DIESEL FUEL INJECTION — ISUZU & LUV

Isuzu
I-Mark
P'UP

LUV
Pickup

DESCRIPTION

Diesel fuel injection system includes the fuel injection pump, injection nozzles, delivery and return lines, fuel filter with water warning light and glow plug system. The thermal glow plug system has a controller, relay unit, thermal switch, dropping resistor, sensing resistor and glow plugs. I-Mark models also have a glow plug timer. Warning lights in the instrument cluster indicate when the glow plugs are operating or the fuel filter is filled with water.

OPERATION

FUEL INJECTION PUMP

The injection pump is located on the lower right side of the engine and driven by a toothed belt. It draws fuel from the tank, pressurizes it, and sends a specific quantity to each cylinder at the proper time. Excess fuel is returned from the injectors and sent back to the tank. A fast idle system is used when coolant is below a specified temperature. A vacuum unit actuates the throttle and increases idle speed. A fuel cut solenoid is actuated by the ignition switch and stops fuel flow at the pump so the engine can be shut down.

INJECTION NOZZLES

The injection nozzles spray fuel into a prechamber as each compression stroke occurs. A fuel return line connects all injectors and returns excess fuel to the pump. Injectors are opened by high pressure in the fuel lines and cannot be adjusted. If spray patterns are incorrect, nozzles must be replaced.

FUEL FILTER & WATER WARNING SYSTEM

The diesel injection system uses an integral fuel filter and water separator. A water sensor is fitted into the bottom of a fuel filter cartridge and lights a warning lamp when water accumulates in the filter. A hand pump is also incorporated into the filter housing to prime the pump after filter replacement.

GLOW PLUGS

I-Mark — The glow plug system uses 4 glow plugs (heaters) to assist in cold starting. When the engine coolant is below 122° F (50°C), the No. 1 relay supplies battery voltage to heat the glow plugs quickly. When the engine starts, relay No. 1 is turned off and relay No. 2 provides a lower voltage to maintain glow plug temperature. The glow plug timer keeps the glow plugs pulsating on and off up to 3 minutes and/or until 10 MPH is attained.

LUV & P'UP — The glow plug system uses 4 glow plugs (heaters) to assist in cold starting. When the engine coolant is below 122° F (50° C), the No. 1 relay supplies battery voltage to heat the glow plugs quickly. When the glow plugs reach maximum temperature, relay No. 1 is turned off and relay No. 2 provides a lower voltage to maintain glow plug temperature. When the engine starts, the glow plug system is turned off. When engine coolant is above 122° F (50° C), only relay No. 2 is operated. This operation provides easy starting but does not drain the battery or overheat glow plugs.

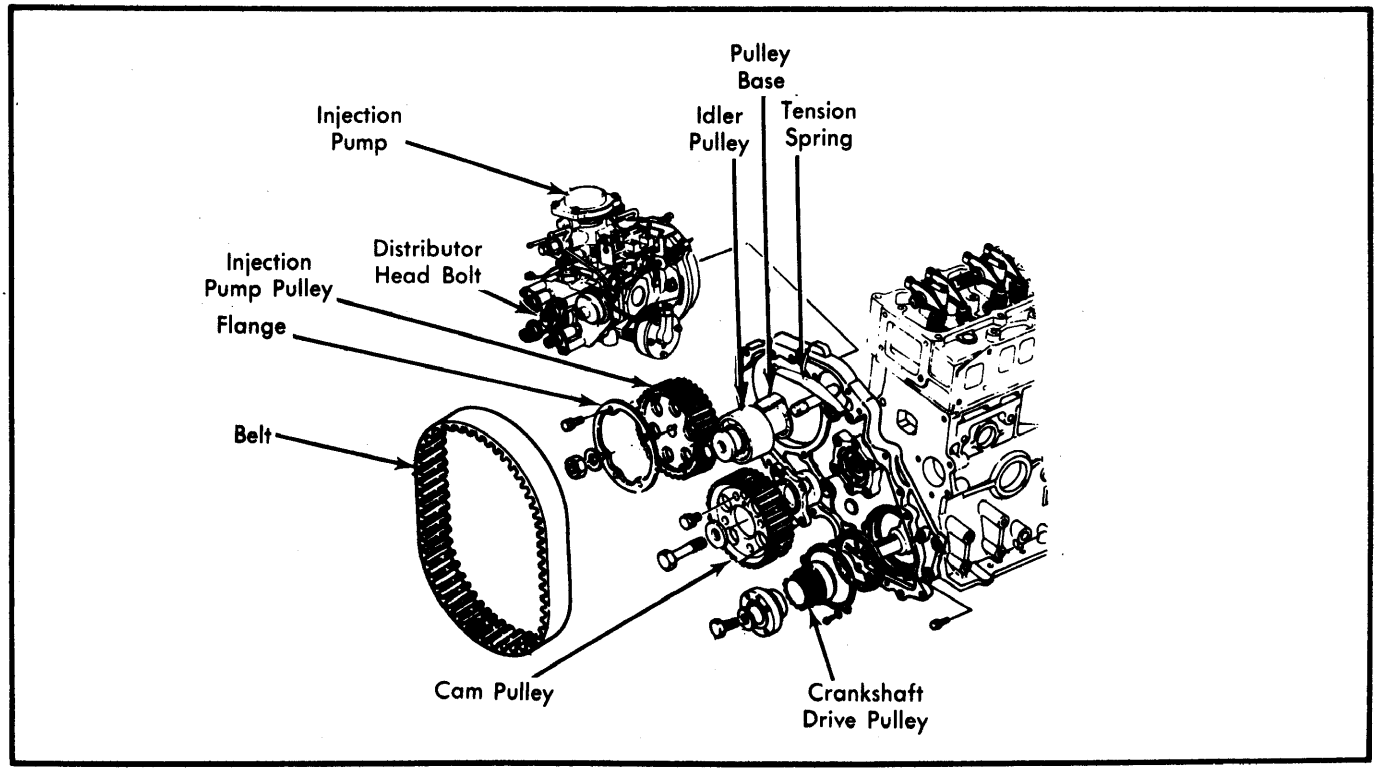

Fig. 1 Exploded View of Injection Pump Drive

DIESEL FUEL INJECTION — ISUZU & LUV (Cont.)

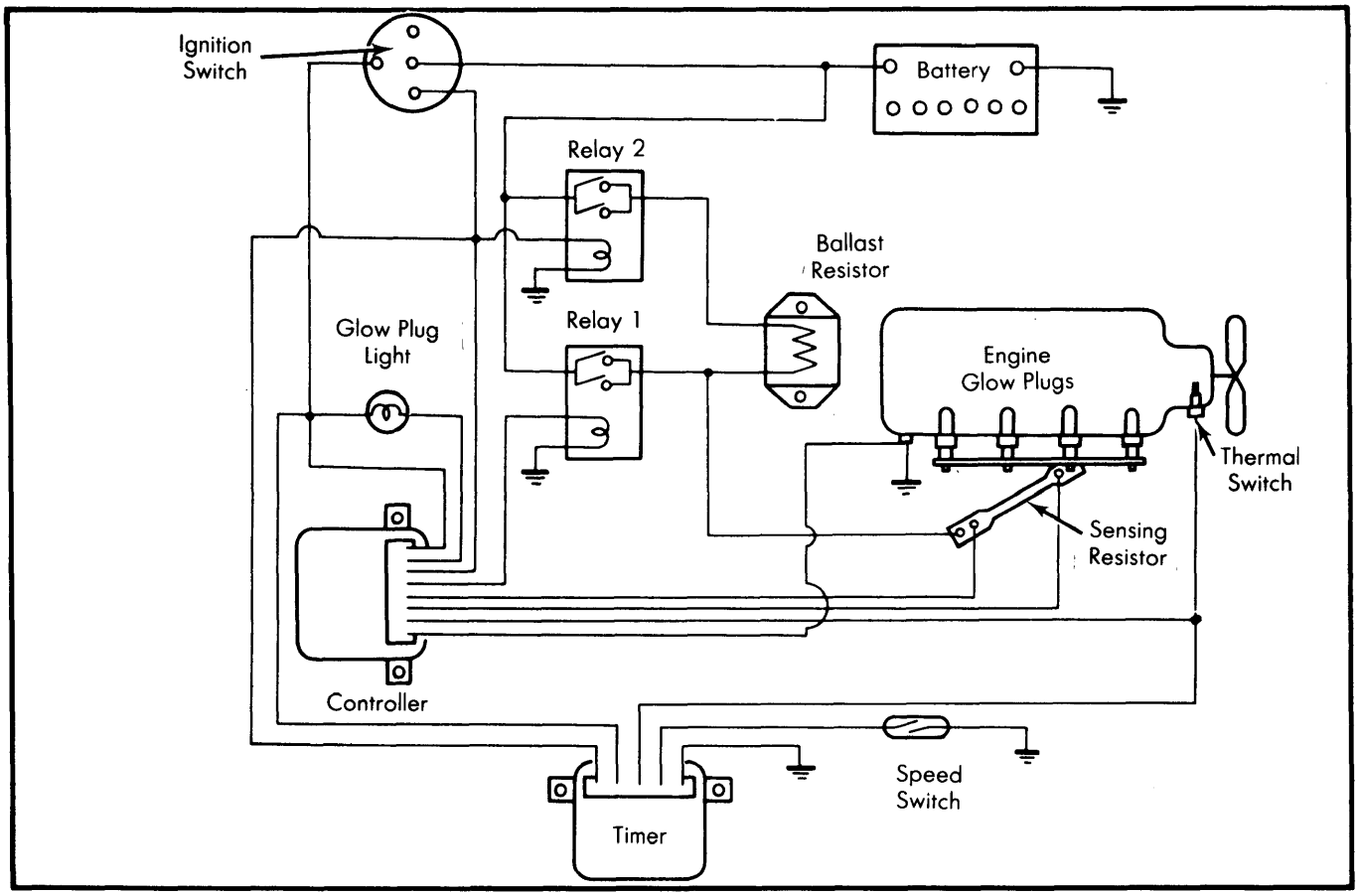

Fig. 2 I-Mark Glow Plug System Wiring Diagram

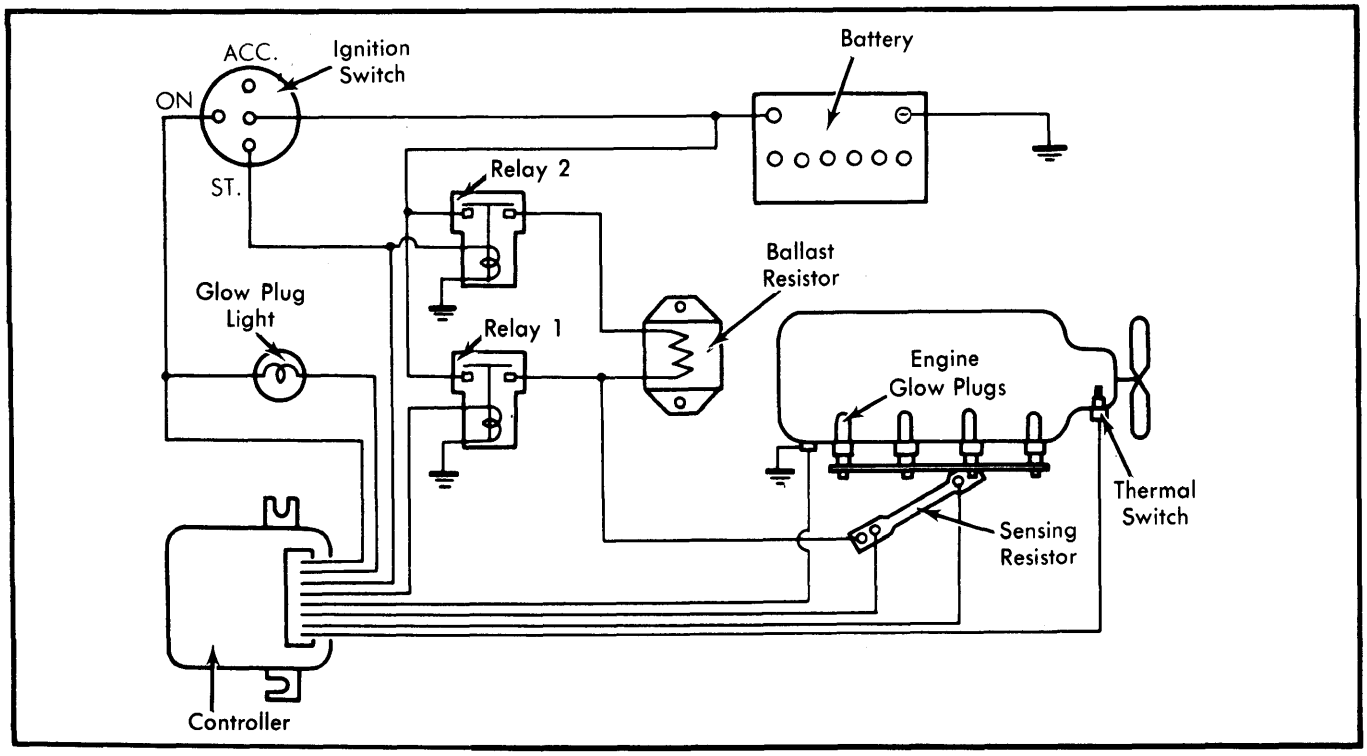

Fig. 3 LUV & P'UP Glow Plug System Wiring Diagram

DIESEL FUEL INJECTION — ISUZU & LUV (Cont.)

TROUBLE SHOOTING

HARD STARTING

Check fuel delivery, injection pump timing and nozzle opening pressures. Check fuel cut solenoid and fuel restrictions. Air leaks.

ROUGH IDLE

Adjust idle speed. Contaminated fuel. Injection timing, nozzle opening pressure or sticking delivery valve in pump.

LACK OF POWER

Air cleaner restriction. Accelerator linkage. Exhaust restriction. Fuel contamination or restriction in lines. Injection timing.

EXHAUST SMOKE

Air cleaner restrictions. Contaminated fuel. Injection timing or nozzle opening pressure.

GLOW PLUG INDICATOR INOPERATIVE

Blown fuse or fusible link. Bad connections at controller. Controller or ignition switch defective.

IMPROPER OPERATION OF GLOW PLUGS

Thermal sensor defective. Controller inoperative. Ignition switch "R" circuit open or intermittent.

TESTING

INJECTION NOZZLES

1) Remove nozzles and connect injection nozzle tester. Pump tester lever about 30 times a minute to observe spray pattern. *See Fig. 4.* If spray is faulty, replace injector.

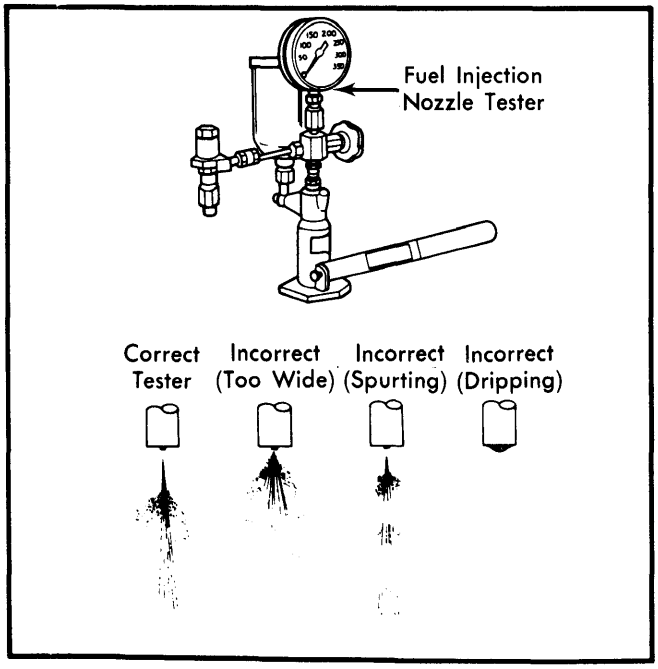

Fig. 4 Injection Nozzle Spray Patterns

2) Pump pressure up slowly to note opening pressure. If not within 1705-1850 psi (120-130 kg/cm²) for I-Mark models or 1495-1635 psi (105-115 kg/cm²) on LUV and P'UP models, injector must be replaced.

NOTE — *When replacing injection nozzles, install parts in this order: ridged washer (with Blue side toward nozzle), gasket, then nozzle holder.*

GLOW PLUG SYSTEM

System Check — 1) Disconnect coolant thermal switch at thermostat housing (front switch). Turn ignition on. Glow plug relay No. 1 (right fenderwell) should make a clicking noise 5-9 seconds after ignition is turned on.

2) Measure voltage between ground and any glow plug terminal. At least 8-9 volts should be present after ignition is turned on.

Glow Plug Relays — No continuity should be present across terminals C and D. With battery voltage applied to terminals A and B, continuity should be present across C and D. If not, replace relay. *See Fig. 5.*

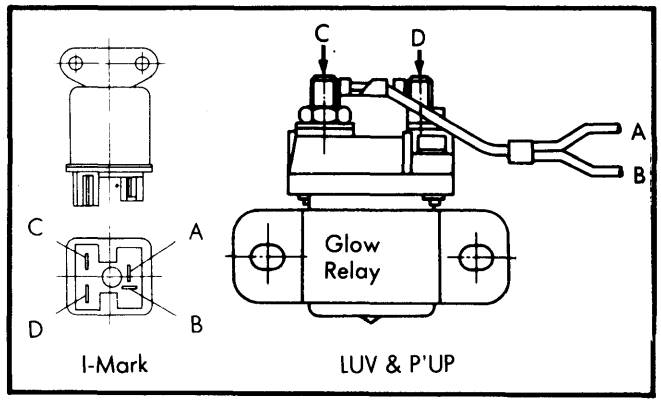

Fig. 5 Glow Plug Relay Testing

Dropping Resistor — Check for continuity across terminals of resistor (in case on fenderwell near battery). If no continiuty, replace resistor.

Glow Plugs — Continuity should exist between plug terminal and top. If not, replace glow plugs.

NOTE — *If one glow plug is defective, all must be replaced as a set.*

Thermal Switch — Continuity should exist when switch is at a temperature lower than 109-122° F (43-50° C). No continuity should exist when above 116-127° F (47-53° C). If switch does not operate properly, replace it.

REMOVAL & INSTALLATION

INJECTION PUMP & TIMING BELT

NOTE — *When the timing belt is loosened or removed, it must be replaced. Do not retension or install a used timing belt.*

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Removal (I-Mark) — 1) Disconnect negative battery cable. Remove panel under engine, drain cooling system and remove fan shroud. Remove fan, fan belts and cooling fan pulley.

2) Remove 10 bolts retaining upper dust cover, then remove dust cover and by-pass hose. Turn engine until No. 1 cylinder is at TDC. Align mark on pump pulley with mark on front plate. *See Fig. 6.* Install a bolt (6mm x 1.25) through hole in injection pump pulley into threaded hole in pulley housing.

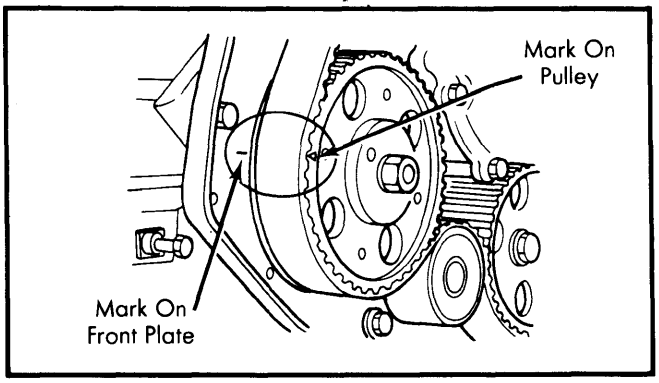

Fig. 6 I-Mark Timing Belt Pulley Alignment

3) Loosen clips and remove air connecting hose, bracket and PCV hose. Remove 3 nuts attaching cam cover and remove cam cover. Loosen rocker arm adjusting screws. Hold camshaft in place by fitting a fixing plate (J-29761) to the slit in rear end of the camshaft. *See Fig. 7.*

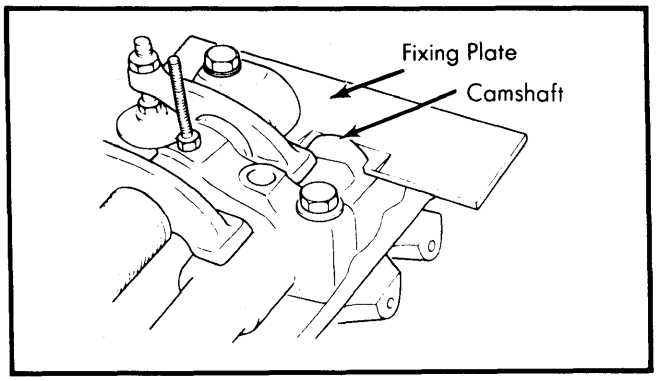

Fig. 7 I-Mark Camshaft Fixing Plate Installation

4) Remove damper pulley, lower dust cover, timing belt holder and tension spring. Loosen tension pulley and plate bolts, then remove timing belt. Remove nut attaching injection pump pulley. Using puller, remove injection pump pulley. Remove lock bolt.

5) Disconnect wiring from fuel cut solenoid valve switch and tachometer pick-up sensor (if so equipped). Disconnect accelerator cable from pump lever. On Auto. Trans. models, disconnect throttle valve control cable from pump lever.

6) On all models, disconnect vacuum hose from actuator of fast idle device and fuel hoses at injection pump. Remove 6 screws attaching injection pipe clips and remove clips. Remove 8 sleeve nuts attaching injection pipe and remove pipe.

7) Remove 4 bolts attaching pump rear bracket and remove bracket. Disconnect control lever spring. Remove 2 nuts attaching injection pump flange. Remove injection pump with fast idle device.

Installation — 1) Install injection pump with fast idle device by aligning notched line on flange with line on front plate. Tighten 4 bolts on rear bracket in sequence. *See Fig. 8.* Ensure that there is no clearance between rear bracket and injection pump bracket.

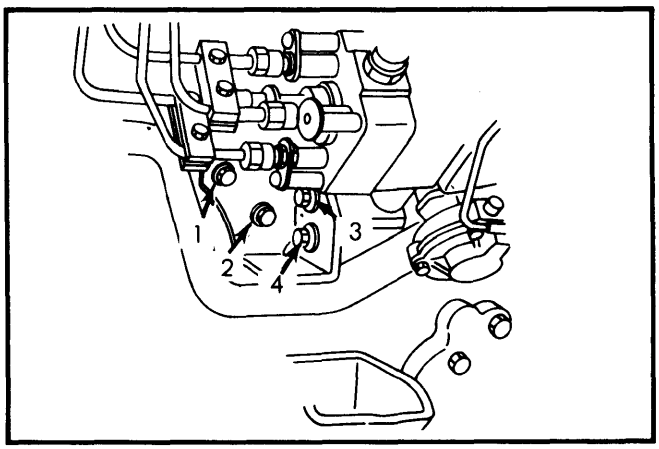

Fig. 8 I-Mark Injection Pump Rear Bracket Bolt Tightening Sequence

2) Install injection pump pulley by aligning it with the key groove. Align mark on pulley with mark on front plate. Using lock bolt, tighten pulley nut. Remove camshaft pulley fixing bolt. Using remover (J-22888), remove pulley from the camshaft, then install pulley on the shaft. Hand-tighten pulley bolts.

3) Install timing belt counterclockwise on crankshaft pulley, idler pulley, camshaft pulley, injection pump pulley, tension pulley, and damper pulley in order. Ensure that cogs on belt and pulley engage properly.

4) Position belt so that slack is in area of tension pulley. Depress tension pulley with finger and install tension spring. Hand-tighten tension pulley plate bolts in sequence shown. *See Fig. 9.*

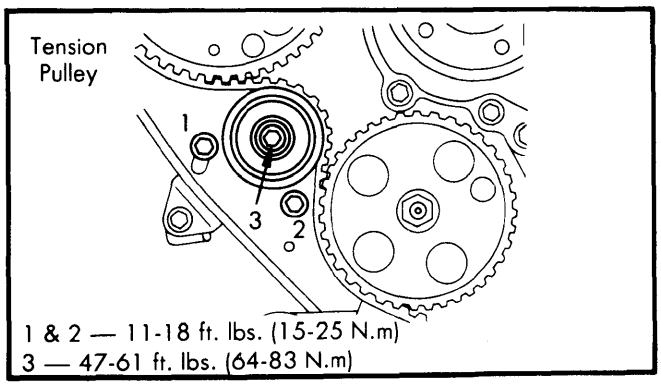

Fig. 9 I-Mark Tension Pulley Bolt Tightening Sequence

DIESEL FUEL INJECTION — ISUZU & LUV (Cont.)

5) Tighten camshaft pulley bolts to 40-47 ft. lbs. (54-64 N.m). Remove injection pump pulley lock bolt and fixing plate on end of camshaft. Install damper pulley on hub. Ensure that No. 1 cylinder is at TDC and that crankshaft is not turned.

6) Tighten tensioner pulley and plate bolts in sequence. *See Fig. 9.* Belt tension between camshaft pulley and injection pump pulley should be 47-64 lbs. (21-29 kg.). Adjust valves and reinstall cam cover. To complete installation, reverse removal procedures.

Removal (LUV & P'UP) — 1) Disconnect battery cables and remove battery assembly. Remove panel under engine, drain cooling system, disconnect coolant hoses and remove fan and shroud.

2) Remove fan belts, air conditioning compressor and crankshaft pulley. Remove both timing belt covers, then remove tension spring and timing belt tension pulley. Remove timing belt. *See Fig 1.*

3) Remove accelerator cable and wiring from injection pump. Using a back-up wrench, remove fuel lines and injection pipes from pump. Install a bolt (6 mm x 1.25) through hole in injection pump pulley into threaded hole in pulley housing. Remove pulley bolts and use a puller to remove injection pulley.

4) Check position of injection pump scribe line relative to mark on front bracket, then remove bolts and injection pump.

Installation — 1) Install injection pump, aligning marks on flange and front bracket. Install injection pump pulley, using holding bolt to keep pulley from turning. Turn engine until No. 1 cylinder is at TDC.

2) Align pulleys so marks are together. *See Fig. 10.* Install timing belt on crankshaft pulley, camshaft pulley and injection pump pulley in order. Position belt so slack is in area of idler pulley.

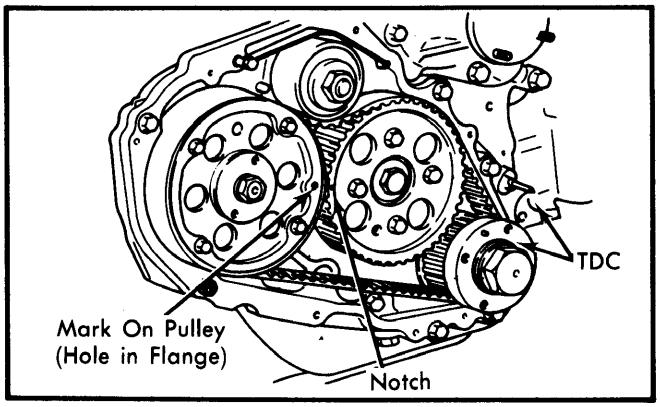

Fig. 10 LUV & P'UP Timing Belt Pulley Alignment

3) Install idler pulley, ensuring base is aligned against 2 pins on timing pulley housing. Hand-tighten pulley nut, then install spring and tighten nut to 22-36 ft. lbs. (30-49 N.m). Turn crankshaft 2 revolutions, then 90° more beyond TDC.

CAUTION — *Always turn engine in firing rotation. Do not rotate in reverse direction.*

4) Loosen tension pulley nut so pulley can take up belt slack, then tighten to specifications. Install injection pump pulley flange so hole in flange is aligned with mark on camshaft pulley. Turn engine 2 revolutions and check that marks are still aligned when No. 1 cylinder is at TDC.

5) Belt tension between injection pump pulley and crankshaft pulley should be 33-55 lbs. (15-25 kg) when measured with tension gauge. To complete gauge. To complete installation, reverse removal procedure and adjust injection timing.

FUEL FILTER

Removal & Installation — 1) Disconnect water sensor wiring at connector. Remove filter cartridge and pour out fuel, then remove water sensor. Install sensor on new filter cartridge.

2) Lubricate gasket with fuel, then install filter cartridge. Tighten $^2/_3$ turn after filter contacts base. Pump hand pump 30-40 times to fill cartridge with fuel. Start engine and check for leaks.

Draining Water — Place container under drain hose. Open drain plug 5 turns and operate pump about 10 times, or until all water is removed from filter. Tighten drain plug and operate pump several times until pressure builds up. Start engine and check that no leaks occur and "FILTER" lamp on dashboard is off.

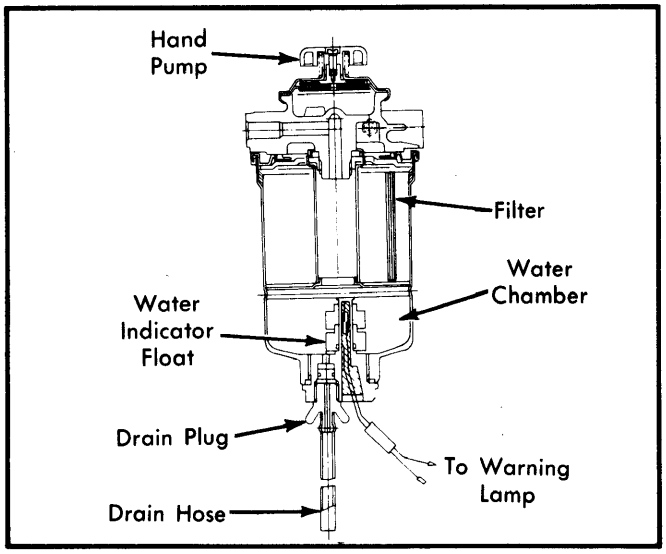

Fig. 11 Fuel Filter and Water Separator

ADJUSTMENTS

INJECTION PUMP TIMING

I-Mark — 1) Check that notch in pump flange is in line with notched line on front plate. Turn engine to position No. 1 cylinder at TDC. Remove injection pump pulley cover (upper front cover) and see that timing marks are aligned. *See Fig. 6.*

2) Remove cam cover and rear plug. Check that fixing plate fits smoothly into slit at rear end of the camshaft, then remove fixing plate. *See Fig. 7.* Disconnect injection pipe from pump (using back-up wrench) and remove distributor head screw.

3) Install timing gauge tool (GM Part No. J-29763) and set lift approximately .04" (1 mm) from the plunger. Turn engine until No. 1 cylinder is 45-60° BTDC, then calibrate dial indicator to zero.

DIESEL FUEL INJECTION - ISUZU & LUV (Cont.)

NOTE – *The crankshaft pulley is provided with a total of 11 notched lines (4 lines in one area and 7 lines in another). The group of 4 is for static timing and should be used for service purposes. The group of 7 is for dynamic timing and used only at the factory.*

4) Turn crankshaft in normal direction of rotation until timing mark (18° BTDC) on crankshaft pulley is in line with indicator. *See Fig. 12.* Dial indicator should show .020" (0.5 mm). If not, loosen pump bolts and rotate pump slightly to obtain proper timing.

LUV & P'UP — 1) Check that notch in pump flange is in line with notch in front bracket. Turn engine to position No. 1 cylinder at TDC. Remove injection pump pulley cover (right half of timing belt cover) and see that timing marks are aligned. *See Fig. 10.*

2) Disconnect injection pipe from pump (using back-up wrench) and remove distributor head screw. Install timing gauge tool (GM Part No. J-29763) and set lift approximately .04" (1 mm) from the plunger.

3) Turn engine until No. 1 cylinder is 45-60° BTDC, then calibrate dial indicator to zero. Turn crankshaft pulley slightly in both directions and ensure that zero reading does not change.

4) Turn crankshaft in normal direction of rotation until timing mark (15° BTDC) on crankshaft pulley is in line with indicator. Dial indicator should show .020" (0.5 mm). *See Fig. 12.* If not, loosen pump bolts and rotate pump slightly to obtain proper timing.

IDLE SPEED

1) Warm engine to normal operating temperature and connect tachometer. Idle speed should be 700-800 RPM on LUV and P'UP models, 575-675 RPM on I-Mark Man. Trans. models or 675-775 RPM on I-Mark Auto. Trans. models. If not, loosen lock nut and adjust idle speed screw.

2) Disconnect vacuum hoses from vacuum switching valve and connect them together using piece of tubing. Fast idle speed should be 900-950 RPM on all models. If not, loosen adjusting nut and adjust with fast idle nut. *See Fig. 13.* Remove hose jumper and reconnect hoses, then remove tachometer.

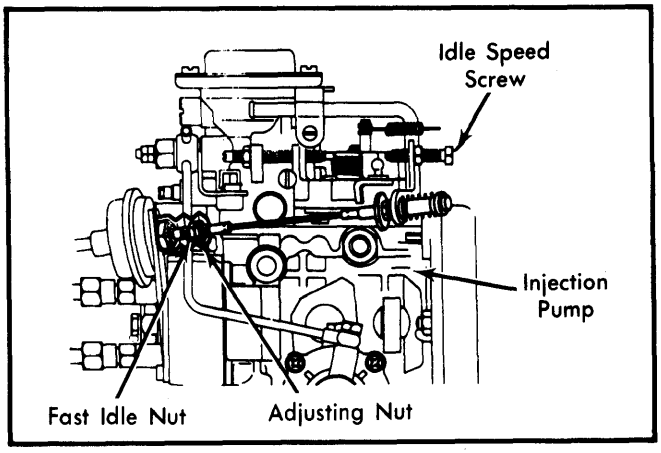

Fig. 13 Idle Speed Adjustments

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Injection Pump Pulley Nut	42-52 (57-71)
Timing Belt Cover Bolts	4-7 (5-10)
Injection Nozzles	51-58 (69-79)

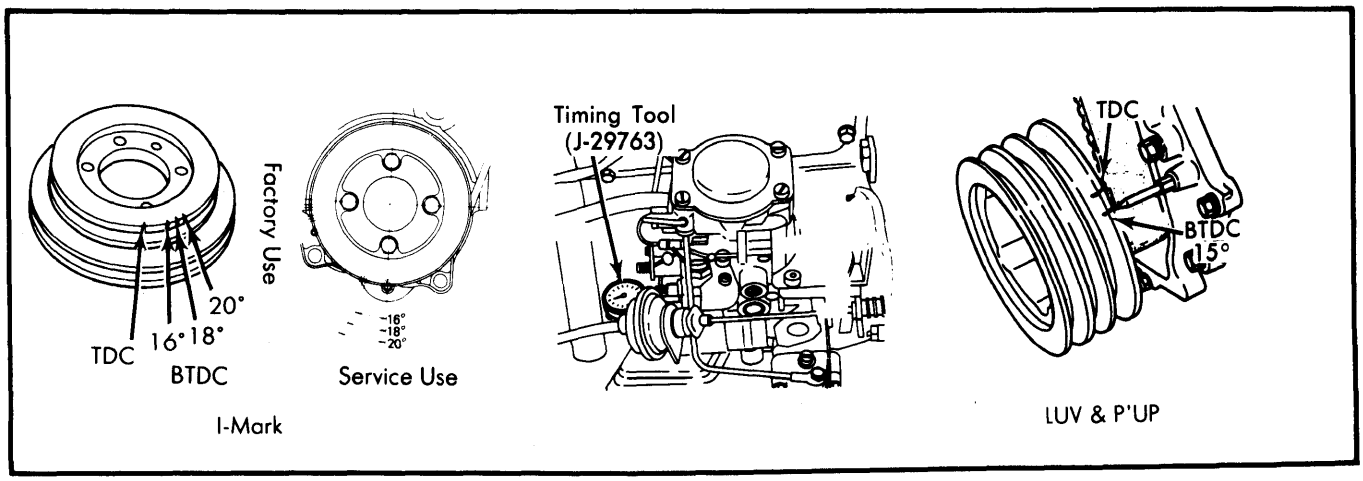

Fig. 12 Injection Pump Timing Adjustment