Date 1-1-89

MC-9 MAINTENANCE MANUAL

SECTION 8

ENGINE

MC-9 MAINTENANCE MANUAL

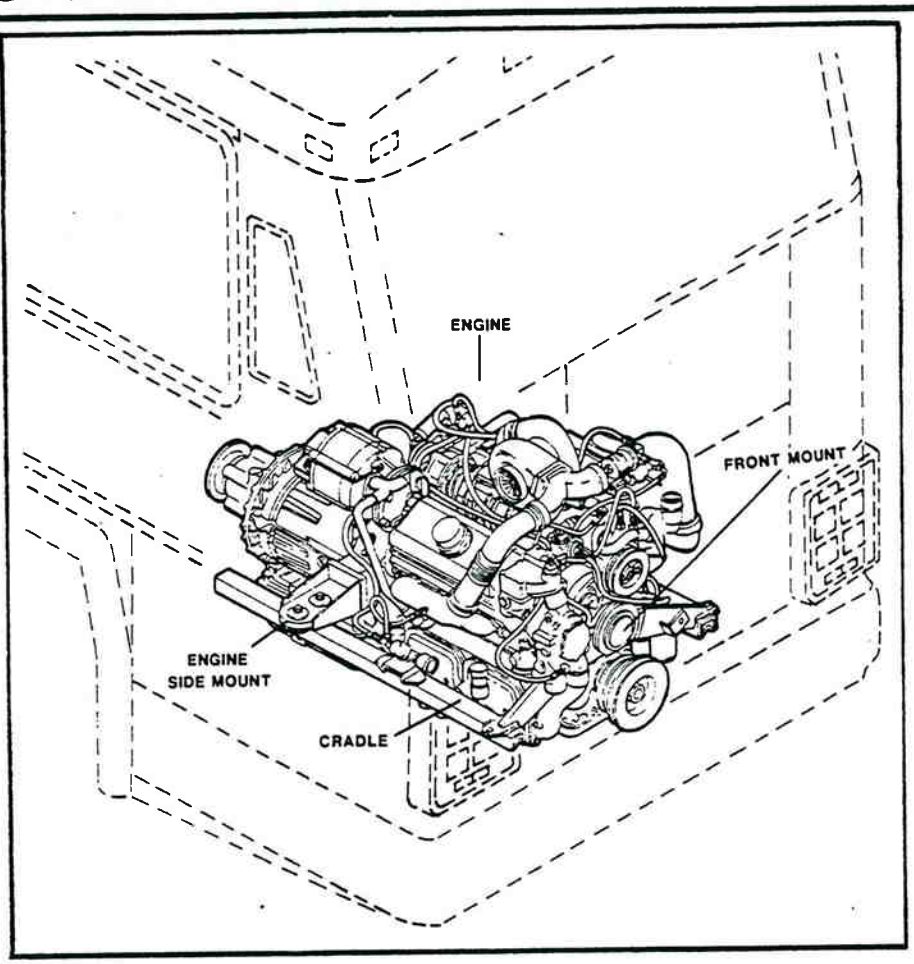

Figure 8-1. Engine Location.

ENGINE

Various Detroit Diesel Engines are used in MC-9 coaches. The 6V-92TA engine is the standard engine; 8V-71 and 8V-92TA engines are optional. Electronically controlled models of the 6V-92TA and the 8V-92TA engines are also used. The general specifications of the engines are shown in the following chart.

Engine Specifications

	6V-92TA	8V-92TA	8V-71
Type	2 Cycle	2 Cycle	2 Cycle
Number of Cylinders	6	8	8
Bore (inches)	4.84	4.84	4.25
Bore (mm)	123	123	108
Stroke (inches)	5	5	5
Stroke (mm)	127	127	127
Comp. Ratio (Nominal) (Turbo. Engines)	17 to 1	17 to 1	—
Comp. Ratio (Nominal) ("N" Engines)	—	—	18.7 to 1
Total Displacement - Cu. In.	552	736	568
Total Displacement - Liters	9.05	12.07	9.32
Number of Main Bearings	4	5	5
Rated Full Load Speed (RPM)	2100	2100	2050

Maintenance and repair information on the engine will be found in the engine manufacturer's service manuals. Engine controls, accessories and related components are covered in the applicable sections of this manual.

Refer to Section 6 (Cooling), 7 (Electrical), 9 (Fuel), and 10 (Lubrication).

To conform with engine manufacturer's practice, TMC/MCI Parts Book, Maintenance Manuals, Service Bulletins and other technical publications identify all engine parts as "L.H.", "R.H.", "Front" or "Rear" when viewing the engine from the flywheel end. This is opposite to the position of these parts with the engine installed in the coach, but the engine manufacturer's designations have been retained to eliminate potential misunderstanding in engine parts identification.

All other parts of the coach are designed "L.H.," "R.H.," "Front" or "Rear" in relation to the normal position of the driver facing forward.

REMOVAL AND REPLACEMENT

The engine unit, including transmission, clutch, air compressor and alternator, may be removed from the coach as a unit for repair to engine or related components. Refer to figure 8-1.

To facilitate removal and replacement of the engine unit and to provide a convenient means of supporting the engine and related components during service work, the use of a dolly is recommended. Such a dolly may be made locally. Refer to tool listings at the end of this section for drawing of dolly.

1. The coach should be driven into a twin-rail hoist and blocks placed between axle bumpers and bumper stops. Dis-

connect height control valve links and pull down to vent air from rear suspension bellows.

2. Drain the engine cooling system as directed in Section 6 of this manual, remove the cooling blower drive belt.

3. Open drain cock and vent air from the brake system. Disconnect the propeller shaft as outlined in Section 14 of this manual. Disconnect transmission and clutch operating linkage. Disconnect clutch cable. Disconnect throttle linkage.

4. Disconnect exhaust muffler slip joint. Disconnect air lines to air compressor governor and fast idle air cylinder.

5. Disconnect electrical connection to speedometer unit (if used), starting motor, starting motor solenoid, alternator, engine controls, tachometer (if used), oil pressure and engine temperature sending units. If the engine is an electronically controlled model (DDEC), disconnect the main DDEC harness from the electronic control module which is on top and to the front of the engine.

6. Disconnect and remove cooling system connections to radiators, surge tank and coach heating system. Disconnect fuel supply and return lines. Remove connections between air cleaner and engine air inlet horn.

7. Remove the air conditioning compressor drive belts. Raise the coach approximately 4-6" (101.6-152.4 mm) above the road height.

8. Remove the clamp bolts securing the engine sub-frame to the coach body. Position the dolly under the engine cradle. Lower the coach body only sufficiently to transfer the weight of the engine onto the dolly.

CAUTION: Due to the minimum clearance between the air compressor and the top of the engine compartment, extreme care should be used to lower the coach body only enough to free the engine cradle. Clearance between engine cradle and coach engine mounting rail should be ⅛-¼" (3.1-6.3 mm).

9. Remove engine assembly as a unit, carefully withdrawing it from the rear of the coach. To reinstall, the procedure is the reverse of the above.

10. Refill cooling system. If engine fuel system has been drained, it will aid restarting if fuel filters are filled with fuel oil. Remove vent plugs and pour fuel oil into filter body until filters are full.

11. Start engine and check operation. Check fuel and cooling system connections for leakage. Test operation of engine controls and accessories.

DIESEL ENGINE LUBRICATING OILS

The oil capacity of coaches equipped with a 6V-92 engine is 30 U.S. quarts (28.28 liters). Coaches equipped with an 8V-71 or 8V-92 engine have an oil capacity of 32 U.S. quarts (30.28 liters). Oil is added through the oil fill tube (figure 8-2).

All diesel engines require heavy-duty lubricating oils. Basic requirements of such oils are lubricating quality, high heat resistance and control of contaminants.

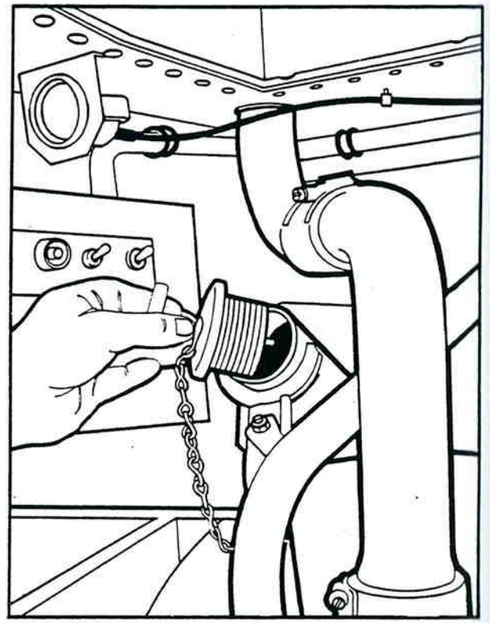

Figure 8-2. Oil Filler Tube.

The reduction of friction and wear by maintaining an oil film between moving parts is the primary requisite of a lubricant. Film thickness and its ability to prevent metal-to-metal contact of moving parts is related to oil viscosity. The optimums for 6V-92, 8V-92 and 8V-71 diesel engines are SAE 40 or 30 weight oil.

Temperature is the most important factor in determining the rate at which deterioration or oxidation of the lubricating oil will occur. The oil should have adequate thermal stability at elevated temperatures, thereby precluding formation of harmful carbonaceous and/or ash deposits.

The piston and compression rings must ride on a film of oil to minimize wear and prevent ring seizure. At normal rates of consumption, oil reaches a temperature zone at the upper part of the piston where rapid oxidation and carbonization can occur. In addition, as oil circulates through the engine, it is continuously contaminated by soot, acids, and water originating from combustion. Until they are exhausted, detergent and dispersant additives aid in keeping sludge and varnish from depositing on engine parts, but such additives in excessive quantities can result in detrimental ash deposits. If abnormal amounts of insolubles form, particularly on the piston in the compression ring area, early engine failure may result.

Oil that is carried up the cylinder liner wall is normally consumed during engine operation. The oil and additives leave carbonaceous and/or ash deposits when subject to the elevated temperatures of the combustion chamber. The amount of deposits is influenced by the oil composition, additive content, engine temperature and oil consumption rate.

LUBRICATING OIL SPECIFICATIONS

Oil quality is the responsibility of the oil supplier. (The term "oil supplier" is applicable to the refiners, blenders and rebranders of petroleum products, and does not include distributors of such products.)

There are many brands of commercial crankcase oil marketed today. Obviously, engine manufacturers or users cannot completely evaluate the numerous commercial oils. The selection of a suitable lubricant in consultation with a reliable oil supplier, observance of his oil drain recommendations (based on used oil sample analysis and experience) and proper filter maintenance, will provide the best assurance of satisfactory oil performance.

Lubricating Oil Recommendation.

API Letter Code Service Classification	Military Specification	SAE Grade
CB	MIL-L-2104A (Supplement 1)	40 or 30
CC	MIL-L-2104B	40 or 30
CD/SC	MIL-L-2104C	40 or 30
CD	MIL-L-45199B (Series 3)	40 or 30
CC/SE	MIL-L-46152	40 or 30
Numerous	Universal	40 or 30

SAE 40 grade oil is recommended in 8V-71 and Series 92 diesel engines. The expected ambient temperatures and engine cranking capability must be considered by the owner-operator when selecting the proper grade of oil. Only when the ambient temperatures and engine cranking capabilities result in difficult starting should SAE 30 grade oil be used.

The 8V-71 and Series 92 engines have given optimum performance and experienced the longest service life with the following oil performance levels having the following ash and zinc limits: The sulfated ash limited (ASTMD-874) shall not exceed 1.000% by weight, except lubricants that contain only barium detergent-dispersant salts where 1.500% by weight is allowed. The zinc content, as zinc diorganodithiophosphate, shall be a minimum of 0.07% by weight.

Lubricants meeting specification MIL-L-46167 are used in Alaska and other extreme sub-zero locations. Generally they may be described as 5W-20 multigrade lubricants made up of synthetic base stock and having low volatility characteristics. Although they have been used successfully in some severe cold regions, they are not considered as desirable as SAE 40, or SAE 30 oils with auxiliary heating aids. For this reason, they should be considered only where engine cranking is a severe problem and auxiliary heating aids are not available on the engine.

POLICY ON LUBRICANT ADDITIVES

TMC/MCI does not recommend or support the use of any supplementary lubricant additives. These include all products marketed as top oils, break-in oils, graphitizers and friction-reducing compounds.

NOTE: TMC/MCI warranty applicable to 8V-71 and Series 92 diesel engines provides in part that the provisions of such warranty shall not apply to any engine unit which has been subject to misuse, negligence or accident. Accordingly, malfunctions attributable to neglect or failure to follow the manufacturer's fuel or lubricating recommendations may not be within the coverage of the warranty.

SERVICE AND INSPECTION INTERVALS

Generally, operating conditions will vary for each engine application, even with comparable mileage or hours and, therefore, maintenance schedules can vary. A good rule of thumb for piston, ring and liner inspection, however, would be at 45,000 miles (54,000 km) or 1,500 hours for the first such inspection and at 30,000 miles (45,000 km) or 1,000 hour intervals thereafter.

A suggested preventive maintenance practice is a regularly scheduled testing of fuel and lubricating oils by either the oil supplier or an independent testing laboratory. Since the oil supplier knows the physical properties of his products and maintains laboratories to determine practical oil drain intervals, take advantage of this service and request him to check drained oil samples frequently and report the results to you.

ENGINE MOUNTS

The engine is mounted to the engine cradle by means of six rubber mounts, two on each side of the flywheel housing and two at the front of the engine (rear of the coach). See figures 8-3 and 8-4.

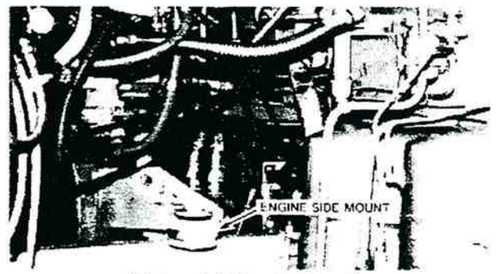

Figure 8-3. Engine Mount.

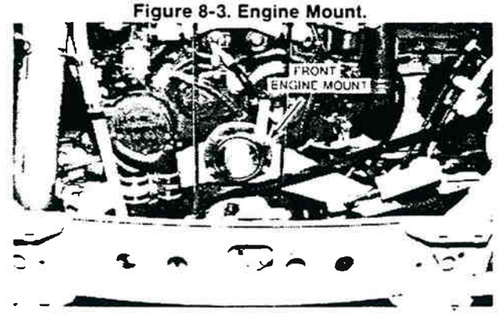

Figure 8-4. Front Engine Mount.

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These rubber mounts should be replaced whenever the engine is removed from the coach (e.g. clutch change, etc.).

The following procedure is recommended for replacement of motor mounts:

1. Remove the existing rubber mounts from brackets.
2. Lubricate new rubber mounts with water and place in position between bracket and engine cradle. By use of a small jack under the cradle, the mounts may be installed in engine bracket.

CAUTION: To properly insert the engine mounts, only water should be used as a lubricant. Insertion of the mounts into the socket using glycerine or any other lubricant will result in the tail of the mounts flaring out with the rubber rupturing or a potential rupture after each installation.

3. Install engine mount bolts with new retaining washer but do not tighten until the full weight of engine is bearing on cradle assembly.

Improper installation of the press fit type motor mounts can contribute to excessive engine vibration. When new mounts are installed, mount bolts should be left loose until engine can be run for a short period of time. If engine is accelerated a few times, the rubber mount will find its correct position and then mount bolts can be torqued and cotter keys installed.

4. When reinstalling the engine cradle assembly, the body tie bar should be installed before attempting to tighten cradle U-bolts. the center U-bolts should be tightened first.

If motor-mount studs are being installed in the transmission case, turn the studs in until they "shoulder out." Check to ensure each stud has reached full thread engagement and snug up no more than ¼ turn. Motor-mount bracket and hardware can then be installed. Tighten lock nuts to 170-198 ft. lbs. (231-268 Nm) torque.

TWO SPEED GOVERNOR ADJUSTMENT (Mechanically Controlled Engines)

The service procedure below provides the necessary inspection instructions for obtaining the maximum operating efficiency of the two speed governor (figure 8-5). This procedure should be accomplished every 30 months or every 50,000 miles (80,000 km), as part of regular coach maintenance.

The engine speeds specified in this procedure are recommended as follows: High maximum no-load speed 2250 rpm; low maximum no-load speed 1850 rpm. The 2250 rpm is achieved by a shim pack inside the two speed governor. Adding shims increases the high maximum no-load and taking shims out decreases the speed. The low maximum no-load engine speed is achieved by an adjusting screw (see figure 8-6).

NOTE: The 2250 rpm is required for coaches equipped with the later version automatic transmission (HT-740), unless the transmission shift points have been adjusted downward. The 1850 rpm will give a coach top speed of approximately 67 mph when equipped with a 3.33:1 rear axle.

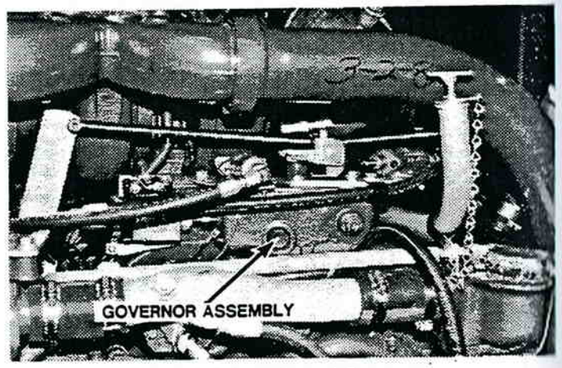

Figure 8-5. Location of Governor.

Figure 8-6.

1. The engine injector control levers should be set in accordance with DDA Service Manual 6SE350, Section 14.3. Make sure the fast idle cylinder projects ⅝" (15.88 mm) from the lock nut to prevent interference while adjusting the maximum no-load speeds.
2. Start the engine and allow it to reach normal operating temperature.
3. Refer to figure 8-6. Disconnect the air line to the two speed governor spring housing.
4. Set the speed control lever (figure 8-7) in the maixmum speed position. Using a tachometer, check and record the engine rpm. This is the maximum no-load low engine speed (approximately 1850 rpm) which will be restored at the end of this procedure.

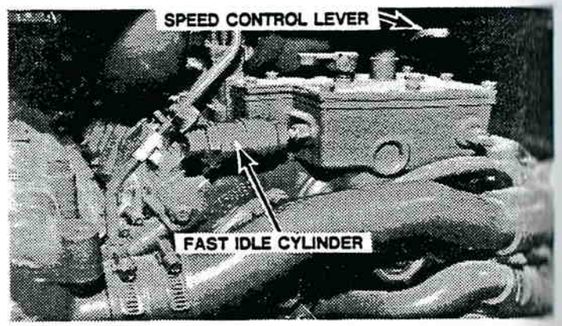

Figure 8-7. Control Lever and Fast Idle Cylinder.

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5. Return the speed control lever to the low speed setting and turn the engine off.
6. Connect the air line previously removed from the governor spring housing.
7. Start the engine and place the speed control lever in the maximum position. Check and record the engine rpm (maximum no-load high engine speed — recommended to be 2250 rpm). Turn the engine off.
8. Determine the shims required for the 2250 high maximum no-load engine speed. Each 0.010-inch shim added to or taken from the shim pack will respectively increase or decrease engine rpm 10 rpm. Shims 0.100-inch thick change engine speed approximately 100 rpm.

NOTE: The shim pack is inside the two speed governor. DDA part number of the 0.010-inch shim is 5123922. The 0.100-inch shim's part number is 5123923.

9 Disconnect the air line to the governor spring housing. Cut and remove the lock wire that is routed through the mounting capscrews an the low maximum no-load adjusting screw.

CAUTION: When removing the two speed governor, use care not to damage the governor mounting gaskets. Also, keep the internal parts within the housing during removal.

10. Remove the two capscrews mounting the housing to the governor and remove the housing. Refer to figure 8-8.
11. Place the housing on a clean work surface and separate the retainer and sleeve from the piston. The shim pack is located inside the piston, between the piston and the sleeve.
12. Add to the shim pack (or take from it) the number of shims necessary for a high maximum no-load speed of 2250 rpm. Reassemble the shims, sleeve, retainer and piston in the housing.
13. Install the housing with the gaskets on the governor and connect the air line.
14. Place the main battery switch in the ON position.
15. Start the engine and allow it to reach normal operating temperature.
16. Place the speed control lever in the high speed position and check for the recommended high maximum no-load speed (2250 rpm) with the tachometeer. If the speed is too high or too low, repeat steps 7 thru 16 to add or take out shims..
17. Place the speed control lever in the low position and turn off the engine.
18. Disconnect the air line to the governor spring housing and start the engine.
19. Place the speed control lever in the high speed position and check the low maximum no-load speed with the tachometer. Adjust the low maximum no-load speed adjusting screw (on the governor spring housing) for 1850 rpm or the engine speed that was recorded in step 4.
20. Reconnect the air line to the housing and install the locking wire.

NOTE: Major changes in the shim pack thickness may change the settings of the governor gap, injector rack control levers, idle speed and buffer screw. Refer to section 14 of the applicable DDA engine manual to adjust the above items.

21. Adjust idle speed screw (figure 8-9) until the engine rpm is approximately 15 rpm below recommended idle speed (650 rpm with automatic transmission; 500 rpm with manual transmission).

NOTE: Use of the fast idle cylinder may be required to eliminate engine roll. After idle speed is established, back out the cylinder to the previous setting of ⅝" (15.88 mm).

22 Hold the idle screw and tighten the lock nut (figure 8-9)
23 Install the high speed spring retainer and tighten to two bolts (figure 8-8).
24. Turn the fast idle cylinder inward so it contacts the differential lever as lightly as possible while still eliminating engine roll.

NOTE: Do not increase engine idle speed more than 15 rpm with fast idle cylinder.

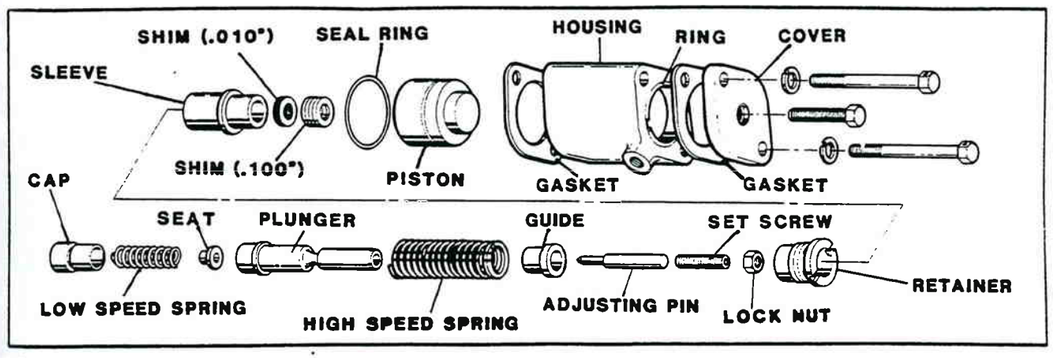

Figure 8-8. Governor Parts Breakdown.

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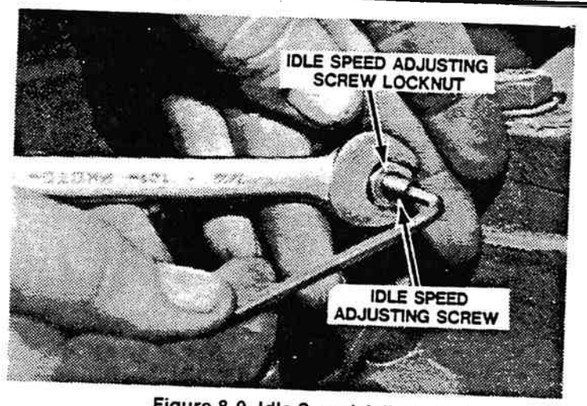

Figure 8-9. Idle Speed Adjustment.

25. Recheck the maximum no-load speeds. If increased more than 25 rpm, back off the fast idle cylinder until the increase is less than 25 rpm.

TWO SPEED GOVERNOR HIGH SPEED SPRING REPLACEMENT

HT-740 automatic transmissions may not shift from third to fourth gear under full throttle if the high speed spring in the two speed governor has "taken a set." When this occurs, the engine maximum no-load speed may be reduced to affect the full-throttle upshift from third to fourth.

No transmission problems are associated with this condition. If engine maximum no-load speed is less than the recommended 2250 RPM, the new high speed spring will increase the speed.

New springs can be ordered from Detroit Diesel Allison, part number 23501874. The replacement springs are color coded with red and brown paint on one side of the spring.

Read the entire procedure before starting.

1. Refer to figure 8-10. Disconnect the air line to the two-speed governor housing.
2. Cut and remove the lock wire that is routed through the mounting capscrews and low maximum no-load adjusting screw.

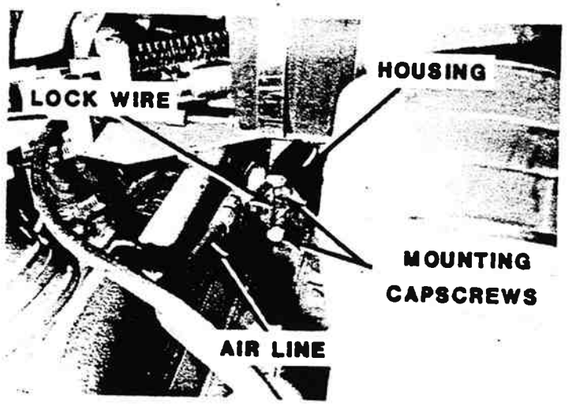

Figure 8-10.

CAUTION: Exercise care in removing the spring housing so that the mounting gaskets are not damaged.

3. Remove the two capscrews mounting the housing to governor and remove the housing. Keep the internal parts within the housing when removing the housing from the governor.
4. Remove any cylinders and/or auxiliary devices mounted on the governor cover.
5. Remove the eight cover screws and lift the governor cover, with the stop lever and cover gaskets, from the governor.

CAUTION: The retainer to be removed in Step 6 is under spring tension from inside the governor. Use adequate counter-force when removing it to prevent the expulsion of parts due to internal spring pressure.

6. Refer to figure 8-8. Remove the spring retainer from the governor governor by rotating it counterclockwise. Use DDA special tool J-1652-01.
7. Refer to figure 8-8. Remove the two-speed governor spring assembly from inside the governor. Keep the parts intact as you guide them through the hole in the governor wall.
8. Disassemble the parts necessary to isolate and remove the high-speed spring. Do not change the location of the lock nut on the set screw.
9. Replace the old spring. Check that the color code on the new spring is red and brown.
10. Reassemble the parts. Make sure the adjusting pin seats properly in the plunger (figure 8-8). Insert the assembly through the hole and into position inside the governor.
11. Place the retainer over the spring and compress it to start the threads into the hole of the governor. Tighten the retainer securely.
12. Install a new gasket P/N 8924869 and reinstall the governor cover with the eight bolts.
13. Install the spring housing with the gaskets on the governor. Connect the air line.

NOTE: Replacing the high speed spring may change the settings of the Governor Gap, Injector Rack Control Levers, Maximum No-Load Engine Speed, Idle Speed and Buffer Screw. Refer to section 14 of the applicable DDA engine maintenance manual to adjust the above items.

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14. Start the engine and check for normal operation.
15. Stop the engine and install a new locking wire. This completes the procedure.

FAST IDLE OVERRULE AND ENGINE SHUT-DOWN VALVES AND CYLINDERS

REMOVAL AND DISASSEMBLY

CAUTION: When removing air lines, loosen connections slowly to vent air pressure.

1. Disconnect air pressure lines from valves and cylinders.
2. Remove quick-disconnect plug from valves.
3. Remove stud nuts retaining valves to mounting bracket
4. Remove screws retaining cylinder to governor cover.
5. Remove cap from piston rod.
6. Pull piston and rod assembly out of cylinder.
7. Reverse for assembly.

INSTALLATION

1. Mount valves and air cylinders as shown in figure 8-12.
2. Install bell cranks and adjust to have 1/32" (.79 mm) clearance with piston extended.
3. Install air supply lines, quick disconnect plugs, ground terminals and clip to left-hand cylinder head.

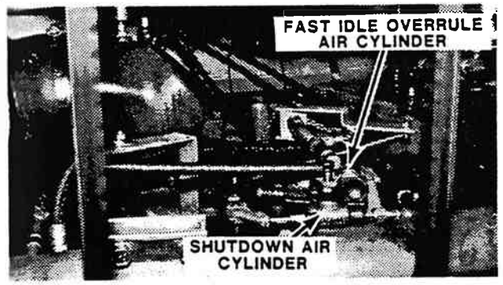

Figure 8-12. Engine Control System.

SENDING UNIT MANIFOLD

The sending unit manifold is mounted in the engine compartment upper frame to provide additional protection to sending units.

Figure 8-13 shows the manifold with the 3 lb. oil tell-tale sending unit, oil pressure gauge sending unit and the manual oil pressure gauge.

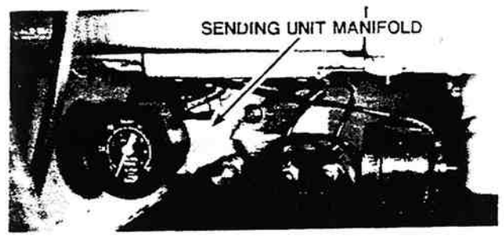

Figure 8-13. Sending Unit Manifold.

COLD WEATHER ETHER START SYSTEM

DESCRIPTION

Cold weather starting is facilitated by the injection of ether into the engine. Ether travels through a line from the ether solenoid valve to an atomizer which is installed in the engine blower housing. A replaceable ether bottle is connected to the solenoid valve.

OPERATION

The coach must be in the start mode (main switch "ON") and the ether switch at the driver's instrument panel must be depressed before the ether injection process will occur. The ether start switch is wired to the starting circuit and becomes inoperative after the engine is running and fuel pressure reaches 9 p.s.i., preventing ether injection during normal engine operation. Additionally, the ether system thermostat, which is surface mounted at the water pump housing, must be sensing a temperature of 60° +6°F before the solenoid valve will open and allow ether to flow to the engine. Refer to the wiring diagram for the ether start system in Section 7 of this manual.

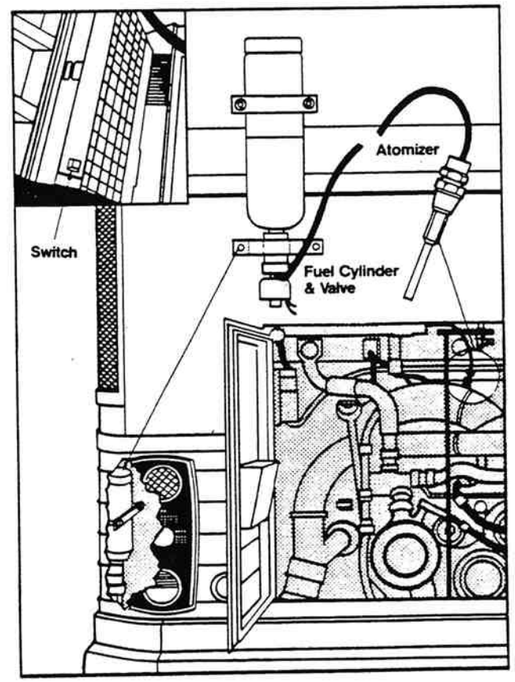

Figure 8-14. Pressurized Ether Starting System.

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MISCELLANEOUS ENGINE TORQUE VALUES

(For complete engine specifications refer to the appropriate Detroit Diesel Engine Service Manual.)

Crankshaft Pulley Bolt ..... 300 lb-ft (407 N·m)
Crankshaft Pulley to Hub Bolts ..... 35 lb-ft (47 N·m)
Front Motor Mount Bolts (8V-92)
(Rear of Coach) ..... 180 lb-ft (244 N·m)
Rear Motor Mount Bolts (8V-92) ..... 225 lb-ft (305 N·m)
Front Motor Mount Bolts (6V-92 & 8V-71)
(Rear of Coach) ..... 30 lb-ft (41 N·m)
Rear Motor Mount Bolts (6V-92 & 8V-71) ..... 225 lb-ft (305 N·m)

FAST IDLE SOLENOID AND CYLINDER SPECIFICATIONS

Solenoid
Manufacturer ..... Bendix
Model V50-4-90
Voltage 24
Air Cylinder
Manufacturer ..... Bendix
Model 3361-2