

# **SEMITRAILER, TANK, WATER, HEAVY, MC4 - FRUEHAUF 37 000 LITRE MEDIUM GRADE REPAIR**

This instruction is authorised for use by command of the Chief of Army. It provides direction, mandatory controls and procedures for the operation, maintenance and support of equipment. Personnel are to carry out any action required by this instruction in accordance with EMEI General A 001.

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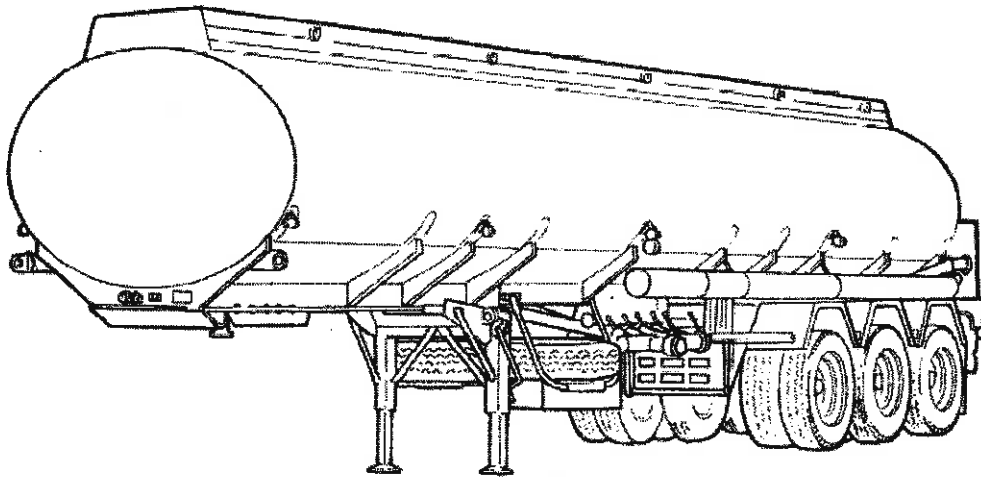
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## INTRODUCTION



**Figure 1 Semitrailer, Tank, Water, Heavy, MC4 - Fruehauf 37 000 Litre**

1. This instruction details all the Medium Grade Repair procedures for the Semitrailer, Tank, Water, Heavy, MC4 - Fruehauf 37 000 Litre (Figure 1).

### Associated Publications

2. Reference may be necessary to the latest issue of the following documents:
  - a. Defence Road Transport Instructions (DRTI);
  - b. Record Book for Service Equipment TGM 120;
  - c. Simplex Complete Equipment Schedules (SCES) 12079;
  - d. Repair Parts Scale (RPS) 02200;
  - e. DEF(AUST)206F - Petroleum, Oils and Lubricants Handbook;
  - f. Other EMEI:
    - (1) Workshop E 410 - Occupational Health and Safety Instruction - Asbestos;
    - (2) Vehicle A119-24 - Repair of Vehicles Under Warranty Agreement - Policy Instruction;
    - (3) Vehicle H 710 - Semi - Trailer, Tank, Water, Heavy, MC4, Fruehauf 37 000 Litre - Data Summary;
    - (4) Vehicle H 712 - Semi - Trailer, Tank, Water, Heavy, MC4, Fruehauf 37 000 Litre - Technical Description;
    - (5) Vehicle H 713 - Semi - Trailer, Tank, Water, Heavy, MC4, Fruehauf 37 000 Litre - Light Grade Repair; and
    - (6) Vehicle H 719 - Semi - Trailer, Tank, Water, Heavy, MC4, Fruehauf 37 000 Litre - Servicing Instruction.

### Rotables Identification

3. The location of identification numbers of Rotables is in Table 1.

**Table 1 Location of Identification Numbers on Rotables**

Serial	Rotables	Identification Number Location
1	Axle number	Stamped on the axle
2	Engine number	Stamped on the identification plate and on the crankcase

## Safety Precautions

### WARNING

Jacked vehicles **MUST** be positioned on axle stands prior to any work commencing. Failure to comply may result in serious injury or death.

### WARNING

Eye protection **MUST** be worn when using compressed air.

### WARNING

Brake linings may contain asbestos. If asbestos is present linings are to be handled in accordance with EMEI Workshop E 410.

## MEDIUM GRADE REPAIR

### Special Tools and Gauges

4. The removal of the valve rocker shaft and engine fly wheel, removal and installation of the crankshaft bearings and tow coupling jaw bushes require the use of special tools. The special tools required are listed in Table 2 and illustrated in Figure 2.

Table 2 Special Tools

Serial	Part Number/Item Name	Paragraph Number	Use
1	7276-3595-040 Rocker shaft puller	10.h	Removal of the valve rocker shaft
2	7271-3595-048 Flywheel puller	11.cc	Removal of the engine flywheel
3	7271-3595-047 Bearing puller	13.c, 14.a, 14.d	Removal and installation of the crankshaft bearings
4	39-010 Puller kit	48.d, 48.e, 49.a, 49.b	Removal and installation of tow coupling jaw bushes

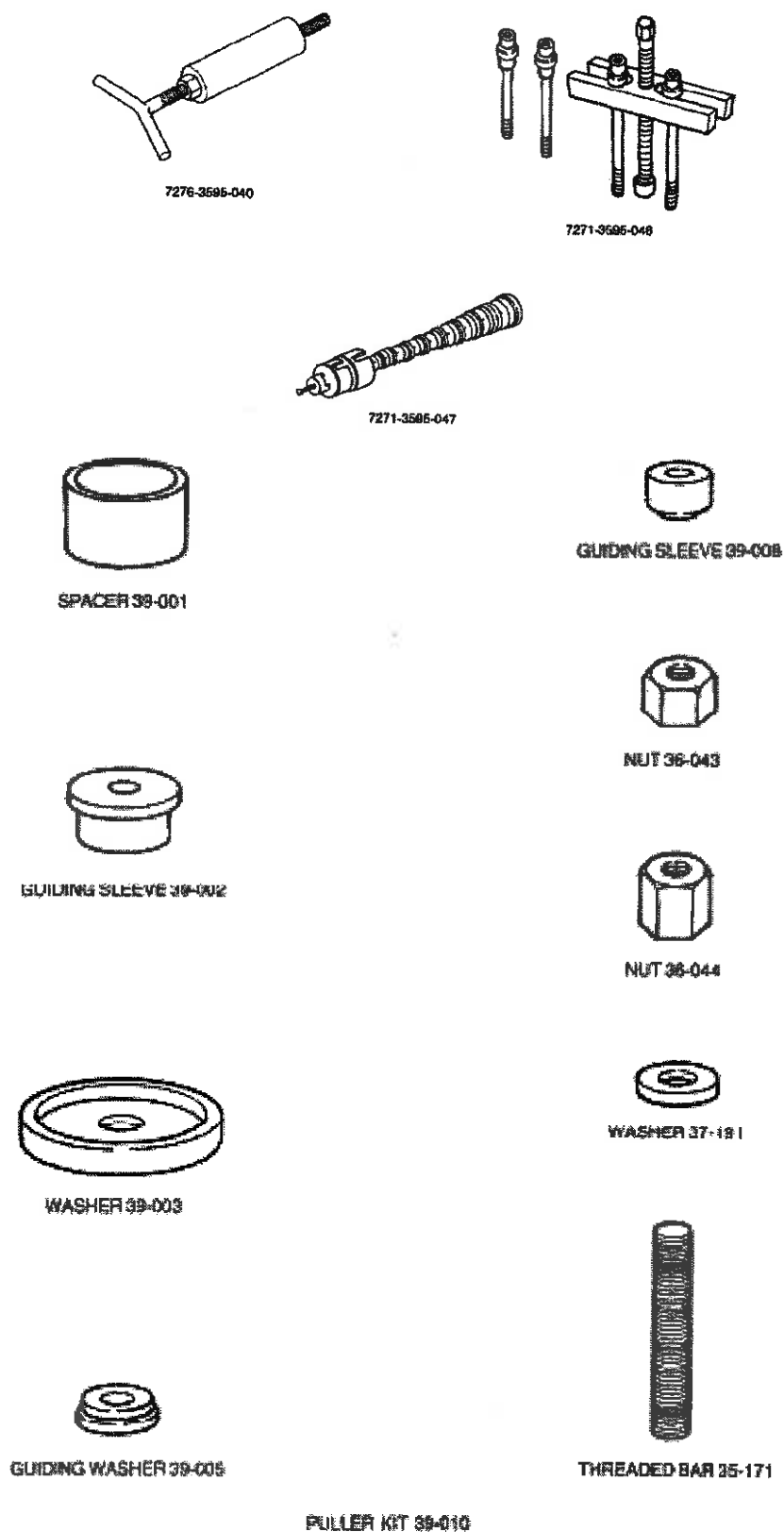


Figure 2 Special Tools

### List of Lubricants

5. The list of lubricants for use on the Semitrailer, Tank, Water, Heavy, MC4 - Fruehauf 37 000 Litre is in Table 3.

**Table 3 List of Lubricants**

Serial	Equipment	Lubricant	Capacity (Litres)
1	King pin	XG-291	As required
2	Apron plate	XG-291	As required
3	Support leg gears	XG-276	As required
4	Support legs (inner)	OMD-115	As required
5	Slack adjuster	XG-291	As required
6	Camshaft bushes	XG-276	As required
7	Wheel bearings	OEP-220	0.65
8	Tow coupling (nut)	XG-291	As required
9	Toolbox hinges	OMD-115	As required
10	Power unit	OMD-115	1.65
11	Air cleaner	OMD-115	0.20

### ENGINE - GROUP 1

#### Engine

6. **Removal.** Remove the engine as follows:
- Attach overhead lifting equipment to the engine enclosure and take up the slack.
  - Disconnect the hoses from the pump outlet pipe and priming pump.
  - Remove the locknuts securing the engine enclosure mountings to the mounting brackets.
  - Remove the nuts and bolts securing the engine mounting brackets to the enclosure base plate.
  - Carefully lift the enclosure assembly from the enclosure mounting brackets.
  - Lower the assembly onto two suitably sized blocks of wood.
  - Remove the lifting equipment.
  - Remove the screws and nuts securing the engine enclosure end cover (water pump end).
  - Move the cover outwards to gain access to the inlet pipe flange bolts.
  - Remove the nuts securing the inlet and outlet pipe flanges to the pump housing.
  - Attach the lifting equipment to the engine and pump assembly.
  - Remove the assembly from the enclosure.
7. **Installation.** Install the engine as follows:
- Position the engine and pump assembly in the enclosure.
  - Position the neoprene gaskets on the inlet and outlet flanges.
  - Install the flange retaining nuts.
  - Tighten the nuts securely.
  - Position the end cover on the enclosure.
  - Install the screws and nuts and tighten them securely.
  - Attach the lifting equipment to the enclosure.

- h. Carefully lift the enclosure into position on the enclosure mounting brackets.
- i. Align the engine mounting bracket bolt holes with the bolt holes in the enclosure base plate.
- j. Install the bolts with new locknuts.
- k. Tighten them securely.
- l. Install new locknuts on the enclosure mountings.
- m. Tighten them securely.
- n. Reconnect the hoses to the pump outlet pipe and priming pump.
- o. Close the enclosure covers.

#### **Oil Pan (Sump Gasket)**

- 8. Replacement.** Replace the oil pan (sump gasket) as follows:

- a. Remove the engine assembly from the engine enclosure (Paragraph 6.).

#### **WARNING**

**Eye protection must be worn when using compressed air.**

- b. Wash the area around the oil pan with a cleaning agent.
- c. Blow it dry with compressed air.
- d. Drain the oil from the oil pan into a container.
- e. Remove the twelve bolts and washers securing the oil pan to the crankcase.
- f. Remove the oil pan and discard the gasket.
- g. Remove all trace of gasket material from the oil pan and the crankcase.
- h. Clean the oil pan thoroughly.
- i. Place a new gasket on the oil pan.
- j. Position the oil pan on the crankcase and install the twelve washers and bolts.
- k. Torque the bolts to 25 N.m (18 lbf.ft).
- l. Replenish the engine with clean engine oil, before installing the engine assembly into the enclosure.
- m. Install the engine assembly in the enclosure (Paragraph 7.).

#### **Cylinder Head**

- 9. Removal.** Remove the cylinder head as follows:

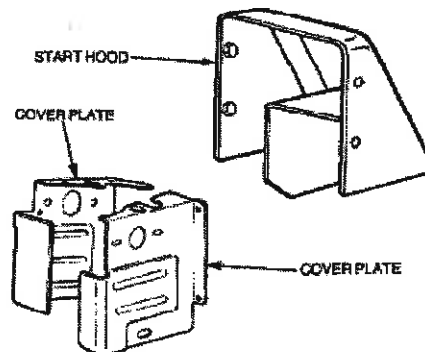
- a. Remove the engine and pump assembly from the engine enclosure (Paragraph 6.).

#### **WARNING**

**Eye protection must be worn when using compressed air.**

- b. Clean the engine assembly with a cleaning agent.
- c. Blow the assembly dry with compressed air.
- d. Remove the fuel tank (Ref EMEI Vehicle H 713 - Group 4).
- e. Remove the nuts securing the muffler to the engine.
- f. Remove the muffler.

- g. Discard the gasket.
- h. Remove the air cleaner assembly (Ref EMEI Vehicle H 713 - Group 4).
- i. Remove the two cover plates and the start hood (Figure 3).



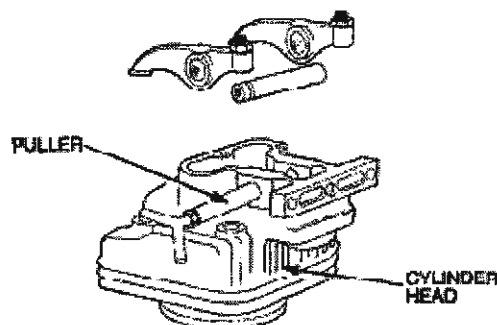
**Figure 3 Engine Covers - Removal**

- j. Remove the fuel injector (Ref EMEI Vehicle H 713 - Group 4).
  - k. Remove the four nuts and washers securing the cylinder head to the cylinder.
  - l. Remove the head.
  - m. Discard the gasket.
10. **Overhaul Procedure.** Overhaul the cylinder head as follows:
- a. Remove the two Allen head bolts, securing the valve cover to the cylinder head.
  - b. Remove the valve cover
  - c. Discard the gasket.

**WARNING**

**Eye protection must be worn when using compressed air.**

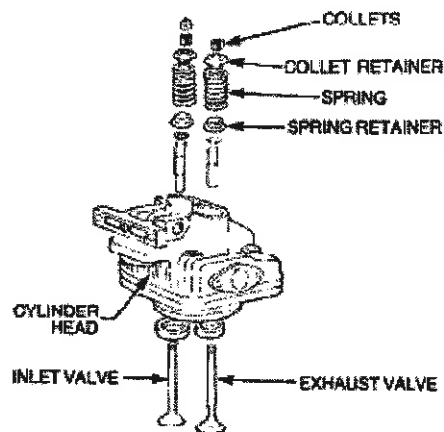
- d. Thoroughly clean the cylinder head and components in a cleaning agent.
- e. Blow them dry with compressed air.
- f. Slacken the nut securing the rocker shaft locking bolt.
- g. Unscrew and remove the bolt.
- h. Install special tool 7276-3595-040 rocker shaft puller (Figure 4) into the end of the rocker shaft.
- i. Using an open-ended spanner, lock the nut against the pipe section.



**Figure 4 Rocker Shaft Puller**

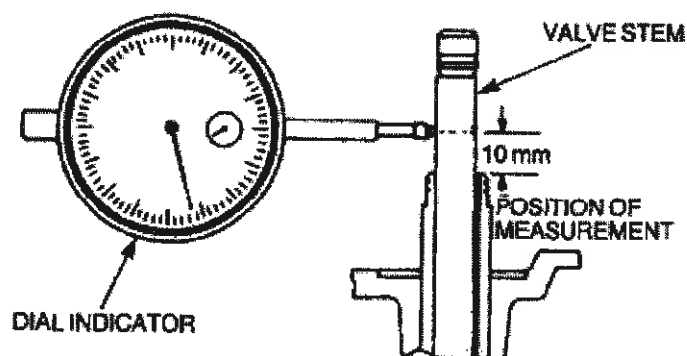


- j. Hold the nut firmly against the pipe section of the tool.
- k. Rotate the puller T-bar in a clockwise direction and withdraw the rocker shaft from the cylinder head.
- l. Remove the valve rocker arms from the cylinder head.
- m. With a set of vernier calipers, measure the internal diameter of the rocker arm and the diameter of the rocker shaft.
- n. If the difference between the two exceeds 0.1 mm (0.004 in), replace the rocker arm and shaft assembly.
- o. Using a valve spring compressor, compress the valve springs and remove the collets (Figure 5).
- p. Remove the valve spring compressor.
- q. Remove the collet retainer, the spring, the spring retainer and the valve.



**Figure 5 Valve - Removal**

- r. Check the cylinder head for distortion using a straight edge and feeler gauges.
- s. If the distortion exceeds 0.1 mm (0.004 in) the cylinder head will require machining.
- t. The head may be machined to a maximum of 0.3 mm (0.012 in).
- u. Check the valve guides for wear by installing the valves in their respective guides.
- v. Using a dial indicator as shown (Figure 6), push the stem back and forth against the dial indicator plunger.
- w. The standard clearance for both the inlet and exhaust valve guides is 0.03 to 0.08 mm (0.001 to 0.003 in). The maximum wear limits for the guides is 0.15 mm (0.006 in).
- x. Replace the valve guides if the clearance exceeds the maximum limit.



**Figure 6 Measuring Valve Guide Wear**

- y. If the valve guides require replacing, use a hammer and punch and remove the valve guides from the cylinder head (Figure 7).

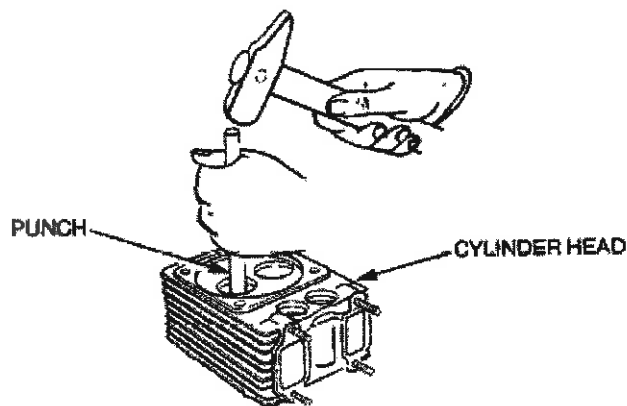


Figure 7 Valve Guide - Removal

**WARNING**

During this procedure care must be taken to avoid personal injury.

- z. Place the cylinder head in an oven and heat the cylinder head to a temperature of 160 to 180°C (320 to 360°F).
- aa. Using a pair of gloves remove the cylinder head from the oven.
- bb. Position the valve guides on the cylinder head.
- cc. Using a hammer and punch install the valve guides.
- dd. Check the valve contact width of the valve seat.
- ee. If the contact width exceeds the 2.0 mm (0.079 in) limit, insert the valve in the port ensuring that the valve head thickness (Figure 8) is between 0.6 to 0.8 mm (0.024 to 0.031 in).
- ff. Measure the amount of depression between the cylinder head surface and the head of the valve (Figure 9).
- gg. The standard dimension is 0.55 to 0.95 mm (0.022 to 0.037 in) and the maximum limit is 1.65 mm (0.065 in).
- hh. If the dimension is within these limits, carefully grind or cut the valve to obtain the correct contact width.
- ii. Recheck the amount of depression.
- jj. If the depression exceeds 1.65 mm (0.065 in) or if cracks or surface imperfections are evident, replace the valve seat.

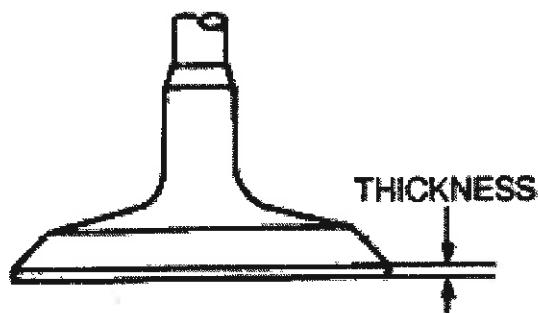
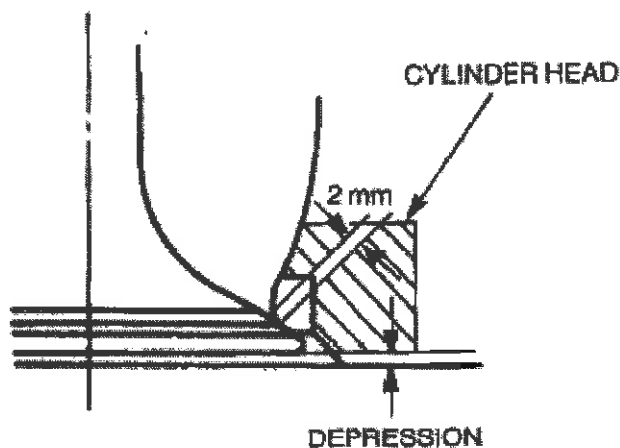


Figure 8 Measuring Valve Head Thickness

- kk. If the valve seats require replacing, remove the seat using a valve seat cutting tool.

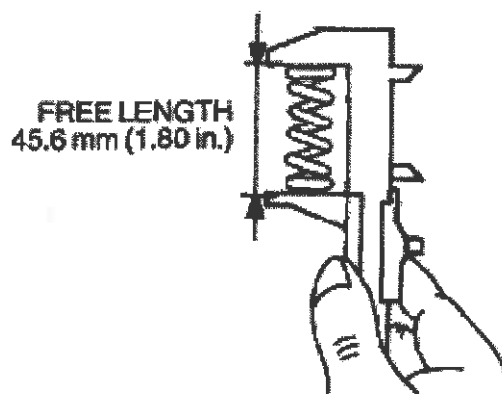
**WARNING**

During this procedure care must be taken to avoid personal injury.



**Figure 9 Measuring Valve Depression**

- ll. Place the cylinder head in an oven.
- mm. Heat the cylinder head to a temperature of 160 to 180°C (320 to 360°F).
- nn. Using a pair of tongs, remove the cylinder head from the oven.
- oo. Position the valve insert of the cylinder head.
- pp. Install the insert using a hammer and a punch.
- qq. Carefully grind the valve seat to an angle of 45°.
- rr. Ensure that the contact width of the seat face does not exceed 2.0 mm (0.079 in).
- ss. Repeat this procedure for each valve seat.
- tt. Lap the valves to their respective seats.
- uu. Ensure that both the valve and seat are 'lapped in' evenly.
- vv. Using a set of vernier callipers check the free length of the spring (Figure 10).



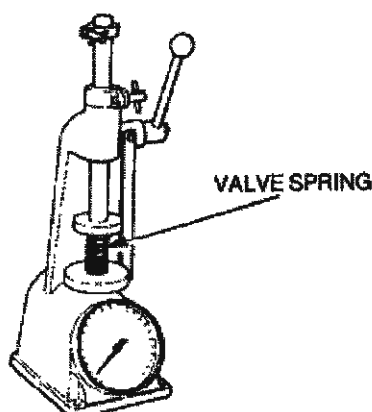
**Figure 10 Measuring Spring Free Length**

- ww.** Check the spring tension of the valve springs on a valve spring tester (Figure 11).
- xx.** Measure the compressed height at the limits shown in Table 4.
- yy.** Discard any spring that does not comply with the tolerances.

**Table 4 Valve Spring Tension**

Serial	Set Length mm (in)	Kg (lb)
1	34.2 (1.35)	16.8 (37)
2	25.2 (0.992)	30.0 (66)

- zz.** Thoroughly clean the cylinder head and components.
- aaa.** Liberally coat the valve stems and guides with engine oil and install each valve into its respective port.



**Figure 11 Measuring Spring Tension**

- bbb.** Install the valve spring retainer, the spring, and the collet retainer.
- ccc.** Install a valve spring compressor and compress the valve spring.
- ddd.** Install the two collets, ensuring that they are properly positioned and are correctly seated on the valve stem.
- eee.** Remove the valve spring compressor.
- fff.** Repeat this procedure for the other valve assembly.
- ggg.** Position the valve rockers in the cylinder head.
- hhh.** Install the rocker shaft.
- iii.** Install and tighten the rocker shaft locating bolt.
- jjj.** Tighten the locknut.
- kkk.** Position a new cylinder head gasket on the engine cylinder and install the cylinder head.
- lll.** Ensure that the tappet adjusting screws align with the push rods.
- mmm.** Secure the cylinder head with the four washers and nuts.
- nnn.** Torque the head nuts to 49 N.m (36 lbf.ft).
- ooo.** Adjust the valve clearance (Ref EMEI Vehicle H 713 - Group 1).
- ppp.** Install the fuel injector (Ref EMEI Vehicle H 713 - Group 4).
- qqq.** Install the two cover plates and the start hood.
- rrr.** Install the air cleaner assembly (Ref EMEI Vehicle H 713 - Group 4).
- sss.** Position the muffler, together with a new gasket, on the cylinder head.

- ttt.** Install the retaining nuts and washers.
- uuu.** Tighten the nuts securely.
- vvv.** Install the fuel tank (Ref EMEI Vehicle H 713 - Group 4).
- www.** Install the engine and pump assembly on the engine support frame (Paragraph 7.).

## **Engine**

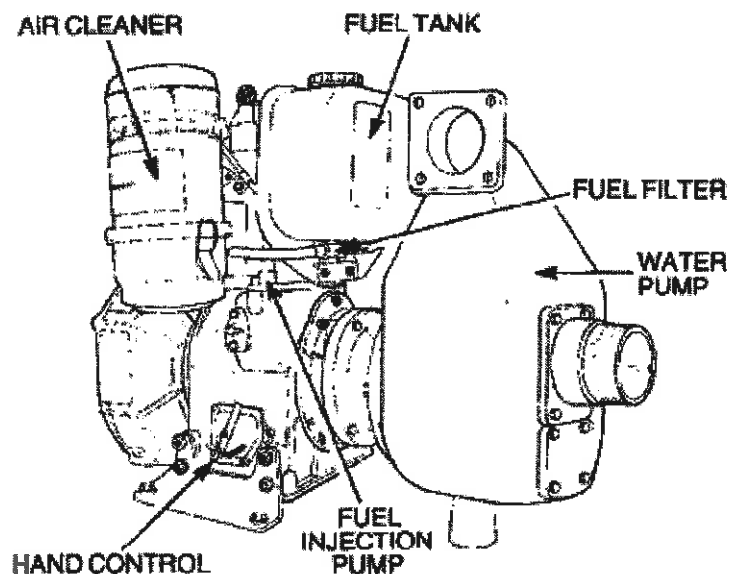
### **11. Disassembly.** Disassemble the engine as follows:

- a.** Remove the engine and pump assembly from the engine enclosure (Paragraph 6.).

## **WARNING**

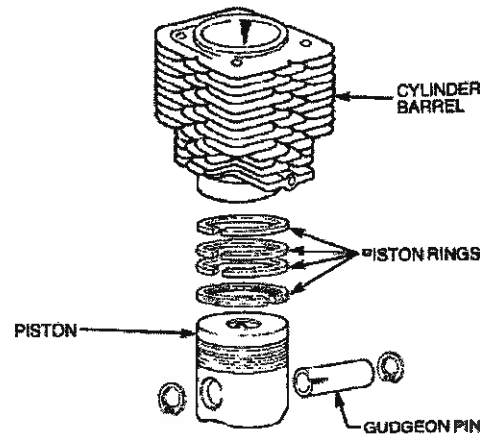
**Eye protection must be worn when using compressed air.**

- b.** Clean the engine assembly with a cleaning agent.
- c.** Blow the assembly dry with compressed air.
- d.** Remove the six bolts securing the water pump to the water pump adapter.
- e.** Remove the water pump housing from the engine.
- f.** Remove the bolt and washer securing the water pump's impeller to the engine crankshaft.
- g.** Using a puller, remove the impeller, the impeller spacer and the ceramic seal.
- h.** Remove the four bolts securing the water pump adapter to the engine cover (Figure 12).
- i.** Remove the adapter.
- j.** Remove the cylinder head from the engine (Paragraph 9.).



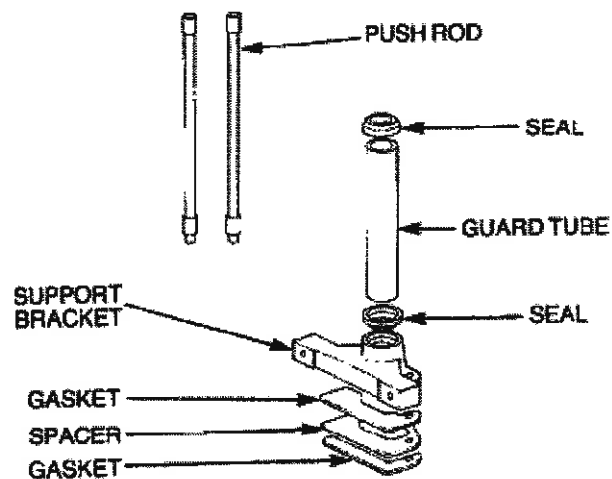
**Figure 12 Water Pump Mounting**

- k.** Carefully lift the barrel away from the engine crankcase in an upward direction taking care not to damage the piston or the piston rings (Figure 13).



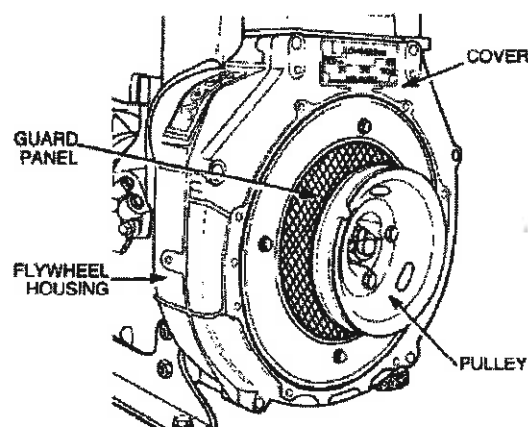
**Figure 13 Cylinder Barrel and Piston Assembly**

- l.** Remove the circlips securing the gudgeon pin (piston pin) to the piston and the connecting rod.
- m.** Remove the gudgeon pin and the piston.
- n.** Remove the piston rings from the piston, taking care not to damage the piston.
- o.** Drain the oil from the engine oil pan into a container.
- p.** Remove the twelve bolts and washers securing the oil pan to the crankcase.
- q.** Remove the oil pan and discard the gasket.
- r.** Remove the push rods from the guard tube (Figure 14).
- s.** Remove the guard tube and the upper oil seal.



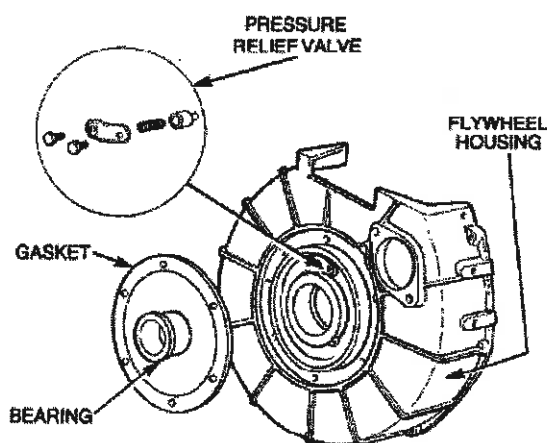
**Figure 14 Push Rods and Guard Tube**

- t.** Remove the guard tube support bracket, the gaskets and the spacer.
- u.** Discard the gaskets.
- v.** Remove the three bolts and washers from the starter pulley.
- w.** Secure the crankshaft and remove the nut and washer securing the pulley to the crankshaft.
- x.** Remove the pulley (Figure 15).



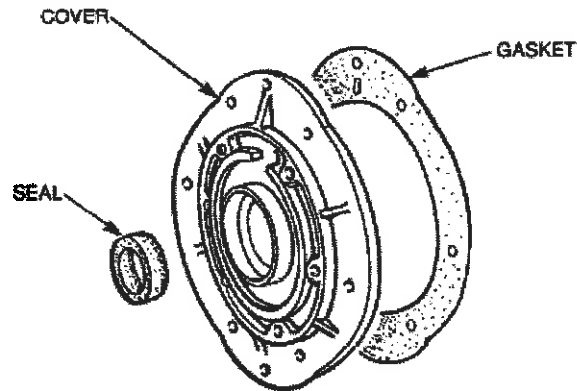
**Figure 15 Flywheel Removal**

- y. Remove the four screws and washers securing the guard panel to the flywheel.
- z. Remove the panel.
- aa. Remove the six Allen head bolts securing the cover to the flywheel housing.
- bb. Remove the housing.
- cc. Using special tool 7271-3595-048 flywheel puller, remove the flywheel from the crankshaft.
- dd. Remove the six nuts and washers securing the flywheel housing to the crankcase.
- ee. Remove the housing and the gasket (Figure 16).
- ff. Discard the gasket.



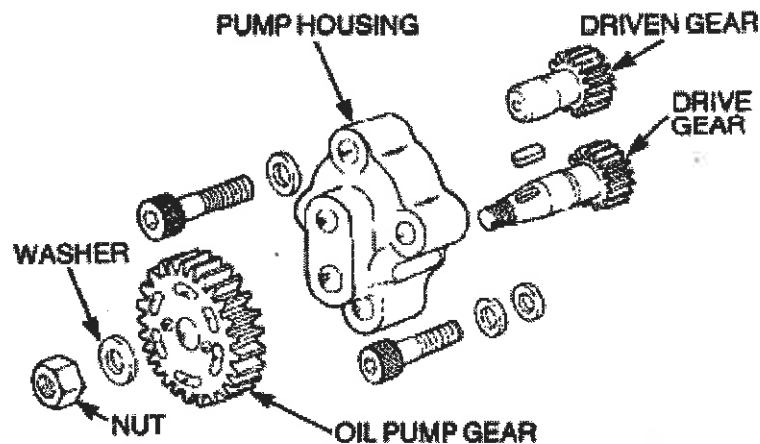
**Figure 16 Flywheel Housing Removal**

- gg. Remove the pressure relief valve from the flywheel housing (Figure 16).
- hh. Remove the fuel pump (Ref EMEI Vehicle H 713 - Group 4).
- ii. Remove the eight nuts and washers securing the crankshaft support cover (Figure 17) to the crankcase.
- jj. Remove the cover and the gasket.
- kk. Discard the gasket.
- ll. Remove and discard the seal from the cover.



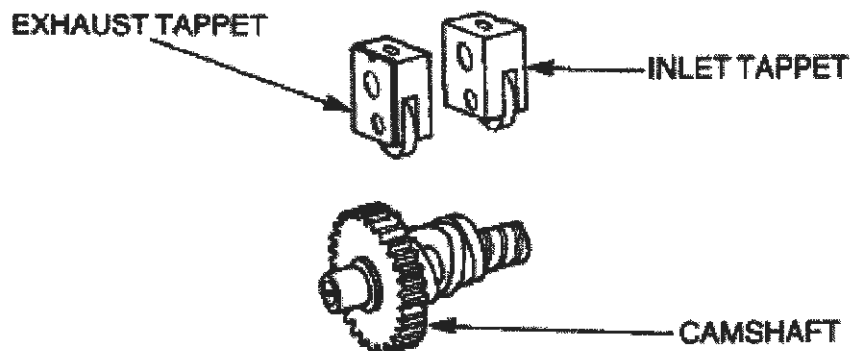
**Figure 17 Crankshaft Support Cover - Removal**

- mm. Secure the oil pump gear to stop the gear from rotating.
- nn. Remove the nut and washer securing the gear to the oil pump drive shaft (Figure 18).
- oo. Remove the gear from the shaft.



**Figure 18 Oil Pump - Exploded View**

- pp. Remove the Allen head bolts securing the oil pump to the engine crankcase.
- qq. Remove the oil pump.
- rr. Remove the camshaft and the inlet and exhaust valve tappets from the crankcase (Figure 19).



**Figure 19 Camshaft and Tappets**

- ss. Remove the circlip securing the pump rocker lever to the pivot (Figure 20).
- tt. Remove the rocker lever.



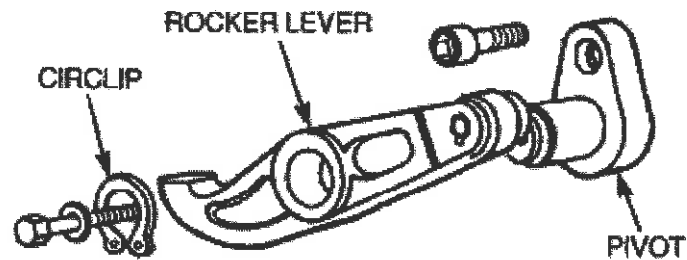


Figure 20 Fuel Pump Rocker Lever

- uu. Remove the two bolts securing the rocker lever pivot to the crankcase.
- vv. Remove the pivot.
- ww. Remove the two nuts and the locking plate securing the connecting rod to the crankshaft (Figure 21).
- xx. Remove the connecting rod and bearings.
- yy. Remove the crankshaft from the crankcase.
- zz. Remove the two screws securing the hand throttle cover to the hand throttle assembly.
- aaa. Remove the cover and lever assembly (Figure 22).
- bbb. Remove the four bolts and washers securing the throttle housing to the crankcase.
- ccc. Remove the housing assembly (Figure 23).

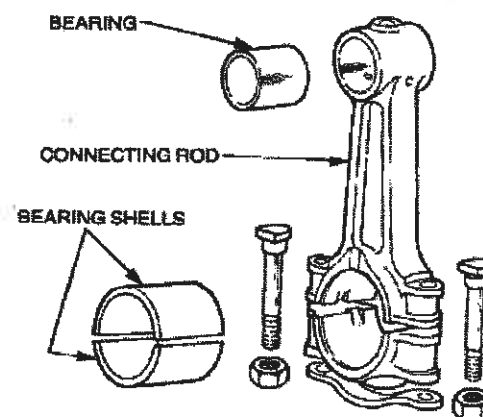


Figure 21 Connecting Rod and Bearings

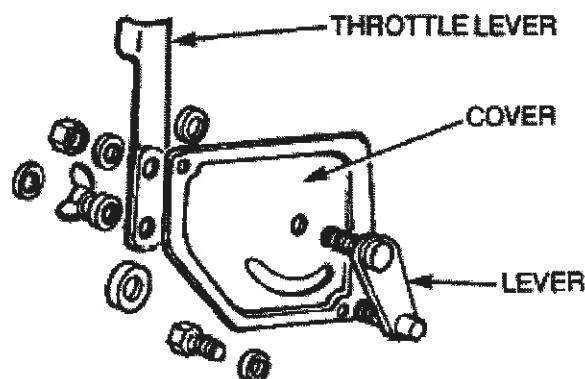
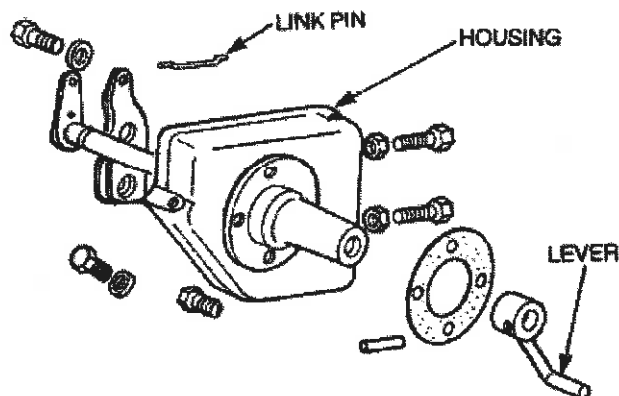
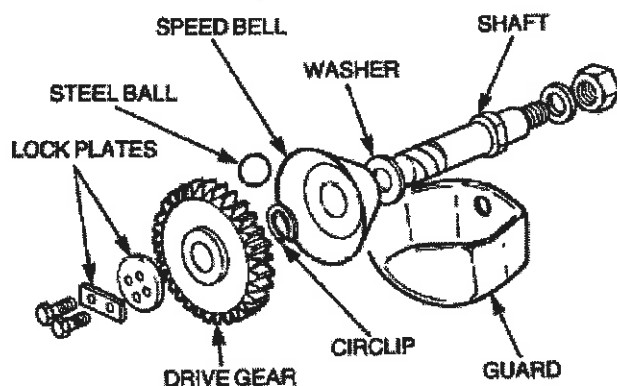


Figure 22 Hand Throttle Cover Assembly - Exploded View



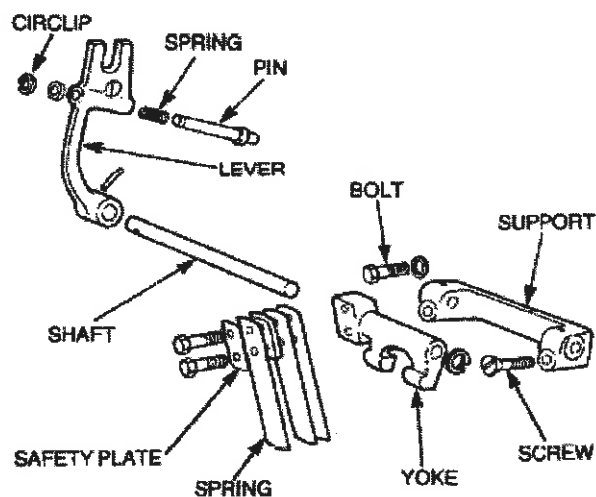
**Figure 23 Throttle Housing Assembly - Exploded View**

- ddd.** Remove the bolt securing the governor drive gear guard to the crankcase.
- eee.** Remove the guard (Figure 24).
- fff.** Remove the two bolts securing the governor drive gear lock plates to the governor shaft.
- ggg.** Remove the lock plates, drive gear, steel balls, circlip, speed bell and washer.



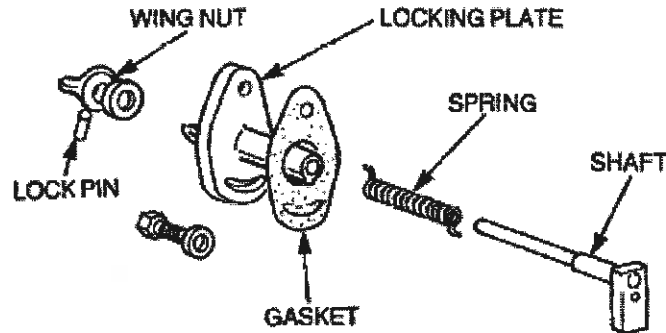
**Figure 24 Governor Assembly - Exploded View**

- hhh.** Remove the bolt, screw and washer securing the governor support to the crankcase.
- iii.** Remove the injection pump governor control assembly (Figure 25).



**Figure 25 Governor Control Assembly - Exploded View**

- jjj. Remove the nut and washer securing the governor shaft to the crankcase (Figure 24).
- kkk. Remove the shaft.
- lll. Remove the two bolts securing the excess fuel device to the crankcase (Figure 26).
- mmm. Remove the excess fuel device.



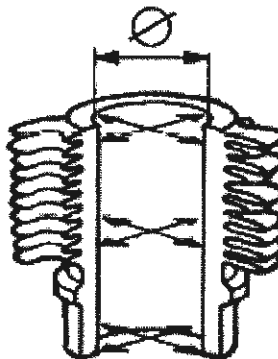
**Figure 26 Excess Fuel Device - Exploded View**

- 12. Cleaning and Inspection.** Cleaning and inspection of the engine is as follows:

**WARNING**

**Eye protection must be worn when using compressed air.**

- a. Thoroughly clean the crankcase and engine components with a cleaning agent.
- b. Blow them dry with compressed air.
- c. Inspect the cylinder barrel for cracks, damage or visible wear.
- d. Measure the bore of the cylinder barrel with an inside micrometer.
- e. Check the cylinder bore for an oval shaped wear pattern at the six points shown (Figure 27).
- f. The standard dimension of the bore is 85.00 to 85.02 mm (3.3465 to 3.3472 in).
- g. Rebore the cylinder if the measured dimensions exceed the standard dimension by 0.1 mm (0.004 in).



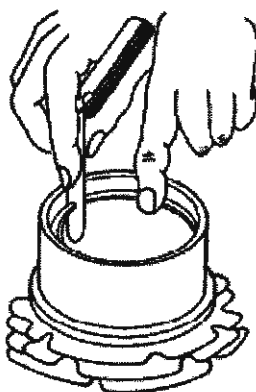
**Figure 27 Measuring Cylinder Bore**

- h. Using a micrometer, measure the dimension of the piston 2.0 mm (0.0787 in) up from the base of the piston skirt.
- i. Check for an oval shaped wear pattern.
- j. Replace the piston if the measured dimension is more than 0.05 mm (0.002 in) below the standard dimensions of 84.87 to 84.90 mm (3.3413 to 3.3425 in).

- k. Before assembling the piston rings on the piston, check the piston ring gap by installing the piston rings in the cylinder barrel and measuring the gap (Figure 28).
- l. The correct piston ring gap tolerances are in Table 5.

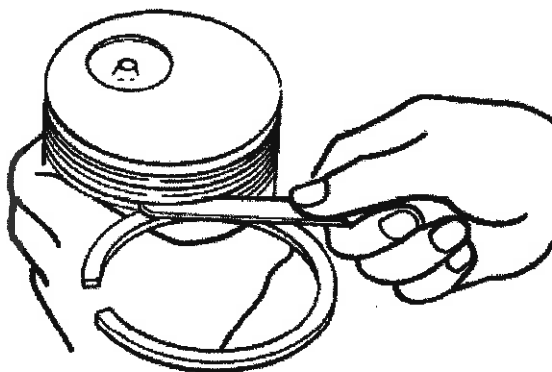
**Table 5 Piston Ring Gap Tolerances**

Serial	Piston Ring	Standard mm (in)
1	1 <sup>st</sup> Compression	0.30 to 0.50 (0.0118 to 0.0197)
2	2 <sup>nd</sup> Compression	0.30 to 0.50 (0.0118 to 0.0197)
3	3 <sup>rd</sup> Compression	0.30 to 0.50 (0.0118 to 0.0197)
4	Oil control	0.25 to 0.50 (0.0098 to 0.0197)



**Figure 28 Measuring Piston Ring Gap**

- m. If the piston ring gap is insufficient, clamp the piston ring in a soft-jawed vice and carefully file the end of the ring with a file.
- n. Ensure that only a small portion of the ring end is protruding above the vice jaws to prevent ring distortion and/or breakage.
- o. Check the ring gap regularly to ensure that the tolerance is not exceeded.
- p. Ensure that all trace of carbon is removed from the piston ring grooves.
- q. With the aid of a set of feeler gauges, measure the clearance between the piston ring and the piston ring land (Figure 29).
- r. Standard dimensions for the piston ring to piston ring land are in Table 6.
- s. Replace the piston where the clearance exceeds the upper limit of the standard dimension.

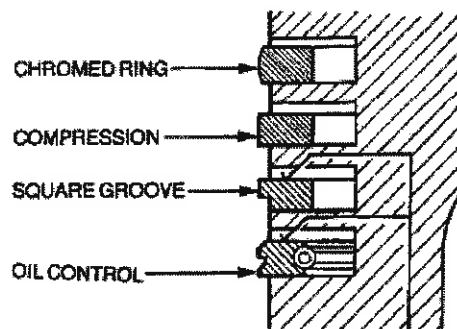


**Figure 29 Measuring Piston Ring Clearance**

**Table 6 Piston Ring Clearances**

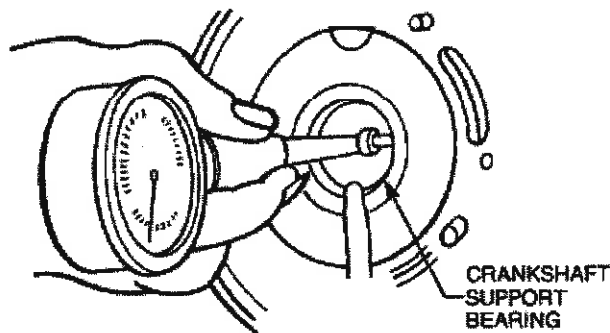
Serial	Piston Ring	Standard mm (in)
1	1 <sup>st</sup> Compression	0.11 to 0.15 (0.0043 to 0.0059)
2	2 <sup>nd</sup> Compression	0.06 to 0.10 (0.0024 to 0.0039)
3	3 <sup>rd</sup> Compression	0.06 to 0.10 (0.0024 to 0.0039)
4	Oil control	0.05 to 0.10 (0.002 to 0.0039)

- t. Once the piston rings are correctly sized, install the rings onto the piston.
- u. Ensure that the ring end gaps are staggered 180° apart and that the rings are installed as shown (Figure 30).



**Figure 30 Piston Ring Installation**

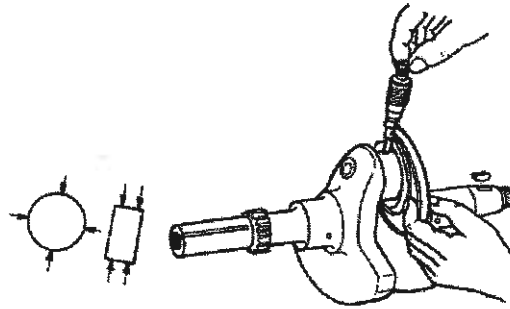
- v. Check the internal dimension of the crankshaft support bearings with an internal micrometer (Figure 31).
- w. The standard dimensions are: flywheel side 40.03 to 40.06 mm (1.5760 to 1.5772 in) and timing gear side 42.03 to 42.06 mm (1.6547 to 1.6559 in).
- x. If the crankshaft is fully functional, subtract the crankshaft bearing journal from the internal dimensions of the crankshaft support bearings.
- y. The standard clearance dimension is 0.04 to 0.06 mm (0.0016 to 0.0024 in).
- z. If the clearance exceeds this dimension, remove and replace the crankshaft support bearings (Paragraph 13.).



**Figure 31 Measuring Crankshaft Support Bearing**

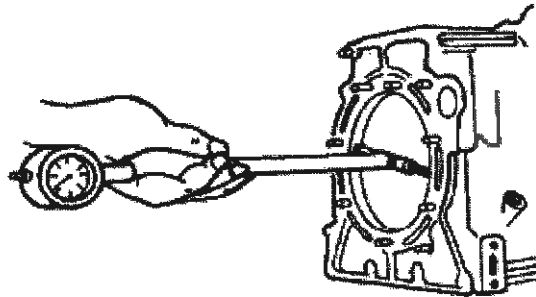
- aa. Using an external micrometer measure the crankshaft bearings journals (Figure 32).
- bb. For the crankshaft support journals the standard dimensions are: flywheel side 39.99 to 40.00 mm (1.5744 to 1.5748 in) and the timing gear side 41.99 to 42.00 mm (1.6531 to 1.771 in).
- cc. The connecting rod bearing journal standard dimension is 41.987 to 42.00 mm (1.6530 to 1.6535 in).
- dd. Check each journal for taper and/or an oval shaped wear pattern.

- ee. Replace the crankshaft if these dimensions are exceeded.



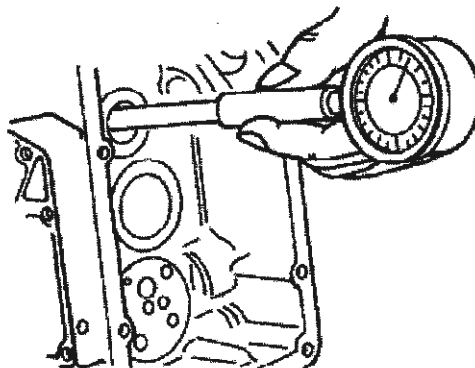
**Figure 32 Measuring Crankshaft Bearing Journals**

- ff. Using an internal micrometer, measure the crankcase flywheel mounting flange for an oval shaped wear pattern (Figure 33).
- gg. The standard dimension is 145.0 to 145.02 mm (5.7087 to 5.7094 in).
- hh. Replace the crankcase if these dimensions are exceeded.



**Figure 33 Measuring Flywheel Mounting Flange**

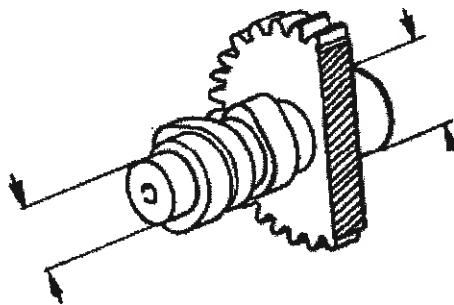
- ii. Using an internal micrometer, measure the camshaft support in the crankcase (Figure 34).
- jj. The standard dimension is 18.00 to 18.018 mm (0.7087 to 0.7094 in).
- kk. If the camshaft is fully functional, subtract the camshaft journal dimension from the internal dimensions of the camshaft support.
- ll. The standard clearance dimension is 0.04 to 0.038 mm (0.0016 to 0.0015 in).
- mm. If the standard clearance is exceeded, replace the crankcase.



**Figure 34 Measuring Camshaft Support**

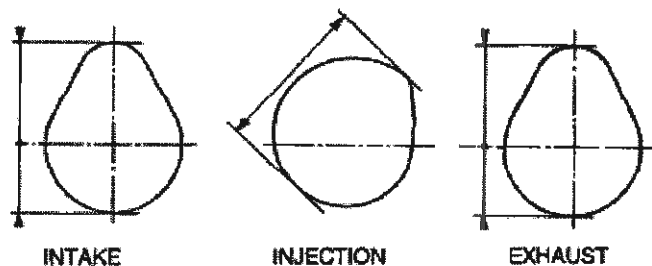
- nn. Using an external micrometer, measure the camshaft journals (Figure 35).
- oo. The standard dimension is 17.96 to 17.98 mm (0.7071 to 0.7079 in).

- pp.** If the journal wear is below the limit, replace the camshaft.



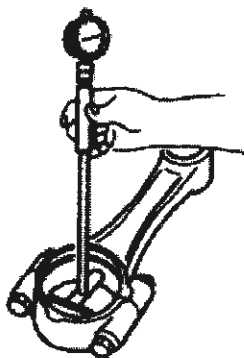
**Figure 35 Measuring Camshaft Journals**

- qq.** With an external micrometer, measure the height of the camshaft lobes (Figure 36).
- rr.** The standard height of the lobes is: inlet lobe 33.68 to 33.78 mm (1.3259 to 1.3299 in), fuel injection pump lobe 31.51 mm (1.2406 in) and the exhaust lobe 33.45 to 33.55 mm (1.3169 to 1.3209 in).
- ss.** Replace the camshaft if the lobes are worn below the lower limit of the standard height dimension.



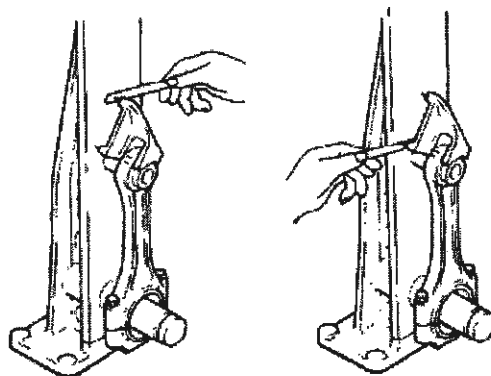
**Figure 36 Camshaft Lobes**

- tt.** Install the new bearings into the connecting rod big-end and cap.
- uu.** Install the cap.
- vv.** Torque the nuts to 29 N.m (22 lbf.ft).
- ww.** With an internal micrometer, measure the inside diameter of the bearing (Figure 37).
- xx.** The standard dimension of the bearing is 42.017 to 42.065 mm (1.6542 to 1.6561 in).
- yy.** Subtract the standard dimension of the crankshaft bearing journal diameter from the diameter of the bearing to obtain the clearance.
- zz.** The standard clearance is 0.030 to 0.065 mm (0.0011 to 0.0026 in).
- aaa.** If the clearance exceeds the upper limit of the standard clearance, replace the crankshaft.



**Figure 37 Measuring Connecting Rod Bearing**

- bbb.** Using an internal micrometer, measure the dimension of the gudgeon pin bore.
- ccc.** The standard dimension is 23.015 to 23.035 mm (0.9061 to 0.9069 in).
- ddd.** If the gudgeon pin is fully functional, subtract the gudgeon pin dimension from the internal dimension of the gudgeon pin bore.
- eee.** The standard clearance dimension is 0.020 to 0.035 mm (0.0008 to 0.0014 in).
- fff.** If the dimension exceeds 0.07 mm (0.0028 in), replace the gudgeon pin and bushing.
- ggg.** Using an external micrometer, measure the diameter of the gudgeon pin
- hhh.** The standard dimension is 22.995 to 23.0 mm (0.9053 to 0.9055 in).
- iii.** Install the connecting rod on an alignment jig and check for bend or twist (Figure 38).
- jjj.** The allowable bend or twist is 0.05 mm (0.002 in).
- kkk.** Replace the connecting rod if the bend or twist exceeds this dimension.
- lll.** Install the crankshaft into the crankcase support bearing.
- mmm.** Install the flywheel housing and secure to the crankcase with two bolts.
- nnn.** Invert the crankcase and with the aid of a set of feeler gauges, measure the crankshaft end-play.
- ooo.** The allowable end-play is 0.10 to 0.30 mm (0.0039 to 0.012 in).
- ppp.** The end-play is adjustable by varying the thickness of the gasket(s) at the flywheel end of the crankshaft.



**Figure 38 Checking Connecting Rod Alignment**

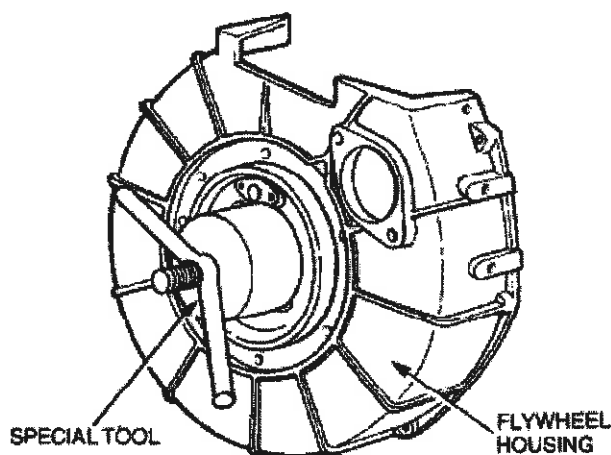
- qqq.** When the gasket size has been determined, record the measurement for use during the reassembly sequence.
- rrr.** Invert the crankcase and remove the flywheel housing and the crankshaft.
- sss.** Position the camshaft in the crankcase camshaft support.



- ttt.** Install the end cover and secure to the crankcase with two bolts.
- uuu.** With the aid of a set of feeler gauges measure the camshaft end-play.
- vvv.** The allowable end-play is adjustable by varying the thickness of the gasket(s) at the camshaft end of the crankcase.
- www.** When the gasket size has been determined, record the measurement for use during the reassembly sequence.

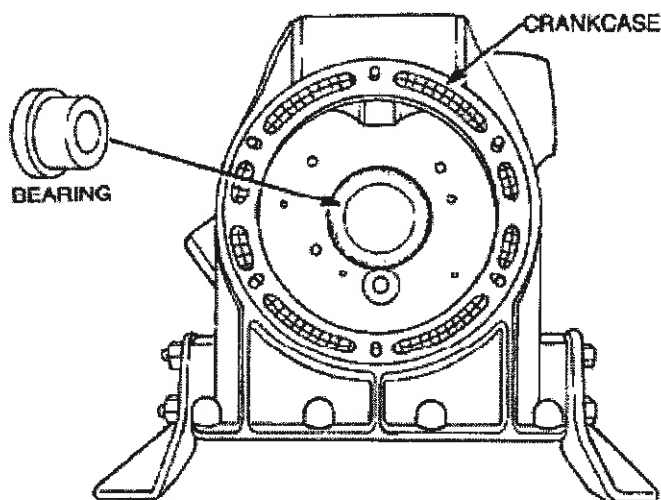
**13. Removal of Crankshaft Support Bearings.** Remove the crankshaft support bearings as follows:

- a.** Assemble special tool 727-3259-047 in the crankshaft support bearing located in the flywheel housing (Figure 39).
- b.** Rotate the puller T-bar in a clockwise direction and remove the bearing from the flywheel housing.



**Figure 39 Crankshaft Support Bearing - Flywheel Housing**

- c.** Assemble special tool 7271-3595-047 in the crankshaft support bearing located in the crankcase (Figure 40).
- d.** Rotate the puller T-bar handle in a clockwise direction and remove the bearing from the crankcase.



**Figure 40 Crankshaft Support Bearing - Crankcase**

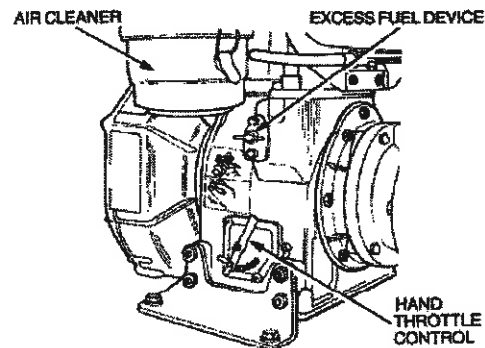
**14. Installation of Crankshaft Support Bearings.** Install the crankshaft support bearings as follows:

- a.** Align the new bearing with the locating pin in the crankcase.
- b.** Assemble the special tool 7271-3595-047 with the T-bar on the timing gear side of the crankcase.

- c. Rotate the puller T-bar in a clockwise direction and install the bearing.
- d. Align the new bearing with the locating pin in the flywheel housing.
- e. Assemble the special tool 7271-3595-047 with the T-bar on the flywheel side of the flywheel housing.
- f. Rotate the puller T-bar in a clockwise direction and install the bearing.

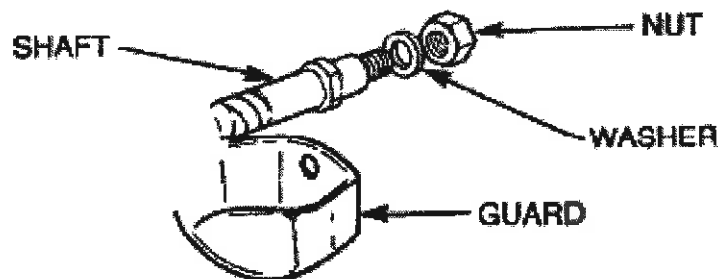
**15. Reassembly.** Reassemble the engine as follows:

- a. Position the excess fuel device in the crankcase.
- b. Secure it in position with the two washers and bolts (Figure 41).



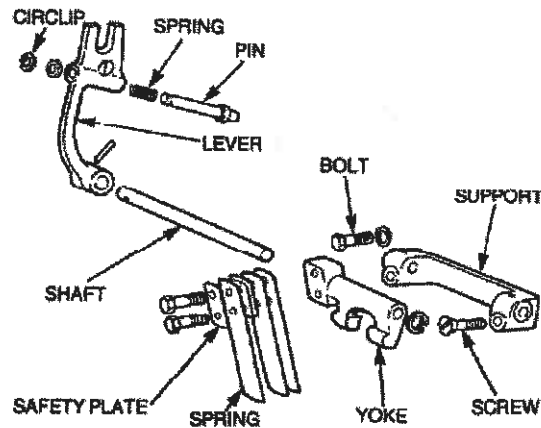
**Figure 41 Excess Fuel Device - Installation**

- c. Position the governor shaft in the crankcase.
- d. Secure the shaft in the crankcase with the washer and nut (Figure 42).
- e. Torque the nut to 39 N.m (29 lbf. ft)



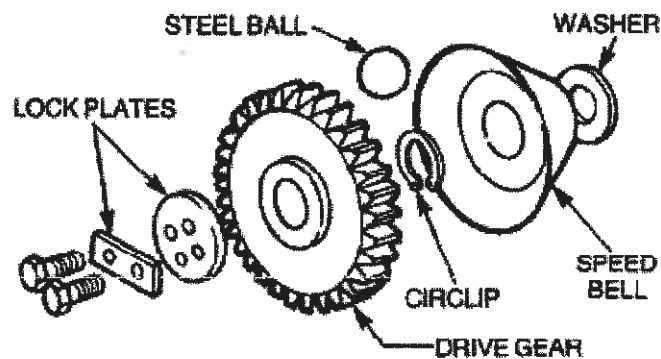
**Figure 42 Governor Shaft - Installation**

- f. Position the injection pump governor control assembly (Figure 43) in the crankcase.
- g. Secure it with the washer, bolt and screw.
- h. Position the governor gear guard in the crankcase and secure it with the bolt.



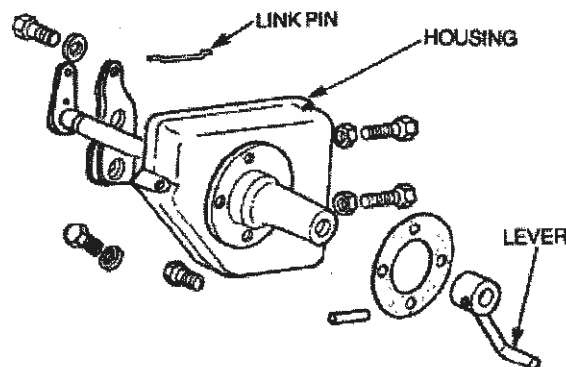
**Figure 43 Governor Control Assembly - Exploded View**

- i. Install the washer and the speed bell on the governor shaft.
- j. Secure it with the circlip.
- k. Install the steel balls, drive gear and lock plates.
- l. Secure them with the two bolts (Figure 44).



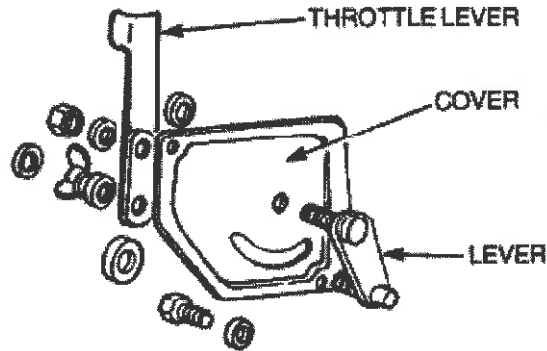
**Figure 44 Governor Drive Gear and Speed Bell - Exploded View**

- m. Install the throttle housing on the crankcase.
- n. Ensure that the lever is positioned at the rear of the governor control assembly springs (Figure 45).



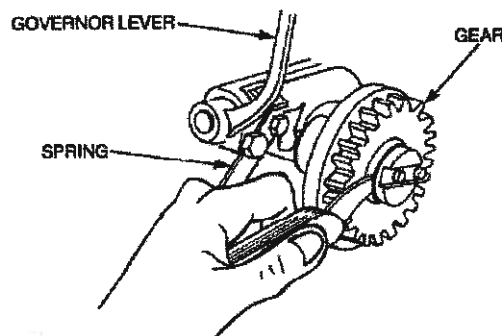
**Figure 45 Throttle Housing Assembly - Exploded View**

- o. Secure the throttle housing assembly to the crankcase with the four bolts.
- p. Install the hand throttle cover assembly (Figure 46).
- q. Ensure that the peg on the throttle plate engages in the hole in the housing arm.
- r. Secure the cover to the throttle housing with the two washers and screws.

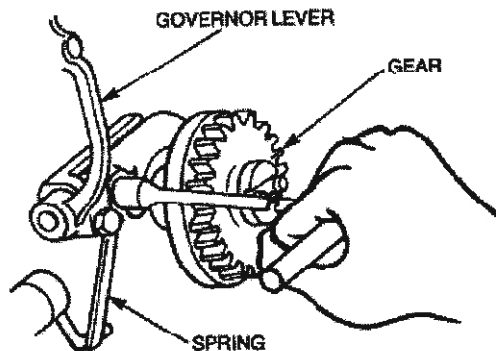


**Figure 46 Hand Throttle Cover Assembly - Exploded View**

- s. Using a set of feeler gauges, measure the clearance between the governor drive gear and the lock plate (Figure 47).
- t. The minimum allowable clearance is 0.5 mm (0.0196 in).
- u. If necessary, adjust the clearance by turning the spring adjusting bolt in a counterclockwise direction (Figure 48).

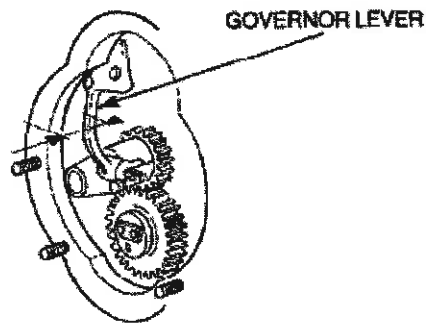


**Figure 47 Measuring Governor Clearance**

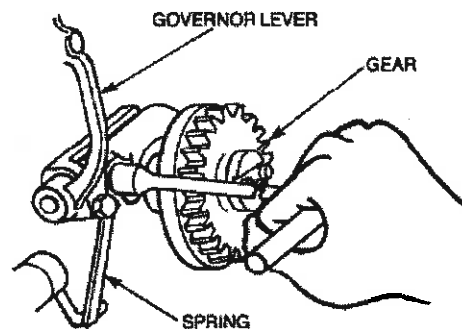


**Figure 48 Adjusting Governor Clearance**

- v. With the hand throttle lever locked in the stop position, measure the distance from the crankcase to the governor lever (Figure 49).
- w. If necessary, adjust the clearance by turning the spring adjusting bolt (Figure 50), in a clockwise direction to obtain a distance of 22 mm (0.866 in).

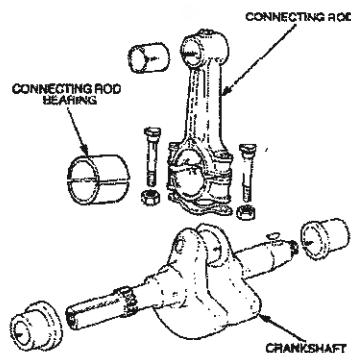


**Figure 49 Measuring Governor Lever Clearance**



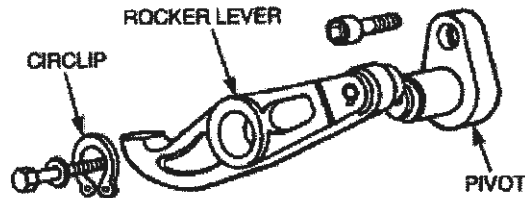
**Figure 50 Adjusting Governor Lever Clearance**

- x. Liberally coat the crankshaft journals with clean engine oil.
- y. Install the crankshaft in the crankcase and engage the timing gear with the governor drive gear.
- z. Remove the connecting rod bearing cap (if not previously removed).
- aa. Lubricate both halves of the connecting rod bearing with clean engine oil.
- bb. Install the connecting rod on the crankshaft journal (Figure 51).
- cc. Torque the nuts to 29 N.m (22 lbf.ft).



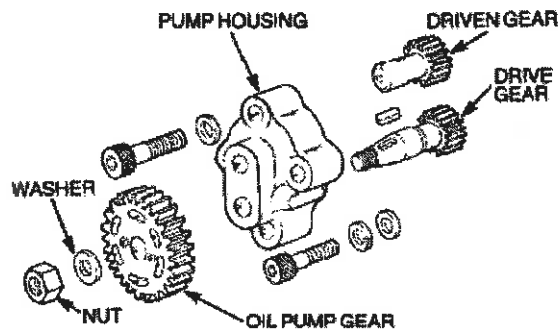
**Figure 51 Crankshaft and Connecting Rod**

- dd. Install the fuel injection pump rocker lever pivot.
- ee. Secure the pivot to the crankcase with the two bolts.
- ff. Install the rocker lever.
- gg. Secure the lever to the pivot with a new circlip (Figure 52).



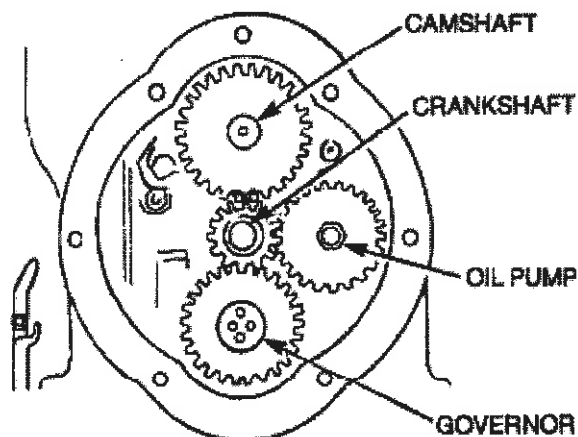
**Figure 52 Fuel Injector Pump Rocker Lever**

- hh. Position the oil pump in the crankcase.
- ii. Secure the pump to the crankcase with the washers and Allen head bolts (Figure 53).
- jj. Install the oil pump gear.
- kk. Secure the gear with the washer and nut.
- ll. Torque the nut to 20 N.m (15 lbf.ft).



**Figure 53 Oil Pump - Exploded View**

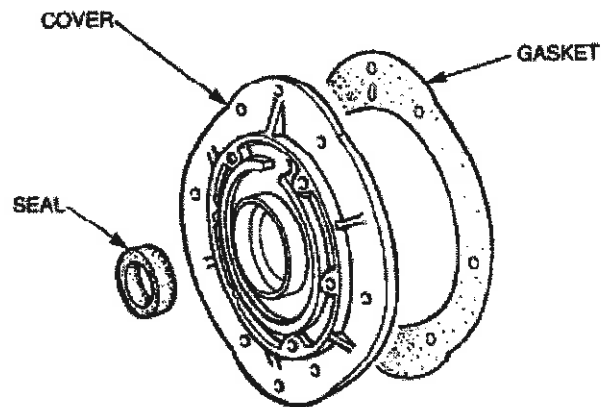
- mm. Rotate the crankshaft until the timing mark on the crankshaft timing gear is at the 12 o'clock position.
- nn. Install the camshaft, aligning the two timing marks on the camshaft gear with the crankshaft timing mark (Figure 54).
- oo. Install the tappets ensuring that the notches in the top of the tappets face outwards.



**Figure 54 Timing Gears**

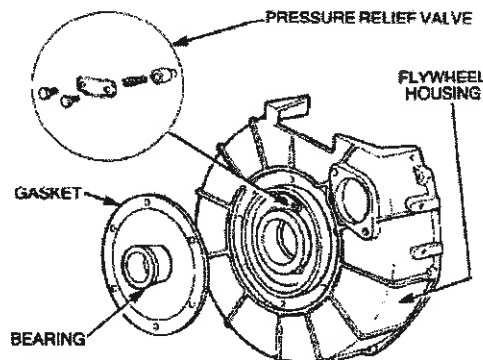
- pp. Using a seal installer, install the seal in the crankshaft support cover (Figure 55).
- qq. Position the gasket, the size of which was determined during the measurement of the camshaft endplay, on the crankcase.
- rr. Install the cover.

- ss.** Secure the cover to the crankcase with the eight washers and nuts.



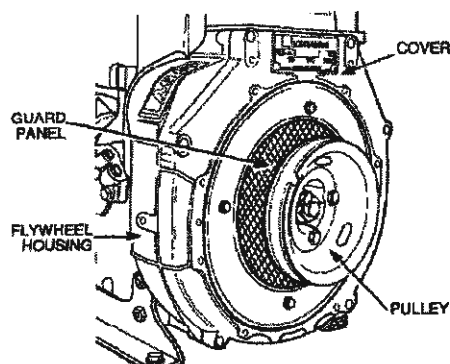
**Figure 55 Crankcase Support Cover - Installation**

- tt.** Install the pressure relief valve into the flywheel housing.
- uu.** Position the gasket previously determined during the measurement of the crankshaft endplay, on the crankcase.
- vv.** Install the flywheel housing (Figure 56).
- ww.** Secure the flywheel housing to the crankcase with the six washers and nuts.
- xx.** Torque the nuts to 25 N.m (18 lbf.ft).



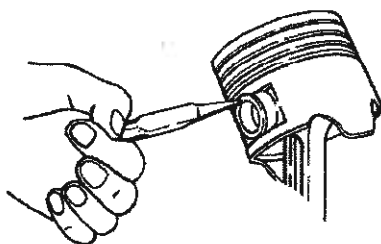
**Figure 56 Flywheel Housing - Installation**

- yy.** Align the flywheel keyway with the key on the crankshaft.
- zz.** Install the flywheel using a soft face hammer.
- aaa.** Position the flywheel cover on the housing (Figure 57).
- bbb.** Secure the cover to the housing with the six washers and Allen head bolts.
- ccc.** Install the guard panel.
- ddd.** Secure the panel to the flywheel with the four washers and screws.



**Figure 57 Flywheel Housing Cover - Installation**

- eee.** Position the pulley on the crankshaft.
- fff.** Align the bolt holes.
- ggg.** Install the three retaining bolts and washers.
- hhh.** Tighten the bolts securely.
- iii.** Install the flywheel-to-crankshaft retaining nut and washer.
- jjj.** Torque the nut to 167 N.m (123 lbf.ft).
- kkk.** Position the oil pan gasket on the sump.
- lll.** Secure the oil pan to the crankcase with the twelve washers and bolts.
- mmm.** Torque the oil pan bolts to 25 N.m (18 lbf.ft).
- nnn.** Align the gudgeon pin holes in the piston and connecting rod.
- ooo.** Ensure that the recess in the crown of the piston is facing the flywheel.
- ppp.** Coat the surface of the gudgeon pin with clean engine oil.
- qqq.** Push the gudgeon pin into position in the piston and connecting rod.
- rrr.** Install the circlips into the grooves in the piston (Figure 58).
- sss.** Ensure that the circlips are correctly seated.



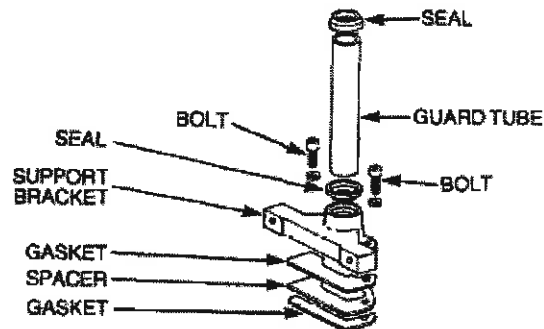
**Figure 58 Installing Circlips**

- ttt.** Ensure that the piston is at TDC.
- uuu.** Lubricate the piston rings and skirt with clean engine oil.
- vvv.** Install a ring compressor over the piston and compress the rings.
- www.** Place a new gasket on the base of the cylinder barrel.
- xxx.** Position the cylinder barrel on the mounting studs and carefully lower the barrel over the piston and rings.
- yyy.** When the rings have been covered by the barrel, remove the ring compressor and push the barrel into position on the crankcase.



**zzz.** Install the push rod guard tube together with the seals, gaskets, spacer and support into position on the crankcase.

**aaaa.** Secure the assembly to the crankcase with the two washers and Allen head bolts (Figure 59).



**Figure 59 Push Rod Guard Tube and Support**

**bbbb.** Position the push rods into the guard tube.

**cccc.** Ensure that they are correctly located in the tappets.

**dddd.** Install the cylinder head.

**eeee.** Torque the head retaining nuts to 49 N.m (36 lbf.ft).

**ffff.** Install the fuel injection pump (Ref EMEI Vehicle H 713 - Group 4).

**gggg.** Install the fuel injector (Ref EMEI Vehicle H 713 - Group 4).

**hhhh.** Position the water pump adapter on the crankcase.

**iiii.** Secure the adapter with the four washers and bolts to the engine cover.

**jjjj.** Install the water pump spacer, ceramic seal and impeller on the crankshaft.

**kkkk.** Secure to the crankshaft with the washer, O ring and bolt.

**llll.** Tighten the bolt securely.

**mmmm.** Position the water pump on the adapter flange.

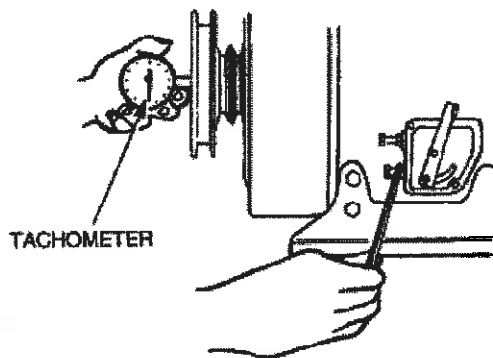
**nnnn.** Secure with the six bolts.

**oooo.** Install the engine and pump assembly into the engine enclosure (Paragraph 7.).

### Engine Speed Setting

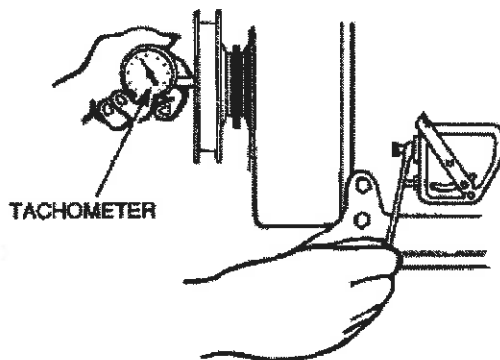
**16. Idle Adjustment.** The engine idle adjustment is set as follows:

- a.** Start and run the engine at idle.
- b.** Using a hand held tachometer on the engine starter pulley, check the idle speed (Figure 60).
- c.** If necessary, adjust the idle speed to 1050 rpm by means of the lower adjusting bolt in the throttle housing.



**Figure 60 Checking Engine Idle Speed**

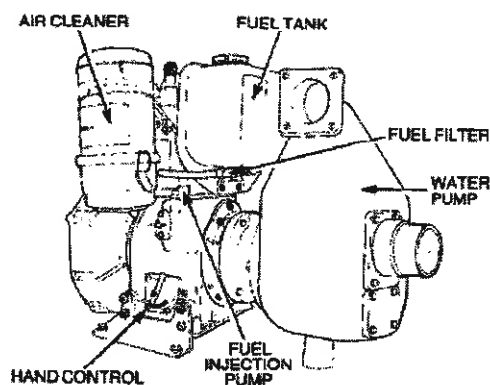
17. **Maximum Speed Adjustment.** The engine maximum speed adjustment is set as follows:
- Increase the engine speed to maximum rpm.
  - Check the speed using the hand held tachometer (Figure 61).
  - If necessary, adjust the maximum speed to 3180 rpm by means of the upper adjusting bolt in the throttle housing.



**Figure 61 Checking Engine Maximum Speed**

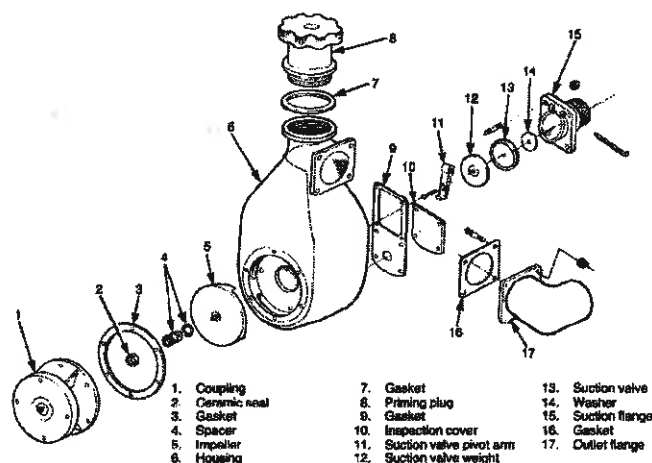
### Water Pump

18. **Removal.** Removal of the water pump is as follows:
- Remove the engine and pump assembly from the engine enclosure (Paragraph 6.).
  - Support the water pump.
  - Remove the six bolts securing the water pump to the adapter (Figure 62).
  - Remove the pump, taking care not to damage the impeller or the pump housing.
  - Discard the gasket.



**Figure 62 Water Pump Mounting**

- 19. Disassembly.** Disassemble the water pump as follows:
- a. Remove the four nuts securing the suction flange to the pump housing.
  - b. Remove the flange from the housing.
  - c. Remove the split pin securing the suction valve pivot arm to the suction flange.
  - d. Remove the pivot arm and the suction valve (Figure 63).



**Figure 63 Water Pump - Exploded View**

- 20. Reassembly.** Reassemble the water pump as follows:
- a. Position the rubber gasket on the delivery flange studs.
  - b. Install the delivery flange.
  - c. Secure the flange with the four nuts.
  - d. Position the rubber gasket on the suction flange and inspection cover studs.
  - e. Install the inspection cover.
  - f. Secure the cover with the four nuts.
  - g. Assemble the suction valve, ensuring that a new suction valve rubber is used.
  - h. Secure the valve assembly to the suction valve pivot arm with the brass screw.
  - i. Position the pivot arm at the suction valve flange.
  - j. Secure it with the split pin
  - k. Install the suction valve and flange on the pump housing.
  - l. Secure it with the four nuts.

- 21. Installation.** Install the water pump as follows:
- Position a new gasket on the adapter.
  - Carefully position the pump housing on the adapter.
  - Secure it with the six bolts.
  - Install the engine and pump assembly into the engine enclosure (Paragraph 7.).
- 22. Specifications - Engine.** The specifications for the engine are in Table 7.

**Table 7 Specifications - Engine**

Serial	Item	Specification	Value
1	Valve rocker shaft and arm	Maximum clearance	0.1 mm (0.004 in)
2	Cylinder head	Distortion	less than 0.1 mm (0.004 in)
		Machining limit	0.3 mm (0.012 in)
3	Valve guides	Inlet and exhaust valves	0.03 TO 0.08 mm (0.001-0.003 in)
		Maximum clearance	0.15 mm (0.006 in)
4	Valves	Seat contact width	2.0 mm (0.079 in)
		Head thickness	Not less than 0.6 mm (0.024 in) or more than 0.8 mm (0.031 in)
		Valve depression	Not to exceed 1.65 mm (0.065 in)
		Valve seat angle	45°
5	Valve springs	Free length	45.6 mm (1.80 in)
		Tension	34.2 mm (1.35 in) with weight of 16.8 kg (37 lb) 25.2 mm (0.992 in) with weight of 30 kg (66 lb)
6	Cylinder head nut	Tightening torque	49 N.m (36 lbf.ft)
7	Cylinder barrel bore I.D.	Clearance	85.0 mm to 85.02 mm (3.3465 to 3.3472 in)
		Maximum clearance	0.1 mm (0.004 in)
8	Piston	Standard dimension	84.87 to 84.90 mm (3.3413 to 3.3425 in)
		Maximum wear	0.05 mm (0.002 in)
9	Piston ring clearance	First compression	0.30 to 0.50 mm (0.0112 to 0.0197 in)
		Second compression	0.30 to 0.50 mm (0.0112 to 0.0197 in)
		Third compression	0.30 to 0.50 mm (0.0112 to 0.0197 in)
		Oil control	0.25 to 0.50 mm (0.0098 to 0.0197 in)
10	Piston ring gap tolerance	First compression	0.11 to 0.15 mm (0.0043 to 0.0059 in)
		Second compression	0.06 to 0.10 mm (0.0024 to 0.0039 in)
		Third compression	0.06 to 0.10 mm (0.0024 to 0.0039 in)
		Oil control	0.05 to 0.10 mm (0.002 to 0.0039 in)
11	Crankshaft support bearings	Standard i.d. flywheel side	40.03 to 40.06 mm (1.5760 to 1.5772 in)
		Standard i.d. timing gear side	42.03 to 42.06 mm (1.6547 to 1.6559 in)
		Clearance	0.04 to 0.06 mm (0.0016 to 0.0024 in)
12	Crankshaft journals	Standard o.d. flywheel side	39.99 to 40.0 mm (1.5744 to 1.5748 in)
		Standard o.d. timing gear side	41.99 to 42.0 mm (1.6531 to 1.7717 in)
13	Connecting rod journal	Standard o.d.	41.987 to 42.0 mm (1.6530 to 1.6535 in)
14	Flywheel mounting flange	Standard i.d	145.0 to 145.02 mm (5.7087 to 5.7094 in)

**Table 7 Specifications – Engine (continued)**

Serial	Item	Specification	Value
15	Camshaft support	Standard i.d	18.0 to 18.018 mm (0.7087 to 0.7094 in)
		Clearance	0.04 to 0.038 mm (0.0018 to 0.0015 in)
17	Camshaft lobes standard height	Inlet lobe	33.68 to 33.78 mm (1.3259 to 1.3299 in)
		Injection pump lobe	31.51 mm (1.2406 in)
		Exhaust lobe	33.45 to 33.55 mm (1.3169 to 1.3209 in)
18	Connecting rod big-end	Tightening torque	29 N.m (22 lbf.ft)
		Standard i.d.	42.017 to 42.065 mm (1.6542 to 1.6561 in)
		Clearance	0.03 to 0.065 mm (0.0011 to 0.0026 in)
19	Connecting rod little-end	Standard i.d.	23.015 to 23.035 mm (0.9061-0.9069 in)
		Clearance	0.2 to 0.035 mm (0.0008 to 0.0014 in)
		Maximum clearance	0.07 mm (0.0028 in)
20	Gudgeon pin	Standard o.d.	22.95 to 23.0 mm (0.9053 to 0.9055 in)
21	Connecting rod	Distortion	Less than 0.05 mm (0.002 in)
22	Crankshaft	End-play clearance	0.10 to 0.3 mm (0.0039 to 0.012 in)
23	Camshaft	End-play clearance	0.2 to 0.4 mm (0.0078 to 0.0157 in)
24	Governor shaft nut	Tightening torque	39 N.m (29 lbf.ft)
25	Governor gear	Clearance	0.5 mm (0.0196 in)
26	Governor lever	Clearance	22 mm (0.866 in)
27	Oil pump gear nut	Tightening torque	20 N.m (15 lbf.ft)
28	Flywheel housing nuts	Tightening torque	25 N.m (18 lbf.ft)
29	Flywheel bolts	Tightening torque	167 N.m (123 lbf.ft)
30	Oil pan (sump) bolts	Tightening torque	25 N.m (18 lbf.ft)

23. **Fault Finding - Engine.** The fault finding for the engine is in Table 8.

**Table 8 Fault Finding - Engine**

Serial	Symptom	Probable Cause	Action
1	Engine will not start	a. No fuel	Check fuel level
		b. Injector sticking	Replace injector
		c. Fuel filter blocked	Replace filter
		d. Injection pump delivery valve sticking	Overhaul pump
		e. Injection pump incorrectly calibrate	Calibrate pump
		f. Air in the fuel system	Tighten fuel connections
		g. Injection timing advanced	Adjust timing
		h. Valves sticking	Free-up valves
		i. Sticking governor linkage	Free-up linkage
		j. Blocked air filter	Clean filter
2	Engine starts but stops	a. Fuel filter blocked	Replace filter
		b. Air in the fuel system	Tighten fuel connections
		c. Oil level too high	Drain oil to correct level
		d. Low idle speed	Adjust idle speed
		e. Sticking governor linkage	Free-up linkage
3	Poor acceleration	a. Fuel filter blocked	Replace filter
		b. Air in the fuel system	Tighten fuel connections
		c. Injection pump incorrectly calibrated	Calibrate pumps
		d. Blocked air filter	Clean filter
4	Speed fluctuates	a. Oil level to high	Drain oil to correct level
		b. Incorrect governor linkage setting	Adjust linkage
		c. Sticking governor linkage	Free-up linkage
5	Engine runs (excessive black smoke)	a. Injector incorrectly adjusted	Adjust injector
		b. Injection pump incorrectly calibrated	Calibrate pump
		c. Blocked air filter	Clean filter
6	Engine runs (excessive white smoke)	a. Excessive idling	Do not idle for long periods
		b. Worn or sticking rings	Replace or free-up rings
		c. Worn cylinder barrel	Rebore barrel
7	Low oil pressure	a. Sticking oil pressure relief valve	Free-up relief valve
		b. Worn oil pump	Replace pump
		c. Oil suction line blocked	Clear blockage
		d. Worn connecting rod bearings.	Replace bearings

#### FUEL SYSTEM - GROUP 4

##### Fuel Injection Pump

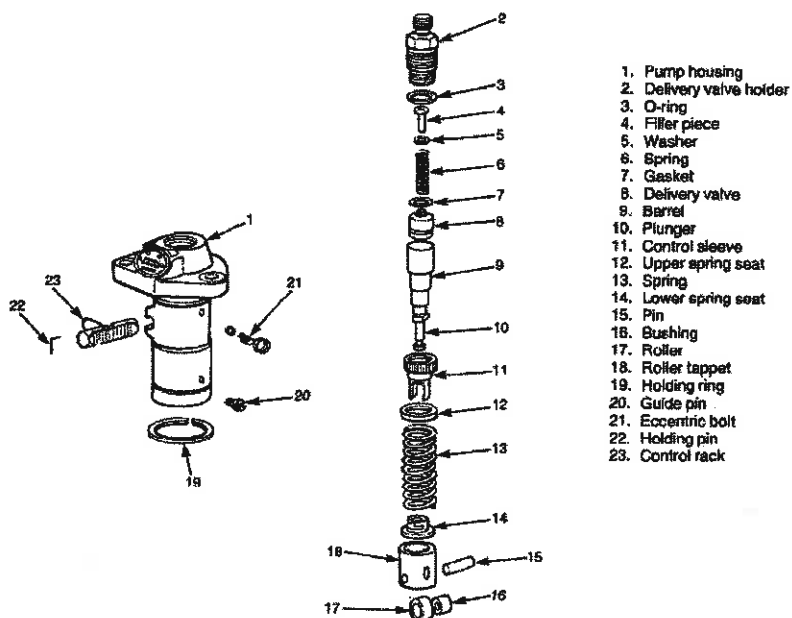
24. **Disassembly.** Disassembly of the fuel injection pump is as follow:

- a. Remove the fuel injection pump from the engine (Ref EMBI Vehicle H 713 - Group 4).

**CAUTION**

**All work on the fuel injection pump must be performed in a clean, dust free environment. Dust or dirt will damage the internal components.**

- b. Secure the pump housing in a soft-jawed vice.
- c. Remove the delivery valve holder (Figure 64).
- d. Remove and discard the O ring.
- e. Remove the pump from the vice.
- f. Invert the pump and remove the filler piece, washer, spring, gasket, delivery valve and the barrel.
- g. Discard the gasket.
- h. Secure the pump housing in the soft-jawed vice with the roller tappet uppermost.
- i. Remove the holding ring.
- j. Push the tappet roller in against spring tension.
- k. Remove the guide pin
- l. Remove the roller tappet.
- m. Remove the pump from the vice.
- n. Invert the pump and remove the lower spring seat, plunger, spring, upper spring seat and the control sleeve.



**Figure 64 Fuel Injection Pump - Exploded View**

**25. Cleaning and Inspection.** The cleaning and inspection procedure for the fuel injection pump is as follows:

**WARNING**

**Eye protection must be worn when using compressed air.**

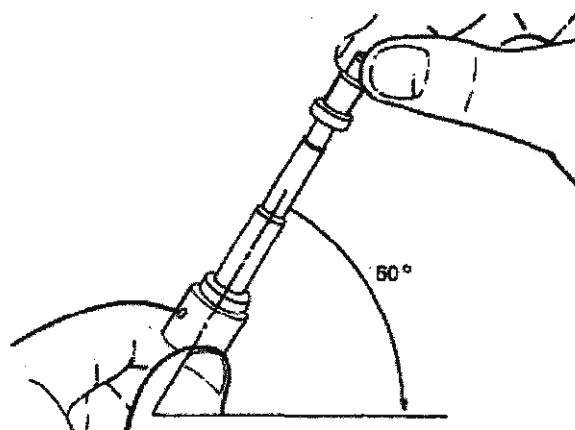
- a. Wash all parts except the barrel and plunger assembly and the delivery valve assembly, with a cleaning agent.

- b. Blow the parts dry with clean, moisture free compressed air.
- c. Wash the barrel and plunger assembly and the delivery valve assembly in clean diesel fuel.
- d. Inspect the barrel and plunger assembly.
- e. Ensure that the helix on the plunger and the inlet/spill port in the barrel are not damaged.
- f. Ensure that neither the barrel nor plunger are discoloured or scored and that the plunger moves smoothly in the barrel.

**NOTE**

Avoid excessive handling of the plunger or the barrel, as expansion due to body heat transfer can affect the fine tolerances between the plunger and barrel assembly.

- g. Lubricate the barrel and plunger assembly with clean diesel fuel.
- h. Check that the plunger slides smoothly into the barrel under its own weight when the assembly is inclined at 60° (Figure 65).
- i. Rotate the plunger slightly several times and check that each time the plunger slides smoothly into the barrel.
- j. Replace the plunger and barrel assembly if the plunger fails to slide smoothly, or if it slides too quickly into the barrel.
- k. Inspect the delivery valve and valve seat for nicks, dents or excessive wear.
- l. Hold the valve assembly and block off the fuel inlet port with a finger while pushing the valve into the valve body, then release the valve.
- m. Pressure of the air compressed in the bore of the valve body should cause the valve to rise when the valve is released.
- n. Replace the delivery valve assembly if the valve fails to rise when released or if damage or wear is evident.
- o. Check the delivery valve return spring for damaged, broken or weakened coils (loss of tension).
- p. Replace as necessary.
- q. Inspect the delivery valve holder for cracks or damage and for a scratched or scored sealing face.
- r. Replace the delivery valve holder as necessary.



**Figure 65 Checking Plunger for Smooth Operation**

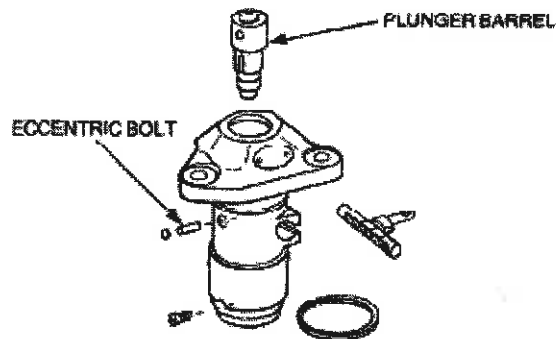
- s. Inspect the control sleeve for visible signs of wear on the gear teeth and the sleeve.
- t. Replace the control sleeve as necessary.
- u. Inspect the roller tappet for visible signs of wear and check the roller tappet return spring for damaged, broken or weakened coils (loss of tension).



- v. Replace as necessary.
- w. Inspect the pump housing for signs of cracks or damage.
- x. Check the bore for evidence of scoring or pitting.
- y. Replace the pump housing as necessary.

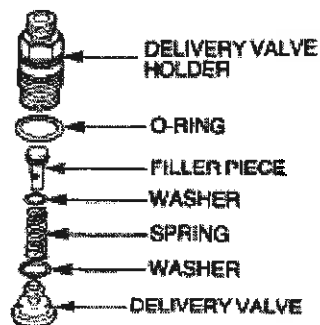
**26. Reassembly.** Reassemble the fuel injection pump as follows:

- a. Install the plunger barrel into the pump housing, ensuring that the slot on the barrel (Figure 66) aligns with the eccentric bolt in the pump housing.



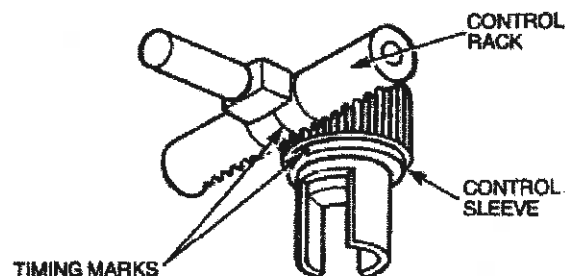
**Figure 66 Plunger Barrel Installation**

- b. Lubricate the delivery valve with clean diesel fuel.
- c. Install the delivery valve in the pump housing.
- d. Install the washer, spring, filler piece and washer.
- e. Place a new O ring on the delivery valve holder and install the delivery valve holder (Figure 67).



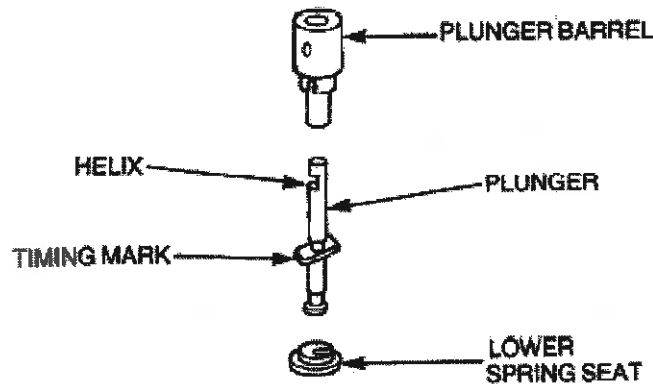
**Figure 67 Delivery Valve - Installation**

- f. Invert the pump housing and centralize the control rack in the pump housing.
- g. Install the control sleeve.
- h. Ensure that the timing marks on the control rack and the control sleeve align (Figure 68).



**Figure 68 Control Sleeve - Installation**

- i. Install the upper spring seat and the spring.
- j. Lubricate the plunger with clean diesel fuel.
- k. Install the plunger in the guide slot in the lower spring seat (Figure 69).
- l. Install the plunger into the barrel.
- m. Ensure that the plunger helix is facing upwards and the timing mark is facing the control rack.



**Figure 69 Plunger and Lower Spring Seat**

- n. Secure the pump housing in a soft-jawed vice in the inverted position.
- o. Install the roller tappet.
- p. Push the roller tappet in against spring tension.
- q. Install the guide pin and the holding ring.
- r. Invert the pump housing in the soft-jawed vice.
- s. Torque the delivery valve holder to 34 N.m (25 lbf.ft).
- t. Connect the inlet union of the injection pump to a regulated air supply.
- u. Submerge the pump in a container of clean diesel fuel.
- v. Turn on and adjust the air supply to a pressure of 503 kPa (73 psi) for a period of 20 seconds.
- w. Check for any air leaks.
- x. Rectify any leaks by replacing washers, O rings or gaskets as necessary.

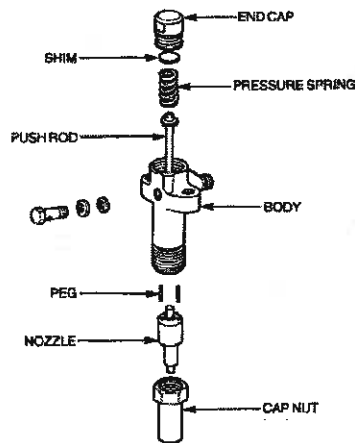
### Fuel Injector

- 27. Disassembly.** Disassemble the fuel injector as follows:
- a. Remove the fuel injector from the engine (Ref EMEI Vehicle H 513 - Group 4).

**CAUTION**

**All work on the fuel injector assembly must be performed in a clean, dust free environment. Dust or dirt will damage the internal components.**

- b. Secure the injector body in a soft-jawed vice.
- c. Remove the end-cap, shim, pressure spring and push rod (Figure 70).



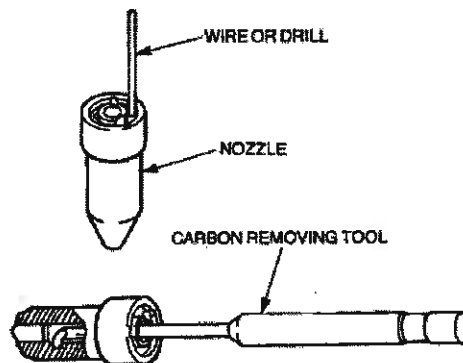
**Figure 70 Fuel Injector - Exploded View**

- d. Invert the injector body in the vice and remove the nozzle holder and the nozzle assembly.
  - e. Remove the injector body from the vice.
- 28. Cleaning and Inspection.** Cleaning and inspection of the fuel injector is as follows:
- a. Soak all components in a carbon removing and cleaning agent.
  - b. Wash all external dirt, grease and carbon deposits from the body and nozzle holder.
  - c. Use a brass wire brush as necessary, to assist the removal of carbon deposits.

**NOTE**

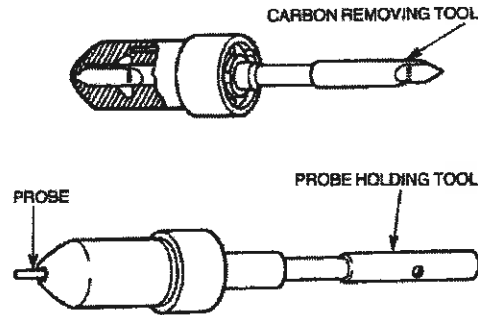
When cleaning the needle valve and nozzle, take care not to scratch or score the valve seat.

- d. Using a diameter wire or drill, clean the fuel feed passages in the nozzle (Figure 71).
- e. Using an injector cleaning kit, remove the carbon from the recess in the nozzle.



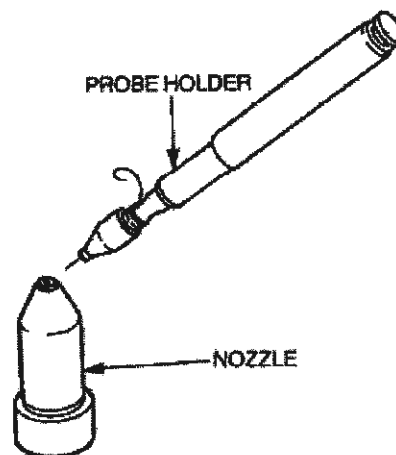
**Figure 71 Nozzle - Cleaning**

- f. Using the tools provided in the cleaning kit, remove the carbon from the valve seat (Figure 72).
- g. Select a probe from the kit to clean the main fuel outlet.



**Figure 72 Nozzle Valve Seat - Cleaning**

- h. Using the probe wire, clean out the carbon from the nozzle spray holes (Figure 73).
- i. To prevent the wire bending or breaking in the nozzle ensure that no more than 1.5 mm (0.062 in) of wire extends from the holder.



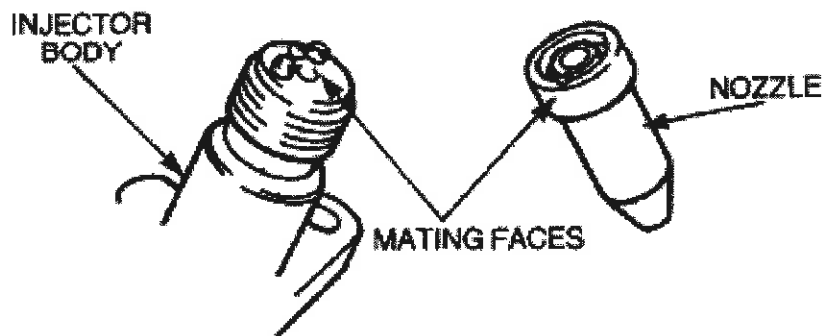
**Figure 73 Nozzle Spray Holes - Cleaning**

- j. Clean the needle valve and inspect it for wear or damage.

**NOTE**

If the needle valve is blued or has a dull appearance, this indicates wear. The valve and the nozzle must be replaced as a matched pair. Do not attempt to lap-in the nozzle.

- k. Inspect the mating faces of the nozzle and the body, these should be smooth and free of scratches or scores (Figure 74).
- l. Replace the injector assembly if these components are faulty.



**Figure 74 Injector Mating Faces - Inspection**

29. **Reassembly.** Reassembly of the fuel injector is as follows:

**NOTE**

Do not hold the needle valve for too long, as expansion due to body heat transfer will prevent valve installation.

- a. Immerse the nozzle and needle valve in clean diesel fuel.
- b. Insert the valve in the nozzle.
- c. Ensure that the valve moves freely.
- d. Ensure that the injector body is clean.
- e. Fit the nozzle to the body, aligning the locating pegs.
- f. Install the cap-nut and tighten.
- g. Secure the injector body in the vice.
- h. Torque the cap-nut to 58-78 N.m (43-58 lbf.ft).
- i. Insert the push rod in the body, fit the pressure spring, shim and the end-cap.
- j. Remove the injector from the vice.

**Spray Pattern Test**

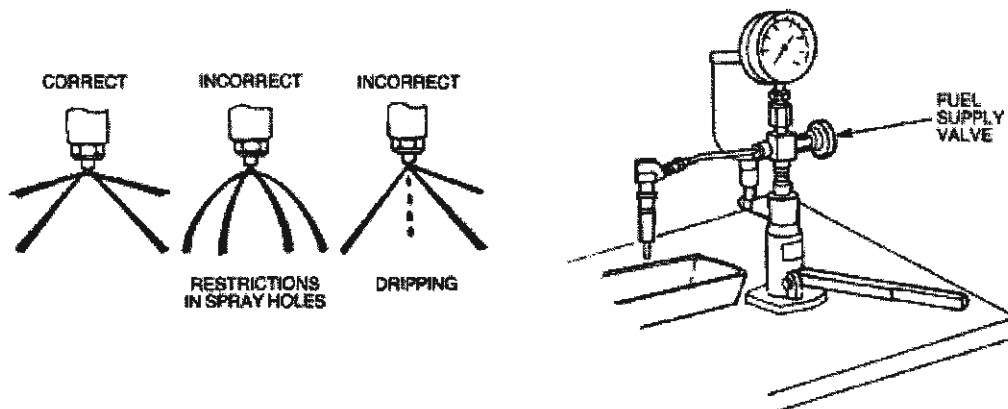
**WARNING**

Due to the high pressures involved in the spray pattern test and the possibility of a defective injector spraying in any direction, keep hands away from the injector outlet to prevent personal injury.

**NOTE**

Spray patterns should be checked by operating the hand lever at a rate of four to six strokes per second, as operating the lever too slow will cause the fuel to spray in coarse particles. Fuel delivery accompanying a weak pulsating noise from the injector, may cause fuel to be sprayed in a solid stream, without being atomised.

- k. Install the injector on the test rig.
- l. Ensure that there is sufficient clean fuel in the reservoir.
- m. Close off the fuel supply to the gauge and operate the handle two to three times while observing the spray pattern (Figure 75).



**Figure 75** Injector Spray Pattern Test

- n. Replace any injector that fails to spray correctly.
- o. Open the fuel supply to the gauge and operate the handle to build up pressure, but do not allow the injector to spray.
- p. Observe the starting pressure reading on the test rig gauge while holding the pressure with the handle as the injector sprays.
- q. The injection starting pressure must be 18 634 to 19 618 kPa (2702 to 2845 psi). If not, replace the shim with one of larger or smaller thickness to increase or decrease the starting pressure as required.
- r. Install the end-cap.
- s. Torque to 58 to 78 N.m (42 to 58 lbf.ft).
- t. Check that the starting pressure is correct and the leak down rate is not less than fifteen seconds from 14 710 kPa (2133 psi) to 9809 kPa (1422 psi) when the handle is released and the pressure is allowed to fall naturally.
- u. Check the end-cap and the cap-nut for any leaks.
- v. Rectify as necessary.
- w. If the leak-down rate is less than fifteen seconds, replace the nozzle assembly.
- x. Replace the injector if it does not conform to specification.

**30. Specifications - Fuel System.** The specifications for the fuel system are contained in Table 9.

**Table 9 Specifications - Fuel System**

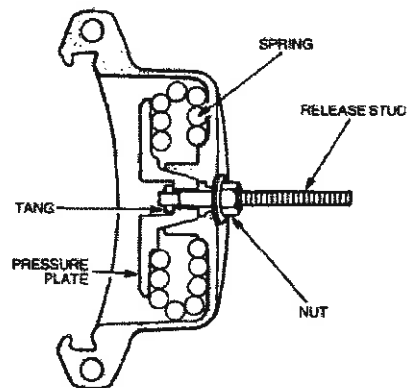
Serial	Item	Specification	Value
1	Fuel injection pump delivery valve holder	Tightening torque	34 N.m (25 lbf.ft)
2	Fuel injection pump leakage test	Air pressure	503 kPa (73 psi)
3	Fuel injector end-cap	Tightening torque	59-78 N.m (43-58 lbf.ft)
4	Fuel injector	Starting pressure	18 634 to 19 618 kPa (2707 to 2845 psi)
5	Fuel injector	Leak-down rate	Not less than fifteen seconds from 14 710 to 9809 kPa (2133 to 1422 psi)

**AXLES - GROUP 9**

**Axles**

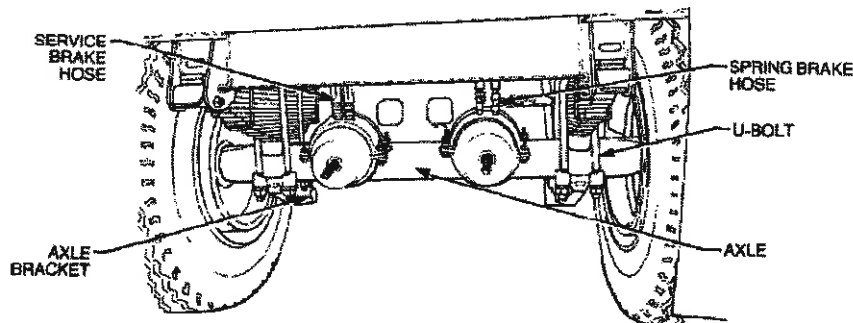
**31. Removal.** The procedure for the removal of the axles is as follows:

- a. Chock the wheels.
- b. Remove the dust cap from the spring brake housing.
- c. Insert the spring brake release stud through the opening in the rear of the chamber, into the spring pressure plate.
- d. Rotate the stud one-quarter of a turn to engage the tangs of the stud in the slot in the pressure plate (Figure 76).



**Figure 76 Spring Brake Release Stud**

- e. Ensure that the release stud remains engaged in the pressure plate.
- f. Tighten the nut with a wrench to fully compress the spring.
- g. Drain the air from the air reservoirs.
- h. Tag and remove the service and spring brake air hoses from the brake chambers.
- i. Remove the wheels (Ref EMEI Vehicle H 713 - Group 11).
- j. Remove the four bolts securing the U-bolts to the axle bracket.
- k. Remove the U-bolts (Figure 77), and swing the axle brackets and the radius rods away from the axle.



**Figure 77 Axle Assembly - Removal**

**WARNING**

**This assembly is heavy. Care must be taken to avoid personal injury.**

- l. Support the axle assembly on a trolley jack.
- m. Remove the safety stands.
- n. Lower the assembly and manipulate it out from beneath the trailer.

**32. Installation.** The procedure for installation of the axles is as follows:

**WARNING**

**This assembly is heavy. Care must be taken to avoid personal injury.**

- a. Position the axle assembly under the trailer and support the assembly on safety stands.
- b. Swing the radius rods and the axle brackets into position.

- c. Install the U-bolts.
- d. Torque the U-bolt securing nuts to 407 N.m (300 lbf.ft).

**NOTE**

The U-bolts must be retorqued after approximately 1000 km. The trailer must be loaded.

- e. Install the wheels (Ref EMEI Vehicle H 713 - GROUP 11), but do not remove the wheel chocks at this stage.
- f. Connect the service and spring brake air hoses onto the brake chambers.
- g. Charge the air reservoirs to normal operating pressure.
- h. Remove the release stud and nut to uncage the spring brake pressure plate and spring.

**NOTE**

The axle alignment should be checked as soon as possible using alignment equipment.

- i. Apply the service and spring brakes in turn.
- j. Check for any air leaks.
- k. Rectify as necessary.
- l. Apply the parking brakes.
- m. Remove the wheel chocks.

33. **Specifications - Axles.** The specifications for the axles are contained in Table 10.

**Table 10 Specifications - Axles**

Serial	Item	Specification	Value
1	U-bolt nuts	Tightening torque	407 N.m (300 lbf.ft)

**BRAKE SYSTEM - GROUP 12**

**Brake Shoes**

**WARNING**

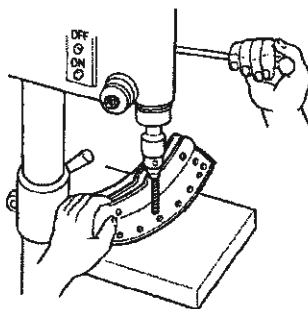
Brake linings may contain asbestos. If asbestos is present linings are to be handled in accordance with EMEI Workshop E 410.

Any material suspected of containing or being asbestos is to be treated as asbestos until proven otherwise. Small components suspected of being asbestos are to be assumed to be asbestos for maintenance and disposal procedures.

34. **Relining.** Relining of the brake shoes is carried out as follows:

- a. Remove the brake shoes from the trailer (Ref EMEI Vehicle H 713 - Group 12).
- b. Using a twist drill with a diameter slightly larger than that of the rivet, carefully remove the riveted end of each rivet (Figure 78) taking care not to drill into the shoe.
- c. Push out the rivets and remove the lining.





**Figure 78 Brake Shoe Lining Removal**

- d. Check that the brake shoe is not bent, twisted or cracked.
- e. Thoroughly clean the shoes, removing any rust scale which may have formed under the lining.
- f. Apply a rust preventative paint if necessary.

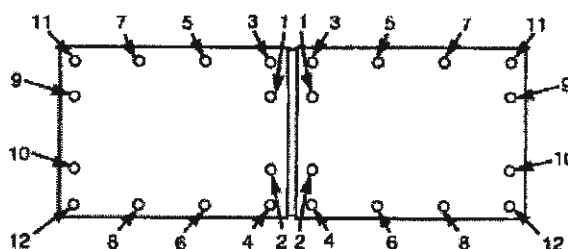
**CAUTION**

**Ensure that the rivets are the correct length and diameter. Brake failure could be caused by using the incorrect rivets.**

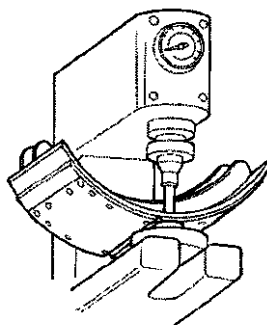
**NOTE**

The replacement lining must be kept clean and free of oil and grease during assembly.

- g. Position the lining on the shoe with the tapered section at the end of the shoe.
- h. Install the rivets from the centre outwards.
- i. With all the rivets in position stake the rivets in the sequence shown (Figure 79) from the centre using a press (Figure 80).
- j. Ensure that all rivets are secure and the lining is not cracked.



**Figure 79 Brake Lining Riveting Sequence**



**Figure 80 Brake Shoe Lining - Installation**

### Relay Valve (CA43)

35. **Disassembly.** Disassembly of the relay valve (CA43) is as follows (Figure 81):

- a. Remove the relay valve from the trailer (Ref EMEI Vehicle H 713 - Group 12).

### WARNING

**Components within this valve are under spring pressure. Care must be taken to avoid personal injury.**

- b. Remove the four bolts securing the cover, (Figure 81, Item 1), to the body (Figure 81, Item 10).
- c. Remove the cover.
- d. Remove the piston (Figure 81, Item 3) from the cover.
- e. Remove and discard the O rings (Figure 81, Items 2, 4 and 5) from the piston.
- f. Remove and discard the O ring (Figure 81, Item 9) from the body (Figure 81, Item 10).
- g. Using circlip pliers, remove the circlip (Figure 81, Item 21) from the body.
- h. Remove the plate, the lower piston and the spring (Figure 81, Items 20, 19 and 18) from the body.
- i. Remove and discard the O ring (Figure 81, Item 17) from the lower piston.
- j. Using circlip pliers, remove the circlip (Figure 81, Item 15) from the inlet valve (Figure 81, Item 6).
- k. Remove the inlet valve guide (Figure 81, Item 14) from the lower half of the body.
- l. Remove the inlet valve guide seat (Figure 81, Item 12) from the inlet valve guide.
- m. Discard the O ring (Figure 81, Item 11).

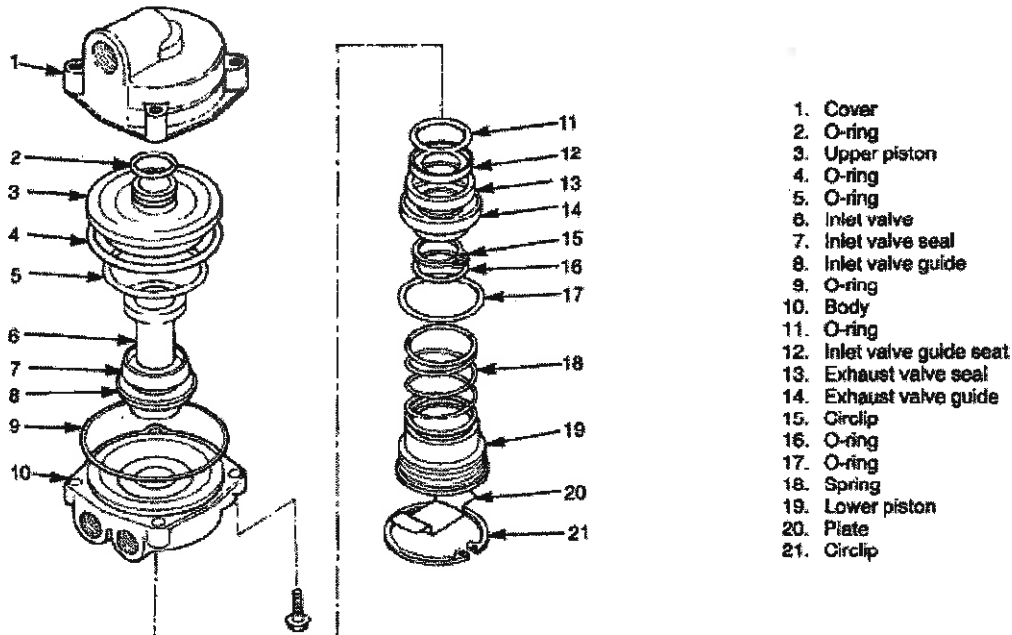


Figure 81 Relay Valve (CA43) - Exploded View

- n. Remove and discard the exhaust valve seal and the O ring (Figure 81, Items 13 and 16).
  - o. Remove the inlet valve guide, inlet valve seal and the inlet valve (Figure 81, Items 8, 7 and 6) from the upper half of the body.
  - p. Remove the inlet valve (Figure 81, Item 6) from the inlet valve guide (Figure 81, Item 8) then remove and discard the inlet valve seal (Figure 81, Item 7).
- 36. Reassembly.** Reassembly of the relay valve (CA43) is as follows (Figure 81):

**WARNING**

**Eye protection must be worn when using compressed air.**

- a. Thoroughly clean all metal parts in a cleaning solvent and blow dry with compressed air.

**NOTE**

Prior to assembly of the relay valve, lubricate all O rings, O ring grooves, piston bores and metal to metal surfaces with a silicone base lubricant.

- b. Install the inlet valve seal (Figure 81, Item 7) in the inlet valve guide (Figure 81, Item 8).
- c. Install the inlet valve (Figure 81, Item 6) into the guide.
- d. Install the exhaust valve seal (Figure 81, Item 13) in the exhaust valve guide (Figure 81, Item 14).
- e. Install the O ring (Figure 81, Item 11) in the inlet valve guide seat (Figure 81, Item 12).
- f. Position the inlet valve guide seat (Figure 81, Item 12) in the exhaust valve seal (Figure 81, Item 13).
- g. Position the inlet valve, inlet valve seal and the inlet valve guide (Items 6, 7 and 8) in the upper half of the body.
- h. Install the inlet valve guide seal, exhaust valve seal and the exhaust valve guide (Figure 81, Items 12, 13 and 14) in the lower half of the body over the inlet valve (Figure 81, Item 6).
- i. Secure in position with the circlip (Figure 81, Item 15).
- j. Install the O ring (Figure 81, Item 17) on the lower piston (Figure 81, Item 19).
- k. Install the spring (Figure 81, Item 18) and the piston into the body.
- l. Holding the piston down against spring pressure, install the plate (Figure 81, Item 20).
- m. Secure in place with the circlip (Figure 81, Item 21).
- n. Install the O ring (Figure 81, Item 9) on the body (Figure 81, Item 10).
- o. Install the O rings (Figure 81, Items 2, 4 and 5) on the upper piston (Figure 81, Item 3).
- p. Install the upper piston in the cover (Figure 81, Item 1).
- q. Position the cover on the body.
- r. Secure with the four bolts.
- s. Install the relay valve on the trailer (Ref EMEI Vehicle H 713 - Group 12).

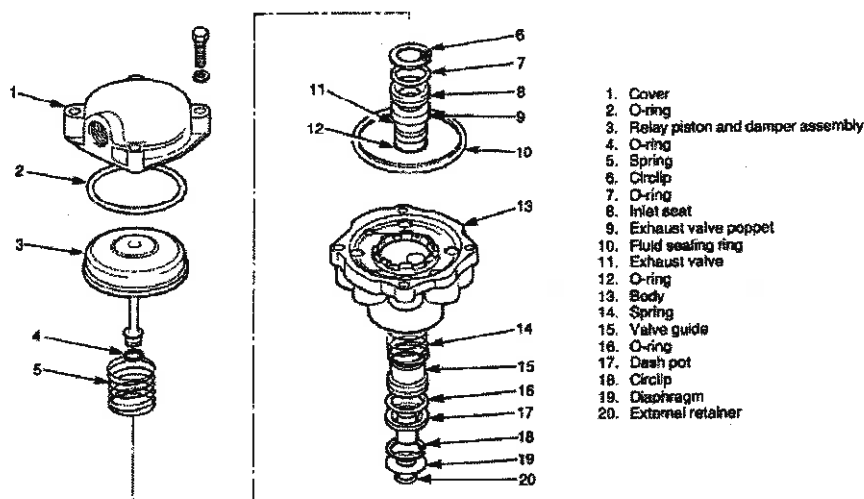
**Service Brake Relay Valve (CA38)**

- 37. Disassembly.** Disassembly of the service brake relay valve (CA38) is as follows (Figure 82):
- a. Remove the relay valve from the trailer (Ref EMEI Vehicle H 713 - Group 12).

**WARNING**

**Components within this valve are under spring pressure. Care must be taken to avoid personal injury.**

- b. Remove the four bolts and washers securing the cover (Figure 82, Item 1) to the body (Figure 82, Item 13).
- c. Remove the cover, together with the relay piston and damper assembly (Figure 82, Item 3) from the body.



**Figure 82 Service Brake Relay Valve (CA38)**

- d. Remove the relay piston and damper assembly from the cover.
  - e. Remove and discard the O rings (Figure 82, Items 2 and 4)
  - f. Remove the spring (Figure 82, Item 5) and the fluid sealing ring (Figure 82, Item 10) from the body.
  - g. Discard the sealing ring.
  - h. Using circlip pliers, remove the upper circlip (Figure 82, Item 6) from the body.
  - i. Remove the inlet seat (Figure 82, Item 8).
  - j. Remove and discard the O ring (Figure 82, Item 7) from the inlet seat.
  - k. Remove the exhaust valve (Figure 82, Item 11).
  - l. Remove and discard the exhaust valve poppet (Figure 82, Item 9) and the O ring (Figure 82, Item 12) from the exhaust valve.
  - m. Remove the spring (Figure 82, Item 14).
  - n. Remove and discard the valve guide (Figure 82, Item 15) and the O ring (Figure 82, Item 16).
  - o. Remove the external retainer (Figure 82, Item 20).
  - p. Remove and discard the diaphragm (Figure 82, Item 19).
  - q. Using circlip pliers remove the lower circlip (Figure 82, Item 18).
  - r. Remove the dash pot (Figure 82, Item 17) from the body.
- 38. Reassembly.** Reassembly of the service brake relay valve (CA38) is as follows (Figure 82):

**WARNING**

**Eye protection must be worn when using compressed air.**

- a. Thoroughly clean all metal parts in a cleaning solvent.
- b. Blow them dry with compressed air.

**NOTE**

Prior to reassembly of the relay valve, lubricate all O rings, O ring grooves, piston bores and metal to metal surfaces with a silicone base lubricant.

- c. Using circlip pliers install the lower circlip (Figure 82, Item 18) in the body (Figure 82, Item 13).
- d. Install the dash pot (Figure 82, Item 17) into the body.
- e. Position the diaphragm (Figure 82, Item 19) on the dash pot.
- f. Secure with the external retainer (Figure 82, Item 20).
- g. Install the O ring (Figure 82, Item 16) on the valve guide (Figure 82, Item 15).
- h. Install the valve guide in the body (Figure 82, Item 13).
- i. Install the spring (Figure 82, Item 14).
- j. Install the O ring (Figure 82, Item 12) and the exhaust valve poppet (Figure 82, Item 9) on the exhaust valve (Figure 82, Item 11).
- k. Install the O ring (Figure 82, Item 7) on the inlet seat (Figure 82, Item 8).
- l. Install the exhaust valve and the inlet seat into the body.
- m. Secure them with the upper circlip (Figure 82, Item 6).
- n. Install the fluid sealing ring (Figure 82, Item 10) into the body.
- o. Install the O ring (Figure 82, Item 4) onto the shaft of the relay piston and damper assembly (Figure 82, Item 3).
- p. Position the O ring (Figure 82, Item 2) in the cover (Figure 82, Item 1).
- q. Install the relay piston and damper assembly in the cover.
- r. Position the spring (Figure 82, Item 5) in the body (Figure 82, Item 13).
- s. Install the cover, relay piston and damper piston.
- t. Secure the cover (Figure 82, Item 1) to the body (Figure 82, Item 13) with the four bolts and washers.
- u. Install the relay valve on the trailer (Ref EMEI Vehicle H 713 - Group 12).

**Spring Brake Relay Valve (CA41 PARC)**

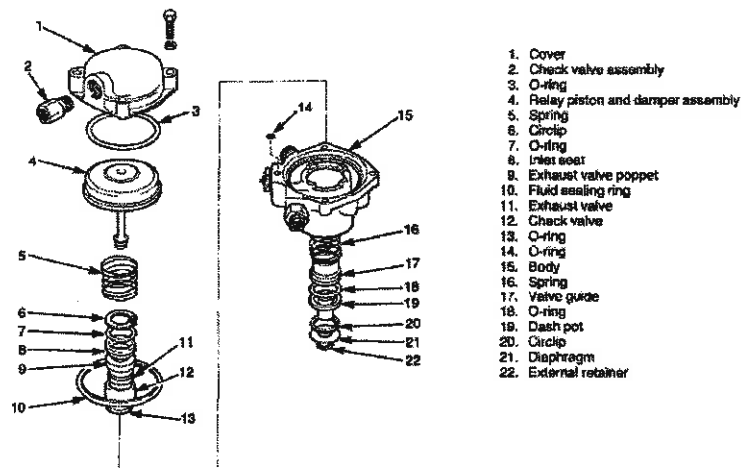
- 39. Disassembly.** Disassemble the spring brake relay valve (CA41 PARC) as follows (Figure 83):
- a. Remove the relay valve from the trailer (Ref EMEI Vehicle H 713 - Group 12).

**WARNING**

**Components within this valve are under spring pressure. Care must be taken to avoid personal injury.**

- b. Remove the four bolts and washers securing the cover (Figure 82, Item 1) to the body (Item 15).
- c. Remove the cover, together with the relay piston and damper assembly (Item 4), from the body.
- d. Remove the relay piston and damper assembly from the cover.
- e. Remove and discard the O ring (Item 3).
- f. Remove the spring (Item 5) and the fluid sealing ring (Item 10) from the body and discard the sealing ring.
- g. Using circlip pliers, remove the upper circlip (Item 6) from the body.
- h. Remove the inlet seat (Item 8).
- i. Remove and discard the O ring (Item 7) from the inlet seat.

- j. Remove the exhaust valve (Item 11).
- k. Remove and discard the exhaust valve poppet (Item 9) and the O ring (Item 13) from the exhaust valve.
- l. Remove the spring (Item 16) then remove and discard the check valve (Item 12).
- m. Remove and discard the valve guide (Item 17) and the O ring (Item 18).
- n. Remove the external retainer (Item 22).
- o. Remove and discard the diaphragm (Item 21).
- p. Using circlip pliers, remove the lower circlip (Item 20).
- q. Remove the dash pot (Item 19) from the body.

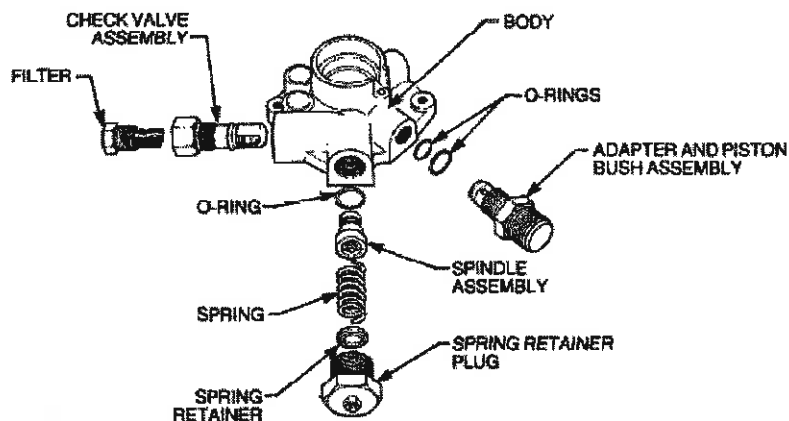


**Figure 83 Spring Brake Relay Valve (CA41 PARC) - Exploded View**

- r. Remove the spring retainer plug (Figure 84).
- s. Remove the spring retainer, the spring, the spindle assembly and the O ring.
- t. Discard the spindle assembly and the O ring.

**NOTE**

The filter, the check valve assembly and the adapter and piston bush assembly are not contained in the repair kit and are replaced as assemblies only.



**Figure 84 Body - Exploded View**

- u. Remove and discard the filter and the check valve assembly.

- v. Remove and discard the adapter and piston bush assembly complete with the two O rings.
- 40. Reassembly.** Reassembly of the spring brake relay valve (CA41 PARC) is as follows (Figure 83):

**WARNING**

**Eye protection must be worn when using compressed air.**

- a. Thoroughly clean all metal parts in a solvent.
- b. Blow them dry with compressed air.

**NOTE**

Prior to the reassembly of the relay valve, lubricate all O rings, O ring grooves, piston bores and metal to metal surfaces with a silicone base lubricant.

- c. Install the two O rings on the adapter and piston bush assembly.
- d. Install the assembly in the body (Figure 84).
- e. Install the filter and check valve assembly in the body.
- f. Install the O ring on the spindle assembly.
- g. Install the assembly, the spring, the spring seat and the spring retainer plug.
- h. Using circlip pliers, install the lower circlip (Figure 83, Item 20) in the body (Figure 83, Item 15).
- i. Install the dash pot (Figure 83, Item 19) into the body.
- j. Position the diaphragm (Figure 83, Item 21) on the dash pot.
- k. Secure with the external retainer (Figure 83, Item 22).
- l. Install the O ring (Figure 83, Item 18) on the valve guide (Figure 83, Item 17).
- m. Install the valve guide in the body (Figure 83, Item 15).
- n. Install the check valve (Figure 83, Item 12).
- o. Install the spring (Figure 83, Item 16) in the body.
- p. Assemble the O ring (Figure 83, Item 13) and the exhaust valve poppet (Figure 83, Item 9) on the exhaust valve (Figure 83, Item 11).
- q. Install the O ring (Figure 83, Item 7) on the inlet seat (Figure 83, Item 8).
- r. Install the exhaust valve and the inlet seat into the body.
- s. Secure it with the upper circlip (Figure 83, Item 6).
- t. Install the fluid sealing ring (Figure 83, Item 10) into the body.
- u. Position the O ring (Figure 83, Item 3) in the cover (Figure 83, Item 1).
- v. Install the relay piston and damper assembly in the cover.
- w. Position the spring (Figure 83, Item 5) in the body (Figure 83, Item 15).
- x. Install the cover, relay piston and damper assembly.
- y. Secure the cover (Figure 83, Item 1) to the body (Figure 83, Item 15) with the four bolts and washers.
- z. Install the relay valve on the trailer (Ref EMEI Vehicle H 713 - Group 12).

**Service and Spring Brake Chamber**

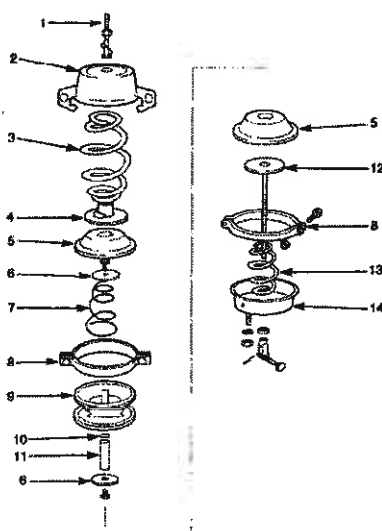
- 41. Disassembly.** Disassembly of the service and spring brake chamber is as follows (Figure 85):

- a. Cage the spring brake and remove the complete brake chamber assembly from the trailer (Ref EMEI Vehicle H 713 - Group 12).

**WARNING**

Components within this valve are under spring pressure. Care must be taken to avoid personal injury.

- b. Remove the clamp (Figure 85, Item 8) securing the spring brake chamber (Figure 85, Item 2) to the adapter housing (Item 9).
- c. Slide the spring brake chamber and the diaphragm (Figure 85, Item 5) off the adapter housing.

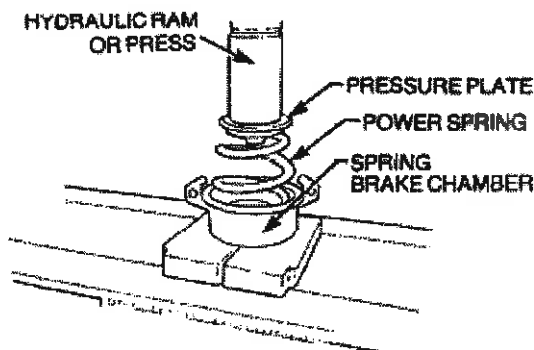


**Figure 85 Service and Spring Brake Chamber - Exploded View**

**WARNING**

Do not attempt to remove the power spring without using a hydraulic press or clamping equipment, as personal injury may result.

- d. Remove the diaphragm.
- e. Using a hydraulic press or clamping equipment (Figure 86) remove the power spring (Figure 85, Item 3) and the pressure plate (Figure 85, Item 4) from the spring brake chamber (Figure 85, Item 2).



**Figure 86 Power Spring - Removal**

- f. Remove the clamp (Figure 85, Item 8) securing the service brake chamber (Figure 85, Item 14) to the adapter housing (Figure 85, Item 9).
- g. Remove the chamber and the diaphragm (Figure 85, Item 5).
- h. Remove the screw securing the plate (Figure 85, Item 6) to the adapter push rod (Figure 85, Item 11).



- i. Remove the adapter push rod and the spring (Figure 85, Item 7).
  - j. Remove the O ring (Figure 85, Item 10) from the adapter housing.
  - k. Remove the nut and clevis from the push rod assembly (Figure 85, Item 12).
  - l. Remove the assembly and the spring (Figure 85, Item 13) from the chamber.
- 42. Inspection.** Inspection of the service and spring brake chamber is as follows (Figure 85):
- a. Inspect each diaphragm for wear or cracking.
  - b. Replace if necessary.
  - c. Inspect the springs for cracks or evidence of undue wear.
  - d. Replace if necessary.
  - e. Inspect the push rods, the adapter housing and the chambers for evidence of wear.
  - f. Replace if necessary.
- 43. Reassembly.** Reassembly of the service and spring brake chamber is as follows:
- a. Position the spring (Figure 85, Item 13) in the service brake chamber (Figure 85, Item 14).
  - b. Install the push rod assembly (Figure 85, Item 12).
  - c. Install the nut and clevis on the push rod.
  - d. Install a new O ring (Figure 85, Item 10) in the adapter housing.
  - e. Lubricate the O ring and bore of the housing with rubber grease.
  - f. Position the spring (Figure 85, Item 7) in the adapter housing (Figure 85, Item 9).
  - g. Install the adapter push rod (Figure 85, Item 11).
  - h. Retain the spring and the push rod with the plates (Figure 85, Item 6) and screws.
  - i. Position the diaphragm (Figure 85, Item 5) in the service brake chamber (Figure 85, Item 14).
  - j. Secure the chamber to the adapter housing (Figure 85, Item 9) with the clamp (Figure 85, Item 8).
  - k. Cage the power spring (Figure 85, Item 3) and the pressure plate (Figure 85, Item 4) using a hydraulic press or clamping equipment.
  - l. Secure in position with the release stud (Item 1).
  - m. Position the diaphragm (Figure 85, Item 5) in the spring brake chamber (Figure 85, Item 2).
  - n. Slide the diaphragm and chamber onto the adapter housing (Figure 85, Item 9).
  - o. Secure the chamber to the housing with the clamp (Figure 85, Item 8).
  - p. Install the brake chamber on the trailer (Ref EMEI Vehicle H 713 - Group 12).

## FRAME - GROUP 16

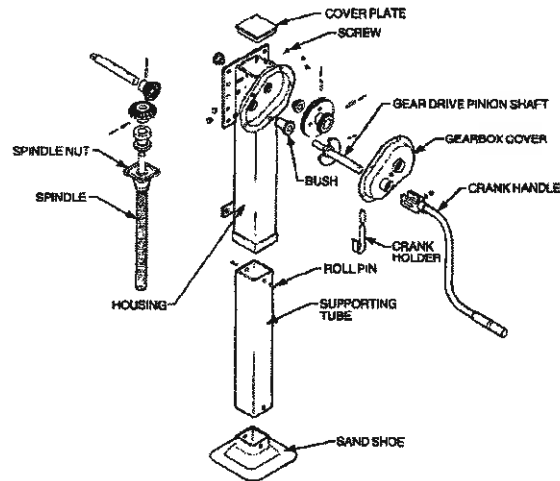
### Support Leg (Left-hand)

- 44. Disassembly.** Disassembly of the support leg left-hand is as follows:

#### WARNING

**This assembly is heavy. Care must be taken to avoid personal injury.**

- a. Remove the support leg from the trailer (Ref EMEI Vehicle H 713 - Group 16).
- b. Fully extend the support leg and remove the two roll pins securing the spindle nut into the supporting tube (Figure 87).
- c. Remove the tube and the sandshoe.



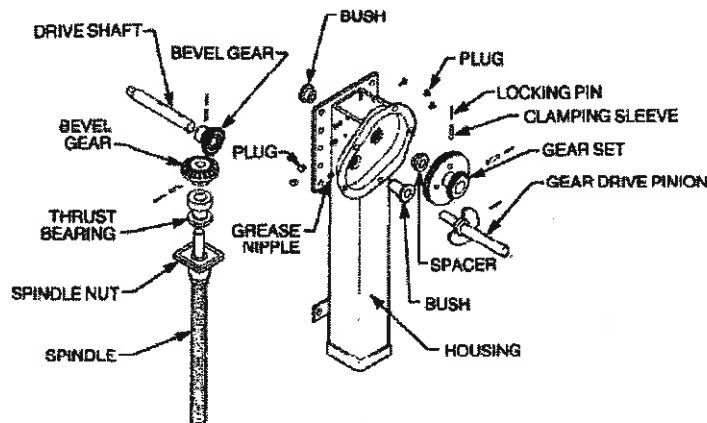
**Figure 87 Left-hand Support Leg - Exploded View**

- d. Remove the bolt, nut and washer securing the crank handle to the gear drive pinion shaft.
- e. Remove the handle.
- f. Remove the five bolts and nuts securing the gearbox cover to the gearbox.
- g. Remove the cover and the crank holder.
- h. Remove the two screws securing the cover plate into the housing.
- i. Remove the plate.

**WARNING**

**Eye protection must be worn when using compressed air.**

- j. Using a cleaning agent remove the grease from within the gearbox and the housing.
- k. Blow it dry with compressed air.
- l. Remove the gear drive pinion and the bush from the gearbox.
- m. Using a pin punch and a hammer, remove the locking pins and the clamping sleeves securing the gear set to the drive shaft (Figure 88).
- n. Remove the gear set.
- o. Remove the spacer from the drive shaft and the gear drive pinion bush.



**Figure 88 Housing and Drive Gears**

- p.** Remove the upper plastic plug from each side of the housing.
- q.** Rotate the drive shaft until the locking pin securing the small bevel gear to the drive shaft is aligned with the drilling in the housing.
- r.** Using a pin punch and hammer remove the locking pin and the clamping sleeve.
- s.** Remove the drive shaft, bevel gear and the bush.
- t.** Remove the lower plastic plug from each side of the housing.
- u.** Rotate the spindle until the locking pin securing the large bevel gear to the spindle is aligned with the drilling in the housing.
- v.** Using a pin punch and hammer, remove the locking pin and clamping sleeve.
- w.** Remove the bevel gear, spindle nut and the spindle from the housing.
- x.** Remove the thrust bearing from the bearing mounting plate in the housing.

**45. Reassembly.** Reassembly of the support leg (left-hand) is as follows:

- a.** Install the thrust bearing into the bearing mounting plate in the housing.
- b.** Install the spindle into the thrust bearing.
- c.** Ensure that the spindle nut is at the bottom of the spindle.
- d.** Rotate the spindle until the hole in the spindle is aligned with the lower drilling in the housing, then install the large bevel gear and secure to the spindle with the clamping sleeve and locking pin
- e.** Install the bush in the rear of the housing.
- f.** Position the small bevel gear in the housing.
- g.** Install the drive shaft ensuring that the holes in the gear, drive shaft and the drilling in the housing are aligned.
- h.** Install the clamping sleeve and the locking pin to secure the gear to the drive shaft.
- i.** Install the plastic plugs in each side of the housing.
- j.** Install the spacer on the drive shaft.
- k.** Position the gear set on the drive shaft.
- l.** Secure it with the clamping sleeves and the locking pins.
- m.** Install the bush into the gearbox.
- n.** Install the gear drive pinion shaft.
- o.** Position the gearbox cover and the crank holder at the gearbox.
- p.** Secure them with the five bolts and nuts.
- q.** Install the cover plate into the top of the housing.
- r.** Secure it with the two screws.
- s.** Position the supporting tube on the spindle nut.
- t.** Ensure that the holes in the tube and the nut are aligned.
- u.** Install the roll pins to secure the tube to the nut.
- v.** Position the crank handle on the drive shaft.
- w.** Secure it with the bolt, washer and nut.
- x.** Grease the gearbox with grease.
- y.** Check for the correct operation of the support leg in high and low gear.
- z.** Install the support leg on the trailer (Ref EMEI Vehicle H 713 - Group 16).

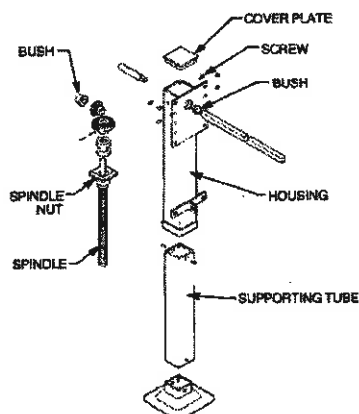
### Support Leg (Right-hand)

46. **Disassembly.** Disassembly of the support leg (right-hand) is as follows:

#### WARNING

**This assembly is heavy. Care must be taken to avoid personal injury.**

- a. Remove the support leg from the trailer (Ref EMEI Vehicle H 713 - Group 16).
- b. Fully extend the support leg.
- c. Remove the two roll pins securing the spindle nut into the supporting tube (Figure 89).
- d. Remove the tube and the sandshoe.



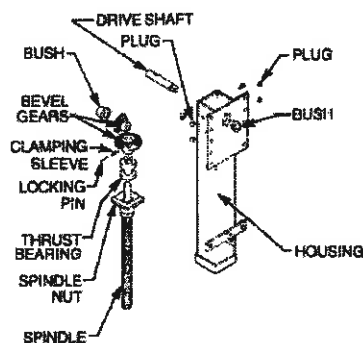
**Figure 89 Right-hand Support Leg - Exploded View**

- e. Remove the two screws securing the cover plate into the housing.
- f. Remove the plate.

#### WARNING

**Eye protection must be worn when using compressed air.**

- g. Using a cleaning agent, remove the grease from the gears and the housing.
- h. Blow them dry with compressed air.
- i. Remove the upper plastic plug from each side of the housing.
- j. Rotate the drive shaft until the locking pin securing the bevel gear to the drive shaft is aligned with the drilling in the housing (Figure 90).



**Figure 90 Housing and Drive Gears**

- k. Using a pin punch and hammer remove the locking pin and the clamping sleeve.
- l. Remove the drive shaft bevel gear and the bushes.
- m. Remove the lower plastic plug from each side of the housing.
- n. Rotate the spindle until the locking pin securing the bevel gear to the spindle is aligned with the drilling in the housing.
- o. Using a pin punch and hammer, remove the locking pin and the clamping sleeve.
- p. Remove the bevel gear, spindle nut and the spindle from the housing.
- q. Remove the thrust bearing from the bearing mounting plate in the housing.

**47. Reassembly.** Reassembly of the support leg (right hand) is as follows:

- a. Install the thrust bearing into the bearing mounting plate.
- b. Install the spindle into the thrust bearing.
- c. Ensure that the spindle nut is at the bottom of the spindle.
- d. Rotate the spindle until the hole in the spindle is aligned with the lower drilling in the housing.
- e. Install the large bevel gear.
- f. Secure to the spindle with the clamping sleeve and locking pin
- g. Install the bushes in the front and rear of the housing.
- h. Position the small bevel gear in the housing.
- i. Install the drive shaft.
- j. Ensure that the holes in the gear, drive shaft and the drilling in the housing are aligned.
- k. Install the clamping sleeve and the locking pin to secure the gear to the drive shaft.
- l. Install the cover plate.
- m. Secure to the housing with the two screws.
- n. Install the plastic plugs in each side of the housing.
- o. Position the supporting tube on the spindle nut.
- p. Ensure that the holes in the tube and the nut are aligned.
- q. Install the roll pins to secure the tube to the nut.
- r. Grease the drive gears.
- s. Check for the correct operation of the support leg.
- t. Install the support leg on the trailer (Ref EMEI Vehicle H 713 - Group 16).

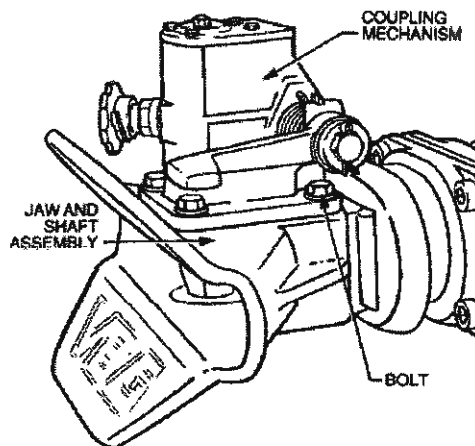
**Tow Coupling (Jaw Bushes)**

**48. Removal.** Removal of the tow coupling (jaw bushes) is as follows:

**NOTE**

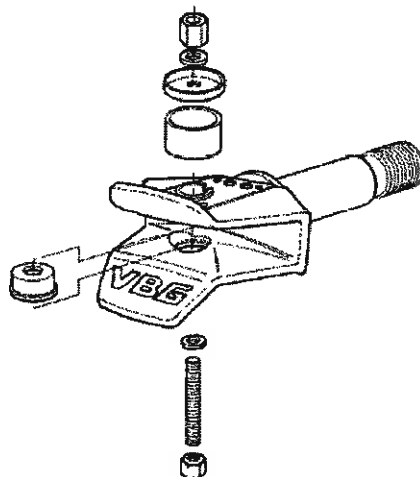
The coupling jaw bushes can be replaced with the coupling installed on the vehicle.

- a. Remove the four bolts and washers securing the coupling mechanism housing to the coupling jaw and shaft assembly (Figure 91).
- b. Remove the mechanism.
- c. Discard the washers.



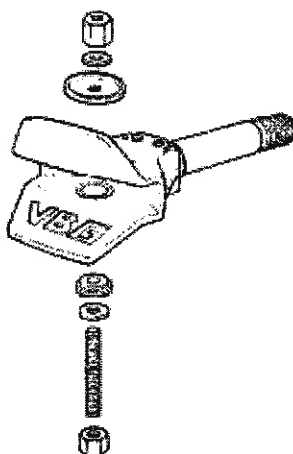
**Figure 91 Tow Coupling**

- d. Assemble the bush puller from VBG kit 39-010 (Figure 92) and remove the upper bushing.



**Figure 92 Upper Bush - Removal**

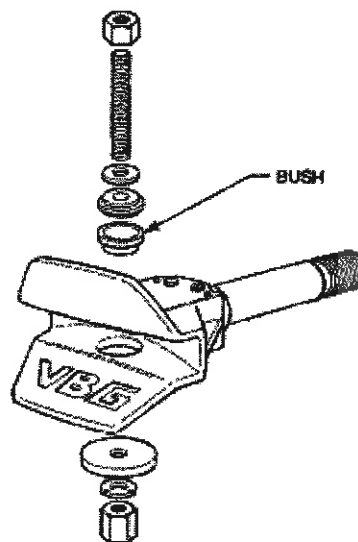
- e. Assemble the bush puller from VBG kit 39-010 (Figure 93) and remove the lower bush.



**Figure 93 Lower Bush Removal**

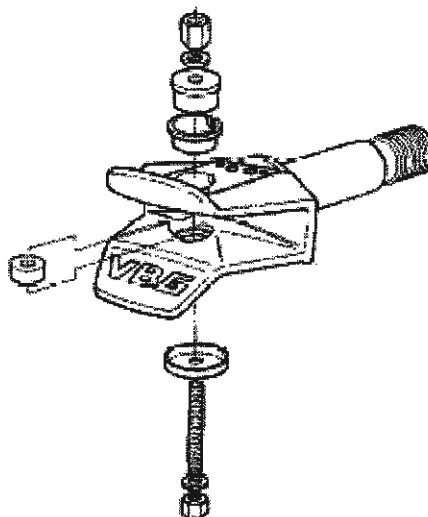
49. **Installation.** Installation of the tow coupling (jaw bushes) is as follows:

- a. Assemble the bush installer from VBG kit 39-010 (Figure 94) and install the lower bush.



**Figure 94 Lower Bush - Installation**

- b. Assemble the bush installer from VBG kit 39-010 as shown in (Figure 95) and install the upper bush.



**Figure 95 Upper Bush - Installation**

- c. Position the coupling mechanism on the coupling jaw.  
d. Secure to the jaw with the four bolts and new washers.  
e. Ensure that the mechanism is operating correctly while tightening the bolts.  
f. Torque the securing bolts to 80 to 90 N.m (59 to 66 lbf.ft).

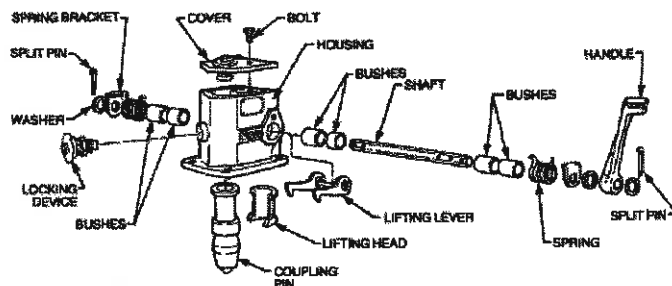
#### **Tow Coupling (Coupling Mechanism)**

50. **Disassembly.** Disassembly of the tow coupling (coupling mechanism) is as follows:

#### **NOTE**

The coupling mechanism can be disassembled and worn parts replaced with the tow coupling installed on the vehicle.

- a. With the coupling pin in the closed position, remove the four bolts securing the cover to the mechanism housing (Figure 96).  
b. Remove the cover.



**Figure 96 Coupling Mechanism - Exploded View**

- c. Remove the split pins from each end of the shaft.
  - d. Remove the washers and the handle.
  - e. Using a pair of pliers to hold the spring, remove the spring bracket from each spring.
  - f. Remove the spring and the two bushes from both sides of the housing.
  - g. Install the handle on the shaft.
  - h. Rotate the shaft in a clockwise direction until the lifting levers contact the back of the housing.
  - i. Remove the coupling pin and the lifting head from the top of the housing.
  - j. Secure the lifting levers and the two bushes.
  - k. Remove the shaft and the handle.
  - l. Remove the lifting levers and the two bushes from the housing.
51. **Reassembly.** Reassemble the tow coupling (coupling mechanism) is as follows:
- a. Align the lifting levers and the two bushes in the housing.
  - b. Install the shaft.
  - c. Install the two outer bushes on each side of the shaft then.
  - d. Ensure that the lifting levers are in the raised position and contacting the rear of the housing.
  - e. Install the coupling pin and the lifting head.
  - f. Align the lifting levers with the lifting head and rotate the shaft in a counterclockwise direction to completely lower the pin into the coupling jaws.
  - g. Install the springs on the shaft and align the tang of each spring in the locating hole in the housing.
  - h. Install the spring brackets and locate the springs using a pair of pliers.
  - i. Install the washers, handle and split pins.
  - j. Install the cover on the housing.
  - k. Secure it with the four bolts.
52. **Specifications - Tow Coupling.** The specifications for the tow coupling are at Table 11.

**Table 11 Specifications - Tow Coupling**

Serial	Item	Specification	Value
1	Coupling mechanism securing bolts	Tightening torque	80 to 90 N.m (5 to -66 lbf.ft)

**END**

Distribution List: **VEH H 09.0 – Code 4** (Maint Level)  
(Sponsor: LV SPO, Mdm/Hvy B Vehicles)  
(Authority: TRAMM)