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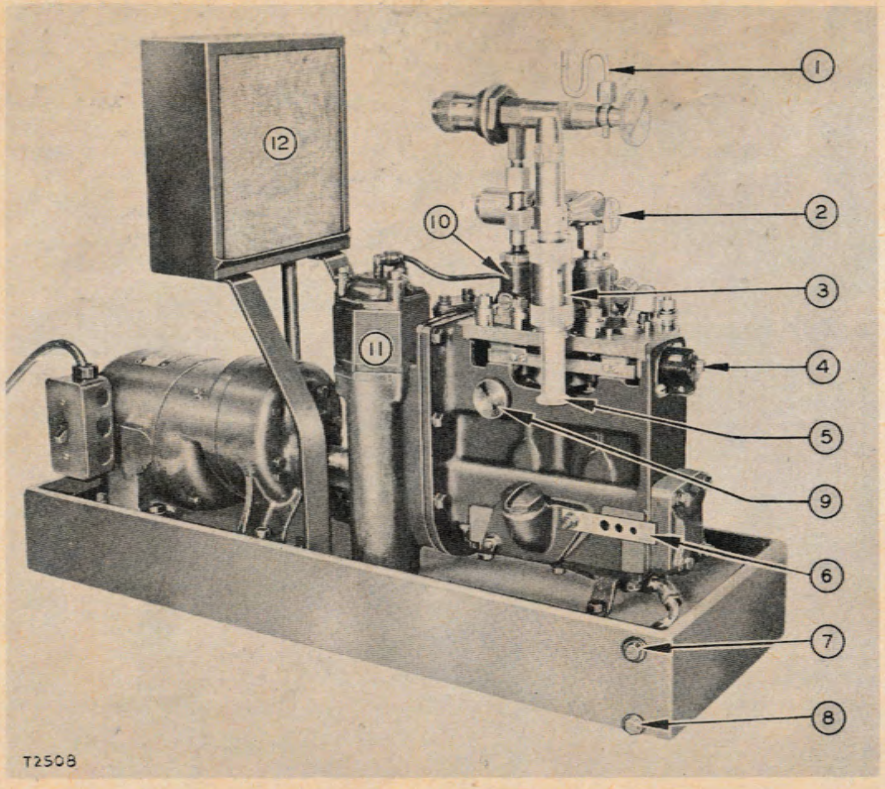


FIGURE 1—

TEST APPARATUS

(Earlier type)

1. By-pass measuring tube
2. Unseating pressure calibrating valve
3. Fuel pump discharge collector assembly
4. Counter
5. Collector jar
6. Gauge—Fuel pump plunger
7. Pump housing oil drain
8. Storage tank fuel drain
9. Rack lock screw
10. Special fuel injection pump
11. Fuel filter
12. Spray screen

DESCRIPTION OF TEST APPARATUS

The "Caterpillar" Fuel Injection Test Apparatus provides a means for determining the condition of "Caterpillar" Diesel fuel injection pumps and valves. It also makes possible the accurate adjustment of unseating pressure and needle lift in injection valves.

Fig. 1 shows the test apparatus. Power is supplied by an electric motor driving through reduction gears to turn the camshaft in the fuel pump housing at approximately 125 RPM. This closely corresponds to the camshaft speed when cranking the Diesel engine. An electric motor suitable for use with the voltage and current frequency of the local power supply is provided. A revolution counter mounted on the housing indicates the revolutions of the fuel pump camshaft.

Four pump locations are provided in the pump housing. Three are for testing pumps, and are marked for 10 mm (5¾", 5¼" & 5⅛" bore engines), 8 mm (4½" & 4¼" bore engines) and 7 mm (4" & 3¾" bore engines). The fourth location is for a permanently mounted special pump (fig. 2) for testing and adjusting fuel injection valves.

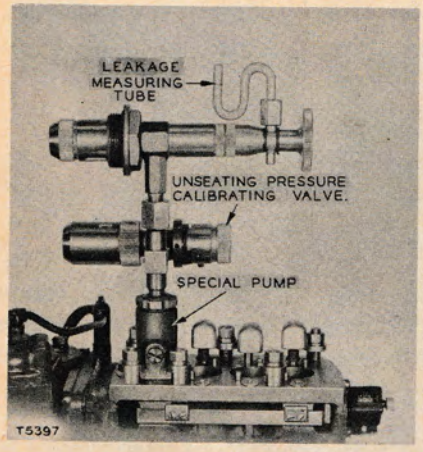


FIGURE 2—SPECIAL PUMP

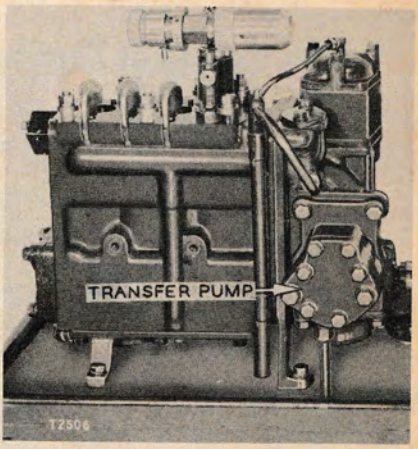


FIGURE 3—TRANSFER PUMP

The fuel supply is kept in the base of the apparatus and is circulated by a transfer pump (fig. 3). The fuel is forced through an absorbent type filter (fig. 4) before entering the manifold supplying the injection pumps.

Description of Testing Fuel Injection Pumps

Pumps are tested by mounting in the proper location on the pump housing and measuring the volume of fuel the pump will deliver into a calibrated collector jar in an established number of strokes of the pump. A counter is provided to record the number of pump strokes.

The collector jar (fig. 5) is for 12 mm, 10 mm, 7mm and 8mm pumps. This jar is marked "Good" and "Poor", to indicate the condition of the pump being tested.

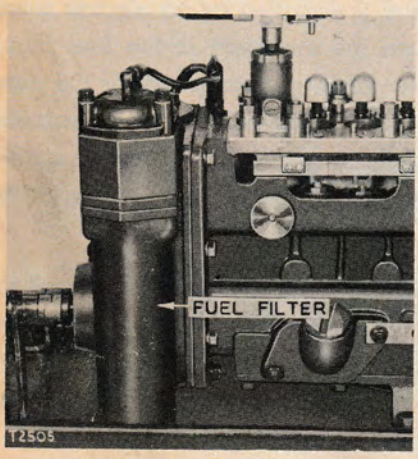


FIGURE 4–FUEL FILTER

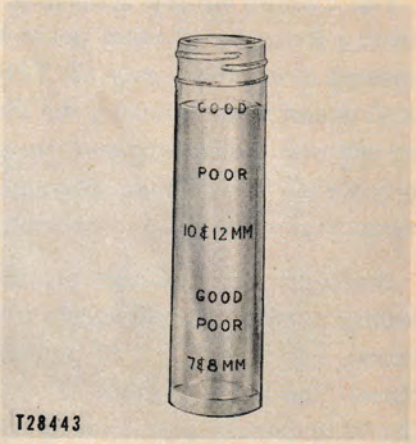


FIGURE 5–COLLECTOR JAR

Description of Testing Fuel Injection Valves

An injection valve is considered satisfactory for service if:

1. The spray characteristics are satisfactory
2. The unseating pressure is correct
3. Internal leakage is not excessive

A "Tee" fitting on top of the special pump for testing injection valves provides two openings for mounting valves. The unseating pressure calibrating valve (fig. 2) is mounted permanently at the side opening, and the top opening is for valves to be tested.

For checking spray characteristics, the calibrating valve is placed in the shut-off position, so that only the valve being tested operates. The spray impinges against the spray screen, and the fuel thus collected is returned to the supply tank.

For checking and setting the unseating pressure, the calibrating valve may be set to the normal unseating pressure of the valve being tested—

1750 psi for valves for 6⅛", 5¾" and 5¼" bore engines, and 1500 psi for valves for 4¼" and 3¾" bore engines. A thimble on the end of the calibrating valve is marked for these two settings, as well as an 1875 psi setting, which is used when observing spray characteristics (shut-off position).

When the unseating pressure of the valve being tested equals the unseating pressure of the calibrating valve, both valves will spray. If the unseating pressures are not equal, only the valve having the lower unseating pressure will spray, and the unseating pressure of the valve being tested should be raised or lowered until both valves discharge simultaneously.

Internal leakage usually results from excessive wear between the needle and nozzle of the spray valve assembly, which permits fuel to by-pass into the top of the valve where it is carried off by the overflow line. In rare cases, internal leakage may also result from an improper seal between internal parts of the valve. Such leakage is detected and measured with the by-pass measuring tube (fig. 2).

There are two types of flat seat fuel valves (see fig. 7 and 8). Reference should be made to these figures for fuel valve nomenclature used in these instructions.

Description of Special Tools

A complete set of special tools (fig. 6) for assembling, disassembling

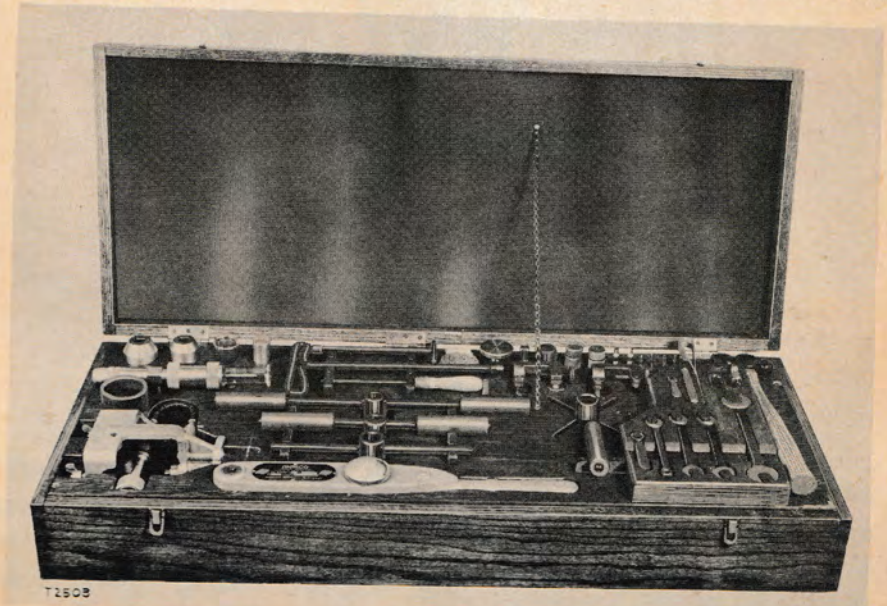


FIGURE 6—SPECIAL TOOLS

and adjusting fuel injection pumps and valves is furnished as part of the test apparatus.

NOTE

Instructions for installing the test apparatus are given in the topic of that name.

SERVICING FUEL INJECTION EQUIPMENT

Capsule-Type Fuel Injection Valves

TESTING THE NOZZLE

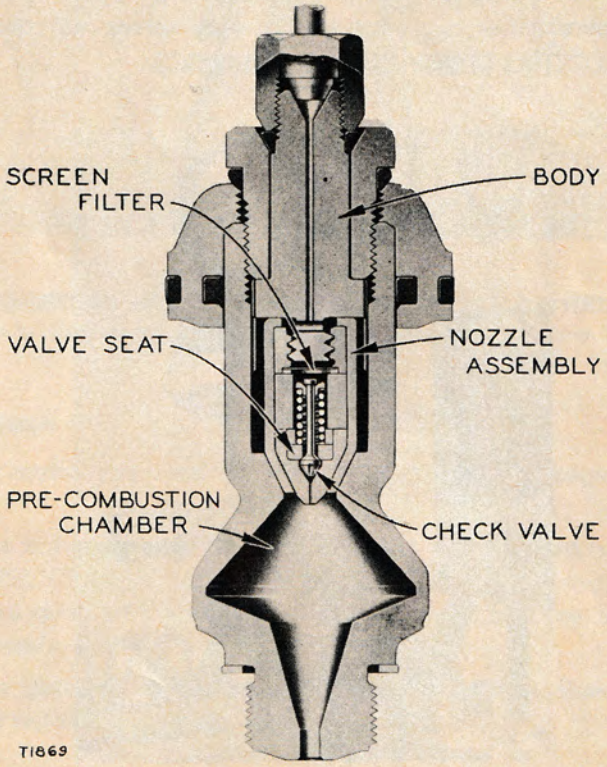


FIGURE 6A
CAPSULE-TYPE FUEL INJECTION VALVE ASSEMBLY

The nozzles of capsule-type fuel injection valves can be tested on the fuel injection test apparatus by the use of the 6F5568 Adapter Group shown in Fig. 6B. Spray characteristic, valve unseating pressure, and rate of leakage are the three tests which should be made on the nozzles.

The procedure for checking capsule nozzles is as follows (Fig. 6C):

General

1. Attach the adapter group to the test apparatus in the same manner as with the earlier type flat-seat injection valves. See the topic, "Flat-Seat Injection Valves, Checking Spray Characteristics".

2. Insert the nozzle **(3)** in the sleeve **(1)** and tighten the nut **(2)**.

Spray Characteristics

3. Open the valve **(5)** and close the valve **(6)**.

4. Start the motor and operate, observing the spray characteristics. The same general rules apply as for flat-seat valves, as covered in the topic, CHECKING SPRAY CHARACTERISTICS.

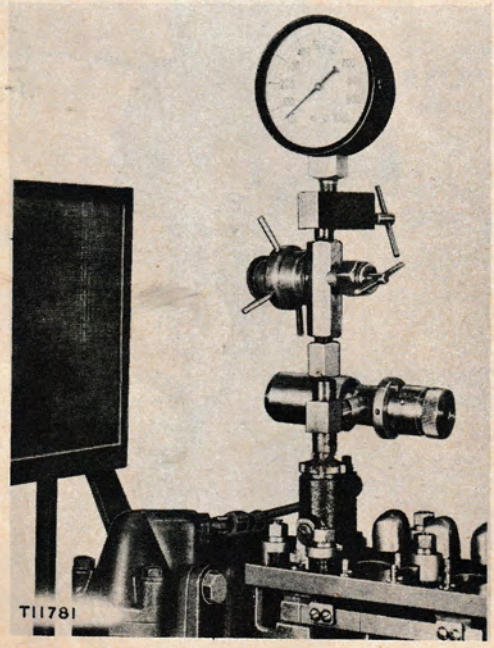


FIGURE 6B
ADAPTER FOR TESTING NOZZLE

Valve Unseating Pressure

5. With the apparatus running, slowly open the valve **(6)**, allowing fuel to enter the gauge. The valve **(6)** is now used to control gauge fluctuations. Valve unseating pressure may range from 300 to 800 PSI, as registered on the gauge. If the valve fails to reach a minimum of 300 PSI, it should be discarded.

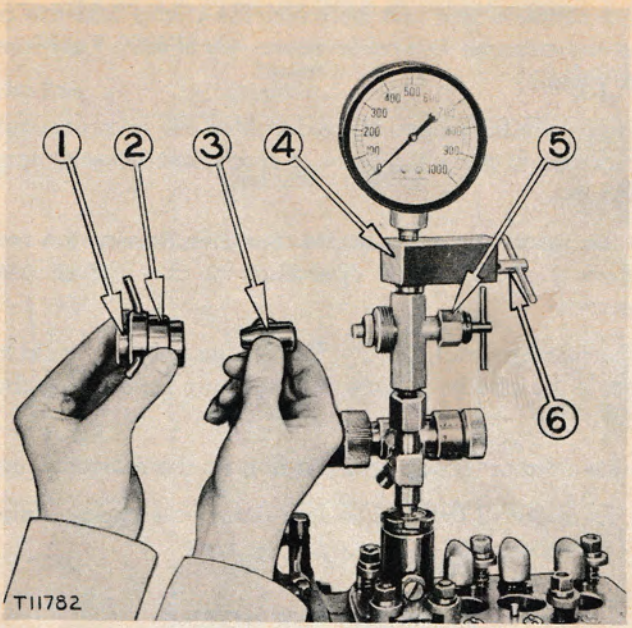


FIGURE 6C
INSERTING NOZZLE IN HOLDING SLEEVE FOR TESTING
1—Nozzle holding sleeve. 2—Retaining nut. 3—Nozzle. 4—Adapter. 5—Valve. 6—Valve.

Rate of Leakage

6. Stop the motor and close the valve **(5)** to prevent leakage back to the pump.
7. Open the valve **(6)** to reduce the pressure as indicated on the gauge to 300 PSI. Observe the gauge to note whether leakage causes an additional drop in pressure. If the pressure falls more than 100 PSI in 30 seconds, the nozzle should be discarded.

Except for cleaning deposited carbon from the orifice, there are no adjustments or repairs that can be made to nozzles.

CARE OF 6F5549 GAUGE

If the gauge on the tester fails to rapidly return to zero upon the release of the retaining nut **(2)**, it may be assumed that the gauge is air locked.

The difficulty of an air lock can be remedied by filling the gauge completely with fuel thus eliminating all the air. Do this in the following manner:

1. Install another pump (preferably a 10 mm) on the injection test apparatus.

2. Connect a suitable fuel line between the pump and the adapter **(4)** such that the adapter is upside down. (A 5F5002 Fuel Injection Line works very well).

3. Install a nozzle in the sleeve **(1)** and tighten the retaining nut assembly **(2)** only enough to allow the valve to spray, but allowing some leakage around the nut.

4. Operate the tester several minutes and then tighten the retaining nut **(2)** completely and continue operation for about a minute. Stop the test apparatus.

5. Loosen the retaining nut rapidly. The gauge needle should fall promptly to zero. If the needle is slow in returning, repeat the above operations.

6. Remove the adapter group and install it on the master pump.

Once the air is out of the gauge, it will not enter again unless the unit is handled roughly enough to shake out the fuel.

CLEANING THE NOZZLE

The 5B1401 Cleaning Tool Group contains a .028" drill to clean the orifice of the capsule-type nozzle of the D397, D386, D375 and D364 engines and 5⅛" bore engines. This drill is identified by a green shank. The .024" drill (red shank) is used for cleaning the nozzles of 4" and 4½" bore engines. See the chart on NOZZLE INFORMATION for drill size to use on the nozzles of other engines.

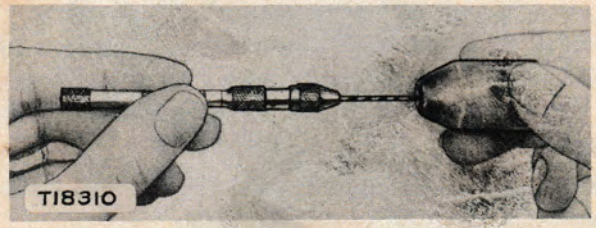
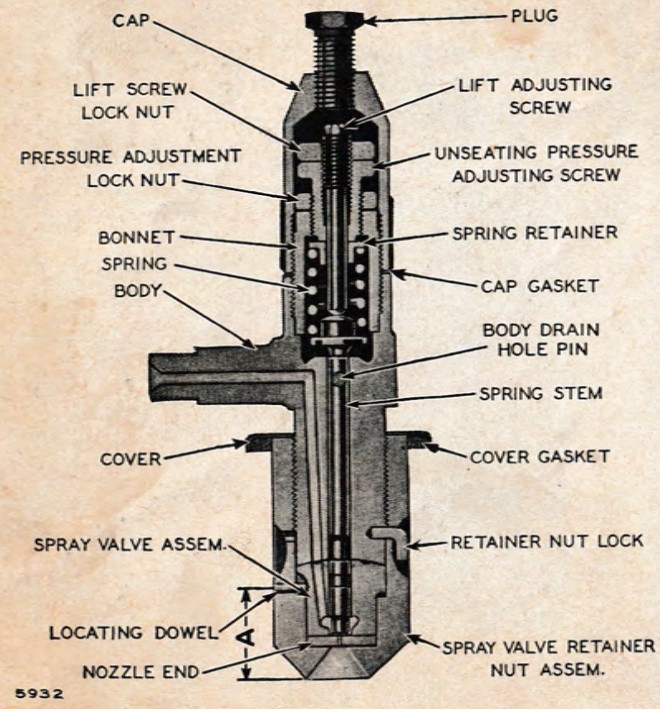


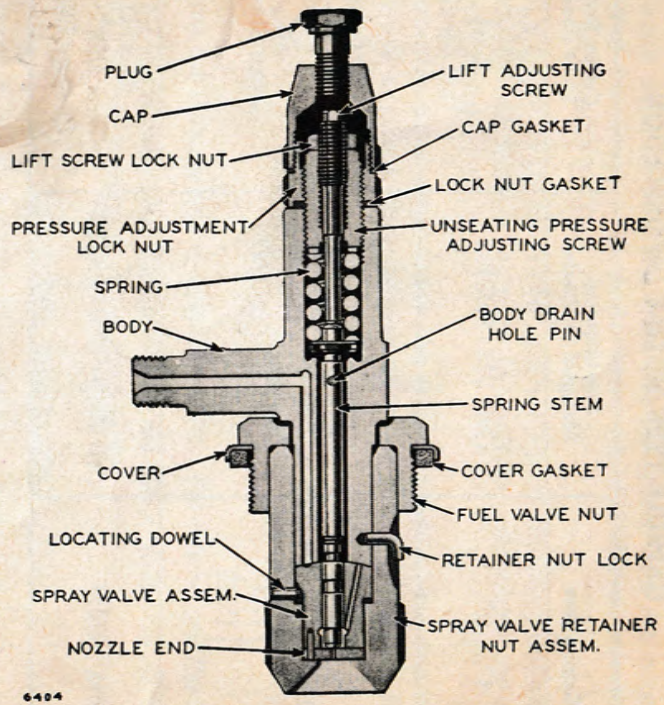
FIGURE 6D
CLEANING CAPSULE-TYPE NOZZLE

CAPSULE-TYPE NOZZLE INFORMATION

Engine Bore	Identification Stamped on Nozzle	Orifice Drill To Be Used
4", 4½"	Orif .025 - 6H3364	5B2178 .024" Red Shank
5¾" D397, D386, D375, D364, D342, D339 5⅛"	Orif .029 - 9F2393 Orif .028 { 9F160, 6H3347 }	7F1522 .028" Green Shank
6¼" D353	Orif .0325 - .033 - 5H7936	6H8639 .032" Orange Shank

NOMENCLATURE





NOTE: The pintle-type valve is no longer serviced for "Caterpillar" engines.

Flat-Seat Fuel Injection Valves

TESTING, ADJUSTING AND RECONDITIONING

1. Clean the valve — exterior and orifice
2. Check spray characteristics

If Spray Characteristics Are Satisfactory:

3. Adjust unseating pressure
4. Adjust needle lift
5. Check amount of internal leakage

If Spray Characteristics Are Unsatisfactory:

6. Clean needle, nozzle bore and nozzle end. Perform steps (2), (3), (4) and (5).

If New Valve Service Group Is Required:

7. Determine correct valve service group
8. Disassemble valve
9. Install new service group
10. Assemble valve
    Repeat steps (2), (3), (4) and (5).

The names and part numbers of the fuel valve parts are listed in the topic, PARTS LISTS, FLAT-SEAT FUEL INJECTION VALVES.

The 2A3397 Fuel Valve Clamp Cap and 2A4011 Sleeve used to hold the 5¼", 5¾" and 6⅛" bore fuel valves into the precombustion chamber (except screw-in type) were formerly serviced only as part of the fuel valve assemblies, but can now be obtained separately.

If while reconditioning the fuel valve, it is noted that the fuel valve body is mutilated and requires replacement, it will usually be found more economical to replace the complete fuel valve assembly than to try to replace all the parts necessary for reconditioning.

It is sometimes necessary to replace the retainer nut assemblies because they have become overheated, or have not been seating properly in the precombustion chamber, or the angular seat has become mutilated in some manner. Retainer nuts are made with extreme precision to insure

proper seating in the precombustion chamber for the most effective cooling of the fuel valves. Consequently, when retainer nut assemblies are no longer serviceable, it is far easier to replace them than to attempt to recondition them.

The best possible fuel valve reconditioning job, where the valve has been in service for an appreciable length of time, is obtained by installing a new service group, together with a new retainer nut assembly.

1. Cleaning The Valve — Exterior And Orifice.

Before any attempt is made to test fuel valves, the exterior and nozzle end orifice should be cleaned. Close the fuel inlet and overflow openings with the covers provided and clean with cleaning solvent or Diesel fuel.

Carbon accumulated in the orifice can be removed by means of the orifice drill chuck and the proper drill, as shown in fig. 9. Drills furnished are: .0175" for 3¾" bore engine fuel valves with heavy rate springs, identified by a yellow shank; .0197" for other 3¾" and 4¼" bore engine fuel valves, identified by a blue shank; and a .024" drill for 5¼", 5¾" and 6⅛" bore engine fuel valves, identified by a red shank.

FIGURE 9—CLEANING ORIFICE

◆

2. Checking Spray Characteristics.

Attach the fuel valve in parallel with the calibrating valve (Fig. 10). Install the fuel pump rack so the marked tooth of the special pump coincides with the calibration mark on the rack. Install the 3H1690 Rack Setting Gauge in one of the fuel injection pump positions in the housing so that the marked tooth on the gauge coincides with the proper mark on the rack. Move the rack to the right .350 inches and lock in position with rack lock. Turn the thimble on the calibrating valve to the 1875 psi mark so only the valve being tested will spray.

Start the test apparatus and carefully observe the spray coming from the valve. A solid stream or jet of fuel emitted with little or no atomiza-

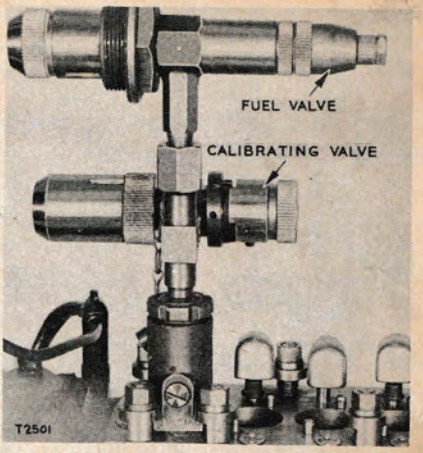


FIGURE 10—CALIBRATING VALVE

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tion (fig. 11) indicates that the needle is not seating properly. This may be caused either by a gummy carbon accumulation in the clearance between the needle and the nozzle, or the presence of a particle of foreign material on the needle seat.

If the fuel is atomized properly and the cut-off is sharp with no dribble (fig. 12), the spray characteristics of the valve may be considered to be satisfactory. **The new operator should study the spray characteristics of several new valves taken from stock to familiarize himself with normal spray appearance.**

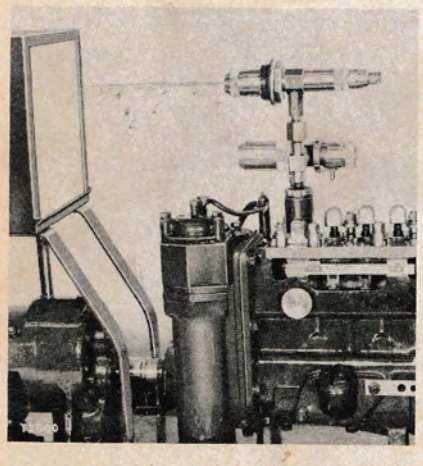

FIGURE 11—IMPROPER SPRAY

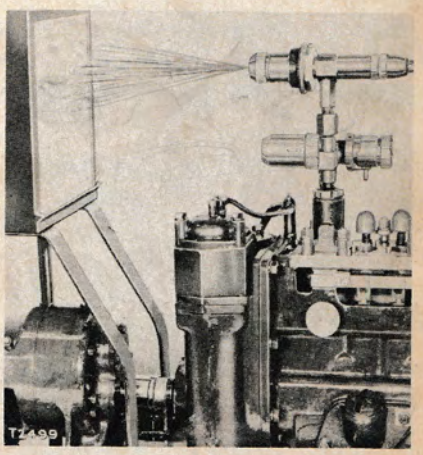

FIGURE 12—PROPER SPRAY

3. Adjusting Unseating Pressure.

Clamp the valve in the vise, using soft jaw faces. Remove the cap (fig. 13) with the cap wrench. Remove the lift screw lock nut (fig. 13) and back the lift adjusting screw off approximately three revolutions so that

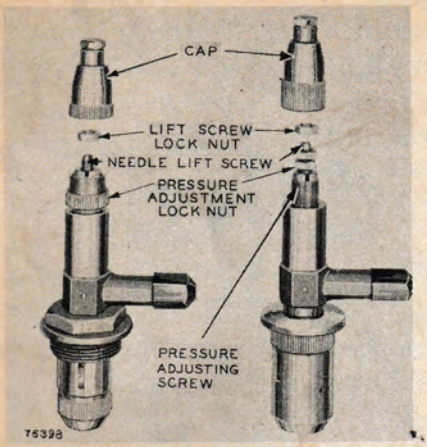

FIGURE 13—CAPS AND LOCK NUTS REMOVED

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it will not interfere with the pressure adjustment. Loosen the pressure adjustment lock nut (fig. 13) and install valve on the test apparatus.

Set the calibrating valve for the normal unseating pressure of the valve being tested. This is 1750 psi for all flat seat 5¼", 5¾" and 6⅛" bore engine fuel valves, and 1500 psi for 3¾" and 4¼" bore engine fuel valves. The original pintle type valves should be reset to 1575 psi unseating pressure. This pressure is not marked on the thimble of the calibrating valve, but for all practical purposes can be approximated by turning the thimble about one-third of the way between the 1500 psi and 1750 psi marks.

Start the test apparatus and adjust the unseating pressure of the valve using the 7B2601 Wrench (fig. 14) until both valves discharge evenly (fig. 15). The pressure adjustment lock nut should then be tightened. This may

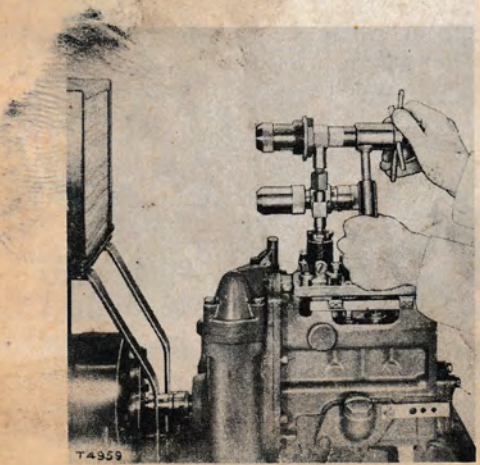

FIGURE 14
UNSEATING PRESSURE ADJUSTING WRENCH

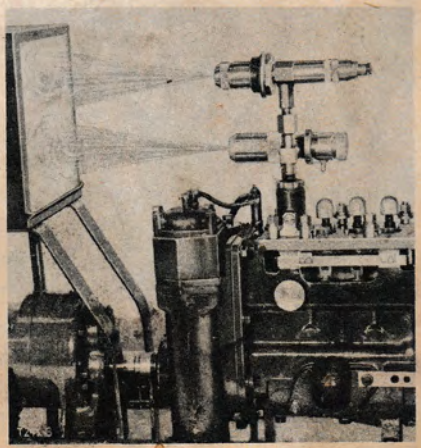

FIGURE 15
CORRECT ADJUSTMENT

disturb the adjustment of the unseating pressure, making readjustment necessary. Practice will enable the operator to allow for the effect of tightening the lock nut when making the unseating pressure adjustment.

On later type valves the lock nut should be given the final tightening in a vise, as tightening while on the machine is likely to damage the test apparatus.

4. Adjusting Needle Lift.

The correct needle lift on all valves is .007".

Replace lift adjusting screw lock nut. Turn lift adjusting screw down lightly against the fuel valve spring stem, using the wrench provided. Clamp the correct needle lift adjusting fixture to the fuel valve body. Adjust the top screw of the fixture (fig. 16) until a clearance of .017", measured with a thickness gauge, is obtained between it and the lift adjusting screw. Lock the top screw of the fixture in place with the clamping screw.

Remove the thickness gauge and back off the lift adjusting screw until .010" clearance, measured with the thickness gauge, exists between it and the top fixture screw, after the lift screw lock nut has been tightened (fig. 17). The adjusting screw has now been backed off exactly .007" which permits the needle to lift .007".

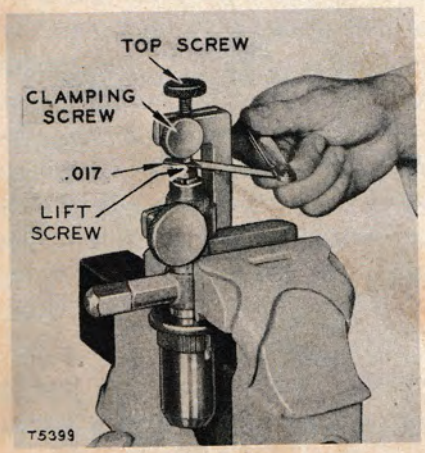

FIGURE 16—SETTING TOP SCREW

FIGURE 17—SETTING NEEDLE LIFT

5. Checking Amount Of Internal Leakage.

Replace the cap on valve and attach the leakage measuring tube (fig. 18). Sufficient fuel oil should be placed in the tube to bring the fuel level to approximately 1/8" below the lower line. Tighten the knurled screw compressing the rubber gaskets until the fuel level is raised to the lower line in the measuring tube.

Reset the revolution counter to zero. Start the test apparatus and allow the pump to discharge thirty (30) times. If the fuel in the tube rises to the top line, the clearance between the nozzle and needle has increased approximately 100% due to wear. If the fuel oil level is between the two lines in the measuring tube, fuel leakage is considered to be within reasonable limits. If the fuel level is above the top line, it does not necessarily mean that the valve should be discarded. If there is no serious objection to leakage of fuel from the valve (in later engines such leakage is returned to the fuel system), the small loss of power resulting from a moderate amount of leakage may not justify the expense of completely reconditioning or replacing the valve. However, the valve cannot be considered to be in first class condition if internal leakage exceeds the limit established by this test.

Internal leakage may also result from an improper seal between the valve body and the spray valve assembly. This may be due to a particle

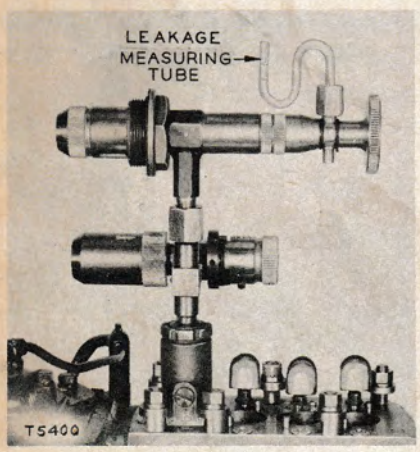

FIGURE 18
LEAKAGE MEASURING TUBE

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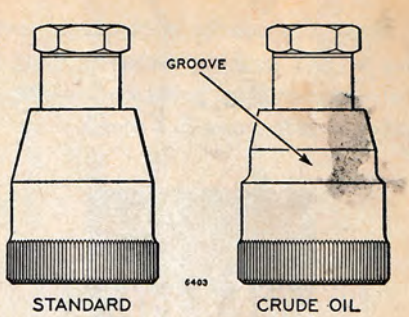
of foreign matter, or more rarely, improper machining of the mating surfaces. The latter case would normally be detected only on new valves.

Even in new valves a slight amount of leakage may be observed.

NOTE

This check cannot be used with crude oil valves. A crude oil valve can be identified by a groove in the fuel valve cap (fig. 19) and by the letters "CR" stamped on the fuel inlet connection.

FIGURE 19
IDENTIFYING CRUDE
OIL VALVES



6. Cleaning Needle, Nozzle Bore And Nozzle End.

A gummy carbon accumulation in the clearance between the needle and nozzle, causing the needle to stick, or a particle of foreign material on the needle seat may prevent the needle from seating properly.

Remove the cap, the bonnet or unseating pressure adjusting screw, spring retainer, spring and spring stem (see fig. 6 and 7). Insert the needle extracting tool through the valve body and tighten over the end of the needle. If the needle is tight, it will be necessary to completely disassemble the valve to clean or replace the entire spray valve assembly and nozzle end (valve service group).

If a fuel valve has a chip of scale, metal or foreign matter on the seat, the chip prevents the needle from seating on the spray valve nozzle end, with the result that the inner surface of the nozzle end and the needle end become coated with carbon. A bright spot will be left where the chip has been seated. The carbon should be carefully removed from the end of the needle and from the top surface of the nozzle end by means of the carbon scraper. The carbon scraper can be placed in the needle extracting tool and inserted into the nozzle bore and against the nozzle end. One revolution of the tool made with slight pressure should remove the carbon very effectively.

The cutting surface of these scrapers has been lapped as perfectly flat and square with the center line of the tool as possible. Unless it remains so, it cannot effectively remove carbon. It is well to handle this tool with care. Two of these scrapers are provided so that if one becomes marred, the second can be used while another is being obtained from the factory.

Wipe the needle carefully with a clean cloth or chamois. Clean the bore of the nozzle with the nozzle bore wiper and a piece of chamois. Flush the fuel valve carefully in clean solvent, and blow out with air pressure. The air should be blown in through the fuel inlet connection, which will allow foreign matter to be blown out through the large bore instead of through the small fuel channels.

Rinse the needle in clean solvent and insert it in the nozzle. Reassemble the valve, making sure all part are thoroughly clean. Adjust the fuel valve unseating pressure, needle lift and check for internal leakage, as explained in steps 3, 4 and 5.

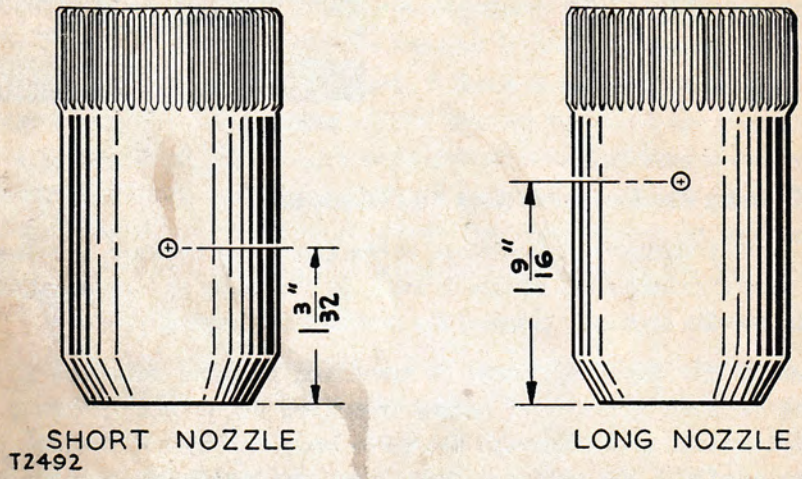


FIGURE 20—"LONG NOZZLE" VALVE IDENTIFICATION

7. Determining The Correct Valve Service Group.

The Valve Service Group consists of the needle, nozzle and nozzle end (fig. 23).

The following chart gives the part number of the fuel injection valve service group required for valves used in the various engines.

Engine Bore	Valve Service Group Part Numbers	Orifice Drill	Identification
3¾" (Heavy Spring)	6B2854	Yellow Shank (.0175")	Engine bore not stamped on body. Screw-in type. 3/16" dia. groove cut in nozzle end around orifice.
3¾" (Light Spring)	6B914	Blue Shank (.0197")	Engine bore not stamped on body. Screw-in type. 5/16" dia. groove cut in nozzle end around orifice.
4¼"	6B914	Blue Shank (.0197")	Body stamped "4¼" bore only."
4¼" (Automotive)	7B4341	Blue Shank (.0197")	Engine bore not stamped on body. Screw-in type. Fuel inlet hole 1/16" dia. instead ⅛" dia.
5¼", 5¾" & 6⅛"	6B927	Red Shank (.024")	Body stamped "5¼, 5¾, 6⅛ Bore" or "7B1730".
5¼" & 5¾" (Crude Oil)	7B4342	Red Shank (.024")	Body stamped "CR". Groove cut in cap (see fig. 19).

PINTLE TYPE VALVES—No parts are serviced to recondition worn pintle type valves.

"LONG NOZZLE" VALVES—The first flat seated fuel valves had a spray valve assembly with a nozzle ½" longer than current valves. No parts are serviced to recondition these so-called "long nozzle" valves. They are readily identified by the position of the dowel pin, as shown in fig. 20.

8. Disassembling Valve.

Remove the cap and cap gasket (fig. 7 and 8). Remove the bonnet or the unseating pressure adjusting screw which holds the needle lift adjusting screw, spring retainer, spring and spring stem in place.

Remove the spray valve retainer nut assembly locking pin (fig. 21) with the lock pin remover. These pins are hardened and care should be taken in their removal to prevent breakage or personal injury. If the

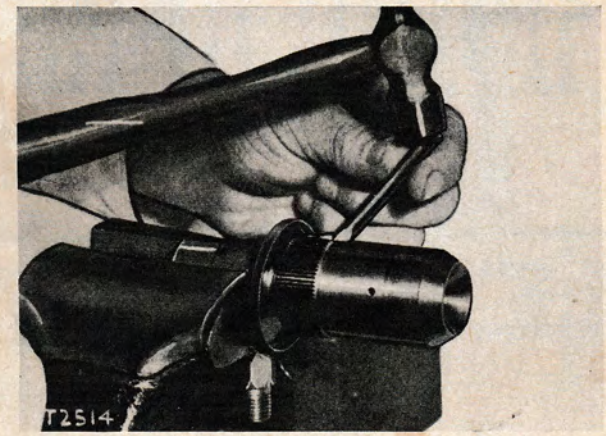


FIGURE 21—REMOVING LOCK PIN

lock pin is broken, it may be removed by alternately tightening and loosening the retainer nut until the piece drops out or can be removed with needle-nosed pliers. It may be necessary to strike the valve against a piece of wood to dislodge the broken pin. The retainer nut can then

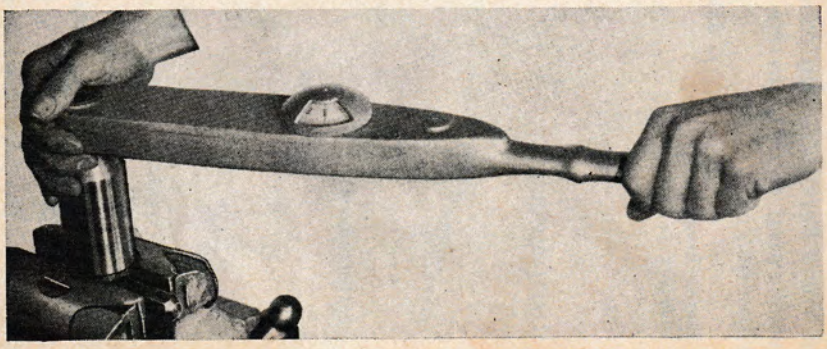
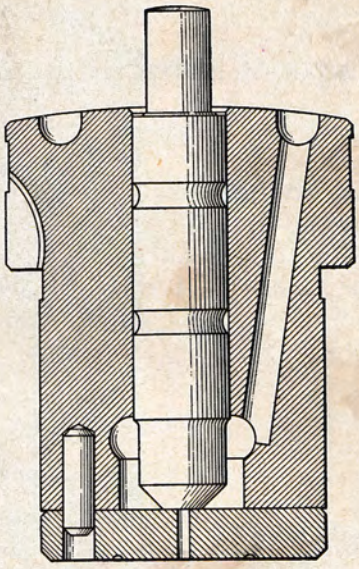


FIGURE 22—USING TORQUE WRENCH TO LOOSEN OR TIGHTEN RETAINER NUT ASSEMBLY

be removed with the sockets provided (fig. 22). Invert the retainer nut and the service group should fall out. If the service group is stuck, it may be dislodged by striking the retainer nut against a piece of wood.

9. Installing Service Group.

Fuel valve service group (fig. 23) includes the nozzle assembly, nozzle end and needle. These groups have been manufactured as units and should be installed as such. No attempt should be made to interchange parts between groups.



5940 FUEL INJECTION VALVE SERVICE GROUP

FIGURE 23

Service groups can easily be installed by using the holder provided. Hold the service group in the inverted position with the holder as shown (fig. 24). Insert the service group in the retainer nut assembly. **Turn slowly until the groove in the nozzle lines up with the locating dowel.** The assembled parts can then be turned right side up and the holder removed.

10. Assembling The Valve.

Before the valve is assembled all parts should be thoroughly cleaned in cleaning solvent or Diesel fuel. Screw the retainer nut assembly onto the fuel valve body by hand (fig. 25).

Place the fuel valve in the vise in the upright position and assemble the spring stem, spring, spring retainer and bonnet or pressure adjusting screw. This will prevent the needle from falling out of the service group.

CAUTION

Make sure the pressure adjusting screw and the lift screw, if installed, are backed off sufficiently before the retainer is tightened, as this may cause the nozzle end to be broken or damaged.

FIGURE 24

INSTALLING SERVICE GROUP

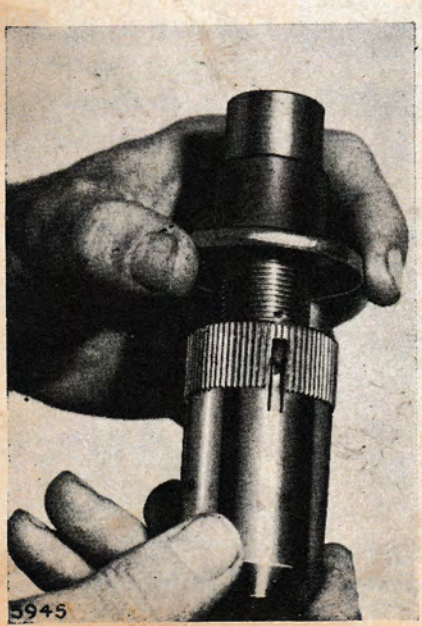


FIGURE 25

ASSEMBLING NUT AND BODY

Tighten the retainer nut with the torque wrench and the proper socket to a torque of 70 pounds feet (fig. 22). Over-tightening the retainer nut may cause distortion of the lapped nozzle bore and binding of the needle. If the retainer nut is not tightened sufficiently, leakage may occur between the radius on the fuel valve body and that on the spray valve assembly. It will not be necessary to reinstall the retainer nut locking pin as the hole in the retainer nut may not line up properly with the hole in the fuel valve body, and any attempt to align the two will result either in over-tightening or under-tightening the retainer nut.

Proceed with steps (2), (3), (4) and (5).

Fuel Injection Pumps

TESTING

Pumps are tested at or near (within .025") the full load rack setting of the engine they were removed from. The test apparatus fuel rack is positioned by a 3H1690 Rack Setting Gauge installed in one of the fuel injection pump positions in the housing. Rack setting information is obtained from "Rack Setting Charts".

11. Clean the pump exterior
12. Install pump on test apparatus
    A. Forged body pumps
    B. Flange type pumps
13. Follow pump test procedure
14. Determine condition of pump

Caterpillar fuel injection pumps have no adjustments, and replacement parts for rebuilding worn pumps are not available.

If the test apparatus reveals that the pump is no longer serviceable, it should be discarded.

11. Cleaning The Pump Exterior

Before installing the fuel pump on the test apparatus it should be thoroughly cleaned.

Any abrasive material allowed to enter the pump may be carried into the discharge collector, with resulting impairment of discharge measurement accuracy. Close the openings with the covers provided, hold the plunger in place and clean thoroughly with clean solvent.

12. Installing Pump on Test Apparatus

A. Forged Body Pumps

Check to determine plunger diameter by inserting the portion of the plunger under the gear into the gauge supplied with the test apparatus Install the fuel pump in the housing at the proper location marked on the housing (fig. 26.)

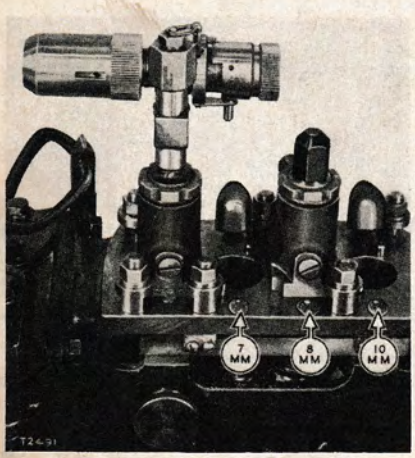


FIGURE 26
PUMP LOCATIONS

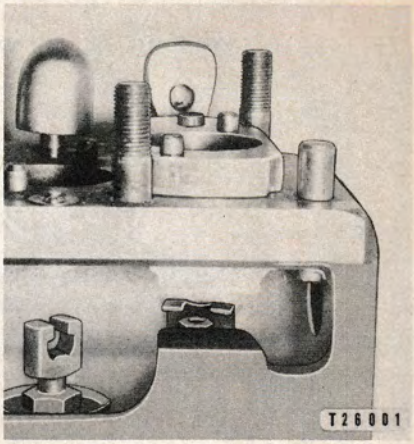


FIGURE 27
12 MM ADAPTER PLATE ON OLD HOUSING

a. Before testing 12 mm pump assemblies, Type 1 and Type 2 test apparatuses must be reworked according to "Instructions for Modifying the Fuel Test Apparatus" Form 32136.

b. The 6H9693 Spacer Assembly must be installed on the housing at the 10 mm position to correctly position the 12 mm pump assembly (Figure 27). Install the 12 mm pump plunger in the universal lifter adapter and proceed as directed below.

On the Type 3 apparatus the spacer assembly remains in the 12 mm position. The 3H1690 Gauge remains in the unmarked position to the right of the 12 mm position for 7, 8 and 10 mm pump tests. When testing 12 mm pumps, move the gauge to the 7 or 8 mm position. The 12 mm position is equipped with a 12 mm lifter.

Line up the mark on the fifth tooth of the pump gear with the mark on the fuel rack for that particular pump (Fig. 28).

Install a 3H1690 Rack Setting Gauge on the housing so the mark on the fifth tooth of the gauge gear lines up with the mark on the rack (Fig. 28A). For convenience, the rack setting gauge may be installed in the special pump position.

FIGURE 28
RACK SET ON MARKED TOOTH

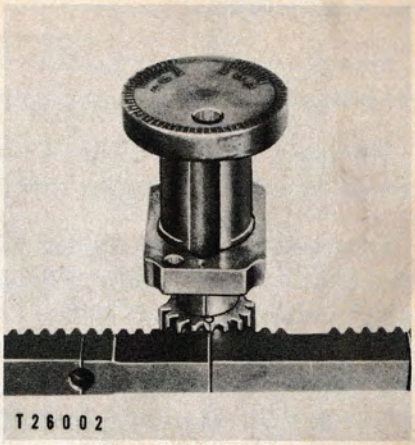


FIGURE 28A
GAUGE SET ON MARKED TOOTH

B. Flange Type Pumps

Flange type Fuel pumps (2A1611) can be tested by using an adapter mounted over the 10 millimeter pump opening of the test apparatus (Fig. 29).

Rotate the test apparatus camshaft until the lifter is at its lowest position and install the adapter.

Install the pump on the adapter and tighten the wing nuts. Insert the fuel passage screw placing a gasket on each side of the fuel pump, and tighten enough to seal against leakage. Push the pump rack against the stop pin and lock in position with spring (Fig. 29A).

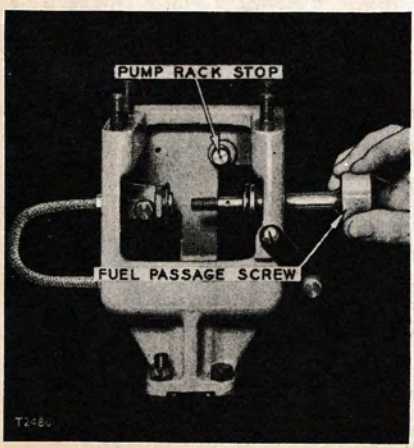


FIGURE 29
7B8847 FLANGE TYPE PUMP
ADAPTER

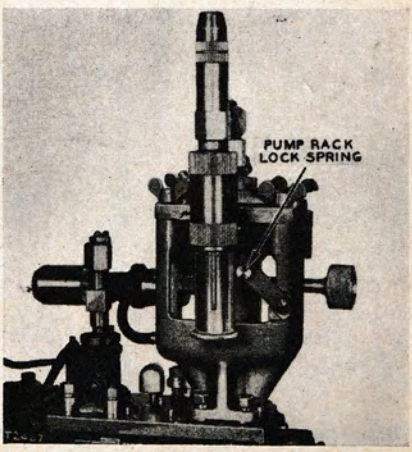


FIGURE 29A
TESTING FLANGE-TYPE PUMP

13. Test Procedure

Refer to the Rack Setting Charts and find the full load rack setting for the engine from which the pumps were removed.

The pump test chart (Fig. 30) lists the number of discharge strokes required for a pump at a given rack setting.

For example: To test a pump removed from a Caterpillar D337 Industrial Engine serial number 37B1 up, first refer to the Rack Setting Charts which indicate the rack setting for this engine is .415". Mount the pump on the test housing and using the 3H1690 Rack Setting Gauge, set the test apparatus fuel rack to correspond within .050" to the rack setting, which is .400". Next refer to the Pump Test Chart and to the rack setting column which corresponds to the engine setting (.400"). Opposite the pump part number and under the .400" rack setting is the prescribed number of discharge strokes required.

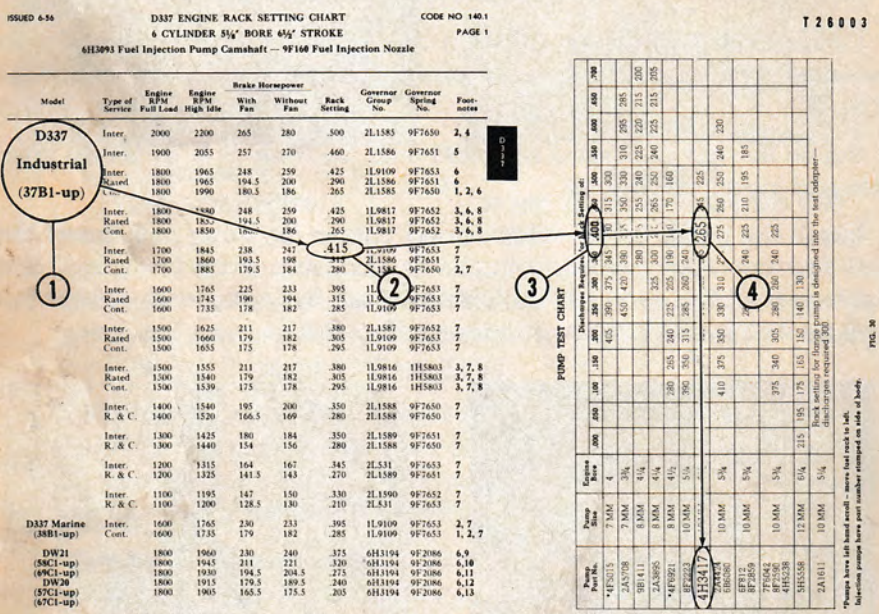


FIGURE 30A
USE OF RACK SETTING CHART AND PUMP TEST CHART

1. Locate product in Rack Setting Chart.
2. Find corresponding full load rack setting.
3. Locate full load rack setting to nearest .050" in Pump Test Chart.
4. Locate number of discharge strokes for pump.

PUMP TEST CHART

Pump Part No.	Pump Size	Engine Bore	Discharges Required for Rack Setting of:														
			.000	.050	.100	.150	.200	.250	.300	.350	.400	.450	.500	.550	.600	.650	.700
*4F5015	7 MM	4					405	390	375	345	330	315	300				
2A5708	7 MM	3 3/4						450	420	390	365	350	330	310	295	285	
9B1411	8 MM	4 1/4								280	265	255	240	225	220	215	200
2A3895	8 MM	4 1/4							325	300	280	265	250	240	225	215	205
*4F6921	8 MM	4 1/2			280	265	240	225	205	190	180	170	160				
8F2223	10 MM	5 1/8			390	350	315	285	260	240							
4H3417	10 MM	5 1/8				470	425	365	325	295	265	245	225				
2A4424 6B6080	10 MM	5 3/4			410	375	350	330	310	290	275	260	250	240	230		
6F812 8F2859	10 MM	5 3/4						280	260	240	225	210	195	185			
7F6042 8F2590 4H5238	10 MM	5 3/4			375	340	305	280	260	240	225						
5H5558	12 MM	6 1/4	215	195	175	165	150	140	130								
2A1611	10 MM	5 1/4	Rack setting for flange pump is designed into the test adapter— discharges required 300.														

***Pumps have left hand scroll – move fuel rack to left.**
Injection pumps have part number stamped on side of body.

FIG. 30

Attach the collector assembly loosely to the fuel pump and install the collector jar onto the collector assembly (Fig. 31). It is very important that air be bled from the pump and collector assembly. Open the pump bleed screw on pumps so equipped. Operate the apparatus with the collector assembly loose. Before making a test, **always operate the pump at least 50 strokes** to eliminate air in it and in the collector assembly.

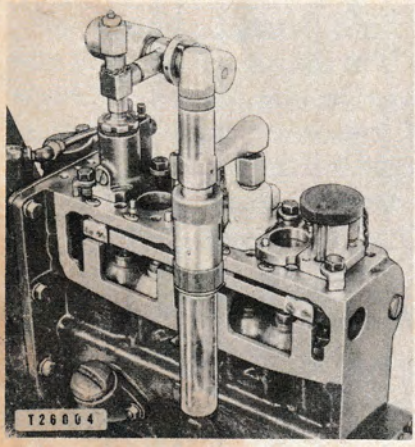


FIGURE 31
COLLECTOR ASSEMBLY AND JAR

◆

After priming, remove the collector jar and drain. Re-set the counter to zero and attach the collector jar to the collector assembly. Operate the unit the prescribed number of strokes listed in Pump Test Chart. Remove the collector jar and place on a level surface. The fuel level in the jar is to be read from the bottom of the meniscus **(1)** as shown in Figure 32.

FIGURE 32
CORRECT LEVEL OF FUEL IN COLLECTOR JAR

1–Meniscus.

◆

14. Determine Condition of Pump

The condition of the pump is indicated directly by the calibration on the collector jar.

1. If the fuel level is within or above the "good" range, the pump is equivalent to a new one.
2. If the fuel level is in or below the "poor" range, it indicates that wear to the pump plunger and barrel has progressed to the point where difficult starting as well as reduced power output of the engine may be encountered. Such pumps should be replaced.

MAINTENANCE OF TEST APPARATUS

Fill the fuel pump housing with S.A.E. No. 30 straight mineral lubricating oil. The oil in the housing should be changed periodically, depending on the amount of use of the apparatus.

The storage tank (capacity 3 gallons) should be filled with Diesel fuel. Although the fuel is used over and over, it need not be changed unless it becomes contaminated. The 2A5886 Filter Element should last for a long time, but it is advisable to change it periodically.

Calibrating Valve

The calibrating valve can be accurately reset by adjusting the sleeve which is held in place by means of the two hollow-head setscrews. Its calibration should be checked periodically with new valves. If this check indicates that the calibration has changed, a standard fuel valve for a 5¾" bore engine should be ordered from the Parts Department at Peoria. When the order is placed, a request should be made to have the valve calibrated at the factory to unseat at 1750 PSI, so it can be used as a guide in resetting the calibrating valve. Adjust the sleeve on the calibrating valve until the spray emitted is the same as that from the standard fuel valve, which was ordered for this purpose.

Special Fuel Pump

The special fuel pump used with the calibrating valve has been very accurately set to provide the closest possible check of fuel valves. Any damage to the special fuel pump makes it necessary to return it to the factory for repair. **Return the pump, calibrating valve and connecting tee as a unit without disassembling one from the other.**

Collector Assembly

The collector assembly has been carefully calibrated at the factory and should not be adjusted or altered in any way. The general condition of the collector assembly can be checked by running a test on several new 10 mm pumps. The test run, using the prescribed number of strokes, should bring the fuel level (bottom of meniscus) within the "good" range. If the collector is suspected of being out of adjustment, it should be returned to the factory for calibration.

Pump Lifter Setting

If for any reason the pump lifter setting is altered, such as when making changes to the lifter yoke screw as described in the topic, INSTALLING PUMP ON TEST APPARATUS, it can be reset as follows:

1. The pump lifter can be set by the use of a depth gauge (fig. 33). Turn the camshaft until the lobe is at **TOP.** (This can be determined with a dial indicator.) Loosen the lifter lock nut and adjust the lifter yoke to 1.565" from the top of the pump housing to the lifter yoke.

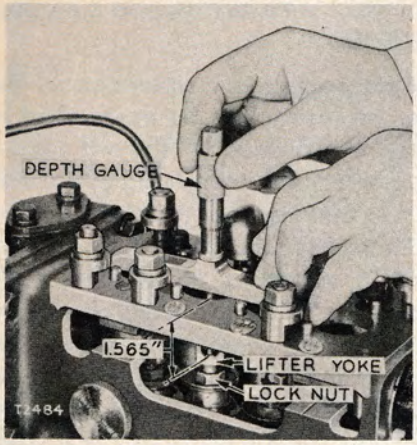


FIGURE 33
USING THE DEPTH GAUGE TO SET LIFTERS

◆

2. The lifters may also be set by using a dial indicator and the 4B6059 Gauge (fig. 34 and 35).

   Install the 4B6059 Gauge. Set up the dial indicator so that the anvil is overlapping the plunger hole of the 4B6059 Gauge (fig. 34).

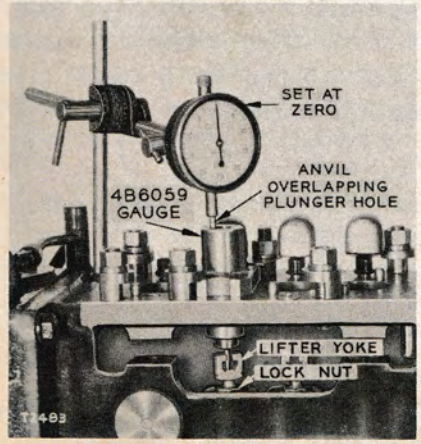


FIGURE 34
USING DIAL INDICATOR TO SET LIFTERS

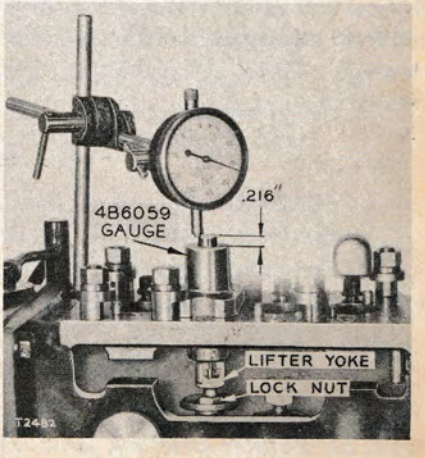


FIGURE 35
ADJUST LIFTER YOKE TO GIVE A MAXIMUM LIFT OF .216"

Make sure the anvil is perpendicular to the top (ground surface) of the 4B6059 Gauge. Set the indicator at zero. Rotate the camshaft slowly and note the indicator reading. The lifter yoke is correctly adjusted when the gauge plunger raises .216" above the zero setting (fig. 35).

Electric Motor

The following information has been taken from the Instruction Tags furnished with each multiple parallel geared head Master motor:

LUBRICATION

Lubrication is extremely important for satisfactory operation of the geared head motors; therefore, proper oil level must be maintained in gear case at all times. The correct level is indicated by the red square head plug. Frequent inspections, with motor not running, and preferably when warm, should be made by removing the plug to see that the level is being maintained. If low, additional lubricant must be added through one of the upper openings until it comes out the oil level hole, which should be kept open during this operation. "The lubricant should be drained and gear case refilled every 1000 hours of operation under normal conditions; more frequently when running continuously or at higher temperatures." Use only recommended lubricants as listed below. Motor shaft ball bearing at gear end is lubricated by the oil in the gear case; rear motor shaft bearing must be lubricated separately, with a good grade of bearing grease.

LUBRICATION RECOMMENDATIONS

For parallel shaft type multi-stage reduction geared head motors use only a nationally recognized automobile oil, in sealed containers, with a straight mineral base. DO NOT USE COMPOUNDED LUBRICANTS.

S.A.E. 50 when room temperature is 60°F. to 110°F.
S.A.E. 30 when room temperature is 35°F to 70°F.

NOTE

All parallel type reduction geared head motors are lubricated at the factory with S.A.E. 50 unless otherwise specified. Selection of the correct lubricant can be made from the above table for all normal operating conditions.

WARNING — LUBRICATION

SLEEVE BEARING MOTORS ARE SHIPPED WITHOUT OIL. Reservoirs must be filled to overflow level before placing motor in operation. Use a good grade of medium machine oil and refill at least once every six months. Do not put oil on commutator or brushes.

BALL BEARING MOTORS are lubricated at the factory. Use a good grade of pure grease at least every six months. Use small amounts at short intervals rather than large amounts too infrequently.

VENTED PLUGS

All geared head motors have a vented plug located above oil level. It is important that the vent be kept open at all times during the operation of motor to prevent pressure being built up in the gear case and causing damage. For shipping purposes the vent is closed with a small screw. Remove the screw before placing motor in service.

OPERATING TEMPERATURES

Heating is a natural characteristic of these units and a maximum temperature of 180°F. is not uncommon. However, lubrication and design have fully taken into consideration these conditions, and there is no danger of damage from this cause, when recommended lubricants are used and motors are not carying excessive loads.

MAINTENANCE

Geared head motors are accurately adjusted and tested at the factory. Extreme care must be taken should it be necessary to open or reassemble the motor or gear case. Whenever possible this work should be done by a Master authorized service station, as damage to bearings, gears and seals may result through improper handling and assembling.

OPERATION

This motor will bring its rated load up to rated speed within five or ten seconds after starting. Failure or sluggish action of the motor in coming up to speed is an indication of OVERLOAD OR LOW VOLTAGE. Low voltage may result from actual low voltage delivered by the Power Company or use of too small wire size from power line to motor.

INSTALLATION OF TEST APPARATUS

Proper arrangement and display of the "Caterpillar" Fuel Injection Testing Apparatus will impress customers with the high quality of service offered for testing and reconditioning fuel injection pumps and valves. In addition, suitable housing (fig. 36) is essential in order that the apparatus be given proper care and protection.

A well planned installation and assignment of the right man as operator is a combination which will bring the maximum benefit to the Dealer offering this service to present and prospective owners of "Caterpillar" Diesel equipment.

The floor space for the fuel injection test apparatus room should not be less than 5' 6" x 8' 6" inside. This will allow for a bench of the dimensions given in fig. 39. In some cases the floor space may be more or less

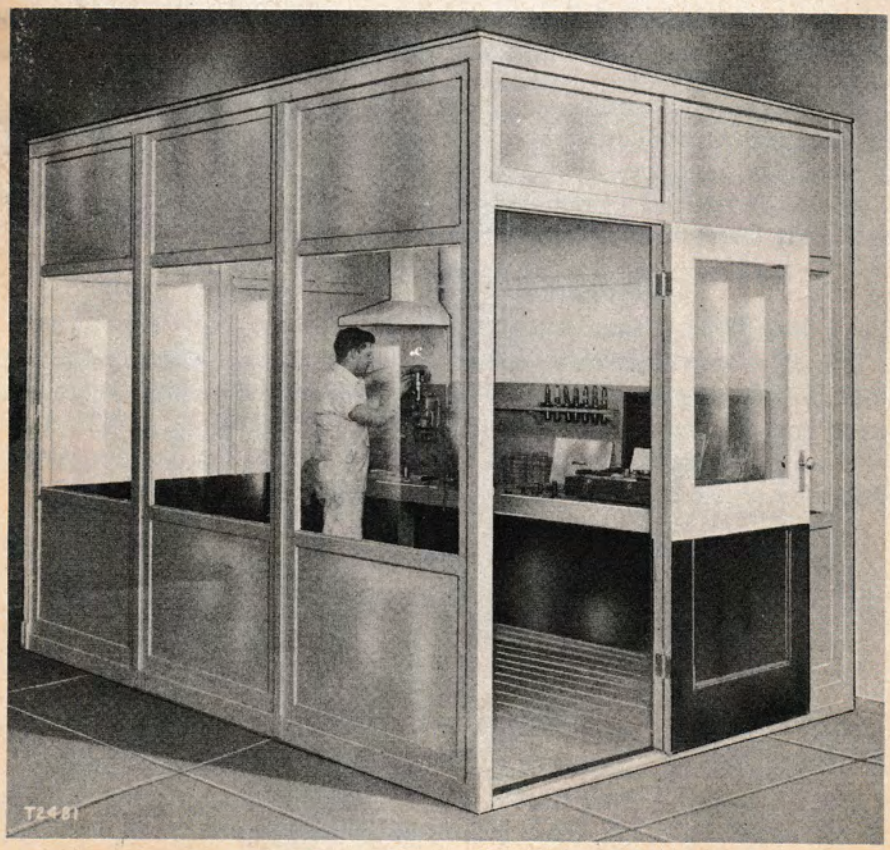


FIGURE 36—A WELL PLANNED TESTING ROOM

governed by the building arrangement. The cutaway view (fig. 37) shows the enclosure, bench and exhaust system which have satisfactorily met the requirements of this type of work.

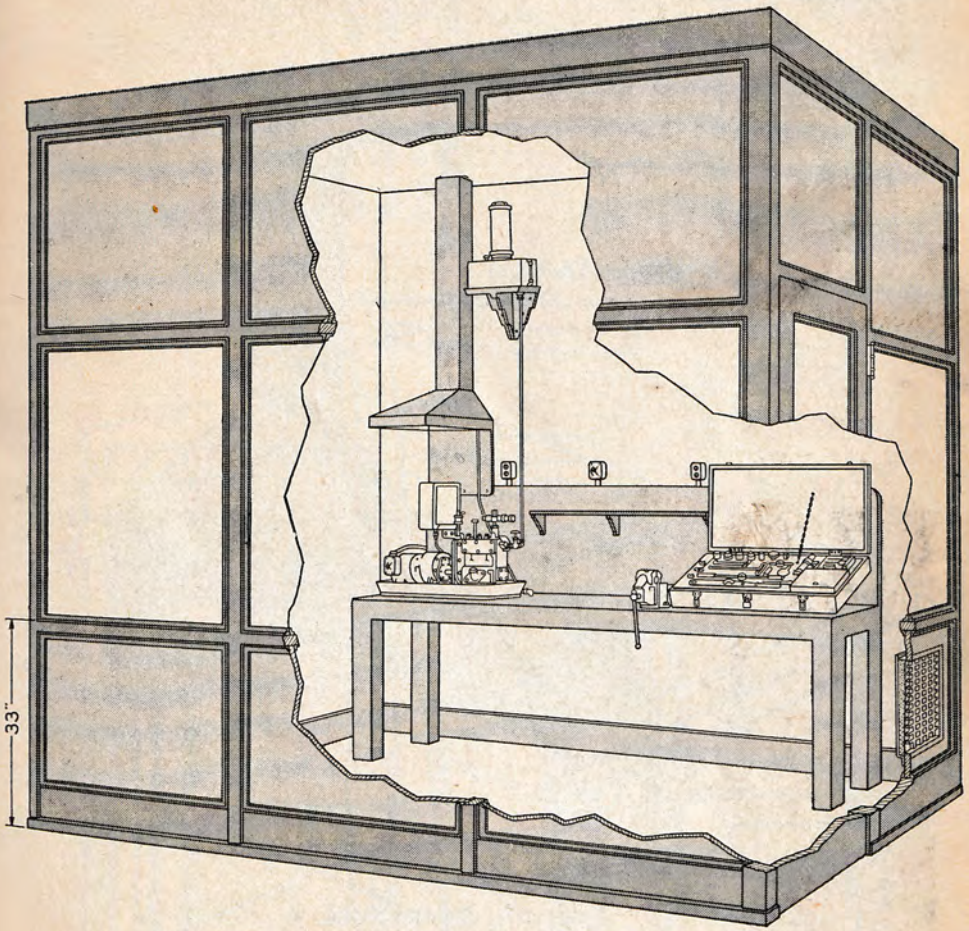


FIGURE 37—CUT-AWAY VIEW OF ENCLOSURE

The lower portion of the inside and outside of the enclosure should be painted grey as should the door and the test bench. The upper portion should be white enamel to obtain maximum light benefit and to facilitate cleaning. The floor should be smooth and easily cleaned. All this serves to give the whole layout the aspect of being a miniature laboratory.

An exhaust hood over the test apparatus serves to keep the enclosure free of dust and oil fumes. Specifications for the exhaust hood are given in fig. 38. The fan should have a capacity of 800 to 1000 cu. ft. per minute (Free Delivery). A ventilator should be placed in the wall, preferably at the opposite end of the enclosure from the exhaust hood and located between the floor and the glass window. This ventilator should be con-

structed to accommodate an ordinary furnace air filter element. The filter should be placed at the air intake to prevent dust from entering the test-room. The replaceable filter elements come in standard sizes which can be obtained locally.

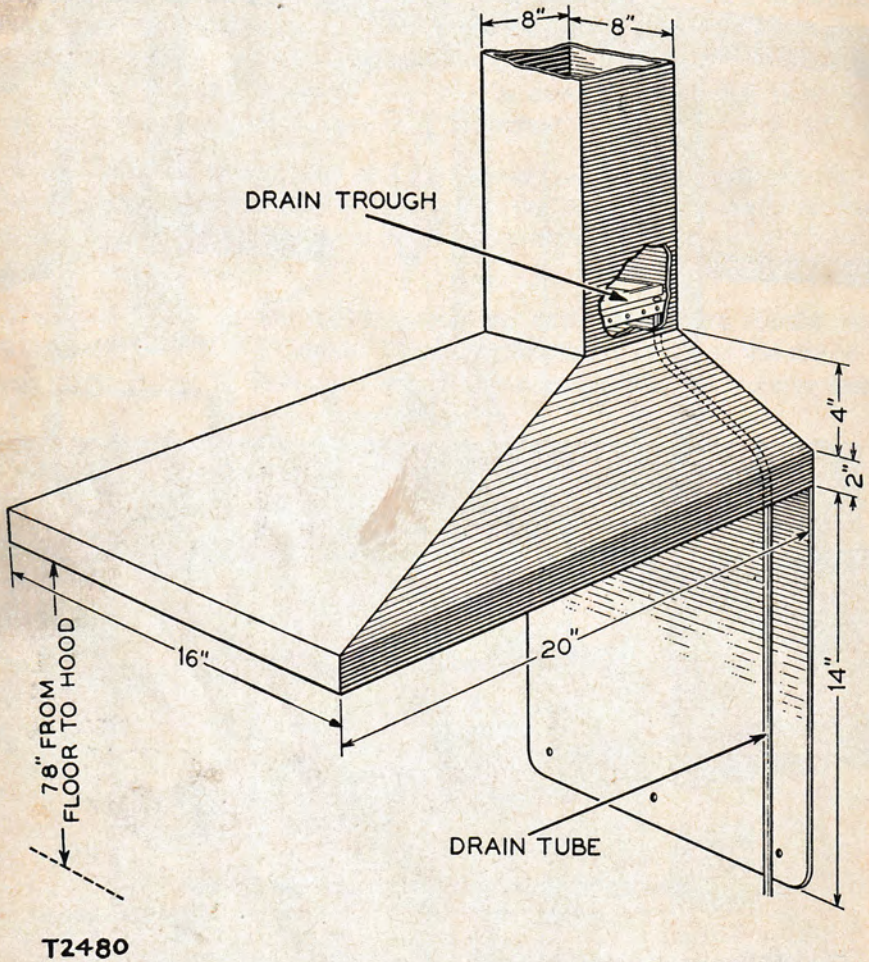
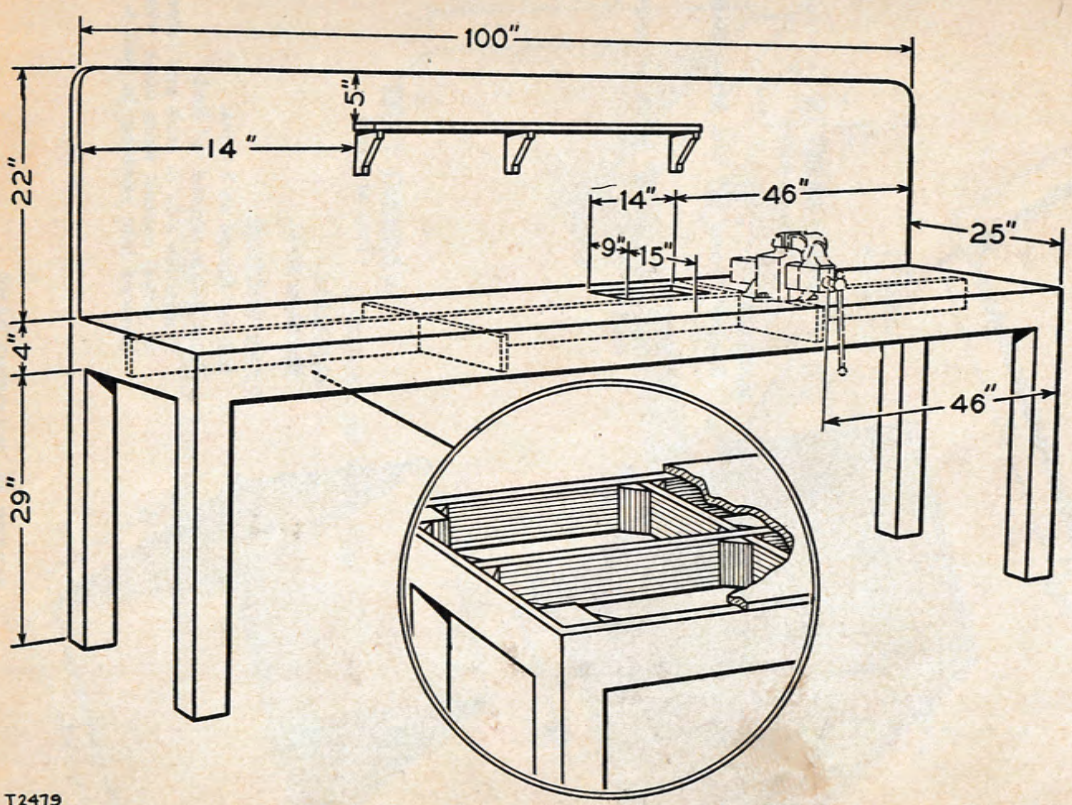


FIGURE 38—EXHAUST HOOD
Material—Sheet Metal



T2479

FIGURE 39—BENCH

Material: Wood.

Legs—2¾" x 2¾".

Side Rails—1" x 3¼".

Top—¾" (Glue Jointed).

Back Supports—¾" x 2" (4 pieces).

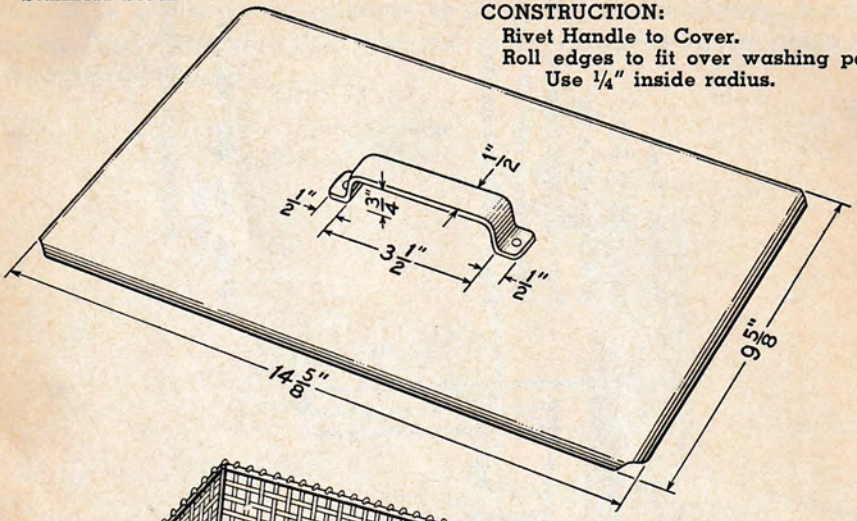
Pump and Valve Bracket—¾".

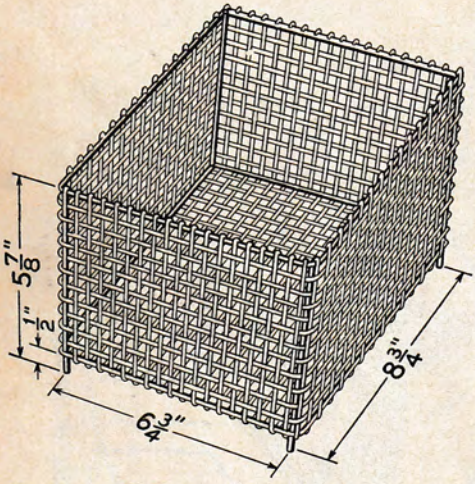
NOTE: Use vise with soft jaw faces.

Place vise to clear tool box.

MATERIAL:
Stainless Steel.

CONSTRUCTION:
Rivet Handle to Cover.
Roll edges to fit over washing pans.
Use 1/4" inside radius.

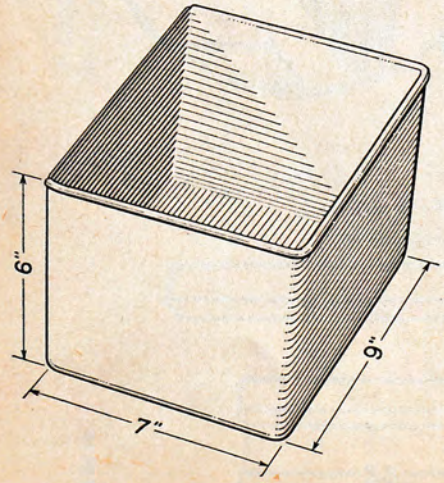




WIRE BASKETS
(Two of each)

MATERIAL:
Support Frame 1/8" Dia. Brass Stock.

Wire:
Not less than 1/8" Mesh or larger than 1/4" Mesh.

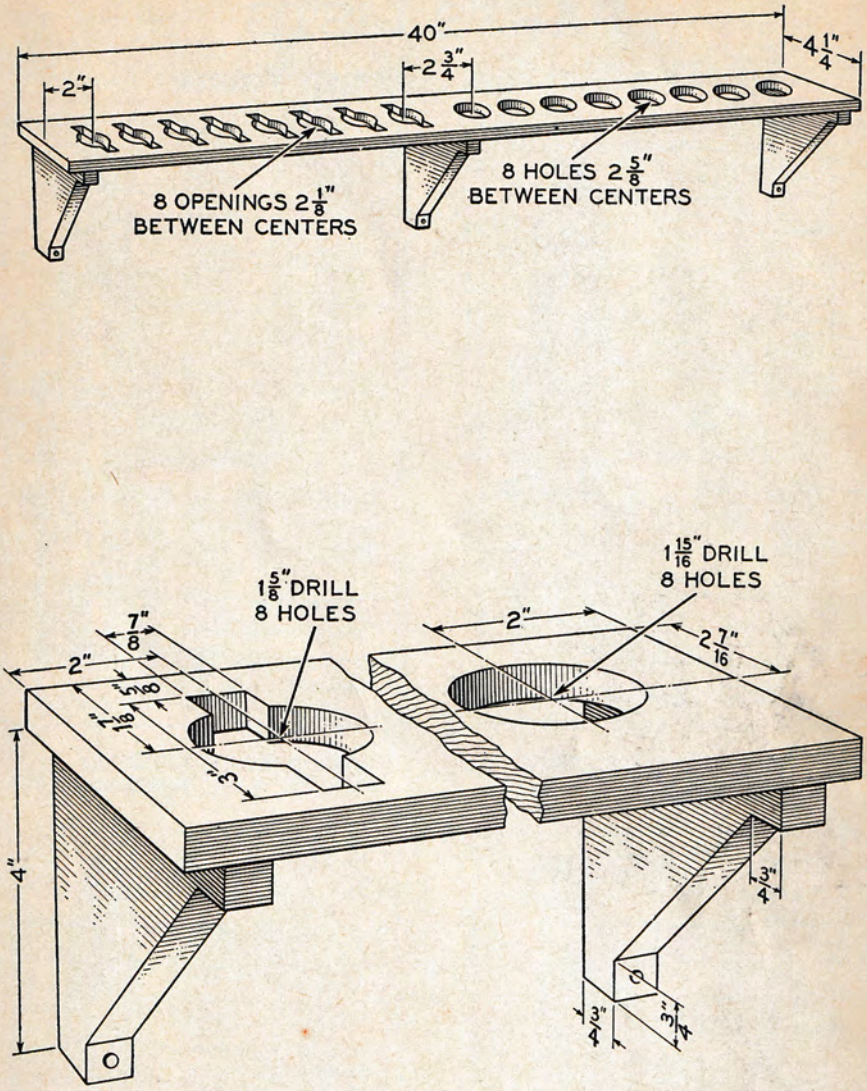


WASHING PANS
(Two of each)

MATERIAL:
Stainless Steel.

CONSTRUCTION:
Roll 1/4" flange on 3 sides.
Form flange around 1/8" Rod.
Flangeless side of each pan (along 9" edge) contact each other when lowered into opening in bench.

FIGURE 40—WASHING PANS



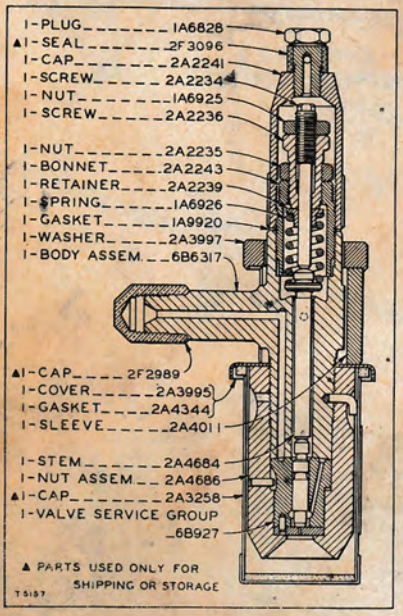
MATERIAL: 3/4" White Pine

FIGURE 41—PUMP AND VALVE BRACKET

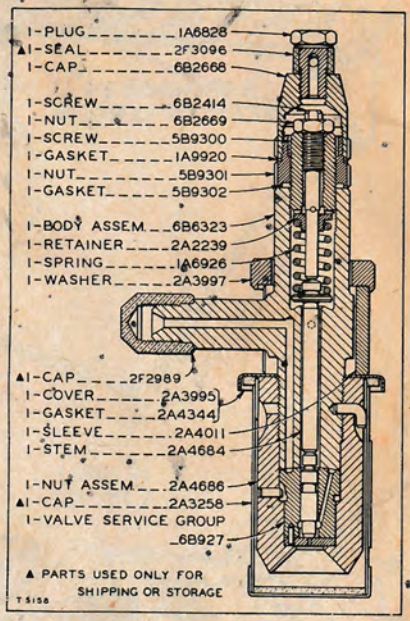
Cap 5F2807

PARTS LISTS

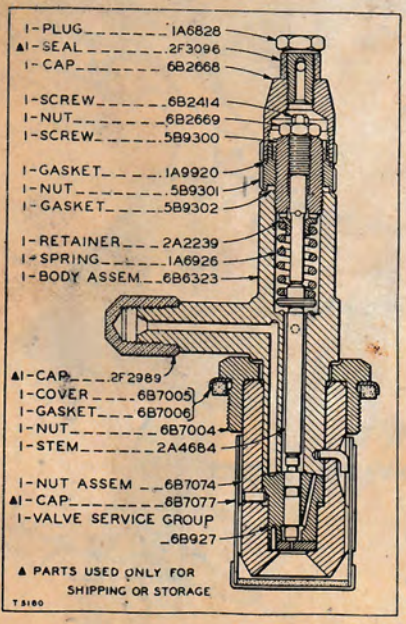
Flat-Seat Fuel Injection Valves



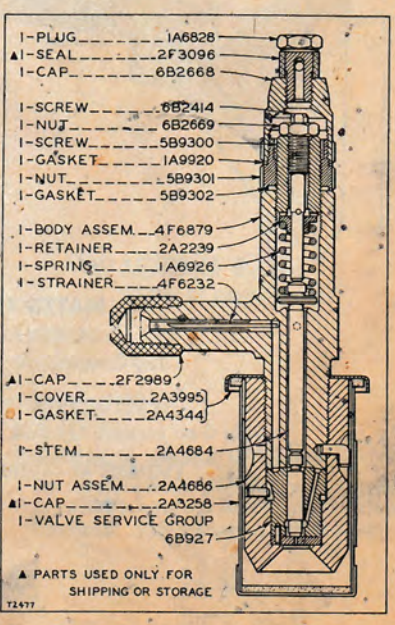
2A4848 VALVE ASSEMBLY
5¼", 5¾" & 6⅛" Bore Engines



6B2846 VALVE ASSEMBLY
5¼", 5¾" & 6⅛" Bore Engines

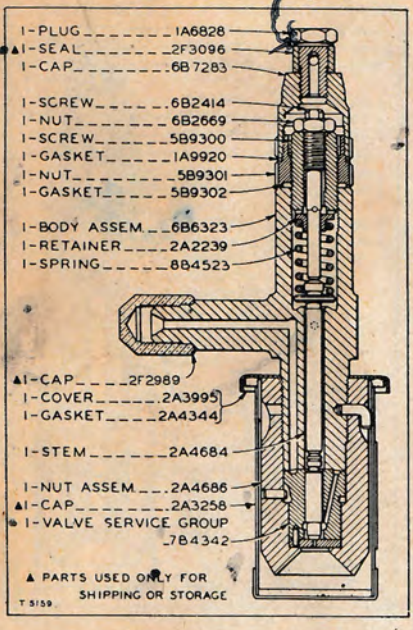


7B1730 VALVE ASSEMBLY
5¼" & 5¾" Bore Engines

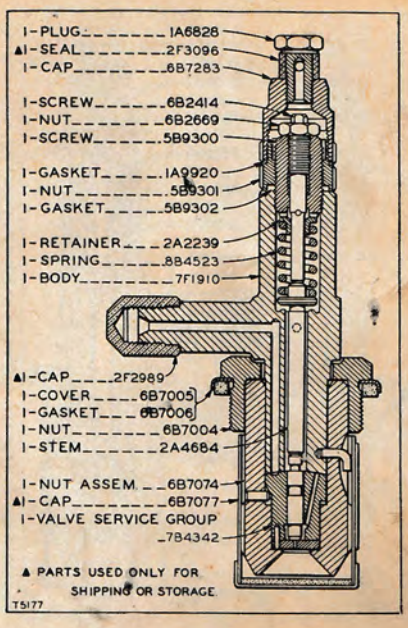


1F2979 VALVE ASSEMBLY
5¼", 5¾" & 6⅛" Bore Engines

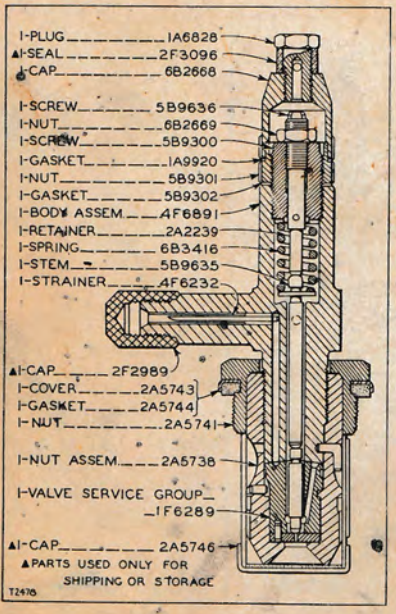
1F1569 Gasket



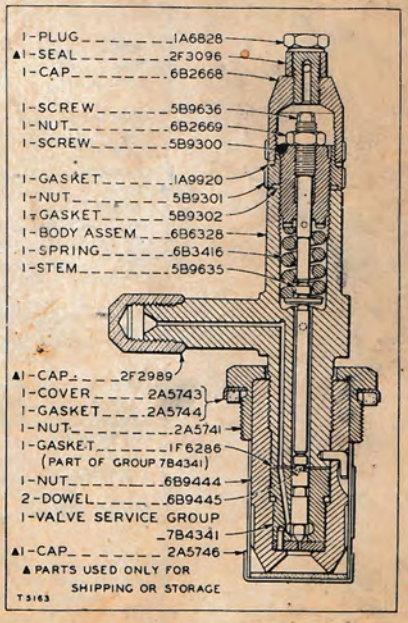
6B6079 VALVE ASSEMBLY
5¼", 5¾" & 6⅛" Bore Engines



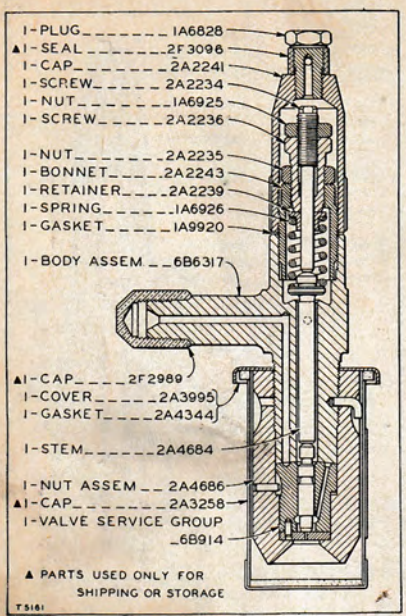
8B2448 VALVE ASSEMBLY
5¼" & 5¾" Bore Engines



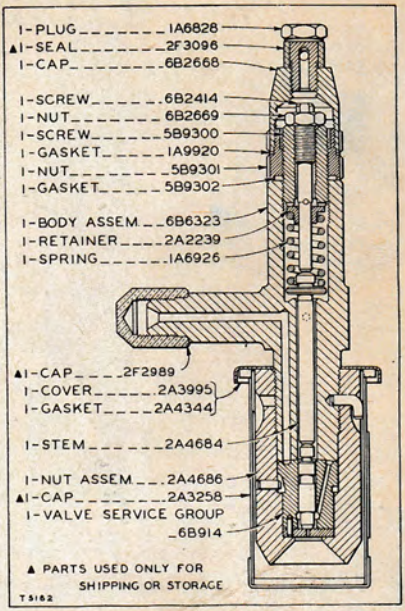
1F6288 VALVE ASSEMBLY
4¼" Bore Engine
(DW10 & D468)



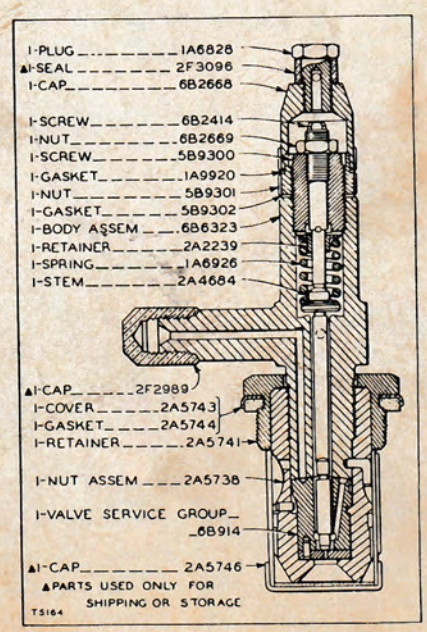
6B5743 VALVE ASSEMBLY
4¼" Bore Engine
(DW10 & D468)



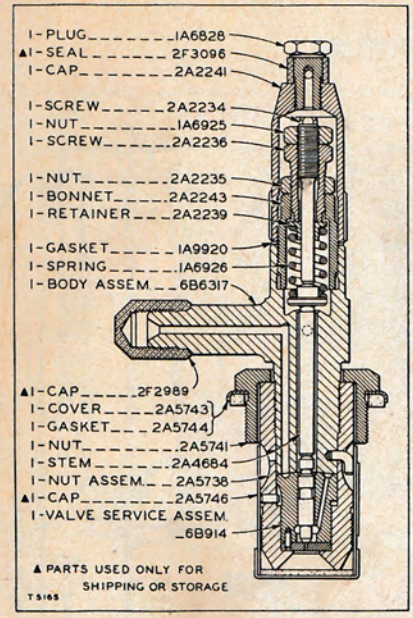
2A4850 VALVE ASSEMBLY
4¼" Bore Engine



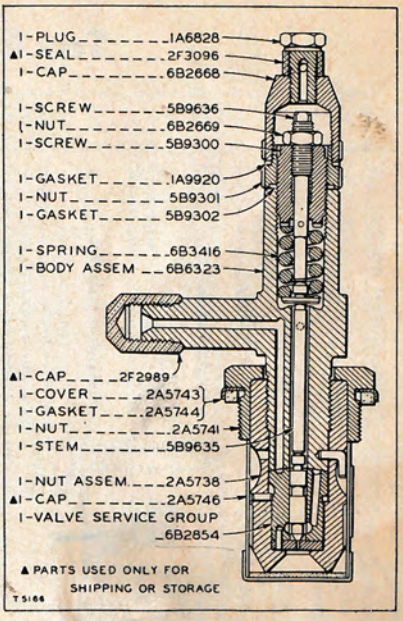
6B2845 VALVE ASSEMBLY
4¼" Bore Engine



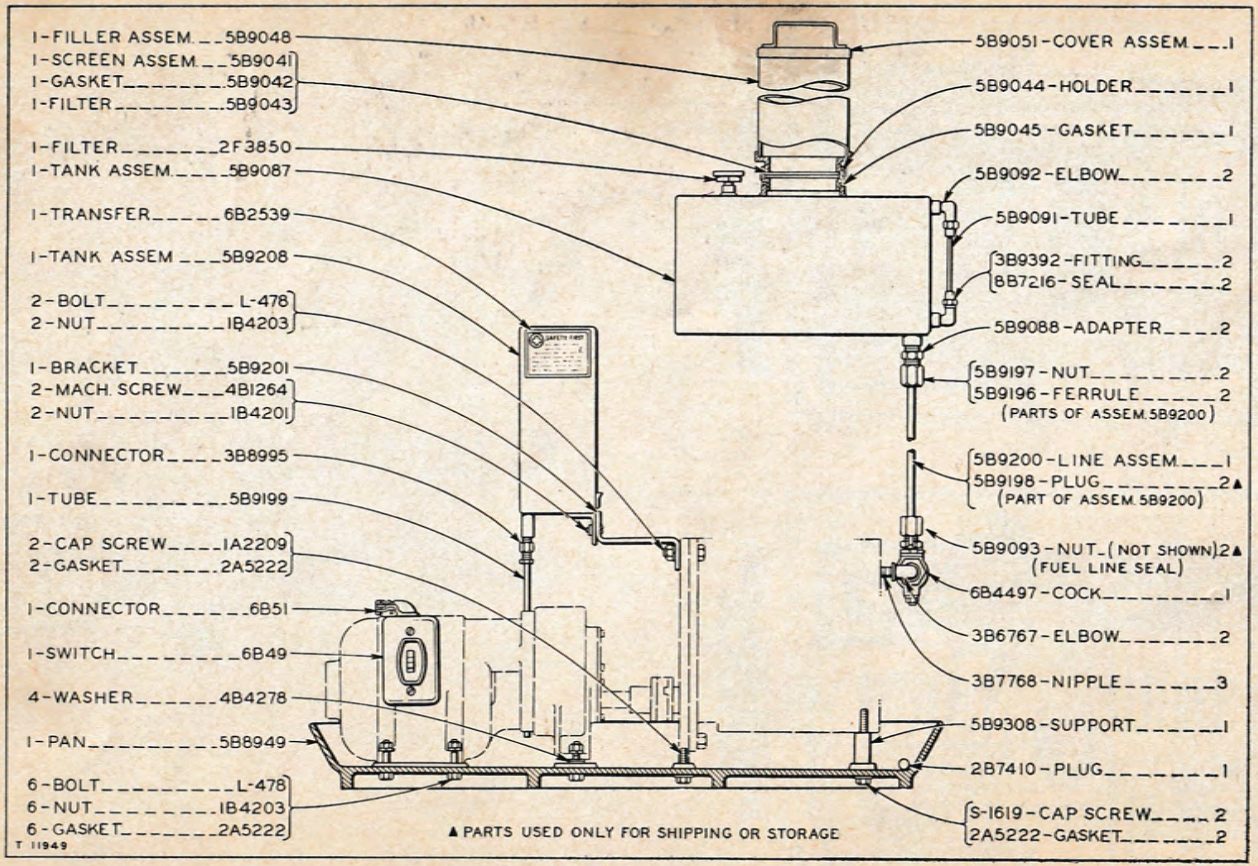
7B8089 VALVE ASSEMBLY
4¼" Bore Engine



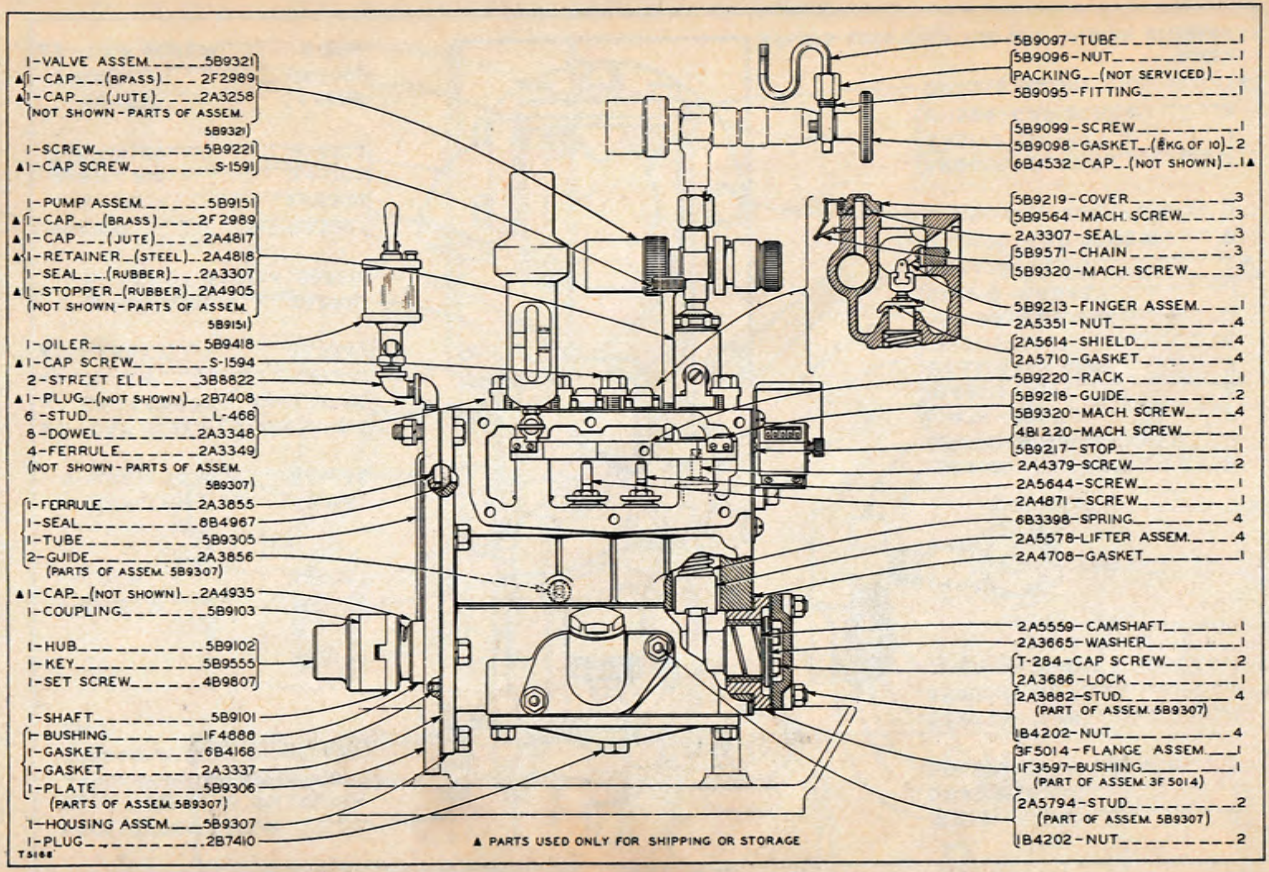
2A5750 VALVE ASSEMBLY
3¾" Bore Engine



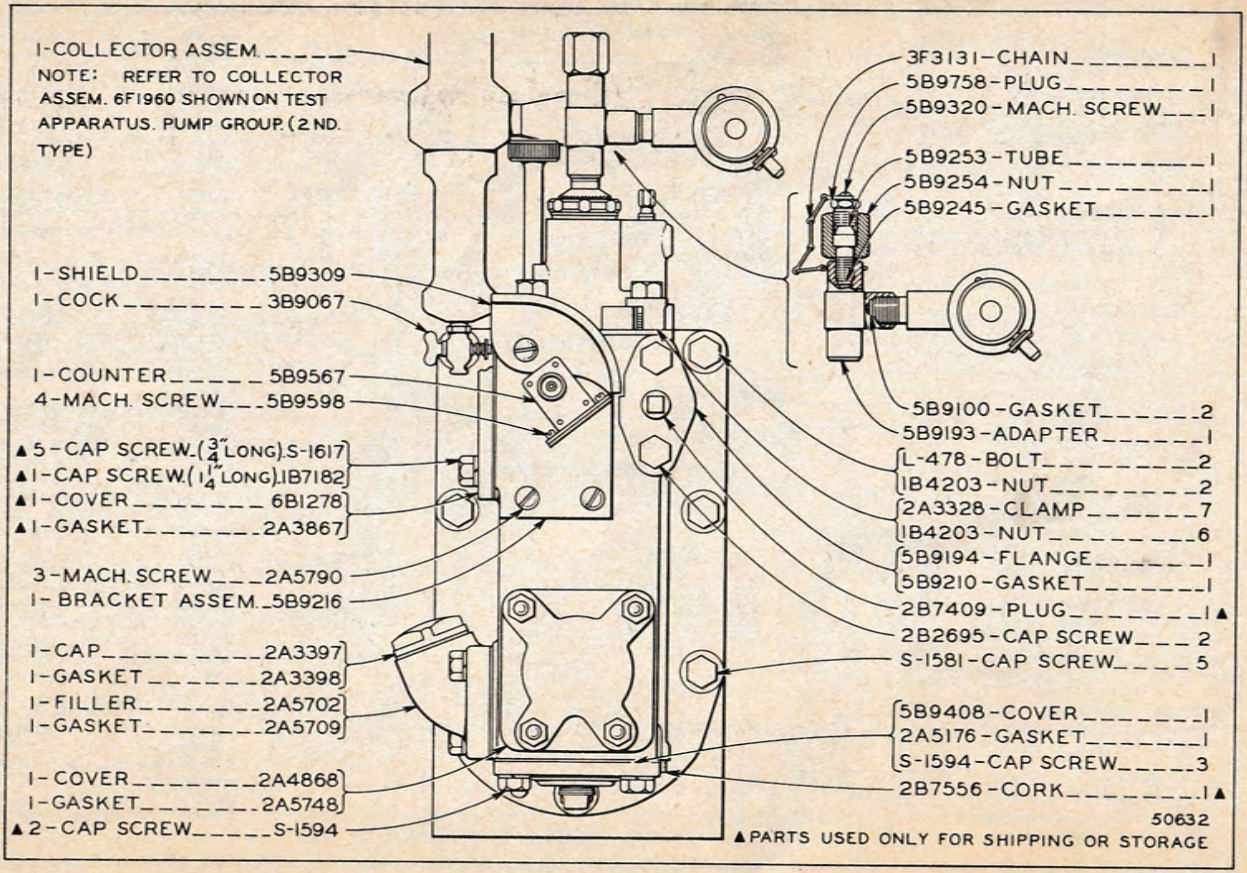
5B9297 VALVE ASSEMBLY
3¾" Bore Engine



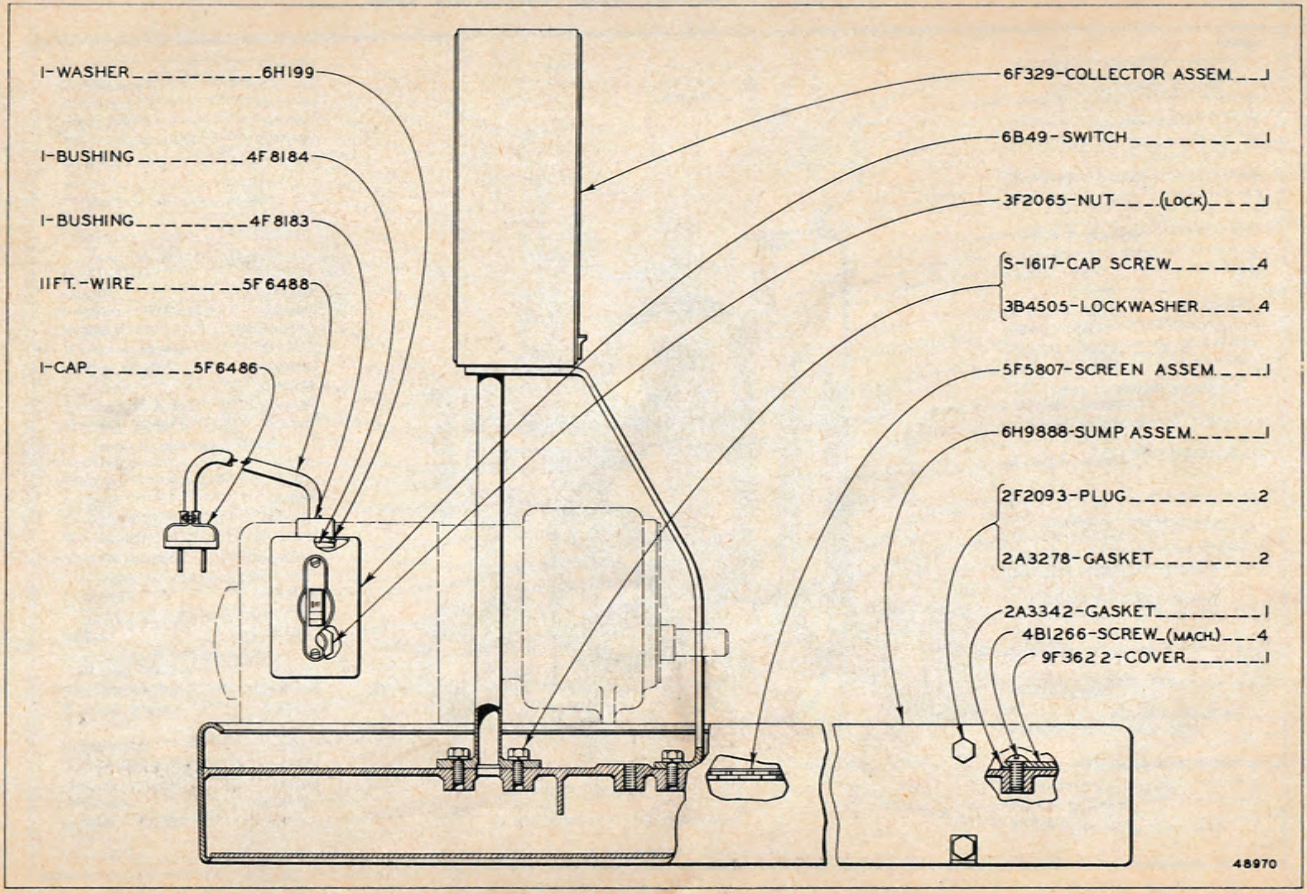
TEST APPARATUS MOUNTING GROUP—(1st Type)



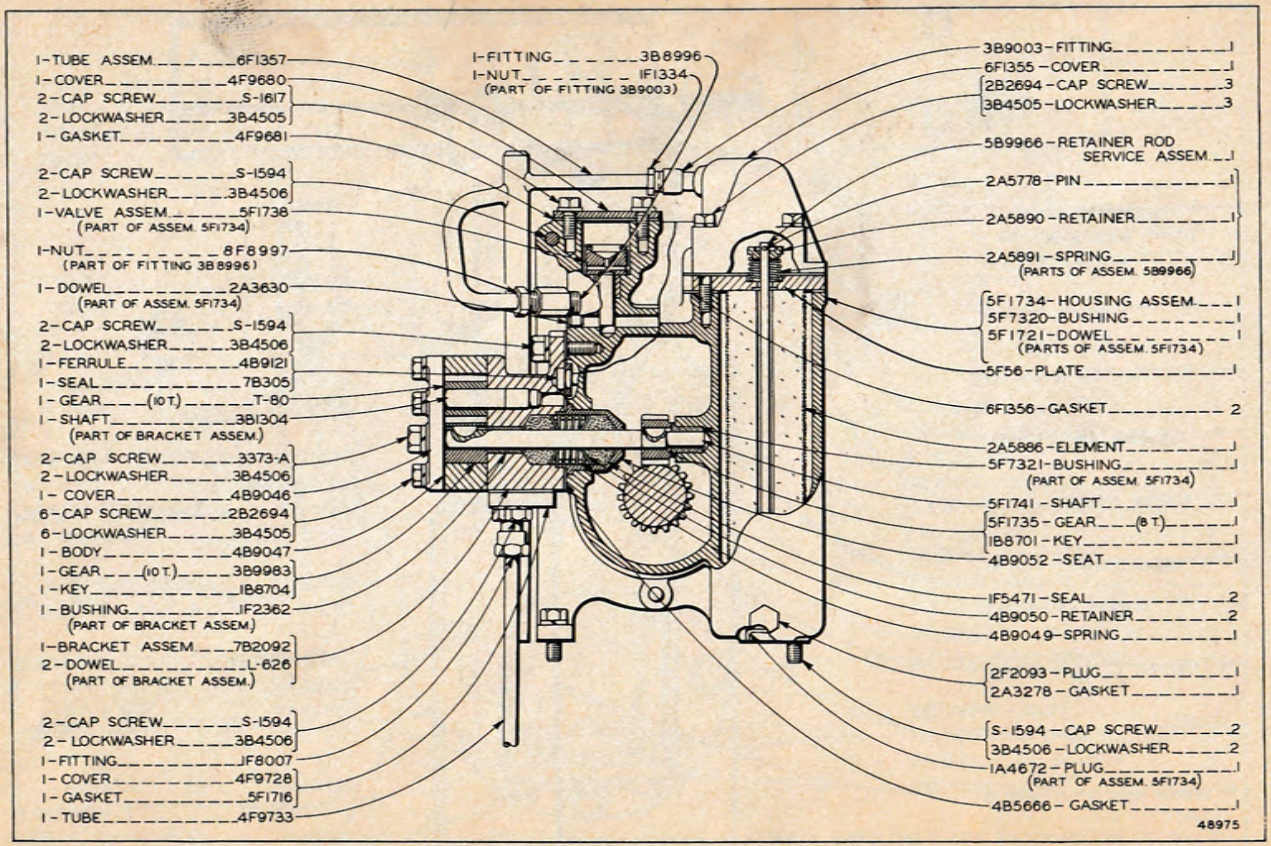
TEST APPARATUS PUMP GROUP—(1st Type)
(Side View)



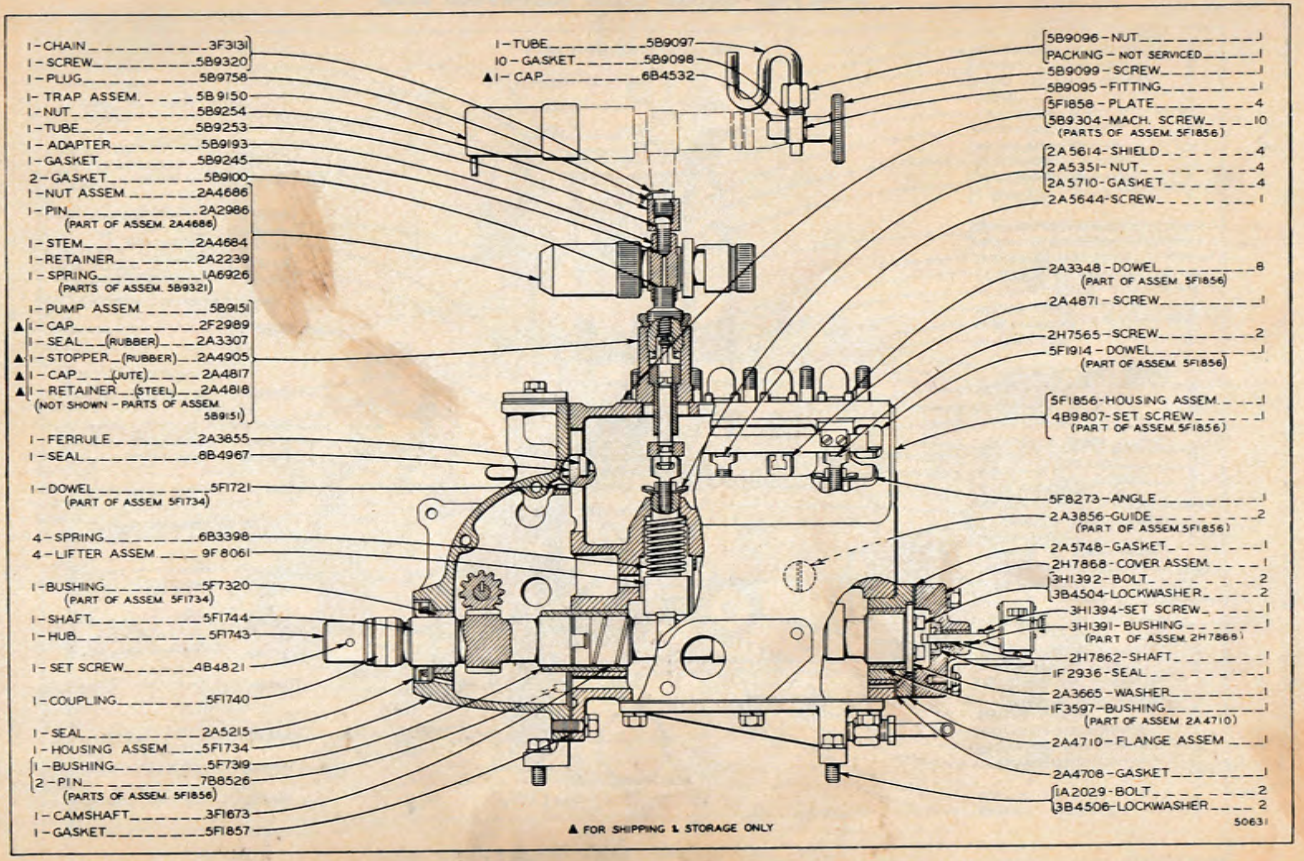
TEST APPARATUS PUMP GROUP—(1st Type)
(End View)



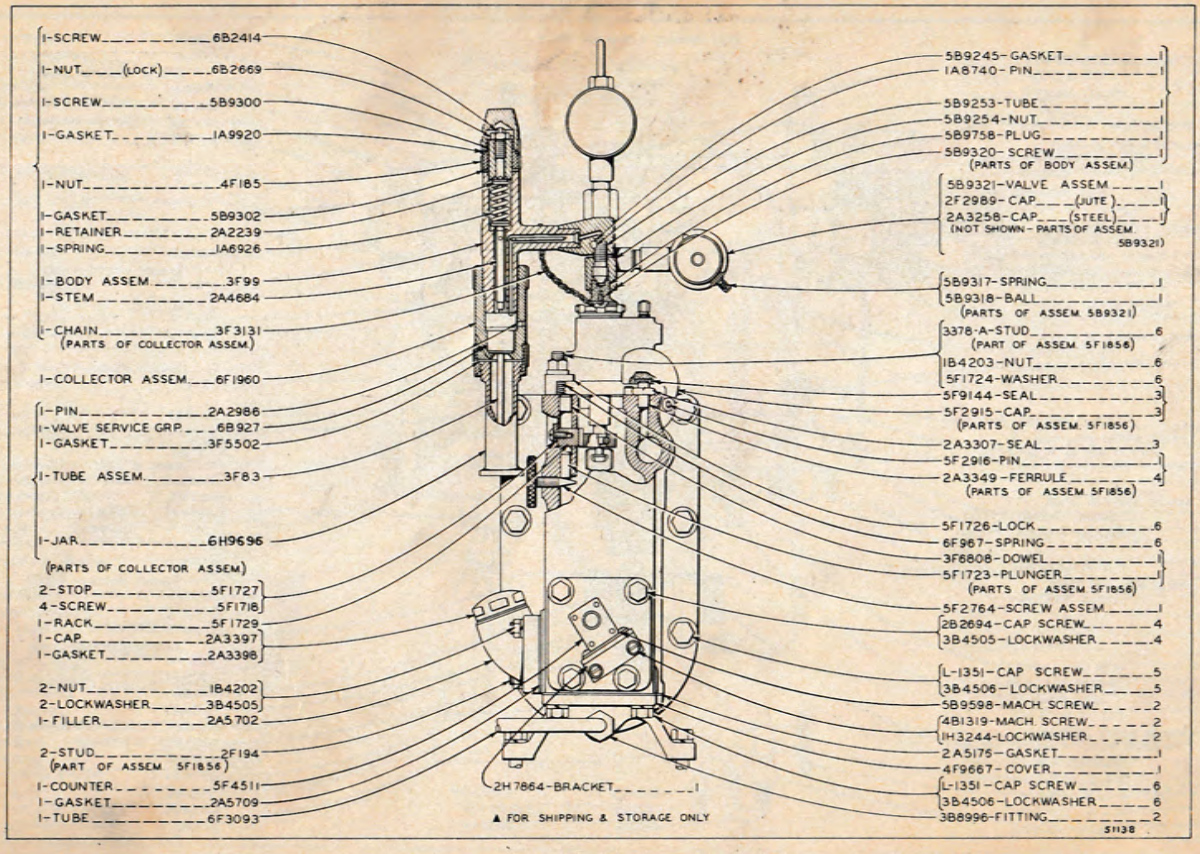
TEST APPARATUS MOUNTING GROUP–(2nd and Third Type)



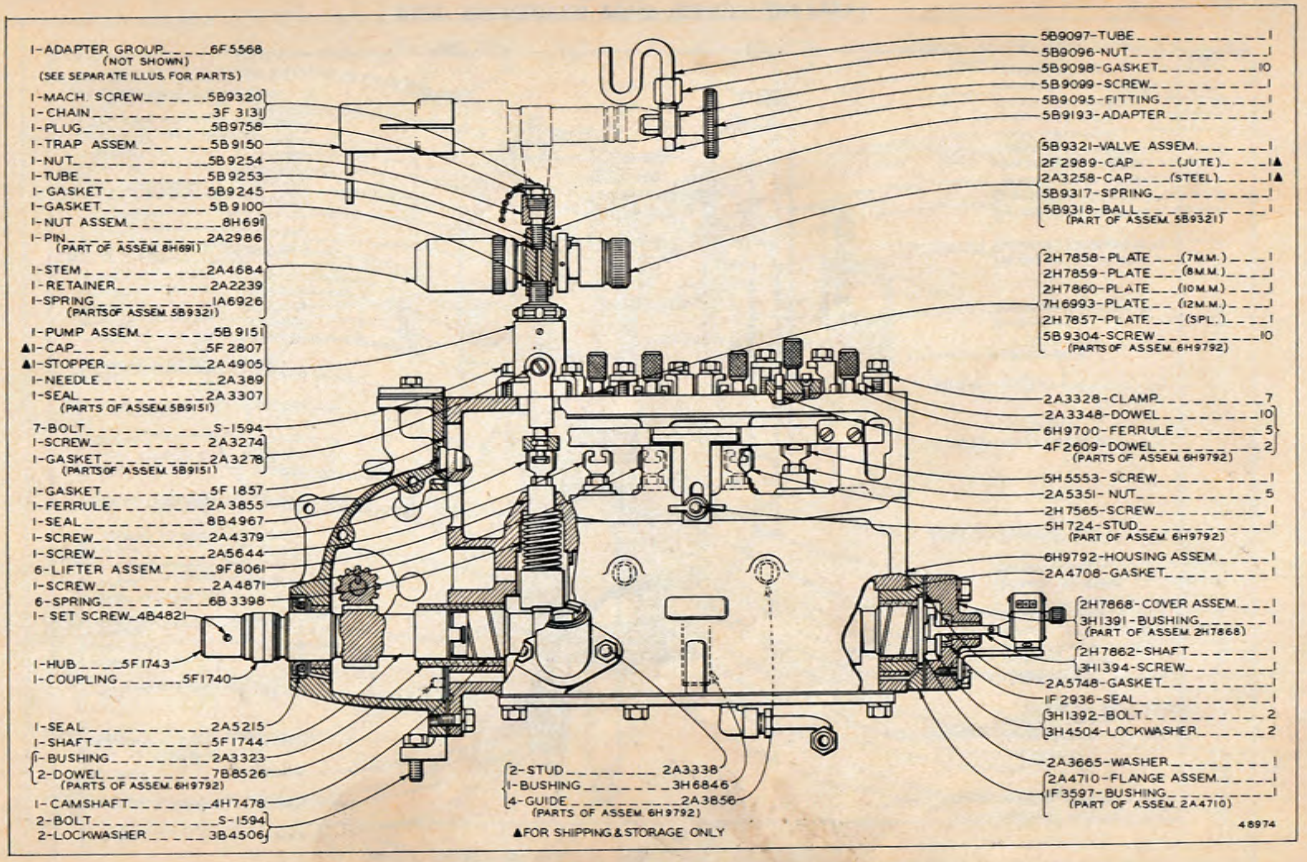
TEST APPARATUS PUMP GROUP-(2nd and 3rd Type)
(End View)



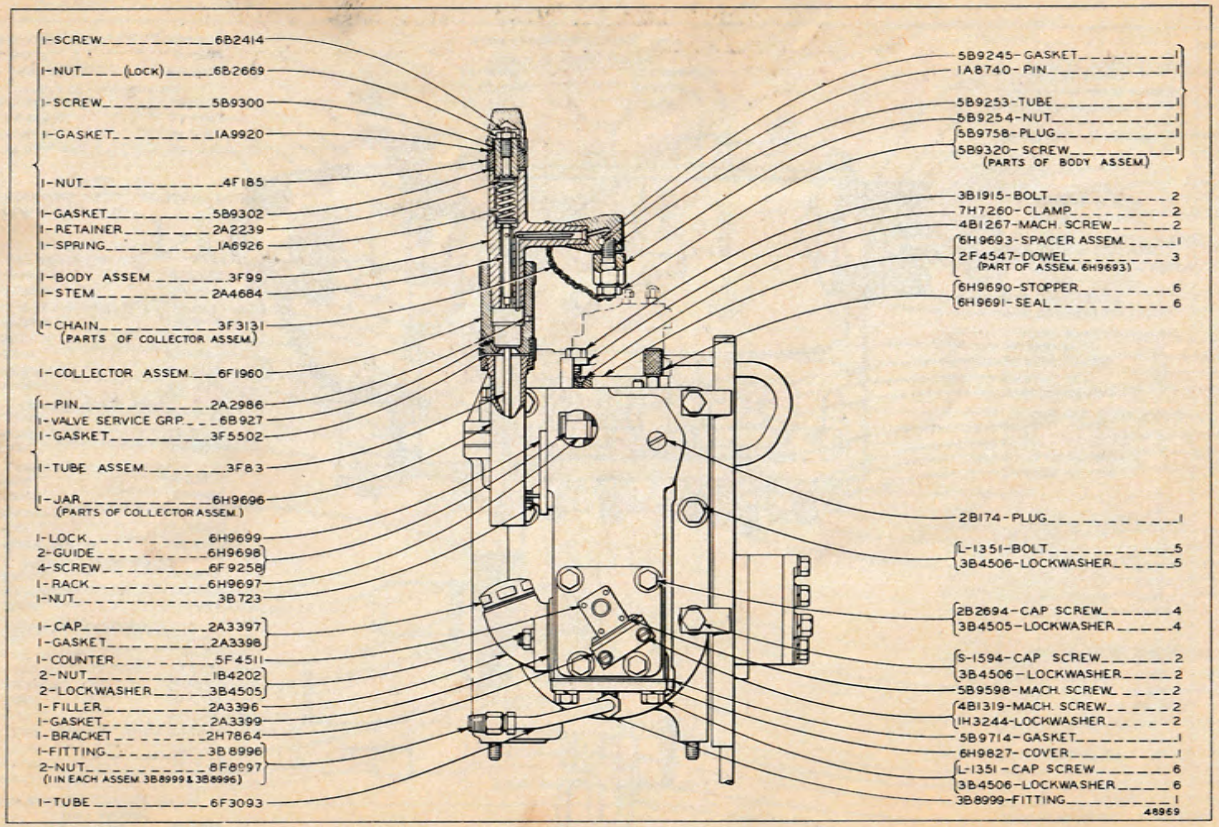
TEST APPARATUS PUMP GROUP—(2nd Type)
(Side View)



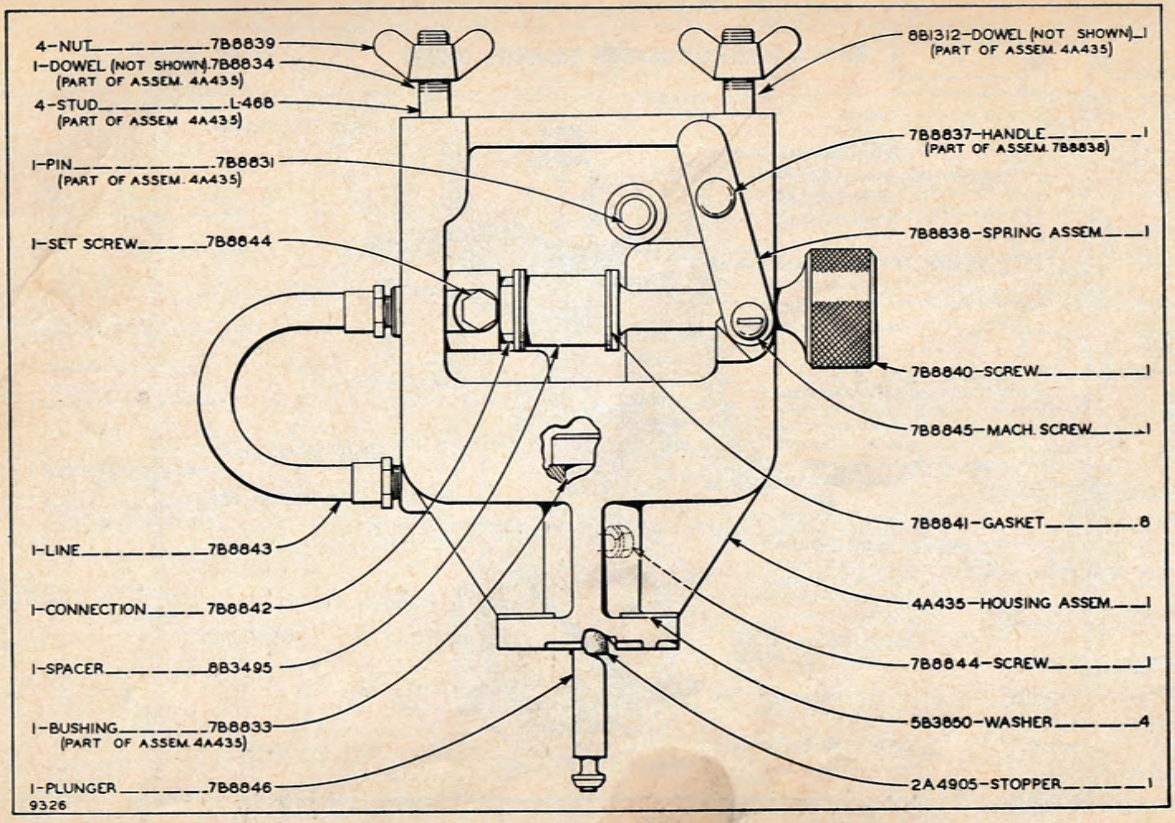
TEST APPARATUS PUMP GROUP—(2nd Type)
(End View)



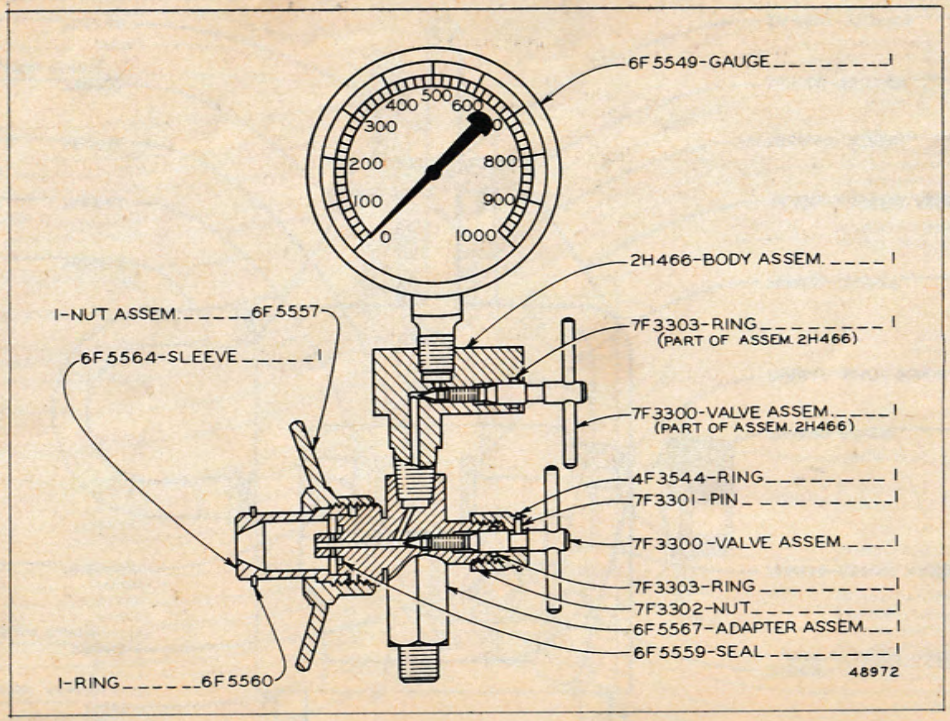
TEST APPARATUS PUMP GROUP–(3rd Type)
(Side View)



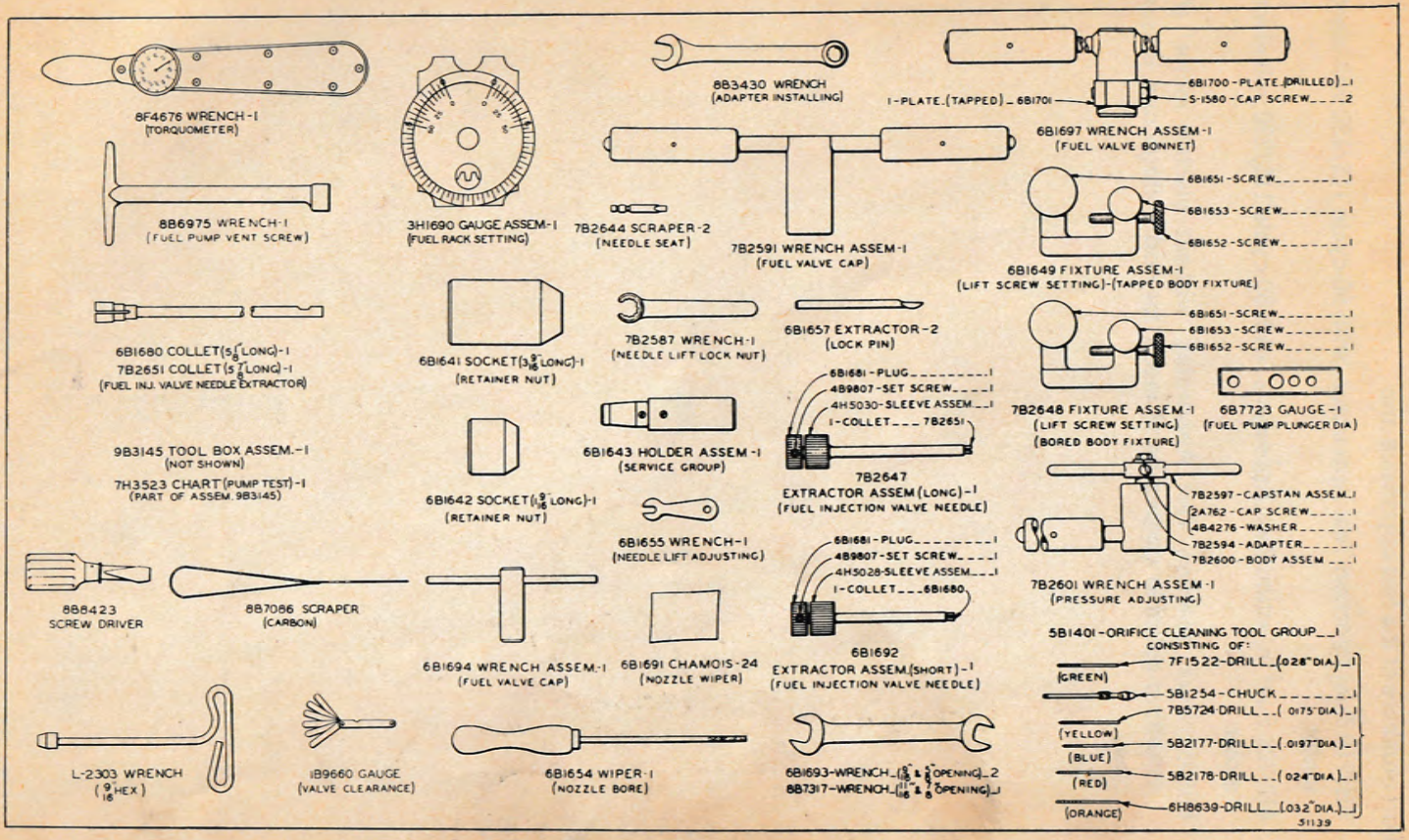
TEST APPARATUS PUMP GROUP-(3rd Type)
(End View)



FUEL PUMP ADAPTER HOUSING ASSEMBLY



6F5568 ADAPTER GROUP-CAPSULE VALVE



TEST APPARATUS TOOLS

Part numbers of the test apparatus are:

6H9710 Fuel Injection Test Apparatus, with 60-cycle 115/230 volt electric motor.

6H9709 Fuel Injection Test Apparatus, with 50-cycle 115/230 volt electric motor.

6H9957 Fuel Injection Test Apparatus, without electric motor. (For mounting suitable geared-head motor for odd voltage and frequencies.)