ROBERT BOSCH

MODEL PE(S)-6 MW

FUEL INJECTION PUMP

SERVICE MANUAL

FORM CGES-375

SEPTEMBER, 1984

Printed in United States of America

SERVICE MANUAL

FORWARD

This manual is part of a series of manuals intended to assist service technicians in maintaining International® Engines in accordance with the latest technical advancements.

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FORM NO.	DESCRIPTION
CGES-185-3	300/400 Series Engine Service Manual
1 171 575 R1	DT/DTI-466C Diesel Engine Operation Manual
CGES-240-3	Diesel Engine Diagnostic Manual
CGED-365	Diagnostic Form (DT/DTI-466C)

CGES-375
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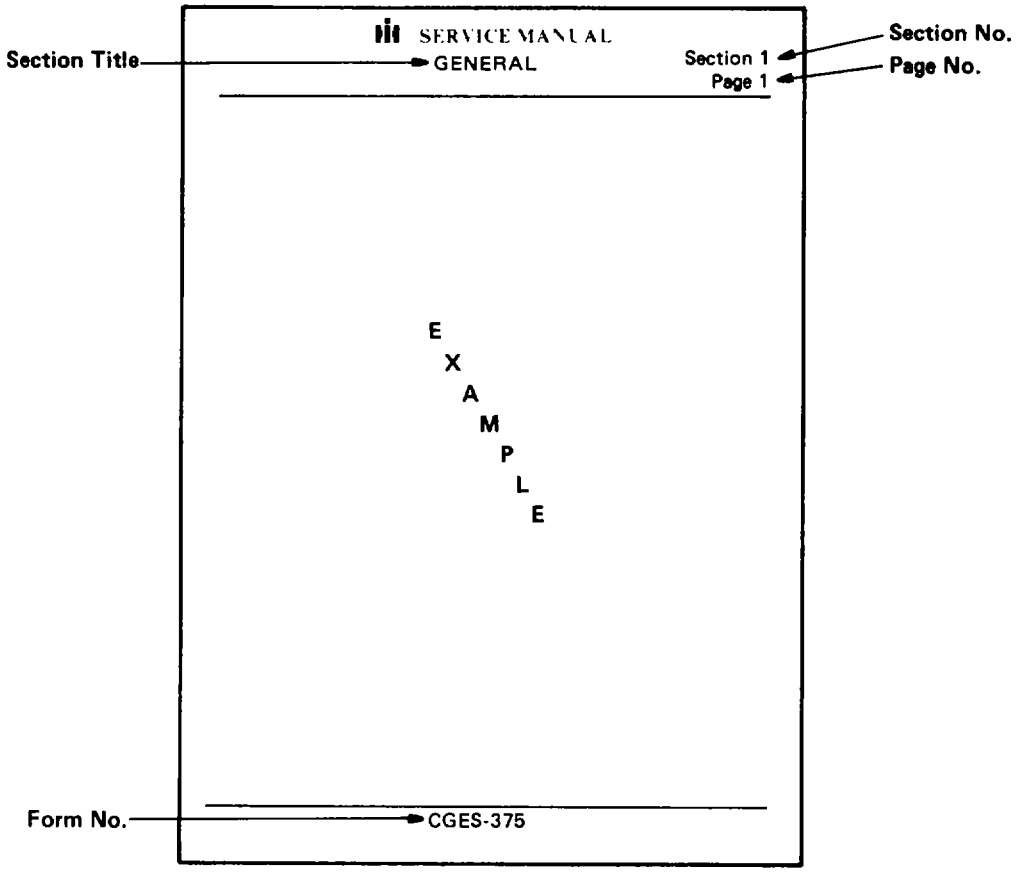
SERVICE MANUAL

INTRODUCTION

This manual is arranged in sections with the pages numbered consecutively in each section. Any drawings are also numbered consecutively in each section. Included at the top of each page is the section title, section number and page number. The bottom center of each page will show the manual form (i.e. CGES-375).

NOTE: Future revisions will be indicated by a dash one, dash two, etc. after the form number (i.e. CGES-375-1 will be revision number one).



An index arranged according to sections will be found at the beginning of this manual. This manual is divided into six sections which are:

SECTION ONE - - General Pump Information

SECTION TWO - Disassembly

SECTION THREE - Cleaning and Inspection

SECTION FOUR - Reassembly

SECTION FIVE - - Calibration

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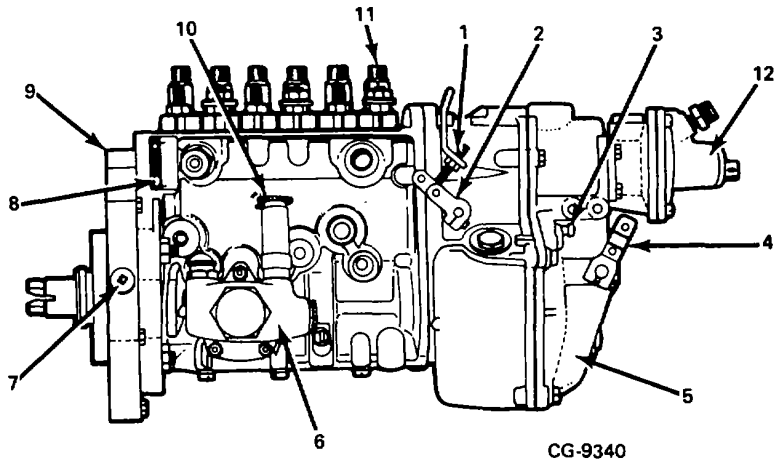


Figure 1. Robert Bosch Model MW Fuel Injection Pump

1.	Shut-off Stop Screw	5.	RQV Governor Housing	9.	Mounting Adapter
2.	Shut-off Lever	6.	Fuel Supply Pump	10.	Hand Priming Pump
3.	High Idle Stop	7.	Timing Pointer Plug	11.	Plunger
4.	Throttle Lever	8.	Serial Number Plate	12.	Aneroid

DESCRIPTION

The Robert Bosch Model PE(S)-6MW Injection Pump is used on the International DT-466C diesel engine.

The injection pump is an in-line, plunger type, with an individual plunger and barrel pumping element for each engine cylinder. The injection sequence is 1,5, 3, 6, 2, 4.

The injection pump assembly incorporates mechanical, flyweight type RQV variable speed governor.

The pump throttle lever and the high-speed stop screw are located on the left side of the governor assembly. The fuel shut off lever is also located on the left side of the governor.

The injection pump is located on the left side of the engine. High pressure lines connect the pump to the nozzles. Operating and service instructions for the nozzles are given in CGES-200-2 Service Manual.

IDENTIFICATION

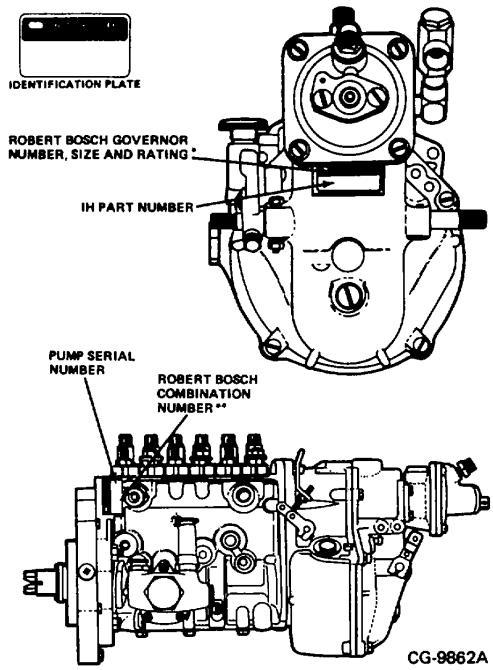
Identification of injection pump and governor can be made by referring to two nameplates, one on the rear of the governor housing, and one on the front top left of the injection pump (Figure 2). The nameplate on the rear of the governor gives the IH part number of the complete pump and governor assembly and the Robert Bosch governor number, size and rating. The nameplate on the left side, gives the Robert Bosch pump description number.

OPERATING PRINCIPLES

The injection pump is the in-line type with an individual plunger and barrel pumping element for each engine cylinder. Each plunger stroke is constant, but its effective pumping (metering) stroke is variable and is controlled by the positioning of a common control rack connected through linkage to the governor and the vehicle's throttle lever.

The individual plunger and barrel pumping elements receive fuel at supply pump pressure from the injection pump housing fuel gallery, and forces it under very high pressure through the injection nozzles into the engine combustion chamber.

The injection pump plungers are moved by tappet assemblies which ride on the lobes of the injection pump camshaft. The injection pump camshaft is timed to the engine to inject fuel into each cylinder at the proper time.



* Code for Robert Bosch governor number RQV 350 1200 MW 43-5:
- R = Flyweight governor
- Q = Fulcrum lever model
- V = Variable speed governing (all-speed)
- 350 = Low idle pump speed
- 1200 = Full load rated speed
- MW = Fits on "MW" size pump
- 43-5 = Application number

** Code for Robert Bosch combination number PES 6MW 100/320 RS 1108:
- PE = Inline injection pump
- S = Flange mounted
- 6 = Number of cylinders
- MW = "MW" size pump
- 100 = Plunger diameter in 1/10 mm
- / = Pump model
- 320 = Number code for location of feed pump and governor
- R = Rotation of pump as seen from drive end (right hand clockwise)
- S1108 = Application number

Figure 2. Injection Pump Identification

Each plunger has a delivery valve above the plunger. The delivery valve, which is held on its seat by spring pressure, prevents fuel from draining out of the high pressure line between pumping cycles.

The injection cycle can be described by observing the plunger in its four principle positions in the barrel. The four positions are shown in Figure 3.

At bottom dead center the plunger is held down on the lowest point of the cam lobe by the plunger spring. Top of plunger is below the charging port of barrel. Fuel at supply pump pressure flows through the charging port to fill the area above the plunger.

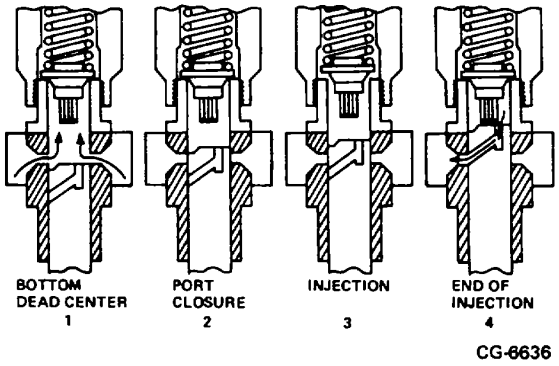


Figure 3. Four Principle Plunger Positions of Injection Cycle

1. Bottom Dead Center
2. Port Closure
3. Injection
4. End of Injection

Port closure begins when the rising plunger covers the charging port and fuel is trapped above the plunger.

Start of injection occurs as the plunger continues with charging ports covered, fuel is forced upward under high pressure, unseats the delivery valve and is injected into the cylinder.

End of injection occurs when the plunger moves up to the point where the charging port is again uncovered by the lower helix. Fuel pressure above the plunger is relieved to the charging gallery. This pressure drop allows delivery valve and injection nozzle to seat thus ending injection.

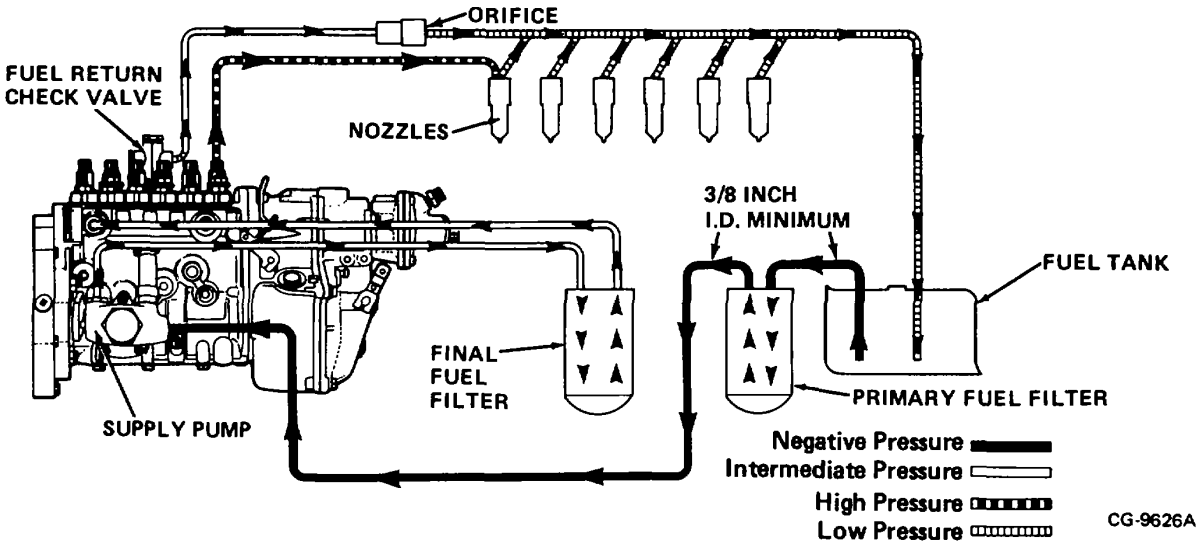


Figure 4. Fuel System Flow

FUEL SYSTEM FLOW

As fuel travels through the fuel system, it will be under suction (negative pressure), intermediate pressure, high pressure (injection pressure) and low pressure (Figure 4).

Negative Pressure

The piston type supply pump creates a suction at its inlet and pulls fuel from the fuel tank, through the fuel supply lines and through the primary fuel filter. No filter is used on the fuel suction line extending into the fuel tank because wax particles could plug the filter in cold weather. Fuel lines and fittings between the supply pump inlet and the fuel tank must be a minimum of three-eighths inches inside diameter. Small diameter fuel supply lines or fittings will reduce fuel flow and can reduce engine power output.

Intermediate Pressure

The supply pump produces an intermediate pressure, called supply pump pressure, at its outlet and forces fuel through the final fuel filter and into the injection pump housing. Fuel under intermediate pressure surrounds each barrel assembly. Fuel pressure in the housing is controlled by the orificed fitting in the fuel return hose located "downstream" of the fuel return check valve and the supply pump piston spring calibration. A special rubber hose between the final filter outlet and the injection pump housing dampens pressure waves from the supply pump. Substitute hoses can cause lower engine power even though supply pump pressure can be within specifications.

High Pressure

The injection pump meters and delivers fuel at high pressure, up to an instantaneous 9000 psi pressure after nozzle valve opening, through the injection pipes or lines to the injection nozzle assemblies. This high pressure fuel causes the nozzle valve to open and fuel flows through the nozzle orifices into the combustion chamber. The amount of fuel delivered is controlled by the injection pump governor. A small amount of low pressure fuel returns from the nozzle assemblies to the fuel tank through the leakoff lines.

Low Pressure

An orifice fitting in the end of fuel hose from the fuel return check valve limits the amount of fuel returned to the fuel tanks. After fuel passes through the orifice, it is at low pressure.

METERING

Metering (providing proper amount of fuel to meet engine requirements at various loads and speeds) is accomplished by rotating the plunger in its barrel to change the effective pumping stroke. The effective stroke is the distance traveled upward by the plunger from the time the charging port is covered until it is again uncovered by the lower helix. A short effective stroke means a small amount of fuel is injected. As effective stroke increases, the amount of fuel injected increases.

The metering function can be described by observing the relationship of plunger helix to barrel charging port under various metering positions as shown in Figure 5.

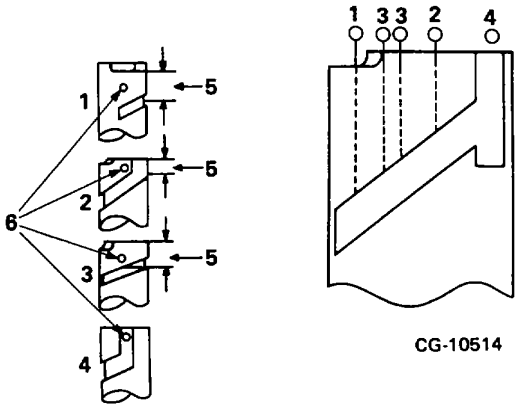


Figure 5. Helix and Charging Port Metering Positions

1. Start Position (Charging Port Closed)
2. Idle Position (Charging Port Closed)
3. Full Load Position (Charging Port Closed)
4. Stop Position (Charging Port Open)
5. Effective Stroke
6. Charging Port Position

Starting (Excess Fuel)

For starting, plunger is rotated by control rack to a point where the maximum effective stroke (port closing to port opening) is obtained. When engine starts, release accelerator pedal. This rotates plunger out of start fuel position to decrease fuel delivery.

Engine Operating (Metered Delivery)

At engine operating speeds from idle through maximum governed speed, the quantity of fuel delivered is determined by effective stroke (port closing to port opening) as controlled by the position of the throttle lever and governor.

Engine Stop (No Delivery)

To stop the engine, plungers are rotated so that vertical slots (stop slots) are in line with barrel ports. As plunger moves up and down fuel is transferred back and forth from top of plunger through vertical slots and into charging gallery. The ports do not close - thus, no delivery.

Plungers are rotated to the various metering positions by the control rack. Rack movement is controlled by the throttle lever and governor speed.

PUMP FEATURES

Mounting Adapter

A mounting adapter (9, Figure 1) incorporating four studs attaches to the injection pump housing. Capscrews through the injection pump drive gear cover secure the mounting adapter to the engine front plate. Removal of the timing pointer plug (7, Figure 1) in the adapter is necessary when verifying or adjusting pump to engine timing.

The mounting adapter is an integral part of the injection pump because it contains the timing pointer. During injection pump calibration, a port closure mark is stamped on the injection pump hub directly in line with the pointer. Because the timing pointer is located on the mounting adapter and the mounting adapter is fastened to the injection pump housing by the four studs and nuts, these four nuts should not be loosened.

Loosening the nuts and rotating the pump housing in relationship to the mounting adapter will change the relationship of the timing pointer/hub mark which was established during injection pump calibration.

Supply Pump With Hand Priming Pump

The piston-type supply pump (6, Figure 1) is activated by the eccentric on the injection pump camshaft and serves as a mount for the hand priming pump (10, Figure 1). Since all fuel entering the injection pump must be filtered to ensure long pump life, the hand priming pump should be used when changing fuel filters. Always install the fuel filters "dry" and use the hand pump to fill the filters and bleed air from the fuel system.

Aneroid Assembly

Exhaust smoke levels during engine acceleration are controlled by using an aneroid (12, Figure 1). The aneroid limits fuel delivery during acceleration until the turbocharger speed is sufficient to provide adequate air for complete combustion. An external line connects the intake manifold to the aneroid to allow manifold pressure to activate the aneroid. A leak in the aneroid diaphragm or intake manifold to aneroid line will cause the injection pump to stay in the "cutback" position, and reduce engine power.

Fuel Return Valve

A fuel return check valve is mounted to the injection pump housing (1, Figure 6) and all fuel that is not injected passes through the check valve and then through a special orificed rubber hose. The function of the fuel return check valve is to provide a positive seal to prevent fuel from draining out of the pump housing when the engine is stopped. The fuel return check valve opens at approximately 18 psi. Therefore, total fuel flow through the injection pump housing is controlled by the orifice in the rubber hose as long as the supply pump pressure is above 18 psi. After the fuel flows through the orifice, the fuel pressure drops from the intermediate pressure ahead of the orifice to low pressure (Figure 4).

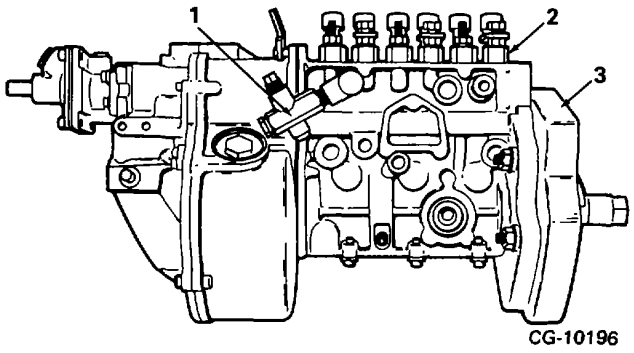


Figure 6. Right Side View of Injection Pump

1. Fuel Return Valve
2. Delivery Valve Holder
3. Drive Gear

GOVERNOR

The mechanical flyweight governor (5, Figure 1) which is mounted on the injection pump, is the variable speed type, identified by the manufacturer as ROV 350-1200 (or -1300). The 350-1200 (or -1300) designation refers to the injection pump speed range in which the governor functions. This corresponds to 700 to 2400 (or 2600) engine RPM, since the pump camshaft rotates at 1/2 engine speed. Figure 7 illustrates a typical cut-away view of the RQV governor

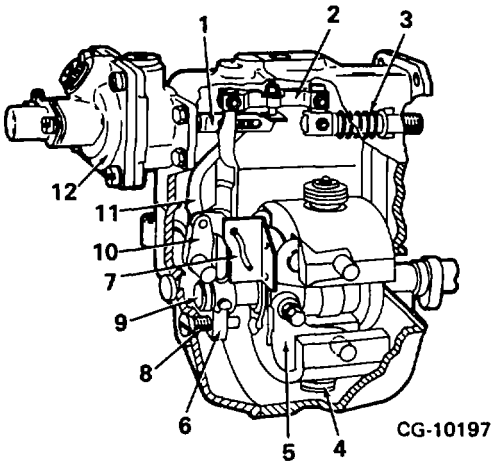


Figure 7. Cut-Away View of Governor Assembly

1. Stop Shackle
2. Rack Link
3. Control Rack
4. Governor Springs
5. Bell Crank
6. Sliding Block
7. S-Plate
8. Guide Pin
9. Adjusting Pin
10. Guide Lever
11. Rocker Arm
12. Aneroid

The functions of the governor are:

(1) limit minimum (lo-idle) engine speed, (2) limit maximum engine speed and (3) maintain smooth speed control (without stalling, surging or hunting) within the limits of its regulation throughout the operating speed range of the engine.

The all-speed governor provides speed control at any fixed position of the control lever (accelerator pedal). This provides the vehicle operator with the most satisfactory driving characteristics. The governor tends to keep engine speed constant at the level determined by position of the accelerator pedal and automatically increases or reduces fuel delivery in response to minute changes in engine speeds without a significant change in road speed and without the operator changing position of the accelerator pedal.

The transfer pump, a single action none positive displacement plunger type pump, is driven by the injection pump camshaft.

The transfer pump can supply more fuel than is required for injection. Excess fuel, utilized for cooling injection pump, is routed from the injection pump fuel gallery back to the fuel pump.

NOZZLE

The American Bosch ADB-M type nozzles (Figure 8) are of the closed differential hydraulically-operated type.

Fuel, under high pressure, flows into the fuel duct in the body and enters the pressure chamber. When fuel pressure in the pressure chamber exerts sufficient force on the differential area of the nozzle valve to overcome the opposing spring preload, the nozzle valve is lifted, allowing fuel to enter the nozzle body sac and flow through the spray holes. The fuel flowing through the spray holes is atomized as it enters the combustion chamber.

When the end of the pumping stroke occurs, there is a sudden drop in line pressure. As a result, the pressure in the nozzle pressure chamber drops rapidly. Since the pressure adjusting spring is exerting a downward force on the nozzle valve and is no longer being opposed by fuel pressure, the nozzle valve moves downward rapidly until it seats in the nozzle body - the nozzle is now closed.

Since there is a slight amount of clearance (controlled) between the nozzle valve and body, a small amount of leakage between the valve and body will occur. This leakage is necessary for valve O.D. and body I.D. lubrication.

NOZZLE HOLDER

The American Bosch AKN-M type nozzle holder (Figure 8) is a unit which retains the nozzle in the cylinder head and transfers the fuel from the high pressure tubing to the nozzle duct. The holder

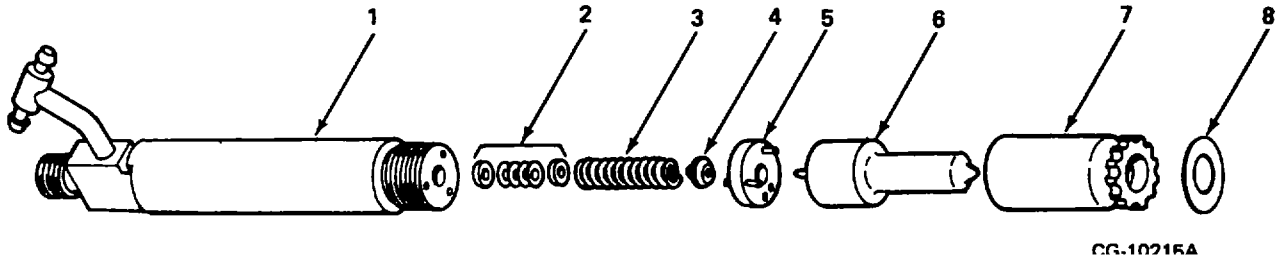


Figure 8. Exploded View of Fuel Injection Nozzle and Holder Assembly

1. Holder Body
2. Shim(s)
3. Pressure Adjusting Spring
4. Spring Seat Guide
5. Valve Stop Spacer
6. Nozzle Body and Nozzle Valve
7. Cap Nut
8. Copper Gasket

assembly consists of a holder body, doweled nozzle spacer, lower spring seat, pressure adjusting spring, shims and a nozzle retaining nut.

The holder body contains a high pressure tubing connection at the upper end, a high pressure fuel duct, a leak-off duct and drain connection. The lower end is counterbored to accept the pressure adjusting spring and shims. The lower face is lapped to a fine surface finish and contains two locating dowel pin holes. The lower spring seat provides a seat for the spring and a contact surface for the nozzle valve stem. The nozzle spacer contains two locating dowel pins which locate the nozzle radially to the holder body to insure proper spray pattern orientation. Both faces of the spacer are lapped to a fine surface finish to provide gasketless, high pressure seals between the holder body face, spacer faces and nozzle body face. The spacer also acts as the nozzle valve stop. The cap nut clamps the nozzle and spacer to the holder body.

Fuel flowing through the high pressure tubing enters the nozzle holder and flows down the high pressure duct, through the spacer duct and to the nozzle. The slight fuel leakage between the nozzle valve and body enters the spring chamber in the holder body and flows through a return duct to a drain connection.

PUMP SPECIFICATIONS

Injection Pump Type	In-Line Plunger
Pump Speed	One-Half Engine Speed
Pump Rotation (Viewed From Drive End)	Clockwise
Firing Order	1, 5, 3, 6,2, 4
"Slider-to-Housing" Distance	39.15 t 0.2 mm (1.54± .008 in.)
Basic Setting of S-Plate	21.5 ± 0.2 mm (.847 ± .008 in.)
Camshaft Protrusion	20.7 - 22.2 mm (.817 - .877 in.)'
Axial End Play of Governor Weight Assembly	.05 - .10 mm (.002 - .004)

TOOLS		
Quantity Required	**Robert Bosch Part Number**	**Description**
1	KDEP 2919/A	Holding Fixture
1	KDEP 2988	Camshaft Slotted Cylindrical Nut Remover (also used for reassembly).
1	KDEP 2886	Governor Flyweight Remover
1	KDEP 1056	Side Plug Puller
3	KDEP 1068	Tappet Holder
1	KDEP 1505	Tappet Depressor
1	KDEP 1066	Assembly Jig
1	9 681 238 902	Spacer Ring Installer
3	KDEP 1052	Plunger Retainer
2	KDEP 1057	Spacer Plate
1	KDEP 1059	Bearing Installer
1	KDEP 1069	Ball Bearing installer
1	KDEP 1058	Side Plug Installer
1	1 682 329 038	Guide Bolt Gauge
1	9 681 238 904	S-Plate Gauge
1	KDEP 2949	Screwdriver Bit
1	1 413 462 040	Plug
1	2 916 710 611	Copper Gasket
1	1 688 130 030	Bracket (Rack Travel)
1	1 687 233 015	Dial Indicator
2	9 683 233 302	Fuel Gallery Plug 1/4 NPT (for high pressure phasing)
1	1 413 462 040	Fuel Gallery Plug M16 Thread (LPC)
1	1 683 350 065	Adapter Bushing
1	1 682 012 008	Pin for LPC (lift-to-port closure) Gauge
1	1 688 130 135	Plunger Lift Device
1	1687 233 012	Dial Indicator (LPC)
1	1 683 350 066	Adapter Bushing (LPC)
1	KDEP 2989	Governor Spring Adjusting Wrench
1	KDEP 1047	Aneroid Tool (Full Load)
1	KDEP 1048	Aneroid Tool (Cutback)
6	1 688 901 016	Test Nozzle Holder Assy (.5 mm orifice)

Additional Tools Required When Using Robert Bosch Test Stand		
Quantity Required	**Robert Bosch Part Number**	**Description**
1	KDEP 2885	Coupling Wrench
1	KDEP 2916	Coupling Puller
1	KDEP 2963	Pump Holding Bracket
1	0 681 440 006	Governor Setting Protractor
2	1 683 457 020	Fuel Gallery Adapter
1	1 685 720 060	Mounting Flange
1	1 687 233 015	Dial Indicator
2	1 688 030 122	Support Bracket
1	1 688 130 095	Dial Indicator Stand
6	1 688 901 016	Test Nozzle Holder Assy (.5 mm orifice)
1	9 681 236 402	Drive Coupling
1	9 681 237 201	Aneroid Tester

Bacharach Calibration Stand Accessories*		
Quantity Required	**Bacharach Part Number**	**Description**
1	67-6635	Adapter
6	77-0194	Fuel Lines (6 mm OD x 2 mm ID x 600 mm Length)
1	67-6973	Spacer Assembly
1	67-5387	Flange Mounting Bracket, use #67-4125 for Rail Type Stands.
1	67-2863	Drive Hub 25 mm
1	67-5649	Throttle Arm Positioner, use #67-3905 for Rail Type Stands.
2	67-0916	Rubber Hose Assembly (1/2 ID x 36")
2	67-0915	PVC Hose (1/2 ID x 36")
1	67-5538	Base Bracket, use #67-2861 for Rail Type Stands.

*Calibration Stand of 10 HP or more is recommended. Existing 5 HP bench is acceptable.

TOOL SOURCE ADDRESS LIST

Robert Bosch Corporation
2800 South 25th Avenue
Broadview, IL 60153

Viscosity Oil Company
3200 South Western Avenue
Chicago, IL 60608

Bacharach Instruments
Division of United Technologies
625 Alpha Drive
R.I.D.C. Industrial Park
Pittsburgh, PA 15238

TORQUE CHART

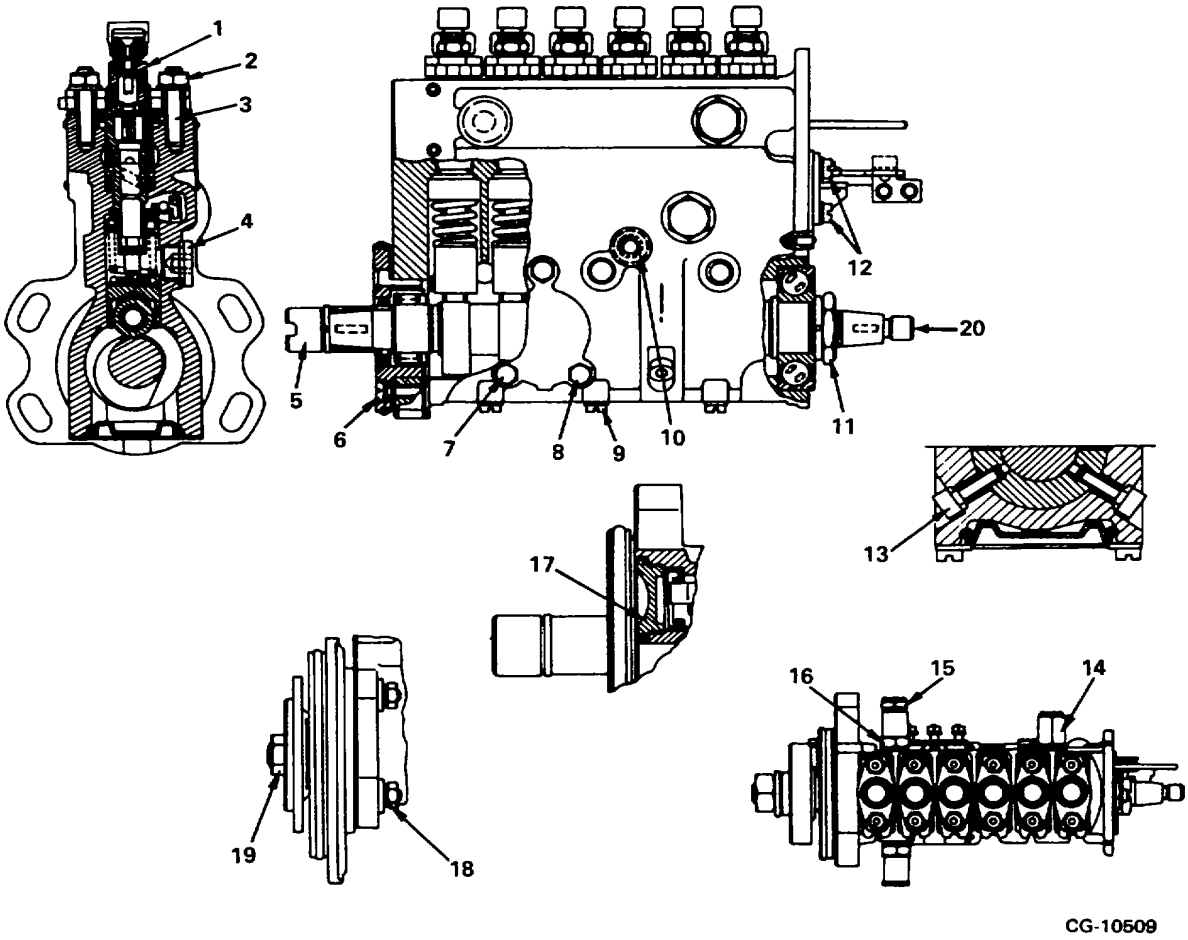


Figure 9. Torque

1. Delivery Valve Holder 60 minus 10 N•m (43 minus 7 ft-lbs)
2. Barrel Flange Nut 20-25 N•m (14-18 ft-lbs)
3. Barrel Stud 8-13 N•m (6-10 ft-lbs)
4. Lift to Port Closure Plug 3040 N•m (22-30 ft-lbs)
5. Injection Pump Hub Nut 85-100 N•m (83-74 ft-lbs)
6. Bearing End Plate 10-12 N•m (7-8 ft-lbs)
7. Transfer Pump Mounting Studs 3-4 N•m (2-3 ft-lbs)
8. Transfer Pump Mounting Nuts 4-7 N•m (3-5 ft-lbs)
9. Bottom Cover Screws 4-7 N•m (3-5 ft-lbs)
10. Oil Inlet Fitting 3040 N•m (22-30 ft-lbs)
11. Camshaft 100-120 N-m (74-88 ft-lbs)
12. Lock Plate Screws 4-7 N•m (3-5 ft-lbs)
13. Camshaft Support Bearing Screw 8-10 N•m (6-7 ft-lbs)
14. Fuel Return Valve 30-40 N•m (22-30 ft-lbs)
15. Fuel Fitting 30-40 N•m (22-30 ft-lbs)
16. Fuel Inlet Fitting 30-40 N•m (22-30 ft-lbs)
17. Rack Housing Plug 45-55 N•m (33-40 ft-lbs)
18. Adapter Nuts 45-50 N•m (33-36 ft-lbs)
19. Adapter Nut 100-110 N•m (74-81 ft-lbs)
20. Governor Weight Nut 54 N•m (40 ft-lbs)

Not pictured - governor mounting screws 6-8 N•m (4-6 ft-lbs)

DISASSEMBLY

Special Tools

To overhaul the pump assembly, metric wrenches and sockets will be required. Special rebuild tools called out throughout the text will speed repair and protect parts from damage. See Service Tool Chart (Section 1, Page 8).

PREPARATION

Pump and governor repair should be performed in a clean area free from airborne dirt. A separate injection room is preferred. Work bench, vise and tools should be clean. The use of trays is recommended for keeping injection pump parts in order. The pump assembly should be thoroughly cleaned before disassembly. Use only clean solvent and clean filtered test oil to clean injection pump parts.

Prepare the pump for disassembly as follows:

1. Drain fuel and lubricating oil from pump and governor housings.

2. Cap or plug fuel and lube oil openings after draining.

3. Use clean diesel fuel or kerosene to clean exterior of pump and governor assembly.

4. Clamp holding fixture KDEP 2919/A (Figure 1) in vise. Remove two pump housing to adapter bolts. Secure injection pump assembly to holding fixture.

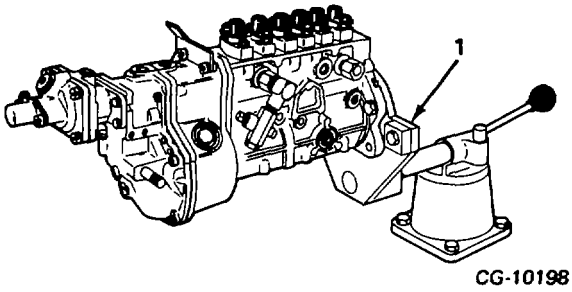


Figure 1. Injection Pump Mounted in Holding Fixture

1. Holding Fixture KDEP 2919/A

5. Remove fuel supply pump mounting bolts (Figure 2). Remove supply pump and drain lubricating oil into a container.

6. Remove fuel return valve. Hold adapter in place with a 3/4 inch wrench while removing elbow and valve body (Figure 3).

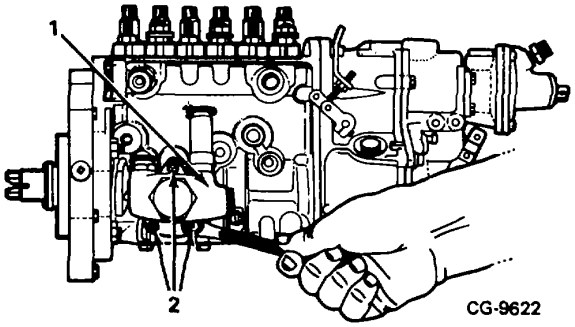


Figure 2. Removing Fuel Supply Pump

1. Fuel Supply Pump
2. Mounting Bolts

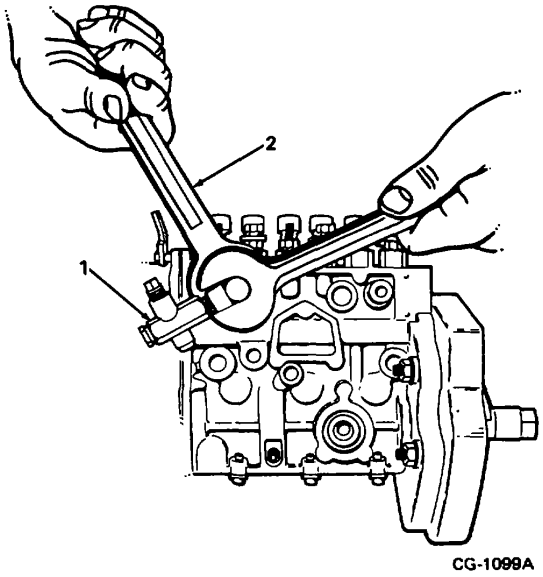


Figure 3. Fuel Return Valve Removal

1 Fuel Return Valve
2. 3/4 Inch Wrench

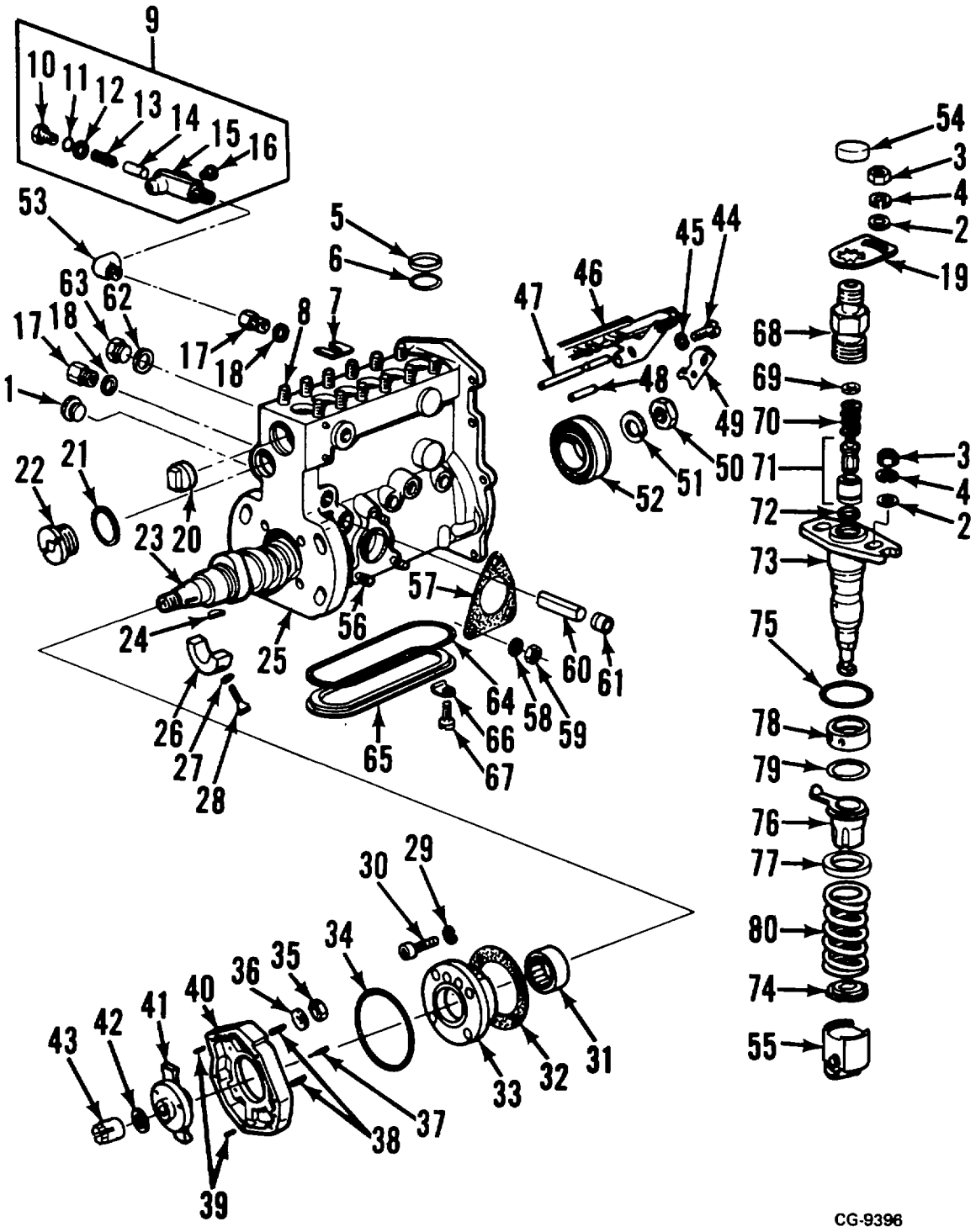


Figure 4. Exploded View of Pump Housing

Legend for Figure 57.

1. Housing Screw Plug
2. Housing Stud and Plunger Plate Lock Spacer
3. Housing Stud and Plunger Plate Lock Nut
4. Housing Stud and Plunger Plate Lock Washer
5. Housing Plunger Spacer
6. Housing Plunger O-Ring
7. Plunger and Barrel Shim
8. Pump Housing Stud
9. Check Valve Assembly
10. Plug
11. Piston Plug Gasket
12. Washer (.0.3 mm)
13. Piston Spring
14. Valve Stem
15. Valve Body
16. Piston Plug
17. Fuel In & Out Fitting
18. Fuel In & Out Fitting Gasket
19. Plunger Lock Plate
20. Housing Rack Plug
21. Housing Plug Gasket
22. Housing Screw Plug
23. Injection Pump Camshaft
24. Camshaft Woodruff Key
25. Pump Housing Assembly
26. Camshaft Support
27. Support Lock Washer
28. Camshaft Support Screw
29. Front Bearing Housing Washer
30. Front Bearing Housing Screw
31. Camshaft Front Bearing
32. Front Bearing Housing Gasket
33. Front Bearing Housing
34. Front Bearing Housing Ring
35. Adapter Stud Nut
36. Adapter Stud Washer
37. Timing Pointer
38. Adapter Stud
39. Dowel Pin
40. Pump Mounting Adapter Assembly
41. Injection Pump Hub
42. Pump Drive Hub Lock Washer
43. Pump Drive Hub Nut
44. Control Rack Screw
45. Control Rack Washer
46. Plunger Control Rack
47. Pump Rack Pin
48. Stop Plate Pin
49. Stop Plate
50. Camshaft Rear Nut
51. Camshaft Rear Lock Washer
52. Camshaft Rear Bearing
53. Overflow Elbow
54. Delivery Valve Sealing Cap
55. Roller Tappet Assembly
56. Pump Housing Fuel Supply Stud
57. Fuel Supply Pump Gasket
58. Lock Washer
59. Supply Pump Stud Nut
60. Camshaft Spacer
61. Camshaft Plug
62. Port Closure Plug Gasket
63. Port Closure Plug
64. Bottom Cover Gasket
65. Housing Bottom Cover
66. Cover Screw Lock Washer
67. Bottom Cover Screw
68. Delivery Valve Holder
69. Valve Spring Washer
70. Delivery Valve Spring
71. Delivery Valve With Cap
72. Delivery Valve Gasket
73. Plunger and Barrel
74. Lower Spring Seat
75. Impact Cap O-Ring
76. Control Sleeve
77. Upper Spring Seat
78. Impact Cap
79. Cap Retainer Snap Ring
80. Tappet Roller Spring

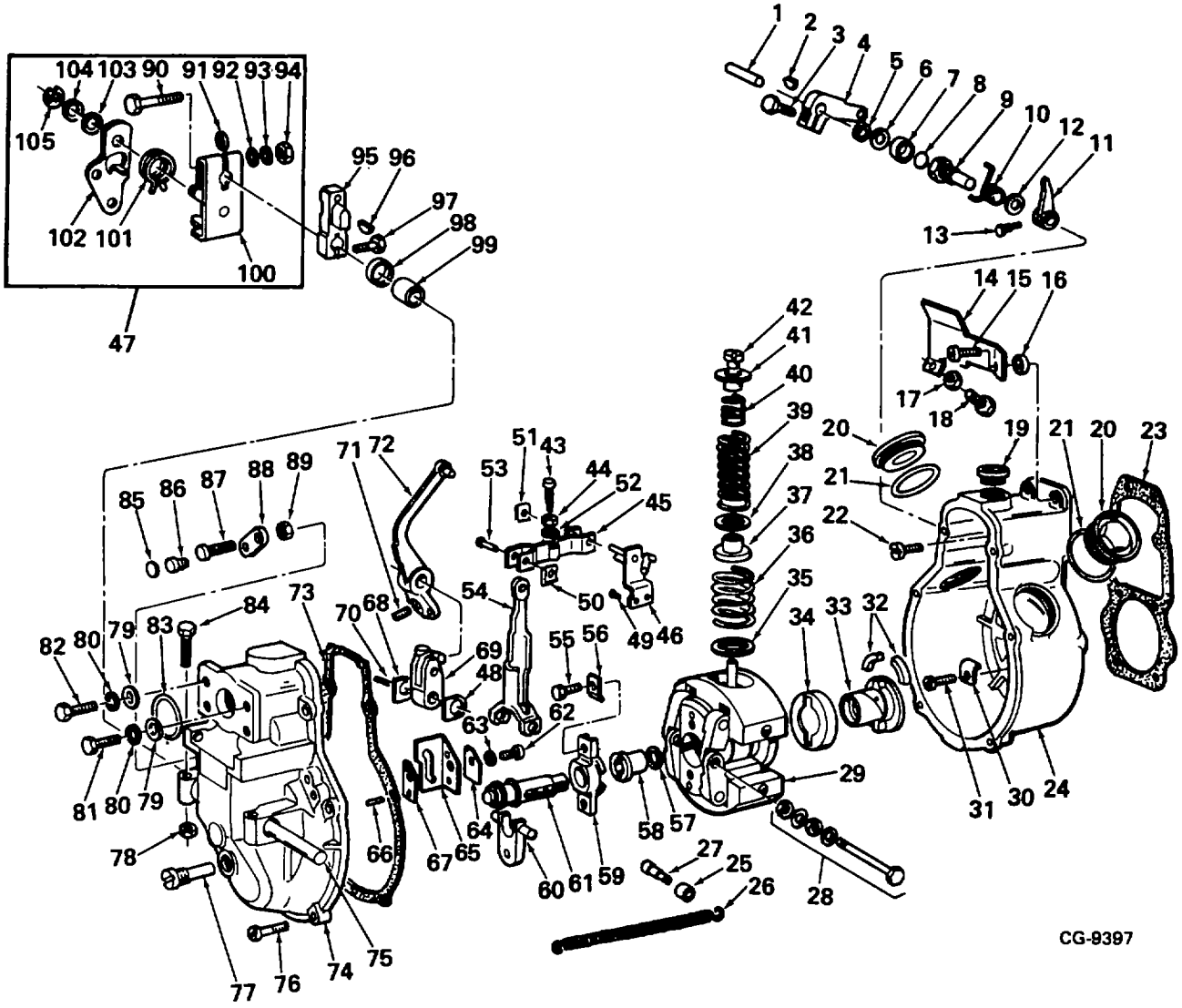


Figure 5. Exploded View of Governor

Legend for Figure 58.

1. Stop Lever Shaft
2. Woodruff Key
3. Screw
4. Stop Lever Control
5. Not Used
6. Stop Lever Shim
7. Cap
8. Stop Lever O-Ring
9. Governor Housing Bushing
10. Not Used
11. Stop Lever
12. Stop Lever Spacer
13. Screw
14. Shut-Off Bracket
15. Governor Housing and Bracket Screw
16. Spacer Ring
17. Shut-Off Bracket Nut
18. Shut-Off Bracket Screw
19. Governor Housing Top Plug
20. Governor Housing Side Plug
21. Side Plug Gasket
22. Governor Housing Screw
23. Governor Housing to Pump Gasket
24. Governor Housing Assembly
25. Retaining Pin Bushing
26. Extension Spring
27. Retaining Pin
28. Governor Flyweight Bolt Assembly
29. Governor Flyweight Assembly
30. Governor Housing Lock Washer
31. Governor Housing Screw
32. Flyweight Rubber Damper
33. Flyweight Drive Hub
34. Flyweight Retainer
35. Outer Spring Shim
36. Outer Idling Spring
37. Lower Spring Seat
38. Middle Spring Shim
39. Middle Spring
40. Inner Spring
41. Upper Spring Seat
42. Nut
43. Link Screw
44. Link Screw Nut
45. Fulcrum Lever and Connector Plate Link
46. Connector Plate
47. Control Lever Assembly
48. Governor Rocker Arm Plate
49. Connector Plate Rivet
50. Link Clip
51. Link Clip
52. Link Lock Washer
53. Link Pin
54. Fulcrum Lever
55. Guide Bushing Screw
56. Guide Bushing Lock Plate
57. Flyweight Securing Nut Shim
58. Flyweight Securing Nut
59. Guide Bushing
60. Guide Block
61. Guide Sleeve
62. Screw
63. Lock Washer
64. Lock Plate
65. S-Plate
66. S-Plate Pin
67. S-Plate Shim
68. Governor Rocker Arm Plate
69. Guide Block
70. Control Pin
71. Govenor Rocker Arm Spring
72. Governor Rocker Arm
73. Governor Cover Gasket
74. Governor Cover Assembly
75. Governor Control Lever Shaft
76. Governor Cover Screw
77. Guide Bolt
78. Lever Stop Nut
79. Flat Washer
80. Lock Washer
81. Aneroid Screw
82. Aneroid Screw
83. Aneroid O-Ring
84. Lever Stop Screw
85. Seal Plug
86. Seal Holder Screw
87. Stop Screw
88. Seal Holder
89. Seal Nut
90. Control Lever Screw
91. Control Lever Spacer
92. Control Lever
93. Lock Washer
94. Control Lever Screw Nut
95. Throttle Lever
96. Woodruff Key
97. Throttle Lever Screw
98. Control Lever Shaft Seal
99. Governor Cover Bushing
100. Control Lever with Shaft
101. Control Lever Spring
102. Control Lever
103. Control Lever Washer
104. Control Lever Shim
105. Control Lever "C" Clip

GOVERNOR DISASSEMBLY

1. Using 10 mm Allen wrench, remove plug from rack link adjustment access hole in top of governor housing.

2. Remove seal wire and remove 4 aneroid assembly to governor housing screws (Figure 6).

3. Move control lever fully back against low idle stop screw.

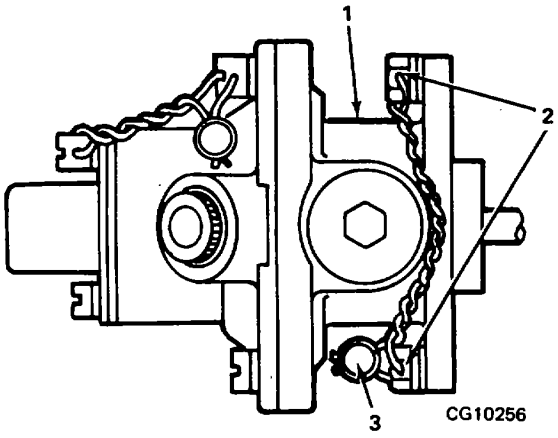


Figure 6. Aneroid Mounting

1. Intermediate Housing
2. Mounting Screws
3. Seal Wire

Caution should be exercised when removing aneroid assembly from governor housing not to damage link.

4. Turn aneroid assembly slightly counterclockwise and unlock link from rocker arm guide pin before trying to remove (Figures 7 and 8).

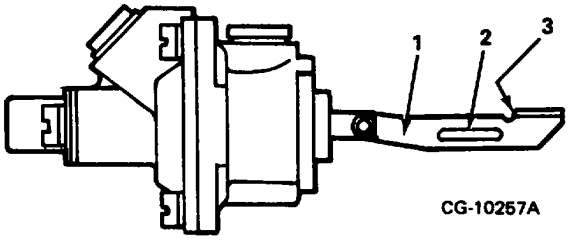


Figure 7. Aneroid Assembly

1. Link
2. Rocker Arm Guide Pin Slot
3. Maximum Fuel Stop Surface

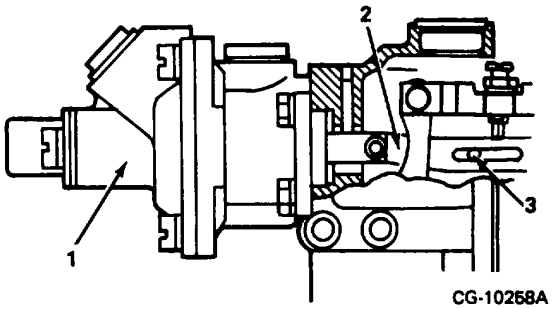


Figure 8. Removing Aneroid

1. Aneroid Assembly
2. Link
3. Rocker Arm Guide Pin

5. Remove slotted screw guide pin (Figure 9) from governor cover. Use large screwdriver to fit slot of this screw which has been sealed in place with Loc-Tite Red.

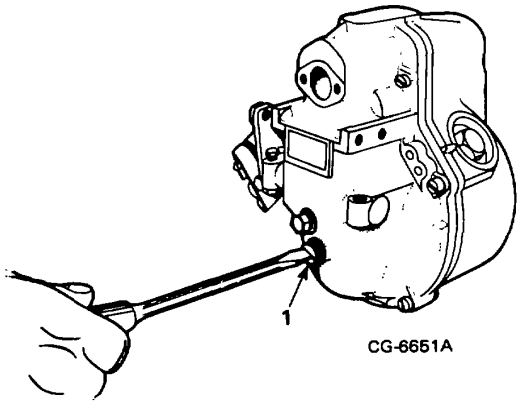


Figure 9. Removing Guide Pin

1. Slotted Screw Guide Pin

6. Remove six governor cover screws and take off governor cover (Figure 10). Lift cover up and operate control lever to release internal linkage.

7. Remove pin retaining clip and link pin and disconnect floating lever from rack link.

8. Pull top of floating lever back and down to remove floating lever and slider (Figure 11) from guide bushing.

NOTE: U sing a rubber band or wire around delivery valve secure rack link-up to prevent link damage (Figure 11).

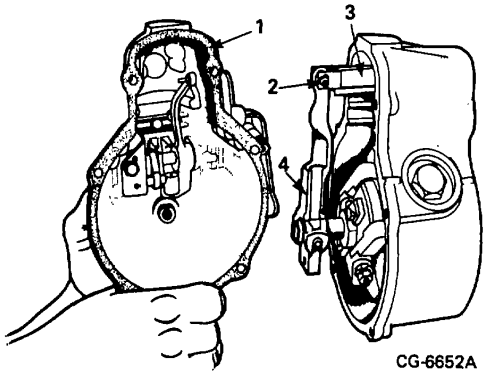


Figure 10. Removing Governor Cover

1. Cover
2. Link Pin
3. Rack Link
4. Floating Lever

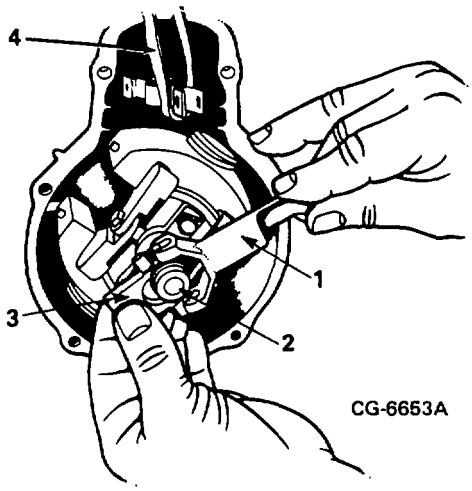


Figure 11. Removing Floating Lever and Slider

1. Floating Lever
2. Guide Bushing
3. Slider
4. Rubber Band or Wire

9. Raise tabs on lock washer and remove double nutted thru-bolt and guide bushing from governor flyweight assembly (Figure 12).

10. Raise tabs on lock plates, remove two cap screws and take out guide bushing (Figure 13).

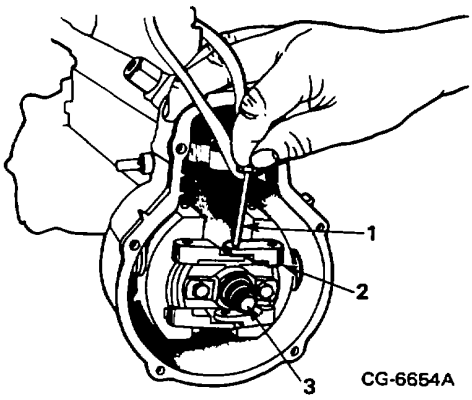


Figure 12. Removing Thru-Bolt from Flyweight Assembly

1. Thru-Bolt
2. Flyweight Assembly
3. Guide Bushing

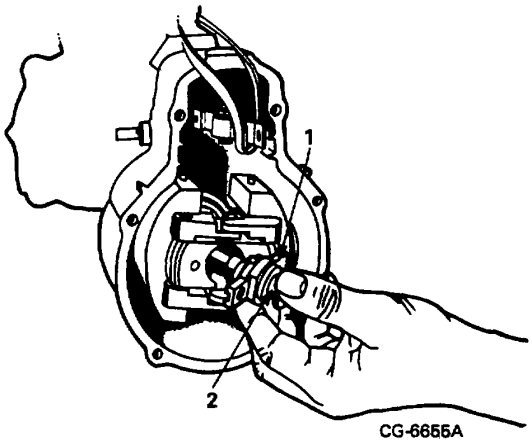


Figure 13. Removing Guide Bushing

1. Guide Bushing Support
2. Guide Bushing

11. Using KDEP 2988 remover tool on slotted cylindrical nut and holding the camshaft with a wrench at the front of the pump to keep it from rotating, remove the cylindrical nut (Figure 14) and spacer shim under the nut.

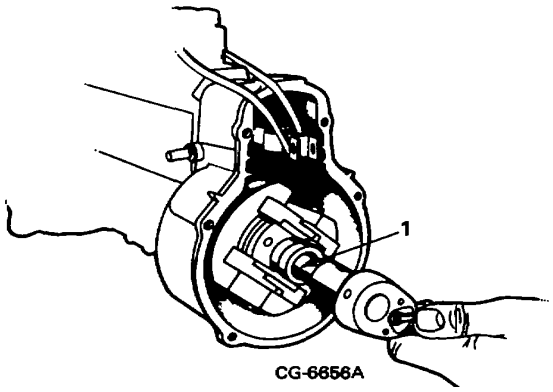


Figure 14. Removing Cylindrical Nut

1. Cylindrical Nut Remover KDEP 2988

12. Install KDEP 2886 governor flyweight remover tool (Figure 15) and remove flyweight assembly. Since governor weight assembly is serviced as a complete unit, no further disassembly is required until rebuild.

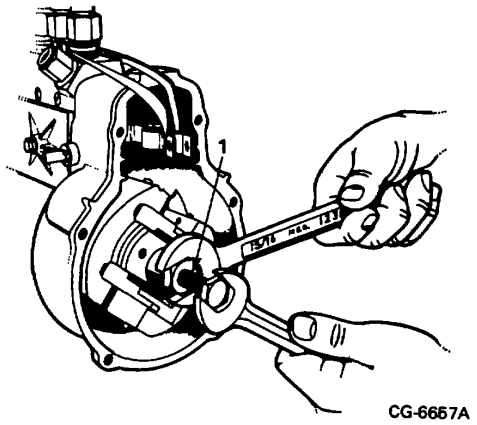


Figure 15. Removing Governor Flyweight Assembly

1. Governor Flyweight Remover Tool KDEP-2886

13. To remove governor housing remove rack link and unscrew eight governor housing to pump housing mounting screws. Remove governor housing and bracket (Figures 16 and 17).

NOTE: Governor housing screws are locktited. Governor housing will not have to be removed from pump housing unless governor housing is damaged or cracked, fuel dilation is suspected, there are other leaks, or camshaft bearing damage is evident.

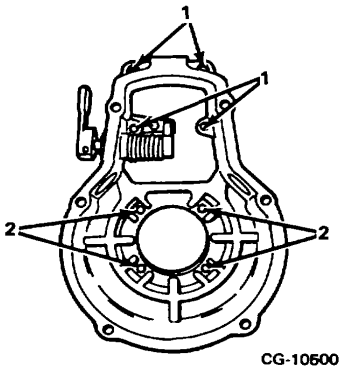


Figure 16.

1 & 2. Capscrews

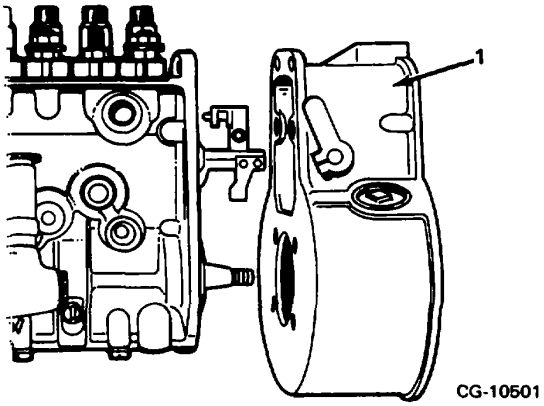


Figure 17.

1. Governor Housing

IMPORTANT
BE CAREFUL NOT TO DAMAGE EXPOSED CONTROL RACK GUIDE PIN WHEN GOVERNOR IS REMOVED FROM THE PUMP.

Pump Disassembly

14. Remove camshaft rear bearing nut and lockwasher (Figure 18) if rear bearing is to be replaced.

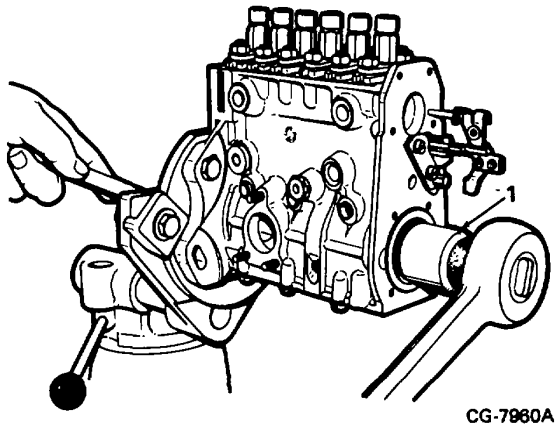


Figure 18. Removing Rear Bearing Nut and Lockwasher

1. 32 mm Socket

15. Assemble side puller KDEP 1056 to plug (Figure 19). Remove side plug by inserting collet jaws into side of plug. Tighten wing nut until jaws grip plug. Hold handle and turn shaft with a 27 mm wrench until plug is free. Repeat for other two plugs.

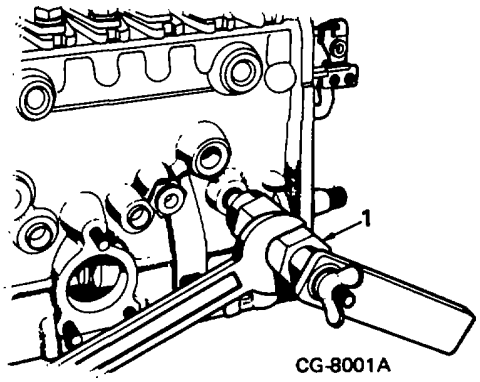


Figure 19. Removing Side Plugs

1. KDEP 1056

16. Remove tappet spacer block from side plug hole with long nose pliers (Figure 20).

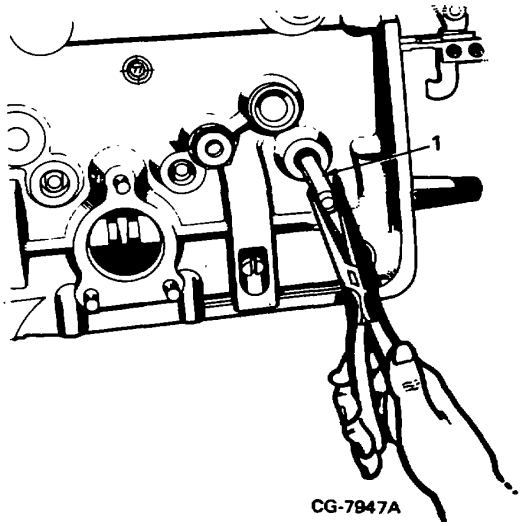


Figure 20. Removing Tappet Spacer Block

1. Tappet Spacer

Camshaft Removal

17. To make insertion of tappet holders KDEP 1068 easier loosen barrel flange nuts 3 turns, remove split shims and tap flanges so there is a slight clearance between barrel flanges and pump housing.

18. Remove bottom cover (Figure 21).

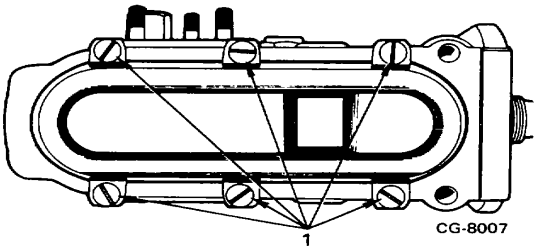


Figure 21. Removing Bottom Cover

1. Screws

19. Turn rotating handle of tappet holder (KDEP 1068) counterclockwise as far as it will go. Grease ramps and guide piece (Figure 22).

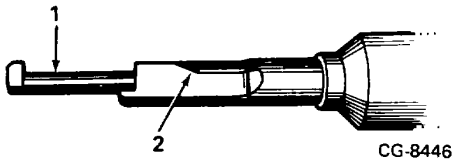


Figure 22. Tappet Holder 1068

1. Guide Piece 2. Ramps

20. With pump upside down, rotate camshaft until No. 1 plunger is at TDC.

NOTE: Camshaft front end should have drive end cam nut installed to protect end from damage when rotating (Figure 23).

21. Hold tappet holder with ramps up and insert holder as far as possible into the side hole. The tappet holder will only go part way in, lifting tappet No. 1 off the camshaft (Figure 23). Rotate camshaft until plunger No. 2 is at TDC. Push tappet holder the rest of the way in (push hard with the palm of hand).

IMPORTANT

DO NOT DRIVE IN WITH HAMMER.

The tappet holder will depress both tappets when correctly installed. Tappet No. 2 is now lifted off the camshaft.

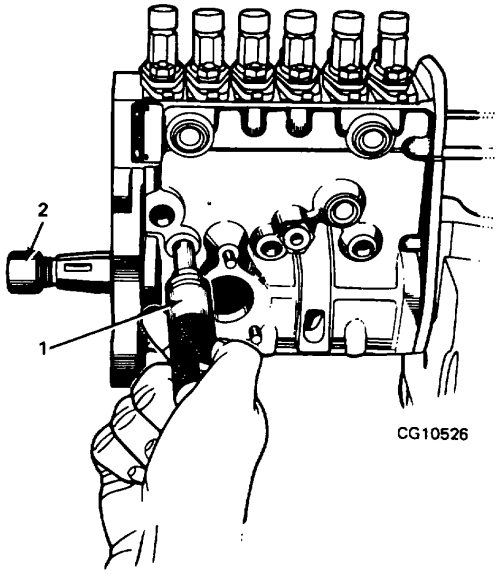


Figure 23. Installing Tappet Holder

1. Tappet Holder KDEP 1068
2. Drive End Cam Nut

22. Rotate camshaft and repeat step 16 until all tappets are lifted off camshaft. Check all holders to be sure they are properly installed before removing camshaft. When holders are properly installed camshaft should oscillate freely.

23. Remove intermediate bearing screws.

24. Use an arbor press to push camshaft, with attached rear bearing, out of the pump housing (Figure 24).Be careful with intermediate bearing. Do not let camshaft fall to floor.

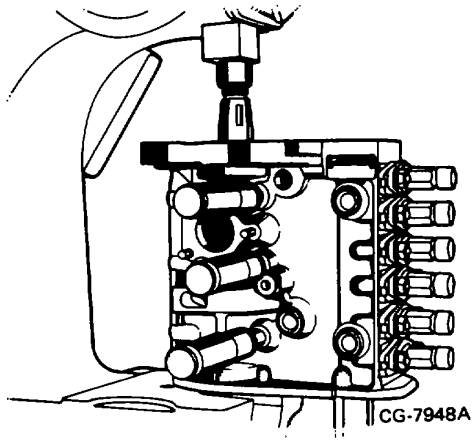


Figure 24. Camshaft Removal

IMPORTANT

CARE SHOULD BE TAKEN TO PROTECT EXPOSED CONTROL RACK GUIDE PIN WHEN USING THE ARBOR PRESS.

PUMP TAPPET AND BARREL REMOVAL

25. Attach bracket of tappet depressor tool KDEP 1505 (Figure 25) to pump bottom edge using two screws (supplied with tool) and tighten. Using the double adapter (holds two tappets) insert adapter into tube end of small round bar.

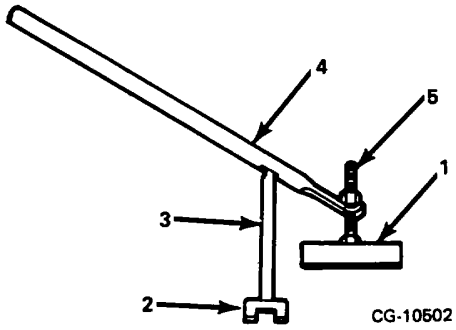


Figure 25. Tappet Depressor Tool KDEP 1505

1. Bracket
2. Double Adapter
3. Small Round Bar
4. Depressor Bar
5. Threaded Screw on Bracket

26. Place adapter over tappets No. 1 and No. 2. Hook depressor bar under upper nut of threaded rod on bracket and adjust nut for leverage.

27. While pushing on tappets screw knurled handle of tappet holder in until it pops out (Figure 26). Hold on to holder when depressing tappets because foot of holder is spring loaded and toll will spring out.

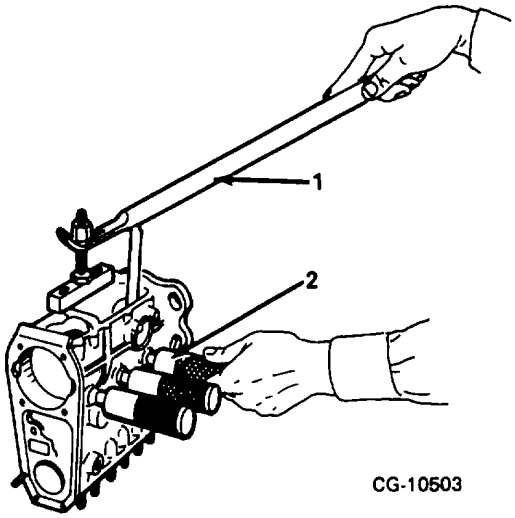


Figure 26. Tappet Removal

1. Tappet Depressor Tool KDEP 1505
2. Tappet Holder

NOTE: If tappet depressor tool KDEP 1505 is not available use spring compressor KDEP 1067 as follows:

a. Mount pump in spring compressor KDEP 1067 (5, Figure 27). Place pump upside down with governor end toward vise. With spacer plate in between, slide clamping device (2, Figure 27) against right side of pump and secure pump in place.

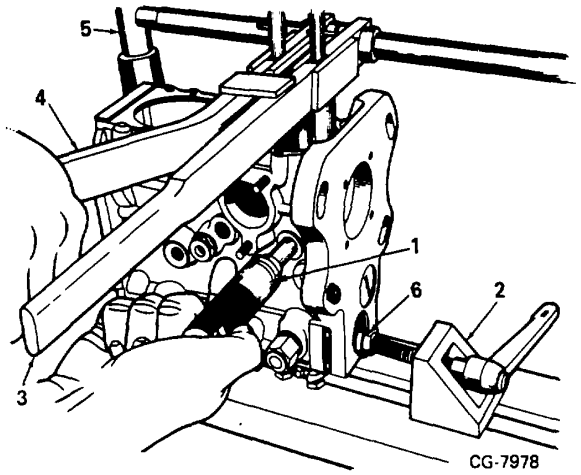


Figure 27. Tappet Removal (If Tappet Depressor Tool KDEP 1505 is not available)

1. Tappet Holder
2. Clamping Device
3. Right Lever
4. Left Lever
5. KDEP 1067
6. Spacer Plate Location

b. Position right lever (3, Figure 27) and then left lever (4) over first two tappets. Adjust crossbar (5) up or down to make levers point up slightly when resting on tappets.

c. Holding one hand on tappet holder (1, Figure 27), depress left lever compressing both springs to unload and remove tappet holder. Hold onto holder when depressing tappets because foot of holder is spring loaded and tool will spring out.

28. Repeat procedure for the next four tappets.

29. Remove each roller tappet, lower spring seat, plunger and spring.

IMPORTANT

KEEP PARTS FOR EACH CYLINDER TOGETHER.

30. Position rack so control sleeve ball is in notch of pump housing (Figure 28).

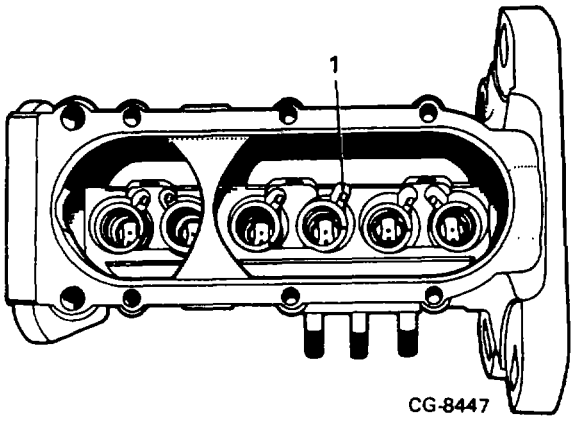


Figure 28. Rack Positioning

1. Control Sleeve Ball

31. Remove control sleeves and upper spring seats.

32. Remove tappet depressor tool (or, if used, remove pump from spring compressor KDEP 1067).

BARREL REMOVAL

33. Remove barrel flange nuts and lockwashers (Figure 29) (assembly jig KDEP 1066 may be used). Remove each barrel from housing. Store each barrel with its plunger and shims.

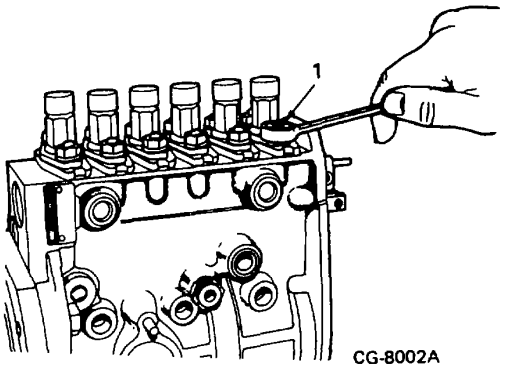


Figure 29. Barrel Removal

1. Flange Nuts

34. Remove four capscrews and lockwashers from camshaft bearing retainer on drive end of pump (Figure 30).

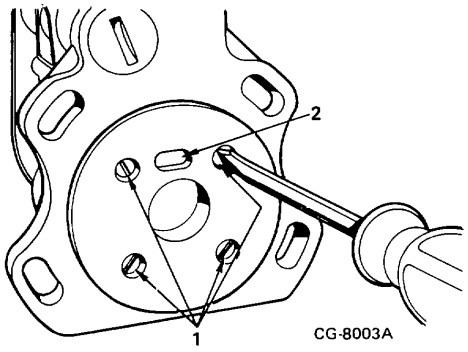


Figure 30.

1. Retainer Mounting Screws 2. Oil Drain Hole

35. Remove rack screws, lockwashers and retaining plate (Figure 31). Pull rack out of pump housing.

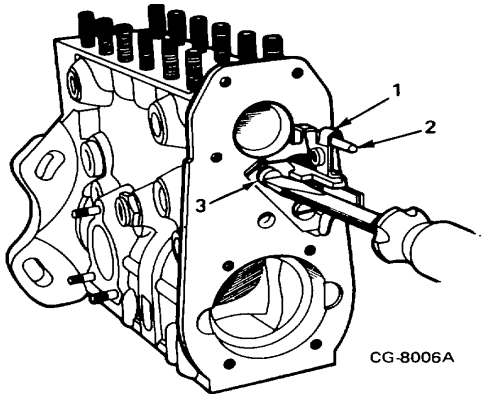


Figure 31.

1. Control Rack
2. Guide Pin
3. Screws

Injection pump housing is now ready for inspection.

ANEROID

The aneroid (Figure 32) should be disassembled, cleaned and inspected when the injection pump is disassembled or if the aneroid is suspected of malfunction. The diaphragm assembly must be replaced if signs of leakage, cracking or hardening exist. Replace o-ring on diaphragm stop.

IMPORTANT

TO REPLACE A LEAKING ANEROID DIAPHRAGM, THE INJECTION PUMP MUST BE REMOVED, THE NEW DIAPHRAGM INSTALLED AND THE INJECTION PUMP RECALIBRATED. DO NOT ATTEMPT TO REPLACE THE ANEROID WITHOUT RECALIBRA-TING THE INJECTION PUMP. SEEMI-NGLY SMALL CHANGES TO THE INJECTION PUMP CONTROL RACK SETTINGS CAN DESTROY THE ENGINE.

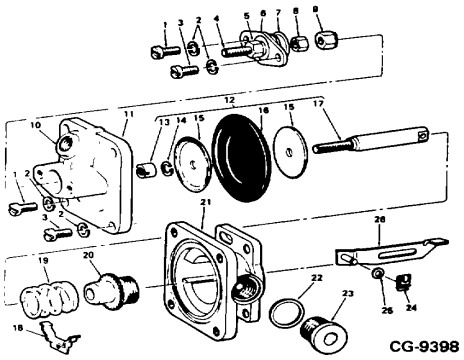


Figure 32. Exploded View of Aneroid

1. Screw
2. Washer
3. Screw (w/Seal Hole)
4. Pin
5. Nut
6. Stop Assy.
7. O-Ring
8. Nut
9. Nut
10. Bushing
11. Cover Assy.
12. Shaft Assy.
13. Nut
14. Washer
15. Seat
16. Diaphragm
17. Shaft
18. Clip
19. Spring
20. Bushing
21. Housing
22. Gasket
23. Plug
24. Clip
25. Washer
26. Max. Fuel Aneroid Shackle

FUEL SUPPLY PUMP

The fuel supply pump(Figure 33) should be disassembled, cleaned and inspected for damage or wear. Damaged or worn parts must be replaced, along with gaskets and o-ring before reassembly.

CHECK VALVE

The check valve assembly should be cleaned and inspected. If signs of malfunction exist the valve must be replaced.

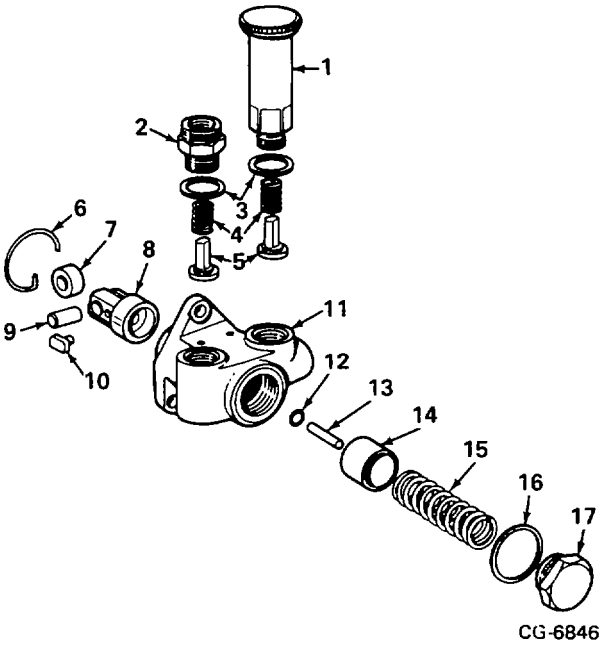


Figure 33. Exploded View of Fuel Supply Pump

1. Hand Priming Pump
2. Fitting
3. Gasket
4. Spring
5. Valve
6. Snap Ring
7. Roller
8. Tappet
9. Pin
10. Slider
11. Housing
12. O-Ring
13. Spindle
14. Piston
15. Spring
16. Gasket
17. Plug

CLEANING AND INSPECTION

A thorough cleaning and inspection of all parts is important for the injection pump and governor assembly.

Each machined surface should be cleaned of all old gasket material and wash all parts in clean fuel oil or calibrating oil.

When inspecting for damage or wear, it is a good practice to replace any part that is questionable.

Part	Inspect For Following Condition(s)	Corrective Action When Required
Injection Pump Housing	Cracks, chips, evidence of overtorque or stripping of screw threads, damage in roller tappet bores.	If damaged, replace
	Damaged camshaft bearing located in front bearing retainer and bearings on camshaft.	If damaged, replace bearing as follows: 1. Remove governor housing from pump housing (Governor Disassembly, step 13, section 2, page 8). 2. Remove gasket material from governor and pump housings. 3. Obtain new gasket and install governor housing onto pump housing. Apply Loctite to mounting screws to secure. 4. Remove and replace bearing in front bearing retainer. 5. Remove and replace bearing on camshaft.
	Leak at fuel gallery closing plug.	If known to be leaking, replace pump housing.
Camshaft	Deep wear or grooving on cams or bearing surfaces.	Replace camshaft (with camshaft replacement, bearing must also be replaced). IMPORTANT: See Page 4, this section.
Roller Tappets	Pressure marks or grooving.	Slight marks or grooving - smooth out with polishing cloth. More serious wear - replace parts.
Spring Seats	Worn or bent.	Replace seats
Springs	Broken or rust coated.	Replace springs.
Barrels and Plungers	Damage (scratches, scoring, etc.) on lapped surfaces of plunger. See NOTE*	Replace barrel and plunger
Control Sleeves	Damage	If damaged, replace

*NOTE: Test the set by washing out with test oil and pulling plunger part way out of barrel. It must fall back slowly by its own weight.

Part	Inspect For Following Condition(s)	Corrective Action When Required
Control Rack	Burrs on gear teeth or scratches along sides.	Polish with crocus cloth. Replace if any binding with housing exists.
Delivery Valve Assembly	Damage at delivery valve seat or needle.	Replace complete assembly.
Gaskets, Seats and O-Rings	ALWAYS REPLACE WHEN REBUILDING PUMP When replacing barrel lower spacer rings, spacer ring installer 9 681 238 902 must be used (see Reassembly'- Section 4, Page 1).	
Transfer Pump	Fuel leakage past pump drive stem. See NOTE*	Replace as a complete unit only.
Governor Housing and Cover	Cracks, stripped screw threads, burrs on mating surfaces.	Replace.
Governor Weight Assembly	Worn bell cranks, damaged weights, stripped adjusting nut threads, worn or damaged springs.	Replace weight assembly as complete unit. Weight springs and shims may be replaced individually.
Governor	ADJUST AS OUTLINED BELOW.	

*NOTE: Plug outlet side of transfer pump and pressurize inlet side with air to 103-137 kPa (15-20 psi). When submerged in fuel oil, no air leaks are permitted past pump drive assembly.

GOVERNOR ADJUSTMENT

1. Perform a static check on balanced movement of governor weights by making a temporary build-up *less springs* but using spring seats, trial spacer bushings (obtained locally) and adjusting nuts (Figure 1) on each weight as follows:

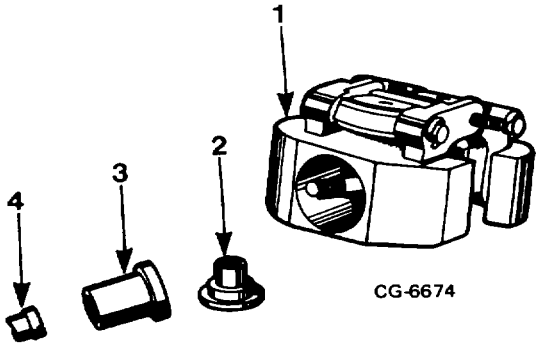


Figure 1. Details of Flyweight Assembly

1. Governor Flyweight Assembly
2. Spring Seat
3. Trial Spacer Bushing
4. Adjusting Nut

Install double-nutted thru-bolt in weight assembly. Apply slight pressure to center of bolt and check for excessive rocking movement in one or the other weights (Figure 2). If excessive rocking does occur try using a different size lower spring seat (available in three sizes). When installing the three different size weight springs, remove the trial spacer bushings.

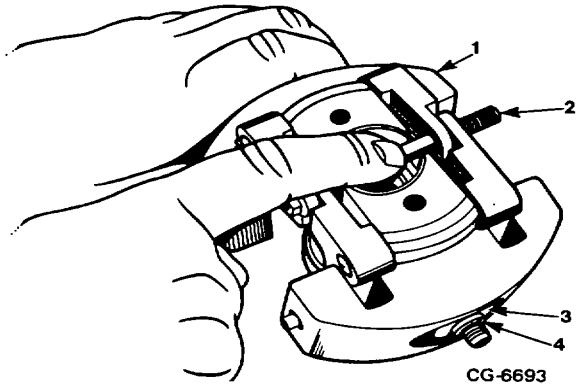


Figure 2. Checking Flyweight Trail Build-Up

1. Rocking Movement
2. Through Bolt
3. Trail Spacer Bushing
4. Adjusting Nut

2. Reinstall flyweight springs. Always start preliminary shim pack under governor shims as follows:

   Outer spring: 0.5 (.020") Intermediate Spring: 1.5 mm (.060") Inner Spring: None

   Install outer spring seat and adjusting nut.

   When installing adjusting nut, preload of governor springs should range from 4 to 10 90 degree "clicks" from flush nut position with threaded bolt. Preliminary adjustment should be equal on both spring sets.

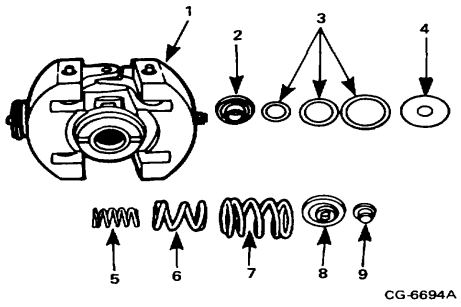


Figure 3. Exploded View of Flyweight Springs

1. Flyweight Assembly
2. Lower Spring Seat
3. Adjusting Shims
4. Wear Shim
5. Inner Spring
6. Intermediate Spring
7. Outer Spring (Lo-Idle)
8. Upper Spring Seat
9. Adjusting Nut

3. Inspect damper buffers for damage. If any loose rotational movement exists in governor weight assembly relative to the camshaft, replace buffers. Replace buffers as a set if needed (Figure 5).

4. Assemble prelubricated buffers in damper retainer and place damper hub on weight assembly.

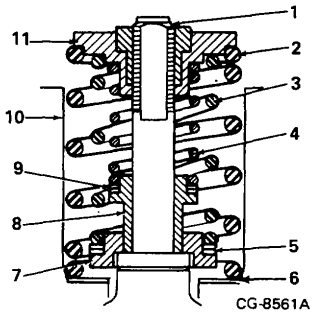


Figure 4. Sectional View of Flyweight Spring Installation

1. Cylindrical Adjusting Nut
2. Lo-Idle Spring
3. intermediate Spring
4. Hi-Idle Spring
5. Intermediate Adjusting Shim
6. Wear Shim
7. Lower Spring Seat (Lower Half)
8. Lower Seat (Upper Half)
9. Inner Spring Shim
10. Flyweight Assembly
11. Upper Spring Seat

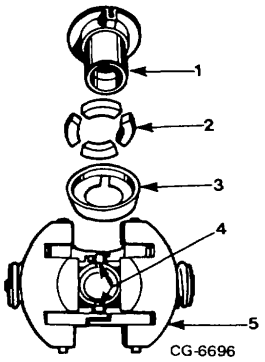


Figure 5. Exploded View of Damper Hub

1. Damper Hub
2. Buffer
3. Retainer
4. Mounting Tang
5. Flyweight Assembly

S-Plate: Sliding parts should operate free of bind; any grooves or pressure marks on curve should be smoothed with fine emery.

Guide Bushing: If any parts of the guide bushing are worn or damaged, replace the complete unit.

CAMSHAFT

Injection pump part numbers 1 802 604 C91, 1 802 605 C91, 1 802 606 C91, 1 802 607 C91, 1 802 608 C91, 1 802 643 C91 and 1 802 995 C91 were built with old style camshaft (Figure 6) and old style fuel return hose with a .062 in. diameter orifice (Figure 7). If camshaft replacement is required order new style camshaft (IH P/N 1 806 505 C1) and new style fuel return hose with a .046 in. diameter orifice (IH P/N 1 806 503 C1). The new camshaft provides improved fuel supply pump performance and the reduced orifice diameter is required to maintain appropriate fuel return flow to the tank and internal fuel injection pump housing pressures.

IMPORTANT

THE NEW CAMSHAFT (1 806 505 C1) MUST USE THE FUEL RETURN HOSE WITH .046 IN. DIAMETER ORIFICE (1 806 503 C1). CONVERSELY THE OLD CAMSHAFT (691 248 C1) MUST USE THE FUEL RETURN HOSE WITH .062 IN. DIAMETER ORIFICE (1 802 897 C1).

NOTE: With the new camshaft and fuel return hose added to any of the injection pumps listed above it becomes a C92 suffix pump. This is important when determining correct supply pump pressure on individual pump data sheets (Section 5 - Calibration).

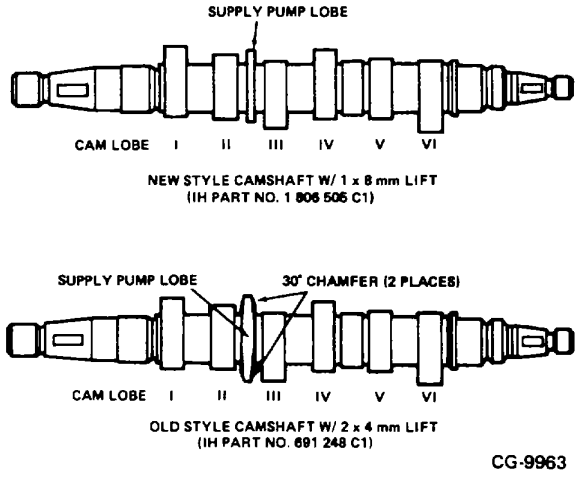


Figure 6. Camshaft Identification

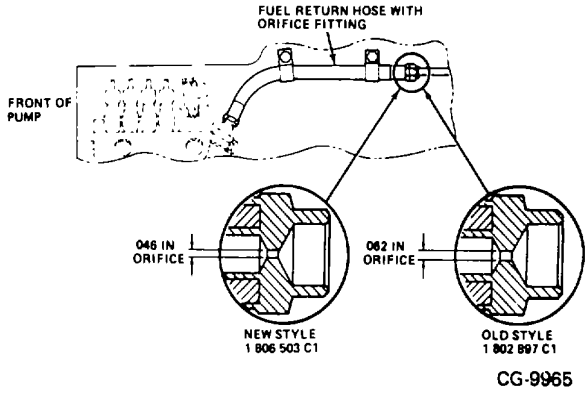


Figure 7. Old vs. New Fuel Return Hose with Orifice Fitting

PUMP ASSEMBLY

1. It is suggested that all delivery valves and plunger and barrel assemblies be inspected and ready prior to pump reassembly.
While still in assembly jig KDEP 1066 install copper gasket, delivery valve, spring and washer into barrel. Tighten delivery valve holder nut with O-ring to specifications (see torque chart Section 1, Page 10).

IMPORTANT
DELIVERY VALVE HOLDER MUST BE TIGHTENED (SEE TORQUE CHART, SECTION 1, PAGE 10) OUTSIDE OF PUMP PRIOR TO PUMP REASSEMBLY.

All parts must be returned to their original position. Clean fuel oil or calibration oil must be available for lubricating the individual parts prior to assembly.

BARREL

2. Install barrel lower O-ring in housing. Install barrel lower spacer ring in pump housing, if it was removed, using 9 681 238 902.

3. Assemble impact cap with snap ring and O-ring onto barrel. Be sure hole in impact cap does not line up with spill/fill port in barrel.

4. Lubricate O-ring and lower surface of barrel, and install barrel with adjustment slot on the barrel flange opposite the control rack (Figure 1).

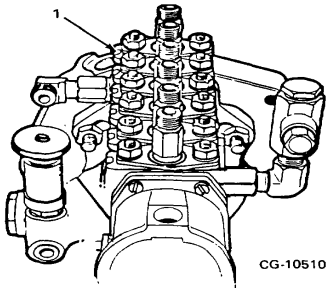


Figure 1. Adjustment Slot Location

1. Adjustment Slot

Push down with hand pressure: the barrel should stay down when pressure is released. If not, remove barrel and check for pinched O-ring.

5. Install spacer plates KDEP 1057 under barrel flanges and install flat washer, lockwasher and nuts. Tighten to specifications. Install fitting locks, flat washer, lockwasher and nuts.

6. Turn pump upside down. Install each plunger in correct barrel. Position the notch on the plunger foot so it points away from the rack, thus sealing the port (Figure 2)

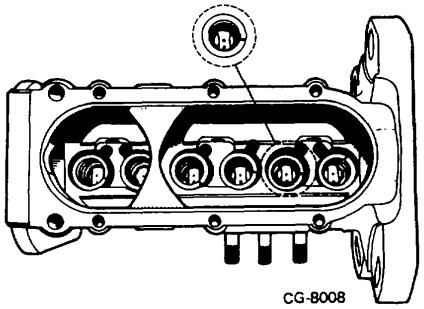


Figure 2.

1. Plunger

7. Install plunger retainersKDEP1052 (Figure3).

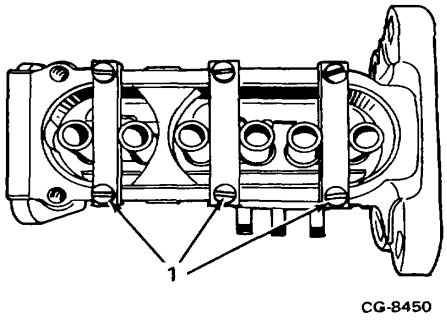


Figure 3. Install Plunger Retainers

1. Plunger Retainers

8. Connect air coupling to intake of gallery and plug return port. Submerge pump housing in an oil bath and pressurize pump to 5 bar (75 PSI).

   Look for leakage (bubbles) from top and bottom of pump. Any bubbles other than small bubbles coming from inside plunger retainer tubes indicates a leak. Correct any leaks found. If no leaks are found remove air hose, gallery outlet plug, plunger retainers and plungers.

9. Loosen barrel retaining nuts and back off so washers are loose.

PLUNGER AND RACK

10. Install control rack and fasten retaining plate with two screws and lockwashers. Check rack for freedom of movement.

11. Insert each control sleeve after positioning rack so that the control sleeve ball will fall into the slot of the control rack (Figure 4).

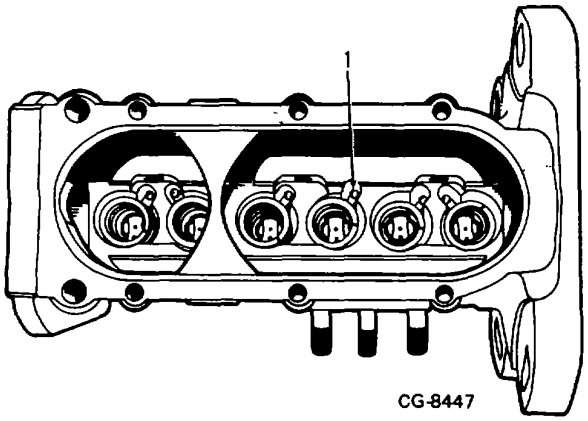


Figure 4. Control Sleeve Ball Positioning

1. Control Sleeve Ball

12. When all control sleeves are installed, move rack back and forth to make sure control sleeves all move freely and together.

13. Coat each upper spring seat with grease and stick upper spring seat to spring.

14. Insert each spring and upper seat into pump housing.

15. Insert each plunger into correct barrel. Make sure each plunger foot is positioned so that notch on plunger foot points away from control rack (Figure 5).

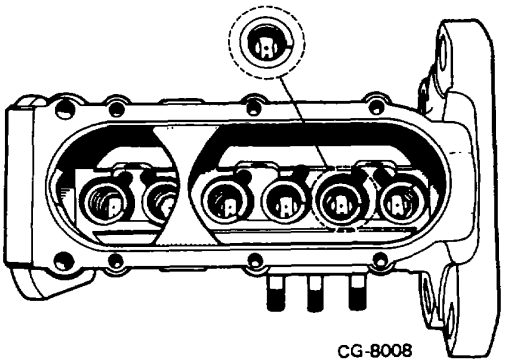


Figure 5.

1. Notch on Plunger Foot

17. Move rack back and forth and watch plungers. The control rack should move freely without binding and the plungers should rotate together.

18. Coat each lower spring seat with grease. Stick lower spring seat on each roller tappet (Figure

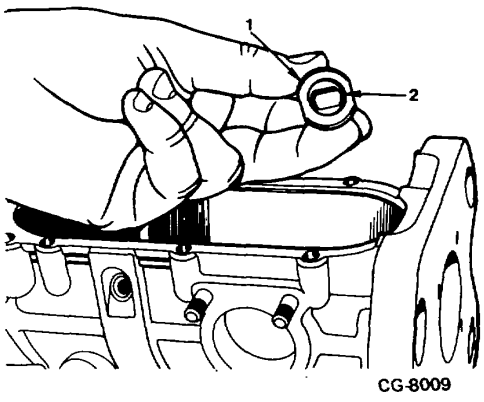


Figure 6. Tappet and Spring Seat

1. Tappet 2. Spring Seat

19. Insert tappets in normal position (when using spring compressor KDEP 1067 follow procedure in note below).

20. Reassemble tappet depressor tool KDEP 1505 (see note below). Turn tappet holder handles fully counterclockwise, grease ramps and guide piece.

21. Starting with tappets No. 1 and 2 push tappets down. Insert tappet holder (ramps up) into side plug hole between two tappets. A fourthinch should show between holder handle and pump housing.

NOTE: If tappet depressor tool KDEP 1505 is not available mount pump in spring compressor KDEP 1067 and proceed as follows (eliminate steps 1 9-21):

a. Insert each tappet in housing so that roller tappet axis is at a right angle to the pump (Figure 7)

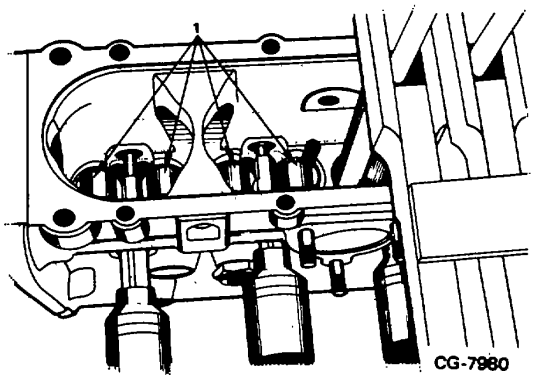


Figure 7. Tappet Positioning

1. Tappets at Right Angles

b. Turn tappet holder handles fully counterclockwise, grease ramps and guide piece. With spring compressors handles pointing in opposite directions, place spring compressor levers over first two tappets. Depress right lever of spring compressor as far as possible. Hold lever down and slowly turn right handle clockwise 45° (Figure 8).

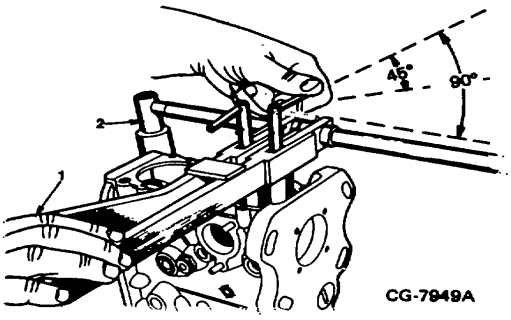


Figure 8.

1. Downward Force 2. Spring Compressor

c. When handle is turned 45° the foot of the plunger will go into the lower spring seat hole allowing the lever to go down farther.

d. Depress right lever further and turn handle clockwise until the handle is at 90° from lever (Figure 8).

e. Push other tappet down with left lever. The left lever will hold both tappets down. Slowly turn left handle clockwise. When left handle is turned approximately 45° foot of the plunger will go into lower spring seat hole. Push lever all the way down and turn clockwise until handle is at 90° from lever.

f. While holding left lever down (both tappets depressed), fully insert a tappet holder (ramps up) into the side plug hole between two tappets.

22. The first two tappets have now been held in place by the tappet holder. Repeat this procedure until-all tappets are held in place with tappet holders.

CAUTION

Make sure tappet holders are properly seated.

23. Remove tappet depressor tool (or spring compressor) and mount the pump right side up in vise.

24. Look at tops of plungers to be sure all are oriented in the same direction.

25. Install roller bearing in drive end bearing plate with KDEP 1059.

26. Install drive end bearing retaining plate, oil return hole must be toward top of pump (Figure 9). Mounting screws must be coated with Loc-Tite 601.

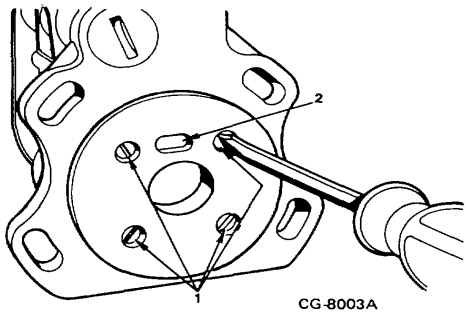


Figure 9. Install Drive End Bearing Plate

1. Mounting Screws 2. Oil Return Hole

27. Lubricate intermediate bearing. Install camshaft with intermediate bearing. Carefully press in camshaft from governor end. Using ball bearing installer KDEP-1069, press only on outer race of ball bearing while guiding intermediate bearing into place. Be careful camshaft does not catch on roller tappets.

NOTE: If camshaft replacement is required see Section 3, Page 4.

28. Install camshaft intermediate bearing screws with copper washers. See torque specifications.

29. Remove tappet holders as follows: Starting from governor end of pump, rotate camshaft until No. 6 cam lobe is at TDC. Turn handle of tappet holder clockwise until #6 tappet contacts cam lobe. Rotate camshaft until No. 5 cam lobe is at TDC. Turn handle of tappet holder clockwise until No. 5 tappet contacts cam lobe. The tool can now be removed from housing.

30. Repeat step 32 until all holders are removed.

IMPORTANT

DO NOT ALLOW TAPPETS TO SLAM AGAINST CAMSHAFT. DOING SO COULD CAUSE PREMATURE FAILURE OF CAMSHAFT AND/OR ROLLER TAPPETS.

31. Install tappet spacer block in side plug holes.

32. Coat new side plug with Loctite 601 and install with side plug installer KDEP 1058.

33. Place a new O-ring on bottom cover and mount bottom cover to pump.

34. Remove spacer plates and install correct shims under each barrel flange.

35. Install supply pump.

36. Tighten supply pump mounting nuts. See torque chart.

37. Install fuel return valve.

GOVERNOR REASSEMBLY

1. Install governor housing to pump, (See torque chart). Apply Loctite 601 to internal screws.
2. Install flyweight assembly to camshaft (Figure 10). Install spacer shim and secure to camshaft with slotted cylindrical nut. Spacer shims are available in .05 mm increments to adjust for axial end play of governor weight assembly, specified at .05 .10 mmm (.002 .004 in). Use cylindrical nut tool KDEP 2988. Torque nut to specifications.
3. Check action of damper by holding camshaft, grasping weight assembly and twisting to note for slight movement.
4. Install guide bushing; secure bushing with two cap screws lock screws in place with lock plate tabs.
5. Install guide bushing assembly; temporarily secure with thru-bolt at this time, since another measurement will be made later in procedure.

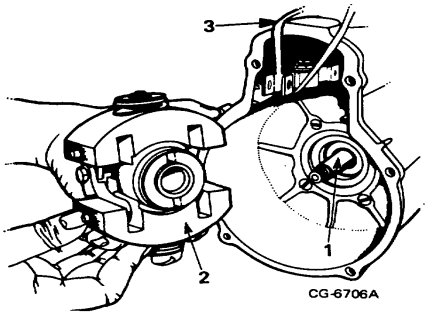


Figure 10. Installing Flyweight Assembly

1. Camshaft
2. Flyweight Assembly
3. Rubber Band or Wire

6. Install slider and floating lever open slot of floating lever to right. Pin floating lever to rack link to hold in place.

7. Check "slider-to-housing" distance with guide bolt gauge 1 682 329 038 (Figure 11). Notch in gauge must fit in groove on guide bushing when gauge is placed against mating surface of housing (no gasket)

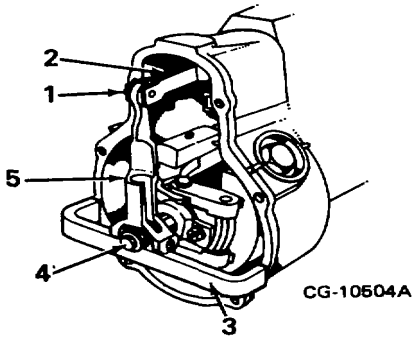


Figure 11. Slider-to-Housing Distance

1. Pin
2. Rack Link
3. Guide Bolt Gauge 1 682 329 038
4. Adjusting Pin
5. Floating Lever

NOTE: If guide bolt gauge 1 682 329 038 is not available use a depth micrometer to measure from back of slider to governor mating surface (no gasket) (Figure 12). Distance (item 4) should be 39.15 i .2 mm (1.54 ± .008").

Adjust by turning screw inside of guide bushing. Back screw out to increase distance or turn screw in to decrease distance (one half turn of screw moves sliding block approximately .5 mm (.020").

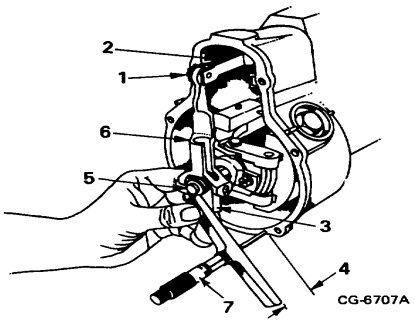


Figure 12. Measuring Slider-to-Housing Distance (If Guide Bolt Gauge 1 682 329 038 is not available)

1. Pin
2. Rack Link
3. Slider
4. Slider-to-Housing Distance
5. Guide Bushing
6. Floating Lever
7. Depth Micrometer

8. Secure double-nutted thru-bolt in governor weight assembly by installing lockwasher and nut. Bend over tabs of lockwasher to secure. Operate rack back and forth to recheck all linkage for free movement.

Remove seal cover from hi-idle adjusting screw locknut on governor cover and back out hi-idle adjusting screw. Hi-idle screw is removed so that control lever can be moved full forward for making next check.

Check "basic setting of S-plate", the distance from governor cover surface (gasket in place) to guide pin shaft when guide pin is in maxim fuel position and bottomed in S-plate. Using S-plate gauge 9 681 238 904 (Figure 13), notch in tang of gauge should fit over guide pin shaft when bar is placed on governor cover surface (gasket in place).

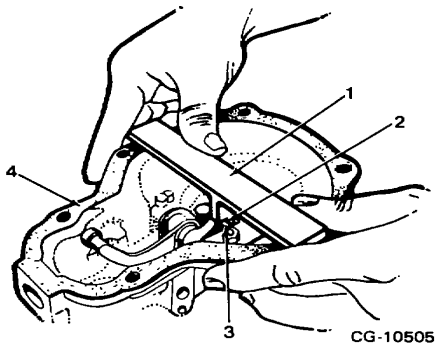


Figure 13. Basic Setting of S-Plate

1. S-Plate Gauge 9 681 238 904
2. Notch in Gauge
3. Guide Pin
4. Gasket

NOTE: If S-plate gauge 9 681 238 904 is not available use a depth micrometer to measure S-plate setting (distance to measure described above) (Figure 14). Basic setting is 21.5 ± 0.2 mm (.847

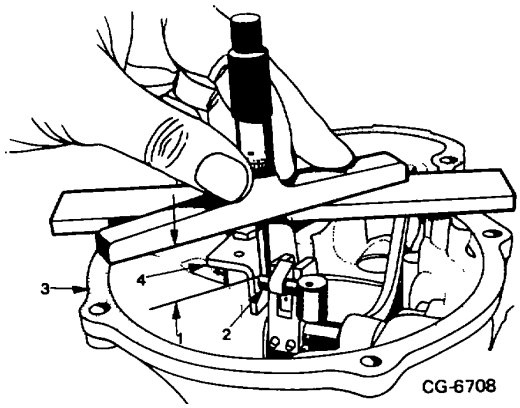


Figure 14. Measuring S-Plate Basic Setting (If S-Plate Gauge 9 681 238 904 is not available)

1. Basic Setting
2. Guide Pin
3. Gasket
4. Curve Plate
5. Depth Micrometer

9. Add shims under S-plate mounting to decrease basic setting or remove shims to increase basic setting (Figure 15). Check for free travel of guide pin shaft in S-plate after resetting. Check to be sure cotter pin has been used to secure pin between rack link and floating lever.

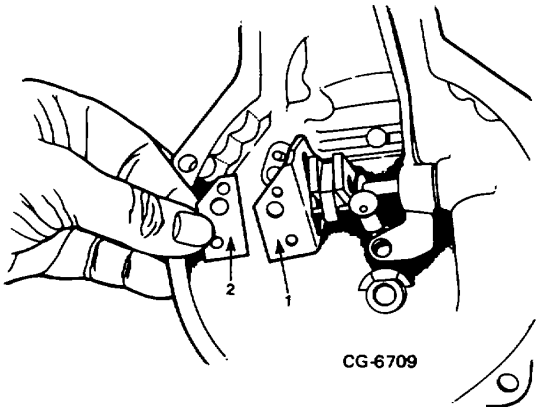


Figure 15. Locating for S-Plate Shim Adjustment

1. S-Plate 2. Shim

10. Install governor cover to housing. When installing, apply small dab of grease to floating block to hold hollow end up and note that floating block enters floating lever. Operate control lever to facilitate installation. Secure cover with six cover screws.

11. Install guide bolt in rear of governor cover. Apply Loctite hydraulic sealant compound to threads before installing.

12. If governor control lever and/or accelerator lever assembly were removed, reinstall at this time as follows:

    a. Install woodruff key and governor control lever on shaft and tighten securely.

    b. Install accelerator lever assembly on shaft (Figure 16) and tighten securely.

IMPORTANT

ACCELERATOR LEVER CAN BE INSTALLED IN ANY POSITION AND CAN BE REMOVED AND REINSTALLED AT ANY TIME. GOVERNOR CONTROL LEVER, ONCE HIGH SPEED SCREW HAS BEEN SET, SHOULD *NEVER* BE REMOVED AND REINSTALLED WITHOUT RECHECKING HIGH IDLE SPEED.

13. Position control lever fully back against loidle stop screw.

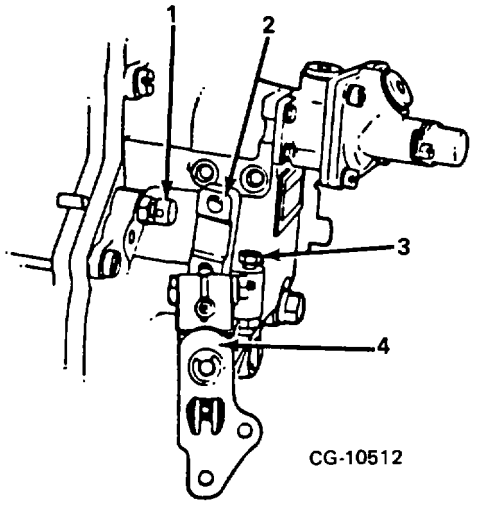


Figure 16. Accelerator Lever Assembly

1. Full Load Position
2. Governor Control Lever
3. Low Idle Position
4. Accelerator Lever

14. Insert aneroid assembly into governor housing. Rotate aneroid assembly approximately 45 degrees in the counterclockwise direction (from installed position). Slide aneroid assembly into governor housing, then rotate aneroid assembly 45 degrees clockwise to the horizontal position (Figure 17).

15. Move control lever to the vertical position.

NOTE: To ease this operation, interior of governor housing can be lighted by removing seal wire and plug from governor adjustment access cover on side of governor housing and inserting penlight through access hole.

16. After aneroid strap is engaged with rocker arm pin, push aneroid assembly into position against governor housing and secure with 4 mounting screws.

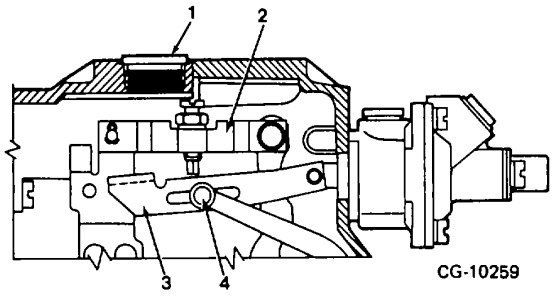


Figure 17. Engaging Aneroid Strap to Rocker Arm Pin (Governor Housing Cut Away for Illustration.)

1. Starting Fuel Cut-Out Speed Adjustment
2. Rack Link
3. Max. Fuel Shackle Access Hole
4. Rocker Arm Pin

Check aneroid assembly as follows:

a. Hold accelerator lever full forward. This should place rack in excess fuel (starting) position with adjustment screw of rack link resting on top of mating flange on aneroid shackle (Figure 18).

b. Slowly move fuel shut-off lever to rear. If installation is correct, a distinct "click" will be heard as rack moves back from excess fuel position and adjustment screw on rack link engages with rear edge of mating flange on aneroid shackle (Figure 19).

c. If correct positions of parts (steps a and b) cannot be obtained ("click" is not heard), check for proper engagement of slot in aneroid strap to rocker arm pin. If necessary, loosen aneroid assembly mounting screws and connect aneroid strap to rocker arm pin per step 14.

Further reassembly including hi-idle adjusting screw, miscellaneous locks, seals, etc. cannot be completed until after pump is calibrated. Pump is now ready for mountinq to calibrating stand.

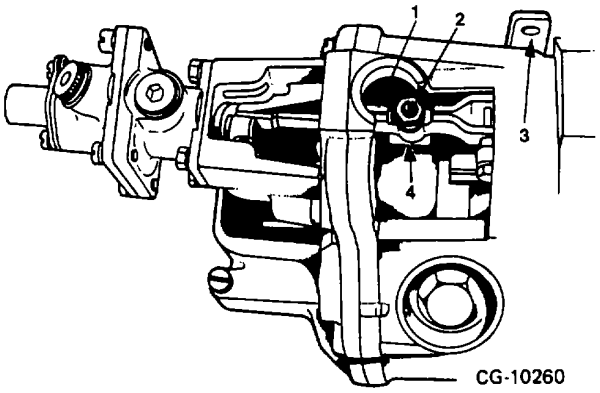


Figure 18. Rack Link and Stop Shackle in Excess Fuel (Starting) Position (Governor Housing Cut Away for Illustration)

1. Rack Link
2. Adjustment Screw Resting on Top of Mating Flange
3. Shut-Off Lever
4. Aneroid Shackle Mating Flange

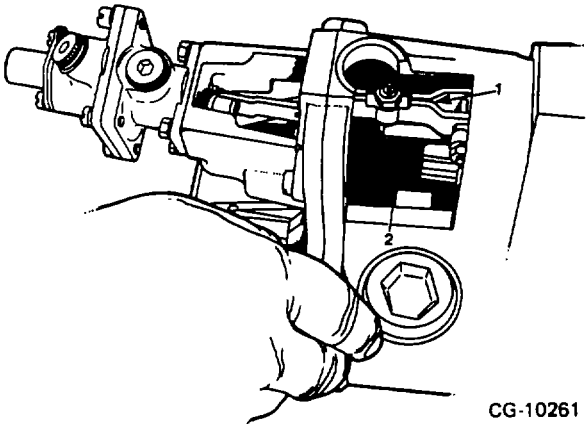


Figure 19. Rack Link and Max. Fuel Aneroid Shackle in Full Load Fuel Position (Govenor Housing Cut Away for Illustration)

1. Rack Link
2. Aneroid Shackle Mating Flange

INJECTION PUMP CALIBRATION

Following injection pump or governor service and overhaul, the pump must be recalibrated to establish correct internal timing, fuel delivery and governor operation. It is also recommended that pump calibration be checked on a calibrating stand anytime the injection pump is removed to perform engine service operations.

IMPORTANT

FOR PROPER INJECTION PUMP OPERATION IT IS NECESSARY THAT CALIBRATION AND ADJUSTMENT CHECKS ARE PERFORMED IN SEQUENCE, AS OUTLINED IN THIS SECTION.

NOTE: Refer to individual pump calibration charts and data sheets (at end of this section) for specifications mentioned throughout this section.

CALIBRATING STAND

A calibration stand with 10 HP or more is recommended. Existing stands of 5 HP are acceptable.

When installing the pump on the test stand follow instructions furnished with the stand.

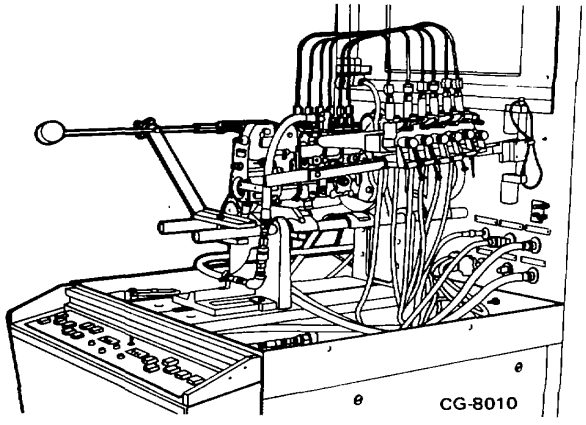


Figure 1. Pump on Calibration Stand

Calibrating Stand Maintenance

The calibrating stand must be kept in good operating condition. Maintenance checks and lubrication of test stand components must be performed periodically to assure satisfactory results. Calibrating oil must be of the specified type. Calibrating oil and filter must be changed regularly. Transfer (supply) pump must maintain minimum specified pressure since injection pump calibration depends upon correct supply pump oil pressure.

To assure uniform delivery, calibrating stand test nozzles should be tested for balance (equal delivery) every six months or whenever 200 pumps have been tested. The method for balancing the test nozzles is as follows:

a. Adjust all test nozzles to specified test nozzle opening pressure. (See Pump Stand Manual.)

b. Install an injection pump on calibrating stand.

c. Perform the "Maximum Fuel Delivery Check" and record amount of fuel obtained from No. 1 pumping element.

d. Install each of the remaining test nozzles in the No. 1 nozzle position and note delivery from each nozzle. If necessary, adjust nozzle opening pressure to obtain same flow as recorded for nozzle No. 1 (Step c.). Nozzles must be balanced to within 0.5cm3 per 1000 strokes.

e. After nozzle balance (uniform delivery) has been obtained, recheck opening pressure of all nozzles. If nozzle opening pressure is not within specified limits (3000 $\pm$ 25 psi), nozzle should be repaired or replaced.

MOUNTING ON STAND

Before mounting the pump on stand, make sure pump camshaft can be rotated more then 360°. This is especially important when the pump has been overhauled.

When installing pump on stand follow instructions with stand.

Before mounting pump on stand remove access plug with screwdriver bit KDEP 2949. Remove fuel inlet adapter and plug opening with bushing 1 413 462 040 and copper gasket 2 916 710 611 so it is flush with pump housing.

ESTABLISH PORT CLOSURE ON NO. 1 CYLINDER

1. Mount pump on stand and install rack dial indicator 1 687 233 015, bracket 1 688 130 030, adapter bushing 1 683 350 065 and rack pin 1 683 201 013 (Figure 2).

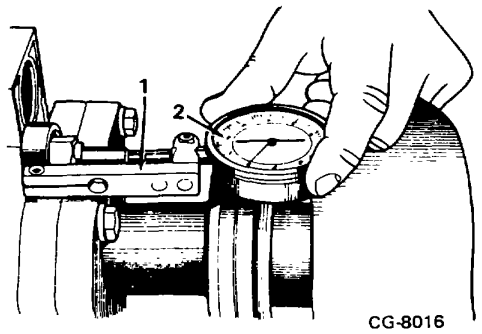


Figure 2. Installing Dial Indicator (Rack Gauge)

1. Bracket 1 688 130 030 with Adapter Bushing 1 683 350 065 and Rack Pin 1 683 201 013.

2. Dial Indicator 1 687 233 015

2. Zero dial indicator when rack is pushed to shut-off. Be sure rack does not bottom out on indicator. Move throttle lever to max. position Total rack travel should be as specified on individual pump calibration chart for starting fuel delivery (Step 17).

3. Move rack out of starting fuel position with shut-off lever. Dial indicator should read about 10 mm ± 2 mm.

4. Mount lift-to-port closure measuring device 1 688 130 135 with dial indicator 1 687 233 012, adapter bushing 1 683 350 066 and tappet pin 1 682 012 008 to pump (Figure 3). Make sure tappet number one is at bottom dead center (B.D.C.). The plunger lift-to-port closure is the distance in mm from the B.D.C. position of the cam to port closing by the plunger. Lift-to-port closure is only measured at element number one. Subsequent elements are phased at 60 degree intervals (see Step 10).

5. Zero the dial indicator at bottom dead center position of the roller tappet.

IMPORTANT

HIGH PRESSURE PHASING IS RECOMMENDED. (FOR LOW PRESSURE PHASING REMOVE DELIVERY VALVE, SPRING AND WASHER. UPON REPLACEMENT, NEW DISCHARGE FITTING AND GASKET AT BOTTOM OF DELIVERY VALVE ARE REQUIRED EACH TIME AS THEY ARE A ONE-TIME TORQUE DESIGN).

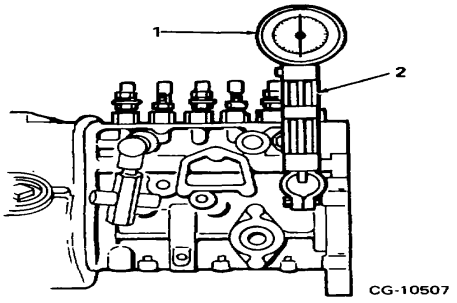


Figure 3. Establishing Initial Plunger Lift (No. 1 Pumping Element)

1. Dial Indicator 1 687 233 012

2. Plunger Lift Device 1 688 130 135 with Pin 1 682 012 008 and Adapter Bushing 1 683 350 066.

6. With the bleeder screw open at number one calibrating nozzle holder assembly, increase feed pressure until calibration fluid comes out of overflow tube with no bubbles.

7. Turn camshaft slowly in direction of rotation (clockwise) until port closure is reached. Port closure is reached when the flow of calibrating fluid from nozzle holder overflow tube changes from a steady stream to drops.

8. Read dial indicator for proper lift (see Calibration Chart for specification). Zero the pump stand degree wheel at this point for phasing. Return tappet to B.D.C. and repeat Steps 6 and 7 to ensure repeatability.

9. Compensate for deviation from the specified measurement by inserting the proper size adjusting spacer (available in thickness steps of 0.05 mm) between the barrel flange and pump housing (Figure 4).

IMPORTANT

ADJUSTING SPACERS OF THE SAME THICKNESS MUST BE USED ON BOTH SIDES OF BARREL AND VALVE ASSEMBLY AND ONLY ONE SPACER SHOULD BE USED ON EACH SIDE.

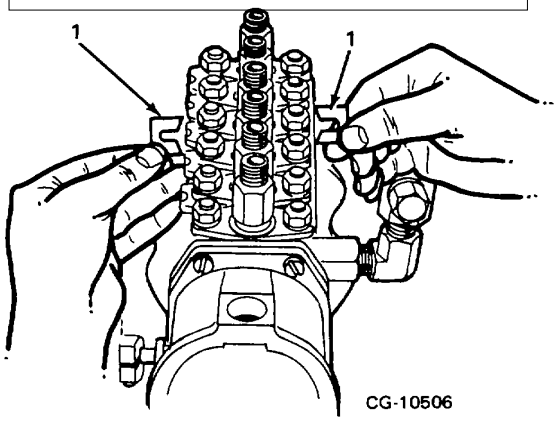


Figure 4. Inserting Adjusting Spacers

1. Adjusting Spacers

PHASING

10. Check port closure for the remaining plungers in pump discharge order by rotating the camshaft in 60 degree intervals.

No. 1	No. 5	No. 3	No. 6	No. 2	No. 4
0°	60° ± 1/20	120° ± 1/2°	180° ± 1/2°	240° ± 1/2°	300° ± 1/2°

At each of these intervals check port closure as outlined in Steps 7 and 8 (nozzle bleeder screw opening to correspond with element number).

11. If port closure is not exactly as specified ± 1/2 degree, adjust by selecting proper spacer for under the barrel flange. If port closure occurs too early, increase spacer thickness. If too late, reduce spacer thickness.0.05 mm spacer equals 0.2°.

GOVERNOR ADJUSTMENT

12. Insure zero dial indicator setting as outlined in Step 2. Adjust shut-off lever stop screw (Figure 5) to 1.5 - 2.0 mm (.060 - .079") rack position.

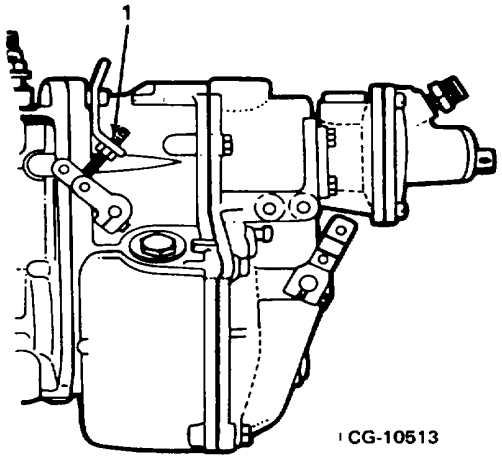


Figure 5.

1. Shut-off Lever Stop Screw

IMPORTANT

INSTALL DELIVERY VALVE SPRING AND WASHER, IF REMOVED.

13. Add clean engine oil to injection pump sump (one pint). Set feed pump pressure to 2 PSI.

Check Governor Preliminary Cut-Off (Governor Internal Adjustment)

14. With control lever assembly in full forward position and hi-idle stop screw removed, rack position should be 20.0 21.0 mm (.787" .827") as shown on dial indicator prior to start. Operate calibrating stand at specified RPM and observe rack position. Rack position should be 8.0 mm (.315") as shown on dial indicator.

    If preliminary governor cut-off does not come into effect within specifications, corrective adjustments inside governor housing are made as follows:

    a. Remove seal wire and governor access plug from side of governor housing.

    b. Check control rack and governor assembly for binding and correct if needed.

    c. Adjust cut-off by increasing or decreasing pre-tension of governor weight springs. Use KDEP 2989 governor spring adjusting wrench on cylindrical nut to make this adjustment (Figure 6).

       To raise governor cut-off, pre-tension is increased; to lower governor cut-off, pretension is decreased. "Cam" nut is selflocking but must be turned 1/4 turns to assure its being in locked position. Preload of governor springs should range from 4 to 10 quarter (1/4) turns (clicks) from flush on each side. Alter preload range as required.

    d. Spring set may be one-half turn out of balance with opposite set if necessary to obtain desired governor cut-off.

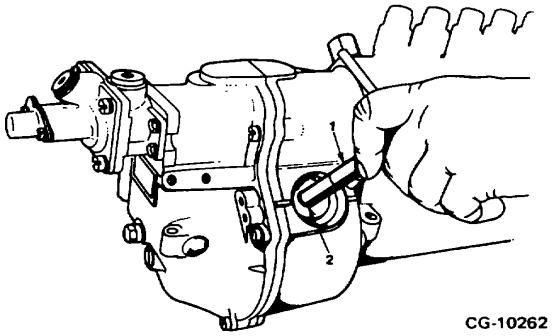


Figure 6. Making Preliminary Governor Cut-Off Adjustment

1. Adjusting Wrench KDEP 2989
2. Governor Cut-Off Adjusting Nut

    e. If specified governor cut-off can not be obtained by adjusting preload, remove adjusting nut, spring seat and intermediate spring. Add or remove intermediate spring shims on both sides to achieve specified control rack position and recheck (must end up with same amount of shims on each side).

    f. If specified governor cutoff cannot be obtained by steps c, d or e, recheck "slider to housing" and "S-plate" basic dimensions.

Check Governor Cut-Off (Governor External Adjustment)

15. Install hi-idle stop screw and operate test stand, with control lever assembly in full load position (fully forward), at specified RPM. Check rack setting on dial indicator and compare with specifications given on CALIBRATION CHART.

    If rack is not positioned within specified limits, make hi-idle adjustments (Figure 7) as follows:

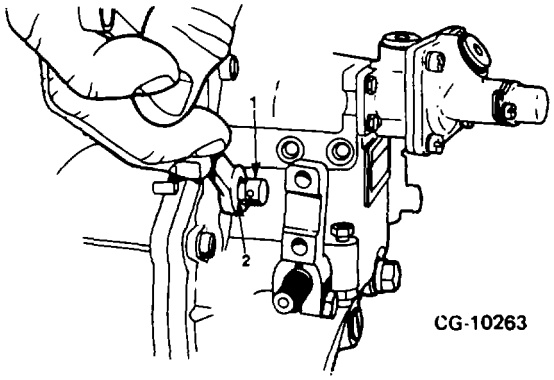


Figure 7. Adjusting Hi-Idle Rack Position

1. Hi-Idle Stop Screw 2. Lock Nut

a. Loosen locknut and turn hi-idle stop screw with wrench counterclockwise to decrease rack dimension, or clockwise to increase rack dimension.

b. Tighten locknut and recheck rack dimension.

Governor Performance at No-Load (Hi-Idle) Check

16. Operate test stand, with control lever assembly positioned as specified, at specified RPM listed on CALIBRATION CHART and observe rack position. Rack position as shown on dial indicator should be as specified on Calibration Chart.

    If specified rack position is unattainable, recheck governor cut-off (internal adjustment) and governor cut-off (external adjustment) calibrations.

Governor End Regulation Check

17. Operate test stand at specified RPM with control lever assembly in full load position (fully forward) and observe rack position. Rack position should be 0.1-1.0 mm (.0039-.039"). If specified rack position is unattainable, recheck governor cut-off internal adjustment and governor external adjustment calibrations.

Governor Lo-Idle Regulation Check

NOTE: Steps 18 and 19 are not independent checks. One must not be achieved without the other.

18. Operate test stand at specified RPM with control lever assembly positioned as specified.

    If rack is not within specified limits, make governor adjustments as follows:

    a. Remove adjusting nut (count clicks to flush), spring seat and outer spring. Add or remove outer spring shims to achieve specified control rack position.

    b. To increase rack position shims must be added and to decrease rack position shims must be removed. Add or remove same shim pack on both sides.

    c. Install outer spring, spring seat, adjusting nut, preload governor springs to initial setting from flush position and recheck.

    d. If specified rack position still cannot be obtained by steps a, b and c, recheck "slider to housing" and "S-plate" basic dimensions (Section 4, Page 5).

Lo-Idle Back-Up Check

19. Operate test stand at specified RPM with control lever positioned as specified.

    Decrease test stand speed to 100 RPM. Rack position should be 9.0 mm (.354") or greater as shown on dial indicator.

    If rack is not positioned as specified, repeat Steps 3 on. Bring low idle stop screw up to touch control lever (Figure 8).

Step/No Step Check

20. Check for continuous rack movement while increasing speed within the range specified on calibration chart (Step/No Step Check). Rack should not stay in any one position for more than 25 RPM. If rack is "sticky, " correct.

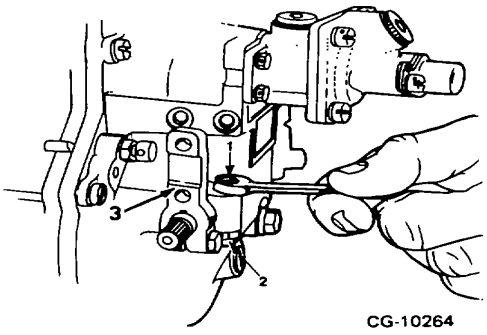


Figure 8. Adjusting Lo-Idle Position

1. Lo-Idle Stop Screw
2. Lock Nut
3. Control Lever

Adjust Full Load Fuel Setting and Balance Delivery

21. This is an operating test to assure that the injection pump provides the proper quantity of fuel at full load setting and at the same time provides a balanced fuel delivery between pumping elements. Test and adjustment is made as follows:

    a. Operate test stand at specified RPM with control lever in full load position (fully forward) and specified boost pressure, note rack position as shown on dial indicator.

    b. If not within specifications remove cover from rear of aneroid. Remove aneroid fuel adjustment plate. Using KDEP 1047 loosen inner jam nut then adjust outer nut clockwise to reduce power and fuel or counterclockwise to increase power and fuel (Figure 9).

    c. Operate test stand for fuel delivery at specified RPM and boost pressure for 1000 strokes. Read and record flow to each of the six graduates.

    d. If average fuel delivery for all pumping elements and imbalance between individual pumping elements do not meet specifications (see CALIBRATION CHART), adjust affected elements (see balanced delivery adjustment procedure).

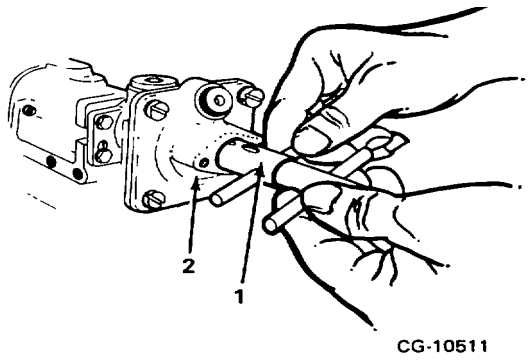


Figure 9. Adjusting Full Load Fuel Setting

1. KDEP 1047
2. Aneroid

Balanced Delivery Adjustment Procedure

22. If fuel flow of one or more pumping elements are not within specified balance limits given on CALIBRATION CHART, adjust affected elements as follows:

NOTE: Loosen injection line nut prior to adjusting barrel assemblies.

    a. Loosen barrel flange clamping nuts.

    b. Adjust barrels by turning clockwise (as viewed from top) to increase delivery, counterclockwise to decrease delivery.

> **IMPORTANT**
>
> ALWAYS USE BACK-UP WRENCH ON DELIVERY VALVE HOLDER WHEN TIGHTENING OR LOOSENING FUEL INJECTION LINE NUT.

    c. Check balance at low idle RPM. Adjust throttle lever to obtain low idle delivery.

    d. Maximum difference between cylinders is ±1 cc from average at rated and ± 2 cc from average at low idle.

NOTE: Balance should be maintained to as close a tolerance as is reasonably possible to prevent readjustment in later tests.

Fuel Delivery at Lo-Idle Check

23. This is an operating test to assure that the injection pump provides the proper quantity of fuel at lo-idle. Test and adjustment are made as follows:

    a. Operate test stand at specified RPM with control lever in lo-idle position (fully back) for 1000 strokes.
    b. Record fuel delivery from elements and compare results with specifications given on CALIBRATION CHART.
    c. Check balanced delivery between pumping elements and compare imbalance with specifications given on CALIBRATION CHART.
    d. Adjust fuel delivery and imbalance (see Test 21).

Check Fuel Delivery at Torque Check Speed

24. This is an operating test to assure proper pump and governor operation. Perform the test as follows:

    a. Operate stand at specified RPM with control lever locked in full load (fully forward) position for 1000 strokes.

    b. Record fuel delivery from elements and check for balanced delivery between pumping elements and compare with specifications given on CALIBRATION CHART. If not within specifications repeat Steps 20, 21 and 22.

Check Aneroid Controlled Power and Fuel (Cutback)

25. Check with boost line disconnected. If not within specifications proceed as follows:

    a. Remove cap from rear of aneroid.

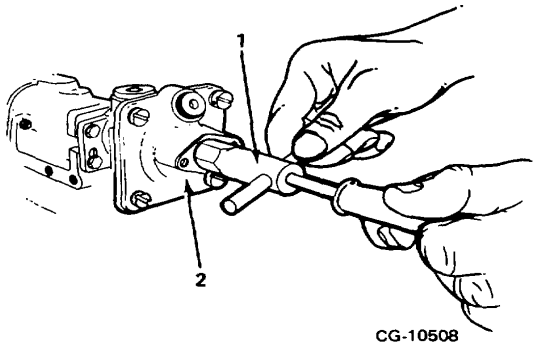


Figure 10. Adjusting Aneroid Cutback

1. KDEP 1048 2. Aneroid

    b. Using KDEP 1048 (Figure 10) turn socket head screw clockwise to increase power and fuel or counterclockwise to decrease power and fuel.

Check Low Speed Power and Fuel (Aneroid Controlled)

26. This adjustment is for correct spring preload. If not within specifications on calibration chart (Step 14) adjust as follows:

    a. Remove recessed hex head plug from top of aneroid. Use a screwdriver as a lever for turning the star wheel.

    b. If power or fuel are below specifications engage screwdriver blade with star wheel pushing screwdriver towards engine. This reduces spring preload, increasing power and fuel.

    c. If power or fuel are above specifications pull engaged screwdriver away from engine, increasing spring preload and reducing power and fuel.

    After adjustments are made make sure Steps 21 and 25 are still correct.

Check Fuel Shut-Off

27. This adjustment is made to protect pump internal stop and rack from damage. Adjustment is made by loosening stop bracket against which shutoff lever will strike (Figure 11). Operate shutoff lever to rear and hold in this position (rack against internal stop). Reposition external stop lever bracket so that shutoff lever will contact bracket stop screw just before rack would be stopped by the internal stop. Rack setting (dial indicator reading) with rack against external stop should be between 1.5 2.0 mm (.059 .079").

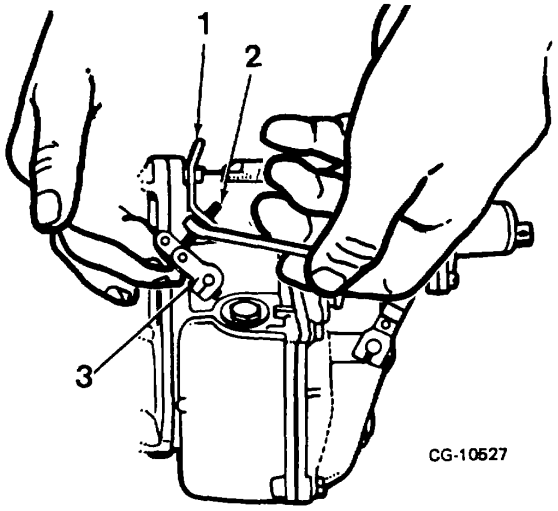


Figure 11. Adjusting External Stop Bracket

1. Stop Bracket
2. Stop Screw
3. Shutoff Lever

Check Start Fuel Cutout

28. This is an operating test made to assure that control rack will move from start fuel to full load fuel position at specified pump speed. Adjustment is made by varying the height of the rack link adjustment screw.

    Increase test stand speed slowly from 50 RPM and simultaneously operate control lever between lo-idle and hi-idle stops until cutout occurs and observe test stand speed. Test stand speed should be between specified RPM. If specified test speed is not obtained, reposition rack link adjusting screw height as follows: (See Figure 12)

    a. Using 10 mm Allen wrench, remove plug from adjustment access hole in top of governor housing.

    b. Loosen adjusting screw locknut (10 mm).

    c. If cutout occurred below specified speed, turn adjusting screw counterclockwise and if cutout occurred above specified speed turn adjusting screw clockwise.

    d. Tighten adjusting screw locknut and repeat test.

    e. Reinstall plug in adjustment access hole.

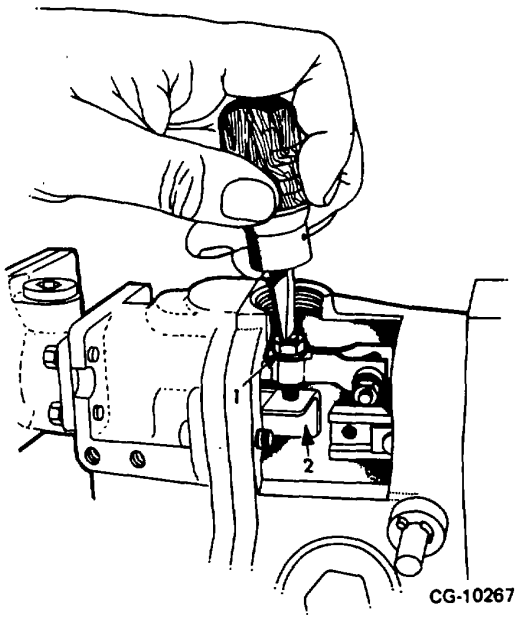


Figure 12. Adjusting Excess Fuel Rack Position (Governor Housing Cut-Away for Illustration)

1. Adjustment Screw
2. Stop Shackle

Check Start Fuel Quantity

29. This is an operating test made to assure that the injection pump provides the proper quantity of fuel to start the engine. Test is made as follows:

    a. Remove dial indicator from injection pump and install rack end cap.

    b. Operate test stand at specified RPM with control lever locked in start position (fully forward) for 1000 strokes.

    c. Record fuel delivery from elements and compare with specifications given on CALIBRATION CHART.

    d. If fuel delivery does not meet minimum specifications, remove shim(s) from under screw head located at the end of control rack. If fuel delivery exceeds maximum specification, add shim(s) under screw head.

    e. Install rack end cap and recheck fuel delivery.

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INJECTION PUMP AND ENGINE TEST DATA
(CALIBRATION DATA ON REVERSE SIDE)

Pump No: 1 802 608 C92
Application: ..... S-Series, Cargostar, Paystar, 1853 FC Bus

Engine DTI-466C
Model B210C
Rating ..... 210 BHP @ 2600 RPM
Timing:
Static ..... 1 8°± 1° BTDC
Turbocharger No 684 698 C91
1 806 078 C91
Lift-to-Port Closing ..... 3.05 ± 0.05 mm
Governor Spring No:
Outer 684 872 C1
Middle 397 764 C1
Inner 1 806 308 C1

Supply Pump Pressure (Rated)
1 802 608 C91 ..... 31 psi
1 802 608 C92 ..... 50 psi
Test Nozzles: SAE 0.5 Orifice Plate Nozzles
Tool Number ..... Bosch No. 1 688 901 016
Service Tool No. SE-2756
Test Nozzle Opening Pressure ..... 3, 000 psi
High Pressure Test Fuel Lines:
Length ..... 600 mm (24")
O.D ..... 6 mm (.24")
I.D ..... 2 mm (.079")
Tool Number: ..... Bacharach No. 77-0194
Calibrating Fluid ..... VISCOR 1487 or 1487AW (SAE J967 D Standard +)
Fluid Operating Temperature ..... 100-110°F
Calibration Feed Pump Pressure ... 1.5 BAR (21.5 psi)

ENGINE TEST DATA**

		Rated Speed	Torque Check Speed	Droop Check Speed
Engine (RPM) +10		2600	1800	1400
Horsepower	Max.	210	186	-
Fuel (lbs/hr)	Max.	93	68	39
Manifold Pressure (in. Hg.)	Int.	36-42	24-30	-
	Exh.	36-42	14-20	-
Exhaust Temperature at Sea Level ('F Max.)***		-	-	-

*See CAMSHAFT, Section 3, Page 4.
**Engine test ambient conditions are: Air temperature 85°F, Barometer 29.38 In. Hg.
***Exhaust temperature increase 15°-20°F per 1000 ft. increase in altitude.
+ Latest Revision.