

# 1975-79 FUEL SYSTEMS

## International Harvester Diesel Fuel Injection

### 1976-79 6-Cylinder Diesel Engine Equipped Models

#### DESCRIPTION

A piston-type fuel feed pump, driven by fuel injection pump, draws fuel from tank. After passing through a constant volume filter, fuel is delivered to injection pump. Pressurized fuel is then forced to injectors mounted in cylinder head. The injectors are lubricated by fuel leaking back past needle valve stems. Fuel used for lubrication is then returned to fuel tank by a leak-off pipe. Engine control is maintained by either a diaphragm or mechanical-type governor.

#### OPERATION

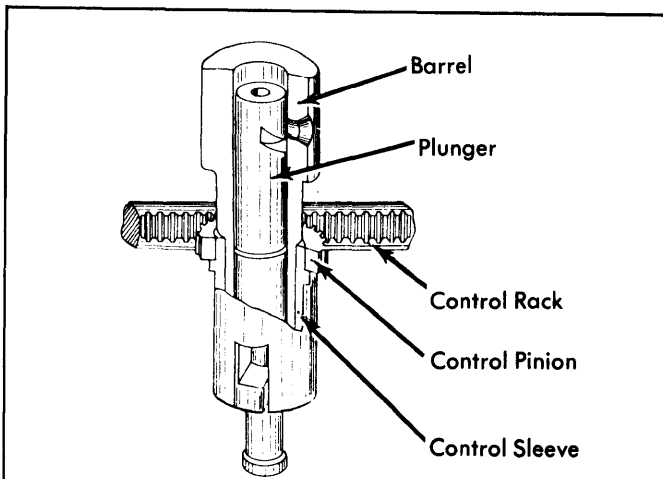
##### INJECTION PUMP

This system uses a Bosch Type A fuel injection pump. Through action of a governor and timer, the pump feeds pressurized fuel to the engine. Pump transfers fuel from the tank, through the filter, to the plunger assembly. Plunger then forces fuel, in correct amounts, to the injector nozzles.

Pump has one plunger and one delivery valve for each cylinder. An automatic timer is mounted on the drive end of pump housing. Governor is on opposite end. Pump housing contains the camshaft, tappet, plunger, control sleeve and control rack assemblies.

Pump plungers have a constant stroke and are operated, through roller tappets, by a camshaft in pump assembly. Pump camshaft is driven at half engine speed by a gear meshed with engine camshaft gear. Lower end of each plunger engages fork on control rod which is connected to governor. See Fig. 1.

Governor movement is transmitted to each plunger, causing them to turn in their cylinders. This turning action changes position of helical groove machined in each plunger in relation to cylinder ports. Fuel delivery is controlled by this change in groove-to-port positions.



Courtesy of International Harvester Co.

Fig. 1: Pump Plunger & Control Rack

##### DELIVERY VALVE

As plunger pressure becomes high enough to force fuel into delivery valve, valve opens and fuel is delivered to the injector nozzle. A spring maintains closing pressure in the valve. When correct amount of fuel has been delivered, spring pressure closes valve.

A piston in the bottom of the delivery valve, instantly restricts fuel passage through valve. This prevents fuel seepage at the injector and maintains better fuel control. Delivery valve is located directly above the plunger assembly inside the pump housing. Fuel line to injector nozzle is attached above the delivery valve.

##### GOVERNOR

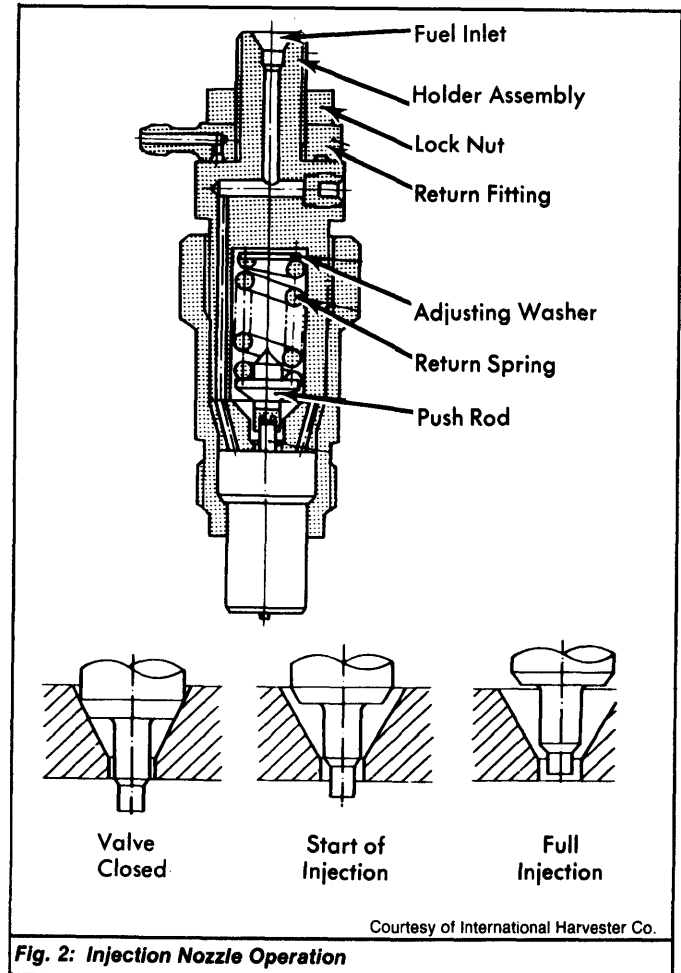
**RVS Mechanical Type** – The centrifugal governor controls engine speed in relation to accelerator position, load and vehicle speed. This is accomplished through the counter-balancing action of springs and governor weights. Engine speed is directly proportional to governor spring load, enabling accurate speed control to be maintained throughout engine speed range.

**MZ Diaphragm Type** – The governor diaphragm housing contains a diaphragm which separates a vacuum chamber and an atmospheric pressure chamber. Changes in vacuum will change position of diaphragm, moving it in or out. Diaphragm is connected to a rack that controls plunger position and amount of fuel injection.

As engine requirements vary, so does the vacuum available to move the diaphragm. With a constant throttle position, vacuum will increase with engine speed. This increased vacuum pulls diaphragm back to a leaner position. Whenever engine load increases, vacuum also drops. This allows main diaphragm spring to press diaphragm to a richer injection position. In this way, governor responds to engine requirements and controls amount of fuel to injection nozzles.

##### INJECTION NOZZLES

Fuel from injection pump is delivered to nozzle, under high pressure, which injects fuel into a swirl chamber in cylinder head. A pintle throttle type of nozzle with a single orifice is used. This pintle projects from orifice in nozzle body and is designed so that when the pintle is lifted slightly, at beginning of injection, a fine spray mist is injected. As pintle is lifted further full injection is provided. See Fig. 2.



Courtesy of International Harvester Co.

Fig. 2: Injection Nozzle Operation

## International Harvester Diesel Fuel Injection (Cont.)

### FUEL FEED PUMP

A piston-type fuel feed pump is mounted to side of injection pump and is cam-driven. See Fig. 3. Feed pump is equipped with a smaller priming pump. By manually operating priming pump, fuel can be brought from tank to injection pump with engine stopped. With engine operating, feed pump maintains fuel pressure to injection pump between 28.5-42.7 psi (2-3 kg/cm<sup>2</sup>).

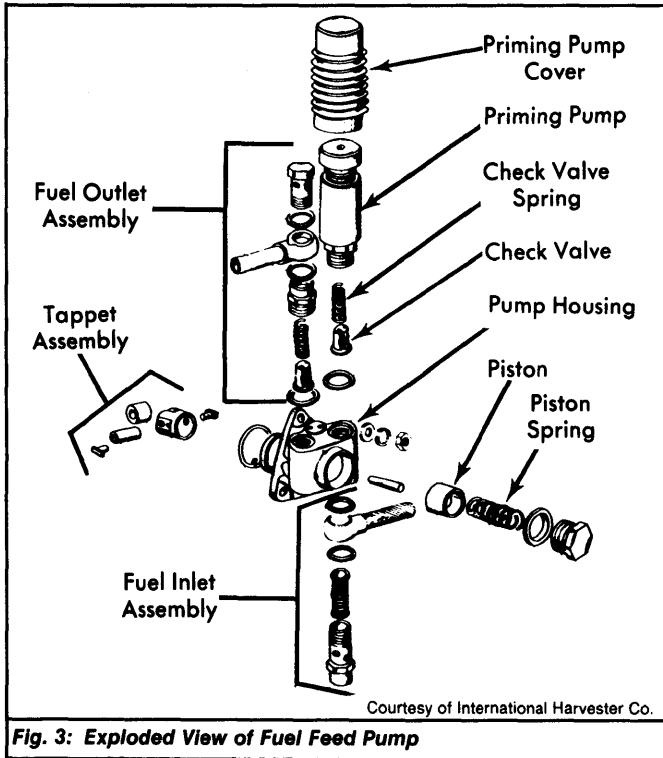


Fig. 3: Exploded View of Fuel Feed Pump

### FUEL INJECTION TIMER

Fuel injection timer uses weight and spring to automatically change injection timing in accordance with engine speed. Timer employs centrifugal force on weights to advance injection timing when engine speed increases and to retard injection timing when engine speed decreases.

### TESTING

Information not available from manufacturer.

### REMOVAL & INSTALLATION

#### INJECTION PUMP

**Removal** - 1) Disconnect fuel line and fuel filter hoses from fuel feed pump. Disconnect linkage from governor. Disconnect injection lines from delivery valves on injection pump.

2) Remove fan, fan pulley and water pump. Remove crankshaft pulley, timing cover and oil seal. Remove timing gear case and oil slinger. Remove tachometer driver support nuts. Lock flywheel and remove timer round nut.

3) Thread Timer Extractor (57926-581) into timer weight holder and remove timer. Remove the 4 nuts securing injection pump to front end plate and remove pump.

**Installation** - To install pump, reverse removal procedure. Make sure all surfaces and fuel lines are free of dirt and other foreign materials.

#### DELIVERY VALVE

**Removal** - 1) Disconnect and cap fuel lines to injectors. Remove lock plates holding delivery valves in place. Loosen delivery valve holder then remove delivery valve holder with delivery valve spring.

2) Thread Delivery Valve Extractor (57020-032) into valve. Remove delivery valve and gasket. See Fig. 4. Push plunger barrels from below and remove them from top of pump housing.

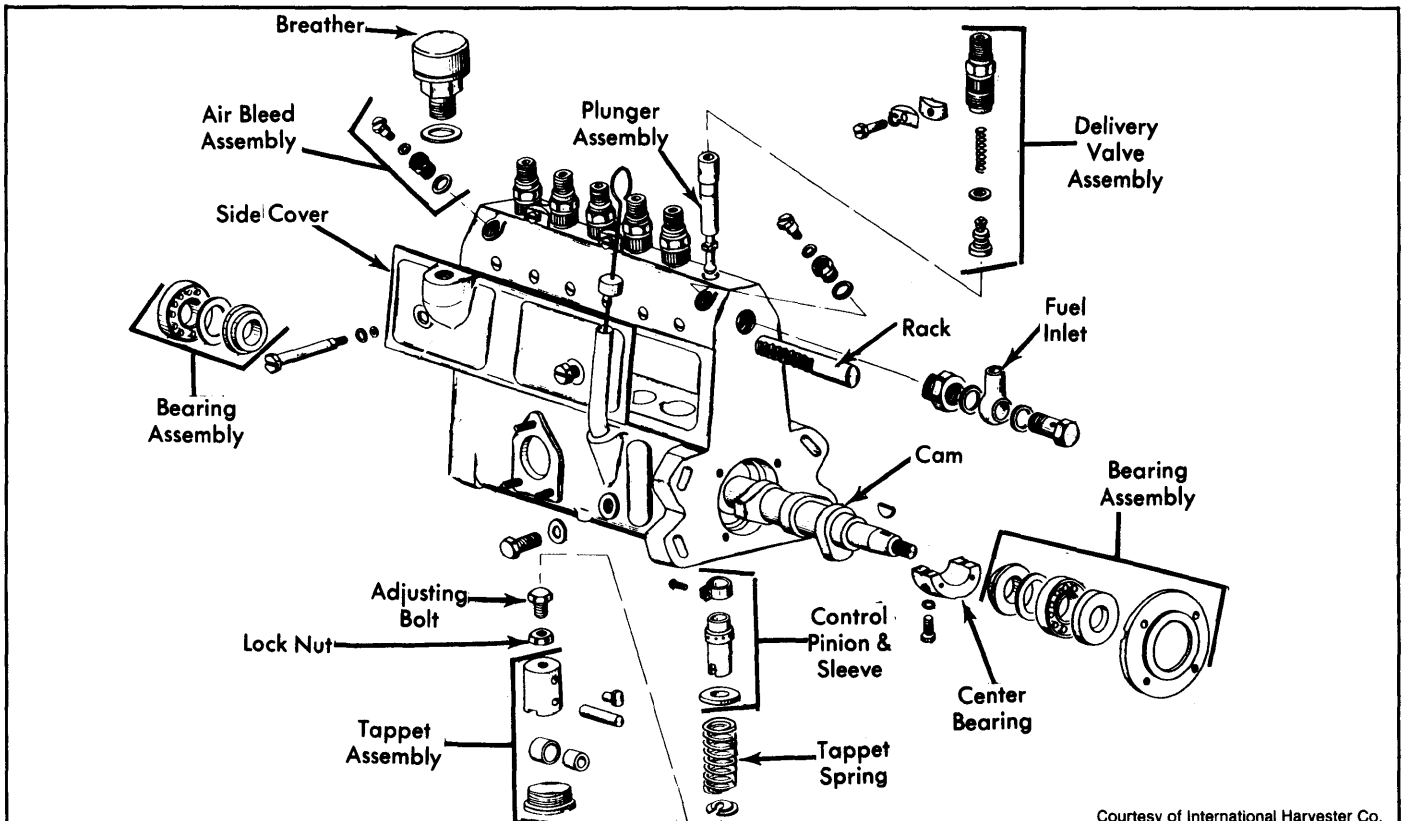


Fig. 4: Exploded View of Fuel Injection Pump

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## International Harvester Diesel Fuel Injection (Cont.)

**Installation** - Install delivery valve, plunger, and plunger barrel in reverse order of removal. Make sure all components are completely free from dirt or other foreign materials. Lightly coat plunger and barrel with fuel.

### INJECTION NOZZLES

**Removal** - Disconnect fuel lines and cap both fuel lines and injection nozzles. Remove fuel injection nozzles from cylinder head. Cover injector hole in cylinder head with rag.

**Installation** - To install, reverse removal procedure. Make sure all fuel connections are free from dirt or any other foreign materials.

### ADJUSTMENTS

**NOTE:** Fuel injection pump adjustments are made with pump removed from engine and mounted on tester.

### INJECTION PUMP

**Start of Injection** - 1) Install pump on tester and attach tester coupling to timer end of pump and secure with round nut. Connect coupling to tester drive shaft. Connect tester hose to nozzle tube on pump. Remove cap and connect tester dial to pump camshaft for rotating angle measurement.

**NOTE:** Injection tester supplies fuel to nozzle tube at 427-498 psi (30-35 kg/cm<sup>2</sup>) for checking start of injection.

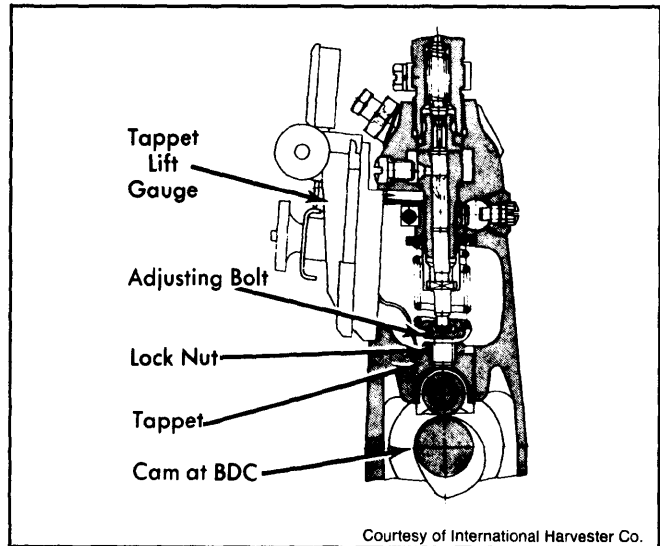
2) Attach a tappet lift gauge to the first plunger. See Fig. 5. Position pump cam so that plunger tappet is at BDC (Bottom Dead Center, lowest point of cam). Zero dial gauge. Loosen pump bleeder screw and bleed pump. Loosen ball valve of nozzle holder.

3) With a test nozzle connected to pump, feed fuel to pump so that fuel flows from test nozzle then turn pump cam by hand (turn tester coupling) in same direction as engine would turn pump. Turn cam slowly until fuel just stops flowing from nozzle. This point is start of injection. Dial gauge reading should be .089-.093" (2.26-2.36 mm). This is tappet lift from BDC.

4) If fuel continues to flow past this point turn adjusting nut on tappet counterclockwise to raise plunger. If fuel flow stops before this point, turn adjusting nut clockwise to lower plunger.

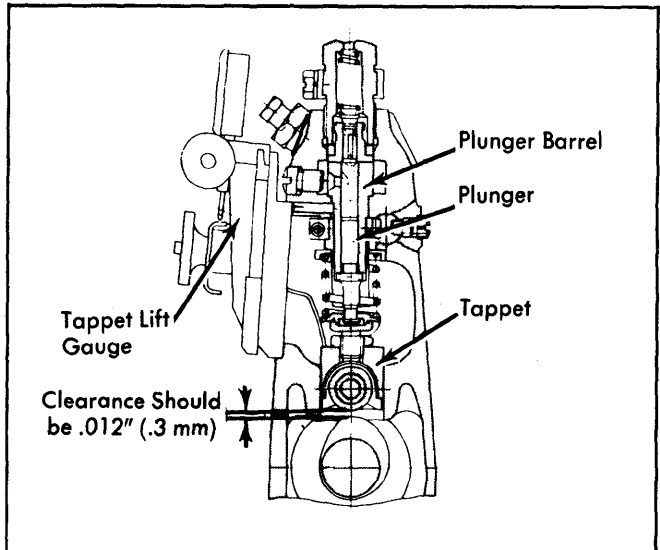
5) With the first plunger correctly set, repeat the procedure on the next plunger in firing order sequence (1-4-2-6-3-5) by turning the cam 60 degrees for each plunger.

**Tappet Clearance** - 1) With start of injection set, turn cam so that first plunger is at TDC (Top Dead Center). See Fig. 6. Attach dial gauge to first tappet as was done in start of injection adjustment. With tappet at highest point on cam (TDC), insert screwdriver under adjusting nut and pry tappet up.



Courtesy of International Harvester Co.

Fig. 5: Installation of Tappet Lift Gauge



Courtesy of International Harvester Co.

Fig. 6: Measuring Tappet to Cam Clearance

### 1976-77 INJECTION PUMP VOLUME SPECIFICATIONS

Pump Number	Rack Position In. (mm)	Pump RPM	Volume for One Plunger	Plunger Strokes
Mechanical Governor 5410-091				
Test 1	.551 (14)	750	34.4±1	1000
Test 2	.472 (12)	750	21.1±.09	1000
Test 3	.393 (10)	300	7.5±1.1	1000
Vacuum Governor 5520-659 & 5520-664				
Test 1	.583 (14.8)	800	41±1	1000
Test 2	.559 (14.2)	1900	43±1	1000
Test 3	.354 (9)	1900	12.8±1	1000
Test 4	.393 (10)	300	7.5±1.1	1000

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## International Harvester Diesel Fuel Injection (Cont.)

1978 INJECTION PUMP VOLUME SPECIFICATIONS				
Pump Number	Rack Position In. (mm)	Pump RPM	Mean Injection Volume cc	Plunger Strokes
Vacuum Governor (SD22) 5520-634 & 5520-675				
Test 1	.591" (15)	800	40.4 ±1.0	1000
Test 2	.551" (14)	1700	38.9 ±1.6	1000
Test 3	.354" (9)	1700	11.0 ±0.8	1000
Test 4	.394" (10)	300	7.5 ±1.1	1000
Vacuum Governor (SD33) 5520-659 & 5520-664				
Test 1	.583" (14.8)	800	41 ±1.0	1000
Test 2	.559" (14)	1900	43 ±1.0	1000
Test 3	.354" (9.0)	1900	12.8 ±1.0	1000
Test 4	.394" (10)	300	7.5 ±1.1	1000
5412-072				
Test 1	.571" (14.5)	600	36.4 ±1.0	1000
Test 2	.543" (13.8)	1500	36.7 ±1.5	1000
Test 3	.394" (10)	300	7.5 ±1.1	1000
Mechanical Governor (SD22 & SD33) 5410-087 & 5410-091				
Test 1	.551" (14)	750	34.4 ±1.0	1000
Test 2	.472" (12)	750	21.1 ±0.9	1000
Test 3	.394" (10)	300	7.5 ±1.1	1000

1979 INJECTION PUMP VOLUME SPECIFICATIONS				
Test Application	Rack Position In. (mm)	Pump RPM	Mean Injection Volume cc	Plunger Strokes
Test 1	.551" (14)	750	34.4 ±1.0	1000
Test 2	.472" (12)	750	21.1 ±0.9	1000
Test 3	.394" (10)	300	7.5 ±1.1	1000

2) When tappet is pryed up, measure clearance between cam and tappet. Clearance reading should be .012" (.30 mm). If clearance is incorrect, check tappet and cam for excessive wear or damage. Replace parts if necessary and recheck start of injection adjustment.

**Injection Volume - 1)** On vacuum governor injection pump, turn set screw at bottom of governor housing until correct maximum injection volume is obtained. See 1976-77, 1978 or 1979 INJECTION PUMP VOLUME SPECIFICATIONS table. To increase injection pump volume, turn set screw counterclockwise. Decrease injection pump volume by turning screw clockwise.

2) On mechanical governor injection pump, use governor linkage to pull rack all the way to left side of pump (governor end). With rack in this position, install a measuring device (on right or drive end) so that right end of rack is at zero mark on measuring device.

3) With measuring device set up, remove rack guide screw and install the lock screw that will hold rack in position specified. See 1976-77, 1978 or 1979 INJECTION PUMP VOLUME SPECIFICATIONS table. Set fuel feed pressure, on tester, at 21.3-22.8 psi (1.5-1.6 kg/cm<sup>2</sup>).

4) On the first volume measurement test, push rack toward full throttle position .551" (14 mm) and tighten lock screw so that rack will not move. DO NOT over tighten lock screw or rack will be bent and have to be replaced.

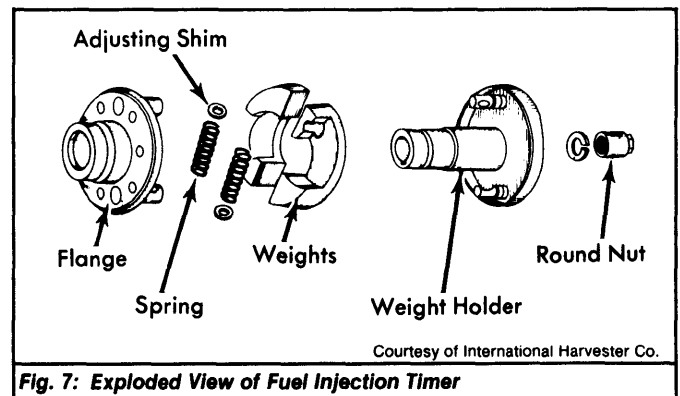
5) With rack set in correct position, run pump at 750 RPM for 1000 plunger strokes. Volume should be 33.4-35.4 cc. Repeat procedure with rack set at .472" (12 mm) from zero mark and run pump at 750 RPM for 1000 strokes. Volume should be 20.2-22.0 cc. Repeat

procedure with rack set at .393" (10 mm) from zero mark and run pump at 300 RPM. Volume should be 6.4-8.6 cc.

6) If injection volume is not to specifications, loosen set screw securing the control pinion. Insert a pin or rod, of adequate length, into the hole of the control sleeve. With pin inserted, rotate control sleeve little by little, repeating volume tests, until correct volume is attained.

### FUEL INJECTION TIMER

1) Using strobe light and Synchronizer (5783-001), install the synchronizer to pump housing so that synchronizer lever is in contact with plunger tappet. Position strobe light so degree wheel on tester will be illuminated when light is turned on.



**Fig. 7: Exploded View of Fuel Injection Timer**

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## International Harvester Diesel Fuel Injection (Cont.)

2) Operate pump at different speeds and record degrees advance. See 1976-77 or 1978-79 FUEL INJECTION TIMER SPECIFICATIONS table. If advance is not to specifications, disassemble timer and adjust spring force by increasing or decreasing the thickness of adjusting shims, or replace spring. See Fig. 7.

### 1976-77 FUEL INJECTION TIMER SPECIFICATIONS

RPM	Degrees Advance
500 .....	0
700 .....	0.5-1.5
1100 .....	2.0-3.5
1500 .....	4.5-5.0
1800 .....	7.0-8.0

### 1978-79 FUEL INJECTION TIMER SPECIFICATIONS

Application	Degree BTDC Advance
Base .....	7.5 (1 <sup>15</sup> )
Starting .....	1 <sup>20</sup>
High Speed .....	1 <sup>35</sup>

1 - 1 - Engine crankshaft angle.

### INJECTION PUMP SPECIFICATIONS

Application	Specification
Pump Oil Capacity	
SD22 .....	80 cc
SD33 .....	180 cc
Governor Oil Capacity	
Vacuum .....	3 or 4 Drops
Mechanical .....	200 cc
Injector Opening Pressure .....	1422.5 psi (100 kg/cm <sup>2</sup> )
Feed Pump Pressure .....	25.6 psi (1.8 kg/cm <sup>2</sup> )

### TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (kgm)
Injection Pump	
Delivery Valve Holder .....	22-25 (3-3.5)
Air Bleed Screw .....	15-22 (2-3)
Tappet Lock Nut .....	43-51 (6-7)
Timer	
Round Nut .....	43-51 (6-7)
Lock Nut .....	72-130 (10-18)
Nozzle	
Nozzle Nut .....	72-87 (10-12)
Nozzle Holder Nut .....	51-58 (7-9)