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MAINTENANCE MANUAL

MODEL 6046—SERIES 71 TWIN 6 CYLINDER DIESEL ENGINE

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DETROIT DIESEL ENGINE DIVISION
GENERAL MOTORS CORPORATION
DETROIT, MICHIGAN, U. S. A.

MODEL 6046 SERIES 71

TWIN 6 CYLINDER

DIESEL ENGINE

MAINTENANCE MANUAL

FIRST EDITION REVISED

DETROIT DIESEL ENGINE DIVISION
GENERAL MOTORS CORPORATION
DETROIT, MICHIGAN

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FOREWORD

Presented in this manual are complete detailed description and tested maintenance instructions pertaining to the 6046 (M-3A3), (M-3A5) and (M-4A2) Models of the Twin 6-cylinder Power Unit. References in the text refer to (M-3A5) and (M-4A2) only, but apply also to the (M-3A3).

Long life and dependability are provided in the engines of this unit by rugged construction, low piston speeds, and oversize bearings supplemented by effective lubrication.

Satisfactory performance depends upon intelligent maintenance and care, necessitating thorough familiarity with the various engine parts, their functions, and maintenance requirements. Before maintenance operations are performed, therefore, it is suggested that the mechanic thoroughly familiarize himself with the instructions contained in this text.

This REVISED edition differs from the original Maintenance Manual in that revisions to the (M-3A5) are included, also, complete instructions on the (M-4A2) are described and illustrated.

SUBJECT INDEX

SUBJECT

General Description of the Two-Cycle Diesel Engine and the Model 6046 Power Unit

The power unit described and illustrated in this Manual consists of two six-cylinder, in-line, two-cycle, General Motors Diesel Engines.

The Diesel Principle—The diesel engine is an internal combustion power unit, in which the heat of fuel is converted into work in the cylinder of the engine.

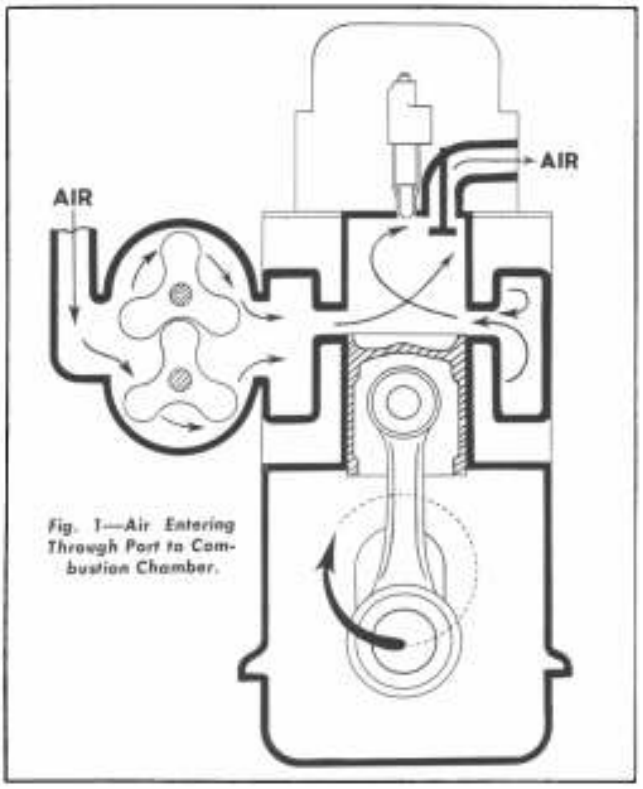

Fig. 1—Air Entering Through Port to Combustion Chamber.

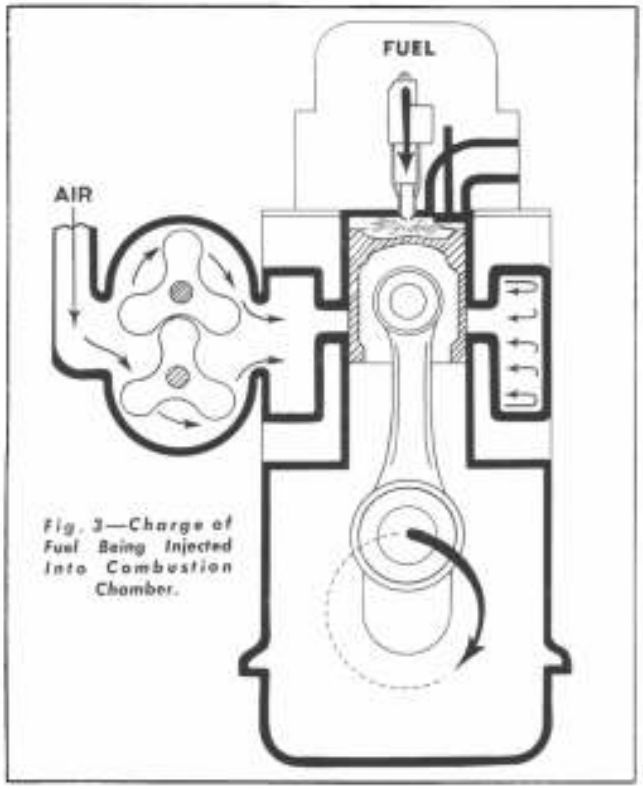

Fig. 3—Charge of Fuel Being Injected Into Combustion Chamber.

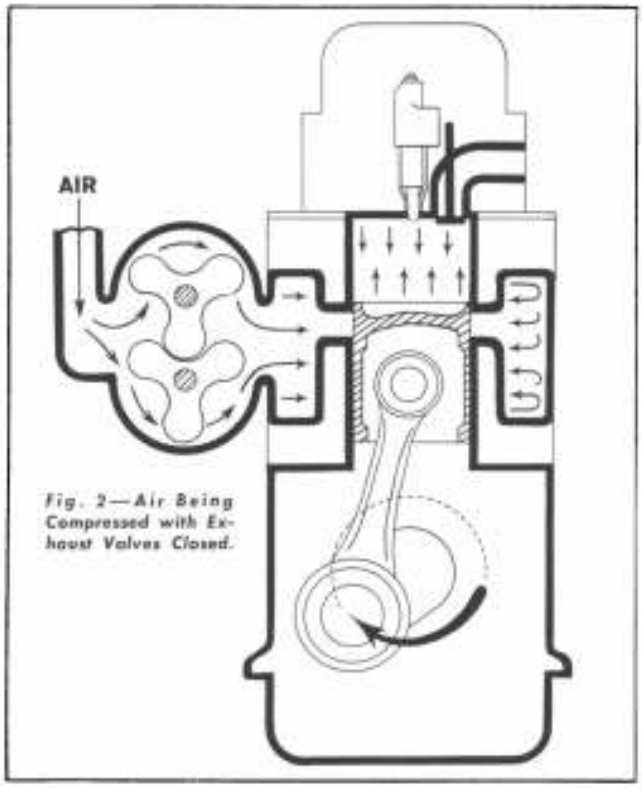

Fig. 2—Air Being Compressed with Exhaust Valves Closed.

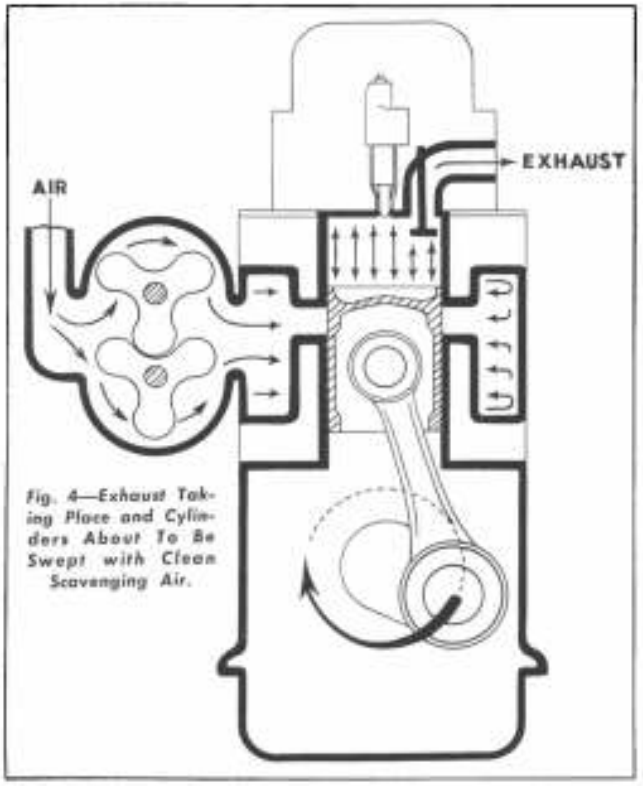

Fig. 4—Exhaust Taking Place and Cylinders About To Be Swept with Clean Scavenging Air.

Diesel engines differ from gasoline engines principally in the method used to introduce and ignite the fuel. Gasoline engines draw a mixture of fuel and air through the carburetor into the combustion chamber, where it is ignited by an electric spark. In the Diesel engine, air alone is compressed in the cylinder; then, a charge of fuel is sprayed into the cylinder, after the air has been compressed, and ignition is accomplished by the heat of compression.

Two-Cycle Diesel Engine—Four strokes are required to complete a cycle in the four-cycle engine, which functions half the time as an air pump. In the two-cycle engine, intake and exhaust take place during part of the compression and power strokes. A two-cycle engine, therefore, does not function as an air pump, so an external means of supplying the air is provided. A specially designed blower, bolted to the side of the engine, forces air into the cylinders in order to expel the exhaust gases and fill the cylinders with fresh air for combustion, as shown in Figs. 1, 2, 3, and 4.

A series of ports cut into the circumference of the cylinder wall, above the piston, in its lowest position, admits the air from the blower into the cylinder as soon as the top face of the piston uncovers the ports, as shown in Fig. 1. The unidirectional flow of air towards the exhaust valves produces a scavenging effect, leaving the cylinders full of clean air when the piston again covers the inlet ports.

As the piston continues on the upward stroke, the exhaust valves close and the charge of fresh air is subjected to the final compression, as shown in Fig. 2. In any internal combustion engine, the higher the compression ratio, the greater the efficiency. These engines are designed for a 16:1 compression ratio.

Shortly before the piston reaches its highest position, the required amount of fuel is sprayed into the combustion space by the unit fuel injector, as shown in Fig. 3. The intense heat generated during the high compression of the air ignites the fine fuel spray immediately, and the combustion continues as long as the fuel spray lasts. The resulting pressure forces the piston downward until the exhaust valves are again opened. As shown in Fig. 4, the burnt gases escape into the exhaust manifold as the downward moving piston is about to uncover the inlet ports. When these ports are uncovered, the cylinder volume is again swept with clean scavenging air, as shown in Fig. 1. This entire combustion cycle is completed in each cylinder for each revolution of the crankshaft, or, in other words, two strokes; hence, the ***"two-stroke cycle."***

MODEL 6046 POWER UNIT— (M-3A5), (M-3A5) REVISED AND (M-4A2)

The Model 6046 Power Unit described and illustrated in this REVISED text includes:
(a) The (M-3A5) and (b) the (M-4A2) units, hereinafter identified as the (M-3A5) and the (M-4A2) units, respectively.

Basically, the (M-3A5) and the (M-4A2) are the same. That is, both units develop the same horsepower and have the same manifold and accessory arrangement. Slight modifications were necessitated, however, to adapt the units to the vehicle design in which the two power units are used.

The major differences between the (M-3A5) and the (M-4A2) units are:

1. **Cooling Fans.** Change from cast, three-blade fans to stamped steel five-blade, together with the necessary detail changes in fan shafts, bearing retainers, etc.
2. **Battery Charging Generator.** Two battery charging generators are used on the (M-4A2) power units, whereas only one was used on the (M-3A5) units. Two voltage and current regulators are also used along with the two generators.
3. **Engine Rear Support Brackets.** The (M-4A2) uses longer engine rear support brackets with vehicle mounting holes relocated, to agree with new position of power unit in vehicle.
4. **Lubricating and Fuel Oil Filter Panel Assembly.** Four lubricating oil filters used with the (M-4A2) units to replace the two formerly used, necessitated a complete new design of the filter panel with relocation of the primary fuel oil filters, air heater coils and auxiliary starting switches.
5. **Propeller Shaft**—To conform with vehicle changes, a somewhat longer propeller shaft is used with the (M-4A2) units, also, the later (M-3A5) units. In addition, the tube diameter has been increased from 3½" to 4".

In addition to the change from the (M-3A5) to the (M-4A2), two major changes were made in the (M-3A5) units that were continued on in the (M-4A2) units.

These changes were:

1. **Power Transfer Unit.** Gear ratio change from 1.19 to 1.37 to produce a vehicle speed from 25 MPH to 29 MPH at 2100 engine RPM.
2. **Cooling Fans.** Change from cast, three-blade fans to stamped steel five-blade together with the necessary changes in fan shafts, bearing retainers, etc.

   The only difference in the steel fan assemblies used on the (M-3A5) and the (M-4A2) is the fan shafts and bearing retainers, which are somewhat longer on the former.

   Wherever changes occur in the (M-3A5) units, such changes will be described and illustrated in detail in the suitable sections of the Manual.

GENERAL DESCRIPTION
(M-3A5) and (M-4A2) Units

Engine Accessory and Manifold Arrangement—Due to the unique features of the engine design, a pair of engines, which constitute the Model 6046 Power Unit, are placed side-by-side with the exhaust manifolds together and the essential accessories, including blowers, fuel pump, water pumps, oil coolers, oil strainers, air cleaners, secondary fuel oil filters, and governors on the outside, as shown in Figs. 16 and 17.

By means of a heavy junction plate at the front end, and a double clutch housing and step-up gear (transfer) unit at the flywheel end of the engines, the two engines are joined together to form a single unit. As viewed from the fan end, the crankshaft directional rotation is counter-clockwise. The engine on the right side is Model 671LA24M, and on the left side Model 671LC24M, hereinafter identified as "LA" and "LC," respectively.

Interchangeability—All of the principal parts of the engines are identical, except a few right and left-hand pieces. Practically all parts subject to wear or replacement are the precision replaceable type, and exactly alike for both engines. The unit is designed for heavy-duty field service on a perpetual maintenance basis.

Flexibility—This power plant consists of two independent engines, each complete, with its own fuel system, lubricating oil system and supply tanks, water cooling system, and radiator.

Separate clutches are interposed between each engine and the step-up gear unit. Provision has been made for locking out either clutch by a control placed on the instrument panel on the (M-3A5) and on the hand throttle panel on the (M-4A2). In this way, it is possible to obtain maximum vehicle performance on both engines or to operate on either engine singly, if desired.

Accessibility for Maintenance—With the present vehicle design, the entire power unit may be removed from the vehicle after the engine compartment roof plates have been removed. Also, if required, either engine may be removed from the vehicle without disturbing the other.

Valve lash may be adjusted and injectors changed through the doors in the roof. Cylinder heads may also be removed through these doors.

By dropping the covers in the floor, the oil pans may be removed, giving access to the main and connecting rod bearings. Pistons and cylinder liners may then be removed; thus, the main running parts may be serviced without removing the engines from the vehicle.

Performance—Each individual engine of the power unit is tested separately before assembling as a complete unit. The normal rated output of the complete power unit at the driven shaft is 375 HP at 2500 RPM shaft speed on units with 1.19 power trasnfer gear ratio and 2880 RPM shaft speed on units with 1.37 power transfer gear ratio (2100 engine RPM). The governor is adjusted to give a full throttle speed of 2100 RPM. With this setting, the vehicle shows a speed of 25 MPH with the 1.19 gear ratio and 29 miles per hour with the 1.37 gear ratio, on a level concrete road with both engines operating, the speed being limited by the engine governor rather than the power of the engines. With one engine only at full throttle, the speed on the level is approximately 22 miles per hour with the 1.19 ratio and approximately 20 miles per hour with the 1.37 ratio, indicating a generous margin of power with both engines operating.

Lubricating System—Dry sump oiling system with a pressure pump for full pressure lubrication and double scavenging pumps, with inlets at each end of the oil pan, permits operation of engines up to 35° angle in any direction. External oil tanks are used for each engine.

Cooling System—Two high-efficiency, 20″, axial-flow cooling fans, turning at 2.20 times engine speed, are used on the power unit.

Air is drawn through openings in the roof of the vehicle over the engines, and blown through the radiators. The air is then discharged downward and rearward at the rear of the vehicle, behind an armored radiator shield.

Thermostats in the water manifold, in conjunction with by-pass pipes, permit rapid warm-up of the engines, and maintain constant engine temperatures under extreme variations of operating conditions. When the engines are warm, the thermostats permit unrestricted flow of the cooling water through the circulating system.

Air Induction System—Air is supplied to the blower through three heavy-duty oil-bath air cleaners, mounted on the blower air inlet housing of each engine. Air cleaners are protected by being mounted inside the hull, but are easily serviced through the doors in the roof of the vehicle. The individual units can be cleaned, filled with fresh oil, and replaced as an assembly without interfering with any other parts of the engine.

Fuel System—The fuel system used in the G. M. Diesel engines differs from the one commonly used, in that fuel is constantly circulated through the injectors at the rate of approximately 35 gallons per hour. This serves two purposes: first, it washes out any air bubbles which may collect in the system, thereby preventing it from becoming air bound; and, second, it serves to cool the injectors.

The piping system is so arranged that either one or both engines may be run on the right or left pair of fuel supply tanks.

For example, fuel is drawn from the right set of tanks, through the primary filter, fuel transfer pump, secondary filter, then through the injectors, and by suitable valving the spill is returned to the set of tanks from which it was withdrawn.

Starting System—Separate Delco-Remy 24-volt, heavy-duty, solenoid operated starting motors are mounted on each engine. A starting button for each engine is recessed into the instrument panel, and readily accessible to the operator. Auxiliary starting buttons are mounted in the engine compartment for turning the engines when service adjustments are necessary.

Normally, each engine will be started separately by its own starter. At normal temperatures, both engines may be started with one starter—by disengaging the clutches and starting either engine, then re-engaging the clutch and starting the other engine.

One Delco-Remy 24-volt 1200 watt battery charging generator is furnished on the (M-3A5) and two generators of similar design on the (M-4A2) units. Generator drive is off the blower drive shaft and at 1.95 times engine speed.

A vibrating-type voltage and current regulator for each generator is part of the electrical starting system and must be separately mounted on the vehicle structure.

All the various parts going to make up the complete power unit are treated separately in the various sections of this Manual.

MODEL DESIGNATIONS

A serial number plate as illustrated in Figs. 5 and 6, is attached to the cylinder block of each engine of the 6046 power unit; which shows the model and serial number of the individual engine.

Fig. 5—Typical Serial Number Plate Used on LA Engine.

On the LA engines, the number plate is located at the rear near the top of the cylinder block. On the LC engines, the number plate is located at the front near the top of the cylinder block.

Fig. 6—Typical Serial Number Plate Used on LC Engine.

LA engines are designated by the suffix "LA" after the first three digits of the model number. LC engines are designated by the suffix "LC" after the first three digits of the model number. Thus: 671LA24M designates an LA engine and 671LC24M designates an LC engine.

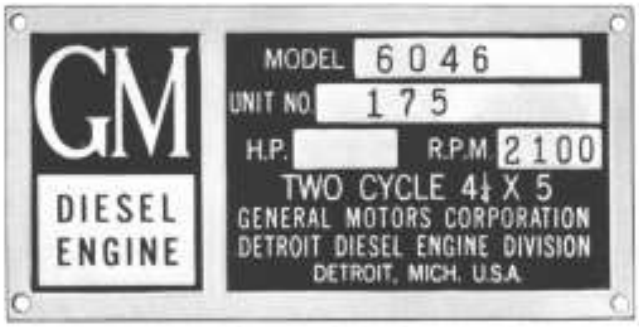

Fig. 7—Typical Unit Number Plate as Used on Early (M-3A5) Power Units.

Power Unit Number and Gear Ratio—In addi-

Fig. 8—Typical Unit Number Plate Used on Later (M-3A5) Power Units.