circulation of cooling water when the total dynamic head is within their range of performance. When the head is beyond this range or if a suction lift is imposed then positive displacement pumps must be used.

Positive Displacement Pumps—When positive displacement pumps are used they must be fitted for hot water. A pressure relief valve must be installed in the discharge line close to the pump without a shut-off valve between it and the pump. Set the relief valve 5 pounds per square inch higher than the discharge pressure.

Location of Pumps—All centrifugal pumps should be located in such a position that the top of the pump is below the low water level.

GENERAL INSTALLATION DATA ON COOLING SYSTEMS

Manifold Pipe Connections—Details of the manifold pipe connections are shown on the pipe connection plan which is furnished with each engine. Pipe sizes tabulated on this page refer to the main inlet and outlet pipes. The piping should be run down into a trench under the floor, by the shortest route; otherwise, run the pipes horizontally to the wall and then down, making the neatest and most convenient arrangement possible.

Emergency Cooling Water Connection—When running water under pressure or from a high tank is available, the piping should be so arranged that in an emergency, the regular cooling water supply can be shut off and the running water used instead. Such a precaution may eliminate costly shut downs, if repairs in the cooling water system should become necessary. The emergency inlet and outlet connections may be made at the opposite ends of the manifold from that used for the regular cooling water system, or the emergency supply may be run into the overhead tank

Engine Control Valves—The inlet water manifold on earlier engines is equipped with control valves at each cylinder. These valves should be wide open when the engine is first started. After the temperatures have become constant, the valves on the cylinders having the lowest temperatures should be adjusted until the outlet temperatures of all cylinders are uniform.

Water Supply Valves—A valve should be placed in the main supply line as shown in Fig. 14. This valve should not be used to regulate the flow of water to the engine, unless the rate is in excess of the recommended rate.

Water Inlet Valve—When the emergency cooling water connections are made at the opposite end of the manifold from the regular connections, a valve should be placed in each inlet line. With this arrangement, the emergency inlet will be closed when the regular inlet is being used, and vice versa.

"Open" Discharge Connections—Earlier engines were provided with a open overflow pipe for each cylinder. These overflow pipes connected to the upper part of the cylinder heads and discharged into individual funnels attached to the water outlet manifold.

"Closed" Discharge Connections—Individual closed discharge connections are provided from the cylinder heads to the water outlet manifold. These pipes have two tapped holes,

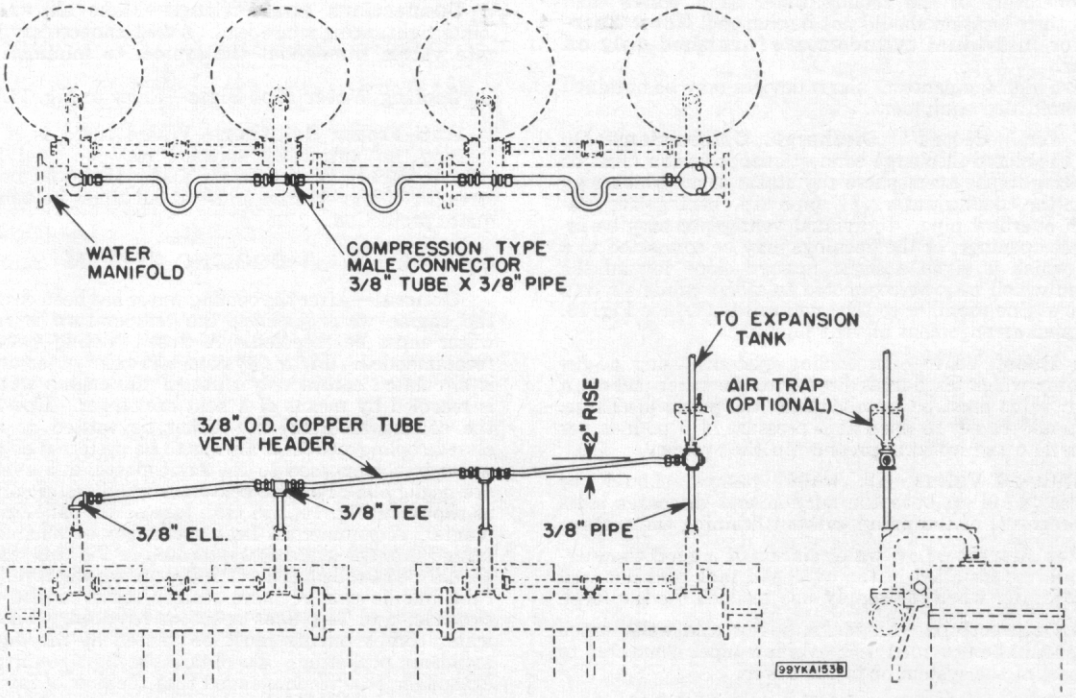
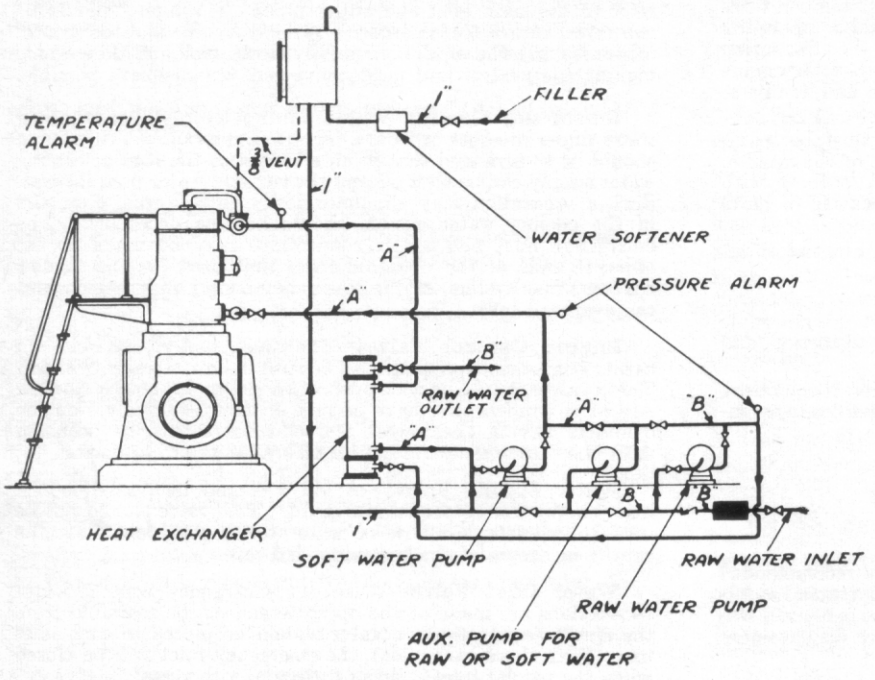


Fig. 13. Water Outlet Manifold Vent Piping



12 x 15

NO. CYL.	H.P	PIPE SIZES "A"	PIPE SIZES "B"	G.P.M. CIRCULATED	GAL. OF WATER IN ENG.
2	120	2	2	60	28
3	180	2½	2½	90	40

14 x 17

NO. CYL.	H.P	PIPE SIZES "A"	PIPE SIZES "B"	G.P.M. CIRCULATED	GAL. OF WATER IN ENG.
2	150	2½	2½	75	38
3	225	3	3	110	55
4	300	3	3	150	75
5	375	4	4	185	100
6	450	4	4	225	115

NOTE:—

ALL PIPE SIZES BASED ON 50 FEET OF PIPE AND 10 ELLS. USE NEXT LARGER PIPE SIZE IF THESE VALUES ARE EXCEEDED.

AUXILIARY PUMP IS OF SAME SIZE AS RAW AND SOFT WATER PUMPS.

ALL FIGURES IN TABLE ARE FOR 12 x 15 - 360 R.P.M. OR 14 x 17 - 300 R.P.M. AND CORRESPONDING HORSEPOWER.

USE THE SAME PIPE SIZES FOR ENGINES RUNNING AT LOWER SPEEDS.

MAKE-UP AND EXPANSION TANK OF ABOUT 50 GAL. CAPACITY INSTALLED ABOUT 5'-0" ABOVE CYLINDER HEAD.

USE GATE VALVES IN ALL CASES.

THIS IS A DIAGRAMMATIC PIPING LAYOUT. LOCATE AUXILIARIES TO SUIT INSTALLATION.

30YJB4C

Fig. 14. Cooling System Piping Diagram

one for ⅜" pipe to accommodate a vent or riser, and the other for ½" pipe to take the cooling water thermometer. **Note: Thermometers for individual cylinders are furnished only on special order.**

Thermometer—Screw the thermometers into the openings provided in each water overflow pipe. These thermometers indicate the temperature of the cooling water as it leaves each cylinder, and their location should not be changed. **Note: Thermometers for inidvidual cylinders are furnished only on special order.**

Inexpensive high temperature alarm devices may be obtained and are recommended equipment.

Venting for "Closed" Discharge Connections—On engines with the closed discharge connections, provision must be made for venting to the atmosphere any steam or air which may separate from the cooling water. ⅜" pipe tap openings are provided in each overflow pipe. Individual vent pipes may be installed in these openings, or the openings may be connected to a header pipe which is given a slight upward slope toward the outlet end and which may be connected to a high grade air trap located in the engine room, or to the overhead tank. See Fig. 13. for the suggested arrangement of vent piping.

Pressure Relief Valve—On cooling systems using a displacement pump which discharges directly to the water jackets, a pressure relief valve must be installed near the pump discharge. This valve should be set to open at a pressure of 5 pounds per sq. in. higher than the working pressure in the system.

Pump Shut-off Valves—All water pumps should be equipped with valves on both the suction and discharge sides to allow the removal of the pump without draining the system.

Low Water Alarms—Low water alarms of a good commercial type should be installed in the overhead tank and hot well to warn the operator when the supply has reached the low level.

Overflow Connections—All tanks, hot or cold wells, catch basins, etc., should be provided with overflow pipes connected to some other part of the system or to the sewer.

Drains—The lower water manifold is provided with drain connections to which a drain pipe may be attached. Plugged openings are provided in the lower flange of each cylinder for completely draining the cylinders when there is danger of freezing or when the jackets are cleaned. On multi-cylinder engines, where frequent draining is necessary a drain header should be connected to these openings. All other low points in the system should be provided with proper drains.

Connections and Fittings—Make all water connection joints tight, using white lead. Avoid unnecessary bends, and use gate valves throughout the system to minimize pipe friction.

Cooling Water Pipe Sizes—Refer to Fig. 14.

Anti-Freeze Solutions—Where there is a possibility of freezing, an anti-freeze solution may be used if desired. A reliable variety of anti-freeze material should be used and the strength of the solution must at all times be sufficient for adequate protection.

COOLING SYSTEM

General—After the cooling water has been circulated through the engine water jackets, the temperature is raised, and the water must be recooled. A closed cooling system is strongly recommended. In this system soft rain water or treated water is circulated continously through the engine water jackets and is recooled by means of a heat exchanger. Raw water, used as the cooling medium, can either be wasted or recooled. The closed cooling system is always to be preferred as the soft cooling water is not exposed to the atmosphere, and evaporation losses are negligible. For this reason, a small water softener, installed as shown in Fig. 14, will take care of all make-up water requirements. A commercial heat exchanger of reliable make is connected into the system as indicated in Fig. 14. Heat exchangers should be installed in a vertical position wherever possible as the tube bundle can be more readily removed and replaced when cleaning, and less floor space is required. The raw and soft water compartments must be vented at the highest points to avoid air pocketing. To obtain the best results from the heat exchanger, it is recommended that the flow of raw water through the exchanger is in the opposite direction to the flow of soft water (as shown in Fig. 14).

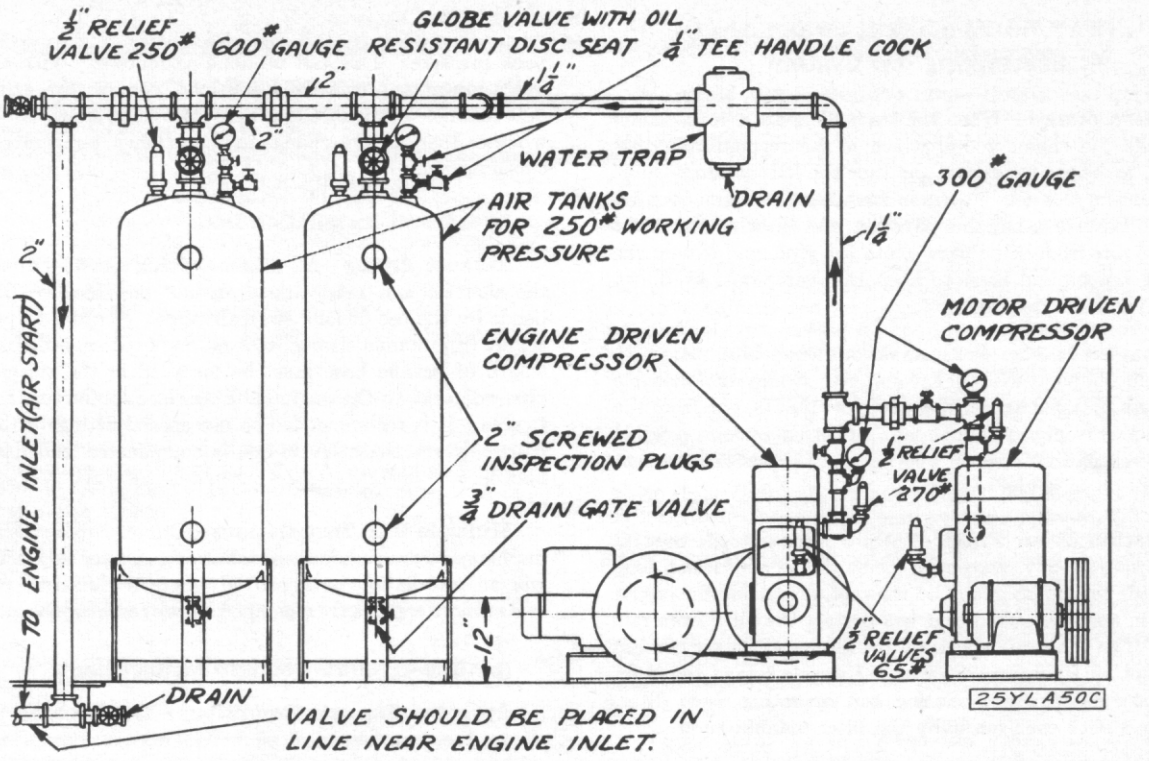


Fig. 15. Air Start Piping Diagram

7. Air Start System

Since the air starting mechanism is incorporated in the engine, installation work on the air starting system will consist of installing the air compressor, starting air tanks, and the piping from the tanks to the engine.

Air Compressor—The air compressor may be driven by a motor, an auxiliary engine, or by the engine for which it supplies the air. In the last arrangement, the drive pulley is fitted to the shaft extension. This last arrangement is not recommended unless a small independently driven auxiliary compressor is included; for, otherwise there would be no provision for supplying air for the initial start or in case of loss of air.

Air Tanks—One 20″ x 60″ air tank is recommended for the 2 and 3 cylinder 12 x 15 engines and the 2 cylinder 14 x 17 engines; two 20″ x 60″ air tanks for the 3 and 4 cylinder 14 x 17 engines and three 20″ x 60″ air tanks for the 5 and 6 cylinder 14 x 17 engines. The air tanks should be placed between the compressor and engine inlet so that all dirt, water and oil will becollectedin the tanks and can be drained off periodically. It is not recommended that the air line to the engine inlet be directly connected to the compressor discharge line between the compressor and air tanks.

Pipe Fittings—Fittings used in the air line should be of the extra heavy pattern (250#).

Air Line Valve—The air line valve should be a globe valve with lead composition disc, Jenkins Fig. 106A Spec. or equivalent make. Working pressure 250 lbs. gauge. May be ordered from Fairbanks, Morse & Co., Purchasing Dept., Chicago, on specification No. 21FM7F.

Pressure Gage and Relief Valve—A ½″ 250# relief valve and a ¼″ 600# pressure gage should be installed in separate connections on tanks and piped vertically to insure positive drains back into the tanks. Tee handle cocks (¼″) are installed in the pressure gage lines for inspection use.

Air Pressure—The normal working pressure for the starting air is 225 pounds gauge pressure. In direct connected installations where the standing air must turn both the engine and the driven unit, the air should be maintained at this pressure to insure good starting.

Arrangement of Equipment—Fig. 15 shows a typical arrangement of air starting equipment. Drains should be provided for all tanks, and at the low point in the main pipe line. Either drain plugs or valves may be used in the line, but valves must be used for the tanks. Avoid all unnecessary joints, and make each connection carefully, using thick shellac or a mixture of litharge and glycerine.

Pipe Sizes—The following table gives pipe sizes for the air line depending upon the distance from the tanks to the engine

Model Numbers	Bore and Stroke	Air Pipe Sizes	
		Max. Length, Feet	Diameter
32	12x15″	25	2″
		50	2″
32	14x17″	25	2″
		50	2½″

Pipe and Fittings—The following tabulation lists pipe and fittings with the exception of valves and pressure gauges, to cover an average installation. This equipment may be obtained through the Fairbanks, Morse & Co., Purchasing Dept., Chicago, or may be purchased locally.

Pipe and Fittings Required to Connect Air Starting System on Models 32E12 and 32E14 Stationary Diesel Engines

Quantity			Size	Material	Description
1 Tank	2 Tanks	3 Tanks			
2	4	6	1½″ x 2½″	*W.I.	Nipple
1	1	1	2″ x 1″ x 1½″	C.I.	Reducing Tee—Ex. Hvy.
	1	2	2″ x 2″ x 1½″	C.I.	Reducing Tee—Ex. Hvy.
1	3	5	2″ x 10″	*W.I.	Nipple
2	3	4	2″	**	Union
2	2	2	2″	C.I.	Ell—Ex. Heavy
1	1	1	2″ x ¾″ x 2″	C.I.	Reducing Tee—Ex. Hvy.
1	1	1	¾″	C.I.	Pipe Plug
1	1	1	2″ x 1½″	C.I.	Pipe Bushing
1	1	1	1″ x ¾″	C.I.	Pipe Bushing
2	2	2	1½″ x 5″	*W.I.	Nipple
1	1	1	¾″	**	Union
1	1	1	¾″ x 5″	*W.I.	Nipple
1	1	1	¾″	C.I.	Ell—Ex. Heavy
1	1	1	¾″	*W.I.	Pipe—Random Length
2	2	2	2″	*W.I.	Pipe—Random Length
1	1	1	¾″ x ¾″ x ¾″	C.I.	Tee—Ex. Hvy.

*Standard wrought iron or steel pipe is satisfactory for 250 lbs. per sq. in.

**Forged steel unions or equivalent wrought iron R.R. unions may be used. Forged steel unions may be obtained through Fairbanks, Morse & Co., Purchasing Dept., Chicago, on specification No. 20FM8J(Petro).

8. Scavenging Air System

Air Inlet Conduit—When the scavenging air is to be taken from outside the engine room, which is the recommended arrangement, make the conduit at the time the foundation is built. Specifications for this conduit will be found on the engine foundation plan. Provide a suitable covering and filter at the outer end to keep dirt from being drawn into the pipe, and extend the pipe above the ground level to keep the water out, as shown in Fig. 5.

Optional Air Inlets—For installations where both extremely hot and cold temperatures are encountered, it may be advisable to provide an optional scavenging air inlet; that is, one from the outside and one from the engine room. This will make it possible to provide ventilation in warm weather and to conserve the heat in the engine room in the winter.

Installation of Air Filter—When a filter is to be used, it may be located at any convenient point in the air suction line; that is, inside the engine room, on the roof, or outside the engine room wall in a suitable shed that will protect the filter from rain and snow. The connection between the filter and the air conduit must be kept air tight, especially on the engine side of the filter. Detailed instructions for mounting and operating these filters are furnished with each outfit by the filter manufacturer.

9. Exhaust System

For the description and operation of the various exhaust systems that may be applied to these engines, read the material under "Exhaust Systems," Section I.

Recommendations for the various exhaust arrangements are given on the following pages. If any departure from these arrangements seems necessary, approval must be obtained from Fairbanks, Morse & Co. Also, any installation that varies from one of the recommended arrangements must be checked for back pressure. This can be done as follows: With the engine operating at approximately full load, remove the exhaust conduit manhole cover or the exhaust pot hand hole plate and note whether there is any change in the exhaust temperature or fuel consumption.

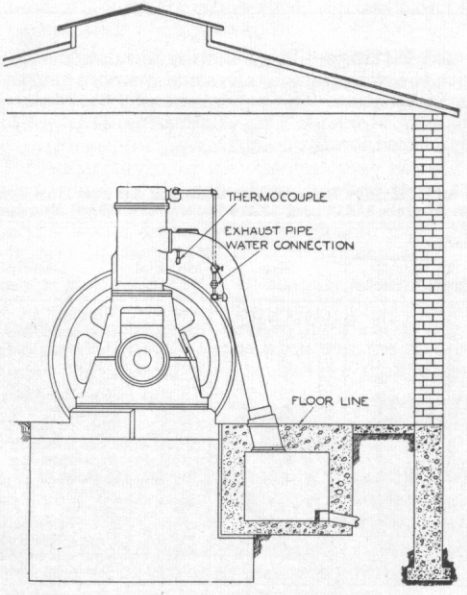


Fig. 16. Individual Exhaust Pipe and Underground Conduit Arrangement (99YKA62)

(a) General Installation Data

Exhaust Piping—All exhaust piping should be installed in the shortest and most direct manner possible, avoiding sharp bends by the use of long sweep fittings. In order to protect the engine from undue strains, at least one expansion fitting or short length of flexible hose must be installed in the straight run of pipe adjacent to the engine and as close to the engine as practicable. It is recommended to use special fittings with cleanout flanges where the exhaust line is complicated and hard to dismantle.

Multiple Unit Installations—Do not combine the exhaust discharge in multiple unit installations. Under no circumstances will an installation be approved where the exhaust pipes from two or more engines are combined before reaching the atmosphere.

(b) Underground Conduit Arrangement.

Approved Exhaust Conditions—The following tabulation shows the recommended diameters and maximum lengths of exhaust piping when using a plain exhaust pipe or when using an exhaust silencer in the exhaust line.

Model Number	**32E12**	**32E14**	
Number Cylinders	**1, 2 & 3**	**1, 2 & 3**	**4, 5 & 6**
Plain Exhaust Stack; Conduit to Atmosphere:			
Diameter	18″	18″	20″
#Maximum length	60′-0″	60′-0″	60′-0″
Model Numbers	**32E12**	**32E14**	
Number Cylinders	**1, 2 & 3**	**1,2, 3&4**	**5 & 6**
Exhaust Stack; Conduit to Exhaust Silencer:			
*Diameter	10″	12″	14″
Maximum length	6′-0″	6′-0″	6′-0″
Minimum length	12″	12″	12″
Exhaust Pipe; Exhaust Silencer to Atmosphere:			
*Diameter	10″	12″	14″
§Maximum length	12′-0″	12′-0″	12′-0″

#If a greater length is required, a ventilated stack must be installed. (Max. length—200 ft.)

*Use nominal pipe size corresponding to Exhaust Washer or Silencer connections.

§If a greater length is required, a ventilated stack must be installed having a minimum diameter of 14 in., and a maximum length of 200 ft.

Exhaust Diagram—Fig. 24 shows a typical exhaust system with underground conduit.

(c) Exhaust Manifold Arrangements.

Air and Water Cooled Welded Manifold—Welded steel, air or water cooled manifolds are available for the 2 & 3 cyl. Model 32E12 and the 2 cyl. Model 32E14 engines. Refer to Fig. 17. The air and water cooled manifolds are essentially the same in appearance except that the water cooled manifolds

include the water jacketing feature and have 2 water outlets on the top of each manifold and one water inlet connection at the bottom The exhaust outlet connection is normally at the top, however if desired, the whole manifold may be turned so that the outlet will be located at the bottom or 180° from the top location. An exhaust nozzle is used between the manifold and the cylinder.

Stack Sizes with Welded Manifold:

	Plain Stack	Manifold to Silencer	Silencer to Atmosphere
Model 32E12; 2 & 3 Cyl.; 10″ Pipe Dia.			
*Length (no silencer used)....	0′ to 20′		
length (with Burgess).....	.....	17′-0″	13′ to 31′
Length (with Maxim).....	.....	10′-0″	6′ to 33′
	.....	17′-0″	0′ to 26′
	.....	23′-0″	0′ to 6′
Model 32E14; 2 Cyl.; 12″ Pipe Dia.			
*Length (no silencer used)....	0′ to 20′		
Length (with Burgess).....	.....	17′-0″	12′ to 30′
Length (with Maxim).....	.....	10′-0″	5′ to 32′
	.....	17′-0″	0′ to 25′
	.....	23′-0″	0′ to 5′

*For greater length, use ventilated stack.

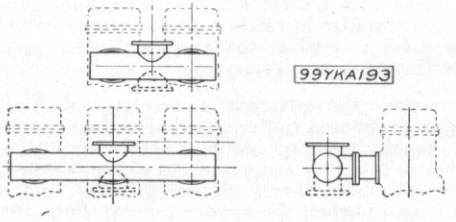


Fig. 17 Water Cooled Welded Manifold Arrangement

Cast Iron Water Cooled Exhaust Manifold—Cast iron water cooled exhaust manifolds are available for the 3, 4, 5 & 6 cyl. Model 32E14 engines. This equipment consists of barrel type, dry joint manifolds with inlet and outlet water piping connections to the water headers. There are two water outlets from each exhaust manifold section, one from each end, and one water inlet thus insuring good cooling water circulation. The water passing through the exhaust manifold does not circulate through the cylinders Exhaust outlet connections may be made from either end of the manifold. See Fig. 18 for arrangements.

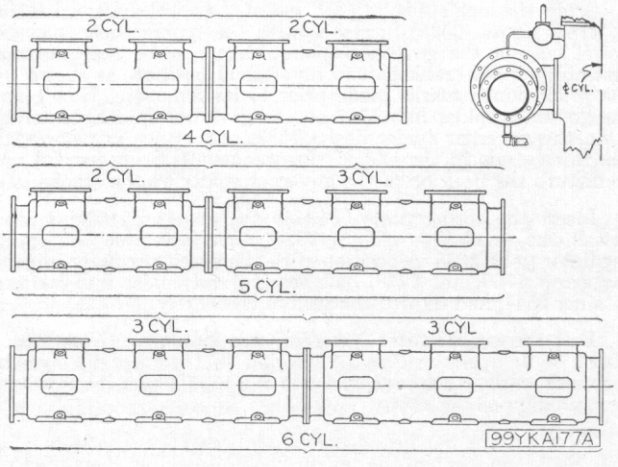


Fig. 18. C.I. Water Cooled Manifold Arrangement

Exhaust Pipe Sizes—Water Cooled Exhaust Manifold 3, 4, 5 & 6 Cyl. Model 32E14

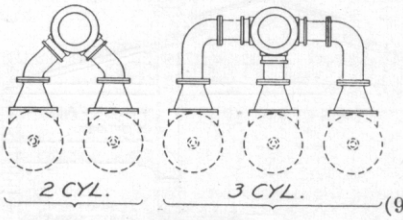
Number of Cylinders	3	4	5	6
†**Plain Exhaust Stack; Manifold to Atmosphere:**				
Diameter	14″	14″	16″	18″
**Maximum Length	30′-0″	40′-0″	40′-0″	40′-0″
Exhaust Pipe; with Silencer:				
*Diam.—Manifold to Silencer	14″	14″	16″	18″
**Maximum Length—Including Silencer and Tailpipe	30′-0″	40′-0″	40′-0″	40′-0″
Exhaust Pipe; Silencer to Atmosphere:				
Diameter	12″	12″	14″	14″
Length	6′ to 12′	6′ to 12′	6′ to 12′	6′ to 12′

*Requires reducer placed adjacent to the silencer.
**Silencer may be located to suit conditions, but maximum length must not be exceeded.
†One 90° elbow may be used with the pipe if necessary. If greater length is required use a ventilated stack.

(d) Exhaust Pot Arrangement.

Exhaust Pots—Fig. 19 shows the number of exhaust pots for each engine and the method of connecting them to the cylinders.

Exhaust Diagram—Fig. 20 shows a typical exhaust system using an exhaust pot.



(99YKA191)

Fig. 19. Arrangements Using Exhaust Pots

Approved Exhaust Conditions—The following tabulation shows the recommended diameters and maximum lengths of exhaust piping for the various exhaust pot combinations.

Model Number	**32E12**	**♦32E14**	
Number of Cylinders	**2 & 3**	**2, 3 & 4**	**5 & 6**
Exhaust Pipe: Engine to Exhaust Pot:			
Diameter	7″	8″	8″
Minimum Length	*	*	*
Plain Exhaust Stack; Exhaust Pot to Atmosphere:			
#Diameter	12″	12″	12″
#Length	12′ to 15′	12′ to 15′	12′ to 15′
Exhaust Pipe; Exhaust Pot to Exhaust Silencer:			
§Diameter	10″	12″	△12″
Maximum Length	6′-0″	6′-0″	6′-0″
Exhaust Pipe; Exhaust Silencer to Atmosphere:			
⊙Diameter	10″	12″	△12″
**Length	6′ to 12′	6′ to 12′	6′ to 12′

*Connections regularly furnished with Exhaust Pot equipment are as follows: Model 32E12, 2 and 3 cyl., 3-4½″; Model 32E14, 2, 3, 4, 5 and 6 cyl., 3-10″.

#This is the size and length of pipe listed for each Exhaust Pot equipment. If a greater length is required use a ventilated stack.

§A special 12″ pipe B.C. flange, tapped 10″, for attaching the exhaust pipe to the exhaust pot, is required for the Model 32E12 engines. This can be furnished by Fairbanks, Morse & Co.

**If a greater length is required, a ventilated stack must be installed, having a maximum length of 200 ft. The ventilated stack is the preferred arrangement for all installations.

⊙Use nominal pipe size corresponding to connections at the exhaust silencer.

△A 12″ silencer is used on 5 and 6 cylinder engines with exhaust pot arrangement.

♦Service data—Exhaust pots are not offered for 4, 5 & 6 cylinder engines (8-41).

(e) Dredge Exhaust Arrangement.

Approved Exhaust Conditions—With the dredge exhaust, an exhaust nozzle, the same as used with the exhaust pot arrangement, is bolted to the cylinder exhaust connection; a long sweep elbow is bolted to the nozzle, and a tapped flange is bolted to the elbow. On the 12″x15″ engines, a 8″x6′-0″ pipe is screwed into the flange and on the 14″x17″ engines an 8″x8′-0″ pipe is used.

Exhaust Diagram—Fig. 21 illustrates a typical dredge exhaust.

(f) Pyrometer Equipment.

Read Pyrometer Instructions—Before installing the pyrometer, read over carefully the instructions furnished by the manufacturer of the equipment.

Pyrometer Conduits—For the switchboard type of pyrometer, it is desirable to run the extension leads from the thermocouples to the switchboard in a conduit. The Manufacturing Division is prepared to furnish a special conduit which attaches to the exhaust side of the engine and has fittings for connecting to each thermocouple. The conduit extends to the governor end of the engine and is equipped with extension leads that project from the end of the conduit. Additional extension leads and conduit are required to connect to the switchboard.

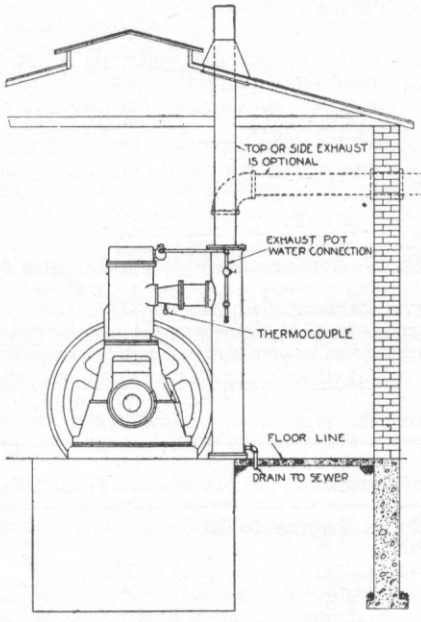


Fig. 20. Exhaust Pot Arrangement (99YKA63)

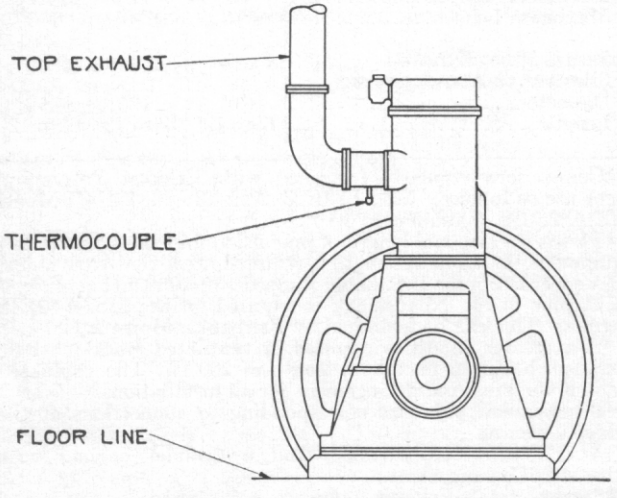


Fig. 21. Dredge Exhaust (99YKA60)

#Ventilated Stack Sizes:

If regular Stack Size is (Dia.)	Ventilated Stack should be (Dia.)
10″	14″
12″	18″
14″	20″
16″	22″
18″	28″
20″	28″

#Not to exceed 200 ft. in length.

10. Synchronizer

The following instructions cover the installation of a synchronizer on an engine in the field.

Note: All repair charts referred to are in "Section VI, Repair Charts and List".

Installation—Set No. 1 piston on its upper dead center Remove the governor case 2341 (See Repair Chart No. 16) and the governor case dowels. Before touching the governor assembly, mark with a scratch awl or prick punch the position of the governor spider in relation to the crankshaft. This will make it possible to replace the governor spider exactly in its original position.

Then remove the governor assembly, and slip the synchronizer governor case centering arbor on the crankshaft and up to the shoulder near the end of the crankshaft. The purpose of this arbor is to center the outer end of the synchronizer governor case while new dowels are being drilled and reamed in the lower base. Detach the synchronizer governor case 2341A (See Repair Chart No. 17) from the synchronizer and place it over the studs that originally held the governor case; then tighten all nuts securely.

If the synchronizer governor case is correctly aligned, the centering arbor can now be turned easily; if the arbor cannot be turned easily, the governor case is binding from misalignment and should be adjusted until perfect alignment is obtained. This centering operation is very essential to the successful operation of the synchronizer and should be done accurately.

When the synchronizer governor case has been centered correctly and while the stud nuts still are tight, drill new dowel holes in the synchronizer governor case and lower base with a $^{27}/_{64}$″ drill, ream $^{7}/_{16}$″ and drive in the dowels. The synchronizer governor case may now be removed to permit the assembling of the governor and synchronizer.

Screw the long studs into the end of the crankshaft; drive the $^{1}/_{2}$″x1$^{3}/_{8}$″ dowel (2533) furnished with the synchronizer into the dowel hole in the governor spider; then replace the governor assembly on the crankshaft in its original position, as shown by the prick punch marks made prior to its removal. Now place the governor spider hub 1767 on the governor spider, centering it on the governor spider dowel 2533, and clamp in place with the three studs in the end of the crankshaft, being careful not to disturb the position of the governor spider on the crankshaft.

Insert the spring posts 504A in the governor weights, and install the regulating springs 222. Next assemble the speed regulator yoke 2538 in position with the speed regulator adjusting screw 1769, nut 1770, ball bearing and spider hub bearing retainer 2544, and tighten the stud nuts securely.

Bolt the synchronizer governor case in place. With No. 1 piston on its upper dead center, mark a "C" or other distinguishing mark on the governor spider hub dial 1767, under the governor case timing pointer 2344A.

Take out the flat head machine screws on the speed regulator dial 2546, and remove the pinion 2549. Assemble the adjusting screw housing 1771A complete with the handwheel, on the syn-

chronizer governor case; then tighten the cap screws. Turn the handwheel 1602A in a clockwise direction until the regulating spring 222 has only a slight initial tension, then insert the indicator pinion with the hand 2547 pointing to zero on the dial 2546. Fasten the dial screws.

After refilling the synchronizer case with oil and pouring a small quantity of oil on the pinion through opening for plug 2545, the engine will be ready to start.

11. Checking Existing Installations

Importance of Proper Alignment—The importance of knowing that the proper alignment of the crankshaft and extension shaft is being maintained cannot be over-estimated. If an improper alignment is not corrected, serious damage to the engine may result. In checking over an existing installation, read very carefully the points covered in "3. Installing the Engine and Drive Equipment," Section II.

III. OPERATING INSTRUCTIONS

Note:—All repair charts referred to are in "Section VI, Repair Charts and List".

General—The following instructions refer particularly to a first start, or to a start after a long shut-down. Subsequent starts will not require such detailed preparation.

1. Before Starting the Engine

(a) Inspect the Engine.

Make a final check of the complete installation. See that the engine is properly lined up and fastened securely to the foundation. Open the compression relief valves and bar the flywheel over several complete revolutions to make certain that all parts move freely.

(b) Fuel System.

Clean Tanks and Piping—Before filling the fuel tank and other parts of the system, clean the tank and blow out or flush out the piping.

Fuel—Use an approved fuel oil. For cold weather operation, use a fuel oil that will flow readily at the atmospheric temperature in which the engine is to operate.

Fill Storage Tank and inspect for leaks.

Fill Gravity Feed Fuel Regulator, if one is used, and inspect for leaks.

Prime Fuel Supply System—Remove the cover (986D), on the fuel suction and overflow fitting and pour in **strained** fuel until the suction line and filter housing are full. Then replace the cover, and fill the fuel reservoir. (See Repair Chart No. 10).

Prime Fuel Injection Pumps and Valves—With the fuel system filled and ready for priming, proceed as follows:

Loosen the air vent plugs in the fuel injection valves and prime each injection pump, tube, and valve by moving the hand lever at the right side of the fuel reservoir back and forth from "Run" to "Prime" positions. Repeat until fuel free from air bubbles is forced out around the threads of the vent plugs. Then tighten the vent plugs. The normal injection pressure is such that the pump plungers cannot be operated manually to inject fuel through the valves. As the pump for each cylinder is primed, the engine must be turned so that the suction valve for that pump is closed.

(c) Lubricating System.

Study Diagram—Study the lubricating system shown in Fig. 11, and the description and operation of the system as explained in Section I.

Lubricating Oil—Use a good grade of lubricating oil that has been recommended by a reputable oil company for use in a Diesel engine. The oil should check with Fairbanks, Morse specifications and should be free flowing for all temperature conditions in which the engine will operate.

Filling the System—Remove the lubricator filler cap and pour in oil until the level remains constant. (Surplus oil overflows to the clean oil sump). Disconnect the longest lubricator tube at its connection to the engine, and crank the lubricator until oil is discharged, then reconnect the tube. Crank the lubricator again for 30 or 40 turns so that all bearing surfaces supplied by the lubricator will have an ample supply for starting. Watch the oil level in the lubricator, and add more oil if necessary.

Fill the governor case and main bearing oil wells to the level of the overflow pipe.

Fill the oil filter storage tank to the maximum level.

Remove the crankcase covers. Spread the air seal rings from the crankcase webs, distribute lubricating oil over their bearing surfaces; then release the rings. Turn each crank down and with a hand oil can squirt oil into the crankpin oiler rings to insure lubrication to the crankpin bearings. Then replace the crankcase covers.

Do not, under any circumstances, pour oil into the crankcases.

Turn the flywheel several revolutions to distribute the oil.

(d) Cooling Water System.

Fill the cooling water system and inspect all joints for leaks, remedying them if any are discovered.

(e) Air Starting System.

Check the installation of the air starting system. Blow out all air lines before final connection is made at the engine to free them from dirt, scale, etc. Make the final connection of the air line, and charge the tanks to 250 lbs. per sq. in. Inspect the lines for leaks and remedy them if any are found. Check the relief valves to make sure that they open at the proper pressure.

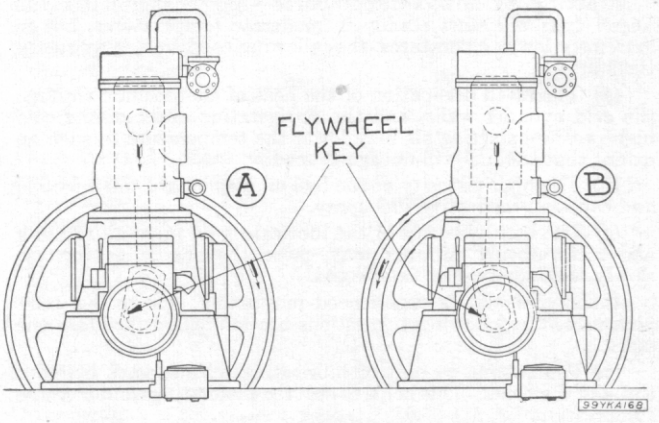


Fig. 22. Direction of Rotation (A—Standard B—Reverse) and Position of Piston and Flywheel Key for Starting

When the engine has been shut down for a period longer than one month, remove the air start valves 570B (See Repair Chart No. 14), from the fuel reservoir, and the air start check valves (853B), (See Repair Chart No. 7), from the cylinder heads and clean the stems with fine emery cloth. Lubricate the stems when replacing the valves.

(f) Position of Flywheel, Controls, Valves, etc.

Flywheel Position—Refer to Fig. 22. The standard direction of rotation is clockwise when looking at the engine from the governor end. See A in Fig. 22. With the relief valves in the

cylinder heads open, turn the flywheel until the crank nearest the governor is about 10 degrees past the upper dead center. Determine the location of the crank in question by noting the location of the flywheel key.

Relief Valves—Close the compression relief valves.

Fuel System—Place the fuel control lever in "Run" position. Then open valves in the fuel line to place the system in operation.

Cooling Water System—Start the cooling water pumps, and check the operation of the system. Be sure that all water jackets are full.

Air Starting System—First place the air control lever in "Run" position, then open valves in the air line necessary to place the system in operation.

2. Starting the Engine

If the foregoing instructions have been carried out, the engine is now ready to start.

Starting Multi-Cylinder Engines—Throw the air control lever quickly to the "Start" position. This allows the starting air supply to rush into the cylinders and rotate the crankshaft. Ignition should occur as soon as the engine attains a good rotative speed. Return the air control lever to the "Run" position as soon as ignition occurs. Failure to fire is sometimes due to insufficient priming. To correct this condition, repeat the priming operation as previously outlined in this section.

Starting Single Cylinder Engines—Single cylinder engines will generally start more promptly, especially in cold weather or when heavy oil is used for fuel, if the starting air supply is shut off as soon as the engine attains a good rotative speed. Therefore, after applying the starting air as described in the preceding paragraph, bring the air control lever back to the "Run" position, and allow the engine to coast; i.e., to continue its rotation on the impulse of air just received. If ignition fails while the engine is coasting, repeat the operation above, always giving the cylinder a new impulse of air to keep the engine rotating.

Starting in Low Temperatures—Any engine of the full Diesel type will start readily in moderate temperatures, but in extremely low temperatures, the following conditions may retard the start:

(a) The rapid dissipation of the heat of compression through the cold cylinder walls, and the refrigerating effect of the cold high pressure starting air may lower the temperature to such an extent that the fuel will not ignite readily.

(b) The high viscosity of the fuel oil may retard the injection and cause an ineffective fuel spray.

(c) The high viscosity of the lubricating oil upon all rotating and reciprocating surfaces may cause the engine to turn so slowly that combustion is affected.

When difficulty is experienced in starting, due to low temperatures, the following suggestions are offered to facilitate the start:

(a) Pour about ½ pint of lubricating oil into each cylinder through the head. This helps to seal the piston rings and increase compression.

(b) Use starting cartridges as outlined below

(c) If possible heat the engine room.

(d) Heat the jacket water.

(e) Use fuel oil with a low congealing point. In case it is impracticable to use fuel oil with a low congealing point, provide a fuel oil heater for regular operation, and run on light oil when starting and stopping.

(f) Use lubricating oil that will flow freely for all temperature conditions in which the engine will operate or heat the lubricating oil.

Gasoline or other highly volatile fuels must never, under any circumstances, be used for starting.

Using Starting Cartridges—If the engine does not start after several attempts, do not exhaust the supply of starting air. First make certain that fuel is being injected. Then remove one or two of the starting cartridge plugs in the cylinder heads on cylinders which do not receive starting air, insert and ignite the starting cartridges and replace the plugs. Then repeat the starting operation as outlined above.

3. After the Engine is Running

Position of Controls, Valves, etc.—As soon as several ignitions have occurred, and the engine has come up to speed, bring the air control lever to "Run" position, and close the valve in the air supply line. It may be necessary to move the fuel control lever toward the "Stop" position until the excess fuel, which has been injected for starting, has been burned; then bring it back to the "Run" position.

Check Fuel System—Determine if the fuel system is operating properly. Check the operation of the fuel supply pump by watching the fuel level in the reservoir gauge glass. The level should remain constant.

Check Lubricating System—Lift the cover of each of the main bearing caps, and see that all of the main bearing oil rings are running properly. See that the clean oil pump is maintaining the oil in the lubricator to the overflow level, and that the lubricator is functioning properly.

Check Cooling Water System—Determine if the cooling water system is operating properly. Adjust the controls so that the cooling water outlet temperature does not exceed 140°F. The maximum difference between the inlet and outlet temperatures must be restricted to 10°F., but it is recommended that a smaller difference be maintained. See "Cooling Water Circulation Rates" in Section II.

Charge Air Tanks—Pump up the air pressure in the air tanks. On installations where the air compressor is driven from the main engine, charge the tanks to the maximum pressure of 250 lbs. per sq. in. immediately after starting the engine. When the tanks are up to this pressure, close all the valves in the air line and at the tanks to prevent leakage. Before stopping the engine, see that the air tanks are up to the maximum pressure ready for the next start.

4. Stopping the Engine

Position of Controls—To stop the engine, bring the fuel control lever to the "Stop" position.

Crank Lubricator by Hand—While the engine is slowing down, turn the lubricator crank 25 or 30 revolutions, so that the pistons and cylinder walls will be properly lubricated for the period of shut-down, as well as for the next start.

Circulate Cooling Water—Continue to circulate the cooling water for ten to fifteen minutes in order to cool the hot cylinders and pistons gradually.

Drain Cooling Water in Freezing Temperatures—When there is any likelihood of freezing temperatures, drain the water jackets, manifolds, and piping.

Care of Engine when Not in Use—In case the engine is to remain idle **for very long periods,** it is advisable to lubricate the pistons and piston pins occasionally by hand cranking the lubricator, after which the flywheel should be turned several revolutions. Also, drain the entire fuel system of all fuel, and fill it with lubricating oil.

IV. INSPECTION ROUTINE

Note—All repair charts referred to are in "Section VI. Repair Charts and Lists".

Cleanliness—Keep the installation clean and in good order. It is our observation that when such is the case, little trouble is encountered with the machinery.

Caution—Do not use gasoline for any cleaning purpose.

Inspection—Inspect the engine and its equipment regularly. It is an excellent plan to have a regular inspection routine, and to assist owners and engineers in making up a suitable routine, the following suggestions are offered.

1. Daily Routine

(a) Under "After the Engine is Running," Section III, will be found certain duties that should be performed after every start.

(b) Inspect fuel level in storage tank.

(c) Where a gravity feed fuel regulator is used, inspect for leakage through the vent.

(d) Inspect water levels in cooling system tanks, hot wells, etc.

(e) Inspect levels in the lubricating oil storage tank, lubricator and main bearing oil wells.

(f) Check the feeds of the lubricator. See heading "Force Feed Lubricator" in Section V.

(g) Watch the drains from the crankcases. These drains discharge into the lubricating oil sump at the governor end of the base, and may be inspected after removing the sump cover. Be sure that the drains are open. **Under no circumstances should oil ever be allowed to accumulate in the crankcases.**

(h) If an exhaust washer is used, blow out the drain pipes.

(j) Readings of all instruments such as gauges, thermometers, meters, etc., should be taken at regular intervals as determined by the owner or engineer.

2. Weekly Routine

(a) Remove drain plug in lubricator, and drain off any accumulated water.

(b) Drain air storage tanks and piping of water and oil accumulations.

(c) Clean the lubricating oil sump, strainers, etc., at the governor end of the engine. To drain the sump, remove the nipple (2316). (See Repair Chart No. 10.)

(d) Clean the lubricating oil filter. See instruction card furnished with filter.

(e) Check bearing temperatures by hand. Normal temperatures are such that the hand may be held on the bearing.

(f) Remove upper base hand hole covers immediately after engine is shut down. Check connecting rod bearing temperatures by hand. Inspect pistons, cylinders, etc. for proper lubrication. Inspect crankpin oiler lubricator tubes. Examine connecting rod bearing bolts and cotter keys. Try connecting rod bearings with crowbar for looseness or wear. Replace hand hole covers.

(g) Check water hardness.

3. Monthly Routine

(a) Inspect and clean exhaust ports, exhaust nozzles, and points of thermocouples of accumulated carbon deposit.

(b) Clean air suction valves.

(c) Clean crankpits with kerosene. Reach well up into the scavenging air passages in the cylinders.

(d) Drain water and sludge from lubricating oil and fuel oil storage tanks, using the drains provided for this purpose.

(e) When the engine is in standby service, or is not in regular daily operation, remove all air starting valves (570B) (See Repair Chart No. 14) and air start check valves (853B) (See Repair Chart No. 7), and clean the stems with fine emery cloth. Lubricate the stems when replacing the valves.

(f) Check and adjust injection valves.

4. Quarter Annual Routine

(a) Remove cylinder inspection plates, and examine for scale. If any deposit is found, consult a reliable manufacturer of water softening systems for suitable treatment.

(b) Inspect all valves in the fuel injection and fuel supply pumps.

(c) Drain the entire lubricating system, and thoroughly wash out with kerosene all parts in which sediment might collect. This applies to the main bearing oil wells, governor housing, oil storage tank, force feed lubricator, oil pumps and piping.

(d) Wash out fuel supply reservoir with kerosene.

(e) Clean the exhaust system including conduit and stack.

(f) Inspect the flywheel bolts for tightness.

5. Semi-Annual Routine

(a) Pull pistons for inspection and cleaning. Remove any rings that are stuck and clean the rings and grooves. Wash off with kerosene. Examine connecting rod bearings.

(b) Examine cylinder walls. When cleaning the cylinders and exhaust and intake ports, place a piece of cloth or canvas over the top of the cylinder, and then with a piston ring placed over the canvas, push both canvas and ring into the cylinder bore until they are well below the ports. This arrangement will provide a receptacle to catch all of the carbon, etc., which would otherwise fall into the crankcase. When the work is completed, the ring, canvas, and carbon may be withdrawn by pulling upward on the edges of the canvas. Clean the cylinder heads at this time, too.

(c) Inspect the inner surface of the exhaust port bridges and of the cylinder wall adjacent to the ports. There is a tendency for the cast iron around the exhaust ports to grow due to the heat of the exhaust gases, and this surface must be kept even or slightly below the general bore of the cylinder. (See "6. Cylinder Exhaust Ports," Section V.

(d) Inspect and clean all water piping, circulating pumps, and cooling equipment.

6. Annual Routine

(a) When pistons are removed for inspection, disassemble and clean the piston pin bearings. See "5. Pistons," Section V.

(b) Check the crankshaft and engine for alignment; also, the driven apparatus.

(c) Clean the main fuel tank with boiling water and washing soda.

V. SERVICING INSTRUCTIONS

Note:—All repair charts referred to are in "Section VI. Repair Charts and List."

1. Main Bearings

Main Bearing Adjustment—Adjustment of the main bearings is necessary when there is excessive clearance between the crankshaft and the upper main bearing shells. To determine the actual bearing clearance and make the proper adjustment, proceed as follows:

Remove the bearing cap and upper shell. Do not remove the shims. Place four pieces of pure lead wire over the exposed journal, one lengthwise and three crosswise. Replace the upper bearing shell and cap, and screw the nuts down to their original position. Then remove the cap and shell and with an outside micrometer, measure the thickness of the compressed wire. Then add or remove sufficient shims on each side of the bearing to give 0.004″ to 0.007″ clearance. After the adjustment is made, and the engine is in operation, note the bearing temperatures from time to time.

Main Bearing Removal—When the bearing cap, upper half of the bearing shell, shims, and the oil ring have been removed, the lower half of the bearing shell may be rolled out after first relieving it of the weight of the crankshaft by means of a small jack placed under the nearest crank web. Corrugations in the shell will assist in rolling it out.

New Bearing Shells—New bearing shells, which will interchange with those on the engine, can be furnished from the factory. It will be necessary to fit the lower shell to its bed in the lower base, and to fit the upper shell to the bearing cap. The shells must be fitted to give a good bearing surface, and special care must be taken in fitting the lower shell so that it receives its share of the load from the crankshaft. Adjust clearance as outlined above.

The lower shell is lined with "Bermax" babbit and, for successful operation it must be fitted to a 100% bearing throughout an arc of at least 120°.

"Time Saver" should be used to produce a good bearing surface. "Time Saver" and instructions for its use may be obtained from Fairbanks, Morse & Co. or from Time Saver Products Co., 31 So. Desplaines St., Chicago, Ill.

2. Connecting Rod Crankpin Bearings

Connecting Rod Crankpin Bearing Adjustment—Adjustment of the connecting rod crankpin bearings is necessary when there is excessive clearance. To determine the clearance and make the adjustment, proceed as follows:

With a bar placed under the connecting rod crankpin bearing, pry up on the bearing to see if there is excessive clearance. **There should be no up and down movement of the bearing.** Should the bearing have excessive clearance take out 1 or 2 shims on each side of the bearing until there is no up and down movement. After shims have been taken out, draw the bolts up until they are tight and then place the bar at the side of the bearing and see that it is free to move sidewise on the crankpin. If the bearing will not move sidewise on the crankpin, then shims must be added until the bearing is free to move sidewise. When proper adjustment has been made see that the nuts are tight and **be sure to replace the cotter pins.** Examine the cotters before replacing them and if any show signs of cracking replace them with new **annealed** cotters.

Connecting Rod Crankpin Bearing Removal—With each engine, there are furnished two piston clamps (2600) (See Repair Chart No. 19), for supporting the piston and connecting rod in the cylinder while the connecting rod crankpin bearing is being removed. When a connecting rod crankpin bearing is to be removed, fasten these clamps to the lower end of the cylinder wall with the cap screws provided allowing the end of the clamp to project up into the cylinder bore. Remove the connecting rod bolts, bearing cap and shims; then, as the engine is barred over, the piston will rest on the clamps, and the bearing box may be removed as the engine is turned to the proper position. This manner of supporting the connecting rod and piston makes it unnecessary to remove the cylinder head and connecting rod when renewing the connecting rod crankpin bearing. **Be sure to remove the piston clamps** as soon as the connecting rod crankpin bearing is reassembled, otherwise serious damage will result to the piston and cylinder.

Connecting Rod Crankpin Bearing Renewal—The connecting rod crankpin bearing box and cap may be renewed if necessary. The bearing is lined with suitable babbit. For successful operation it must be fitted to a 100% bearing throughout an arc of at least 120° on both the upper and lower bearings. The machining clearance of the bearing is 0.004″ to 0.006″. When the bearing is well lubricated there should be no up and down movement although it should be free to move sidewise. The bearing bolts must be tight when checking.

Note:—Late Model 14 x 17 engines use a precision aluminum insert for the box half of the crankpin bearings with the babbitt lining retained in the cap half of the bearing. The aluminum insert does not require fitting while the babbitt half of the bearing requires fitting as described in the preceding paragraph. Crankpin bearings with aluminum inserts have a running clearance of .003″ to .005″. Retaining the shims (44) (see Repair Chart No. 6) permits adapting the aluminum insert to journals that are as much as .0625″ undersize. The out-of-roundness must not exceed .003″.

"Time Saver" should be used to produce a good bearing surface. "Time Saver" and instructions for its use may be obtained from Fairbanks, Morse & Co. or from Time Saver Products Co., 31 So. Desplaines St., Chicago, Ill. Always insert the cotter pins in the holes in the ends of the connecting rod bolts and spread the ends of the pins well apart.

There are two holes in the bolts for the cotter pins, either of which may be used, thus allowing a closer adjustment. When a new connecting rod crankpin bearing has been fitted to an engine, inspect it at intervals after the engine has been started, and apply the load gradually.

Wick Oiler—The crankpin bearing cap is fitted with a felt oil retainer which acts as an oil reservoir to furnish lubrication when the engine is first started.

3. Air Stop Ring

The air stop rings prevent the escape of air from the crankcases through the bearings. They are machined very carefully with the base to secure tight joints. All of the rings are of the split type and may be removed without dismantling the engine.

4. Crank Pin Oil Rings

These rings collect lubricating oil from the force feed lubricator tube and deliver it to the connecting rod crank pin bearings. They are of the split type, and can be removed or replaced without dismantling the engine.

5. Pistons

Removing Pistons—The pistons with connecting rods may be withdrawn after the cylinder heads and connecting rod bearings have been removed. Two ¾″ tapped holes are provided in the top of the piston so that eyebolts may be used for lifting the piston.

Piston Rings—During the periodic inspection of the piston, the rings should be examined. All piston rings should work freely in their grooves, for if they are allowed to stick fast, gases will blow past them, and combustion will be poor due to low compression. If any rings are stuck, they should be removed and the rings and grooves cleaned. Before removing a ring, mark it so that it can be installed again in the same position.

If the rings are gummed fast in the grooves, a hot solution composed of one pound of lye to three gallons of boiling water will assist in freeing them. Use this treatment only when the piston is removed from the cylinder. Wash off the solution after the parts are loosened. Clean all parts with kerosene or light lubricating oil, and lubricate them thoroughly before replacing in the engine.

Oil Scrapers—The oil scrapers, which provide lubrication to the piston pin, fit into recesses in the piston wall at each end of the piston pin.

Needle Roller Piston Pin Bearing—Refer to Fig. 23. The piston pin bearing is of the needle roller type with three rows of needles (or rollers) fitted into the space between the hardened steel bushing and piston pin. Four retainers are used to maintain the three rows of needles in position. Bushings, piston pins, needle rollers, and retainers may be renewed. The bushing fits tightly in the rod. When a bushing is to be replaced, heat the end of the rod to 160°-180° F. in hot oil or water and then put the cooled bushing in place.

Servicing Needle Type Piston Pin Bearings—Each piston pin bearing should be disassembled once a year and cleaned thoroughly. The needles should be rinsed in kerosene, and all oil holes in the piston pin should be cleaned out.

Disassembling the Bearing—To disassemble the needle roller bearing the following procedure is recommended.

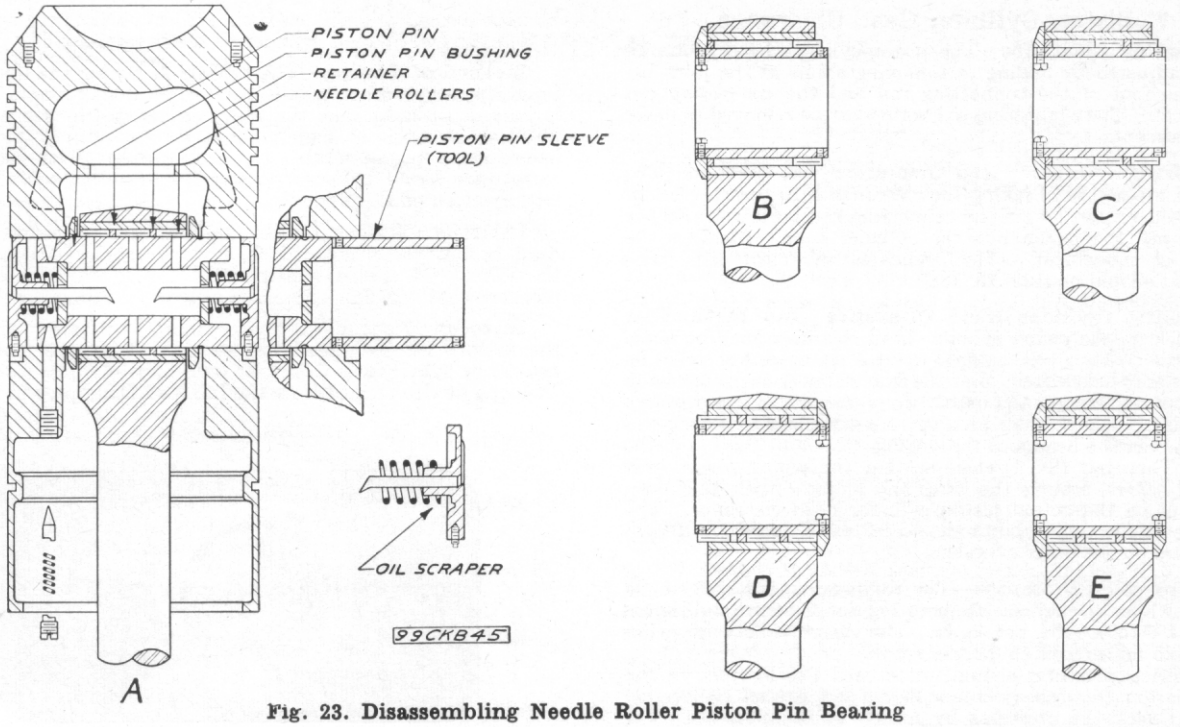


Fig. 23. Disassembling Needle Roller Piston Pin Bearing

After removing the piston and connecting rod from the engine, lay the piston on its side with the piston pin horizontal, or, if a hoist is available for lifting the rod, stand the piston upside down.

Before the piston pin can be removed, the headless set screw, spring and dowel which hold the piston pin in the piston and the oil scrapers on each end of the piston pin, must be removed. (See Fig. 23). After this is done, place the piston pin sleeve in the piston against the small end of the piston pin as shown at "A". Push out the piston pin and follow it through with the piston pin sleeve, until the sleeve is in position in the connecting rod. Tighten the sleeve screws against the two end retainers and remove the connecting rod from the piston as shown at "E".

To remove the needle rollers, loosen the sleeve screws, remove the retaining rings, push the sleeve out of the connecting rod and remove each row of rollers. Keep each row of rollers separate so that the rows can be replaced in their original position. Do not lose any of the rollers. Each bearing on the 12 x 15 engine has 231 rollers or 77 in each row, while each bearing on the 14 x 17 engine has 240 rollers or 80 in each row.

An alternate method of removing the needle rollers is done as follows: Push the sleeve out of the connecting rod just far enough to tie a tape, or similar material around the row of needle rollers. Repeat the procedure for the other two rows. The needle rollers can be cleaned and inspected when taped on the piston pin sleeve. This method simplifies the reassembly procedure considerably.

Replacement of Needle Bearings—After 10,000 hours of operation the needle rollers should be replaced with new ones. After 20,000 hours of operation, the piston pin bushing and the piston pin should be rotated 180° and the needle rollers should be replaced. As noted in Fig. 23 the dowel holes for the piston pin dowel are located 180° apart making it possible for the pin to be rotated 180°. The pin bushing is pressed out of the connecting rod eye. When replacing the bushing heat the eye of the rod in water or oil to 160°-180° F. and cool the bushing. The bushing will normally slide into place. After 40,000 hours of engine operation new piston pins and bushings must be supplied.

Before removing the bushing and pin match mark them so they will be replaced correctly.

Assembling the Bearing—Before assembling the needle roller bearings, be sure to rinse all the parts in kerosene and clean the oil holes in the piston pin. After cleaning, lay the rollers on a clean piece of paper.

The first step in assembling is to mount one of the end retaining rings on the piston sleeve and tighten the sleeve screws against the ring. Next, slip one of the inner retaining rings on the sleeve up against the inside of the end retainer and insert the assembly in the connecting rod. The inner retaining ring tends to hold the sleeve Concentric with the pin bushing and permits the assembly of a full row of rollers as shown at "B" Fig. 23. If the rollers are inserted from the bottom up, the assembly will progress more easily. Check to make sure there are 77 bearings for each row on a 12 x 15 engine or 80 bearings for each row on the 14 x 17 engine, as it is possible to force one too many into a row which can cause excessive wear and consequent damage to the bearing.

After a full row of bearings is assembled on the sleeve, put the other inner retaining ring on the sleeve, at the same time pushing the first row of bearings further into position. The inner retainer and the first row of bearings will be pushed into position when the second row of rollers is assembled on the sleeve. Insert the second row in the same way as the first row, as shown at "C" Fig. 23.

When two full rows of rollers have been assembled on the sleeve with a retaining ring between rows, remove the end retaining ring from the sleeve and mount it on the opposite end. Doing this will put the two rows of rollers already assembled in their running position and permit the assembly of the third row of rollers on the opposite end.

Assemble the remaining row on the sleeve as instructed for the first row. When the third row is put into place, the other inner retainer will also be pushed into position as shown at "D" Fig. 30. After the third row of rollers is on the sleeve, mount the end retaining ring on the sleeve, pushing the rollers into position and then tighten the sleeve screws against the end retainer. Now the connecting rod is ready to be assembled in the piston as shown at "E" Fig. 23.

Place the connecting rod in the piston, loosen the piston pin sleeve screws and push out the sleeve, following it through with the piston pin. Be sure that the connecting rod is not reversed in relation to the piston. After the piston pin is in position insert the dowel, spring and headless set screw which hold the pin in the piston.

6. Cylinder Exhaust Ports

When the pistons are pulled for the semi-annual inspection and cleaning or at any other time that the pistons are removed, the exhaust ports should be thoroughly cleaned and the cylinder walls carefully examined.

Occasionally, when an engine is operating under a very heavy load or possibly under an unfavorable exhaust condition, the bridges around the exhaust ports may have a tendency to grow and to extend into the cylinder. This condition should be checked with a straight edge when the cylinder is open and the extending metal, if any, removed by rubbing down or carefully grinding. It is unnecessary to relieve the surface beyond the surface of the cylinder. Remove sharp edges around the exhaust ports—a 1/16" radius is recommended.

7. Piston-Cylinder Head Clearance

Adjusting Clearance—The piston-cylinder head clearance may be adjusted by adding or removing shims at the joint between the foot of the connecting rod and the connecting rod bearing box. The connecting rod bolts must be removed to make the adjustment.

Checking Cylinder Head Clearance—1st Method—The preferred method of checking the clearance is to turn the crank to top dead center, loosen the connecting rod bolts and pry the rod up until the piston hits the cylinder head. Measure the amount of movement, which indicates the clearance. The movement should be .125″ to .188″.

Checking Cylinder Head Clearance—2nd Method—A close check on the piston cylinder head clearance may be made as follows: With a cold engine, remove the injection valve on the cylinder to be checked. Bar the flywheel over until the piston is near top dead center, and insert two pieces of lead wire through the opening in the cylinder head in such a manner that they will come between the head and the sloping portion at the top of the piston. Then bar the flywheel so that the piston passes over top dead center, remove the wires and measure their thickness, which will be the actual piston cylinder head clearance. The clearance at the closest point should be .0625″ to.094″. Repeat the process on the other cylinders.

Compression Pressures—The compression pressure should be taken while the engine is at operating temperature, and should be from 450 to 500 lbs. per sq. in. The variation between cylinders should not exceed 15 lbs. per sq. in.

The firing pressures should not exceed 725 lbs. per sq. in. The variation between cylinders should not exceed 70 lbs. per sq. in. Check the pressures by means of an indicator. The indicator cocks should be installed in the holes provided in the cylinder heads. It is not necessary to connect up an indicator drive to obtain the pressure; pulling the indicator by hand will give the desired results.

8. Air Start Mechanism

Air Start Valves—The air start valves (570B) (See Repair Chart No. 14), located in the fuel supply reservoir casting just behind the fuel injection pumps should be inspected occasionally and reseated, if necessary. The plugs (903) must be removed before the valves can be taken out. The valves may be reseated in the usual manner. Be sure to replace the parts in their original position.

Air Starting Shut-Off Valve—The air starting shut-off valve (2294B) (See Repair Chart No. 14), is of the disc type and is held in position against the valve cage (2293E) by means of a spring. In the event of leakage between the valve and cage, reseat the valve to its seat on the cage by lapping or grinding.

Air Starting Check Valves—The air starting check valves in the cylinder heads should be removed and cleaned occasionally. If necessary regrind the valves to their seats.

9. Fuel Injection Pump

Reseating Injection Pump Valves—The injection pump valves must be reseated at intervals, for leaking valves will result in dark, smoky exhaust and irregular engine performance. Refer to Repair Chart No. 11B, when removing the valves for reseating. In grinding the valves, use a fine carborundum paste, flour of glass, or pumice stone mixed with oil. Never use emery compounds as even the finest grades are too coarse. After grinding, make sure that all traces of the grinding compound are removed from the valve and seat. Suction valves are provided with screw driver slots for rotating them while grinding. Discharge valves are cup shaped. A small stick shaped to fit into the valve may be used to rotate the valve.

10. Differential Fuel Injection Valve

For servicing information on the differential fuel injection valves, see Instructions No. 2769, latest edition. The injection valve should be checked in about 200 hours after the first start and at monthly intervals thereafter.

Whenever an injection valve is being installed in the cylinder head it must be clamped down very tightly and evenly as otherwise the extreme pressure of injection may disturb the location of the parts and cause unsatisfactory operation.

11. Injection Timing

The fuel injection is timed properly at the factory for best running conditions, and the parts are marked so that they may be reset to their original position. The cylinders are numbered 1, 2, 3, etc., with No. 1 cylinder at the governor end.

Method of Timing—The method of timing the injection is to clamp the governor spider (501B) (See Repair Chart No. 16), in such a position that the injection pump plunger of No. 1 injection pump is at high point a certain number of degrees before No. 1 piston reaches top dead center. With the timing correct for No. 1 cylinder, timing for the other cylinders will be correct automatically.

Injection Timing Marking—With No. 1 piston on top dead center, the mark on the governor spider designated by the letter "C" should register with the governor case timing pointer. (See Fig. 24.) This is the factory setting.

Injection Timing—Injection timing is properly set at the the factory for best performance with an average fuel. For heavier or lighter fuels it may be necessary to adjust the setting. This can be determined from the full load firing pressures.

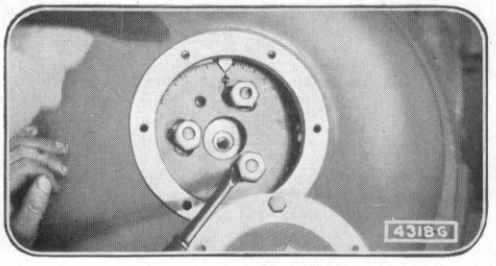


Fig. 24. Adjusting Injection Setting

Dead Center Setting—With No. 1 piston on top dead center, No. 1 pump plunger will be at high point when the prick punch mark on the governor spider registers with the timing pointer.

12. Balancing Load on Cylinders

Uniform exhaust temperatures indicate that approximately the same amount of fuel is being injected to all cylinders; therefore, if the temperatures are not uniform, more fuel should be injected to cylinders with low temperatures, and less to those with high temperatures.

Methods of Taking Exhaust Temperatures—The most satisfactory method of taking exhaust temperatures is with the use of a pyrometer which is furnished when ordered specially. In the absence of pyrometer equipment, an exhaust thermometer may be used.

Exhaust Temperatures—Since the exhaust temperatures will vary with the installation, the readings taken by the factory representative when the engine was first started should be obtained. Subsequent readings taken under similar conditions should conform within reasonable limits. Before making any adjustment, be sure that all thermocouples are clean, and that the injection system is operating properly. Under normal full load operating conditions, with the engine in good condition and with an approved exhaust arrangement the exhaust temperature should not exceed 420°F. The difference between the individual cylinders on an engine should not exceed 30°F. for full load or 60°F. for fractional loads to maintain the cylinders in balance.

Fuel Injected Determined by Suction Valve Closing—The amount of fuel injected depends upon the closing of the suction valve (P) (See Fig. 1), the earlier the valve is closed, the more fuel is injected, and the later the valve is closed, the less fuel is injected.

Suction Valve Closing Affected by Valve Clearance—The time of closing of the suction valve is affected by the amount of clearance between the upper push rod stem (R) and the suction valve (P) measured with the cam in low position. With a small clearance, the suction valve will be lifted farther off its seat, and will close later. With a large clearance, the opposite is true. Thus, if less fuel is to be injected into the cylinder, the clearance must be decreased, and if more, the clearance must be increased.

Suction Valve Clearance—The clearance between the suction valve and push rod should be from .015″ to .050″ on 12″x15″ engines, and from .015″ to .060″ on 14″x17″ engines with the governor cam in low position. To measure the clearance, remove the pump case housing cover (849A), the fuel reservoir cover (986A), and the injection pump discharge valve (91), spring (537), and suction valve spring (259). With the governor cam in low position, hold the suction valve down on its seat, and lift the upper push rod stem (642A) against the valve. Then insert the thickness gauge (feelers) between the push rod stem (642A) and the adjusting screw (626A). (See repair chart No. 11B.)

Sealed Push Rods—The suction valve clearance is adjusted correctly at the factory, and the adjusting screw on No. 1 pump is sealed. On single cylinder engines, no further adjustment should be made, but on multi-cylinder engines, occasional adjustment is required to keep the load balanced on all cylinders. Adjustment should always be made on the unsealed push rods. By following this procedure, No. 1 cylinder is used as the key cylinder, and all other cylinders must be adjusted to it.

Making the Adjustment—The adjustment is made by either lengthening or shortening the push rod. Lengthening the push rod results in decreased clearance, the suction valve closes later, and the amount of fuel injected is decreased. To make the adjustment, loosen the adjusting screw nut (O), and then while holding the push rod (Q) with a stiff wire or nail inserted through the hole in the push rod, turn the adjusting screw in the desired direction. (See Figs. 1 and 25.) Be sure to tighten the lock nut after the adjustment has been made. Start the engine and observe the exhaust temperature under full load. If one of the cylinders has more load than the others, its temperature will be higher. To balance the load, make further adjustments, until the pyrometer indicates exhaust temperatures all within a limit of 30°F. at full load.

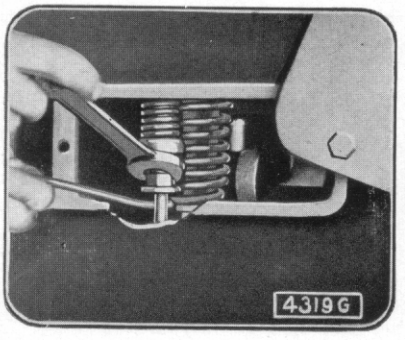


Fig. 25. Adjusting Push Rods

13. Fuel Supply Pump

Suction and Discharge Valves—The fuel supply pump should be inspected occasionally, and the suction and discharge valves (519A) reseated, if necessary. (See Repair Chart No. 10.) To withdraw the valves, remove the fuel reservoir cover plug (2112), and cap (520A).

Strainers—The fuel suction strainers may be cleaned after removing the cover (986D) to which they are attached. Refer to the separate instructions furnished by the manufacturer of the strainers.

14. Gravity Feed Fuel Regulator

If fuel leaks from the vent in the reservoir cover, shut off the fuel supply to the regulator, drain and clean the reservoir by flushing with gasoline or kerosene. It may be necessary to regrind the valve. There are also provided two drains—the lower drain for the water jacket and the upper for the fuel regulator reservoir. Drain the fuel regulator reservoir frequently to remove any accumulated water or sediment which might interfere with the peration of the engine.

15. Force Feed Lubricator

The lubricator should be adjusted to give the following number of drops per minute:

12″ x 15″ Engines 360 r.p.m.	Cylinder feeds—16 drops Crankpin feeds—24 drops
14″ x 17″ Engines 300 r.p.m.	Cylinder feeds—14 drops Crankpin feeds—21 drops—(Babbitt bearings) Crankpin feeds—42 drops—(Aluminum bearings)

During the run in period of engines with aluminum inserts in the box half of the connecting rod bearings, the lubricator for the bearings should be set at 56 drops per minute and gradually reduced to the minimum of 42 drops per minute.

The values given above are for average operating conditions and may require some adjustment to meet local operating conditions and quality of oil.

Checking Lubricator Feeds—To check the lubricator feeds, first count the number of impulses per minute made by the lubricator with the engine running at normal speed. Then divide the number of drops per minute (from the table), by the number of impulses per minute which will give the drops per impulse at which the lubricator should be set. With engine stopped, and while hand cranking lubricator, count the drops per impulse. If necessary, make the adjustment as outlined in the lubricator instruction book.

Cleaning Lubricator—See lubricator instruction book for method of cleaning.

16. Air Filter

Servicing Filter—Non-self cleaning type filters, when dirty, should be removed and cleaned by immersing in light oil or kerosene until all the dirt and grit has been washed free. After draining for several minutes, the filter should be dipped in a special air filter oil as recommended by the filter manufacturer. If the engine is operated continuously, it is advisable to have a spare filter which can be used while the other unit is being cleaned.

Self-cleaning oil bath type filters should be drained and cleaned periodically, depending on operating conditions, and refilled with a light oil.

The pressure drop in the lower base should not exceed 3″ of water between filter cleanings.

17. Exhaust Equipment

Necessity for Cleaning—Although the engine may be operating with a good exhaust condition under full load or less, flakes of carbon, tar, etc., will collect in the exhaust line unless the exhaust is continually washed. If the formation is allowed to collect, it must be removed periodically. The frequency of cleaning depends upon many factors, but may be readily determined for each installation.

18. Crankshaft End Play

The end play of the crankshaft is adjusted by thin shims placed between the air stop ring and a shoulder on the crankshaft. The shims are made in halves for easy installation or removal, and are located to make all adjustments at one crank or bearing, the other cranks or bearings having slightly greater end-wise clearance. The shims may be ordered by Repair No. 577A for thick shims (used only for 14″x17″ engines), and Repair No. 578A for thin shims.

Adjustment—If the end play becomes excessive, it may be reduced by adding shims, always adding two halves at a time. On engines of more than one cylinder, an equal thickness should be added to both points of adjustment, if possible. In making this adjustment, always allow .025″ to .035″ end play, and take especial care that all the other stop rings have greater clearance than the two taking the end thrust.

19. Changing Rotation

Changing the rotation of the engine must be done by a competent mechanic, and to such a man it will be self-evident how to take the governor apart and reassemble it to the opposite hand. It is necessary to obtain from the factory a new governor spider with injection and governor cams, and also a new air starter cam. Reassemble the governor with the weights as shown in Fig. 26.

Note:—Drawings will be furnished upon request, showing how to remachine the old parts in the field to obtain reverse rotation.

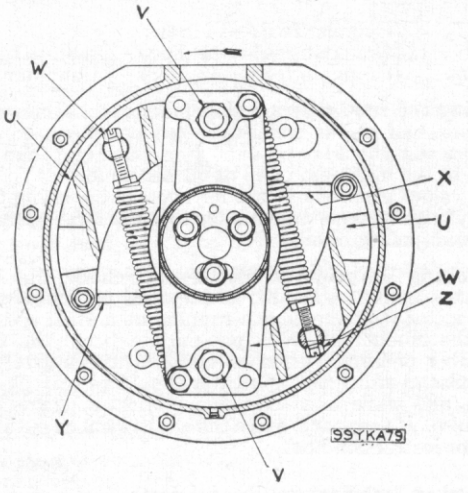


Fig. 26. Reverse Rotation Governor Diagram

20. Changing Speed

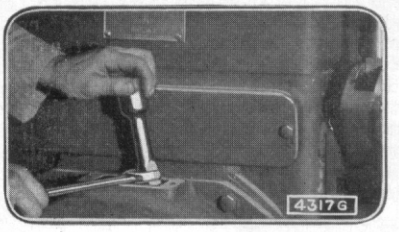


Fig. 27. Changing Speed

To increase the engine speed, tighten the governor springs by means of the adjusting screws W; to decrease the speed, reverse the operation. See Figs. 26 and 27. Adjust the two springs so that they have equal tension.

21. Woodward Governor

For instructions on adjusting Woodward governors see the Woodward Governor Co. Bulletin W-2 covering Type IC governors.

22. INSTRUCTIONS FOR ASSEMBLING MODEL 32 ENGINES DISMANTLED FOR SHIPMENT

Export Shipments—Three different methods of boxing are used for shipping Model 32 engines on export orders. They are shipped·

1. Partially dismantled
2. Totally dismantled
3. Completely assembled

This section deals with a totally dismantled engine. If it is only partially dismantled the erector may finish assembling it, using only the instructions which cover the work yet to be done. The engine must be handled and assembled carefully in order that it may be kept clean and so that all parts will work freely. Study the repair charts while assembling the engine.

Setting Lower Base—When the foundation is ready the lower base may be set in place and assembly work started. Level the lower base carefully and block it firmly so it will not be disturbed by the work which will be done on it. See heading "Installing the Engine and Drive Equipment" in Section II.

Laying Crankshaft—Clean the crankshaft thoroughly, removing all of the rust preventing grease. Lay the crankshaft in place and make sure that it rests properly in all of the lower main bearing shells. Put on the upper halves of the main bearing shells, adjusting them according to Section V. Be sure to put the bearing shells on in their proper position and replace the dowels and shims as they come from the factory. Check the crankshaft end play. See heading "Crankshaft End Play" in Section V.

Do not install the flywheel until after the bearings are tightened down ready to run.

Upper Bases—Install the upper bases, being sure to put each one in its proper place and with the right side to the front. The lower and upper bases on the multi-cylinder engines are plainly marked on the front side. The dowels for locating the upper base are shipped in place in the lower base. The gaskets are in a metal container.

Cylinders—Place the cylinders on the upper bases. Line them up so that the drilled spots at the joints line up exactly. There are no dowels between the cylinder and the upper base so the spots must be matched. The gaskets are in a metal container.

Pistons and Connecting Rods—The connecting rods and both halves of the connecting rod bearings are stamped with the cylinder number. The marks should all be toward the front of the engine. The shims between the upper and lower halves of the connecting rod bearing must be assembled in the same relation as they are when they leave the factory. The shims between the connecting rod bearing and the bottom of the connecting rod are fastened to the upper stud for the hand hole cover on the front of each upper base. See headings 2, 5 and 7 in Section V.

Piston-Cylinder Head Clearance—Be sure the cylinder heads are assembled properly. Each head is stamped on the front side with the cylinder number. To check the cylinder head clearance first turn the engine over by hand to see that all parts are free and then proceed as indicated in heading 7 in Section V.

Governor—The governor is left on the crankshaft except in the case of the Woodward governor. For installing the Woodward governor see Instructions 2818. In this case it is not necessary to consider the section covering the removal of the standard governor.

Injection Pump—The injection pump housing is removed with all parts in place and the crankshaft is removed without disturbing the governor and then the injection pump housing is put back where it belongs. In the 4, 5 and 6 cylinder engines it is necessary to remove the rocker shafts for the lower rockers in order to lift the pump up past the cams. See repair chart 11B. These rocker shafts are put back in place for shipment and must be again removed in order to get the rockers down over the cams when the pump is replaced after laying the crankshaft. Then the rockers are reassembled for operation. To remove the rocker shaft, first remove the small lock plate at the outside end. Then push the shaft back a short distance and remove the split washer from the groove at the inside end. The shaft will slip out leaving the rockers free except for the small springs which hold them against the cam. To replace the rocker shafts reverse the procedure outlined above.

Manifolds and Piping—The installation of the water manifolding and the starting air and lubricator piping and the injection tubing is quite simple. The pipes are the right length and have the proper fittings attached to them. The air start piping and water manifolds are shown in Repair Charts 13 and 18. The injection tubes and some of the lubricator tubes run under the floor of the platform.

General—Too much care cannot be taken during the assembly of the engine to be sure that everything is clean and works easily and is free from leaks. When the assembly work is finished the engine may be installed in the normal manner. See the complete section on Installation (Section II).

Installation of Air Seal Rings on Crankshafts with and without Counterweights

Turn engine with crank pin on top dead center for respective cylinder in which air seal rings are to be installed. Obtain a piece of sheet metal about .020″ to .030″ in thickness and approximately 10″ square. Cut a half circle equivalent to radius of main bearing journal from one edge or use two strips of sufficient width to accomplish the same purpose. Place the above shim adjacent to the web of the crankshaft with the arc resting on the shaft. In a case of an engine fitted with counterweights, obviously that half of the air seal ring which operates adjacent to the counterweight should be installed first. The two holes in this ring half which receives the springs should be nearly filled with cup grease which will aid in holding the springs in place during assembly. Put the springs in place and place the ring on the shaft using the sheet metal shim to prevent the outer end of the spring from fouling on the shoulder on the crankshaft. After the ring half is placed on the shaft, the shim may be removed. Before starting the next operation fabricate two hooks similar to fish hooks (these can be made from heavy wire or 20 penny nails) and also attach a 30″ length of wire to the eye of each hook.

The next step is to move the ring half around the shaft to the bottom side. During this operation the bore of the ring half must be held against the shaft. Invert the hooks and insert them in the threaded holes in the ring half. The wire attached to the hook on the operating side should be passed under the shaft to the assistant on the opposite side. Also, the assistant on the exhaust side should pass the wire under the shaft to the man on the operating side. The ring can now be pulled into position on the bottom of the shaft by pulling on either side of the wires with sufficient resistance on the other wire to hold the bore of the ring snug on the shaft. The ring should now be in position at the bottom of the shaft following which the wire should be brought out through the crankcase opening and secured to the handhole cover stud on the upper base.

Install the other half of the ring by again using the shim mentioned above for guiding the springs in place.

Insert the two capscrews for holding the two halves together. After the capscrews have been pulled down snugly to bring the ring halves together, the two taper dowels should be driven in the air seal ring, the capscrews then tightened firmly and secured in place with lockwire.

VI. REPAIR CHARTS AND LISTS

Complete Assembly.—The complete assembly number shown in large bold face type and followed by the letter "C" (indicating complete) includes all items to the next horizontal line. A complete assembly may be ordered "less" any items unless the words "Not furnished separately" appear against those items.

Bracketed Assembly.—The bracketed assembly number shown in small bold face type includes all of the items in the bracket. The main part of the assembly (in small bold face type) cannot be furnished except with all the parts in the bracket.

Individual Repair Parts.—Individual repair parts and unnumbered parts are furnished separately unless followed by the words "Not furnished separately."

This instruction book effective on the first back flow scavenging engines

Model 32E12 (12x15)		Model 32E14 (14x17)			
1 Cyl.	783165	1 Cyl.	780565	4 Cyl.	781307
2 Cyl.	781314	2 Cyl.	780551	5 Cyl.	780205
3 Cyl.	780568	3 Cyl.	781324	6 Cyl.	780558
and all thereafter		and all thereafter including 4 cyl. 778056			

Instructions for Ordering Repair Parts

Information Required.—To insure shipment of the proper repair parts, without delay, give the complete description of the part, or parts wanted as shown in the following example.

1. Quantity of parts wanted, "one."
2. Repair number, "1F."
3. Name of part, "cylinder."
4. Engine Model 32E14.
5. Number of cylinders and model, "4 cylinder Model 32E14 Diesel."
6. Engine serial number, "No. 876972."
7. Specify AR1, AR2, AR3 or AR4 where found in list as with 422J on page 31. See Fig. 37 on page 29 to determine engine arrangement.

Sample Repair Order.—The repair order in this case should read: One "1F" cylinder for 14"x17" 4 cylinder Model 32E14 Diesel Engine serial number 876972.

Repair Number and Engine Serial Number.—The most important items of the above information are the Repair Number and the Engine Serial Number. The latter is stamped on the upper face of the lower base on the exhaust side of the engine at the governor end. The cylinders are numbered 1, 2, 3, etc., beginning at the governor end.

Index of List Divisions

Index of Repair Numbers

Index of Repair Numbers (Continued)

ALWAYS GIVE ENGINE SERIAL NUMBER

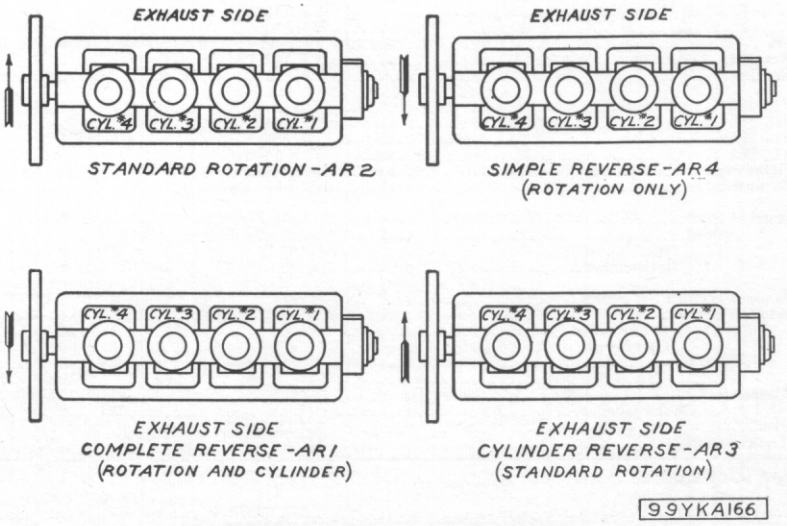
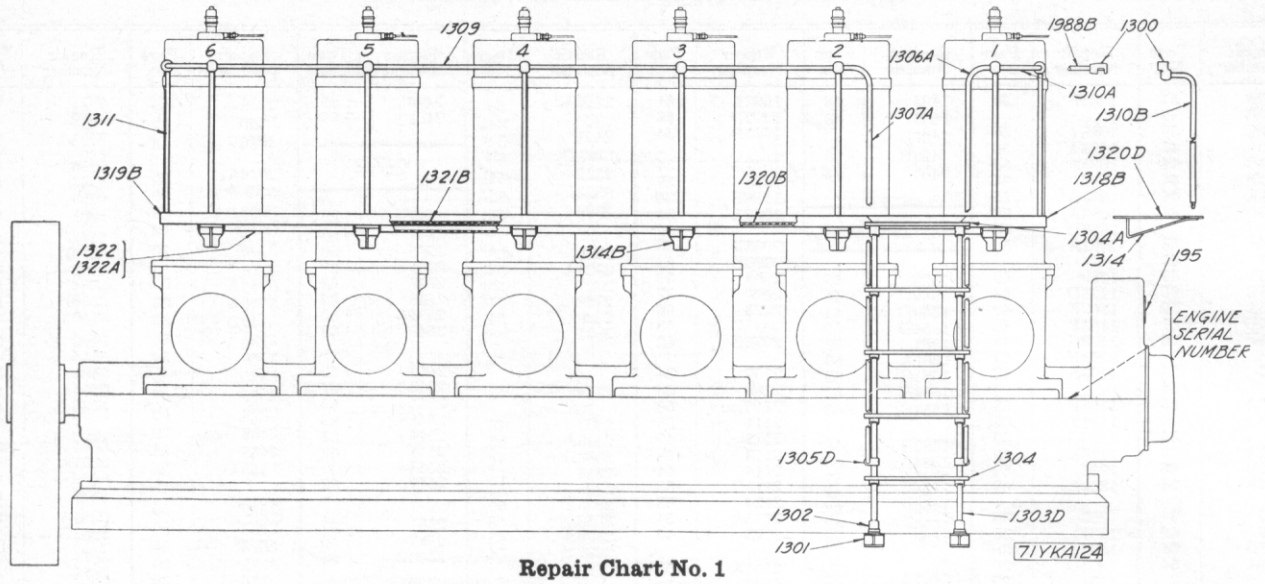


Fig. 37. Arrangement Diagram

List Division No. 1. General Engine Parts and Platform



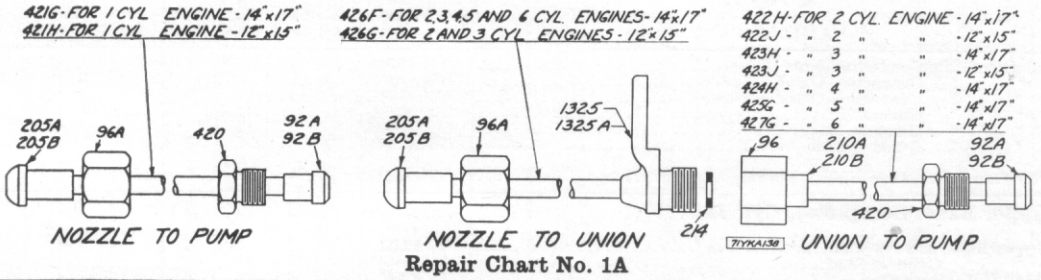
Repair Chart No. 1

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
1304A-C	**Platform Stairs (Complete) for Low Mount**			**1**	**1**		**1**	**1**	**1**	**1**	**1**
1304	Stair Step	YK1304A		4	4		4	4	4	4	4
1304A	" Step (Top)	YK1304D		1	1		1	1	1	1	1
1305D	" Rail Support	Y2KA1305A		2	2		2	2	2	2	2
1301	" Stringer Floor Beam	YK1301B		2	2		2	2	2	2	2
1302	" " Lower Bracket	YK1302B		2	2		2	2	2	2	2
1303D	" Stringer	Y2JA1303C		2	2						
	" Stringer	Y2K1303D					2	2	2	2	2
	" Step Dowel	#631		10	10		10	10	10	10	10
	Top Step Flat Head Cap Screw	½″x1¾″		3	3		3	3	3	3	3
	" " " " " " Lockwasher	½″		3	3		3	3	3	3	3
	" " " " " " Nut	½″		3	3		3	3	3	3	3
	Stair Stringer Support Cap Screw	½″x1½″		2	2		2	2	2	2	2
	" " " " " Lockwasher	½″		2	2		2	2	2	2	2
1304B-C	**Platform Stairs (Complete) for High Mount. Note:—1304B-C same as 1304A-C except omit 1303D and add:**										
1303B	Stair Stringer	Y2JA1303B		2	2						
	Stair Stringer	Y2KA1303C					2	2	2	2	2
1304	Stair Step	YK1304A		1	1		1	1	1	1	1
∈	Stair Steps Dowel	#631		2	2		2	2	2	2	2
1309-AC	**Platform Railing (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Front Hand Rail	Y3JA1309A			1						
	" " Rail	Y3KA1309B						1			
1309	" " Rail	Y4KA1309B							1		
	" " Rail	Y5KA1309A								1	
	" " Rail	Y6KA1309B									1
1310A	End Hand Rail	Y2KA1310A					2	2	2	2	2
1310B	Hand Rail	YJA1310B	1								
1310A	" Rail	YKA1310C		2	2						
1310B	" Rail	YKA1310C									
1311	" Rail Support	YK1311B1		4	5		4	5	6	7	8
1300	Hand Rail End Bracket	YKA1300A	1	2	2	1					
	" " " Bracket	Y3K1300B					2	2	2	2	2
1306A	Stair Hand Rail (R. H.)	Y2JA1306B		1	1						
	" " Rail (R. H.)	Y2KA1306C					1	1	1	1	1
1307A	Stair Hand Rail (L. H.)	Y2JA1307B		1	1						
	" " Rail (L. H.)	Y2KA1307C					1	1	1	1	1
1988B	End Hand Rail Extension	Y2JA1988C		2	2						
	" " " Extension	Y2KA1988G					2	2	2	2	2
	Hand Rail End Bracket Stud	½″x3½″	1	2	2	1					
	" " " " Stud	½″x2					2	2	2	2	2
	" " " " " " Nut	½″ C. P.	1	2	2	1	2	2	2	2	2
	" " " " " " Lockwasher	½″	1	2	2	1	2	2	2	2	2
	Hand Rail End Bracket Hollow Set Screw	⅜″x½″	1	2	2	1	2	2	2	2	2
	" " Support Cap Screw	½″x1¾″		4	4		4	4	4	4	4
	" " " " " " Lockwasher	½″		8	10		8	10	12	14	16
	" " " " " " Cap Screw	½″x2½″		4	6		4	6	8	10	12
	" " " " Set Screw	⅜″x½″		4	5		4	5	6	7	8
	" " " " " " Cap Screw Nut	½″C.P.		8	10		8	10	12	14	16
	Stair Hand Rail Cap Screw	⅜″x2″		2	2		2	2	2	2	2
	" " " " " " Lockwasher	⅜″		2	2		2	2	2	2	2
	" " " " Nut	¾″ C. P.	1			1					
	" " " " Lockwasher	¾″	1			1					
1320D-AC	**Platform Floor (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Floor Plate	Y2JA1320B		1							
	" Plate	Y2KA1320D					1				

(Group continued on next page)

List Division No. 1. General Engine Parts and Platform (Continued)

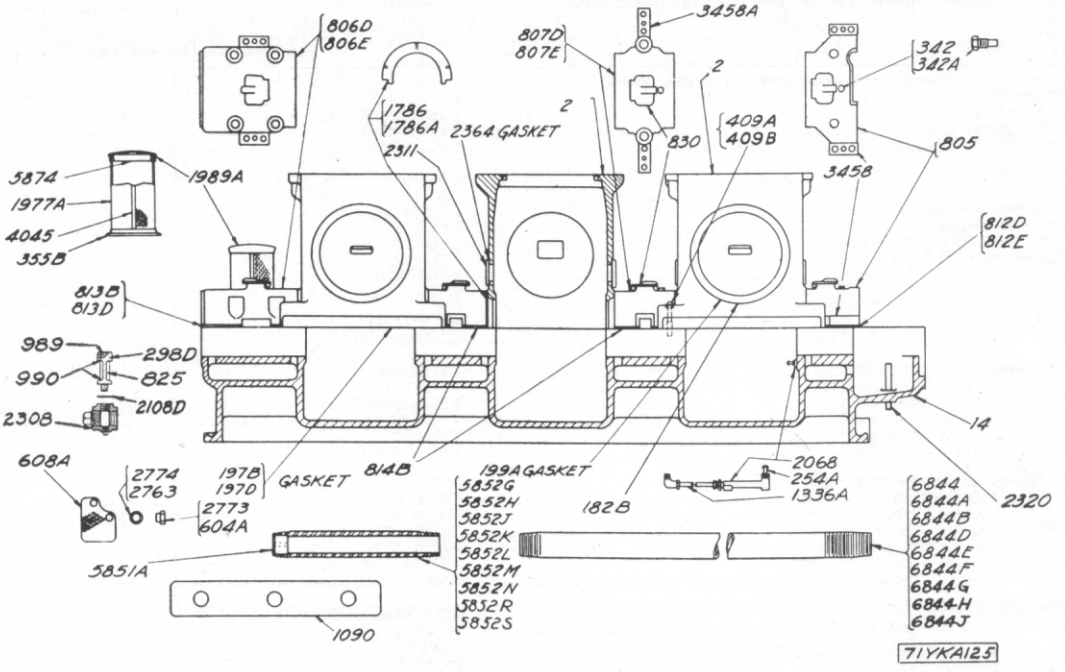
Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
	(Group continued from preceding page)										
1320B	Floor Plate	Y3JA1320A			1						
	" Plate	Y3KA1320B						1			
	" Plate	Y4KA1320B							1		
	" Plate	Y6KA1320B								1	1
1320D	Floor Plate	YJA1320C	1								
	" Plate	YKA1320E				1					
1314	Platform Bracket	YKA1314A	1			1					
1321B	Floor Plate (Opp. Stair End)	Y4KA1321B							1	1	
	" Plate (Opp. Stair End)	Y6KA1321B									1
1322	Lubricating Oil Tube Pan	Y2J1322A		1	2						
1322A	" " " Pan	Y3K1322B					1	2	3	4	6
	" " " " R. H. M. Screw	¼"x½"		4	8		4	8	12	16	20
	" " " " Lockwasher	¼"		4	8		4	8	12	16	20
	" " " " Felt	5/16"x6"x32½"		1			1				
	" " " " Felt	5/16"x11¾"x32½"			2			2	3	4	5
1318B	Platform Angle (Stair End)	Y2JA1318A		1	1						
	" Angle (Stair End)	Y2KA1318C					1				
	" Angle (Stair End)	Y3KA1318B						1			
	" Angle (Stair End)	Y4KA1318B							1		
	" Angle (Stair End)	Y5KA1318A								1	
	" Angle (Stair End)	Y6KA1318B									1
1319B	Platform Angle (Opp. Stair End)	Y2JA1319A		1							
	" Angle (Opp. Stair End)	Y3JA1319A			1						
	" Angle (Opp. Stair End)	Y2KA1319C					1				
	Platform Angle (Opp. Stair End)	Y3KA1319B						1			
	" Angle (Opp. Stair End)	Y4KA1319B							1		
	" Angle (Opp. Stair End)	Y5KA1319A								1	
	" Angle (Opp. Stair End)	Y6KA1319B									1
1314B	Platform Bracket	YKA1314C1		2	3		2	3	4	5	6
	Floor Plate Flat Head Cap Screw	½"x2"		4	6		4	6	8	10	12
	" " " " " Screw	½"x1¼"		7	9		7	9	13	15	19
	" " " " " " Nut	½" C. P.		11	15		11	15	21	25	31
	" " " " " Lockwasher	½"		11	15		11	15	21	25	31
	" " Headless Set Screw	½"x1"	1			1					
	" " " " " Jam Nut	½" C. P.	1			1					
195	Name Plate (Always give engine serial number)		1	1	1	1	1	1	1	1	1



Repair Chart No. 1A

	Note:—When ordering injection tubes, specify AR1, AR2, AR3 or AR4 where found in list. See Fig. 37 on page 34 to determine engine rotation.										
421H	Injection Tube, Nozzle to Pump (81"), (Complete)	YJA421L	1								
421G	Injection Tube, Nozzle to Pump (90"), (Complete)	YKA421M				1					
422J	Injection Tube, Union to Pump (89"), (Complete) AR2 and AR4	Y2JA422K		2							
	" Tube, " " " (93"), (Complete) AR1 and AR3	Y2JA422L		2							
422H	Injection Tube, Union to Pump (97"), (Complete) AR2 and AR4	Y2KA422N					2				
	" Tube, " " " (99½"), (Complete) AR1 and AR3	Y2KA422P					2				
423J	Injection Tube, Union to Pump (113¼"), (Complete) AR2 and AR4	Y3JA423G			3						
	" Tube, " " " (124"), (Complete) AR1 and AR3	Y3JA423H			3						
423H	Injection Tube, Union to Pump (128"), (Complete) AR2 and AR4	Y3KA423N						3			
	" Tube, " " " (111"), (Complete) AR1 and AR3	Y3KA423P						3			
424H	Injection Tube, Union to Pump (174"), (Complete) AR2 and AR4	Y4KA424P							4		
	" Tube, " " " (176"), (Complete) AR1 and AR3	Y4KA424Q							4		
425G	Injection Tube, Union to Pump (209"), (Complete) AR2 and AR4	Y5KA425N								5	
	" Tube, " " " (193½"), (Complete) AR1 and AR3	Y5KA425P								5	
427G	Injection Tube, Union to Pump (238¼"), (Complete) AR2 and AR4	Y6KA427N									6
	" Tube, Union to Pump (214½"), (Complete) AR1 and AR3	Y6KA427P									6
426G	Injection Tube, Nozzle to Union (44¾"), (Complete)	Y2JA426D		2	3						
426F	Injection Tube, Nozzle to Union (50¼"), (Complete)	Y2KA426H					2	3	4	5	6
	See Page 59 for Injection Tube Clamps. Note:—Injection tubes are furnished complete with fittings as shown in Repair Chart No. 1A. Fittings may be ordered separately as follows.										
92A	Injection Tube Connection Gland—Pump	YKA92B				1	2	3	4	5	6
92B	" " Connection Gland—Pump	YJA92A	1	2	3						
96	" " Connection Nut—Union	YF96B		2	3		2	3	4	5	6
96A	" " Connection Nut—Nozzle	YKA96B1	1	2	3	1	2	3	4	5	6
210A	" " Connection Gland—Union	YKA210A					2	3	4	5	6
210B	" " Connection Gland—Union	YJA210A		2	3						

List Division No. 2. **Upper and Lower Base**



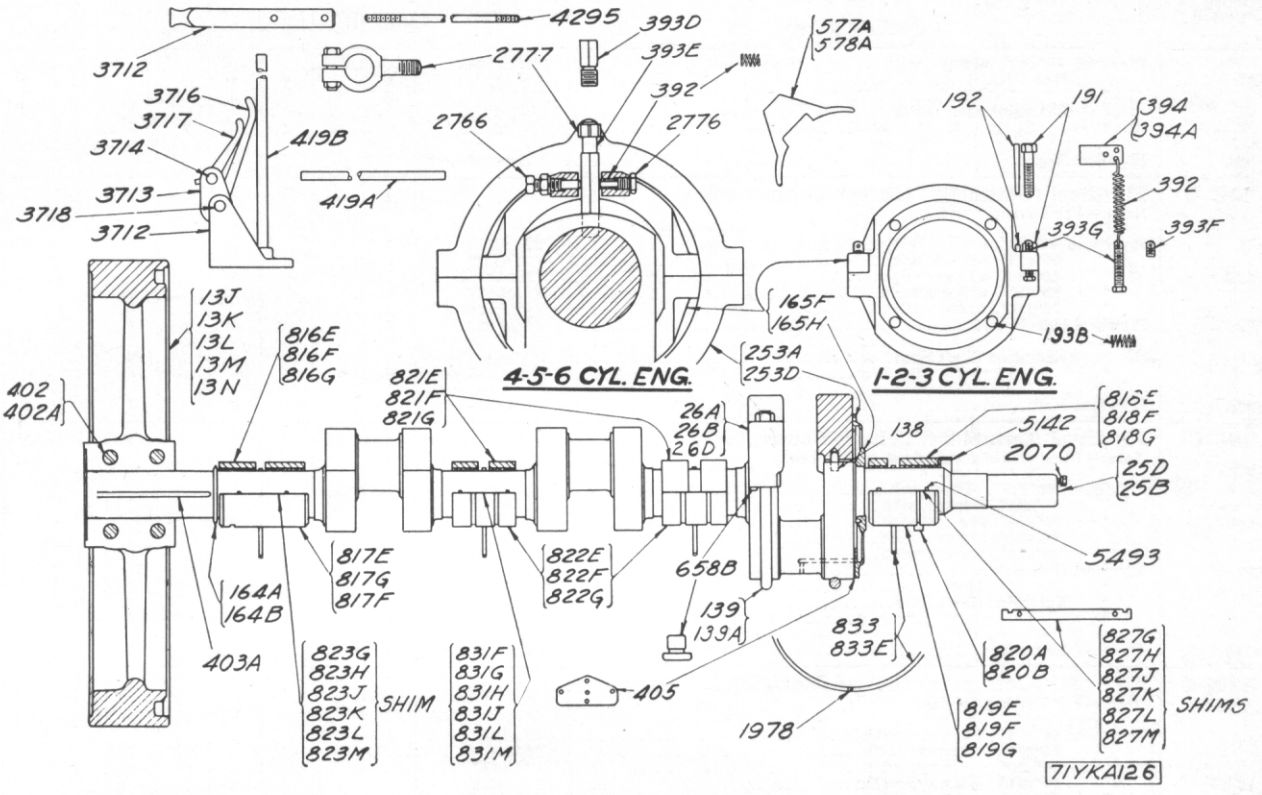
Repair Chart No. 2

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
420	Injection Tube Connection Nut—Pump	YKA420A	1	2	3	1	2	3	4	5	6
205A	" " Connection Gland—Nozzle	YKA205B	.....	.....	.....	.....	2	3	4	5	6
205B	" " Connection Gland—Nozzle	YKA205C	1	2	3						
1325	" " Union	YK1325A	.....	.....	.....	.....	2	3	4	5	6
1325A	" " Union	Y2JA1325A	.....	2	3						
214	" " Union Gasket	YKA214A	.....	2	3	.....	2	3	4	5	6
6726	Pipe Gland Nut Wrench (Not Shown)	YKA6726A	1	1	1	1	1	1	1	1	1
2F-C	**Upper Base (Complete), Cyl. #1**	.....	**1**	**1**	**1**						
2F	**Upper Base, always with**	**YJA2G4**	**1**	**1**	**1**						
	" " Cylinder Stud	1⅜″x5½″	12	12	12						
	Hand Hole Cover Stud	⅝″x2¼	6	6	6						
	Upper Base Oil Ring Pipe Plug	⅛″	3	3	3						
	Air Valve Stud	⅝″x2¼″	6	6	6						
2311	Upper Base Oil Ring Cover	YKA2311A	2	2	2						
2364	" " " " Gasket	YKA2364A	2	2	2						
	" " " " Cap Screw	⅜″x¾″	8	8	8						
409B	Upper Base to Lower Base Dowel	YKA409B	4	4	4						
604A	Cylinder Stud Nut	YJA604A	4								
2763	" " Washer	YJA2763A	2								
2773	Lower Step Nut	YKA2773A	2								
2774	" " Washer	YKA2774A	2								
182B	Upper Base Hand Hole Cover	YJA182C	1	1	1						
199A	" " " " " Gasket	YJ199	1	1	1						
2H-C	**Upper Base (Complete), Cyl. #2, #3**	.....	.....	**1**	**2**						
2H	**Upper Base, always with**	**YJA2H4**	.....	**1**	**2**						
	" " Cylinder Stud	1⅜″x5½″	.....	12	24						
	Hand Hole Cover Stud	⅝″x2¼	.....	6	12						
	Air Valve Stud	⅝″x2¼″	.....	6	12						
	Crank Pin Oiler Pipe Plug	⅛″	.....	3	6						
2311	Side Hand Hole Cover	YKA2311A	.....	2	4						
2364	" " " " Gasket	YKA2364A	.....	2	4						
	" " " " Cap Screw	⅜″x¾″	.....	8	16						
409B	Upper Base to Lower Base Dowel	YKA409B	.....	4	8						
182B	Upper Base Hand Hole Cover	YJA182C	.....	1	2						
199A	" " " " " Gasket	YJ199	.....	1	2						
2L-C	**Upper Base (Complete), Cyl. #1**	.....	.....	.....	.....	**1**	**1**	**1**			
2L	**Upper Base, always with**	**YKA2AA**	.....	.....	.....	**1**	**1**	**1**			
	" " Cylinder Stud	1½″x5¾″	.....	.....	.....	12	12	12			
	Hand Hole Cover Stud	⅝″x2¼	.....	.....	.....	6	6	6			
	Upper Base Oil Ring Pipe Plug	⅛″	.....	.....	.....	3	3	3			
	Air Valve Stud	⅝″x2¼″	.....	.....	.....	6	6	6			
2311	Upper Base Oil Ring Cover	YKA2311A	.....	.....	.....	2	2	2			
2364	" " " " Gasket	YKA2364A	.....	.....	.....	2	2	2			
	" " " " Cap Screw	⅜″x¾″	.....	.....	.....	8	8	8			

List Division No. 2. **Upper and Lower Base** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl Used
604A	Cylinder Stud Nut	YKA604A	.....	.....	.....	4					
2763	" " Washer	YKA2763A	.....	.....	.....	2					
182B	Upper Base Hand Hole Cover	YKA182C	.....	.....	.....	1	1	1			
199A	Upper Base Hand Hole Cover Gasket	YK199	.....	.....	.....	1	1	1			
2M-C	**Upper Base (Complete), Cyl. #1**	.....	.....	.....	.....	.....	.....	.....	**1**	**1**	**1**
2M	**Upper Base, always with**	**YKA2Z**	.....	.....	.....	.....	.....	.....	**1**	**1**	**1**
	" " Cylinder Stud	1⅛″x5¾″	.....	.....	.....	.....	.....	.....	12	12	12
	Hand Hole Cover Stud	⅝″x2¼″	.....	.....	.....	.....	.....	.....	6	6	6
	Upper Base Oil Ring Pipe Plug	⅛″	.....	.....	.....	.....	.....	.....	3	3	3
	Air Valve Stud	⅝″x2¼″	.....	.....	.....	.....	.....	.....	6	6	6
2311	Upper Base Oil Ring Cover	YKA2311A	.....	.....	.....	.....	.....	.....	2	2	2
2364	" " " " Gasket	YKA2364A	.....	.....	.....	.....	.....	.....	2	2	2
	" " " " " Cap Screw	⅜″x¾″	.....	.....	.....	.....	.....	.....	8	8	8
182B	Upper Base Hand Hole Cover	YKA182C	.....	.....	.....	.....	.....	.....	1	1	1
199A	" " " " " Gasket	YK199	.....	.....	.....	.....	.....	.....	1	1	1
2N-C	**Upper Base (Complete), Cyl. #2, #3, #4, #5, #6**	.....	.....	.....	.....	.....	**1**	**2**	**3**	**4**	**5**
2N	**Upper Base, always with**	**YKA2Y1**	.....	.....	.....	.....	**1**	**2**	**3**	**4**	**5**
	" " Cylinder Stud	1⅛″x5¾″	.....	.....	.....	.....	12	24	36	48	60
	" " Hand Hole Cover Stud	⅝″x2¼″	.....	.....	.....	.....	6	12	18	24	30
	Air Valve Stud	⅝″x2¼″	.....	.....	.....	.....	6	12	18	24	30
	Upper Base Oil Ring Pipe Plug	⅛″	.....	.....	.....	.....	3	6	9	12	15
2311	Upper Base Oil Ring Cover	YKA2311A	.....	.....	.....	.....	2	4	6	8	10
2364	" " " " Gasket	YKA2364A	.....	.....	.....	.....	2	4	6	8	10
	" " " " Cap Screw	⅜″x¾″	.....	.....	.....	.....	8	16	24	32	40
182B	Upper Base Hand Hole Cover	YKA182C	.....	.....	.....	.....	1	2	3	4	5
199A	" " " " " Gasket	YK199	.....	.....	.....	.....	1	2	3	4	5
14H-C	**Lower Base (Complete)**	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Lower Base, always with	**YJA14K2**	1								
	" **Base, always with**	**Y2JA14L2**	.....	1							
	" **Base, always with**	**Y3JA14H3**	.....	.....	1						
	" **Base, always with**	**YKA14Q3**	.....	.....	.....	1					
14H	" **Base, always with**	**Y2KA14J2**	.....	.....	.....	.....	1				
	" **Base, always with**	**Y3KA14G3**	.....	.....	.....	.....	.....	1			
	" **Base, always with**	**Y4KA14G3**	.....	.....	.....	.....	.....	.....	1		
	" **Base, always with**	**Y5KA14E4**	.....	.....	.....	.....	.....	.....	.....	1	
	" **Base, always with**	**Y6KA14G3**	.....	.....	.....	.....	.....	.....	.....	.....	1
	Upper to Lower Base Stud	1⅜″x7¼″	4	8	12						
	" " " " Stud	1⅛″x4½″	6	12	18	8	16	24	32	40	48
	" " " " Stud	1⅛″x6¾″	4	8	12	4	8	12	16	20	24
	Main Bearing Stud (Gov. End)	1¼″ x 9¼″	.....	.....	.....	2	2	2	2	2	2
	Main Bearing Stud	1⅜″x8½″	6	6	6						
	" " Stud	1¼″x9″	.....	.....	.....	4	4	4	4	4	4
	" " Stud	1¼″x6¼″	.....	.....	.....	.....	2	4	6	8	10
	Main Bearing Stud	1⅜″x6″	.....	2	4						
	Governor Case Stud	½″x1¾″	6	6	6	6	6	6	6	6	6
	Lubricating Oil Sump Stud	⅝″x8¼″	2	2	2	2	2	2	2	2	2
	Governor Drain Pipe Plug	½″	1	1	1	1	1	1	1	1	1
2068	Crank Pin Oiler Bracket	YKA2068A1	1	2	3	1	2	3	4	5	6
	" " " " Cap Screw	⅜″x1″	2	4	6	2	4	6	8	10	12
	" " " " Lockwasher	⅜″	2	4	6	2	4	6	8	10	12
254A	" " " Spout	YKA254A	1	2	3	1	2	3	4	5	6
	" " Lubricator Oil Tube Fitting	⅛″P.x¼″T.	1	2	3	1	2	3	4	5	6
	" " " " Tube Elbow	⅛″P.x¼″T.	1	2	3	1	2	3	4	5	6
	" " " " Tube	YJA1336A	1	2	3						
1336A	" " " " Tube	YKA1336A	.....	.....	.....	1	2	3	4	5	6
812D	Main Bearing Shell Oil Stop	YJA812D	2	2	2						
812F	" " " " Stop	YKA812H1	.....	.....	.....	2	2	2	2	2	2
813B	" " " " Stop	YJA813C	2	2	2						
813D	" " " " Stop	YKA813C	.....	.....	.....	2	2	2	2	2	2
814B	Main Bearing Shell Oil Stop (Center)	Y2JA814C	.....	2	4						
814D	" " " " Stop (Center)	Y2KA814E	.....	.....	.....	.....	2	4	6	8	10
805D-C	Bearing Cap (Gov. End)	.....	1	1	1						
805F-C	" " (Gov. End)	.....	.....	.....	.....	1	1	1	1	1	1
806D-C	" " (Opp. Gov. End)	.....	1	1	1						
806F-C	" " (Opp. Gov. End)	.....	.....	.....	.....	1	1	1	1	1	1
807D-C	" Cap (Center)	.....	.....	1	2						
807F-C	" " (Center)	.....	.....	.....	.....	.....	1	2	3	4	5
	Main Bearing to Upper Base Capscrew	1½″ x 7¼″	.....	.....	.....	4	8	12	16	20	24
409D	" " " " " Dowel	YKA409C	.....	.....	.....	4	8	12	16	20	24
3458	Thrust Blocks (Gov. and Opp. Gov. End)	YKA3458B1	4	4	4						
3458A	" Blocks (Center)	YKA3458C1	.....	2	4						
	" " Taper Dowel	⅛″	1	1	1						
409A	" " Taper Dowel	YKA409A	8	12	16						
	" " Cap Screw	⅝″x2¼″	4	6	8						
298D-C	Bearing Oil Gauge	.....	1	1	1	1	1	1	2	2	2
355B-C	Lower Base Air Inlet	.....	1	1	2	1	1	1	2	2	2
2F-C	Upper Base (Cyl. #1)	.....	1	1	1						
2H-C	" Base (Cyl. #2, #3)	.....	.....	1	2						
2L-C	" Base (Cyl. #1)	.....	.....	.....	.....	1	1	1			
2M-C	" Base (Cyl. #1)	.....	.....	.....	.....	.....	.....	.....	1	1	1
2N-C	" Base (Cyl. #2, #3, #4, #5, #6)	.....	.....	.....	.....	.....	1	2	3	4	5
197B	Upper to Lower Base Gasket	YJA197B	2	4	6						
	" " " " Gasket	YJA197C	4	8	12						
197D	" " " " Gasket	YKA197D	.....	.....	.....	4	8	12	16	20	24
197E	Upper Base to Lower Base Gasket (Used with YKA197D)	YKA197E	.....	.....	.....	2	4	6	8	10	12
	Bearing Oil Piping (Not Fur. Sep.)	.....	1	1	1	1	1	1	1	1	1
	Oil Drain Piping (Not Fur. Sep.)	.....	1	1	1	1	1	1	1	1	1
	Lower Base Pipe Plug	2½″	4	6	8	4	6	8	10	12	14
	¾″ C. P. S. F. Nuts	.....	4	8	12						
	1⅛″ C. P. S. F. Nuts	.....	16	28	40	12	24	36	48	60	72
	1¼″ C. P. S. F. Nuts	.....	.....	.....	.....	6	8	10	12	14	16
	1⅜″ C. P. S. F. Nuts	.....	4	8	12						
	⅞″ C. P. S. F. Nuts	.....	1	1	1						
	⅞″ Plate Washer	.....	1	1	1						

List Division No. 3. **Crankshaft, Flywheel and Bearings**



Repair Chart No. 3

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
D5852T	Base Sump Nipple (6")	Y5KA5852A	.....	.....	.....	.....	.....	.....	.....	1	1
E5852T	" " Nipple (6½")	Y6KA5852A	.....	.....	.....	.....	.....	.....	.....	.....	1
A6844K	Base Sump Pipe (22")	YKA6844G	.....	.....	.....	1	1	1	1	1	1
B6844K	" " Pipe (55")	YKA6844H	.....	.....	.....	.....	1	1	1	1	1
C6844K	" " Pipe (88")	YKA6844J	.....	.....	.....	.....	.....	1	1	1	1
D6844K	" " Pipe (121")	YKA6844K	.....	.....	.....	.....	.....	...	1	↓	1
E6844K	" " Pipe (154")	YKA6844L	.....	.....	.....	.....	.....	.....	.....	1	1
F6844K	" " Pipe (187")	YKA6844M	.....	.....	.....	.....	.....	.....	.....	.....	1
	" " Pipe.....19FM5A	½" x 21½"	1	1	1						
	" " Pipe.....19FM5A	½" x 51"	.....	1	1						
	" " Pipe.....19FM5A	½" x 80"	.....	.....	1						
1090	Base Sump Pipe Clamp	Y3KA1090A	.....	.....	2	.....	.....	2	2	2	2
	" " " Clamp	Y4KA1090A	.....	.....	.....	.....	.....	.....	2	2	2
	" " " Clamp	Y6K1090A	.....	.....	.....	.....	.....	.....	.....	2	2
	" " " " Capscrew	½" x 2"	.....	.....	.....	.....	.....	2	4	7	7
	" " " " Capscrew	½" x 2¼"	.....	.....	2						
	" " " " Nut	½"	.....	.....	2	.....	.....	2	4	7	7
	" " " " Lockwasher	½"	.....	.....	2	.....	.....	2	4	7	7
	" " Pipe Elbow	½"	1	2	3	1	2	3	4	5	6
5851A	" " Drain Plug	YKA5851D	1	2	3	1	2	3	4	5	6
13H-C	**Flywheel (Complete) (Belted Commercial)** Note:—For Barring Device.	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Flywheel—66"x7", always with	**YJA13T**	1								
	" —66"x6", always with	**Y3JA13F**	.....	1							
13H	**" —66"x11", always with**	**Y2JA13Y**	.....	.....	1						
	" —76"x8", always with	**Y6KA13T**	.....	.....	.....	1	1	1			
	" —78"x10", always with	**Y4KA13G**	.....	.....	.....	.....	.....	.....	1	1	1
402	Flywheel Hub Bolt	YKA402A	4	4	4	4	4	4	4	4	4
⊕⊕⊕	" " " Nut.....11FM25A	2¼" C.P.	8	8	8	8	8	8	8	8	8
	" Extension Shaft Stud.....11FM5A	1½" x 6¾"	6	6	6	6	6	6	6	6	6
	" " " " Nut.....11FM25A	1½" C.P.	6	6	6	6	6	6	6	6	6
403A	" Key										
13J-C	**Flywheel (Complete) (Belted Commercial)** Note:—Rims drilled for straight pulling bar.	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Flywheel 66"x 7", always with	**YJA13V**	1								
	" 66"x 6", always with	**Y3JA13G**	.....	1							
13J	**" 66"x11", always with**	**Y2JA13Z**	.....	.....	1						
	" 76"x 8", always with	**Y6KA13U**	.....	.....	.....	1	1	1			

List Division No. 3. **Crankshaft, Flywheel and Bearings** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl Used	14″x17″ 6 Cyl. Used
402	Flywheel 78″x10″, always with	Y4KA13H	.....	.....	.....	.....	.....	.....	1	1	1
	" Hub Bolt	YKA402A	4	4	4	4	4	4	4	4	4
	" " " Nut	2¼″ C. P.	8	8	8	8	8	8	8	8	8
	" Extension Shaft Stud	1½″x6¾″	6	6	6	6	6	6	6	6	6
	" " " " " Nut	1½″ C. P.	6	6	6	6	6	6	6	6	6
403A	Flywheel Key	YKA403A	1	1	1	1	1	1	1	1	1
13K-C	**Flywheel (Complete) (Direct Connected)** Note:—For Barring Device.	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
13K	Flywheel 66″x13″, always with	YJA13U	1								
	" 66″x11″, always with	Y2JA13Y	.....	1	1						
	" 80″x14″, always with	YKA13AA	.....	.....	.....	1					
	" 78″x10″, always with	Y2KA13Z	.....	.....	.....	.....	1	1			
	" 78″x10″, always with	Y4KA13G	.....	.....	.....	.....	.....	.....	1	1	1
402	Flywheel Hub Bolt	YKA402A	4	4	4	4	4	4	4	4	4
	" " " Nut	2¼″ C. P.	8	8	8	8	8	8	8	8	8
	" Extension Shaft Stud	1½″x6¾″	6	6	6	6	6	6	6	6	6
	" " " " " Nut	1½″ C. P.	6	6	6	6	6	6	6	6	6
403A	Flywheel Key	YKA403A	1	1	1	1	1	1	1	1	1
13L-C	**Flywheel (Complete) (Direct Connected)** Note:—Rims drilled for straight pulling bar.	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
13L	Flywheel, 66″x13″, always with	YJA13W	1								
	" 66″x11″, always with	Y2JA13Z	.....	1	1						
	" 80″x14″, always with	YKA13AB	.....	.....	.....	1					
	" 78″x10″, always with	Y2KA13AA	.....	.....	.....	.....	1	1			
	" 78″x10″, always with	Y4KA13H	.....	.....	.....	.....	.....	.....	1	1	1
402	Flywheel Hub Bolt	YKA402A	4	4	4	4	4	4	4	4	4
	" " " Nut	2¼″ C. P.	8	8	8	8	8	8	8	8	8
	" Extension Shaft Stud	1½″x6¾″	6	6	6	6	6	6	6	6	6
	" " " " " Nut	1½″ C. P.	6	6	6	6	6	6	6	6	6
403A	Flywheel Key	YKA403A	1	1	1	1	1	1	1	1	1
13M-C	**Flywheel (Complete) (Belted Electric)** Note:—For Barring Device.	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
13M	Flywheel 56″x16½″, always with	YJA13R	1								
	" 56″x16″ always with	Y2JA13W	.....	1							
	" 56″x20″ always with	Y3JA13J	.....	.....	1						
	" 67″x16″ always with	YKA13X	.....	.....	.....	1					
	" 67″x18″ always with	Y2KA13V	.....	.....	.....	.....	1				
	" 67″x25″ always with	Y3KA13P	.....	.....	.....	.....	.....	1			
	" 78″x10″ always with	Y4KA13G	.....	.....	.....	.....	.....	.....	1	1	1
402	" Hub Bolt	YKA402A	4	.....	4	4	4	4	4	4	4
402A	" " Bolt	YJA402B	.....	4							
	" " " Nut	2¼″ C. P.	8	8	8	8	8	8	8	8	8
	" Extension Shaft Stud	1½″x6¾″	6	6	6	6	6	6	6	6	6
	" " " " " Nut	1½″ C. P.	6	6	6	6	6	6	6	6	6
403A	Flywheel Key	YKA403A	1	1	1	1	1	1	1	1	1
13N-C	**Flywheel (Complete) (Belted Electric)** Note:—Rims drilled for straight pulling bar.	.....	.....	.....	.....	.....	.....	.....	**1**	**1**	**1**
13N	Flywheel 78″x10″, always with	Y4KA13H	.....	.....	.....	.....	.....	.....	1	1	1
402	" Hub Bolt	YKA402A	.....	.....	.....	.....	.....	.....	4	4	4
	" " " Nut	2¼″ C. P.	.....	.....	.....	.....	.....	.....	8	8	8
	" Extension Shaft Stud	1½″x6¾″	.....	.....	.....	.....	.....	.....	6	6	6
	" " " " " Nut	1½″ C. P.	.....	.....	.....	.....	.....	.....	6	6	6
403A	Flywheel Key	YKA403A	.....	.....	.....	.....	.....	.....	1	1	1
13P-C	**Flywheel (Complete) (Belted Commercial and Belted Electric for Overhung Drive)** Note:—For Barring Device.	.....	**1**	**1**	**1**	**1**	**1**	.....	.....	.....	.....
13P	Flywheel—67″x11″ (Commercial Flat-Belt), always with	YKA13AF	.....	.....	.....	1					
	" —67″x11″ (Commercial V-Belt), always with	YKA13AG	.....	.....	.....	1					
	" —67″x18″ (Commercial and Electric Flat-Belt), always with	Y2KA13V	.....	.....	.....	.....	1				
	" —67″x19″ (Commercial and Electric V-Belt), always with	Y2KA13AK	.....	.....	.....	.....	1				
	" —56″x16½″ (Electric Flat-Belt), always with	YJA13AF	1								
	" —56″x18″ (Electric V-Belt), always with	YJA13AD	1								
	" —56″x11″ (Commercial Flat-Belt), always with	YJA13AE	1								
	" —56″x″11″ (Commercial V-Belt), always with	YJA13AC	1								
	" —56″x16″ (Electric Flat-Belt), always with	Y2JA13W	.....	1							
	" —56″x16″ (Electric V-Belt), always with	Y2JA13AP	.....	1							
	" —50″x16″ (Commercial Flat-Belt), always with	Y2JA13AM	.....	1							
	" —50″x16″ (Commercial V-Belt), always with	Y2JA13AK	.....	1							
	" —50″x24″ (Commercial Flat-Belt), always with	Y3JA13P	.....	.....	1						
	" —50″x24″ (Commercial V-Belt), always with	Y3JA13N	.....	.....	1						
402A	Flywheel Hub Bolt	YJA402B	4	4	4						
402	" " Bolt	YKA402A	.....	.....	.....	4	4				
	" " " Nut 11FM25A	2¼″	8	8	8	8	8				
403A	" Key	YKA403A	.....	.....	.....	1	1				
403A	" Key	YKA403C	1	1	1						
25B-C	**Crankshaft (Complete)**	.....	.....	.....	.....	**1**	**1**	**1**			
25B	Crankshaft (8″ Diam., always with	YKA25C1	.....	.....	.....	1					
	" (8″ Diam.), always with	Y2KA25C2	.....	.....	.....	.....	1				
	" (8″ Diam.), always with	Y3KA25B3	.....	.....	.....	.....	.....	1			

List Division No. 3. **Crankshaft, Flywheel and Bearings** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
164A	Crankshaft Oil Throw Ring	YKA164A	.....	.....	.....	1	1	1			
26B	" Counterweight	YKA26A	.....	.....	.....	2	4				
26D	" Counterweight	Y3KA26C2	.....	.....	.....	.....	.....	6			
138	" " Dowel	YK138	.....	.....	.....	2	4	6			
139	" " Bolt with Nut	YKA139A	.....	.....	.....	2	4				
139A	" " Bolt with Nut	YKA139B	.....	.....	.....	.....	.....	6			
658B	" " Mushroom	Y3K658	.....	.....	.....	4	8	12			
	" Governor Spider Stud	5/8″x2¼″	.....	.....	.....	3	3	3			
	" " " " Nut	5/8″ C. P.	.....	.....	.....	3	3	3			
2070	Crankshaft Governor Spider Stud Washer	YKA2070A	.....	.....	.....	3	3	3			
405	Oil Ring to Shaft Gasket	YK405	.....	.....	.....	1	2	3			
253A-C	Crank Pin Oil Ring	.....	.....	.....	.....	1	2	3			
165G-C	Air Stop Ring	.....	.....	.....	.....	2	4	6			
25D-C	**Crankshaft (Complete)**	.....	**1**	**1**	**1**	.....	.....	.....	**1**		**1**
	Crankshaft (7½″ Diam.), always with	**YJA25B1**	1								
	" (7½″ Diam.), always with	**Y2JA25C2**	.....	1							
25D	**" (7½″ Diam.), always with**	**Y3JA25A2**	.....	.....	1						
	Crankshaft (9″ Diam.), always with	**Y4KA25H2**	.....	.....	.....	.....	.....	.....	1		
	" (9″ Diam.), always with	**Y6KA25G1**	.....	.....	.....	.....	.....	.....	.....	.....	1
164A	Crankshaft Oil Throw Ring	YKA164A	1	1	1						
164B	" " " Ring	Y6KA164B	.....	.....	.....	.....	.....	.....	1	1	1
26A	Crankshaft Counterweight	YJA26A	2	4							
26D	" Counterweight	YJA26E	.....	.....	6						
138	" " Dowel	YK138	2	4	6						
139	" " Bolt	YJA139A	2	4							
139A	" " Bolt	YJA139C	.....	.....	6						
	" " " Nut	1½″ C. P.	4	8	12						
658B	" " Mushroom	Y3K658	4	8	12						
	Crankshaft Governor Spider Stud	5/8″x2¼″	3	3	3	.....	.....	.....	3	3	3
	" " " " Nut	5/8″ C. P.	3	3	3	.....	.....	.....	3	3	3
2070	Crankshaft Governor Spider Stud Washer	YKA2070A	3	3	3	.....	.....	.....	3	3	3
405	Crank Pin Oil Ring to Shaft Gasket	YK405	1	2	3	.....	.....	.....	4	5	6
253A-C	" " " Ring	.....	1	2	3						
253D-C	" " " Ring	.....	.....	.....	.....	.....	.....	.....	4	5	6
165H-C	Air Stop Ring	.....	2	4	6	.....	.....	.....	8	10	12
25E-C	**Crankshaft (Complete)**	.....	.....	.....	.....	.....	.....	.....	.....	**1**	.....
25E	Crankshaft (9″ Diam.)	**Y5KA25D**	.....	.....	.....	.....	.....	.....	.....	1	
	Remainder of group same as 25D-C.										
165K-C	**Air Stop Ring (Complete)**	.....	.....	.....	.....	**2**	**4**	**6**			
165K	**Air Stop Ring (Top), always with**	**YKA165E1**	.....	.....	.....	**2**	**4**	**6**			
	" " Ring (Bottom)	YKA165F1	.....	.....	.....	2	4	6			
191	" " " Bolt	YK191A	.....	.....	.....	4	8	12			
	" " " " Lockwasher	5/8″	.....	.....	.....	4	8	12			
	" " " " Lockwire	1/16″x3½″	.....	.....	.....	4	8	12			
192	" " " Dowel	Y2J192	.....	.....	.....	4	8	12			
393H	Back Lash Set Screw	YKA393C	.....	.....	.....	4	8	12			
392	" " Spring	YK392A	.....	.....	.....	2	4	6			
394	" " " Clip	YK394	.....	.....	.....	2	4				
394A	" " " Clip	YKA394A	.....	.....	.....	.....	.....	6			
193B	Air Stop Ring Spring	YKA193A1	.....	.....	.....	8	16	24			
	" " " Cap Screw	5/16″x2″	.....	.....	.....	2	4				
	" " " " "	5/16″x2½″	.....	.....	.....	.....	.....	6			
	" " " " " Nut	5/16″ C. P.	.....	.....	.....	2	4	6			
	Dog Point Set Screw Jam Nut	½″ C. P.	.....	.....	.....	6	12	18			
	Air Stop Ring Lockwasher	½″	.....	.....	.....	6	12	18			
165H-C	**Air Stop Ring (Complete)**	.....	**2**	**4**	**6**	.....	.....	.....	**8**	**10**	**12**
165H	**Air Stop Ring (Bottom), always with**	**YJA165F**	**2**	**4**	**6**						
	" " Ring (Bottom), always with	**Y6KA165E1**	.....	.....	.....	.....	.....	.....	**8**	**10**	**12**
	" " Ring (Top)	YJA165E1	2	4	6	.....	.....	.....			
	" " Ring (Top)	Y6KA165F1	.....	.....	.....	.....	.....	.....	8	10	12
191	Air Stop Ring Bolt	YK191A	4	8	12	.....	.....	.....	16	20	24
	" " " " Lockwasher	5/8″	4	8	12	.....	.....	.....	16	20	24
	" " " " Lockwire	1/16″x3½″	4	8	12	.....	.....	.....	16	20	24
192	Air Stop Ring Dowel	Y2J192	4	8	12	.....	.....	.....	16	20	24
392	Air Stop Ring Back Lash Spring	YK392	2	4	6						
393G	" " " " " Screw	YKA393B4	2	4	6						
393J	" " " " " Screw	YKA393D1	2	4	6						
394	" " " " " Clip	YK394	2	4							
394A	" " " " " Clip	YJA394B	.....	.....	6						
393D	Driving Stud	Y4KA393A1	.....	.....	.....	.....	.....	.....	4	5	6
393E	Oil Throw Ring Driving Stud	Y4KA393B1	.....	.....	.....	.....	.....	.....	4	5	6
392	Driving Spring	Y4KA392B	.....	.....	.....	.....	.....	.....	8	10	12
2776	" " Plug	Y4KA2776B	.....	.....	.....	.....	.....	.....	8	10	12
193B	Air Stop Ring Spring	YKA193A1	8	16	24	.....	.....	.....	32	40	48
2766	Driving Set Screw	Y4KA2766B	.....	.....	.....	.....	.....	.....	8	10	12
	" " " Lockwasher	⅛″	.....	.....	.....	.....	.....	.....	16	20	24
	" " " Jam Nut	⅛″ C. P.	.....	.....	.....	.....	.....	.....	8	10	12
2777	Driving Clamp	Y4KA2777A1	.....	.....	.....	.....	.....	.....	4	5	6
	" " Cap Screw	⅜″x1¾″	.....	.....	.....	.....	.....	.....	4	5	6
	" " " " Lockwasher	⅜″	.....	.....	.....	.....	.....	.....	4	5	6
	" " " " Nut	⅜″ C. P.	.....	.....	.....	.....	.....	.....	4	5	6
	" " Lockwasher	½″	.....	.....	.....	.....	.....	.....	4	5	6
	" " Nut	½″ C. P.	.....	.....	.....	.....	.....	.....	4	5	6
253A-C	**Crank Pin Oil Ring (Complete)**	.....	**1**	**2**	**3**	**1**	**2**	**3**			
253A	**Crank Pin Oil Ring, always with**	**Y4KA253A2**	**1**	**2**	**3**	**1**	**2**	**3**			
	" " " Ring, always with	**Y4KA253B1**	**1**	**2**	**3**	**1**	**2**	**3**			

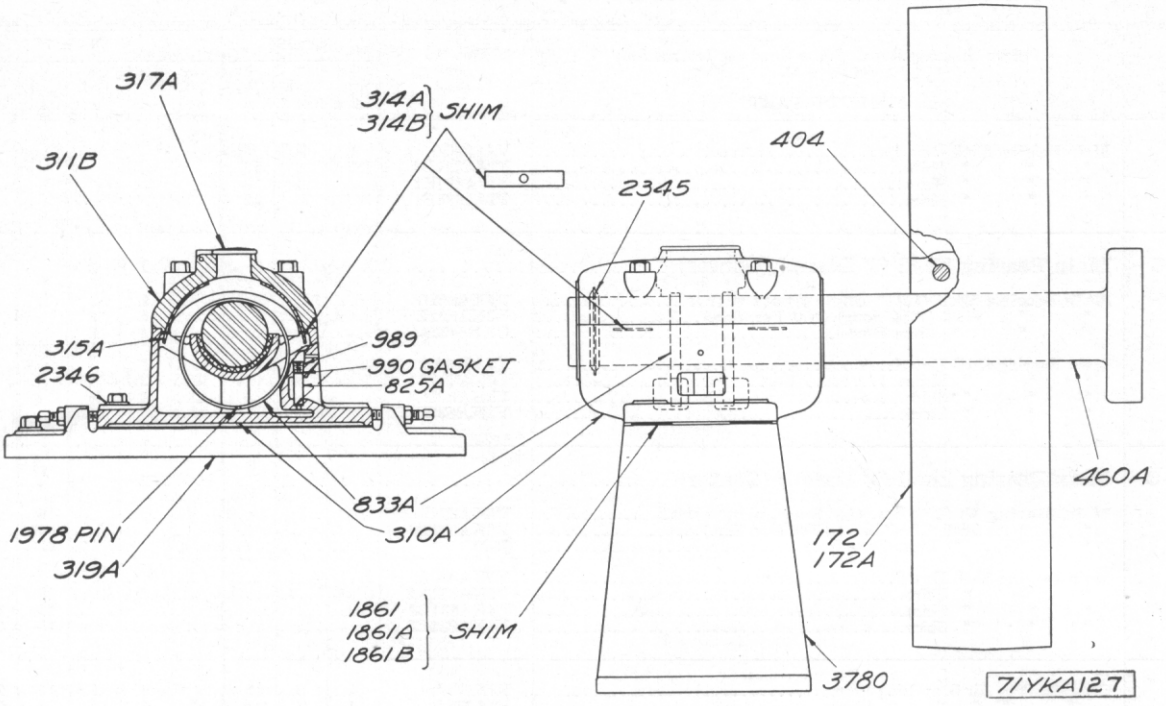
List Division No. 3. **Crankshaft, Flywheel and Bearings** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
	Crank Pin Oil Ring Cap Screw	1/2″x4 1/4″	2	4	6	2	4	6			
	" " " " " " Lockwasher	1/2″	2	4	6	2	4	6			
253D-C	**Crank Pin Oil Ring (Complete)**								**4**	**5**	**6**
253D	**Crank Pin Oil Ring, always with**	**Y6KA253C**							**4**	**5**	**6**
	" " " **Ring, always with**	**Y6KA253D**							**4**	**5**	**6**
	" " " " Cap Screw	1/2″x4 1/4″							4	5	6
	" " " " " " Lockwasher	1/2″							4	5	6
816E-C	**Main Bearing Shell (7 1/2″ Diam.) (Opp. Gov. End)**		1	1	1						
816E	**Main Bearing Shell (2 pcs. 5 1/8″ lg.), always with**	**YJA816D1**	1	1	1						
817E	" " Shell (12 9/16″ long) (Not Fur. Sep.)	YJA817D3	1	1	1						
5493	" " " Shim Dowel	CKB5493A	4	4	4						
820A	Main Bearing Shell Dowel	YJA820A	1	1	1						
823G	" " " Shim	YJA823D1	6	6	6						
823H	" " " Shim	YJA823E1	4	4	4						
823J	" " " Shim	YJA823F1	6	6	6						
816F-C	**Main Bearing Shell (8″ Diam.) (Opp. Governor)**					1	1	1			
816F	**Main Bearing Shell (14 1/16″ lg.), always with**	**YKA816D1**				1	1	1			
817H	" " Shell (14 7/8″ long) (Not Fur. Sep.)	YKA817E				1	1	1			
5493	" " " Shim Dowel	CKB5493A				4	4	4			
820A	Main Be ing Shell Dowel	YJA820A				1	1	1			
823G	" " " Shim	YKA823K1				2	2	2			
823H	" " " Shim	YKA823L1				4	4	4			
823J	" " " Shim	YKA823M1				8	8	8			
816G-C	**Main Bearing Shell (9″ Diam.) (Opp. Gov. End)**								1	1	1
816G	**Main Bearing Shell (6 7/8″, 6 5/8″ long), always with**	**Y6KA816E1**							1	1	1
817G	" " Shell (14 7/8″ long) (Not Fur. Sep.)	Y6KA817E3							1	1	1
	" " " Shim Dowel	#409							4	4	4
820B	Main Bearing Shell Dowel	Y5KA820A							1	1	1
823K	" " " Shim	Y4KA823A1							6	6	6
823L	" " " Shim	Y4KA823B1							4	4	4
823M	" " " Shim	Y4KA823C1							6	6	6
818E-C	**Main Bearing Shell (7 1/2″ Diam.) (Governor End)**		1	1	1						
818E	**Main Bearing Shell (2 9/16″, 5 3/8″ long), always with**	**YJA818D1**	1	1	1						
819E	" " Shell (Not Fur. Sep.)	YJA819D3	1	1	1						
5493	" " " Shim Dowel	CKB5493A	4	4	4						
820A	Main Bearing Shell Dowel	YJA820A	1	1	1						
827G	" " " Shim	YJA827G2	6	6	6						
827H	" " " Shim	YJA827F2	4	4	4						
827J	" " " Shim	YJA827E2	6	6	6						
818F-C	**Main Bearing Shell (8″ Diam.) (Governor End)**					1	1	1			
818F	**Main Bearing Shell (2 11/16″, 4 1/16″ long), always with**	**YKA818C**				1	1	1			
819F	" " Shell (8 7/8″ long) (Not Fur. Sep.)	YKA819D				1	1	1			
5493	" " " Shim Dowel	CKB5493A				4	4	4			
820A	Main Bearing Shell Dowel	YJA820A				1	1	1			
827G	" " " Shim	YKA827G2				2	2	2			
827H	" " " Shim	YKA827H2				4	4	4			
827J	" " " Shim	YKA827J2				8	8	8			
818G-C	**Main Bearing Shell (9″ Diam.) (Governor End)**								1	1	1
818G	**Main Bearing Shell (2 11/16″, 4 1/16″ long), always with**	**Y6KA818E**							1	1	1
819G	" " Shell (8 7/8″ long) (Not Fur. Sep.)	Y6KA819E							1	1	1
	" " " Shim Dowel	#409							4	4	4
820B	Main Bearing Shell Dowel	Y5KA820A							1	1	1
827K	" " " Shim	Y4KA827A3							6	6	6
827L	" " " Shim	Y4KA827B3							4	4	4
827M	" " " Shim	Y4KA827C3							6	6	6
821E-C	**Main Bearing Shell (7 1/2″ Diam.) (Center)**			1	2						
821E	**Main Bearing Shell (2 Pcs. 3 11/16″ long), always with**	**Y2JA821E**		1	2						
822E	" " Shell (8 5/8″ long) (Not Fur. Sep.)	Y2JA822E2		1	2						
5493	" " " Shim Dowel	CKB5493A		4	8						

List Division No. 3. **Crankshaft, Flywheel and Bearings** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
820A	Main Bearing Shell Dowel	YJA820A	2	3	4						
831F	" " " Shim	Y2JA831D1	.....	6	12						
831G	" " " Shim	Y2JA831E1	.....	4	8						
831H	" " " Shim	Y2JA831F1	.....	6	12						
821F-C	**Main Bearing Shell (8″ Diam.) (Center)**	.....	.....	.....	.....	.....	**1**	**2**			
821F	**Main Bearing Shell (10⅝″ long), always with**	**Y2KA821C**	.....	.....	.....	.....	**1**	**2**			
822F	" " Shell (10⅝″ long) (Not Fur. Sep.)	Y2KA822E	.....	.....	.....	.....	1	2			
5493	" " " Shim Dowel	CKB5493A	.....	.....	.....	.....	4	8			
820A	Main Bearing Shell Dowel	YJA820A	.....	.....	.....	.....	1	2			
831F	" " " Shim	Y2KA831B1	.....	.....	.....	.....	2	4			
831G	" " " Shim	Y2KA831C1	.....	.....	.....	.....	4	8			
831H	" " " Shim	Y2KA831D1	.....	.....	.....	.....	8	16			
821G-C	**Main Bearing Shell (9″ Diam.) (Center)**	.....	.....	.....	.....	.....	.....	.....	**3**	**4**	**5**
821G	**Main Bearing Shell (2 Pcs. 4⅛″ long), always with**	**Y6KA821E**	.....	.....	.....	.....	.....	.....	**3**	**4**	**5**
822G	" " Shell (10⅜″ long) (Not Fur. Sep.)	Y6KA822F2	.....	.....	.....	.....	.....	.....	3	4	5
	" " " Shim Dowel	#409	.....	.....	.....	.....	.....	.....	12	16	20
820B	Main Bearing Shell Dowel	Y5KA820A	.....	.....	.....	.....	.....	.....	3	4	5
831J	" " " Shim	Y4KA831A2	.....	.....	.....	.....	.....	.....	18	24	30
831L	" " " Shim	Y4KA831B2	.....	.....	.....	.....	.....	.....	12	16	20
831M	" " " Shim	Y4KA831C2	.....	.....	.....	.....	.....	.....	18	24	30
577A	Crankshaft to Air Stop Ring Shim	YJA577A	4	8	12	4	8	12	16	20	24
578A	" " " " " " Shim	YJA578A	4	8	12	4	8	12	16	20	24
833F	Main Bearing Oil Ring (Fur. in Pairs with #1978B)	YKA833A1	2 Pr.	3 Pr.	4 Pr.	2 Pr.	3 Pr.	4 Pr.			
833G	" " " Ring (Fur. in Pairs with #1978B)	Y4KA833A1	.....	.....	.....	.....	.....	.....	5 Pr.	6 Pr.	7 Pr.
1978	" " " " Hinge Pin	YKA1978B	4	6	8	4	6	8	10	12	14
5142	Main Bearing Shell Oil Deflector	YJA5142A	1	1	1						
	" " Shell Oil Deflector	YKA5142A	.....	.....	.....	1	1	1	1	1	1
5493	Main Bearing Shell Dowel	CKB5493A	8	12	16	8	12	16			
	Main Bearing Shell Oil Deflector Screw	¼—20 x ¼″	4	4	4						
	" " " " " " Screw	¼—20 x 5/16″	.....	.....	.....	4	4	4	4	4	4
3712-C	**Barring Device (Complete)**	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
3712	Barring Fulcrum	YJA3712B	1	1	1						
	" " Cap Screw	1″x4″	2	2	2						
3712	" Bracket	YKA3712D	.....	.....	.....	1	1	1	1	1	1
	" " Set Screw	½″x1¼″	.....	.....	.....	2	2	2	2	2	2
3713	" Socket	YKA3713B	.....	.....	.....	1	1	1	1	1	1
	" " Set Screw	½″x1¼″	.....	.....	.....	2	2	2	2	2	2
3716	Barring Pawl (Long)	YKA3716A	.....	.....	.....	1	1	1	1	1	1
3717	" Pawl (Short)	YKA3717A	.....	.....	.....	1	1	1	1	1	1
3714	" Bracket Socket Pin	YKA3714A	.....	.....	.....	1	1	1	1	1	1
3718	" " Fulcrum Pin	YKA3718A	.....	.....	.....	1	1	1	1	1	1
419A	Barring Bar	YK419	1	1	1						
419B	" Bar	YK419C	.....	.....	.....	1	1	1	1	1	1
4295	" Fulcrum Stud	YJA4295A	1	1	1						
	" " " Nut	¾″ C. P.	3	3	3						

List Division No. 4. **Outboard Bearing and Pulleys**



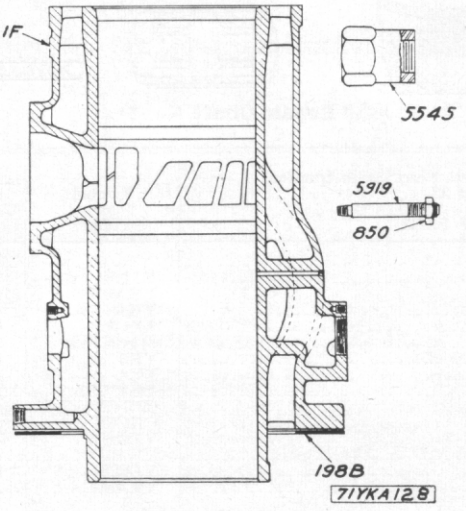
Repair Chart No. 4

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
310A-C	**Outboard Bearing (Complete)**		**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	
310A	**Outboard Bearing Body, always with (5x20)**	**YKA310B**	**1**	**1**	**1**	**1**	**1**	**2**			
	" " Body, always with (6x20)	**Y6KA310A**							**2**	**2**	
	Bearing Body Pipe Plug	1" C't's'k.	1	1	1	1	1	2	2	2	
	" " Drain Pipe Plug	¾"	2	2	2	2	2	4	4	4	
	" " " Stud	1"x7¾"	4	4	4	4	4	8			
	" " " Stud	1"x8¼"							8	8	
	" " " " Nut	1" C.P.	4	4	4	4	4	8	8	8	
311B	Bearing Body Cap (Not Furnished Separately)	YKA311B	1	1	1	1	1	2			
	" " Cap (Not Furnished Separately)	Y6KA311A							2	2	
314A	" " " Shim	YKA314A	12	12	12	12	12	24	24	24	
314B	" " " Shim	YKA314B	8	8	8	8	8	16	16	16	
	Bearing Body Cap Shim Dowel	#413	4	4	4	4	4	8	8	8	
317A	Bearing Oil Well Cover	YKA317A	1	1	1	1	1	2	2	2	
	Bearing Oil Well Cover Hinge Pin	#457	1	1	1	1	1	2	2	2	
833G	Oil Ring Half, always with	YE833B2	4	4	4	4	4	4			
1978	Hinge Pin	YF1978A	4	4	4	4	4	4			
833A	Oil Ring Half, always with	YHA833A							4	4	
1978	Hinge Pin	YF1978A							4	4	
825A	Gauge Glass	YE825	1	1	1	1	1	2	2	2	
989	Gauge Glass Plug	YK989	1	1	1	1	1	2	2	2	
990	" " Gasket	YK990	2	2	2	2	2	4	4	4	
	" " Pipe Plug	½"	1	1	1	1	1	2	2	2	
	Horizontal Adjusting Set Screw	⅝"x3"	4	4	4	4	4	8	8	8	
	Vertical Adjusting Set Screw	⅞"x2"	2	2	2	2	2	4	4	4	
	Horizontal Adjusting Screw Jam Nut	⅝"	4	4	4	4	4	8	8	8	
	Vertical Adjusting Screw Jam Nut	⅞"	2	2	2	2	2	4	4	4	
315A	Bearing Oil Baffle	YKA315A	2	2	2	2	2	4	4	4	
	Bearing Oil Baffle Cap Screw	⅜"x¾"	4	4	4	4	4	8	8	8	
2345	Oil Throw Ring	YKA2345A	2	2	2	2	2	4			
	" " Ring	Y6KA2345A							4	4	
	Oil Throw Ring Felt	⅜"x18"	2	2	2	2	2	4			
	" " " Felt	⅜"x21¼"							4	4	
319A	Bearing Sole Plate	YKA319A	1	1	1	1	1	2	2	2	
1861	" Vertical Adjusting Shim	YKA1861A2	4	4	4	4	4	8	8	8	
1861A	" " " Shim	YKA1861B1	2	2	2	2	2	4	4	4	
1861B	" " " Shim	YKA1861C1	2	2	2	2	2	4	4	4	
2346	" Sole Plate Cap Screw Washer	YKA2346A	4	4	4	4	4	8	8	8	
	" " " " Screw	1"x3½"	4	4	4	4	4	8	8	8	
	" " " " " Lock-washer	1"	4	4	4	4	4	8	8	8	
3780	Bearing Pedestal	DC155B							2	2	2
	" " Shim	DC158A							4		
460A	Extension Shaft (When ordering specify Engine Serial Number)		1	1	1	1	1	1	1	1	1
365	" " Thrust Collar	CC365A							2		
366	" " " Collar	CC366A								2	2
	" " " " Setscrew	¾" x 1"							4	4	4

List Division No. 4. **Outboard Bearing and Pulleys** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
172-C	**Belt Pulley (Complete)**		**1**			**1**	**1**			**1**	
172	**Belt Pulley 48″x 9″, always with**	**YJ172**	1								
	" Pulley 60″x11″, always with	**YK172**				1					
	" Pulley 60″x17″, always with	**Y2K172**					1				
	" Pulley 60″x42″, always with	**Y6K172**								1	
404	Belt Pulley Hub Bolt	YK404	2			2	2				
	" " " Bolt	Y6K404A								2	
	Belt Pulley Hub Bolt Nut	1⅛″C.P.	4	4	4	4	4	4	4	4	4
	" " Key	1″x¾″x9″	1								
	" " Key	1¼″x¾″x17″					1				
	" " Key	1½″x1″x12″								2	
172A-C	**Belt Pulley (Complete)**			**1**	**1**			**1**	**1**		**1**
172A	**Belt Pulley 48″x15″, always with**	**YK172T**		1							
	" Pulley 54″x19″, always with	**1C4718**			1						
	" Pulley 60″x26″, always with	**Y4K172M**						1			
	" Pulley 60″x34″, always with	**Y4K172B**							1		
	" Pulley 60″x50″, always with	**Y6K172F**									1
404	Belt Pulley Hub Bolt	YK404		2	2			2	2		
	" " " Bolt	Y6K404A									2
	Belt Pulley Hub Bolt Nut	1⅛″ C.P.		4	4			4	4		4
	Belt Pulley Key	1¼″x¾″x11″		1		1					
	" " Key	1¼″x¾″x17″			1						
	" " Key	1¼″x¾″x9″						2	2		
	" " Key	1½″x1″x12″									2

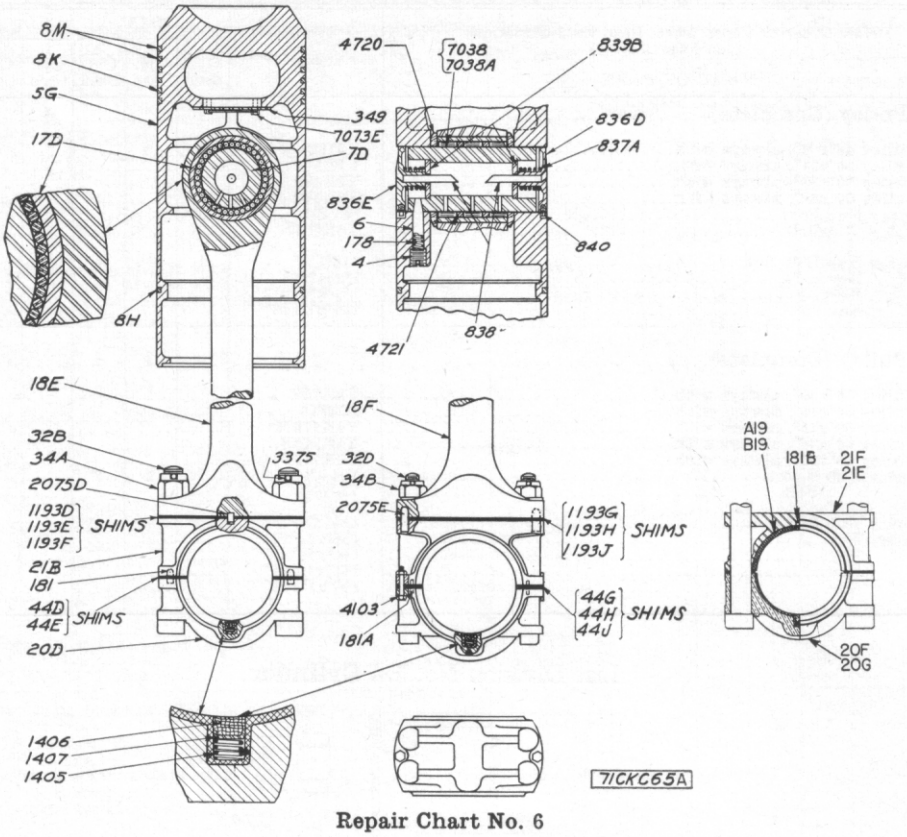
List Division No. 5. **Cylinder**



Repair Chart No. 5

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
1F-C	**Cylinder (Complete)**		**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
1F	**Cylinder, always with**	**YJA1E**	**1**	**2**	**3**						
	" , always with	**YKA1H**				**1**	**2**	**3**	**4**	**5**	**6**
	Cylinder to Head Stud	1½″x11½″	8	16	24						
	" " " Stud	1½″x12¼″				10	20	30	40	50	60
	Cylinder to Exhaust Stud	¾″x2¾″	8	16	24	8	16	24	32	40	48
	Cylinder Pipe Plug (Solid)	2″	2	4	6	2	4	6	8	10	12
	" " Plug (Solid)	2½″	1	2	3	1	2	3	4	5	6
	" " Plug (Solid)	¾″	1	2	3						
	" " Plug (Solid)	1″				1	2	3	4	5	6
	" " Plug (C'S'K. Head)	3″	2	4	6	2	4	6	8	10	12
5919	Cylinder Lub. Oil Pipe	YKA5919B	2	4	6	2	4	6	8	10	12
850	" " " " Nut	CFD850A	2	4	6	2	4	6	8	10	12
	" " " " Packing	⅛″x⅛″x4″	2	4	6	2	4	6	8	10	12
5G-C	Piston (Complete)		1	2	3	1	2	3	4	5	6
198B	Upper Base to Cylinder Gasket	YJA198B	1	2	3						
	" " " " Gasket	YKA198B				1	2	3	4	5	6
5545	Cylinder Head Stud Nut	CKB5545A	2	4	6	2	4	6	8	10	12

List Division No. 6. **Piston and Connecting Rod**



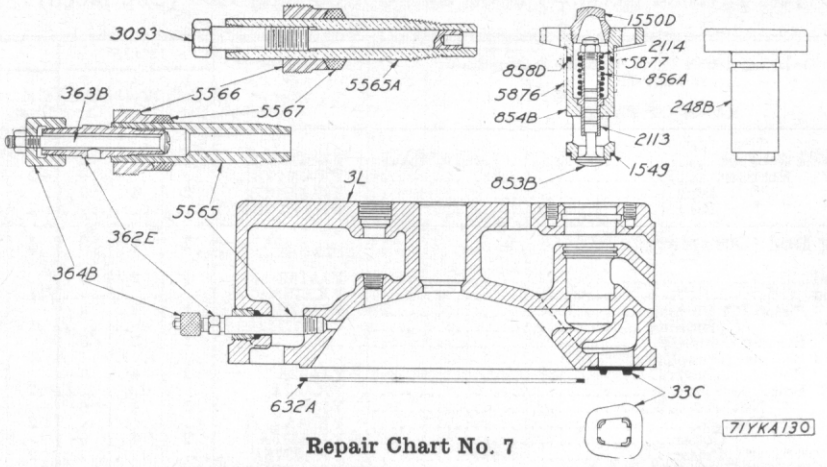
Repair Chart No. 6

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
5G-C	**Piston (Complete)**		**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
5G	Piston (Always with	YJA5P	1	2	3						
5G	Piston)	YKA5W				1	2	3	4	5	6
349	" Baffle Plate	YKA349A	1	2	3	1	2	3	4	5	6
7073E	" " " Cap Screw	⅜″x⅞″ FM106C4	4	8	12	4	8	12	16	20	24
⊖	Cap Screw Lockwire	#15x24″ 3FM4A	1	2	3	1	2	3	4	5	6
6	Piston Pin Dowel	YK6	1	2	3	1	2	3	4	5	6
4	" " " Screw	YK4	1	2	3	1	2	3	4	5	6
178	" " " Spring	YK178A1	1	2	3	1	2	3	4	5	6
8K	Piston Ring (4 Bottom Grooves)	CJB8C	4	8	12						
8K	" " (4 Bottom Grooves)	CKC8F				4	8	12	12	20	24
8M	" " (2 Top Grooves)	YJA8S	2	4	6						
8M	" " (2 Top Grooves)	YKA8U				2	4	6	8	10	12
8H	" Ring, Oil Regulating	YJA8F	1	2	3						
8H	" Ring, Oil Regulating	YKA8G				1	2	3	4	5	
7D-C	Piston Pin Complete		1	2	3	1	2	3	4	5	6
7D-C	**Piston Pin (Complete)**		**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
7D	Piston Pin (Always with	YJA7D2	1	2	3						
7D	" Pin)	YKA7K2				1	2	3	4	5	6
839B	" " Oil Scraper Pipe Guide	YJA839A	2	4	6						
839B	" " " " " Guide	YKA839B				2	4	6	8	10	12
836E	" " " Scraper, Large (Always with	YJA836C1	1	2	3						
836E	" " " Scraper, Large)	YKA836H1				1	2	3	4	5	6
838	Oil Scraper Pipe, Not Furnished Separately	YJA838A	1	2	3						
838	" " Pipe, Not Furnished Separately	YKA838A				1	2	3	4	5	6
840	" " Dowel	YK840	1	2	3	1	2	3	4	5	6
836D	Piston Pin Oil Scraper, Small (Always with	YJA836D1	1	2	3						
836D	" " " Scraper, Small)	YKA836J1				1	2	3	4	5	6
838	Oil Scraper Pipe, Not Furnished Separately	YJA838A	1	2	3						
838	" " Pipe, Not Furnished Separately	YKA838A				1	2	3	4	5	6
840	" " Dowel	YK840	1	2	3	1	2	3	4	5	6
837A	" " Spring	YK837A	2	4	6						
837A	" " Spring	YKA837A				2		6	8	10	12
	Note: It is recommended that 7038-C set of needle bearings always be ordered and furnished with 7D or 7D-C.										
	Note: Separate needles should be furnished only to replace a few nearly new needles that have been lost. When needles are damaged or worn a full set should be furnished and the piston pin carefully inspected										
7038-C	Needle Bearings (Set of 231 needles) 7/32″x1¾″		1	2	3						
7038	" Bearings (Separate Needles) 231 Per Cylinder	16FM34SB1									
7038A-C	Needle Bearing (Set of 240 Needles) ¼x1¾					1	2	3	4	5	6
7038A	" Bearing (Separate Needles) 240 Per Cylinder.	16FM34SB9									

List Division No. 6. **Piston and Connecting Rod** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
4721	Piston Pin Needle Retainer	YJA4721B2	2	4	6						
4721	" " " Retainer	YKA4721B1	.....	.....	.....	2	4	6	8	10	12
4720	" " " " Ring	YJA4720B3	2	4	6						
4720	" " " " Ring	YKA4720B4	.....	.....	.....	2	4	6	8	10	12
18E-C	**Connecting Rod (Complete)**	.....	**1**	**2**	**3**	**1**	**2**	**3**			
18E	Connecting Rod	YJA18E	1	2	3						
18E	" Rod	YKA18K	.....	.....	.....	1	2	3			
17D	" " Piston Pin Bushing	YJA17E1	1	2	3						
17D	" " " " Bushing	YKA17H2	.....	.....	.....	1	2	3			
20D-C	" " Bearing Complete	.....	1	2	3						
20F-C	Connecting Rod Bearing—Complete	.....	.....	.....	.....	1	2	3			
32B	" " Bolt	YJA32A	2	4	6						
32B	" " Bolt	YKA32A	.....	.....	.....	2	4	6			
34A	" " " Nut	YJ34	2	4	6						
34A	" " " Nut	YK34A	.....	.....	.....	2	4	6			
3375	" " " " Cotter	YJA3375A	2	4	6						
3375	" " " " Cotter	YKA3375A	.....	.....	.....	2	4	6			
1193D	Bearing to Rod Shim .031″ Thick	YJA1193D1									
1193D	" " " Shim .031″ Thick } 12 x 15	YKA1193D1	As Required.								
1193E	" " " Shim .062″ Thick	YJA1193E1									
1193E	" " " Shim .062″ Thick	YKA1193E1									
1193F	" " " Shim .015″ Thick } 1, 2 and 3 Cyl. 14x17..	YJA1193F1	.....	.....	.....	As Required.					
1193F	" " " Shim .015″ Thick	YKA1193F1									
18F-C	**Connecting Rod (Complete)**	.....	.....	.....	.....	.....	.....	.....	**4**	**5**	**6**
18F	Connecting Rod	Y4KA18D	.....	.....	.....	.....	.....	.....	4	5	6
17D	" " Piston Pin Bushing	YKA17H2	.....	.....	.....	.....	.....	.....	4	5	6
20G-C	" " Bearing Complete	.....	.....	.....	.....	.....	.....	.....	4	5	6
32D	" " Bolt	CKC32A1	.....	.....	.....	.....	.....	.....	16	20	24
34B	" " " Nut	CKC34A	.....	.....	.....	.....	.....	.....	16	20	24
⊖	" " " " Cotter 11FM2A	¼″x2½″	.....	.....	.....	.....	.....	.....	16	20	24
1193G	Bearing Rod Shim .031″ Thick	CKC1193F1									
1193H	" " " Shim .062″ Thick	CKC1193G1	.....	.....	.....	.....	.....	.....	As Required.		
1193J	" " " Shim .015″ Thick	CKC1193H1									
20D-C	**Connecting Rod Bearing (Complete) (Babbitt)**	.....	**1**	**2**	**3**	**1**	**2**	**3**			
20D	Connecting Rod Cap } Always with	YJA20C	1	2	3						
20D	" " Cap }	YKA20J1	.....	.....	.....	1	2	3			
181	" " to Box Dowel	YKA181A	4	8	12	4	8	12			
21B	" " Box, Not Furnished Separately	YJA21D1	1	2	3						
21B	" " Box, Not Furnished Separately	YKA21L2	.....	.....	.....	1	2	3			
44D	" " " to Cap Shim .025″ Thick	YJA44C	8	16	24						
44D	" " " " " Shim .025″ Thick	YKA44F	.....	.....	.....	8	16	24			
44E	" " " " " Shim .007″ Thick	YJA44D	8	16	24						
44E	" " " " " Shim .007″ Thick	YKA44G	.....	.....	.....	8	16	24			
1405	Cap Wick Support Spring	YK1405A	2	4	6	2	4	6			
1406	" Wick	YJ1406A	1	2	3						
1406	" Wick	YK1406A	.....	.....	.....	1	2	3			
1407	" " Support	YJ1407A2	1	2	3						
1407	" " Support	YK1407A2	.....	.....	.....	1	2	3			
2075D	Rod to Box Dowel	YJA2075D	2	4	6	2	4	6			
20E-C	**Connecting Rod Bearing (Complete) (Babbitt)**	.....	.....	.....	.....	.....	.....	.....	**4**	**5**	**6**
20E	Connecting Rod Cap	YKA20H1	.....	.....	.....	.....	.....	.....	4	5	6
181A	" " " to Box Dowel	YK406A	.....	.....	.....	.....	.....	.....	16	20	24
21D	" " Box, Not Furnished Separately	YKA21K2	.....	.....	.....	.....	.....	.....	4	5	6
44G	" " " to Cap Shim .006″ Thick	Y4KA44A	.....	.....	.....	.....	.....	.....	40	50	60
44H	" " " " " Shim .032″ Thick	Y4KA44B	.....	.....	.....	.....	.....	.....	8	10	12
44J	" " " " " Shim .064″ Thick	Y4KA44C	.....	.....	.....	.....	.....	.....	8	10	12
1405	Cap Wick Support Spring	YK1405A	.....	.....	.....	.....	.....	.....	8	10	12
1406	" Wick	YK1406A	.....	.....	.....	.....	.....	.....	4	5	6
1407	" " Support	YK1407A2	.....	.....	.....	.....	.....	.....	4	5	6
2075E	Rod to Box Dowel	CKC6269A	.....	.....	.....	.....	.....	.....	8	10	12
4103	Cap to Box Bolt	C3FC4103A1	.....	.....	.....	.....	.....	.....	8	10	12
⊖	" " " Nut 11FM29A	½″	.....	.....	.....	.....	.....	.....	8	10	12
⊖	" " " " Cotter 11FM2A	⅜″x1″	.....	.....	.....	.....	.....	.....	8	10	12
20F-C	**Connecting Rod Bearing (Complete) 8″ (Aluminum)**	.....	.....	.....	.....	**1**	**2**	**3**	.....	.....	.....
20G-C	**Connecting Rod Bearing (Complete) 9″ (Aluminum)**	.....	.....	.....	.....	.....	.....	.....	**4**	**5**	**6**
20F	Bearing Cap, always with	YKA20L	.....	.....	.....	1	2	3			
20G	Bearing Cap, always with	YKA20K1	.....	.....	.....	.....	.....	.....	4	5	6
181	Cap to Box Dowel	YKA181A	.....	.....	.....	4	8	12			
181A	Cap to Box Dowel	YK406A	.....	.....	.....	.....	.....	.....	16	20	24
21E	Bearing Box, always with	YKA21N	.....	.....	.....	1	2	3			
21F	Bearing Box, always with	YKA21P	.....	.....	.....	.....	.....	.....	4	5	6
2075D	Box to Rod Dowel	YJA2075D	.....	.....	.....	2	4	6			
2075E	Box to Rod Dowel	CKC6269A	.....	.....	.....	.....	.....	.....	8	10	12
181B	Box to Aluminum Bearing Dowel	DEA181A	.....	.....	.....	1	2	3			
A19	Aluminum Bearing Shell	YKA19B	.....	.....	.....	1	2	3			
B19	Aluminum Bearing Shell	YKA19C	.....	.....	.....	.....	.....	.....	4	5	6
4103	Cap to Box Bolt	YKA35A	.....	.....	.....	.....	.....	.....	8	10	12
⊖	Bolt Nut 11FM29A	½″	.....	.....	.....	.....	.....	.....	8	10	12
	Bolt Cotter 11FM2A	⅜″ x 1″	.....	.....	.....	.....	.....	.....	8	10	12
44D	Box to Cap Shim (.025″)	YKA44F	.....	.....	.....	8	16	24			
44E	Box to Cap Shim (.007″)	YKA44G	.....	.....	.....	8	16	24			
44G	Box to Cap Shim (.006″)	Y4KA44A	.....	.....	.....	.....	.....	.....	40	50	60
44H	Box to Cap Shim (.032″)	Y4KA44B	.....	.....	.....	.....	.....	.....	8	10	12
44J	Box to Cap Shim (.064″)	Y4KA44C	.....	.....	.....	.....	.....	.....	8	10	12
1405	Cap Wick Support Spring	YK1405A	.....	.....	.....	2	4	6	8	10	12
1406	Cap Wick	YK1406A	.....	.....	.....	1	2	3	4	5	6
1407	Cap Wick Support	YK1407A2	.....	.....	.....	1	2	3	4	5	6

List Division No. 7. Cylinder Head and Valves

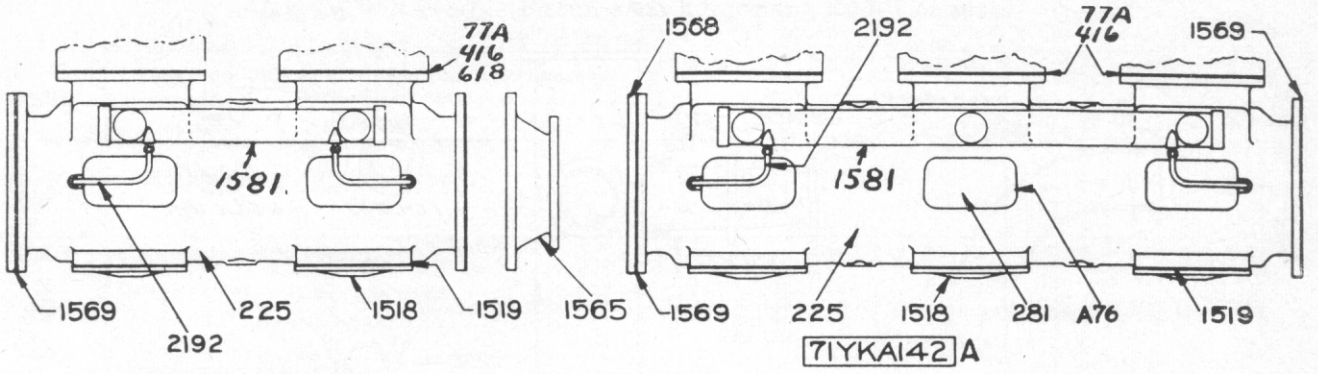


Repair Chart No. 7

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
3L-C	**Cylinder Head (Complete)**		**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
3L	**Cylinder Head, always with**	**YJA3R**	**1**	**2**	**3**						
	" " **always with**	**YKA3W1**				**1**	**2**	**3**	**4**	**5**	**6**
	" " Stud Tube, (Not Fur. Sep.)	YJA6001A	2	4	6						
	" " Water Overflow Stud	½"x2"	2	4	6	2	4	6	8	10	12
	" " Inj. Valve Stud	¾"x3¾"	2	4	6						
	" " " " Stud	¾"x3¾"				2	4	6	8	10	12
	Cylinder Head Air Check Valve Stud	⅝"x2½"	3	6	9						
	" " " " " Stud	⅝"x2¾"				2	4	6	8	10	12
	" " Pipe Plug	1¼"	1	2	3	1	2	3	4	5	6
5565	Relief Valve Adapter Tube	YKA5565H	1	2	3	1	2	3	4	5	6
5566	" " " " Gland	YKA5566A	1	2	3	1	2	3	4	5	6
5567A	" " " " Packing	ND1772B	2	4	6	2	4	6	8	10	12
5565A	Indicator Adapter Tube	YLA5565E	1	2	3	1	2	3	4	5	6
5566	Indicator Adapter Tube Gland	YKA5566A	1	2	3	1	2	3	4	5	6
5567A	" " " Packing	ND1772B	2	4	6	2	4	6	8	10	12
3093	Indicator Adapter Tube Plug	YLA3093A1	1	2	3	1	2	3	4	5	6
5876	Air Check Valve Tube (Not Fur. Sep.)	CKB5876A	1	2	3	1	2	3	4	5	6
5877	" " " " Gasket (Not Fur. Sep.)	YKA5877A	1	2	3	1	2	3	4	5	6
33E	Cylinder Head Gasket (was Repair No. 33C)	YKA33M	8	16	24	10	20	30	40	50	60
632A	Cylinder Head Counterbore Gasket	YJA632F	1	2	3						
	" " " " Gasket	YKA632F				1	2	3	4	5	6
362E-C	**Relief Valve (Complete)**		**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
362E	Relief Valve Body	YF362	1	2	3	1	2	3	4	5	6
363B	" "	YF363	1	2	3	1	2	3	4	5	6
364B	" " Cap	YF364B	1	2	3	1	2	3	4	5	6
	" " Jam Nut	5/16" C. P.	1	2	3	1	2	3	4	5	6
	" " Lockwasher	5/16"	1	2	3	1	2	3	4	5	6
854B-C	**Air Start Check Valve Cage (Complete)**		**1**	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**3**
854B	**Air Start Check Valve Cage, always with**	**YJA854A**	**1**	**1**	**2**						
	" " " " **Cage, always with**	**YKA854C**				**1**	**1**	**2**	**2**	**2**	**3**
2113	" " " " Bushing	YKA2113A1	1	1	2	1	1	2	2	2	3
853B	Air Start Check Valve with Nut and Cotter	YJA853A1	1	1	2	1	1	2	2	2	3
856A	" " " " Spring	YKA856A	1	1	2	1	1	2	2	2	3
2114	" " " " " Cap	YKA2114A	1	1	2	1	1	2	2	2	3
1550D	" " " " Cage Plug	YKA1550C	1	1	2	1	1	2	2	2	3
1549	Air Start Valve Cage Gasket	YKA1549A	1	2	3	1	2	3	4	5	6
858D	" " " " Cylinder Head Gasket	CFE5877A	1	2	3	1	2	3	4	5	6
248B	**Air Start Check Valve Chamber Plug**	**Y2JA248B**	.....	**1**	**1**						
	" " " " " " **Plug**	**Y2KA248C**	.....	.....	.....	.....	**1**	**1**	**2**	**3**	**3**
225E-C	**Exhaust Manifold (Complete) — C. I. Water Cooled**		.....	**1**	**1**	.....	.....	**1**	**1**	**1**	**1**
	Exhaust Manifold—2 Cyl.	**Y2JA225B4**	.....	**1**							
	Exhaust Manifold—3 Cyl.	**Y3JA225B4**	.....	.....	**1**						
	Exhaust Manifold—2 Cyl. Sec.	**Y2KA225F6**	.....	.....	.....	.....	**1**	**1**	**2**	**1**	
225E	**Exhaust Manifold—3 Cyl. Sec.**	**Y3KA225C7**	.....	.....	.....	.....	.....	**1**	.....	**1**	**2**
⊖	Exhaust Manifold Pipe Plug	½"	.....	5	6	.....	2	3	4	5	6
⊖⊖	Exhaust Manifold Pipe Plug	¾"	.....	.....	.....	.....	2	2	4	4	4
⊖	Exhaust Manifold Pipe Plug	2"	.....	10	16	.....	8	12	16	20	24
1518	Side Handhole Cover	CKB1518C	.....	2	3	.....	2	3	4	5	6
1519	Side Handhole Cover Gasket	CKB1519A	.....	2	3	.....	2	3	4	5	6
∈	Side Handhole Cover Capscrew 11FM7A	⅝" x 1½"	.....	12	18	.....	12	18	24	30	36
281	Jacket Handhole Cover	CKB281A	.....	4	6	.....	4	8	8	12	16
A76	Jacket Handhole Cover Gasket	CKB76A	.....	4	6	.....	4	8	8	12	16
⊖	Jacket Handhole Cover Capscrew 11FM7A	½" x 1¼"	.....	24	36	.....	24	48	48	72	96
1568	Head Flange 20FM20C	18"	.....	.....	.....	.....	1	1	1	1	1
1569	Head Flange Gasket 15FM34A	18"	.....	.....	.....	.....	1	1	1	1	1
⊖	Head Flange Cap Screw 11FM7A	1⅛" x 4"	.....	.....	.....	.....	16	16	16	16	16
⊖	Head Flange Nut 11FM7A	1⅛"	.....	.....	.....	.....	16	16	16	16	16
1568	Head Flange 20FM20C	16"	.....	1	1						
1569	" " Gasket 15FM34A	16"	.....	1	1						

(225 E-C con't.)

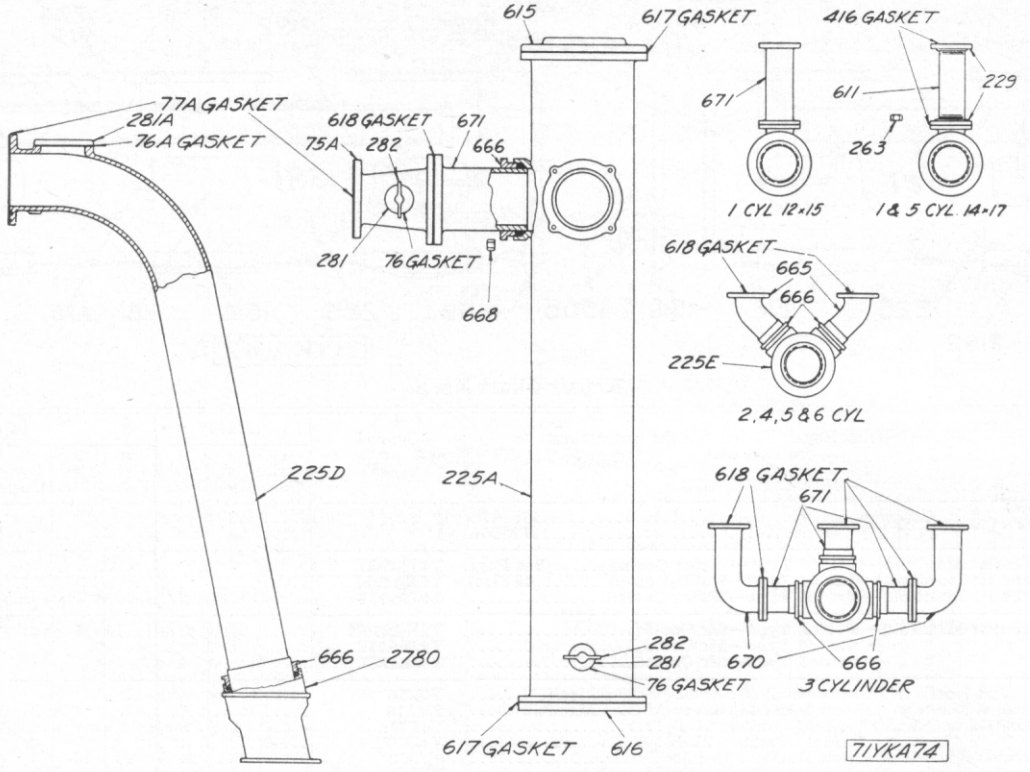
List Division No. 8. Horizontal Exhaust Manifolds



Repair Chart No. 8

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
(225E-C Con't)	" " Capscrew	11FM7A	1″ x 3¾″	16	16						
	" " " Nut	11FM25A	1″	16	16						
225F	**Exhaust Manifold—Welded Type—Water Cooled (See Page 44 also)**	**Y2JA225F**		**1**							
	Exhaust Manifold—Welded Type—Water Cooled	**Y2KA225J**					**1**				
	Exhaust Manifold—Welded Type—Water Cooled	**Y3JA225E**			**1**						
225G	**Exhaust Manifold—Welded Type—Air Cooled**	**Y2KA225H**					**1**				
	" " —Welded Type—Air Cooled	**Y2JA225E**		**1**							
	" " —Welded Type—Air Cooled	**Y3JA225D**			**1**						
416	Exhaust Nozzle to Exhaust Manifold Gasket (Welded Manifold)	YG416		2	3						
618	Exhaust Nozzle to Exhaust Manifold Gasket (Welded Manifold)	YK618					2				
77A	Manifold to Cylinder Gasket (Manifold 225E)	YJA77A		2	3						
	" " " Gasket (Manifold 225E)	YKA77A					2	3	4	5	6
	Exhaust Nozzle to Exhaust Manifold Machine Bolt	¾″ x 3″		16	24		16				
263	Exhaust Nozzle to Exhaust Manifold Machine Bolt Nut	YF263		16	24		16				
	Cylinder to Exhaust Cap Screw	11FM7A		16	24		16	24	32	40	48
4375	Cylinder to Exhaust Capscrew Washer (Not Shown)	YKA4375C					16	24	32	40	48
	Cylinder to Exhaust Cap Screw Washer	11FM1N	¾″	16	24						
1569	Section Flange Gasket	11FM34A	18″						1	1	1
	Section Flange Cap Screw	11FM7A	1⅛″ x 3¾″						16	16	16
	Section Flange Nut	11FM25A	1⅛″						16	16	16
1569	Manifold Outlet Flange Gasket	15FM34A	18″				1	1	1	1	1
1569	Manifold Outlet Flange Gasket	15FM34A	16″	1	1						
	Manifold Outlet Flange Cap Screw	11FM7A	1″ x 3″	16	16						
	Manifold Outlet Flange Nut	11FM25A	1″	16	16						
	Manifold Outlet Flange Cap Screw	11FM7A	1⅛″ x 3½″				16	16	16	16	16
	Manifold Outlet Flange Nut	11FM25A	1⅛″				16	16	16	16	16
A1565	Manifold Outlet Reducing Flange—10″	YJA1565C		1	1						
	" " " " Gasket—10″	15FM34A		1	1						
	" " " " Capscrew	11FM7A	⅞″ x 2¼″	12	12						
	" " Pipe Flange—10″	20FM20A		1	1						
	" " Pipe—10″ O.D. (Specify Length)	19FM5A		As R	eq.						
B1565	Manifold Outlet Reducing Flange—12″	YKA1565F					1	1	1	1	1
	" " " " Gasket—12″	15FM34A					1	1	1	1	1
	" " " " Capscrew	11FM7A	⅞″ x 2¼″				12	12	12	12	12
	" " Pipe Flange—12″	20FM20A					1	1	1	1	1
	" " Pipe—12″ O.D. (Specify Length)	19FM5A					As R	eq.			
B1565	Manifold Outlet Reducing Flange—12″	YJA1565A		1	1						
	" " " " Gasket—12″	15FM34A		1	1						
	" " " " Capscrew	11FM7A	⅞″ x 2¼″	12	12						
	" " Pipe Flange—12″	20FM20A		1	1						
	" " Pipe—12″ O.D. (Specify Length)	19FM5A		As R	eq.						
C1565	Manifold Outlet Reducing Flange—14″	YKA1565-G					1	1	1	1	1
	" " " " Gasket—14″	15FM34A					1	1	1	1	1
	" " " " Capscrew	11FM7A	1″ x 2½″				12	12	12	12	12
	" " Pipe Flange—14″	20FM20A					1	1	1	1	1
	" " Pipe—14″ O.D. (Specify Length)	19FM5A					As R	eq.			
C1565	Manifold Outlet Reducing Flange—14″	YJA1565B		1	1						
	" " " " Gasket—14″	15FM34A		1	1						
	" " " " Capscrew	11FM7A	1″ x 2½″	12	12						
	" " Pipe Flange—14″	20FM20A		1	1						
	" " Pipe—14″ O.D. (Specify Length)	19FM5A		As R	eq.						
D1565	Manifold Outlet Reducing Flange—16″	YKA1565H					1	1	1	1	1
	" " " " Gasket—16″	15FM34A					1	1	1	1	1
	" " " " Capscrew	11FM7A	1″ x 2¾″				16	16	16	16	16
	" " Pipe Flange—16″	20FM20A					1	1	1	1	1
	" " Pipe—16″ O.D. (Specify Length)	19FM5A					As R	eq.			
A2192	Water Outlet Pipe—R.H. (Used with 225F), always with	YJA2192C		1	1						
B2192	" " " —L.H. (Used with 225F), always with	YJA2192D		1	1						
C2192	" " " —L.H. (Used with 225F), always with	YKA2192C					1				
D2192	" " " R. H. (Used with 225 F), always with	YKA2192D					1				
E2192	" " " L. H. (Used with 225E), always with	YKA2192A					1	1	2	2	2
F2192	" " " —R. H. (Used with 225E), always with	YKA2192B					1	1	2	2	2
G2192	" " " —R. H. (Used with 225E), always with	YJA2192A		1	1						
H2192	" " " —L. H. (Used with 225E), always with	YJA2192B		1	1						
	Compression Connector	20FM1A	½ P. x ⅝ T.	4	4		4	4	8	8	8
1581Q	Water Overflow Manifold	Y2KA1581J					1		2	1	
	" " Manifold	Y3KA1581H						1		1	2
1581R	" " Manifold	Y2JA1581P		1							
	" " Manifold	Y3JA1581K			1						

List Division No. 8A. **Exhaust Pot and Pipes** (Continued)



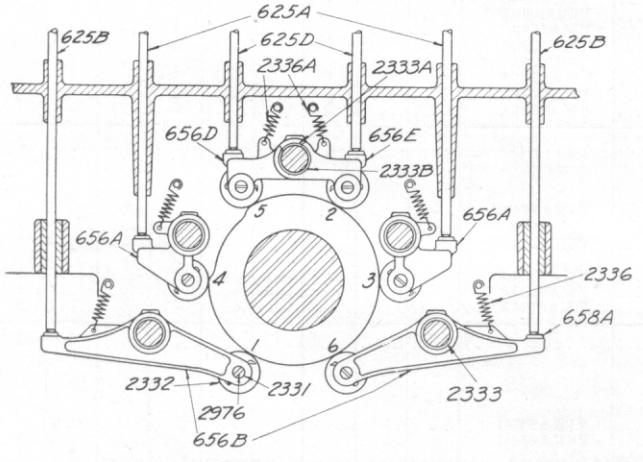
Repair Chart No. 8A

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
225A-C	**Exhaust Pot (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Exhaust Pot, always with	**YJA225A**	1								
	" **Pot, always with**	**Y2JA225A1**		1							
225A	" **Pot, always with**	**Y3JA225A**			1						
	" **Pot, always with**	**YKA225A**				1				1	
	" **Pot, always with**	**Y3KA225A1**						1			
225E	**Exhaust Pot, always with**	**Y2KA225A1**					1		2	2	3
	" " Stuffing Box Stud	⅝"x4½"		8	12		8	12	16	16	24
668	" " " " " Nut	Y2J668		8	12		8	12	16	16	24
	" " Pipe Plug	2"	1	1	1	1	1	1	2	3	3
	" " " Plug	2"	1	1	1	1	1	1	2	3	3
616	Exhaust Pot Bottom Plate	YK616A1	1	1	1	1	1	1	2	3	3
615	" " Cover (Top)	Y3K615	1	1	1	1	1	1	2	3	3
	" " " Bolt	¾"x3¼"	24	24	24	24	24	24	48	72	72
263	" " " " Nut	YH263	24	24	24	24	24	24	48	72	72
617	" " Gasket Top and Bottom	YK617	2	2	2	2	2	2	4	6	6
281	" " Hand Hole Cover	YF281	1	1	1	1	1	1	2	3	3
282	Hand Hole Cover Clamp (All in Bracket)	YF282	1	1	1	1	1	1	2	3	3
	" " " " Set Screw	⅝"x2¼"	1	1	1	1	1	1	2	3	3
76	" " " Gasket	YF76	1	1	1	1	1	1	2	3	3
416	Exhaust Pot Flange Gasket	YG416	2								
229	" " Flange	423				2				2	
618	" " Flange Gasket	YK618				2				2	
	" " " Mach. Bolt	¾"x3"	16								
	" " " " Bolt	¾"x3¼"				16				16	
263	" " " " " Nut	YF263	16			16				16	
666	Stuffing Box Gland	YJA666A		2	3						
	" " Gland	Y2K666					2	3	4	4	6
	Asbestos Wicking	½# Ball		3	5		3	5	6	6	9
225D-C	**Exhaust Pipe (Complete)**		**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
225D	**Exhaust Pipe, always with**	**YJA225C**	**1**	**2**	**3**						
	" **Pipe, always with**	**YKA225E**				**1**	**2**	**3**	**4**	**5**	**6**
	" " Plug	½"	1	2	3	1	2	3	4	5	6
	" " Plug	1"	1	2	3	1	2	3	4	5	6
	Hand Hole Cover Stud	⅝"x2¼"	4	8	12	4	8	12	16	20	24
281A	Hand Hole Cover	YKA281B	1	2	3	1	2	3	4	5	6
	" " " Pipe Plug	½"	1	2	3	1	2	3	4	5	6
76A	" " " Gasket	YKA76B	1	2	3	1	2	3	4	5	6
	" " " Stud Nut	⅝" C. P.	4	8	12	4	8	12	16	20	24
2780	Conduit Thimble with Stud	YJA2780A1	1	2	3						
	" " " Stud	YKA2780B1				1	2	3	4	5	6
666	Conduit Thimble Gland	YJA666	1	2	3						
	" " Gland	Y2K666				1	2	3	4	5	6
	Asbestos Wicking 15FM8A1	½# Ball	2	3	3	2	3	5	6	8	9
668	Thimble Gland Stud Nut	Y2J668	4	8	12	4	8	12	16	20	24
	Exhaust Pot Gland to Thimble Stud	⅝"x4"	4	8	12	4	8	12	16	20	24

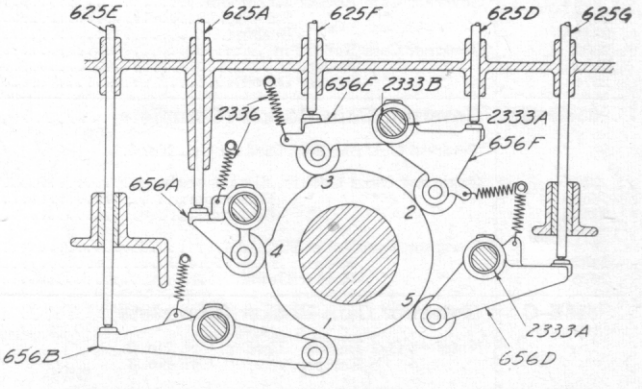
List Division No. 8. **Exhaust Pot and Pipes** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
77A	Cylinder Exhaust Pipe Gasket	YJA77A	1	2	3						
	" " " Gasket	YKA77A	.....	.....	.....	1	2	3	4	5	6
	" " Nozzle Gasket	YJA77A	1	2	3						
	" " " Gasket	YKA77A	.....	.....	.....	1	2	3	4	5	6
75A-C	**Exhaust Nozzle (Complete)**	.....	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
75A	**Exhaust Nozzle, always with**	**YJA75D**	**1**	**2**	**3**						
	" Nozzle, always with	**YKA75A**	.....	.....	.....	**1**	**2**	**3**	**4**	**5**	**6**
	" " Pipe Plug	½"	2	4	6	2	4	6	8	10	12
281	Exhaust Nozzle Hand Hole Cover	YF281	2	4	6	2	4	6	8	10	12
282	" " " " " Clamp	YF282	2	4	6	2	4	6	8	10	12
	" " " " " " Set Screw	⅝"x2¼"	2	4	6	2	4	6	8	10	12
76	" " " " " Gasket	YF76	2	4	6	2	4	6	8	10	12
665-C	**Exhaust Piping (Complete)**	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
665	Exhaust Elbow (Single Flange)	Y2JA665A	.....	2							
	" Elbow (Single Flange)	Y2K665	.....	.....	.....	.....	2	.....	4	4	6
670	" Elbow (Double Flange)	Y3K670	.....	.....	.....	.....	.....	2			
	" Elbow (Double Flange)	Y3JA670A	.....	.....	2						
416	" " Gasket	YG416	.....	2	5						
618	" " Gasket	YK618	.....	.....	.....	.....	2	5	4	4	6
	Exhaust Pipe	YJ671A	1								
671	" Pipe	Y3K671	.....	.....	.....	.....	.....	3			
	" Pipe	Y3JA671A	.....	.....	3						
611	Exhaust Nipple	YK611	.....	.....	.....	1					
	" Nipple	YK611C	.....	.....	.....	.....	.....	.....	.....	1	
	" Pipe Flange Mach. Bolt	¾"x3"	.....	16	40						
	" " " " Bolt	¾"x3½"	.....	.....	.....	.....	16	40	32	32	48
263	" " " " " Nut	YF263	.....	16	40	.....	16	40	32	32	48
	" " Nipple Thread Protector	8"	.....	.....	.....	2	.....	.....	.....	2	

List Division No. 9. **Governor Rocker and Push Rods**



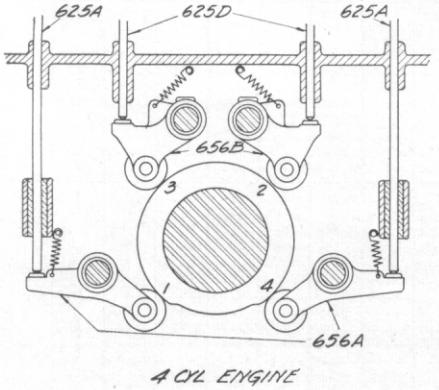
6 CYL. ENGINE



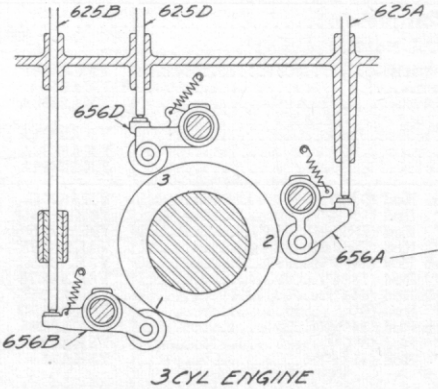
5 CYL. ENGINE

71YKA131

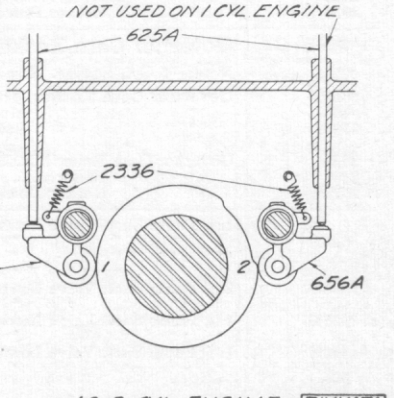
Repair Chart No. 9



4 CYL ENGINE



3 CYL ENGINE



1 & 2 CYL ENGINE

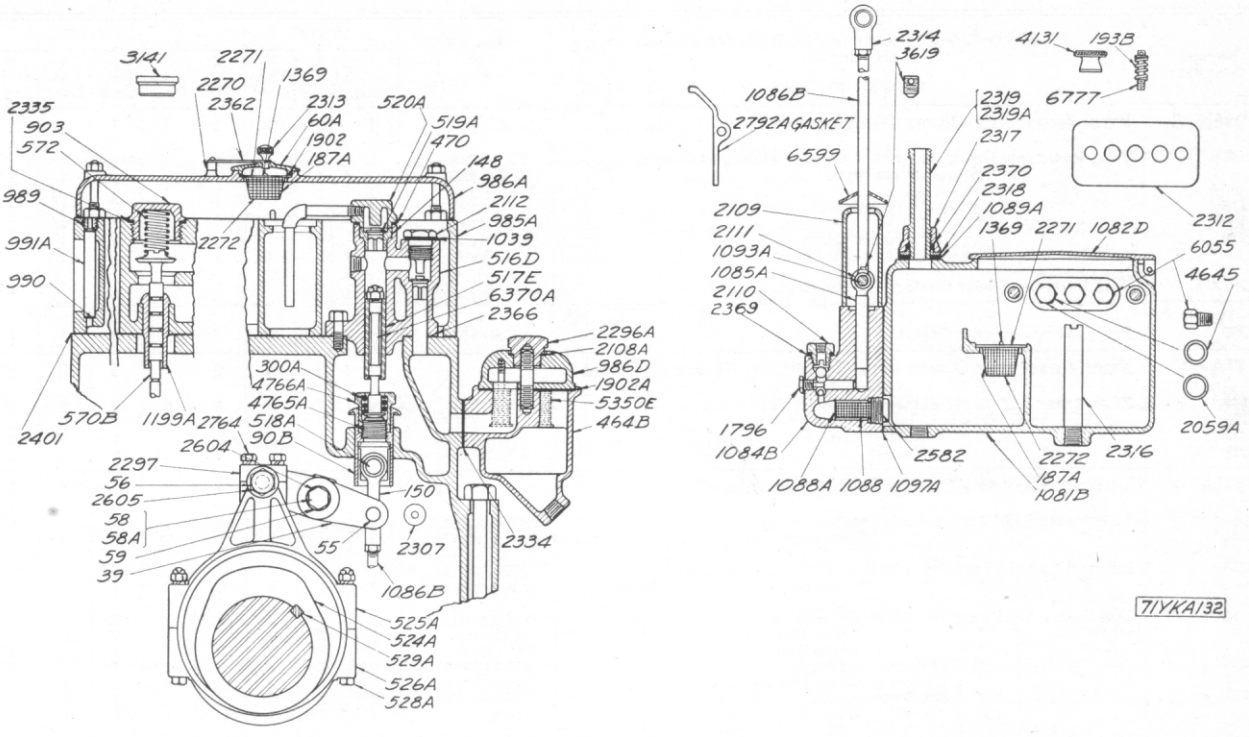
71YKA76

Repair Chart No. 9A

List Division No. 9. **Governor Rocker and Push Rods** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
656A-C	**Governor Cam Rocker (Complete)**		**1**	**2**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
	Note:—6 Cyl. Engine. Used on Cyl. No. 3 and No. 4. 5 " Engine. " " Cyl. No. 4. 4 " Engine. " " Cyl. No. 1 and No. 4. 3 " Engine. " " Cyl. No. 2. 2 " Engine. " " Cyl. No. 1 and No. 2. 1 " Engine. " " Cyl. No. 1.										
656A	**Governor Cam Rocker, always with**	**YKA656A**	**1**	**2**	**1**	**1**	**2**	**1**	.....	**1**	**2**
	" " Rocker, always with	**Y4KA656A**	.....	.....	.....	.....	.....	.....	**2**	.....	.....
658A	Governor Cam Rocker Mushroom	YKA658A	1	2	1	1	2	1	2	1	2
2333	" " " Bushing	YKA2333A	1	2	1	1	2	1	2	1	2
2331	Governor Cam Roller Pin	YKA2331A	1	2	1	1	2	1	2	1	2
2332	" " Roller	YKA2332A	1	2	1	1	2	1	2	1	2
2976	" " " Dowel	YKA2324A	2	4	2	2	4	2	4	2	4
656B-C	**Governor Cam Rocker (Complete)**		.....	.....	**1**	.....	.....	**1**	**2**	**1**	**2**
	Note:—6 Cyl. Engine. Used on Cyl. No. 1 and No. 6. 5 " Engine. " " Cyl. No. 1. 4 " Engine. " " Cyl. No. 2 and No. 3. 3 " Engine. " " Cyl. No. 1.										
656B	**Governor Cam Rocker, always with**	**Y3KA656A**	.....	.....	**1**	.....	.....	**1**	.....	.....	.....
	" " Rocker, always with	**Y4KA656B**	.....	.....	.....	.....	.....	.....	**2**	.....	.....
	" " Rocker, always with	**Y6KA656A**	.....	.....	.....	.....	.....	.....	.....	.....	**2**
	" " Rocker, always with	**Y5KA656A**	.....	.....	.....	.....	.....	.....	.....	**1**	.....
658A	Governor Cam Rocker Mushroom	YKA658A	.....	.....	1	.....	.....	1	2	1	2
2333	" " " Bushing	YKA2333A	.....	.....	1	.....	.....	1	2	1	2
2331	Governor Cam Roller Pin	YKA2331A	.....	.....	1	.....	.....	1	2	1	2
2332	" " Roller	YKA2332A	.....	.....	1	.....	.....	1	2	1	2
2976	" " " Dowel	YKA2324A	.....	.....	2	.....	.....	2	4	2	4
656D-C	**Governor Cam Rocker (All in Bracket)**		.....	.....	**1**	.....	.....	**1**	.....	**1**	
	Note:—5 Cyl. Engine. Used on Cyl. No. 5. 3 " Engine. " " Cyl. No. 3.										
656D	**Governor Cam Rocker, always with**	**Y3KA656B**	.....	.....	**1**	.....	.....	**1**	.....	.....	
	" " Rocker, always with	**Y5KA656D**	.....	.....	.....	.....	.....	.....	.....	**1**	
658A	Governor Cam Rocker Mushroom	YKA658A	.....	.....	1	.....	.....	1	.....	1	
2333	" " " Bushing	YKA2333A	.....	.....	1	.....	.....	1			
2333A	" " " Bushing	Y6KA2333A	.....	.....	.....	.....	.....	.....	.....	1	
2331	Governor Cam Roller Pin	YKA2331A	.....	.....	1	.....	.....	1	.....	1	
2332	" " Roller	YKA2332A	.....	.....	1	.....	.....	1	.....	1	
2976	" " Rocker Dowel	YKA2324A	.....	.....	2	.....	.....	2	.....	2	
656D-C	**Governor Cam Rocker (Complete)**		.....	.....	.....	.....	.....	.....	.....	.....	**1**
	Note:—6 Cyl. Engine. Used on Cyl. No. 5.										
656D	**Governor Cam Rocker, always with**	**Y6KA656B2**	.....	.....	.....	.....	.....	.....	.....	.....	1
658A	" " " Mushroom	YKA658A	.....	.....	.....	.....	.....	.....	.....	.....	1
2333A	" " " Bushing	Y6KA2333A	.....	.....	.....	.....	.....	.....	.....	.....	1
2331	Governor Cam Roller Pin	YKA2331A	.....	.....	.....	.....	.....	.....	.....	.....	1
2332	" " Roller	YKA2332A	.....	.....	.....	.....	.....	.....	.....	.....	1
2976	" " Rocker Dowel	YKA2324A	.....	.....	.....	.....	.....	.....	.....	.....	2
656E-C	**Governor Cam Rocker (Complete)**		.....	.....	.....	.....	.....	.....	.....	**1**	**1**
	Note:—6 Cyl. Engine. Used on Cyl. No. 2. 5 " Engine. " " Cyl. No. 3.										
656E	**Governor Cam Rocker, always with**	**Y5KA656C**	.....	.....	.....	.....	.....	.....	.....	**1**	
	" " Rocker, always with	**Y6KA656C**	.....	.....	.....	.....	.....	.....	.....	.....	**1**
658A	Governor Cam Rocker Mushroom	YKA658A	.....	.....	.....	.....	.....	.....	.....	1	1
2333B	" " " Bushing	Y6KA2333B	.....	.....	.....	.....	.....	.....	.....	2	2
2331	Governor Cam Roller Pin	YKA2331A	.....	.....	.....	.....	.....	.....	.....	1	1
2332	" " Roller	YKA2332A	.....	.....	.....	.....	.....	.....	.....	1	1
2976	" " Rocker Dowel	YKA2324A	.....	.....	.....	.....	.....	.....	.....	2	2
656F-C	**Governor Cam Rocker (Complete)**		.....	.....	.....	.....	.....	.....	.....	**1**	
	Note:—5 Cyl. Engine. Used on Cyl. No. 2.										
656F	**Governor Cam Rocker, always with**	**Y5KA656B**	.....	.....	.....	.....	.....	.....	.....	**1**	
658A	" " " Mushroom	YKA658A	.....	.....	.....	.....	.....	.....	.....	1	
2333A	" " " Bushing	YKA2333A	.....	.....	.....	.....	.....	.....	.....	1	
2331	Governor Cam Roller Pin	YKA2331A	.....	.....	.....	.....	.....	.....	.....	1	
2332	" " Roller	YKA2332A	.....	.....	.....	.....	.....	.....	.....	1	
2976	" " Rocker Dowel	YKA2324A	.....	.....	.....	.....	.....	.....	.....	2	
625A	Inj. Pump Suct. Valve Lower Push Rod (9 5/8")	YKA625C	1	1	.....	1	1	.....	.....	1	1
	" " " " " " Rod (12 15/16")	Y4KA625D	.....	.....	.....	.....	.....	.....	1	.....	.....
	" " " " " " Rod (Drilled) (9 5/8")	YKA625D	.....	1	1	.....	1	1	.....	.....	1
	" " " " " " Rod (Drilled) (12 15/16")	Y4KA625F	.....	.....	.....	.....	.....	.....	1	.....	.....
625B	Inj. Pump Suct. Valve Lower Push Rod (14 1/2")	Y3KA625C	.....	.....	1	.....	.....	1	.....	.....	.....
	" " " " " " Rod (13 5/8")	Y6KA625B	.....	.....	.....	.....	.....	.....	.....	.....	2
625D	Inj. Pump Suct. Valve Lower Push Rod (6 3/16")	Y4KA625E	.....	.....	.....	.....	.....	.....	2	.....	.....
	" " " " " " Rod (6")	Y3KA625D	.....	.....	1	.....	.....	1	.....	1	2
625E	Inj. Pump Suct. Valve Lower Push Rod (14 11/16")	Y5KA625A	.....	.....	.....	.....	.....	.....	.....	1	
625F	" " " " " " Rod (5 9/16")	Y5KA625B	.....	.....	.....	.....	.....	.....	.....	1	
625G	" " " " " " Rod (11 5/8")	Y5KA625C	.....	.....	.....	.....	.....	.....	.....	1	
2336	Gov. Cam Rocker Aux. Spring	YKA2336A	1	2	3	1	2	3	4	.....	4
	" " " " Spring	Y5KA2336A	.....	.....	.....	.....	.....	.....	.....	5	
2336A	Gov. Cam. Rocker Aux. Spring (Top)	YKA2336B	.....	.....	.....	.....	.....	.....	.....	.....	2

List Division No. 10. **Fuel Reservoir, Oil Pump and Oil Sump**



Repair Chart No. 10

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
985A-C	**Fuel Reservoir (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Fuel Reservoir, always with	**YKA985A2**	1	1	.....	1	1				
	" **Reservoir, always with**	**Y3KA985A2**	.....	.....	1	.....	.....	1			
985A	" **Reservoir, always with**	**Y4KA985A2**	.....	.....	.....	.....	.....	.....	1		
	" **Reservoir, always with**	**Y5KA985B1**	.....	.....	.....	.....	.....	.....	.....	1	1
	" **Reservoir, always with**	**Y6KA985A2**	.....	.....	.....	.....	.....	.....	.....	.....	3
1199A	Fuel Reservoir Starting Valve Bushing	YKA1199A	1	1	2	1	1	2	2	2	1
991A	" " Gauge Glass	YKA991A	1	1	1	1	1	1	1	1	1
989	" " " " Plug	YK989	1	1	1	1	1	1	1	1	1
990	" " " " Gasket	YK990	1	1	1	1	1	1	1	1	
3141	Air Start Valve Plug	Y5KA3141A	.....	.....	.....	.....	.....	.....	.....	1	
975-C	Fuel Discharge Strainer (Complete)		1	1	1	1	1	1	1	1	1
	Fuel Reservoir Housing Gasket	YKA2401A	1	1	.....	1	1				
	" " " Gasket	Y3KA2401A	.....	.....	1	.....	.....	1			
2401	" " " Gasket	Y4KA2401A	.....	.....	.....	.....	.....	.....	1		
	" " " Gasket	Y5KA2401A	.....	.....	.....	.....	.....	.....	.....	1	
	" " " Gasket	Y6KA2401A	.....	.....	.....	.....	.....	.....	.....	.....	1
516D-AC	**Fuel Supply Pump (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
516D	Fuel Supply Pump Body with Stud	YKA516C	1	1	1	1	1	1	1	1	1
517E	" " " Plunger	YKA517D	1	1	1	1	1	1	1	1	1
300A	" " " " Spring	YKA300B	1	1	1	1	1	1	1	1	1
4765A	" " " " Push Rod	YKA4765B	1	1	1	1	1	1	1	1	1
4766A	" " " " " Nut	YKA4766B	1	1	1	1	1	1	1	1	1
	" " " Pipe Plug (Cored)	½″ Br.	1	1	1	1	1	1	1	1	1
518A	Fuel Supply Pump Plunger Link Pin	YKA518A	1	1	1	1	1	1	1	1	1
90B	" " " " Sleeve	YKA90C	1	1	1	1	1	1	1	1	1
150	" " " " Link	YKA150A	1	1	1	1	1	1	1	1	1
6370A	" " " " Rod	YKA6370B	1	1	1	1	1	1	1	1	1
	" " " " " Nut (Castle)	½″	1	1	1	1	1	1	1	1	1
	" " " " " Cotter	⅜″x1″	1	1	1	1	1	1	1	1	1
7612	" " " " Gasket (Not Shown)	CKC7612A	1	1	1	1	1	1	1	1	1
519A	Fuel Supply Pump Discharge Valve	YKA519A	1	1	1	1	1	1	1	1	1
	" " " Suction Valve	YKA519A	1	1	1	1	1	1	1	1	1
520A	" " " Discharge " Cap	YKA520A	1	1	1	1	1	1	1	1	1
470	" " " Discharge " " Gasket	YKA470A	1	1	1	1	1	1	1	1	1
	" " " Discharge Cap Nipple	¼″x2¾″	1	1	1	1	1	1	1	1	1
	" " " " " Elbow	¼″	1	1	1	1	1	1	1	1	1
148	" " " " " Seat	YKA148A1	1	1	1	1	1	1	1	1	1
2112	" " " Suction Valve Plug	YKA2112A	1	1	1	1	1	1	1	1	1
1039	" " " " " Gasket	YK1039	1	1	1	1	1	1	1	1	1
	" " " Strainer Nipple	¼″x4″	1	1	1	1	1	1	1	1	1
2366	Fuel Supply Pump Body Gasket	YKA2366A	1	1	1	1	1	1	1	1	1

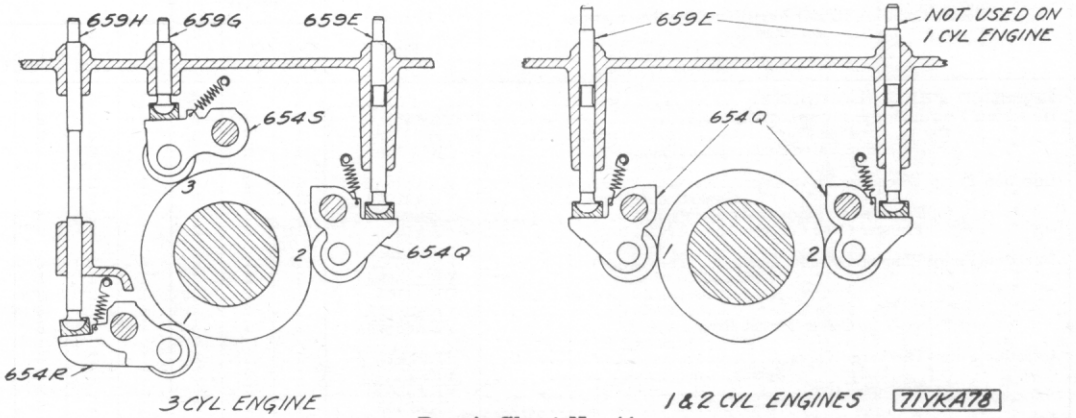
List Division No. 10. **Fuel Reservoir, Oil Pump and Oil Sump** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl Used
986B-C	**Fuel Reservoir Cover (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
986A	**Fuel Reservoir Cover, always with (See Chart 11B also)**	**YKA986A**	**1**	**1**	**1**	**1**	**1**	**1**			
	" " Cover, always with	**Y4KA986A**							**1**	**1**	**1**
60A	" " " Cap	YKA60A	1	1	1	1	1	1	1	1	1
2313	" " " " Handle	YKA2313A	1	1	1	1	1	1	1	1	1
2362	" " " " " Spring	YKA2362A	1	1	1	1	1	1	1	1	1
2270	" " " " Screw Collar	YKA2270A	1	1	1	1	1	1	1	1	1
	" " " " R. H. M. Screw	#10-24x1″	1	1	1	1	1	1	1	1	1
187A-C	Fuel Reservoir Cover Strainer (Complete)		1	1	1	1	1	1	1	1	1
1902	Fuel Reservoir Cover Gasket	YKA1902A	1	1	1	1	1	1	1	1	1
187A-C	**Fuel Reservoir Cover and Oil Sump Strainer (Com.)**		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
187A	**Fuel Reservoir Cover Strainer Side, always with**	**YKA187A**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
2271	" " Strainer Flange (Not Fur. Sep.)	YKA2271A	2	2	2	2	2	2	2	2	2
2272	" " " Bottom (Not Fur. Sep.)	YKA2272A	2	2	2	2	2	2	2	2	2
1369	" " " Handle	YKA1369A	2	2	2	2	2	2	2	2	2
1084A-C	**Lubricating Oil Pump Body (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
1084A	**Lubricating Oil Pump Body, always with**	**YKA1084A3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
1085A	" " " " Plunger	YKA1085A	2	2	2	2	2	2	2	2	2
1093A	Lubricating Oil Pump Plunger Pin	YKA1093A	1	1	1	1	1	1	1	1	1
2111	" " " " " Collar	YKA2111A	2	2	2	2	2	2	2	2	2
2110	Lubricating Oil Pump Discharge Connection	YKA2110A	2	2	2	2	2	2	2	2	2
	" " " " Valve Ball	⅝″ Diam.	2	2	2	2	2	2	2	2	2
	" " " " Valve Ball	¾″ Diam.	2	2	2	2	2	2	2	2	2
1796	" " " Plunger Pin Plug	YKA1796A	2	2	2	2	2	2	2	2	2
2369	" " " Discharge Conn. Gasket	YKA2369A	2	2	2	2	2	2	2	2	2
3619	" " " Set Screw	YKA3619A	2	2	2	2	2	2	2	2	2
	" " " " " Wire	#16x5″	1	1	1	1	1	1	1	1	1
2582-C	Lubricating Oil Pump Strainer (Complete)		2	2	2	2	2	2	2	2	2
1097A	Lubricating Oil Pump Body Gasket	YKA1097A	1	1	1	1	1	1	1	1	1
2582-C	**Lubricating Oil Pump Strainer (Complete)**		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
2582	**Lubricating Oil Pump Strainer Plug, always with**	**YKA2582A**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
1088	" " " " Side (Not Fur. Sep.)	YKA1088A	2	2	2	2	2	2	2	2	2
1088A	" " " " Bottom (Not Fur. Sep.)	YKA1088B	2	2	2	2	2	2	2	2	2
1086B-AC	**Lubricating Oil Pump Rod (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
1086B	**Lubricating Oil Pump Rod, always with**	**YJA1086B**	**1**	**1**	**1**						
	" " " Rod, always with	**YKA1086B**				**1**	**1**	**1**	**1**	**1**	**1**
	" " " " Nut	½″ N. F.	1	1	1	1	1	1	1	1	1
2314	Lubricating Oil Pump Rod End	YKA2314A	1	1	1	1	1	1	1	1	1
6599	" " " " Umbrella	Y3JA6599A	1	1	1	1	1	1	1	1	1
2109	Lubricating Oil Pump Body Cover (Half)	YJA2109B	2	2	2						
	" " " " Cover (Half)	YKA2109A				2	2	2	2	2	2
2792A	Lubricating Oil Pump Body Cover Gasket	YJA2792A	2	2	2						
	" " " " " Gasket	YKA2792A				2	2	2	2	2	2
1081D-C	**Lubricating Oil Sump (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
1081D	**Lubricating Oil Sump, always with**	**YKA1081E**	**1**	**1**	**1**	**1**	**1**	**1**			
	" " Sump, always with	**Y4KA1081E**							**1**	**1**	**1**
1082D	Lubricating Oil Sump. Cover	YKA1082D	1	1	1	1	1	1			
	" " " Cover	Y4KA1082D							1	1	1
6777	Lubricating Oil Sump. Cover Pin	YKA6777A	1	1	1	1	1	1	1	1	1
193B	" " " " Spring	YKA193A	1	1	1	1	1	1	1	1	1
	" " " " " Cotter	1/8″x¾″	1	1	1	1	1	1	1	1	1
	" " " " " Washer	⅜″	1	1	1	1	1	1	1	1	1
	" " " " Handle Stud	⅜″x1¼″	1	1	1	1	1	1	1	1	1
4131	" " " " Handle	CEA4131A	1	1	1	1	1	1	1	1	1
	Lubricating Oil Sump. Pump Stud	½″x4¾″	1	1	1	1	1	1	1	1	1
	" " " " Stud	½″x3¼″	1	1	1	1	1	1	1	1	1
	" " " Pipe Plug	½″	1	1	1	1	1	1	1	1	1
2316	Lubricating Oil Sump Overflow Pipe	YKA2316A	1	1	1	1	1	1	1	1	1
2370	Governor Case Overflow Pipe Gland Washer	YKA2370A	1	1	1	1	1	1	1	1	1
2317	" " " " " Stuffing Box	YKA2317A	1	1	1	1	1	1	1	1	1
2318	" " " " Stuffing Box Gland	YKA2318A	1	1	1	1	1	1	1	1	1
2319	Governor Case Overflow Pipe	YKA2319A				1	1	1			
	" " " Pipe	Y4KA2319A							1	1	1
2319A	" " " Pipe	YJA2319B	1	1	1						
1089A	" " " " Packing Ring	YKA1089A	1	1	1	1	1	1	1	1	1
	Lubricating Oil Sump. Plate	YKA2312B	1			1					
	" " " Plate	Y2KA2312B		1			1				
	" " " Plate	Y3KA2312B			1			1			
2312A	" " " Plate	Y4KA2312B							1		
	" " " Plate	Y5KA2312B								1	
	" " " Plate	Y6KA2312B									1
3056	Lubricating Oil Sump Strainer Gasket	YKA3056A	1	1	1	1	1	1			
	" " " " Gasket	Y4KA3056A							1	1	1
187A-C	Lubricating Oil Sump Strainer (Complete)		1	1	1	1	1	1	1	1	1

List Division No. 10. **Fuel Reservoir, Oil Pump and Oil Sump** (Continued)

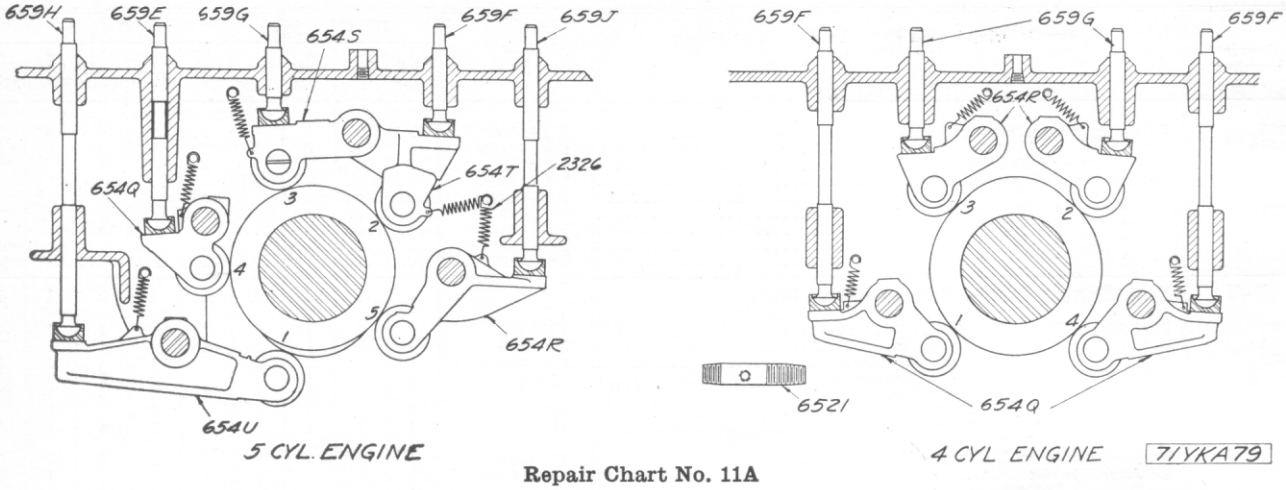
Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
6055	Base Sump Pipe Drain Fitting	YKA6055A	1	2	3	1	2	3	4	5	6
4645A	" " " " " " Gasket	YKA4645B	1	2	3	1	2	3	4	5	6
	Base Sump Pipe Reducer	½″ x ¼″	1	2	3	1	2	3	4	5	6
	Lubricating Oil Sump to Base Shim	YKA2312A	As R	eq....	.....	As R	eq....	.....			
	" " " " " " Shim	Y2KA2312A	.....	As R	eq....	.....	As R	eq....			
2312A	" " " " " " Shim	Y3KA2312A	.....	.....	As R	eq....	.....	As R	eq.		
	" " " " " " Shim	Y4KA2312A	.....	.....	.....	.....	.....	.....	As R	eq.	
	" " " " " " Shim	Y5KA2312A	.....	.....	.....	.....	.....	.....	.....	As R	eq.
	" " " " " " Shim	Y6KA2312A	.....	.....	.....	.....	.....	.....	.....	As R	eq.
39-C	**Fuel Supply Pump Rocker (Complete)**	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
39	Fuel Supply Pump Rocker	YKA39A	1	1	1	1	1	1	1	1	1
55	" " " " " " Pin	YKA55A	1	1	1	1	1	1	1	1	1
2307	" " " " " " Washer	YKA2307A	1	1	1	1	1	1	1	1	1
	" " " " " " Cap Screw	¼″x½″	1	1	1	1	1	1	1	1	1
	" " " " " " Set Screw	⅜″x1″	1	1	1	1	1	1	1	1	1
	" " " " " " Lockwasher	⅜″	1	1	1	1	1	1	1	1	1
	" " " " " " Jam Nut	⅜″	1	1	1	1	1	1	1	1	1
56	Fuel Supply Pump Rocker Ecc. Pin	YKA56A	1	1	1	1	1	1	1	1	1
2605	Eccentric Pin Jam Nut	YKA2605A	1	1	1	1	1	1	1	1	1
	" " Lockwasher	⅝″	1	1	1	1	1	1	1	1	1
	" " Cotter	⅛″x1¼″	1	1	1	1	1	1	1	1	1
58	Fuel Supply Pump Rocker Shaft	YKA58A	.....	.....	.....	.....	.....	.....	1	1	1
58A	" " " " Shaft	YKA58B	1	1	1	1	1	1			
59	" " " " " " Collar	YKA59A	1	1	1	1	1	1	1	1	1
2604	" " " " " " Screw	YKA2604A	1	1	1	1	1	1	1	1	1
	" " " " " " Lockwasher	½″	1	1	1	1	1	1	1	1	1
	" " " " " " Plug	¼″	1	1	1	1	1	1			
	" " " " " " Plug	⅛″	1	1	.....	1	1				
464B-C	**Fuel Supply Pump Strainer and Overflow**	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
464B	**Strainer and Overflow Casing, always with**	**YKA464B**	1	1	1	1	1	1	1	1	1
	" " " " " " Stud	⅝″x2½″	1	1	1	1	1	1	1	1	1
	" " " " " " Dowel	⅝″x½″	1	1	1	1	1	1	1	1	1
	" " " " " " Pipe Plug (Solid)	½″	1	1	1	1	1	1	1	1	1
	" " " " " " Plug (Solid)	¼″	1	1	1	1	1	1	1	1	1
986D	Strainer and Overflow Cover	YKA986B	1	1	1	1	1	1	1	1	1
1902A	" " " " " " Gasket	YKA1902C	1	1	1	1	1	1	1	1	1
2108A	" " " " " " Plug Gasket	YLA2108A	1	1	1	1	1	1	1	1	1
2296A	" " " " " " Plug	YKA2296B	1	1	1	1	1	1	1	1	1
5350E	" " " " " " Purolator Filters	SK2046	3	3	3	3	3	3	3	3	3
2334	" " " " Casing Gasket	YKA2334A	1	1	1	1	1	1	1	1	1
570B-C	**Air Starting Valve (Complete)**	.....	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**3**
570B	Air Starting Valve (See Chart #14 also)	YKA570A	1	1	2	1	1	2	2	2	3
572	" " " " Spring	YKA572A	1	1	2	1	1	2	2	2	3
903	" " " " Plug (See Chart #14 also)	YKA903A	1	1	2	1	1	2	2	2	3
2335	" " " " " " Gasket	YKA2335A	1	1	2	1	1	2	2	2	3
524A-C	**Air Starting Cam and Eccentric (Complete)**	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
524A	**Air Starter Cam and Eccentric,**	**YKA524A**	1	1	1	1	1	1	1	1	1
525A	" " " " " " Strap (Upper) always with	YKA525A1	1	1	1	1	1	1	1	1	1
526A	" " " " " " Strap (Lower)	YKA526A1	1	1	1	1	1	1	1	1	1
2764	" " " " " " " " Stud	YKA2764A	2	2	2	2	2	2	2	2	2
2297	" " " " " " " " Cap	YKA2297A	1	1	1	1	1	1	1	1	1
528A	Air Starter Cam and Eccentric Strap Bolt	YKA528A	2	2	2	2	2	2	2	2	2
	" " " " " " " " " " Nut	½″ N.F. Castle	2	2	2	2	2	2	2	2	2
	" " " " " " " " " " Cotter	⅛″x1″	2	2	2	2	2	2	2	2	2
	" " " " " " " " " " Lockwasher	½″	2	2	2	2	2	2	2	2	2
	" " " " " " " " Stud Nut	⅝″ Slotted	2	2	2	2	2	2	2	2	2
	" " " " " " " " " " Lockwire	.062″x4½″	2	2	2	2	2	2	2	2	2
529A	Air Starter Cam and Eccentric Key	YKA529A	1	1	1	1	1	1	1	1	1

List Division No. 11. **Injection Pump, Rockers and Housing**

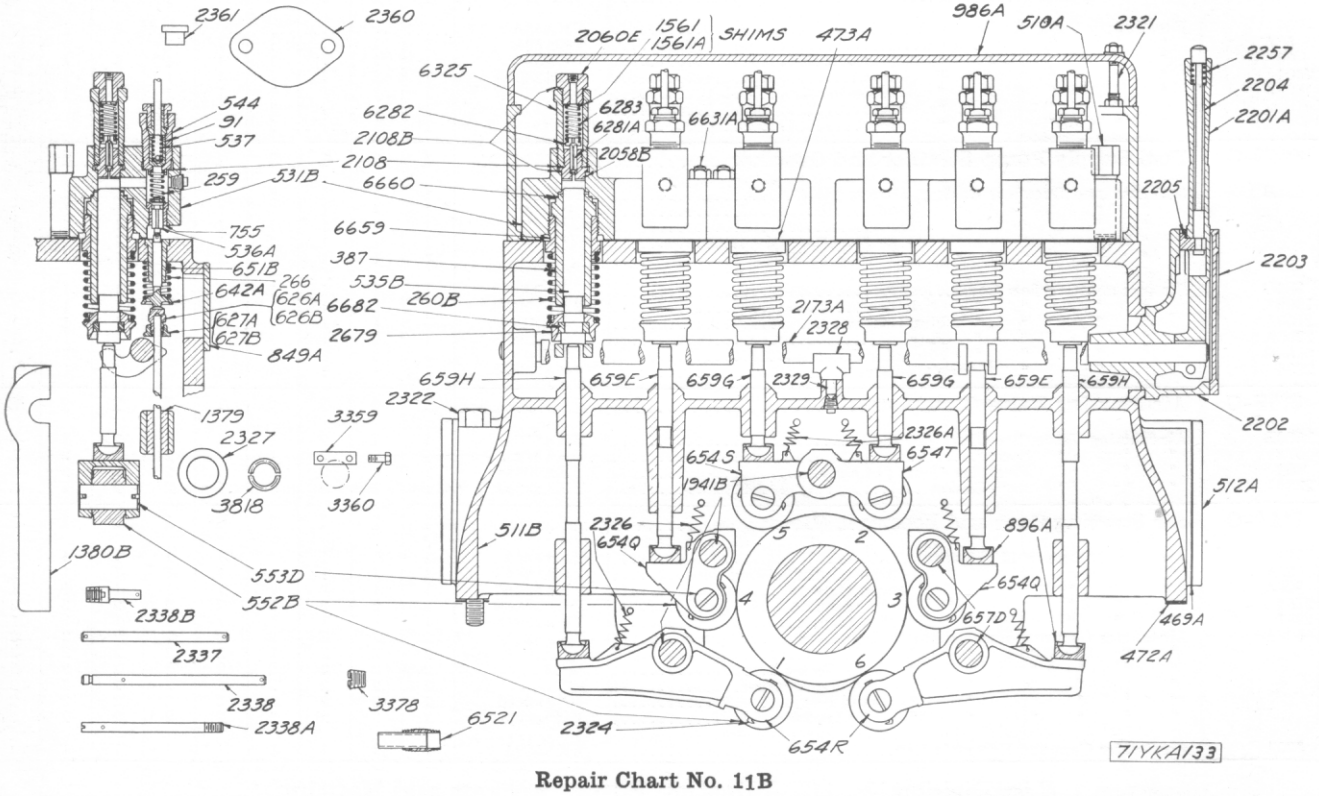


Repair Chart No. 11

List Division No. 11. Injection Pump, Rockers and Housing (Continued)



Repair Chart No. 11A



Repair Chart No. 11B

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl Used	14"x17" 6 Cyl. Used
531B-C	**Injection Pump (Complete)**		**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
531B	**Injection Pump Body, always with**	**YKA531D1**	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
3378	" " " Pipe Plug	CJB3378A	1	2	3	1	2	3	4	5	6
755	" " Suction Valve Seat	CKB755A	1	2	3	1	2	3	4	5	6
544	Injection Pump Discharge Valve Cage	YKA544A2	1	2	3	1	2	3	4	5	6
2108	" " " " " Gasket	YKA2108A	1	2	3	1	2	3	4	5	6
387	" " **Plunger Cylinder, always with**	**YKA387A**	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
535B	" " Plunger (Not Fur. Sep.)	YKA535B	1	2	3	1	2	3	4	5	6
6660	Injection Pump Plunger Cylinder Gasket	YKA6660A	1	2	3	1	2	3	4	5	6
6659	" " " " Nut	YKA6659A	1	2	3	1	2	3	4	5	6
260B	" " " Spring	CKB260A	1	2	3	1	2	3	4	5	6
2679	" " " Drip Collar	YKA2679A	1	2	3	1	2	3	4	5	6
6682	" " " Collar Thrust Ring	YKA6682A	1	2	3	1	2	3	4	5	6
91	Injection Pump Discharge Valve	YK91A1	1	2	3	1	2	3	4	5	6
537	" " " " Spring	YK537	1	2	3	1	2	3	4	5	6
536A	" " " Suction Valve	YKA536A1	1	2	3	1	2	3	4	5	6
259	" " " " " Spring	YKA259A	1	2	3	1	2	3	4	5	6
6325-C	Injection Pump Relief Valve Cage (Complete)		1	2	3	1	2	3	4	5	6

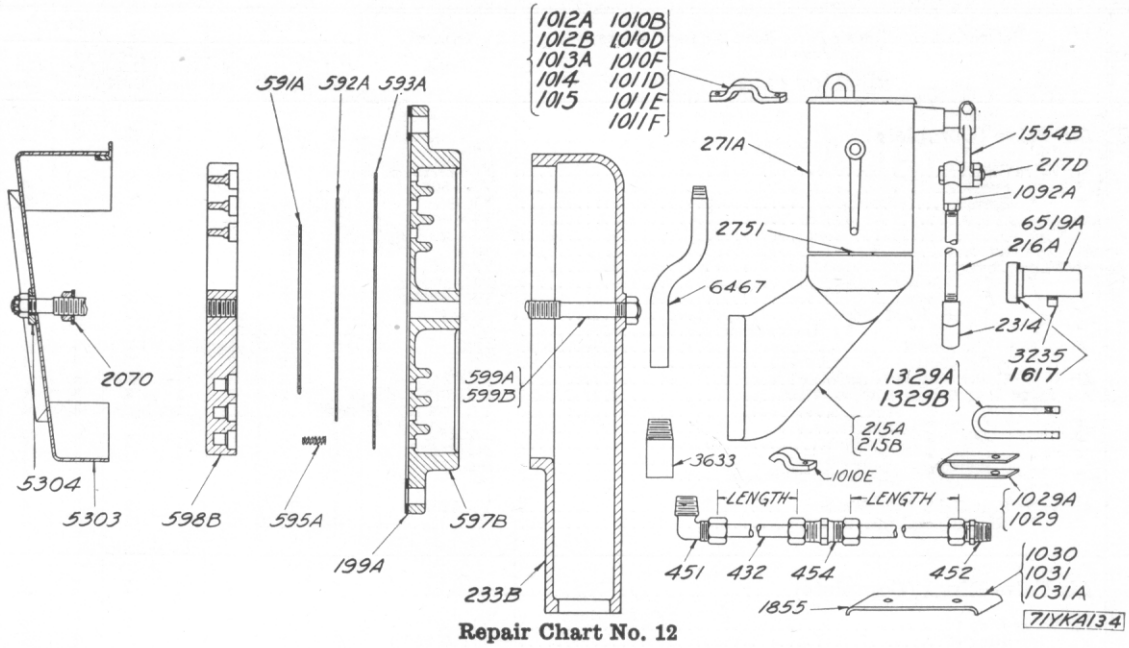
List Division No. 11. **Injection Pump, Rockers and Housing** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
6325-C	**Injection Pump Relief Valve Cage (Complete)**		**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
6325	Injection Pump Relief Valve Cage	CKC6325A	1	2	3	1	2	3	4	5	6
2108	" " " " " Gasket	YKA2108A	1	2	3	1	2	3	4	5	6
2058B	" " " " Seat	CKC2058A	1	2	3	1	2	3	4	5	6
2108B	" " " " " Gasket	CJA2108A	1	2	3	1	2	3	4	5	6
2060E	" " " " Cage Plug	CKC2060A	1	2	3	1	2	3	4	5	6
6281A	Injection Pump Relief Valve	CKC6281A	1	2	3	1	2	3	4	5	6
6282	" " " " Spring Seat	CKC6282A	1	2	3	1	2	3	4	5	6
6283	" " " " Spring	CKC6283A	1	2	3	1	2	3	4	5	6
1561	" " " " " Shim (.031″)	CFE1561A	1	2	3	1	2	3	4	5	6
1561A	" " " " " Shim (.015″)	CFE1561B	1	2	3	1	2	3	4	5	6
2108B	" " " " Cage Plug Gasket	CJA2108A	1	2	3	1	2	3	4	5	6
473A	Injection Pump Body Gasket	YKA473A	1	2	3	1	2	3	4	5	6
654Q-C	**Injection Pump Rocker (Complete)**		**1**	**2**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
	Note:—6 Cyl. Engine. Used on Cyl. No. 3 and No. 4. 5 " Engine. " " Cyl. No. 4. 4 " Engine. " " Cyl. No. 1 and No. 4. 3 " Engine. " " Cyl. No. 2. 2 " Engine. " " Cyl. No. 1 and No. 2. 1 " Engine. " " Cyl. No. 1.										
654Q	Injection Pump Rocker	YKA654C2	1	2	1	1	2	1	.....	1	2
	" " Rocker	Y4KA654E1	.....	.....	.....	.....	.....	.....	2	.....	.....
552D	Injection Pump Cam Roller	YKA552D3	1	2	1	1	2	1	2	1	2
553D	" " " " Pin and Felt	YKA553D3	1	2	1	1	2	1	2	1	2
2324	" " Rocker Dowel	YKA2324A1	2	4	2	2	4	2	4	2	4
654R-C	**Injection Pump Rocker (Complete)**		.....	.....	**1**	.....	.....	**1**	**2**	**1**	**2**
	Note:—6 Cyl. Engine. Used on Cyl. No. 1 and No. 6. 5 " Engine. " " Cyl. No. 5. 4 " Engine. " " Cyl. No. 2 and No. 3. 3 " Engine. " " Cyl. No. 1.										
654R	Injection Pump Rocker	Y3KA654E1	.....	.....	1	.....	.....	1	.....	.....	.....
	" " Rocker	Y4KA654F1	.....	.....	.....	.....	.....	.....	2	.....	.....
	" " Rocker	Y5KA654D	.....	.....	.....	.....	.....	.....	.....	1	.....
	" " Rocker	Y6KA654K	.....	.....	.....	.....	.....	.....	.....	.....	2
552D	" " Cam Roller	YKA552D3	.....	.....	1	.....	.....	1	2	1	2
553D	" " " " Pin and Felt	YKA553D3	.....	.....	1	.....	.....	1	2	1	2
2324	" " Rocker Dowel	YKA2324A1	.....	.....	2	.....	.....	2	4	2	4
654S-C	**Injection Pump Rocker (Complete)**		.....	.....	**1**	.....	.....	**1**	.....	**1**	**1**
	Note:—6 Cyl. Engine. Used on Cyl. No. 5. 5 " Engine. " " Cyl. No. 3. 3 " Engine. " " Cyl. No. 3.										
654S	Injection Pump Rocker (Eye End)	Y3KA654F1	.....	.....	1	.....	.....	1	.....	.....	.....
	" " Rocker	Y5KA654C1	.....	.....	.....	.....	.....	.....	.....	1	.....
	" " Rocker	Y6KA654H1	.....	.....	.....	.....	.....	.....	.....	.....	1
552D	" " Cam Roller	YKA552D3	.....	.....	1	.....	.....	1	.....	1	1
553D	" " " " Pin and Felt	YKA553D3	.....	.....	1	.....	.....	1	.....	1	1
2324	" " Rocker Dowel	YKA2324A1	.....	.....	2	.....	.....	2	.....	2	2
654T-C	**Injection Pump Rocker (Complete)**		.....	.....	.....	.....	.....	.....	.....	**1**	**1**
	Note:—6 Cyl. Engine. Used on Cyl. No. 2. 5 " Engine. " " Cyl. No. 2.										
654T	Injection Pump Rocker (Fork End)	Y6KA654J1	.....	.....	.....	.....	.....	.....	.....	.....	1
	" " Rocker	Y5KA654B1	.....	.....	.....	.....	.....	.....	.....	1	.....
552D	Injection Pump Cam Roller	YKA552D3	.....	.....	.....	.....	.....	.....	.....	1	1
553D	" " " " Pin and Felt	YKA553D3	.....	.....	.....	.....	.....	.....	.....	1	1
2324	" " Rocker Dowel	YKA2324A1	.....	.....	.....	.....	.....	.....	.....	2	2
654U-C	**Injection Pump Rocker (Complete)**		.....	.....	.....	.....	.....	.....	.....	**1**	
	Note:—5 Cyl. Engine. Used on Cyl. No. 1.										
654U	Injection Pump Rocker	Y5KA654A	.....	.....	.....	.....	.....	.....	.....	1	
552D	" " Cam Roller	YKA552D3	.....	.....	.....	.....	.....	.....	.....	1	
553D	" " " " Pin and Felt	YKA553D3	.....	.....	.....	.....	.....	.....	.....	1	
2324	" " Rocker Dowel	YKA2324A1	.....	.....	.....	.....	.....	.....	.....	2	
659E	Injection Pump Plunger Push Rod (8.42″)	YKA659C	1	2	1	1	2	1	.....	1	2
659F	Injection Pump Plunger Push Rod (4.37″)	Y5KA659B	.....	.....	.....	.....	.....	.....	.....	1	
	" " " " Rod (13.15″)	Y3KA659F	.....	.....	1	.....	.....	1	.....		
	" " " " Rod (11.56″)	Y4KA659F	.....	.....	.....	.....	.....	.....	2		
659G	Injection Pump Plunger Push Rod (5.02″) Always with	Y4KA659E	.....	.....	.....	.....	.....	.....	2		
	" " " " Rod (4.34″)	Y3KA659G	.....	.....	1	.....	.....	1	.....	.....	2
659H	" " " " Rod (3.97″)	Y5KA659C	.....	.....	.....	.....	.....	.....	.....	1	
	Injection Pump Plunger Push Rod (12.30″)	Y6KA659C	.....	.....	.....	.....	.....	.....	.....	.....	2
	" " " " Rod (13.05″)	Y5KA659A	.....	.....	.....	.....	.....	.....	.....	1	
659J	Injection Pump Plunger Push Rod (10.11″)	Y5KA659D	.....	.....	.....	.....	.....	.....	.....	1	
896A	Injection Pump Push Rod Shoe	YKA896B1	1	2	3	1	2	3	4	5	6
2326	Injection Pump Rocker Spring	YKA2326A4	1	2	2	1	2	2	4	.....	5
	" " " Spring	Y5KA2326A	.....	.....	.....	.....	.....	.....	.....	5	
2326A	Injection Pump Rocker Spring	YKA2326C	.....	.....	1	.....	.....	1	.....		
	Injection Pump Rocker Spring Pin	⅛″x1½″	.....	.....	1	.....	.....	1	.....	.....	2

List Division No. 11. **Injection Pump, Rockers and Housing** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
2337	Rocker Spring Post (with 2 Holes)	Y2KA2337B	.....	1	1	.....	1	1	2	2	4
2338	" " Post (with 3 Holes)	YKA2338B2	1	1	2	1	1	2	2	1	2
2338A	" " Post (with Slot)	YKA2338D	.....	.....	.....	.....	.....	.....	.....	1	1
2338B	" " Post (with 1 Hole)	YKA2338E	.....	.....	.....	.....	.....	.....	.....	1	1
657D	Rocker Shaft (Short)	Y2KA657E	.....	1	1	.....	1	1	2	2	2
1941B	Governor Cam Rocker Shaft	YKA1941E	1	1	2	1	1	2	2	2	3
3378	" " " " Plug	CDA3378A	1	2	3	1	2	3	4	5	6
626A	Injection Pump Suction Valve Adj. Screw	YKA626B	1	1	2	1	1	2	3	4	5
626B	" " " " " " Screw	YKA626C	.....	1	1	.....	1	1	1	1	1
	" " " " " " " Lockwire	.081″x1″	.....	1	1	.....	1	1	1	1	1
627A	" " " " " " " Nut	YKA627A1	1	1	2	1	1	2	3	4	5
627B	" " " " " " " Nut	YKA627B	.....	1	1	.....	1	1	1	1	1
2327	" " Rocker Spacer	YKA2327A1	3	6	9	3	6	9	12	12	18
511B-DC	**Pump Case Housing (Complete)**	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Pump Case Housing, always with	**YKA511B4**	**1**	**1**	.....	**1**	**1**				
	" " Housing, always with	**Y3KA511B5**	.....	.....	**1**	.....	.....	**1**			
511B-B	**" " Housing, always with**	**Y4KA511B5**	.....	.....	.....	.....	.....	.....	**1**		
	" " Housing, always with	**Y5KA511A5**	.....	.....	.....	.....	.....	.....	.....	**1**	
	" " Housing, always with	**Y6KA511B6**	.....	.....	.....	.....	.....	.....	.....	.....	**1**
	Governor Case Stud	½″x1¾″	6	6	6	6	6	6	6	6	6
2361	Pump Case Housing Plug	YKA2361A	1	.....	.....	1					
2360	" " " Blank Flange	YKA2360A	1	.....	.....	1					
510A	" " " Overflow Pipe	YKA510A	1	1	1	1	1	1	1	1	1
642A	Injection Pump Suct. Valve Push Rod Stem, With	YKA642A	1	2	3	1	2	3	4	5	6
651B	Push Rod Stem Bushing (Not Fur. Sep.)	YKA651A	1	2	3	1	2	3	4	5	6
2321	Pump Case Housing Fuel Reservoir Stud	YKA2321A	4	4	4	4	4	4	4	4	4
1379	Governor Push Rod Bushing	Y3KA1379A	.....	.....	1	.....	.....	1	2	2	2
	Fuel Reservoir Stud	½″x6¾″	2	2	2	2	2	2	2	2	2
6631A	Injection Pump Stud	YKA6631B	4	4	6	4	4	6	8	10	12
	Air Inlet Stud	⅝″x8½″	4	4	4	4	4	4	4	4	4
	Overflow Casing Stud	½″x6″	2	2	2	2	2	2	2	2	2
	Fuel Pump Stud	½″x2″	3	3	3	3	3	3	3	3	3
1380B	Lubricating Rod Cover	YKA1380F	1	1	1	1	1	1	1	1	
	" " " Cover	YKA1380G	.....	.....	.....	.....	.....	.....	.....	.....	
849A	Pump Case Housing Cover	YKA849C	1	1	1	1	1	1			
	" " " " Cover	Y4KA849D	.....	.....	.....	.....	.....	.....	1	1	1
	" " " " " Cap Screw	⅜″x¾″	3	3	3	3	3	3	3	3	3
512A	" " " Side Cover	YKA512A	2	2	2	2	2	2	2	2	2
469A	" " " " " Gasket	YKA469A	2	2	2	2	2	2	2	2	2
	Lubricating Rod Cover Cap Screw	⅜″x¾″	2	2	2	2	2	2	2	2	2
	Lubricator Rod Cover Cap Screw	⅜″x2″	1	1	1	1	1	1	1	1	1
	" " " " " Lockwasher	⅜″	3	3	3	3	3	3	3	3	3
	Pump Case Housing Side Cover Cap Screw	⅝″x¾″	8	8	8	8	8	8	8	8	8
266	Injection Pump Suction Valve Push Rod Spring	YKA266B	1	2	3	1	2	3	4	5	6
472A	Pump Case Housing Gasket	YKA472A	2	2	2	2	2	2			
	" " " Gasket	Y4KA472A	.....	.....	.....	.....	.....	.....	2	2	2
2322	Pump Case Housing Lower Base Tap Bolt	YKA2322A	4	4	4	4	4	4	4	4	4
2328	Fuel Hand Control Shaft Support	Y4KA2328A	.....	.....	.....	.....	.....	.....	1	1	1
2329	" " " " Dowel	Y4KA2329A	.....	.....	.....	.....	.....	.....	1	1	1
2173A-C	**Fuel Hand Control (Complete)**	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Fuel Hand Control Shaft and Cam	YKA2173B	1	1	.....	1	1				
	" " " " " " Cam	Y3KA2173B	.....	.....	1	.....	.....	1			
2173A	" " " " " " Cam	Y4KA2173B	.....	.....	.....	.....	.....	.....	1		
	" " " " " " Cam	Y5KA2173A	.....	.....	.....	.....	.....	.....	.....	1	
	" " " " " " Cam	Y6KA2173B	.....	.....	.....	.....	.....	.....	.....	.....	1
2203	Hand Control Quadrant Plate	YKA2203A	1	1	1	1	1	1	1	1	1
2202	Fuel Hand Control Lever Quadrant	YKA2202A	1	1	1	1	1	1	1	1	1
	Hand Control Quadrant R. H. M. Screw	¼″x⅝″	3	3	3	3	3	3	3	3	3
2201A-C	Hand Control Lever (Complete)	.....	1	1	1	1	1	1	1	1	1
2201A-C	**Fuel Hand Control Lever (Complete)**	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
2201A	Hand Control Lever	YKA2201B	1	1	1	1	1	1	1	1	1
2204	" " " Latch Spindle	YKA2204A	1	1	1	1	1	1	1	1	1
2205	" " " Latch	YKA2205A	1	1	1	1	1	1	1	1	1
2257	" " " " Spring	YKA2257A1	1	1	1	1	1	1	1	1	1
	" " " Cap Screw	⅜″x1¼″	1	1	1	1	1	1	1	1	1
	" " " Key	⅛″x¼″x1″	1	1	1	1	1	1	1	1	1
3359	Rocker Shaft Plate	YKA3359A	1	2	3	1	2	3	4	5	6
3360	" " " Cap Screw	YKA3360A	2	4	6	2	4	6	8	10	12
3818	" " " Lockwasher (Halves)	YKA3818A	2	2	4	2	2	4	4	5	6
	" " " Screw Wire	#19x4″	1	2	3	1	2	3	4	5	6
	Injection Rocker Oil Pipe	Y4KA6521A	.....	.....	.....	.....	.....	.....	1		
6521	" " " " Pipe	YKA6521D	.....	.....	.....	.....	.....	.....	.....	1	
	" " " " Pipe	Y6KA6521B	.....	.....	.....	.....	.....	.....	.....	.....	1
986B-C	Fuel Reservoir Cover (See also Chart #10)	.....	1	1	1	1	1	1	1	1	1

List Division No. 12. Lubricator and Air Valve



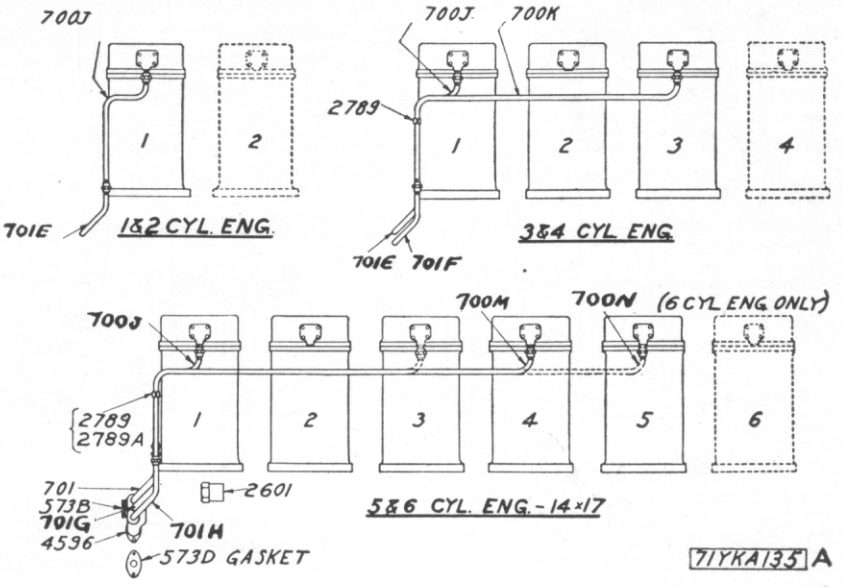
Repair Chart No. 12

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
215A	Lubricator Bracket	YKA215B	1	.....	.....	#1					
	" Bracket	Y2KA215B	.....	1	.....	.....	1				
	" Bracket	Y3KA215B	.....	.....	1	.....	.....	1			
215B	" Bracket	Y4KA215F	.....	.....	.....	.....	.....	.....	1	1	1
271A	Lubricator	12956A	1	.....	.....	1					
	Lubricator	13121A	.....	1	.....	.....	1				
	Lubricator	13122A	.....	.....	1	.....	.....	1			
	Lubricator	13123A	.....	.....	.....	.....	.....	.....	1		
	Lubricator	13124A	.....	.....	.....	.....	.....	.....	.....	1	
	Lubricator	13125A	.....	.....	.....	.....	.....	.....	.....	.....	1
Ⓓ	Lubricator Bracket Capscrew 11FM7A	½"x1"	2	2	4	2	2	4	4	4	4
	" " Capscrew 11FM7A	½"x1¾"	4	4	4	4	4	4	4	4	4
2751	Lubricator Bracket Cap Screw Washer	YKA2751A	2	2	4	2	2	4	4	4	4
216A-C	**Lubricator Drive Mechanism (Complete)**	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
216A	Lubricator Drive Rod	YJA216A	1	1	1						
	" " Rod	YKA216A	.....	.....	.....	1	1	1	1	1	1
1092A	" " Rod Connection (Lub. End)	YKA1092A	1	1	1	1	1	1	1	1	1
2314	" " Rod Connection (Rocker End)	YKA2314A	1	1	1	1	1	1	1	1	1
	" " Rod Nut	½" N. F.	1	1	1	1	1	1	1	1	1
1554D	Ratchet Arm	YKA1554D	1	1	1	1	1	1	1	1	1
	" " Cap Screw	⅜"x1"	1	1	1	1	1	1	1	1	1
3254	" " Washer	YKA3254A	2	2	2	2	2	2	2	2	2
217D	" " Link Pin	YKA217B	1	1	1	1	1	1	1	1	1
	" " " " Nut	7/16"	1	1	1	1	1	1	1	1	1
	" " Key	#2	1	1	1	1	1	1	1	1	1
432	Lubricator Tubing. ¼" O. D.	.....	Order as Required.								
	Note:—Specify Length and Order Fitting required.										
451	Tube Elbow (⅛" Pipe Thd., ¼" O. D. Tube)	.....	Order as Required.								
452	Tube Connector (⅛" Pipe Thd., ¼" O. D. Tube)	.....	Order as Required.								
454	Tube Union (¼" O. D. Tube)	.....	Order as Required.								
1029A-C	**Lubricating Tube Clamps (Complete)**	.....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
1029	Lubricator Tube Clamp (Inside of Pan)	Y3K1029A	.....	2	2	.....	2	2	2	2	2
	" " Clamp (Inside of Pan)	Y3K1029A	.....	.....	1	.....	.....	1			
1029A	Lubricator Tube Clamp (Outside Pan)	Y2KA1029A	.....	1	.....	.....	1				
	Lubricator Tube Clamp (Outside Pan)	Y3KA1029A	.....	.....	1	.....	.....	1			
	" " Clamp (Outside Pan)	Y4KA1029A	.....	.....	.....	.....	.....	.....	1		
	" " Clamp (Outside Pan)	Y5KA1029A	.....	.....	.....	.....	.....	.....	.....	1	
	" " Clamp (Outside Pan)	Y6KA1029A	.....	.....	.....	.....	.....	.....	.....	.....	1
1030	Lubricator Tube Clamp (Inside Pan)	Y3K1030A	.....	.....	2	.....	.....	2	2	2	2
1031	" " Clamp (Inside Pan)	Y3K1031A	.....	.....	.....	.....	.....	.....	2	2	2
1031A	" " Clamp (Inside Pan)	Y6K1031A	.....	.....	.....	.....	.....	.....	.....	.....	2
1855	" " Clamp (Inside Pan)	Y6K1855A	.....	.....	.....	.....	.....	.....	.....	2	2
1010D	Cylinder Lub. Tube Clamp (One Tube)	CFA1010B	1	3	4	1	3	4	5	6	7
1010E	Cylinder Lub. Oil Tube Clamp	CFE1010A	1	2	3	.....	1	2	3	4	5
	" " " " " Screw	#10-24x¾"	1	2	3	.....	1	2	3	4	5
1011E	" " " Clamp (Two Tube)	CFA1011B	1	1	2	1	1	2	3	4	5
	Cylinder Lub. Tube R. H. M. Screw	#10-24x⅜"	4	8	12	4	8	12	16	20	24
	" " " " Screw	#10-24x⅝"	.....	1	1	.....	1	1	1	1	1
	" " " " " Nut	#10-24	.....	1	1	.....	1	1	1	1	1
	" " " " " Lockwasher	5/16"	.....	1	1	.....	1	1	1	1	1
	Lub. Tube Clamp R. H. M. Screw	¼"x1"	.....	2	4	.....	2	4	8	12	16

List Division No. 12. **Lubricator and Air Valve** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
597B-AC	**Air Valve (Complete)**		**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
597B	Air Valve Seat	YJA597B	1	2	3						
	" " Seat	YKA597C				1	2	3	4	5	6
595A	" " Spring	YK595A1	20	40	60	20	40	60	80	100	120
233B	Air Pipe	YJA233B	1	2	3						
	" Pipe	YJA233B	1	2	3	1	2	3	4	5	6
	Air Pipe Nut	5/8"	1	2	3	1	2	3	4	5	6
5303	Air Valve Cover	YJA5303A	1	2	3	1	2	3	4	5	6
5304	" " " Washer	YKA5304A	1	2	3	1	2	3	4	5	6
	" " " Washer	YKA2070A	1	2	3	1	2	3	4	5	6
	" " " R. H. M. Screw	1/4"x1/2"				1	2	3	4	5	6
	" " " " Lockwasher	1/4"				1	2	3	4	5	6
	" " " Dowel	#409	2	4	6	1	2	3	4	5	6
	" " " Slotted Nut	5/8"	1	2	3	1	2	3	4	5	6
	Air Valve Cover Slotted Nut Cotter	1/8"x1 1/2"	1	2	3	1	2	3			
598B	**Air Valve Seat Guide, always with**	**YKA598C**	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
599B	" " " " Stud	YKA599B				1	2	3	4	5	6
599A	" " " " Stud	YJA599A	1	2	3						
	" " " " " Nut	3/4" C. P.	1	2	3	1	2	3	4	5	6
	" " " " " Jam Nut	3/4" C. P.	1	2	3	1	2	3	4	5	6
	" " " " " Lockwasher	3/4"	1	2	3	1	2	3	4	5	6
2070	Air Valve Seat Guide Stud Washer	YKA2070A	1	2	3	1	2	3	4	5	6
593A-C	" " Ring (Complete)		1	2	3	1	2	3	4	5	6
593A-C	**Air Valve Rings (Complete)**		**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
591A	Air Valve Ring #2	YLA591A1	1	2	3	1	2	3	4	5	6
592A	" " Ring #3	YLA592A1	1	2	3	1	2	3	4	5	6
593A	" " Ring #4	YLA593A1	1	2	3	1	2	3	4	5	6
199A	Air Valve Seat Gasket	YJ199	1	2	3						
	" " " Gasket	YK199				1	2	3	4	5	6
6519A	Lubricator Overflow Pipe Bracket	YKA6519C	1	1	1	1	1	1	1	1	1
1617	" " " " Gasket	YKA1617A	1	1	1	1	1	1	1	1	1
	" " " " Cap Screw	3/8"x1"	2	2	2	2	2	2	2	2	2
3235	Spitter	YKA3235A	1	1	1	1	1	1	1	1	1
6467A	Lubricator Overflow Pipe	YJA6467B	1	1	1						
	" " " Pipe	YKA6467B				1	1	1	1	1	1
A3633	Lubricator Overflow Nipple	YKA3633M	1	1	1	1	1	1			
B3633	" " Nipple	YKA3633G	1	1	1	1	1	1	1	1	1
C3633	" " Nipple	YKA3633K							1	1	1
4900	" " Bypass Pipe	YKA4900A	1	1	1	1	1	1			
1015-C	**Injection Tube Clamp (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
1010F	Injection Tube Clamp (To Cyl. and Pan)	YJA1010A	2	2	2						
1010B	" " Clamp (To Cyl. and Pan)	CKA1010B				2	5	8	12	14	14
1011F	" " Clamp (To Pan for 2 Tubes)	YJA1011C		1	1						
1011D	" " Clamp (To Pan for 2 Tubes)	CKA1011B					1	1	1	1	1
1012B	" " Clamp (To Pan for 3 Tubes)	YJA1012A			1						
1012A	" " Clamp (To Pan for 3 Tubes)	CKA1012B						1	1	1	1
1013A	" " Clamp (To Pan for 4 Tubes)	CKA1013B							1	1	1
1014	" " Clamp (To Pan for 5 Tubes)	CKA1014B								1	1
1015	" " Clamp (To Pan for 6 Tubes)	CKA1015B									1
1329B	Injection Tube Clamp (For 2 Tubes)	Y2JA1329A		2							
	" " Clamp (For 3 Tubes)	Y3JA1329A			2						
	Injection Tube Clamp (For 2 Tubes)	Y2KA1329A					2				
	" " Clamp (For 3 Tubes)	Y3KA1329A						2			
1329A	" " Clamp (For 4 Tubes)	Y4KA1329A							2		
	" " Clamp (For 5 Tubes)	Y5KA1329A								2	
	" " Clamp (For 6 Tubes)	Y6KA1329A									2
	Injection Tube Clamp Cap Screw	1/4"x1"	2	2			2	2	2	2	2
	" " " R.H.M. Screw	#10-24x1/2"	4	4	4	4	10	16	24	28	28
	" " " Lockwasher	3/16"	4	6	8	4	14	24	36	44	48
	" " " R.H.M. Screw	#10-24x3/4"		2	4		4	8	12	16	20
	" " " Nut	#10-24		2	4		4	8	12	16	20

List Division No. 13. Air Start Piping

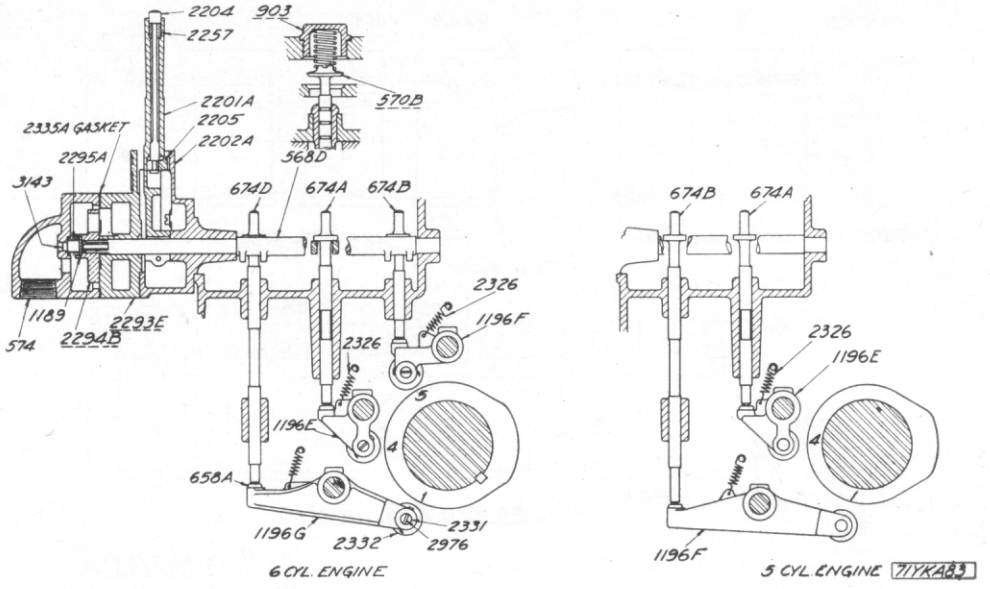


← Gov. End

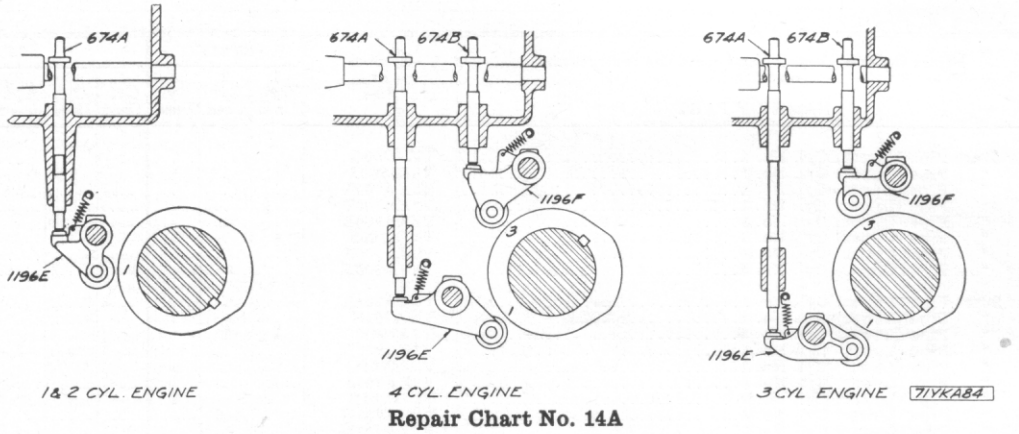
Repair Chart No. 13

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
	Air Start Pipe (Upper) Cyl. No. 1	YKA700G				1	1				
700J	" " Pipe (Upper) Cyl. No. 1	Y3JA700J	1	1	1						
	" " Pipe (Upper) Cyl. No. 1	Y3KA700L						1	1		
	" " Pipe (Upper) Cyl. No. 1	Y5KA700D								1	1
700K	" " Pipe (Upper) Cyl. No. 3	Y3KA700K						1	1		
700L	" " Pipe (Upper) Cyl. No. 3	Y3JA700K	1		1						
700M	" " Pipe (Upper) Cyl. No. 4	Y5KA700E								1	1
700N	" " Pipe (Upper) Cyl. No. 5	Y6KA700X									1
	Air Start Pipe (Lower) Cyl. No. 1	Y5KA701A								1	1
	" " Pipe (Lower) Cyl. No. 1	YKA701E			1	1					
701E	" " Pipe (Lower) Cyl. No. 1	YJA701D	1	1							
	" " Pipe (Lower) Cyl. No. 1	Y3KA701H						1	1		
	" " Pipe (Lower) Cyl. No. 1	Y3JA701G			1						
701F	" " Pipe (Lower) Cyl. No. 3	Y3KA701J							1	1	
	" " Pipe (Lower) Cyl. No. 3	Y3JA701H			1						
701G	" " Pipe (Lower) Cyl. No. 4	Y3KA701H								1	1
701H	" " Pipe (Lower) Cyl. No. 5	Y6KA701M									1
⑪	Air Start Pipe Union Elbow 20FM8DH	1¼"	1	1	2	1	1	2	2	2	3
⑫	" " " R. R. Union 20FM8A	1¼"	1	1	2	1	1	2	2	2	3
⑬	" " " Nipple 20FM6A	1¼"x5½"				1	1	2	2	2	3
⑭	" " " Nipple 20FM6A	1¼"x2½"	1	1	2						
⑮	" " " Clamp Capscrew 11FM7A	⅜"x2"			2			2	2	2	3
⑯	" " " " " Nut 11FM25A	⅜"			2			2	2	2	3
2789	Air Start Pipe Clamp (2 Pipes)	Y4KA2789A			4			4	4	4	4
2789A	" " " Clamp (3 Pipes)	Y3KA2789B									2
	Air Start Distributor Body with Studs	YKA4596A	1	1		1	1				
4596	" " " Body with Studs	Y3KA4596A			1			1			
	" " " Body with Studs	Y4KA4596A							1		
	" " " Body with Studs	Y6KA4596A								1	1
	Air Start Distributor Body Gasket	YKA573A	1	1		1	1				
573B	" " " " Gasket	Y3KA573A			1			1	1		
	" " " " Gasket	Y6KA573A								1	1
573D	Air Start Shut-off Valve Cage Gasket	YKA573B	1	1	1	1	1	1	1	1	1
2601	Air Start Distributor Body Stud Nut	Y6KA2601A								4	4

List Division No. 14. **Air Start Rocker and Push Rods**



Repair Chart No. 14



Repair Chart No. 14A

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Col. Used
1196E-C	**Air Start Rocker (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
1196E	**Air Start Rocker, always with**	**YKA1196B**	1	1	.....	1	1	.....	.....	1	1
	" " **Rocker, always with**	**Y3KA1196C**	.....	.....	1	.....	.....	1			
	" " **Rocker, always with**	**Y4KA1196C**	.....	.....	.....	.....	.....	.....	1		
658A	Air Start Rocker Mushroom	YKA658A	1	1	1	1	1	1	1	1	1
2332	Air Start Rocker Roller	YKA2332A	1	1	1	1	1	1	1	1	1
2331	" " " " Pin	YKA2331A	1	1	1	1	1	1	1	1	1
2976	" " " " " Dowel	YKA2324A	2	2	2	2	2	2	2	2	2
1196F-C	**Air Start Rocker (Complete)**		.....	.....	**1**	.....	.....	**1**	**1**	**1**	**1**
1196F	**Air Start Rocker, always with**	**Y3KA1196D**	.....	.....	1	.....	.....	1	.....	.....	1
	" " **Rocker, always with**	**Y4KA1196D**	.....	.....	.....	.....	.....	.....	1		
	" " **Rocker, always with**	**Y5KA1196A**	.....	.....	.....	.....	.....	.....	.....	1	
658A	Air Start Rocker Mushroom	YKA658A	.....	.....	1	.....	.....	1	1	1	1
2332	Air Start Rocker Roller	YKA2332A	.....	.....	1	.....	.....	1	1	1	1
2331	" " " " Pin	YKA2331A	.....	.....	1	.....	.....	1	1	1	1
2976	" " " " " Dowel	YKA2324A	.....	.....	2	.....	.....	2	2	2	2
1196G-C	**Air Start Rocker (Complete)**		.....	.....	.....	.....	.....	.....	.....	.....	**1**
1196G	**Air Start Rocker, always with**	**Y6KA1196B**	.....	.....	.....	.....	.....	.....	.....	.....	1
658A	" " " Mushroom	YKA658A	.....	.....	.....	.....	.....	.....	.....	.....	1
2332	Air Start Rocker Roller	YKA2332A	.....	.....	.....	.....	.....	.....	.....	.....	1
2331	" " " " Pin	YKA2331A	.....	.....	.....	.....	.....	.....	.....	.....	1
2976	" " " " " Dowel	YKA2324A	.....	.....	.....	.....	.....	.....	.....	.....	2

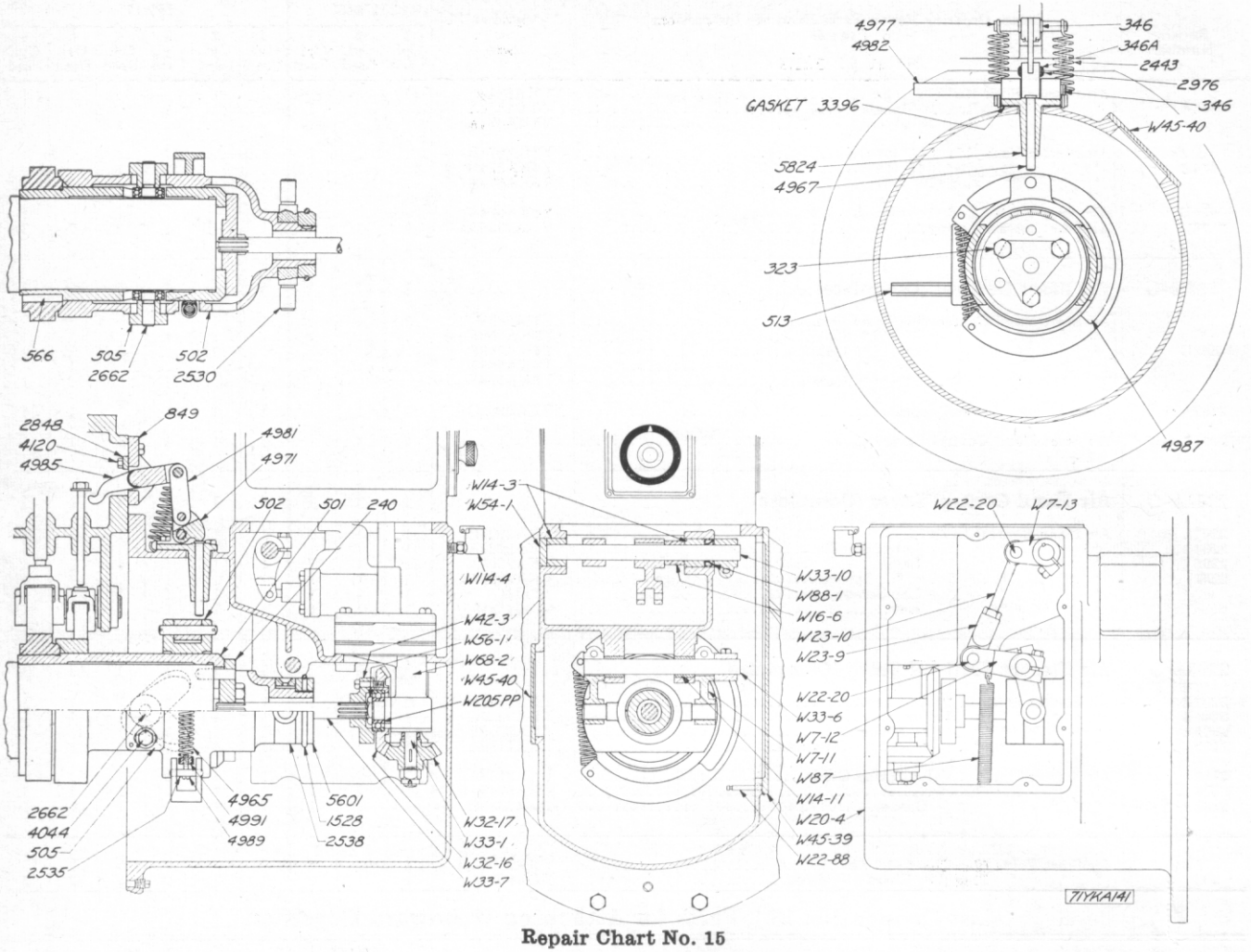
List Division No. 14. Air Start Rocker and Push Rods (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
674A	Air Starter Push Rod (10″ long)	YKA674A	1	1	....	1	1	....	....	1	1
	" " " Rod (15″ long)	Y3KA674A	....	....	1	....	....	1			
	" " " Rod (13 1/16″ long)	Y4KA674A	....	....	....	....	....	....	1		
674B	Air Starter Push Rod (6 1/2″ long)	Y3KA674B	....	....	1	....	....	1	....	....	1
	" " " Rod (6 5/8″ long)	Y4KA674B	....	....	....	....	....	....	1		
	" " " Rod (15″ long)	Y5KA674A	....	....	....	....	....	....	....	1	
674D	Air Starter Push Rod (14″ long)	Y6KA674A	....	....	....	....	....	....	....	....	1
2326	Air Start Rocker Spring	YKA2326A4	1	1	2	1	1	2	2	2	3
568D-C	**Air Start Control (Complete)**	....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
568D	Air Start Hand Control Shaft and Cam	YKA568F	1	1	....	1	1				
	" " " " " " Cam	Y3KA568F	....	....	1	....	....	1			
	" " " " " " Cam	Y4KA568F	....	....	....	....	....	....	1		
	" " " " " " Cam	Y5KA568A	....	....	....	....	....	....	....	1	
	" " " " " " Cam	Y6KA568F	....	....	....	....	....	....	....	....	1
2202A	Hand Control Lever Quadrant	YKA2202C1	1	1	1	1	1	1	1	1	1
2201A-C	Air Start Hand Control Lever	....	1	1	1	1	1	1	1	1	1
2201A-C	**Air Hand Control Lever (Complete)**	....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
2201A	Air Hand Control Lever	YKA2201B	1	1	1	1	1	1	1	1	1
2204	" " " " Latch Spindle	YKA2204A	1	1	1	1	1	1	1	1	1
2205	" " " " Latch	YKA2205A	1	1	1	1	1	1	1	1	1
2257	" " " " " Spring	YKA2257A1	1	1	1	1	1	1	1	1	1
	" " " " Cap Screw	3/8″x1 1/4″	1	1	1	1	1	1	1	1	1
	" " " " Key	5/16″x1/4″x1″	1	1	1	1	1	1	1	1	1
2293E-C	**Air Starter Shut-off Valve (Complete)**	....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
2293E	Air Starter Shut-Off Valve Cage	YKA2293E	1	1	1	1	1	1	1	1	1
2294B	" " " " Valve	YKA2294C	1	1	1	1	1	1	1	1	1
2295A	" " " " " Spring	YKA2295B	1	1	1	1	1	1	1	1	1
1189	" " " " " " Retainer	YKA1189A	1	1	1	1	1	1	1	1	1
3143	Air Starter Shut-Off Valve Spring Guide	YKA3143A	1	1	1	1	1	1	1	1	1
574	" " Inlet Elbow	YKA574B	1	1	1	1	1	1	1	1	1
2335A	" " " " Gasket	YKA2335B	1	1	1	1	1	1	1	1	1
570B	Air Start Valve (See Chart #10 also)	YKA570A	1	1	2	1	1	2	2	2	3
903	" " " Plug (See Chart #10 also)	YKA903A	1	1	2	1	1	2	2	2	3

List Division No. 15. Parts for Attaching Woodward Governor

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cy Used
240	Governor Drive Flange	YKA240A	1	1	1	1	1	1	1	1	1
323	Crankshaft Governor Cap Screw	NW323A	3	3	3	3	3	3	3	3	3
	" " " " Lockwire	#16x12″	1	1	1	1	1	1	1	1	1
	Governor Spiral Sleeve Dowel	#825	1	1	1	1	1	1	1	1	1
	" Cam Sleeve Dowel	#825	1	1	1	1	1	1	1	1	1
346	Overspeed Governor Trip Lever Shaft Spring Ring	PCD346A	1	1	1	1	1	1	1	1	1
	" " " " " Pin Spring Ring	PCD346A	2	2	2	2	2	2	2	2	2
346A	Overspeed Governor Trip Pin Spring Ring	ZBA346	2	2	2	2	2	2	2	2	2
501F	Governor Spiral Sleeve (Std. Rotation)	YKA501H5	1	1	1	1	1	1	1	1	1
501G	" " Sleeve (Rev. Rotation)	YKA501J5	1	1	1	1	1	1	1	1	1
502E	" Cam Sleeve	YKA502C5	1	1	1	1	1	1	1	1	1
505A	" Ball Bearing Adj. Bracket	YKA505A	2	2	2	2	2	2	2	2	2
2751	" Adjusting Bracket Washer	YKA2751A	4	4	4	4	4	4	4	4	4
513	" Oil Thrower	YKA513A1	1	1	1	1	1	1	1	1	1
	" Adj. Bracket Lock Wire	#16″x10″	2	2	2	2	2	2	2	2	2
	" " " Dowel	#309	4	4	4	4	4	4	4	4	4
	" Roller Ball Bearing	#6203 SKF	2	2	2	2	2	2	2	2	2
566B	Injection Cam Key	YKA566B	1	1	1	1	1	1	1	1	1
849B	Valve Gear Housing Governor End Cover	YKA849E	1	1	1	1	1	1	1	1	1
849D	Valve Gear Housing Governor End Cover	Y4KA849E	....	....	....	....	....	....	1	....	1
	" " " " " Cover	Y5KA849B	....	....	....	....	....	....	....	1	
1528	Governor Trunnion Yoke Collar Lock	YKA1528A	1	1	1	1	1	1	1	1	1
2443	Overspeed Governor Trip Spring	YKA2443A	2	2	2	2	2	2	2	2	2
2535	Overspeed Governor Weight Spring Pin	YKA2535B	2	2	2	2	2	2	2	2	2
2538A	Governor Trunnion	YKA2538B	1	1	1	1	1	1	1	1	1
2662	Governor Roller Ball Bearing Pin	YKA2662A	2	2	2	2	2	2	2	2	2
2848	Overspeed Governor Cam Shaft Brg. Cap	YKA2848A	2	2	2	2	2	2	2	2	2
4120	Overspeed Governor Camshaft Brg. Cap Screw 11FM7A	3/8″x7/8″	2	2	2	2	2	2	2	2	2
	" " " " " " Lockwire 3FM4A	#20x6	2	2	2	2	2	2	2	2	2
2976A	" " Trip Pin	YKA2976B	1	1	1	1	1	1	1	1	1
3396	" " Push Rod Guide Gasket	YKA3396A	1	1	1	1	1	1	1	1	1
4044	Governor Ball Bearing Adj. Bkt. Cap Screw	YLA4044A	3	3	3	3	3	3	3	3	3
4965A	Overspeed Governor Weight Spring (300 R. P. M.) (257 R.P.M.)	YKA4965B2	....	....	....	1	1	1	1	1	1
4965B	" " " Spring (360 R. P. M.)	YKA4965C1	1	1	1						
4967	" " Push Rod	YKA4967A	1	1	1	1	1	1	1	1	1
4971	Overspeed Governor Trip Lever	YKA4971A1	1	1	1	1	1	1	1	1	1
4977	" " " " Pin	YKA4977A1	1	1	1	1	1	1	1	1	1
A4981	" " " " Link	YKA4981A									
B4981	Overspeed Governor Trip Lever Link	YKA4981B	Select 1 as required.								
C4981	" " " " Link	YKA4981C									
	" " " " Woodruff Key	#3	1	1	1	1	1	1	1	1	1

List Division No. 15. **Parts for Attaching Woodward Governor** (Continued)

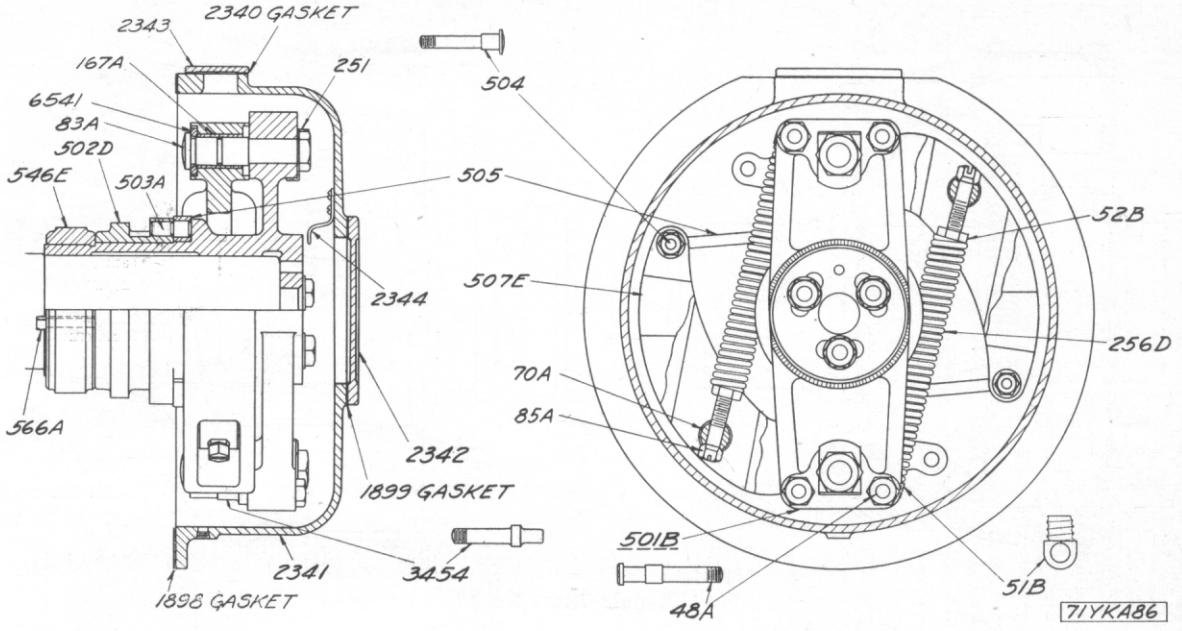


Repair Chart No. 15

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
	Overspeed Governor Trip Lever Pin	YKA4984A	1	1	1	1	1	1	1	1	1
4982	" " " " Shaft	YKA4982A1	1	1	1	1	1	1	1	1	1
4985	Overspeed Governor Cam Shaft	Y3KA4985A2	1	1	1	1	1	1			
	" " " Shaft	Y4KA4985A2	.....	.....	.....	.....	.....	.....	1		
	" " " Shaft	Y5KA4985A2	.....	.....	.....	.....	.....	.....	.....	1	
	" " " Shaft	Y6KA4985A2	.....	.....	.....	.....	.....	.....	.....	.....	1
	Overspeed Governor Cam Shaft Cotter	3/32"x1 1/4"	2	2	2	2	2	2	2	2	2
4987	Overspeed Governor Weight	YKA4987A1	1	1	1	1	1	1	1	1	1
	" " " Pin	#843C	1	1	1	1	1	1	1	1	1
	" " " " Cotter	1/8"x3/4"	2	2	2	2	2	2	2	2	2
4989	" " " Screw	YKA4989A	2	2	2	2	2	2	2	2	2
4991A	" " " Spring Plug	YKA4991B	2	2	2	2	2	2	2	2	2
5601A	Governor Trunnion Yoke Thrust Nut	YKA5601A	1	1	1	1	1	1	1	1	1
	" " " Dowel	#309	1	1	1	1	1	1	1	1	1
5824	Overspeed Governor Push Rod Guide	YKA5824A	1	1	1	1	1	1	1	1	1
	Overspeed Governor Push Rod Guide Fil. Head Screw 11FM8A	5/16"x3/4"	2	2	2	2	2	2	2	2	2
	" " " " " " " Screw 11FM8A	5/16"x1"	2	2	2	2	2	2	2	2	2
	" " " " " " Lockwasher 11FM1A	5/16"	4	4	4	4	4	4	4	4	4
W7-11	Fuel Shaft Yoke Lever	7-11	2	2	2	2	2	2	2	2	2
W7-12	" " Drive Lever	7-12	1	1	1	1	1	1	1	1	1
W7-13	Terminal Shaft Lever	7-13	1	1	1	1	1	1	1	1	1
W14-3	" " Bushing	14-3	2	2	2	2	2	2	2	2	2
W14-11	Fuel Shaft Bushing	14-11	2	2	2	2	2	2	2	2	2
W16-6	Terminal Shaft Spacer	16-6	1	1	1	1	1	1	1	1	1
W20-4	Governor Case	20-4	1	1	1	1	1	1	1	1	1
W22-20	Fuel and Terminal Shaft Lever Pin	22-20	2	2	2	2	2	2	2	2	2
W22-88	Fuel Shaft Lever Spring Post	22-88	1	1	1	1	1	1	1	1	1
W23-9	Fuel to Terminal Shaft Rod End	23-9	1	1	1	1	1	1	1	1	1
W23-10	Fuel to Terminal Shaft Rod	23-10	1	1	1	1	1	1	1	1	1
W32-16	Governor Drive Gear	32-16	1	1	1	1	1	1	1	1	1
W32-17	" Driven Gear	32-17	1	1	1	1	1	1	1	1	1
W33-1	" Shaft	33-1	1	1	1	1	1	1	1	1	1
W33-6	Fuel Shaft	33-6	1	1	1	1	1	1	1	1	1
W33-7	Splined Shaft	33-7	1	1	1	1	1	1	1	1	1
W33-10	Terminal Shaft	33-10	1	1	1	1	1	1	1	1	1
W42-3	Governor Gear Coupling	42-3	1	1	1	1	1	1	1	1	1
W45-39	" Case Cover—Large	45-39	1	1	1	1	1	1	1	1	1
W45-40	" Case Cover—Small	45-40	2	2	2	2	2	2	2	2	2
W54-1	Governor Case Plug	54-1	1	1	1	1	1	1	1	1	1

(Continued)

List Division No. 16 **Governor**

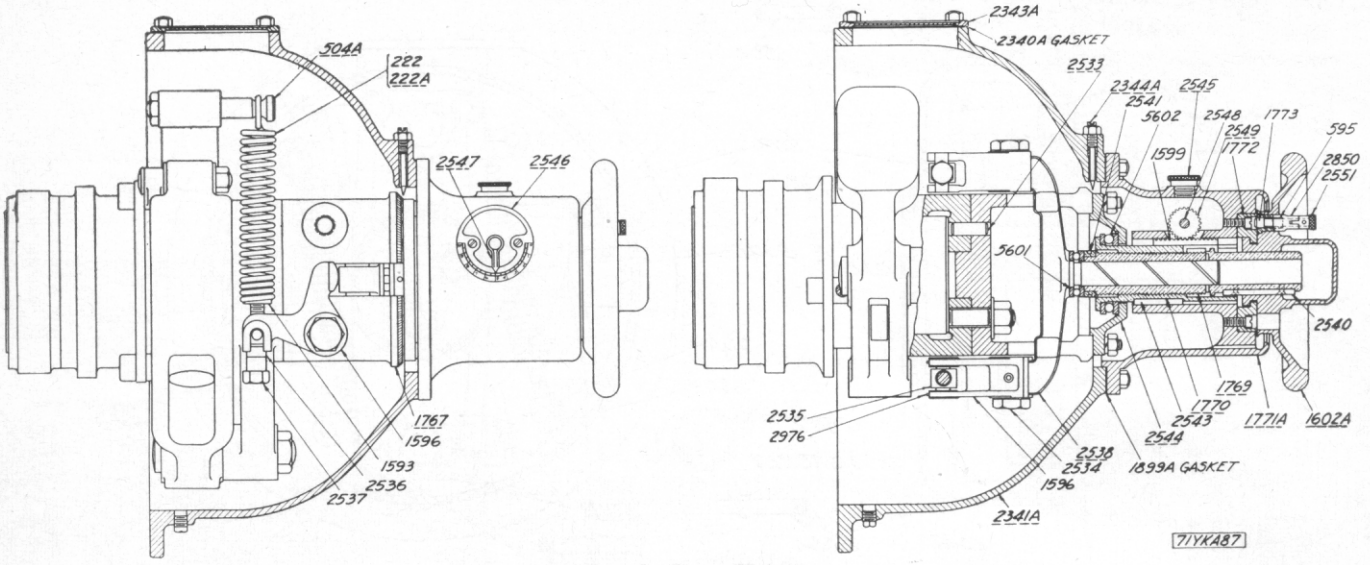


Repair Chart No. 16

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
W56–1	Drive Gear Ball Bearing Retainer	56–1	1	1	1	1	1	1	1	1	1
W68–2	Drive Bearing	68–2	1	1	1	1	1	1	1	1	1
W87	Fuel Shaft Lever Spring	#87	1	1	1	1	1	1	1	1	1
W88–1	Terminal Shaft Oil Seal	88–1	1	1	1	1	1	1	1	1	1
W114–4	Governor Case Oil Cup	114–4	1	1	1	1	1	1	1	1	1
W205PP	Drive Gear Ball Bearing	205PP	1	1	1	1	1	1	1	1	1
501B-BC	**Governor (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
501B	**Governor Spider, always with**	**YKA501C1**	1	1	1	1	1	1	1	1	1
502D	" Cam	YKA502A2	1	1	1	1	1	1	1	2	1
503A	" " Link Pin	YKA503A	2	2	2	2	2	2	2	1	2
546E	Injection Cam	YKA546A1	1	1	1	1	1	1	1	1	1
566A	" " Key	YKA566A	1	1	1	1	1	1	1	2	1
505	Governor Cam Link	YK505	2	2	2	2	2	2	2	2	2
507E	**Governor Weight, always with**	**YJA507E**	**2**	**2**	**2**						
	" Weight, always with	**YKA507G**				**2**	**2**	**2**	**2**	**2**	**2**
167A	" " " Bushing	YKA167A1	2	2	2	2	2	2	2	2	2
83A	Governor Weight Pin	YKA83A1	2	2	2	2	2	2	2	2	2
	" " " Nut	1″	2	2	2	2	2	2	2	2	2
51	" " " " Lock	YKA251A	2	2	2	2	2	2	2	2	2
454	" " Stop Pin	YKA3454A	2	2	2	2	2	2	2	2	2
	" " " " Jam Nut	⅝″ C. P.	2	2	2	2	2	2	2	2	2
6541	Governor Weight Drag Spring	YKA6541B	2	2	2	2	2	2	2	2	2
504	" " Link Pin	YK504	2	2	2	2	2	2	2	2	2
	" " " " Nut	½″ C. P.	2	2	2	2	2	2	2	2	2
48A	" " Spring Pin	YKA48A	2	2	2	2	2	2	2	2	2
	" " " " Nut	⅝″ C. P.	2	2	2	2	2	2	2	2	2
256D-C	Governor Spring (Complete)		2	2	2	2	2	2	2	2	2
256D-C	**Governor Spring (Complete)**		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
256D	**Governor Spring (360 R.P.M.), always with**	**YJA256E**	**2**	**2**	**2**						
	" " (300 R.P.M.), always with	**YKA256J**				**2**	**2**	**2**	**2**	**2**	**2**
52B	" " Plug	YKA52C	2	2	2	2	2	2	2	2	2
51B	Governor Spring Eye Bolt	YKA51B	2	2	2	2	2	2	2	2	2
70A	Adjusting Screw Pin	YKA70A	2	2	2	2	2	2	2	2	2
85A	" Screw	YKA85A2	2	2	2	2	2	2	2	2	2
	" " Cotter	⅛″x1¼″	2	2	2	2	2	2	2	2	2
2341-C	**Governor Case (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
2341	**Governor Case, always with**	**YKA2341A1**	1	1	1	1	1	1	1	1	1
	" " End Plate Cap Screw	⅜″x1″	6	6	6	6	6	6	6	6	6
	" " Hand Hole Plate Cap Screw	⅜″x¾″	2	2	2	2	2	2	2	2	2
	" " Pipe Plug	¼″	1	1	1	1	1	1	1	1	1
	Governor Case Dowel	#613	2	2	2	2	2	2	2	2	2
1899	" " End Plate Gasket	YKA1899A	1	1	1	1	1	1	1	1	1

(Continued)

List Division No. 17. Synchronizer or Speed Regulator

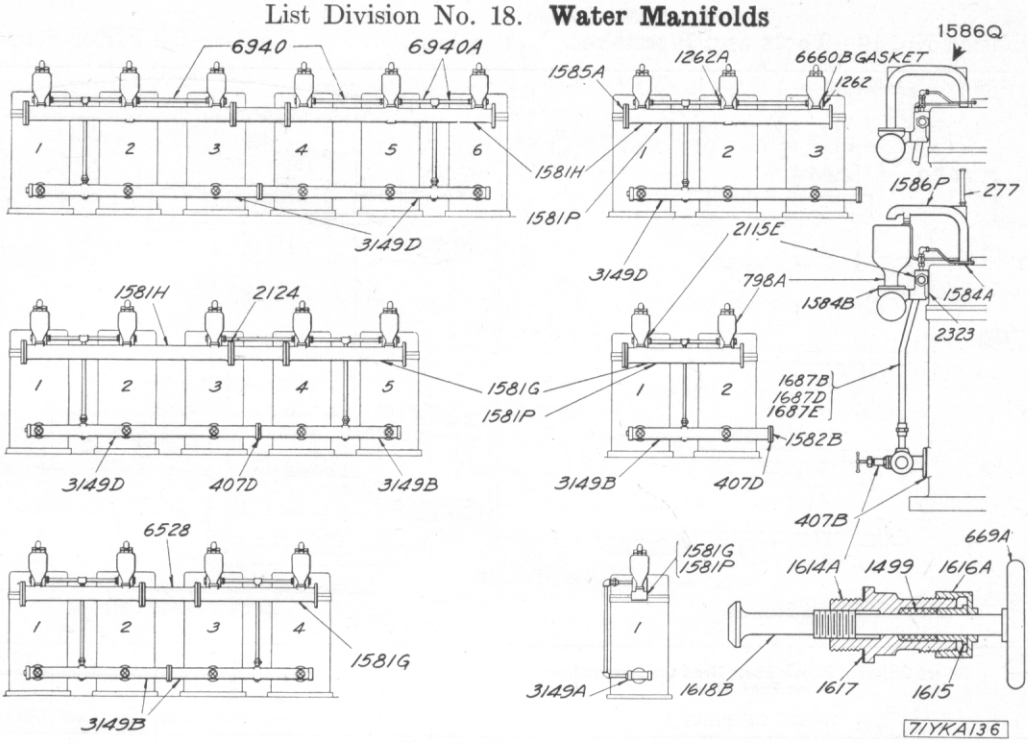


Repair Chart No. 17

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
2340	" " Hand Hole Cover Gasket	YKA2340A	1	1	1	1	1	1	1	1	1
2342	" " End Plate	YKA2342A1	1	1	1	1	1	1	1	1	1
2343	" " Hand Hole Cover	YKA2343A	1	1	1	1	1	1	1	1	1
2344	" " Timing Pointer	YKA2344A	1	1	1	1	1	1	1	1	1
	" " " " R. H. M. Screw	#10-24x⅜"	2	2	2	2	2	2	2	2	2
1898	Governor Case Gasket	YKA1898A	1	1	1	1	1	1	1	1	1
222	Speed Regulator Slow Down Spring (360 R. P. M.)	YKA222F	2	2	2	.....	.....	.....	.....	.....	.....
	" " " " Spring (300 R. P. M.)	YKA222A1	.....	.....	.....	2	2	2	2	2	2
222A	Synchronizer Spring	YKA222B1	2	2	2	2	2	2	2	2	2
504A	Speed Regulator Spring Post	YKA504A	2	2	2	2	2	2	2	2	2
595	Hand Wheel Stop Spring	YK595A1	1	1	1	1	1	1	1	1	1
1593	Speed Regulator Spring Plug	YKA1593A	2	2	2	2	2	2	2	2	2
1596	" " Rocker	YKA1596A1	2	2	2	2	2	2	2	2	2
1599	" " Indicator Rack	YKA1599A	1	1	1	1	1	1	1	1	1
1602A	Hand Wheel	YKA1602M1	1	1	1	1	1	1	1	1	1
1767	Governor Spider Hub, always with	YKA1767A	1	1	1	1	1	1	1	1	1
	" " " Bearing Stud	⅜"x1½"	4	4	4	4	4	4	4	4	4
1769	Speed Regulator Adjusting Screw	YKA1769A	1	1	1	1	1	1	1	1	1
1770	" " " " Nut	YKA1770A	1	1	1	1	1	1	1	1	1
1771A	" " " " Housing	YKA1771K2	1	1	1	1	1	1	1	1	1
1772	Hand Wheel Retaining Ring	YKA1772A1	1	1	1	1	1	1	1	1	1
1773	" " Stop Pin	YKA1773A	1	1	1	1	1	1	1	1	1
1899A	Governor Case End Plate Gasket	YKA1899B	1	1	1	1	1	1	1	1	1
2340A	" " Hand Hole Cover Gasket	YKA2340B	1	1	1	1	1	1	1	1	1
2341A	" Case	YKA2341B1	1	1	1	1	1	1	1	1	1
2343A	" " Hand Hole Cover	YKA2343B1	1	1	1	1	1	1	1	1	1
2344A	Injection Pointer	YKA2344B	1	1	1	1	1	1	1	1	1
2533	Governor Spider Hub Dowel	YKA2533A	1	1	1	1	1	1	1	1	1
2534	Speed Regulator Rocker Pin	YKA2534A	2	2	2	2	2	2	2	2	2
2535	" " " Trunion	YKA2535A	2	2	2	2	2	2	2	2	2
2536	" " " " Washer	YKA2536A	2	2	2	2	2	2	2	2	2
2537	" " Spring Adjusting Screw	YKA2537A	2	2	2	2	2	2	2	2	2
2538	" " Rocker Yoke	YKA2538A	1	1	1	1	1	1	1	1	1
2540	Speed Regulator Adj. Screw Key	YKA2540A	1	1	1	1	1	1	1	1	1
2541	" " " " Collar	YKA2541A	1	1	1	1	1	1	1	1	1
2543	" " " " Nut Key	YKA2543A	1	1	1	1	1	1	1	1	1
2544	Governor Spider Hub Bearing Retainer	YKA2544A	1	1	1	1	1	1	1	1	1
2545	Adjusting Screw Housing Oil Plug	YKA2545A	1	1	1	1	1	1	1	1	1
2546	Speed Regulator Indicator Dial	YKA2546A	1	1	1	1	1	1	1	1	1
2547	" " " Hand	YKA2547A	1	1	1	1	1	1	1	1	1
2548	" " " Pointer Shaft	YKA2548A	1	1	1	1	1	1	1	1	1
2549	" " " Pinion	YKA2549A	1	1	1	1	1	1	1	1	1
2551	Hand Wheel Stop Pin Knob	YKA2551A	1	1	1	1	1	1	1	1	1
2850	" " " " Guide	YKA2850A	1	1	1	1	1	1	1	1	1
2976	Speed Regulator Rocker Pin Dowel	YKA2976A1	2	2	2	2	2	2	2	2	2
5601	" " Yoke Thrust Bearing	16FM34A18	1	1	1	1	1	1	1	1	1
5602	" " Adj. Screw Collar Thrust Bearing	16FM34A19	1	1	1	1	1	1	1	1	1
1581G	Water Overflow Manifold } See List Div. 8 for engines with	YKA1581B	.....	.....	.....	1	.....	.....	.....	.....	.....
	" " Manifold } horizontal exhaust Manifold	Y2KA1581H1	.....	.....	.....	.....	1	.....	2	2	
1581H	" " Manifold }	Y3KA1581G1	.....	.....	.....	.....	.....	1	.....	1	2
6528	Water Overflow Manifold Spacer	Y4KA6528A	.....	.....	.....	.....	.....	.....	1	1	1

(Continued)

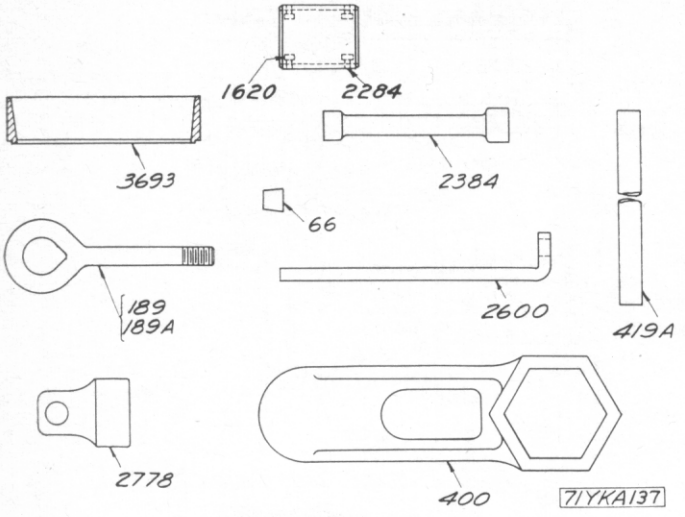
List Division No. 18. Water Manifolds



Repair Chart No. 18

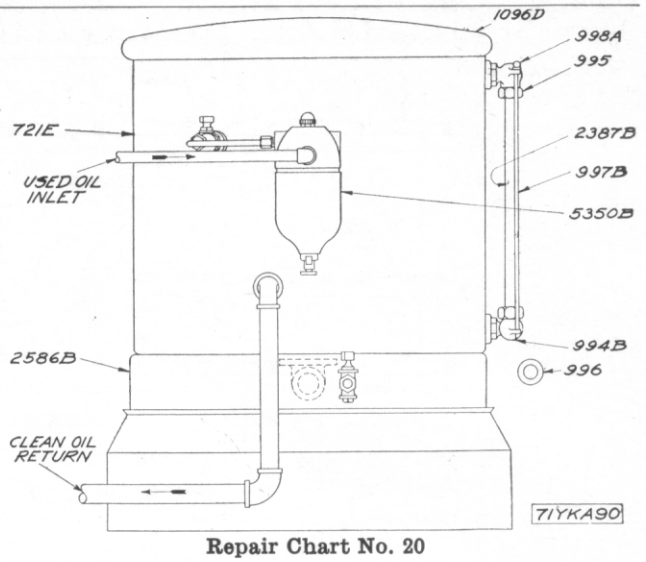
Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
1581P	Water Overflow Manifold } See List Div. 8 for engine with	YJA1581M	1	.....	.....						
	" " Manifold } horizontal exhaust manifolds	Y2JA1581N	.....	1	.....						
	" " Manifold }	Y3JA1581J	.....	.....	1						
2124	" " " Gasket	Standard (4")	.....	.....	.....	.....	1	1	3	3	3
2115E	Air Start Pipe Flange (Upper)	YKA2115G	1	.....	.....	1					
	" " " Flange (Upper)	YKA2115F	.....	2	3	.....	2	3	4	5	6
	Air Start Pipe Flange Plug (Solid)	1¼"	.....	1	1	.....	1	1	2	2	3
2323	Air Start Pipe Flange Gasket	YKA2323A1	1	2	3	1	2	3	4	5	6
1262	Air Start Pipe Flange Gland	YKA1262A	.....	2	2	.....	2	2	4	4	4
1262A	" " " " Gland	YKA1262B	.....	2	4	.....	2	4	4	6	8
6660B	" " " " Plug Gasket	YLA6660A	.....	2	2	.....	2	2	4	4	4
	" " " " Candle Wicking	¼"x10"	.....	2	4	.....	2	4	4	6	8
1585A	" " Blind Flange	Y2KA1585B	.....	.....	.....	.....	1	1	1	1	1
798A	Water Overflow Funnel	YKA798C	1	2	3	1	2	3	4	5	6
1584B	" " " Gasket	YKA1584E	1	2	3	1	2	3	4	5	6
277B	Cooling Water Thermometer (Special Order Only)	16FM39J2	1	2	3	1	2	3	4	5	6
1586P	" " Overflow Elbow	YKA1586R	1	2	3	1	2	3	4	5	6
1586Q	" " " Elbow (Closed System)	YKA1586S	1	2	3	1	2	3	4	5	6
1584A	" " " " Gasket	YKA1584D	1	2	3	1	2	3	4	5	6
6940	Upper Water Header Pipe	Y2JA6940A	.....	.....	1						
	" " " Pipe	Y2KA6940A	.....	.....	.....	.....	.....	1	.....	1	2
6940A	Upper Water Header Pipe	Y2JA6940B	.....	2	2						
	" " " Pipe	Y2KA6940B	.....	.....	.....	.....	2	2	4	4	4
1687E	Upper to Lower Water Manifold Pipe	YJA3816A	1	1	1						
1687B	" " " " " Pipe	YKA3816B	.....	.....	.....	1					
	" " " " " Pipe	Y2KA3816A	.....	.....	.....	.....	1	1	2	2	1
1687D	Upper to Lower Water Manifold Pipe	Y6KA3816A	.....	.....	.....	.....	.....	.....	.....	.....	1
3149A	Lower Water Manifold (One Cyl. Opening)	YKA3149A1	1	.....	.....	1					
3149B	Lower Water Manifold (Two Cyl. Opening)	Y2JA3149C1	.....	1	.....						
	" " Manifold (Two Cyl. Opening)	Y2KA3149B2	.....	.....	.....	.....	1	.....	2	1	
3149D	Lower Water Manifold (Three Cyl. Opening)	Y3JA3149C1	.....	.....	1						
	" " Manifold (Three Cyl. Opening)	Y3KA3149B2	.....	.....	.....	.....	.....	1	.....	1	2
407B	Water Manifold to Cylinder Gasket	YKA407B	1	1	1	1	2	3	4	5	6
407D	" " Gasket	YLA407B	.....	.....	.....	.....	1	1	1	1	1
1582B	" " Flange	YLA1582D	.....	.....	.....	.....	1	1			
1617B	Regulating Valve Bonnet Gasket	CJA858A	.....	2	3	.....	2	3	4	5	6
1618B-C	**Cooling Water Regulating Valve (Complete)** (Note:—Replaced on later models with plug (**Y5LA4379A**) and gaskets (**CJA858A**).	.....	....	**2**	**3**	....	**2**	**3**	**4**	**5**	**6**
1618B	Water Regulating Valve (All in Bracket)	YLA1618A	.....	2	3	.....	2	3	4	5	6
1614A	" " " Bonnet	YLA1614A	.....	2	3	.....	2	3	4	5	6
1499	" " " Packing	CFA1499A2	.....	12	18	.....	12	18	24	30	36
1615	" " " " Gland	CFA1615A1	.....	2	3	.....	2	3	4	5	6
1616A	" " " " " Nut	YLA1616A	.....	2	3	.....	2	3	4	5	6
669A	" " " Handle	YKA669A	.....	2	3	.....	2	3	4	5	6
	" " " " Dowel	#205	.....	2	3	.....	2	3	4	5	9

List Division No. 19—Tools and Wrenches



Repair Chart No. 19

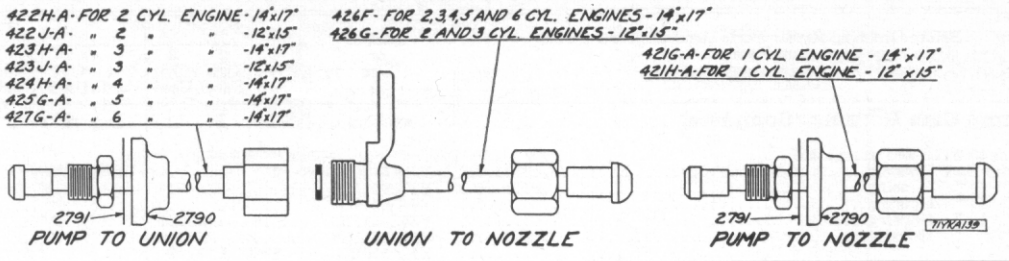
List Division No. 20—Oil Filter Storage Tank

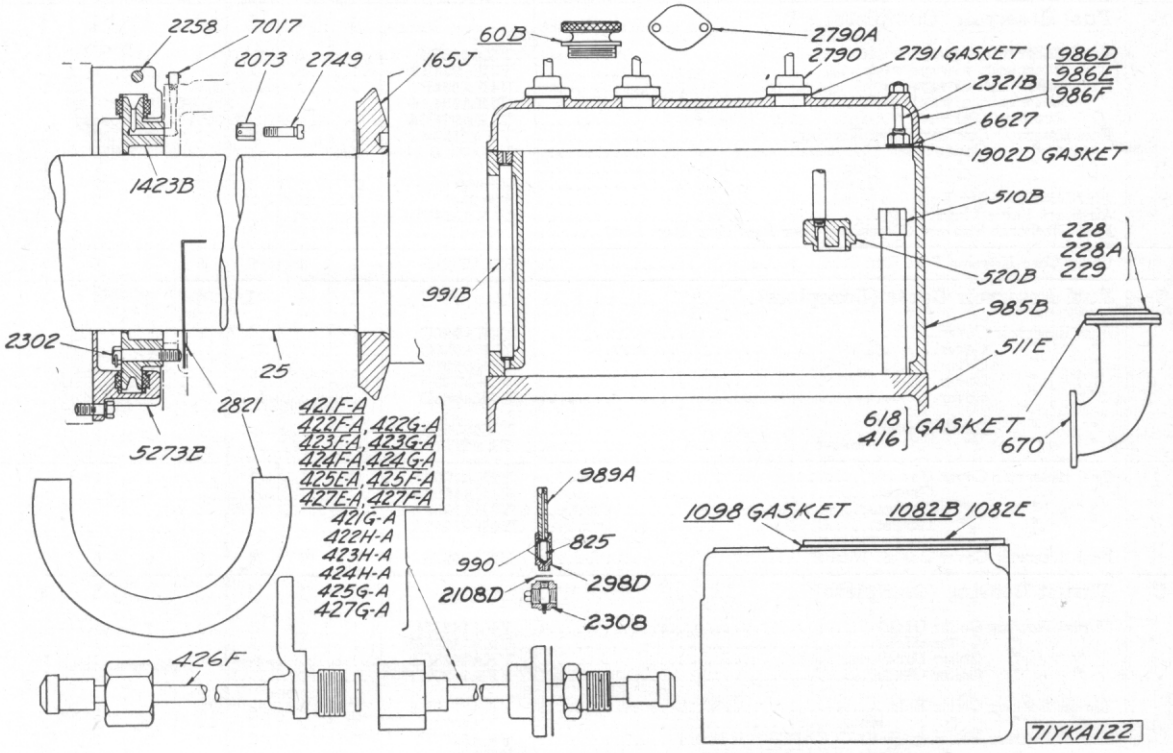


Repair Chart No. 20

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
750B-C	**Tools (Complete Set)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
189A	Fuel Reservoir Eye Bolt	½″	2	2	2	2	2	2	2	2	2
189	Piston Lifting Eye Bolt	YKA189A	2	2	2	2	2	2	2	2	2
419A	Flywheel Turning Bar	YK419A	1	1	1	1	1	1	1	1	1
2600	Piston Clamp, with (2) ½″x1″ Cap Screws	YJA2600A	2	2	2						
	" Clamp, with (2) ⅝″x1¼″ Cap Screws	YKA2600A				2	2	2	2	2	2
3693	Piston Ring Guide	YJA3693A	1	1	1						
	" " Guide	YKA3693A				1	1	1	1	1	1
66	Air Start Cage Plug	ND66	1	1	1	1	1	1	1	1	1
	Leveling Screws 11FM18A	¾-10x5	4	6	8	4	6	8	6	12	8
	Open End Wrench 1⅜″ Nut	#13	1	1	1						
	" " Wrench 1½″ Nut	#14	1	1	1	1	1	1	1	1	1
	" " Wrench 1¾″ Nut	#16				1	1	1	1	1	1
	" " Wrench 5/16″—⅜″ Nut	#27	1	1	1	1	1	1	1	1	1
	" " Wrench ½″—⅝″ Nut	#34	1	1	1	1	1	1	1	1	1
	" " Wrench ¾″—⅞″ Nut	#39	1	1	1	1	1	1	1	1	1
	" " Wrench 1″—1⅛″ Nut	#43	1	1	1	1	1	1	1	1	1
	" " Wrench ⅜″ Cap Screw	#702	1	1	1	1	1	1	1	1	1
	" " Wrench ½″ Cap Screw	#704	1	1	1	1	1	1	1	1	1
	Box Type Wrench 1¼″ Nut	#812							1	1	1
	Box Wrench 1½″ Nut	#814	1	1	1						
	Box Wrench 1¾″ Nut	#816				1	1	1			
	Hollow Head Setscrew Wrench ⅜″	16FM19AA	1	1	1	1	1	1	1	1	1
	" " " Wrench ⅝″	16FM19AA	1	1	1	1	1	1	1	1	1
1080	Adapter Tube Packing Gland Wrench (Not Shown)	CHB1080A	1	1	1	1	1	1	1	1	1
400	Flywheel Hub Bolt Wrench	YK400	1	1	1	1	1	1	1	1	1
2384	Governor Socket Wrench	YK2384A	1	1	1	1	1	1	1	1	1
2778	Main Bearing Socket Wrench	YJA2778A	1	1	1						
	" " " Wrench	YKA2778A				1	1	1	1	1	1
2694	Upper Water Header Packing Gland Wrench (Not Shown)	TD2694A	1	1	1	1	1	1	1	1	1
2284	Piston Pin Sleeve	YJA2284B	1	1	1						
	" " Sleeve	YKA2284B				1	1	1	1	1	1
1620	Piston Pin Sleeve Screw	CFE1620A	4	4	4	4	4	4	4	4	4
	Upper to Lower Base Capscrew Socket Wrench	452D				1	1	1	1	1	1
	Upper to Lower Base Dowel Removing Tool	TD2273A				1	1	1	1	1	1
	" " " " " " " " Nut	TD2274A				1	1	1	1	1	1
721E-C	**Oil Filter Storage Tank (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
721E	**Oil Filter Storage Tank, always with**	**CFB721C**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	" " " " Bottom	CFB721B	1	1	1	1	1	1	1	1	1
	" " " " Coupling	PBD555A	3	3	3	3	3	3	3	3	3
	" " " " Elbow	YKA2794B	1	1	1	1	1	1	1	1	1
	" " " " " Rivets	⅜″x½″	8	8	8	8	8	8	8	8	8
	" " " " Inlet Fitting	CFB4834A	1	1	1	1	1	1	1	1	1
	" " " " Filter Coupling	YKA5305C	1	1	1	1	1	1	1	1	1
	" " " " " Coupling	YKA5305D	2	2	2	2	2	2	2	2	2
2586B	Oil Storage Tank Base	YKA2586D	1	1	1	1	1	1	1	1	1
1096D	" " " Cover	CFB1096A	1	1	1	1	1	1	1	1	1
994B	Gauge Glass Arm	PBD994A	2	2	2	2	2	2	2	2	2
995	" " Gland Cap	PBD995A	2	2	2	2	2	2	2	2	2
996	" " Washer	PBD996A	2	2	2	2	2	2	2	2	2
2387B	" Glass	YKA2387B	1	1	1	1	1	1	1	1	1
997B	Gauge Glass Guard Rod (All in Bracket)	PBD997A	2	2	2	2	2	2	2	2	2
998A	" " " " End	PBD998A	2	2	2	2	2	2	2	2	2
	Oil Filter to Cover Flat Head Screw	5/16″x¾″	3	3	3	3	3	3	3	3	3
	Drain Nipple	½″x10″	1	1	1	1	1	1	1	1	1
	Tee Handle Stop Cock	½″	1	1	1	1	1	1	1	1	1
5350B	Oil Filter (Purolator) 16FM115D38	G48WM34	1	1	1	1	1	1	1	1	1
1091E	Oil Filter Element (Purolator)		1	1	1	1	1	1	1	1	1

List Division No. 21. **Dredge Parts**





Repair Chart No. 21

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12"x15" 1 Cyl. Used	12"x15" 2 Cyl. Used	12"x15" 3 Cyl. Used	14"x17" 1 Cyl. Used	14"x17" 2 Cyl. Used	14"x17" 3 Cyl. Used	14"x17" 4 Cyl. Used	14"x17" 5 Cyl. Used	14"x17" 6 Cyl. Used
298E-C	**Main Bearing Oil Gauge (Complete)**		**1**	**2**	**3**	**1**	**2**	**3**	**3**	**4**	**5**
298D	**Main Bearing Oil Gauge Body, Always with**	**YJA298A**	**1**	**2**	**3**	**1**	**2**	**3**	**3**	**4**	**5**
825	" " " " Glass	YK825	1	2	3	1	2	3	3	4	5
990	" " " " Glass Gasket	YK990	2	4	6	2	4	6	6	8	10
989A	" " " " Vent Plug	YK989A	1	2	3	1	2	3	3	4	5
2108D	" " " " Body Gasket	YKA2108A	1	2	3	1	2	3	3	4	5
2308	Main Bearing Oil Gauge Body Fitting, Always with	YJA2308A	1	2	3	1	2	3	3	4	5
	" " " " Fitting Pipe Plug	⅛"	1	2	3	1	2	3	3	4	5
	" " " " Fitting Pipe Plug	1"	1	2	3	1	2	3	3	4	5
2821	Main Bearing Oil Baffle Plate	YKA2821A	1	1	1	1	1	1	1	1	1
165J	**Air Stop Ring (Bottom), always with**	**YJA165G**	**2**	**2**	**2**						
	" " " **(Bottom), always with**	**YKA165H**				**2**	**2**	**2**			
	" " " **(Bottom), always with**	**Y6KA165G**							**2**	**2**	**2**
	Air Stop Ring (Top)	YJA165H	2	2	2						
	" " " **(Top)**	YKA165G				2	2	2			
	" " " (Top)	Y5KA165A							6	8	
	" " " **(Top)**	**Y5KA165B**							**2**	**2**	
	" " " **(Top)**	**Y6KA165H**									**2**
	Air Stop Ring Bolt	YK191A				4	8	12	16	20	24
	" " " Bolt	YJA191A	4	8	12						
	" " " " Lockwasher	⅝"	**4**	8	12	**4**	8	12	16	20	24
	" " " " Lockwire	1/16"x3½"	**4**	8	12	**4**	8	12	16	20	24
	" " " Dowel	**Y2J192**	**4**	8	12	**4**	8	12	16	20	24
	Air Stop Ring Backlash Spring	YK392A							8	10	
	" " " " " Clip	Y4KA394A							8		
	" " " " " Clip	YK394								10	
	Backlash Spring Clip Capscrew	½"x¾"							8		
	" " " Capscrew	5/16"x2"								10	
	" " " " Nut	5/16"								10	
	Air Stop Ring Setscrew Jam Nut	½"								10	
	" " " Backlash Clip Washer	½"							8		

List Division No. 21. **Dredge Parts** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
511E-C	**Pump Case Housing (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Same as 511B-DC except use										
	Pump Case Housing	YKA511C3	1	1		1	1				
	" " Housing	Y3KA511C4			1			1			
511E	" " Housing	Y4KA511C3							1		
	" " Housing	Y5KA511B3								1	
	" " Housing	Y6KA511E4									1
510B	" " " Overflow Pipe	YKA510B	1	1	1	1	1	1	1	1	1
985B-C	**Fuel Reservoir (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Fuel Reservoir, always with	**YKA985B4**	1	1		1	1				
	" **Reservoir, always with**	**Y3KA985B4**			1			1			
985B	" **Reservoir, always with**	**Y4KA985B4**							1		
	" **Reservoir, always with**	**Y5KA985A4**								1	
	" **Reservoir, always with**	**Y6KA985D4**									1
	Fuel Reservoir Starting Valve Bushing	YKA1199A	1	1	2	1	1	2	2	2	3
991B	" " Gauge Glass	YKA991B	1	1	1	1	1	1	1	1	1
	" " " " Plug	YK989	1	1	1	1	1	1	1	1	1
	" " " " Gasket	YK990	2	2	2	2	2	2	2	2	2
	Air Shut-Off Valve Fuel Res. Stud	⅝″x2½″	2	2	2	2	2	2	2	2	2
	Air Start Valve Plug	Y5KA3141A								1	
975-C	Fuel Discharge Strainer (Complete) (See Reg. Eng. Rep. List)		1	1	1	1	1	1	1	1	1
2321B	Pump Case Housing Fuel Res. Stud	YKA2321B	6	6	6	6	6	6	6	6	6
986F-C	**Fuel Reservoir Cover (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Fuel Reservoir Cover	Y2KA986C	1	1		1	1				
	" " Cover	Y3KA986C			1			1			
986F	" " Cover	Y4KA986E							1		
	" " Cover	Y5KA986B								1	
	" " Cover	Y6KA986D									1
2790A	" " Blank Flange	YKA2790B	1			1					
2791	" " " " Gasket	YKA2791A	1			1					
	Fuel Reservoir Cover Gasket	Y2KA1902A	1	1	1	1	1	1			
1902D	" " " Gasket	Y4KA1902A							1		
	" " " Gasket	Y5KA1902A								1	
	" " " Gasket	Y6KA1902A									1
6627	Fuel Reservoir Cover Gasket Washer	YKA6627A	6	6	6	6	6	6	6	6	6
5273B-C	**Thrust Bearing (Complete)**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Thrust Bearing Collar (Half)	YKA1423J1	1	1	1	1	1	1			
1423B	" " Collar (Half)	YKA1423K1	1	1	1	1	1	1			
	" " Collar (Half)	YKA1423G1							1	1	1
	" " Collar (Half)	YKA1423H1							1	1	1
2749	Thrust Bearing Collar Bolt	YKA2749B1	2	2	2	2	2	2	2	2	2
2073	" " " " Nut	YKA2073A	2	2	2	2	2	2	2	2	2
5273B	Thrust Bearing Housing (Half) (YKA5273H is furn.)	YKA5273F1	2	2	2	2	2	2			
	" " " (Half) (YKA5273J is furn.)	YKA5273E1							2	2	2
	Thrust Bearing Housing Pipe Plug	¼″	2	2	2	2	2	2	2	2	2
2258	" " " Bolt	YKA2258A	2	2	2	2	2	2	2	2	2
	" " " " Lockwasher	½″	2	2	2	2	2	2	2	2	2
	" " " " Nut	½″ C. P.	2	2	2	2	2	2	2	2	2
520B	Fuel Supply Pump Discharge Valve Cap	YKA520B	1	1	1	1	1	1	1	1	1
1082E	Lub. Oil Sump. Cover	YKA1082E	1	1	1	1	1	1			
	" " " Cover	Y4KA1082E							1	1	1
2302	Thrust Collar to Base Cap Screw	YKA2302A	10	10	10	10	10	10	10	10	10
25	Crankshaft		1	1	1	1	1	1	1	1	1
	Note:—When Crankshaft is ordered for Dredge Outfit engine number must be specified. The Standard Crankshaft is used on all outfits except 4 cylinder engine. The arrangement of Air Stop Rings differ and the 4 cyl. engine has special counterweights.										
	Note:—When ordering injection tubes, specify AR1, AR2, AR3 or AR4 where found in list. See Fig. 37 on page 34 to determine engine rotation.										
421H-A	Injection Tube, Pump to Nozzle (96″), (Complete)	YJA421M	1								
421G-A	Injection Tube, Pump to Nozzle (90″), (Complete)	YKA421M				1					
422J-A	Injection Tube, Pump to Union (108″), (Complete) AR2 and AR4	Y2JA422M		2							
	" Tube, " " " (93″), (Complete) AR1 and AR3	Y2JA422L		2							
422H-A	Injection Tube, Pump to Union (97″), (Complete) AR2 and AR4	Y2KA422N					2				
	" Tube, " " " (99½″), (Complete) AR1 and AR3	Y2KA422P					2				
423J-A	Injection Tube, Pump to Union ("139), (Complete) AR2 and AR4	Y3JA423J			3						
	" Tube, " " " (124″), (Complete) AR1 and AR3	Y3JA423H			3						
423H-A	Injection Tube, Pump to Union (128″), (Complete) AR2 and AR4	Y3KA423N						3			
	" Tube, " " " (126″), (Complete) AR1 and AR3	Y3KA423Q						3			
424H-A	Injection Tube, Pump to Union (174″), (Complete) AR2 and AR4	Y4KA424P							4		
	" Tube, " " " (152″), (Complete) AR1 and AR3	Y4KA424R							4		
425G-A	Injection Tube, Pump to Union (209″), (Complete) AR2 and AR4	Y5KA425N								5	
	" Tube, " " " (184″), (Complete) AR1 and AR3	Y5KA425Q								5	
427G-A	Injection Tube, Pump to Union (238¼″), (Complete) AR2 and AR4	Y6KA427N									5
	Injection Tube—Pump to Union (Cyl. #6 Only) (AR2 & AR4)	Y6KA427Q									1
	" Tube, " " " (214½″), (Complete) AR1 and AR3	Y6KA427P									6

(Continued)

List Division No. 22. Springs and Gaskets

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″ 1 Cyl. Used	12″x15″ 2 Cyl. Used	12″x15″ 3 Cyl. Used	14″x17″ 1 Cyl. Used	14″x17″ 2 Cyl. Used	14″x17″ 3 Cyl. Used	14″x17″ 4 Cyl. Used	14″x17″ 5 Cyl. Used	14″x17″ 6 Cyl. Used
426G	Injection Tube, Union to Nozzle (44¾″), (Complete)										
426F	" Tube, " " " (50¼″), (Complete)										
	Note:—Injection tubes are furnished complete with fittings as shown in Repair Chart No. 21. All fittings may be ordered separately. Fittings, with the exception of 2790 and 2791 which are listed below, are found on page 36.										
2790	Fuel Reservoir Cover Flange	YJA2790A	1	2	3						
	" " " " Flange	YKA2790A	....	....	....	1	2	3	4	5	6
2791	Fuel Reservoir Cover Flange Gasket	YKA2791A	1	2	3	1	2	3	4	5	6
748D-C	**Springs (Complete)**	....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
178	Piston Pin Dowel Spring	YK178A1	1	2	3	1	2	3	4	5	6
193B	Air Stop Ring Spring	YKA193A1	8	16	24	8	16	24	32	40	48
	Lubricating Oil Sump Cover Pin Spring	YKA193A1	1	1	1	1	1	1	1	1	1
256D	Governor Spring with Plug	YJA256E	2	2	2						
	" " " " Plug	YKA256J	....	....	....	2	2	2	2	2	2
259	Injection Pump Suction Valve Spring	YKA259A	1	2	3	1	2	3	4	5	6
260B	" " Plunger Spring	CKB260A	1	2	3	1	2	3	4	5	6
266	" " Suction Valve Push Rod Spring	YKA266B	1	2	3	1	2	3	4	5	6
300A	Aux. Fuel Pump Plunger Rod Spring	YKA300B	1	1	1	1	1	1	1	1	1
392	Air Stop Ring Backlash Spring	YK392A	2	4	6	2	4	6			
	" " " " Driving Spring	Y4KA392B	....	....	....	....	....	....	8	10	12
537	Injection Pump Discharge Valve Spring	YK537	1	2	3	1	2	3	4	5	6
572	Air Starting Valve Spring	YKA572A	1	1	2	1	1	2	2	2	3
595A	Air Valve Spring	YK595A1	20	40	60	20	40	60	80	100	120
837	Piston Pin Oil Scraper Spring	YKA837A	....	....	....	2	4	6	8	10	12
837A	" " " " Spring	YK837A	2	4	6						
856A	Air Start Check Valve Spring	YKA856A	1	1	2	1	1	2	2	2	3
1405	Connecting Rod Box Cap Wick Support Spring	YK1405A	2	4	6	2	4	6	8	10	12
2257	Fuel Hand Control Lever Latch Spring	YKA2257A1	2	2	2	2	2	2	2	2	2
2295A	Air Start Shut Off Valve Spring	YKA2295B	1	1	1	1	1	1	1	1	1
2326	Air Start Rocker Aux. Spring	YKA2326A4	1	1	2	1	1	2	2	2	3
	Injection Pump Rocker Aux. Spring	YKA2326A4	1	2	2	1	2	2	4	....	6
	" " " " Spring	Y5KA2326A	....	....	....	....	....	....	....	5	
2326A	Injection Pump Rocker Aux. Spring	YKA2326C	....	....	1	....	....	1			
2336	Gov. Cam Rocker Aux. Spring	YKA2336A2	1	2	3	1	2	3	4	....	4
	" " " " Spring	Y5KA2336A	....	....	....	....	....	....	....	5	
2336A	Gov. Cam R cker Aux. Spring	YKA2336B	....	....	....	....	....	....	....	....	2
2362	Fuel Reservoir Cover Cap Spring	YKA2362A	1	1	1	1	1	1	1	1	1
6283	Injection Pump Relief Valve Spring	CKC6283A	1	2	3	1	2	3	4	5	6
6541	Governor Weight Drag Spring	YKA6541B	2	2	2	2	2	2	2	2	2
749D-C	**Gaskets and Packing (Complete)**	....	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
33E	Cylinder Head Gasket	YKA33M	8	16	24	10	20	30	40	50	60
76	Exhaust Nozzle Hand Hole Cover Gasket	YF76	2	4	6	2	4	6	8	10	12
	" Pot " " " " Gasket	YF76	1	1	1	1	1	1	2	3	3
76A	Exhaust Pipe Hand Hole Cover Gasket	YKA76B	1	2	3	1	2	3	4	5	6
	Exhaust Nozzle to Cyl. Gasket	YJA77A	1	2	3						
	" " " " Gasket	YKA77A	....	....	....	1		3	4	5	6
77A	" Pipe " " Gasket	YJA77A	1	2	3						
	" " " " Gasket	YKA77A	....	....	....	1	2	3	4	5	6
197B	Upper-Lower Base Gasket	YJA197B	2	4	6						
	" " " " Gasket	YJA197C	4	8	12						
197E	Upper-Lower Base Gasket	YKA197E	....	....	....	2	4	6	8	10	12
197D	" " " " Gasket	YKA197D	....	....	....	4	8	12	16	20	24
198B	Cylinder-Upper Base Gasket	YJA198B	1	2	3						
	" " " " Gasket	YKA198B	....	....	....	1	2	3	4	5	6
199	Upper Base Hand Hole Cover Gasket	YJ199	1	2	3						
	" " " " " " Gasket	YK199	....	....	....	1	2	3	4	5	6
	Air Valve Seat Gasket	YJ199	1	2	3						
	" " " " Gasket	YK199	....	....	....	1	2	3	4	5	6
214	Injection Tube Union Gasket	YKA214A	....	2	3	....	2	3	4	5	6
405	Crank Pin Oil Ring Gasket	YK405	1	2	3	1	2	3	4	5	6
407B	Lower Water Manifold to Cyl. Gasket	YKA407B	1	1	1	1	2	3	4	5	6
	" " " " Section Gasket	YLA407B	....	....	....	....	1	1	1	1	1
416	Exhaust Pot Flange Gasket	YG416	2	2	5						
469A	Pump Housing Side Cover Gasket	YKA469A	2	2	2	2	2	2	2	2	2
470	Aux. Fuel Pump Discharge Cap Gasket	YKA470A	1	1	1	1	1	1	1	1	1
472A	Pump Housing Gasket	YKA472A	2	2	2	2	2	2			
	" " " Gasket	Y4KA472A	....	....	....	....	....	....	2	2	2
473A	Injection Pump Body Gasket	YKA473A	1	2	3	1	2	3	4	5	6
573B	Air Start Distributor Body Gasket	YKA573A	1	1	....	1	1				
	" " " " " Gasket	Y3KA573A1	....	....	1	....	....	1	1		
	" " " " " Gasket	Y6KA573A1	....	....	....	....	....	....	....	1	1
573D	Air Start Shut Off Valve Cage Gasket	YKA573B	1	1	1	1	1	1	1	1	1
617	Exhaust Pot Cover to Body Gasket	YK617	1	1	1	1	1	1	2	3	3
618	" " Flange Gasket	YK618	....	....	....	2	2	5	4	4	6
632A	Cylinder Head Counterbore Gasket	YJA632F	1	2	3						
	" " " " Gasket	YKA632F	....	....	....	1	2	3	4	5	6
858D	Air Start Valve Cage Gasket	CFE5877A	1	2	3	1	2	3	4	5	6
990	Main Bearing Oil Gage Glass Gasket	YK990	2	2	2	2	2	2	4	4	4
	Fuel Reservoir Gage Glass Gasket	YK990	1	1	1	1	1	1	1	1	1

List Division No. 22. **Springs and Gaskets** (Continued)

Repair Number	Before Ordering Repair Parts Read the Instructions on Page 33. NAME OF PART	Symbol or Size	12″x15″			14″x17″					
			1 Cyl. Used	2 Cyl. Used	3 Cyl. Used	1 Cyl. Used	2 Cyl. Used	3 Cyl. Used	4 Cyl. Used	5 Cyl. Used	6 Cyl. Used
1039	Aux. Fuel Pump Suction Valve Gasket	YK1039	1	1	1	1	1	1	1	1	1
1097	Lubricating Oil Pump Body Gasket	YKA1097A	1	1	1	1	1	1	1	1	1
1549	Air Start Valve Cage Gasket	YKA1549A	1	2	3	1	2	3	4	5	6
1584A	Water Overflow Pipe Gasket	YKA1584D	1	2	3	1	2	3	4	5	6
1548B	" " Funnel Gasket	YKA1584E	1	2	3	1	2	3	4	5	6
1617	Regulating Valve Bonnet Gasket	CJA858A	.....	2	3	.....	2	3	4	5	6
	Lubricator Overflow Pipe Bracket Gasket	YKA1617A	1	1	1	1	1	1	1	1	1
1898	Governor Case Gasket	YKA1898A	1	1	1	1	1	1	1	1	1
1899	" " End Plate Gasket	YKA1899A	1	1	1	1	1	1	1	1	1
1902	Fuel Reservoir Cover Gasket	YKA1902A	1	1	1	1	1	1	1	1	1
1902B	Aux. Fuel Suction Cover Gasket	YKA1902C	1	1	1	1	1	1	1	1	1
2108	Injection Pump Discharge Valve Cage Gasket	YKA2108A	1	2	3	1	2	3	4	5	6
	" " Relief Valve Cage Gasket	YKA2108A	1	2	3	1	2	3	4	5	6
	Main Bearing Oil Gauge Body Gasket	YKA2108A	2	2	2	2	2	2	4	4	4
2108A	Aux. Fuel Suction Cover Plug Gasket	YLA2108A	1	1	1	1	1	1	1	1	1
2108B	Injection Pump Relief Valve Cage Plug Gasket	CJA2108A	1	2	3	1	2	3	4	5	6
	" " " " Seat Gasket	CJA2108A	1	2	3	1	2	3	4	5	6
2323	Air Start Pipe Flange Gasket	YKA2323A1	1	2	3	1	2	3	4	5	6
2334	Aux. Fuel Suction Overflow Casing Gasket	YKA2334A	1	1	1	1	1	1	1	1	1
2335	Air Starting Valve Spring Plug Gasket	YKA2335A	1	1	2	1	1	2	2	2	3
2335A	Air Start Inlet Elbow Gasket	YKA2335B	1	1	1	1	1	1	1	1	1
2340	Governor Case Hand Hole Cover Gasket	YKA2340A	1	1	1	1	1	1	1	1	1
2364	Upper Base Oil Ring Cover Gasket	YKA2364A	2	4	6	2	4	6	8	10	12
2369	Lub. Oil Pump Discharge Conn. Gasket	YKA2369A	2	2	2	2	2	2	2	2	2
2401	Fuel Reservoir Housing Gasket	YKA2401A	1	1	...	1	1				
	" " " Gasket	Y3KA2401A	.....	.....	1	.....	.....	1			
	" " " Gasket	Y4KA2401A	.....	.....	.....	.....	.....	.....	1		
	" " " Gasket	Y5KA2401A	.....	.....	.....	.....	.....	.....	.....	1	
	" " " Gasket	Y6KA2401A	.....	.....	.....	.....	.....	.....	.....	.....	1
2792	Lub. Oil Pump Body Cover Gasket	YKA2792A	.....	.....	.....	2	2	2	2	2	2
2792A	" " " " " Gasket	YJA2792A	2	2	2						
4645A	Base Sump Pipe Gasket	YKA4645B	1	2	3	1	2	3	4	5	6
5877	Cylinder Head Air Check Valve Gasket	YKA5877A	1	2	3	1	2	3	4	5	6
6660	Injection Pump Plunger Cylinder Gasket	YKA6660A	1	2	3	1	2	3	4	5	6
6660B	Air Start Pipe Flange Plug Gasket	YLA6660A	.....	2	2	.....	2	2	4	4	4
	Water Overflow Manifold Blind Flange Gasket	4″ 15FM34F	.....	.....	.....	.....	1	1	1	1	1
	" " " to Spacer Gasket	4″ 15FM34F	.....	.....	.....	.....	.....	.....	2	2	2
	Specify one of the following gaskets for use on engine with cast iron water cooled horizontal exhaust manifolds.										
	Manifold Outlet Reducing Flange Gasket—10″	15FM34A	.....	1	1						
	" " " " Gasket—12″	15FM34A	.....	1	1	.....	1	1	1	1	1
	" " " " Gasket—14″	15FM34A	.....	1	1	.....	1	1	1	1	1
	" " " " Gasket—16″	15FM34A	.....	1	1	.....	1	1	1	1	1
	Packings										
1089	Governor Case Overflow Packing Ring	YKA1089A	1	1	1	1	1	1	1	1	1
1499	Regulating Valve Packing	CFA1499A2	.....	12	18	.....	12	18	24	30	36
	Air Start Pipe Flange Candle Wicking	¼″x10″	.....	2	4	.....	2	4	4	6	8
	Cylinder Lub. Oil Pipe Packing	⅛″x⅛″x4″	2	4	6	2	4	6	8	10	12
	Exhaust Pot Wicking 15FM8A1	½ lb. Ball	.....	3	5	.....	3	5	6	6	9
5567A	Indicator Cock Adapter Tube Packing	ND1772B	1	2	3	1	2	3	4	5	6
5567A	Relief Valve Body Adapter Tube Packing	ND1772B	1	2	3	1	2	3	4	5	6