

 **Perkins  
engines**

# handbook for marine diesel engines



## ADDENDA

JAN. 73

Certain T6.354(M) and HT6.354(M) engines are now fitted with mechanically governed fuel injection pumps and in such instances, the accompanying diagram should be substituted for Fig. 10(c) on page 52.

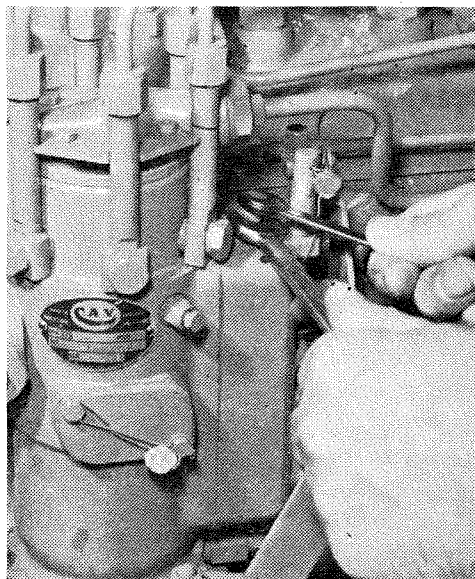


Fig. 13(a) on Page 57 shows the idling speed adjusting screw on a hydraulically governed pump. With mechanically governed fuel pumps, idling speed is adjusted by means of the unsealed screw on the side of the governor housing.

This handbook has been written and produced by the Service Publications Department of Perkins Engines Ltd., Peterborough, England.

Every endeavour has been made to ensure that the information contained in this book is correct at the date of publication, but due to continuous developments, Perkins Engines Ltd. reserve the right to alter the contents without notice.

# HANDBOOK FOR MARINE DIESEL ENGINES

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This marine handbook is general in nature and covers the whole range of current Perkins marine engines. However, workshop manuals covering the overhaul of Perkins engines and the relevant gearboxes are available if required from Perkins Marine Distributors, a list of whom appear on Page 71.

## your engine guarantee

As regards Guarantee, your position will depend on the terms on which you purchased your boat: Perkins do not accept Guarantee claims direct from boat owners. For your information, however, Perkins undertake (subject to their detailed Terms and Conditions of Sale) with the person or firm to whom they sell their engines, normally the Perkins Distributor, to replace or repair such engine or part or parts of an engine which need repair or replacement because of defective design, workmanship or materials during the first twelve months from delivery to the first user or for a period of twenty-four months from despatch of the engine by Perkins, whichever is the shorter.

This guarantee applies to new engines and Perkins Factory Rebuilt Engines but does not apply to secondhand engines or parts, nor to accessories and proprietary fittings.

Should you need any assistance with your engine, there is a list of addresses at the back of this book showing where Perkins Marine diesel engine specialists may be found. In the event of your being away from the boatyard from which you purchased your boat, you are advised to carry some evidence of the date of purchase of your engine/boat, for, although despatch records are normally kept by Perkins, this evidence may assist in a speedy service for you under normal guarantee.

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This handbook has been issued to guide operators in the correct use and maintenance of Perkins Marine Diesel engines. Providing an engine is correctly installed, correct maintenance and certain precautions are observed, then no operating difficulties or failures should be experienced. All matters relating to marine propulsion are covered, also fault diagnosis and remedy, and minor repairs which the average marine operator can undertake, whilst his craft is afloat.

## Introduction

All Perkins Marine Diesel engines operate on the four stroke cycle. The first stroke is the induction stroke (1). The inlet valve is open and the piston is travelling downwards drawing air into the cylinder. The second stroke is the compression stroke (2). Both valves are closed and the piston is moving upwards compressing the air in the cylinder. As the piston reaches the top of its stroke, the compressed air creates such a heat as to ignite the fuel injected through the atomiser. The burning of the fuel forces the piston downwards on the combustion or power stroke (3). The fourth stroke comprises the exhaust stroke (4). The piston is travelling upwards, thus ejecting all the burnt gases from the cylinder through the open exhaust valve.

With turbocharged engines, the exhaust outlet pressure is utilised by the turbocharger to boost the air at the induction intake which assists in increasing the power output of the engine.

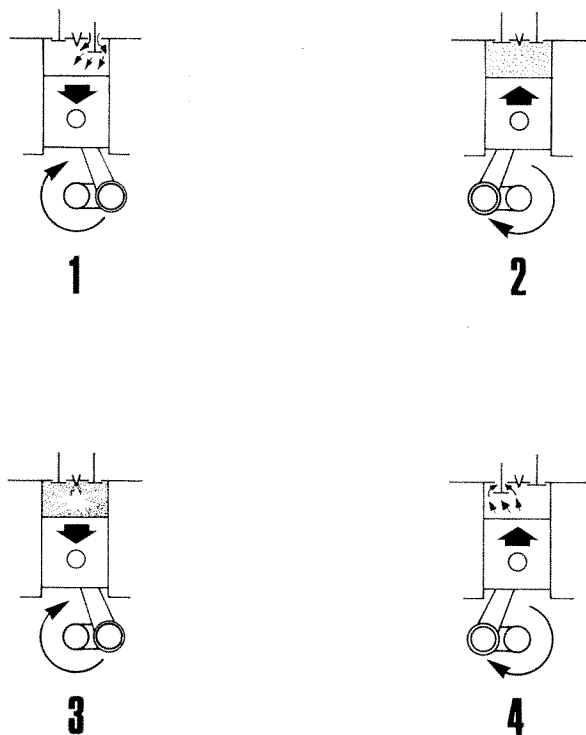


Fig. 1

## engine identification

The engine types with which this marine operator's handbook is associated, are designated 4.107(M), 4.108(M), P3.152(M), 4.236(M), 6.354(M), H6.354(M), T6.354(M), HT6.354(M), V8.510(M) and TV8.510(M).

The first figure in the engine designation, signifies the number of cylinders, whilst the second group of figures, denotes the engine capacity in cubic inches. The letter "H" preceding the engine type denotes a horizontally inclined engine; the letter "T" signifies that the engine is turbocharged; the letter "V" signifies that there are two banks of cylinders in "V" formation.

The letter "M" in parenthesis following the engine type shows that the engine has been especially built for marine use.

Apart from their physical differences, engines can be identified by the engine number stamped on the cylinder block. The number consists of a combination of figures and letters, a typical example being 354U251. In this instance, the engine type would be a 6.354 as the first group of figures represents the cubic capacity: the letter "U" signifies that the engine was built in the U.K. The second group of figures comprises the serial number of the engine. Further letters can be included in the combination — a letter "H" indicates a horizontal engine — a letter "T" indicates a turbocharged engine — a letter "X" indicates a contra-rotating engine.

Fig. 2 shows engine number locations.

Where information, spare parts or assistance is required, this engine number should always be quoted in full.

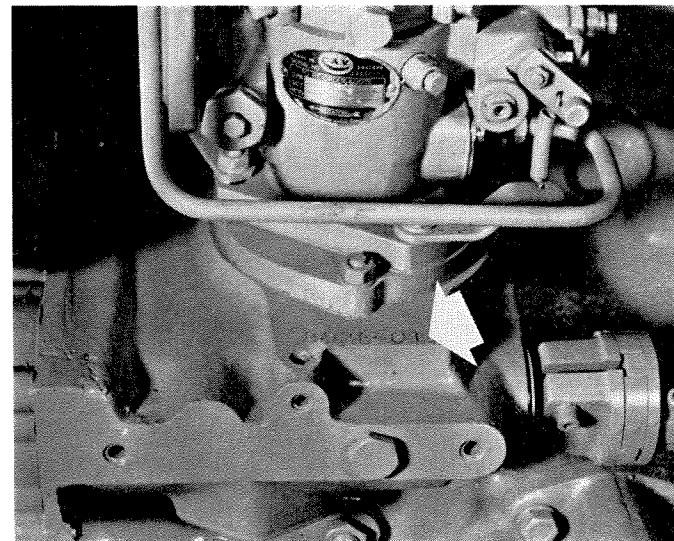


Fig. 2(a)

Engine No. Location 6.354, H6.354, T6.354 and HT6.354

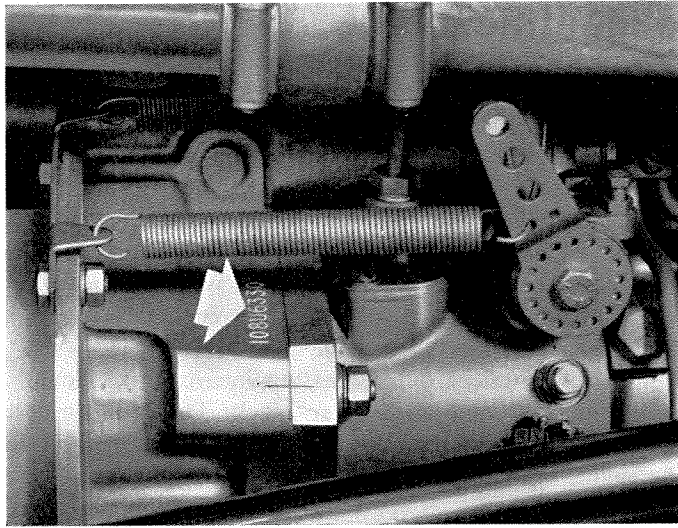


Fig. 2(b)  
Engine No. Location 4.108 and 4.107

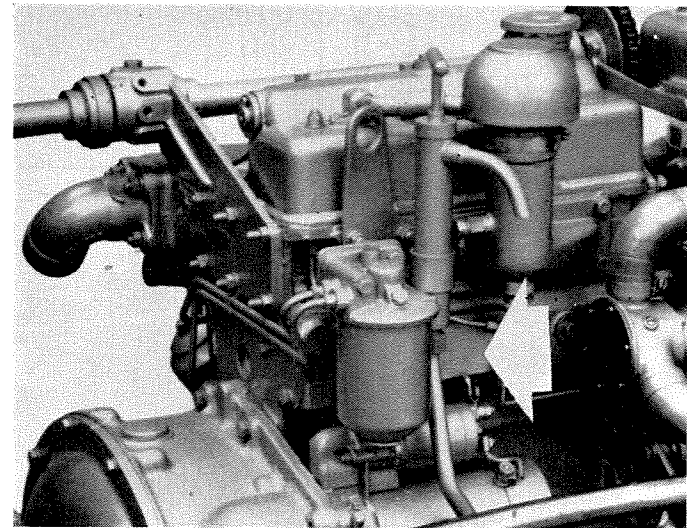


Fig. 2(d)  
Engine No. Location P3.152

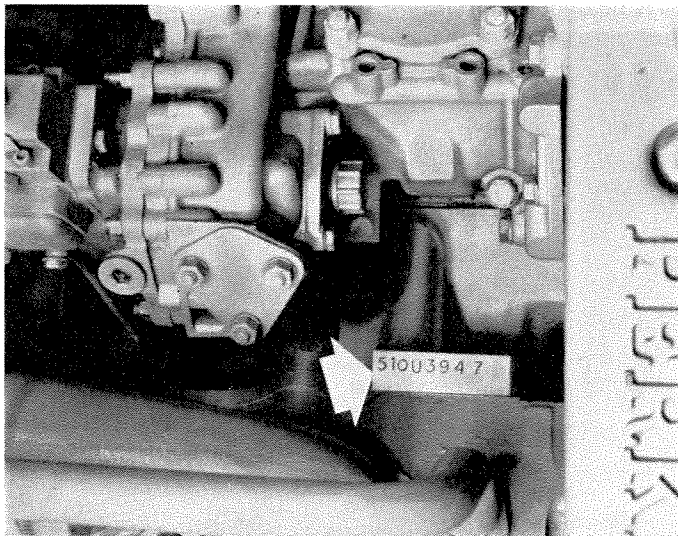


Fig. 2(c)  
Engine No. Location V8.510 and TV8.510

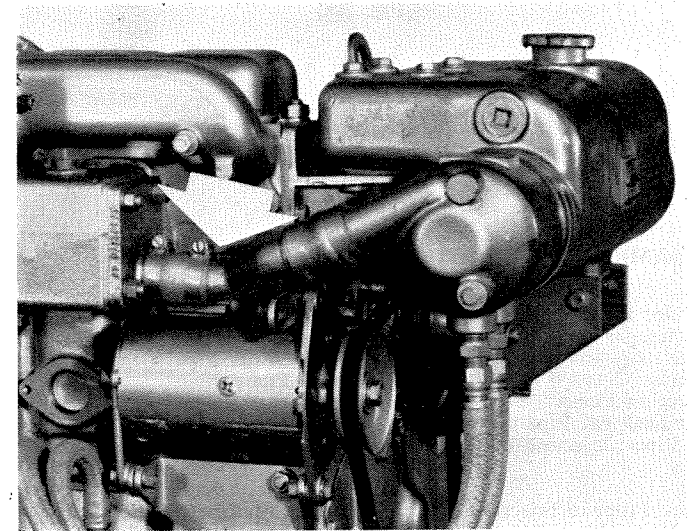


Fig. 2(e)  
Engine No. Location 4.236

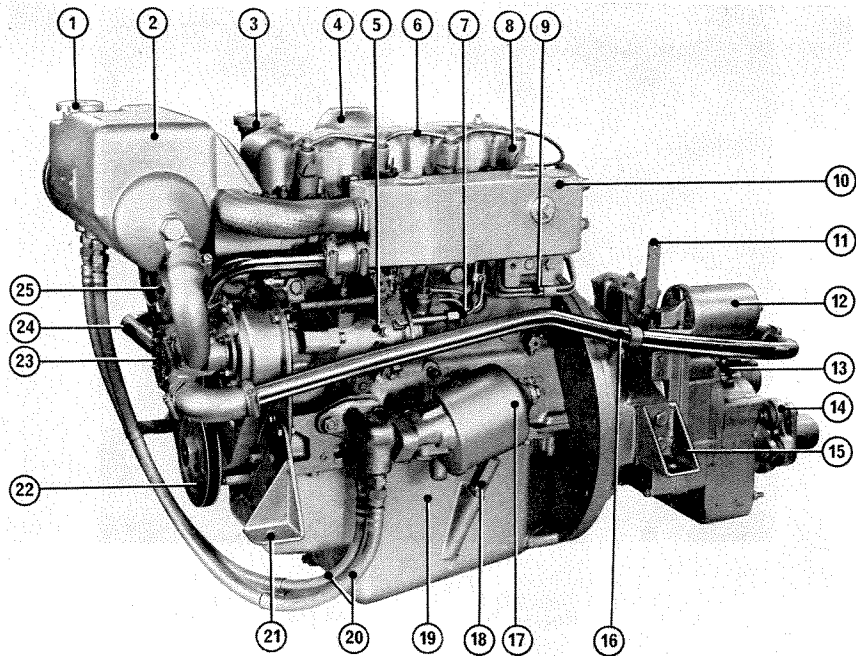


Fig. 3(a)

**KEY TO 4.108(M) ENGINE PHOTOGRAPHS**

- |  |   |
|--|---|
| 1. Fresh Water Filler Cap                      | 14. Output Flange                                 |
| 2. Heat Exchanger                              | 15. Rear Engine Support                           |
| 3. Oil Filler                                  | 16. Water Pipe, Gearbox to Sea Water Pump         |
| 4. Air Filter                                  | 17. Lubricating Oil Filter.                       |
| 5. Fuel Injection Pump                         | 18. Connection for Oil Sump Pump                  |
| 6. Atomiser Leak Off Pipe                      | 19. Sump  |
| 7. Pressure Pipes, Injection Pump to Atomisers | 20. Oil Cooler Pipes                              |
| 8. Atomiser                                    | 21. Front Engine Support                          |
| 9. Fuel Pipes, Filter to Injection Pump        | 22. Crankshaft Pulley                             |
| 10. Exhaust Manifold                           | 23. Sea Water Pump                                |
| 11. Ahead and Astern Engagement Lever          | 24. Water Pipe Exhaust Manifold to Cylinder Block |
| 12. Gearbox Oil Filter                         | 25. Fresh Water Pump                              |
| 13. Reduction Gearbox Oil Filler               |   |

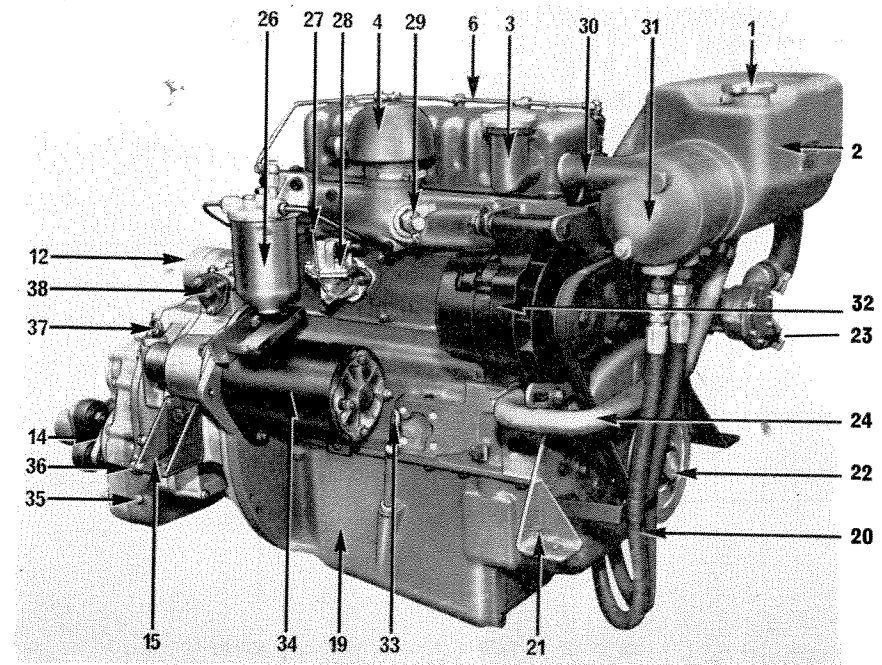


Fig. 3(b)

- |                                  |                                       |
|----------------------------------|---------------------------------------|
| 26. Fuel Oil Filter              | 34. Starter Motor                     |
| 27. Fuel Lift Pump Priming Lever | 35. Reduction Gearbox Oil Level Plug  |
| 28. Fuel Lift Pump               | 36. Gearbox Water Drain Plug          |
| 29. Cold Start Aid               | 37. Gearbox Dipstick                  |
| 30. Sea Water Outlet Connection  | 38. Gearbox Pressure Gauge Connection |
| 31. Oil Cooler                   |                                       |
| 32. Alternator                   |                                       |
| 33. Lubricating Oil Dipstick     |                                       |

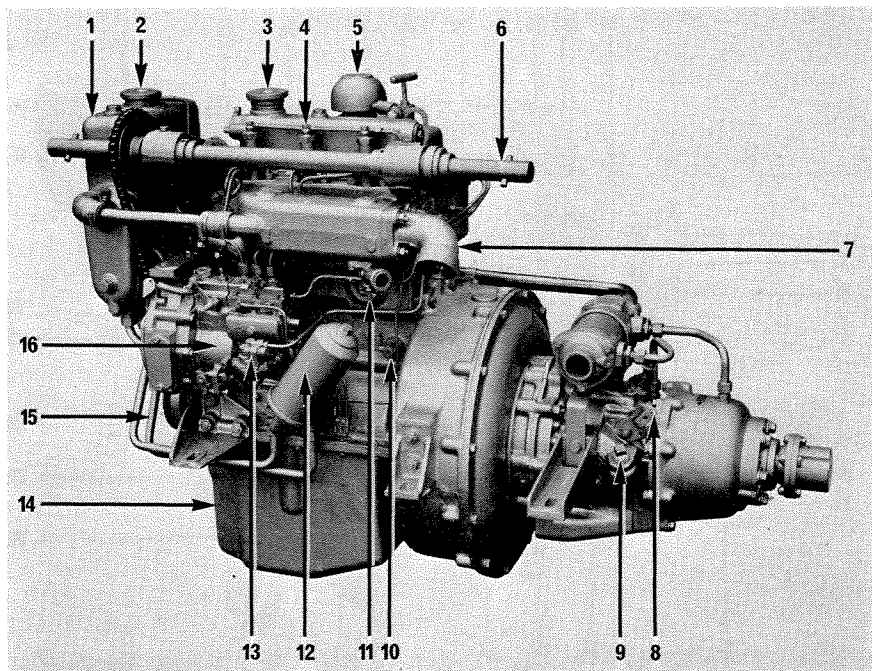


Fig. 3(c)

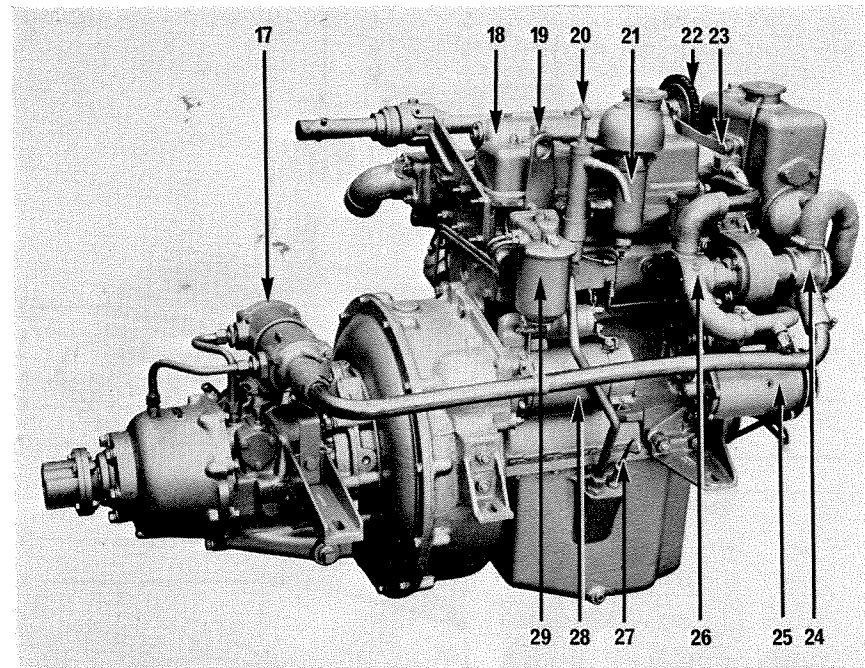


Fig. 3(d)

**KEY TO P3.152(M) ENGINE PHOTOGRAPHS**

1. Fresh Water Header Tank
2. Fresh Water Filler Cap
3. Lubricating Oil Filler
4. Atomiser
5. Air Filter
6. Hand Cranking Shaft
7. Exhaust Manifold Outlet
8. Gearbox Selector Lever
9. Gearbox Filler
10. Cylinder Block Drain Tap
11. Exhaust Manifold Drain Tap
12. Lubricating Oil Filter
13. Fuel Feed Pump
14. Lubricating Oil Sump
15. Lubricating Oil Pipes, Adaptor to Oil Cooler
16. Fuel Injection Pump

17. Gearbox Oil Cooler
18. Rocker Cover
19. Engine Breather Pipe
20. Lubricating Oil Sump Drain Pump
21. Inlet Manifold
22. Hand Starting Chain
23. Decompression Lever
24. Sea Water Pump
25. Dynamo
26. Fresh Water Pump
27. Dipstick
28. Starter Motor
29. Fuel Oil Filter

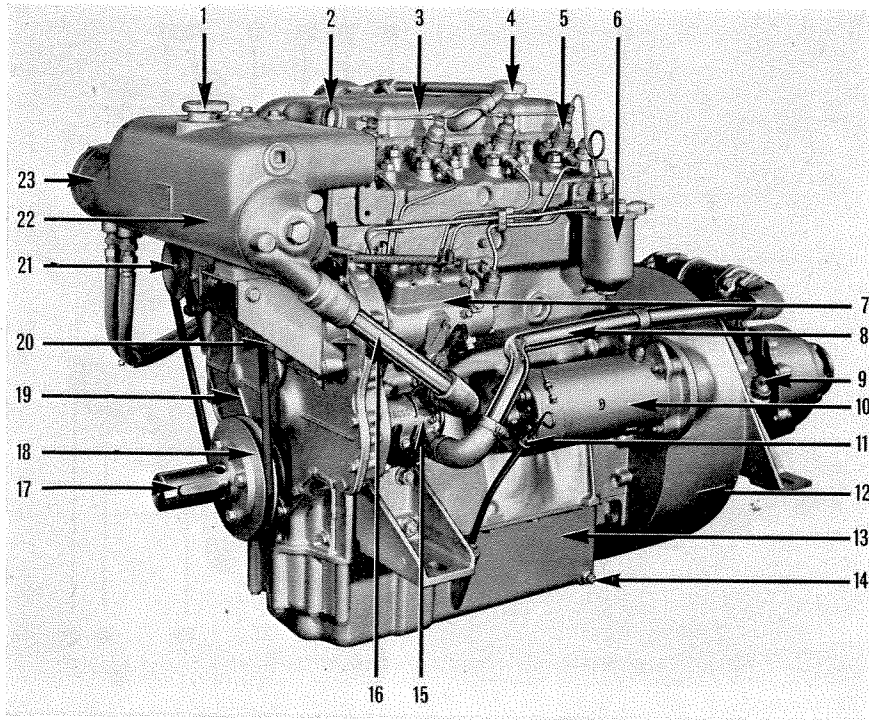


Fig. 3(e)

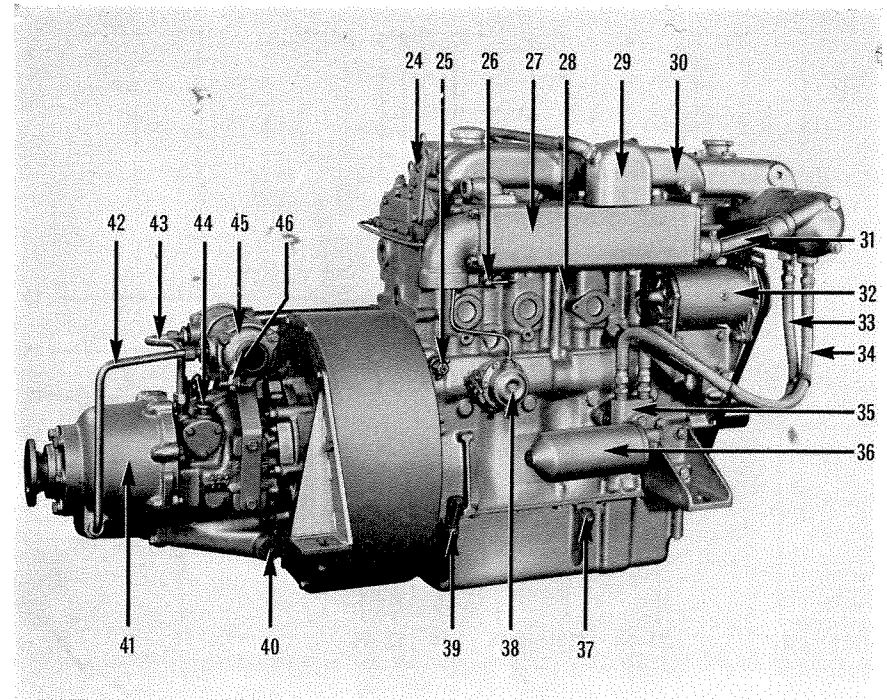


Fig. 3(f)

**KEY TO 4.236(M) ENGINE PHOTOGRAPHS**

- |   |  |
|---|--|
| 1. Coolant Filler Cap                                   | 13. Lubricating Oil Sump                             |
| 2. Front Lifting Eye                                    | 14. Lubricating Oil Sump Drain Plug                  |
| 3. Rocker Cover   | 15. Sea Water Pump                                   |
| 4. Lubricating Oil Filler Cap                           | 16. Water Pipe from Sea Water Pump to Heat Exchanger |
| 5. Atomiser   | 17. Power Take Off from Front of Crankshaft          |
| 6. Fuel Oil Filter                                      | 18. Crankshaft Pulley                                |
| 7. Fuel Injection Pump                                  | 19. Timing Case Cover                                |
| 8. Water Pipe from Gearbox Oil Cooler to Sea Water Pump | 20. Engine Tachometer Drive                          |
| 9. Gearbox Filler Plug and Dipstick                     | 21. Dynamo Pulley                                    |
| 10. Starter Motor                                       | 22. Heat Exchanger                                   |
| 11. Engine Oil Dipstick                                 | 23. Engine Oil Cooler                                |
| 12. Flywheel Housing                                    |  |

- |  |  |
|--|--|
| 24. Rear Lifting Eye                                   | 36. Lubricating Oil Filter             |
| 25. Cylinder Block Drain Tap                           | 37. Alternative Dipstick Position      |
| 26. Exhaust Manifold Drain Tap                         | 38. Fuel Lift Pump                     |
| 27. Exhaust Manifold                                   | 39. Sump Draining Connection           |
| 28. Cylinder Block                                     | 40. Gearbox Oil Drain Cap              |
| 29. Air Filter   | 41. Reduction Gear Housing             |
| 30. Induction Manifold                                 | 42. Oil Inlet Pipe from Cooler         |
| 31. Water Pipe from Heat Exchanger to Exhaust Manifold | 43. Oil Pipe to Cooler                 |
| 32. Dynamo   | 44. Gearbox Breather                   |
| 33. Oil Pipe to Cooler                                 | 45. Gearbox Oil Cooler                 |
| 34. Oil Pipe from Cooler                               | 46. Gearbox Oil Cooler Water Drain Tap |
| 35. Oil Filter Adaptor                                 |  |



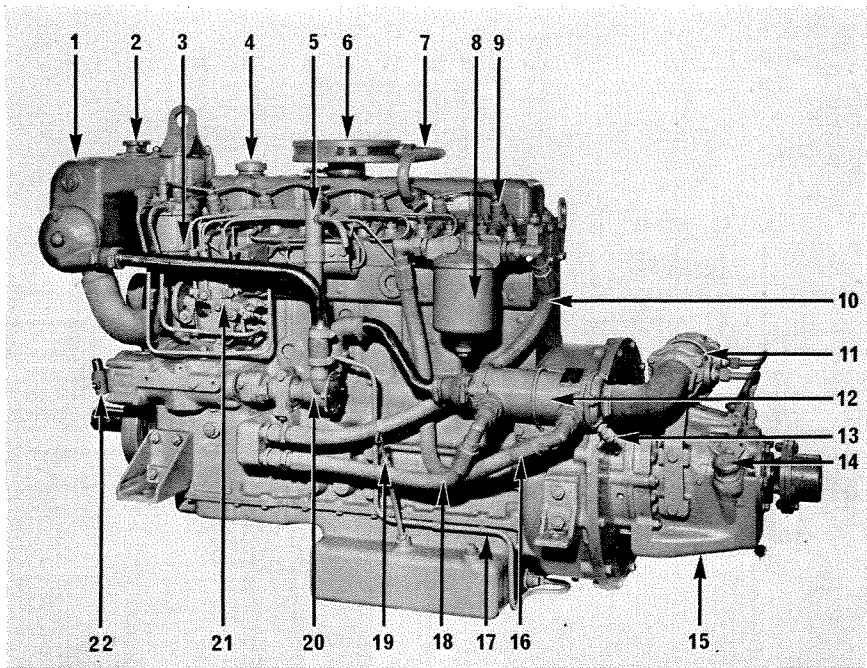


Fig. 3(g)

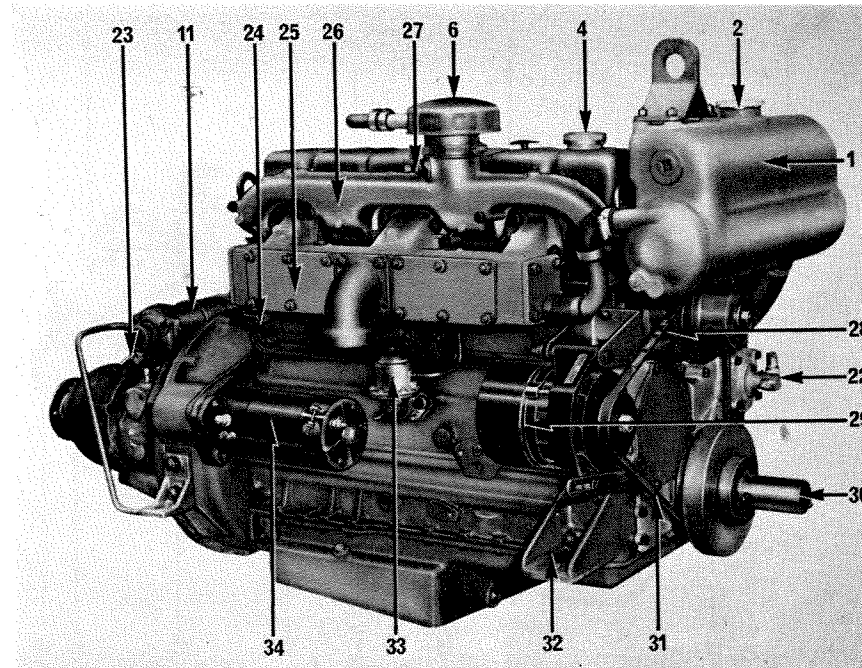


Fig. 3(h)

#### KEY TO 6.354(M) ENGINE PHOTOGRAPHS

1. Fresh Water Heat Exchanger
2. Fresh Water Filler Cap
3. Fuel Oil Filter
4. Lubricating Oil Filler
5. Sump Drain Pump
6. Air Filter
7. Engine Breather Pipe
8. Lubricating Oil Filter
9. Atomiser
10. Lubricating Oil Pipe, Filter to Adaptor
11. Gearbox Oil Cooler
12. Engine Oil Cooler
13. Engine Oil Cooler Drain Tap
14. Gearbox Oil Filler
15. Gearbox
16. Lubricating Oil Pipe, Filter to Cooler
17. Sump Drain Pump Pipe
18. Lubricating Oil Pipe, Adaptor to Filter

19. Dipstick
20. Sea Water Pump
21. Fuel Injection Pump
22. Tachometer Drive
23. Gearbox Oil Cooler Drain Tap
24. Exhaust Manifold Drain Tap
25. Water Cooled Exhaust Manifold
26. Inlet Manifold
27. Cold Starting Aid
28. Fresh Water Pump
29. Generator.
30. Power Take-Off Shaft
31. Generator and Fresh Water Pump Drive Belt
32. Engine Front Support Bracket
33. Fuel Oil Lift Pump
34. Starter Motor

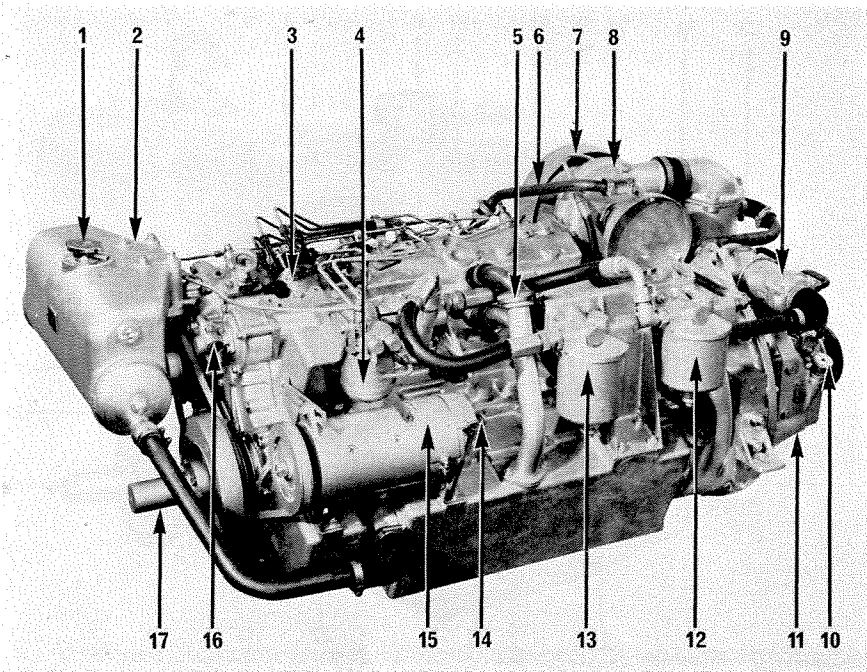


Fig. 3(i)

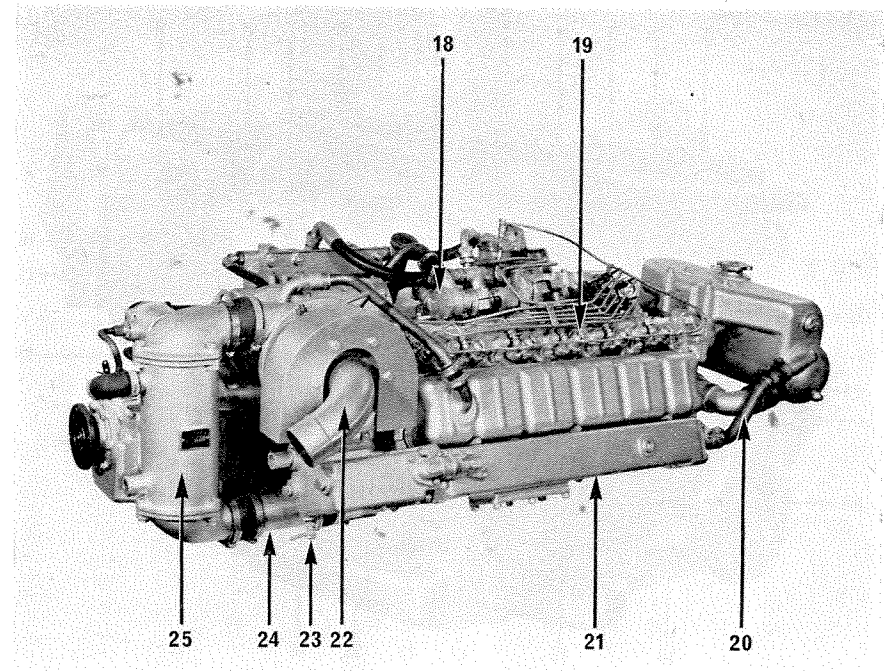


Fig. 3(j)

**KEY TO HT6.354(M) ENGINE PHOTOGRAPHS**

1. Fresh Water Filler Cap
2. Fresh Water Header Tank
3. Fuel Injection Pump
4. Fuel Filter
5. Lubricating Oil Filler
6. Engine Breather Pipe
7. Lubricating Oil Pressure Feed Pipe to Turbocharger
8. Turbocharger
9. Gearbox Oil Cooler
10. Gearbox Oil Filler
11. Gearbox
12. Turbocharger Oil Filter
13. Engine Oil Filter
14. Dipstick
15. Dynamo
16. Tachometer
17. Power Take-Off Shaft

18. Sea Water Pump
19. Atomiser
20. Heat Exchanger to Exhaust Manifold Water Pipe
21. Exhaust Manifold
22. Turbocharger Exhaust Outlet
23. Exhaust Manifold Drain Tap
24. Turbocharger to Inlet Manifold Pipe
25. Air Charge Cooler

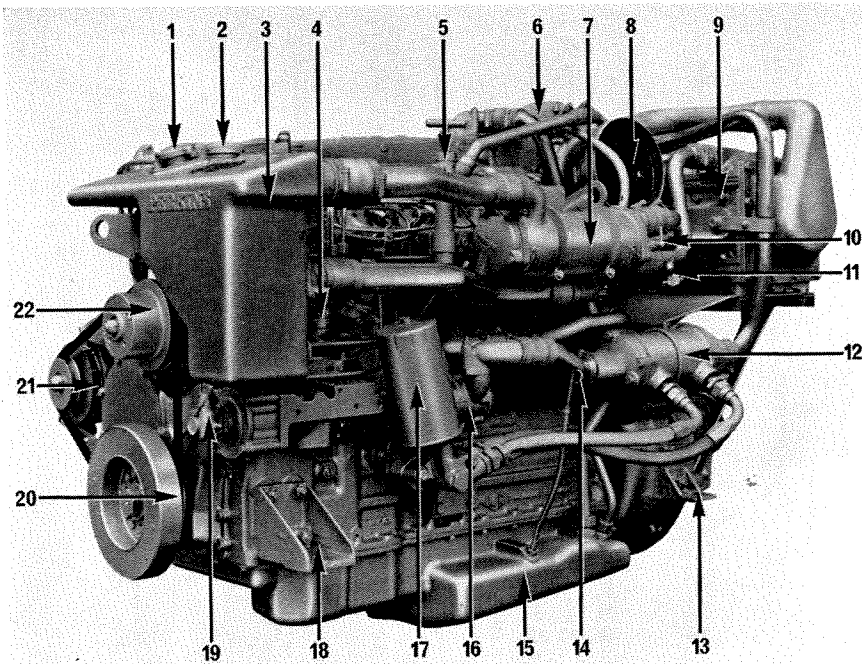


Fig. 3(k)

**KEY TO T6.354(M) ENGINE PHOTOGRAPHS**

- |                                     |                                   |
|-------------------------------------|-----------------------------------|
| 1. Fresh Water Filler Cap           | 12. Oil Cooler                    |
| 2. Lubricating Oil Filler Cap       | 13. Rear Engine Support Bracket   |
| 3. Fresh Water Header Tank          | 14. Lubricating Oil Sump Dipstick |
| 4. Fuel Injection Pump              | 15. Lubricating Oil Sump          |
| 5. Lubricating Sump Drain Pump      | 16. Sea Water Pump                |
| 6. Turbocharger                     | 17. Lubricating Oil Filter        |
| 7. Heat Exchanger                   | 18. Front Engine Support Bracket  |
| 8. Air Cleaner                      | 19. Tachometer Drive Connection   |
| 9. Air Charge Cooler                | 20. Crankshaft Pulley             |
| 10. Heat Exchanger Air Bleed Vent   | 21. Generator                     |
| 11. Heat Exchanger Water Drain Plug | 22. Fresh Water Pump Pulley       |

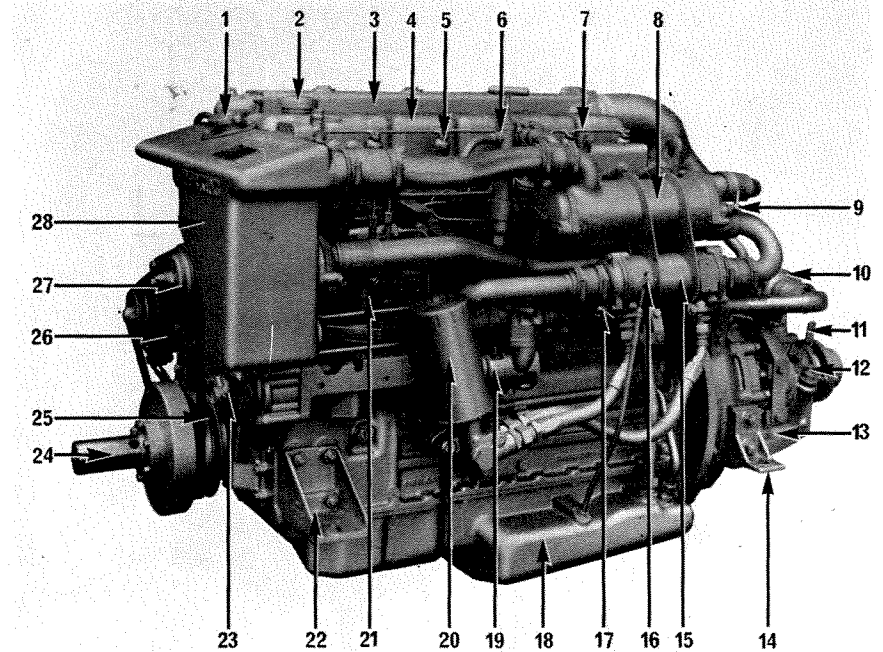


Fig. 3(l)

**KEY TO 6.354(M) LOWLINE ENGINE PHOTOGRAPHS**

- |                                  |                                   |
|----------------------------------|-----------------------------------|
| 1. Fresh Water Filler Cap        | 15. Engine Lubricating Oil Cooler |
| 2. Lubricating Oil Filler Cap    | 16. Lubricating Oil Sump Dipstick |
| 3. Water Cooled Exhaust Manifold | 17. Oil Cooler Water Drain Tap    |
| 4. Cylinder Head Top Cover       | 18. Lubricating Oil Sump          |
| 5. Atomiser                      | 19. Sea Water Pump                |
| 6. Lubricating Sump Drain Pump   | 20. Lubricating Oil Filter        |
| 7. Atomiser Leak-Off Pipe        | 21. Fuel Oil Injection Pump       |
| 8. Heat Exchanger                | 22. Front Engine Support Bracket  |
| 9. Heat Exchanger Air Bleed Vent | 23. Tachometer Drive Connection   |
| 10. Gearbox Oil Cooler           | 24. Power Take-Off Shaft          |
| 11. Gearbox Control Lever        | 25. Crankshaft Pulley             |
| 12. Gearbox Oil Filler Plug      | 26. Generator                     |
| 13. Gearbox                      | 27. Fresh Water Pump Pulley.      |
| 14. Rear Engine Support Bracket  | 28. Fresh Water Header Tank       |

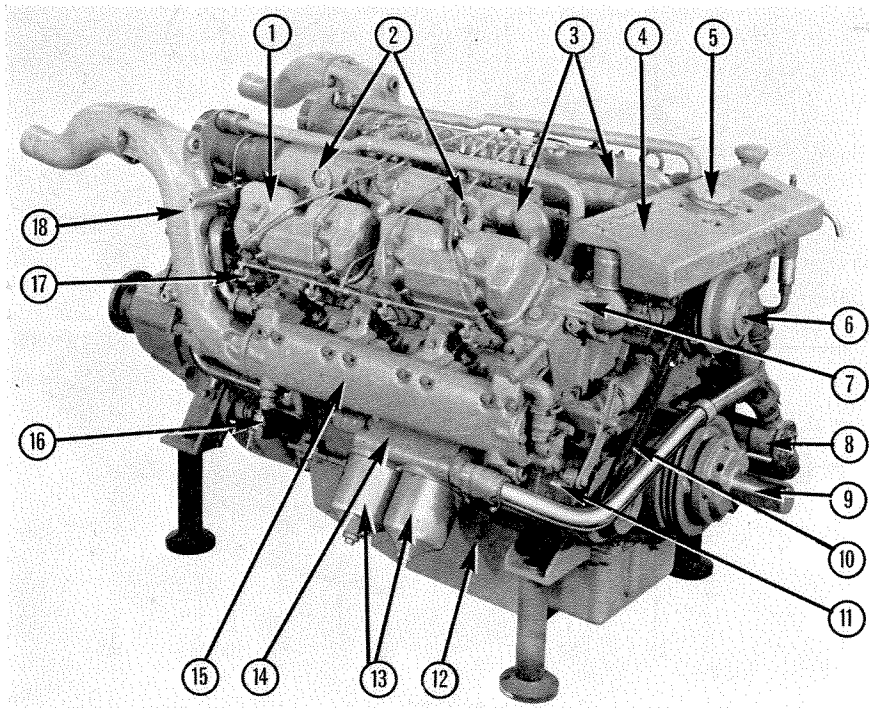


Fig. 3(m)

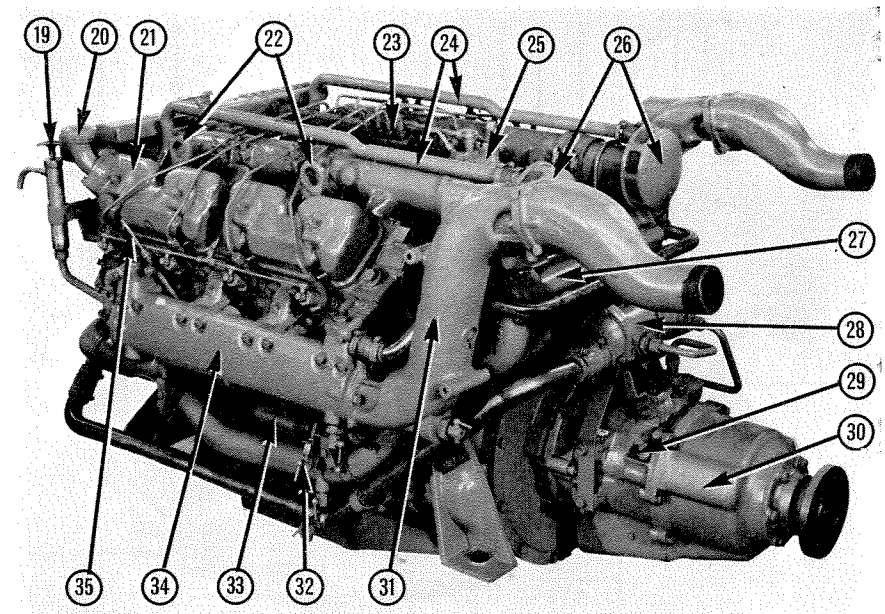


Fig. 3(n)

**KEY TO V8.510(M) ENGINE PHOTOGRAPHS**

1. Rocker Cover (Right Hand)
2. Engine Lifting Plates (Right Hand)
3. Inlet Manifolds
4. Fresh Water Header Tank
5. Fresh Water Filler Cap
6. Fresh Water Pump
7. Thermostat Housing (Right Hand)
8. Sea Water Pump
9. Power Take-Off Shaft
10. Alternator and Water Pump Drive Belts
11. Alternator
12. Lubricating Oil Sump
13. Twin Bowl Lubricating Oil Filter
14. Lubricating Oil Cooler
15. Water Cooled Exhaust Manifold (Right Hand)
16. Drain Tap
17. Atomiser (Right Hand)
18. Exhaust Riser (Right Hand)

19. Lubricating Oil Sump Drain Pump
20. Lubricating Oil Filler
21. Rocker Cover (Left Hand)
22. Engine Lifting Plates (Left Hand)
23. Fuel Injection Pump
24. Engine Breather Pipes
25. Fuel Oil Filter Cover
26. Air Filters
27. Heat Exchanger
28. Gearbox Oil Cooler
29. Gearbox Filler Plug and Dipstick
30. Gearbox
31. Exhaust Riser (Left Hand)
32. Drain Tap
33. Starter Motor
34. Water Cooled Exhaust Manifold (Left Hand)
35. Lubricating Oil Dipstick

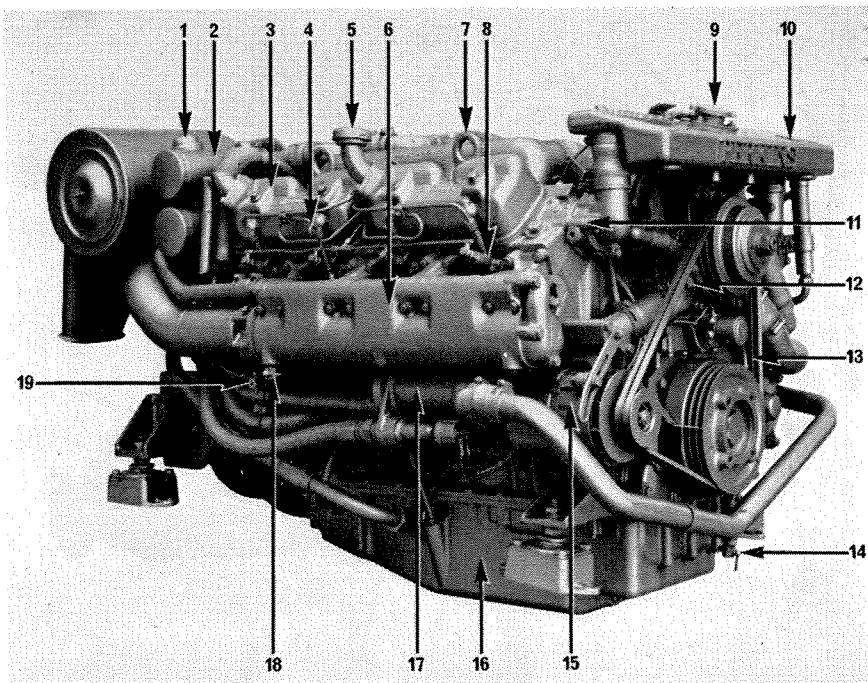


Fig. 3(o)

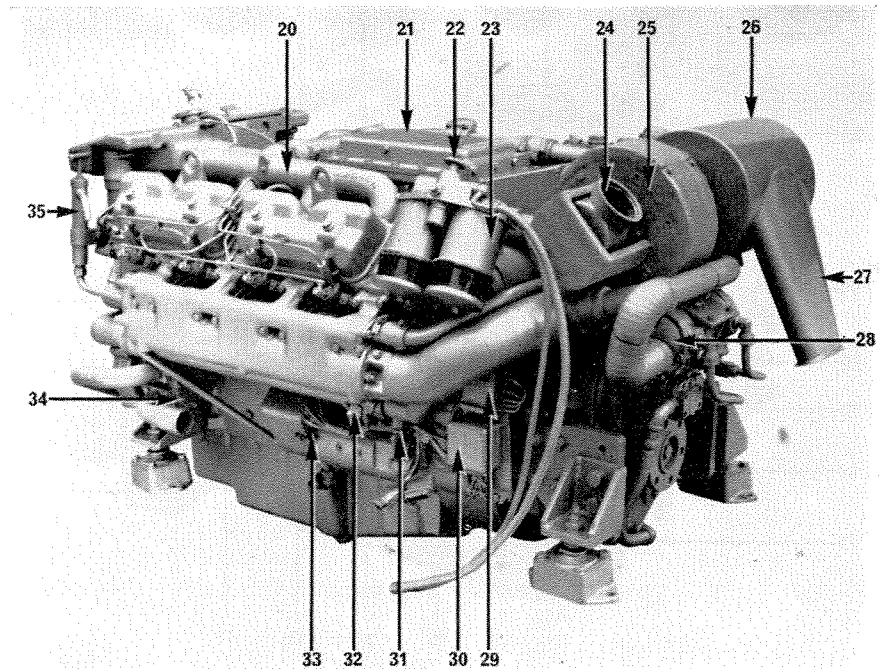


Fig. 3(p)

#### KEY TO TV8.510(M) ENGINE PHOTOGRAPHS

1. Gearbox Oil Filler/Breather/Dipstick.
2. Twin Element Lubricating Oil Filter.
3. Cylinder Head Cover.
4. Sump Dipstick.
5. Lubricating Oil Filler.
6. Water Cooled Exhaust Manifold.
7. Engine Lifting Plate.
8. Atomiser.
9. Fresh Water Filler Cap.
10. Fresh Water Header Tank.
11. Thermostat Housing.
12. Fresh Water Pump.
13. Alternator and Water Pump Drive.
14. Drain Tap.
15. Alternator.
16. Sump.
17. Engine Oil Cooler.
18. Drain Tap.
19. Drain Tap.

20. Inlet Manifold.
21. Air Charge Cooler.
22. Fuel Priming Pump.
23. Twin Element Fuel Filter.
24. Exhaust Outlet.
25. Turbocharger.
26. Air Cleaner/Silencer.
27. Air Intake.
28. Gearbox Oil Cooler.
29. Regulator.
30. Fuse Box.
31. Drain Tap.
32. Drain Tap.
33. Starter Motor.
34. Sea Water Pump.
35. Sump Drain Pump.

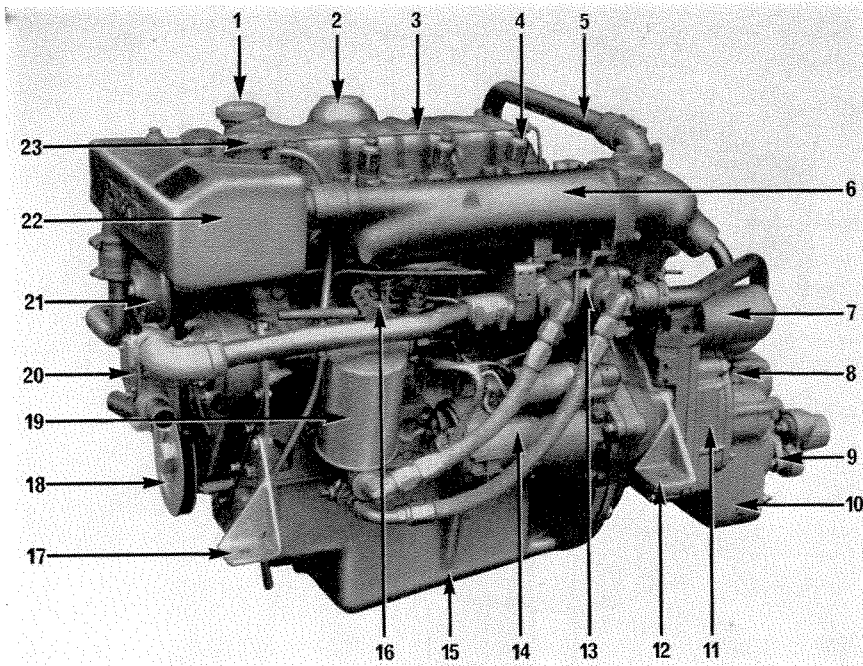


Fig. 3(q)

**KEY TO 4.108(M) LOWLINE ENGINE PHOTOGRAPHS**

- |  |                                   |
|--|-----------------------------------|
| 1. Lubricating Oil Filler                        | 12. Rear Engine Support Bracket   |
| 2. Air Filter                                    | 13. Oil Cooler                    |
| 3. Atomiser Leak-Off Pipe                        | 14. Starter Motor                 |
| 4. Atomiser                                      | 15. Lubricating Oil Sump          |
| 5. Water Pipe Exhaust Manifold to Cylinder Block | 16. Fuel Injection Pump           |
| 6. Water Cooled Exhaust Manifold                 | 17. Front Engine Support Bracket  |
| 7. Gearbox Oil Filter                            | 18. Crankshaft Pulley             |
| 8. Reduction Gearbox Oil Filter                  | 19. Engine Lubricating Oil Filter |
| 9. Output Flange                                 | 20. Sea Water Pump                |
| 10. Reduction Gearbox                            | 21. Fresh Water Pump              |
| 11. Gearbox                                      | 22. Heat Exchanger                |
|  | 23. Fresh Water Filler Cap        |

**data**

**P3.152 Engines**

Type	Four Stroke. Indirect Injection.
Nominal Bore	3.6 in (91,44 mm)
Stroke	5 in (127 mm)
No. of Cylinders	3
Cubic Capacity	152 in <sup>3</sup> (2,5 litres)
Compression Ratio	17.4 : 1
Firing Order	1, 2, 3.
Sump Capacity	16 IMP pints (9,1 litres) 19.2 U.S. pints

**4.107 & 4.108**

Type	Four Stroke. Indirect Injection
Nominal Bore	3.125 in (79,4 mm)
Stroke	3.5 in (88,90 mm)
No. of Cylinders	4
Cubic Capacity	107.4 in <sup>3</sup> (1,76 litres)
Compression Ratio	22 : 1
Firing Order	1, 3, 4, 2.
Sump Capacity	7 IMP. pints (4,0 litres) 8.4 U.S. pints

**4.236**

Type	Four Stroke. Direct Injection.
Nominal Bore	3.875 in (98,43 mm)
Stroke	5 in (127 mm)
No. of Cylinders	4
Cubic Capacity	236 in <sup>3</sup> (3,86 litres)
Compression Ratio	16 : 1
Firing Order	1, 3, 4, 2.
Sump Capacity	14 IMP. pints (8 litres) 16.8 U.S. pints

**6.354 & H6.354**

Type	Four Stroke. Direct Injection. Vertical & Inclined.
Nominal Bore	3.875 in (98,4 mm)
Stroke	5 in (127 mm)
No. of Cylinders	6
Cubic Capacity	354 in <sup>3</sup> (5,8 litres)
Compression Ratio	16 : 1
Firing Order (Normal direction)	1, 5, 3, 6, 2, 4.
Firing Order (Contra-rotation)	1, 4, 2, 6, 3, 5.
Sump Capacity	14 IMP. pints (8 litres) 16.8 U.S. pints.

**T6.354 & HT6.354**

Type	Turbocharged. Four Stroke. Direct Injection. Vertical and Inclined
Nominal Bore	3.875 in (98,4 mm)
Stroke	5 in (127 mm)
No. of Cylinders	6
Cubic Capacity	354 in <sup>3</sup> (5,8 litres)
Compression Ratio	16 : 1
Firing Order (Normal direction)	1, 5, 3, 6, 2, 4.
Firing Order (Contra-rotation)	1, 4, 2, 6, 3, 5.
Sump Capacity	19 IMP. pints (10,8 litres) 22.8 U.S. pints

**V8.510**

Type	Four Stroke. Direct Injection. 90° V.
Nominal Bore	4.25 in (108 mm)
Stroke	4.5 in (114,3 mm)
No. of Cylinders	8
Cubic Capacity	510.7 in <sup>3</sup> (8,36 litres)
Compression Ratio	16.5 : 1
Firing Order	1, 8, 7, 5, 4, 3, 6, 2.
Sump Capacity (Horizontal)	27 IMP. pints (15,3 litres) 32.4 U.S. pints
(Engine at 17° Angle)	21.5 IMP. pints (12,3 litres) 25.8 U.S. pints

**TV8.510**

Type	Turbocharged. Four Stroke Direct Injection. 90° V.
Nominal Bore	4.25 in (108 mm)
Stroke	4.5 in (114,3 mm)
No. of Cylinders	8
Cubic Capacity	510.7 in <sup>3</sup> (8,36 litres)
Compression Ratio	15:1
Firing Order	1,8,7,5,4,3,6,2
Sump Capacity	22,75 IMP. pints (13 litres) 27.3 U.S. pints.
Total Oil Capacity	28 IMP. pints (16 litres) 33.6 U.S. pints.

# starting and stopping engine

## PREPARATION FOR STARTING

### ENSURE FUEL IS TURNED ON!

Open engine coolant seacocks (does not apply with keel cooled engine).

Check coolant level in header tank (does not apply with direct cooled engines).

Check engine and gearbox lubricating oil levels (see page 66 for approved oils). When checking oil level on H6.354 and HT6.354 engines, the procedure given on page 63 should be observed. Where a V8.510 engine has been standing for a period exceeding one month, a pint of engine oil should be added to the fuel injection pump through the filler plug 1 fig. 13(b). With P3.152 engines, engine oil should be added to the fuel injection pump to the level plug situated above the idle speed stop bracket fig. 11(c).

Ensure that the fuel tank contains considerably more than sufficient fuel for the intended voyage. The fuel oil should conform to one of the specifications given on page 50.

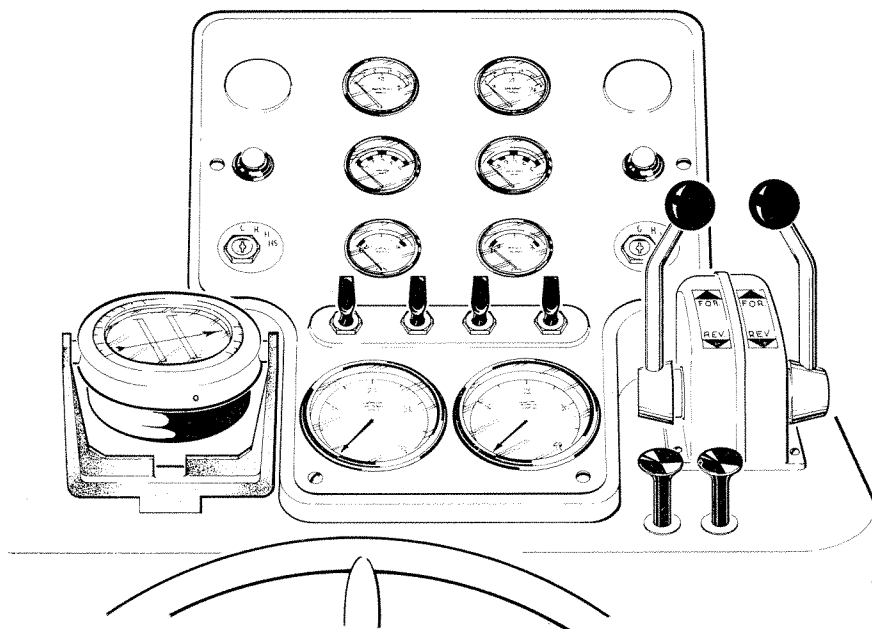


Fig. 4. Typical engine control panel.

## Starting the Engine

(For starting of P3.152(M), TV8.510 and V8.510(M) engines, see separate headings).

Place gearbox control in neutral gear.

Turn starter switch to position "R" fig. 5(a) and ensure that the engine stop control is in the run position (i.e., pushed fully home).

Place engine speed control in maximum speed position.

**If the engine or weather is warm**, turn starter switch in a clockwise direction to the "HS" position.

As soon as the engine starts, release the switch to the "R" position.

Be sure that the starter pinion and engine have stopped rotating before re-engaging the starter motor, otherwise damage may result.

**If weather is cold**, ensure cold start aid reservoir contains fuel oil. Turn on tap between reservoir and cold start aid.

Turn starter switch to the "H" position and hold it there for fifteen to twenty seconds.

Then turn the starter switch to the "HS" position, thereby engaging the starter motor.

If the engine does not start after twenty seconds, return the switch to the "H" position for ten seconds and then re-engage the starter motor by switching to the "HS" position.

As soon as the engine starts, release the switch to the "R" position and turn off the tap on the cold start aid reservoir.

## Earlier Heat Start Switch

The cold start switch supplied with earlier engines is shown in fig. 5(b).

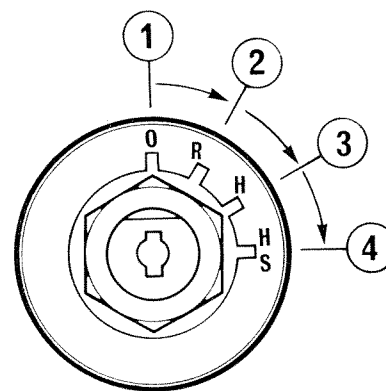


Fig. 5(a)

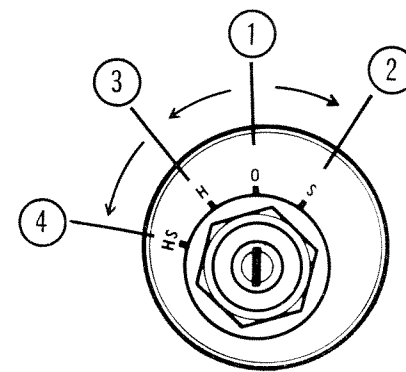


Fig. 5(b)



With this switch, starting a warm engine is effected by turning the switch in a clockwise direction to the "S" position.

In cold weather, the switch should be turned to the "H" position for fifteen to twenty seconds and then to the "HS" position in order to engage the starter motor.

As soon as the engine starts, the switch should be returned to the "O" position.

Where this type of switch is used, it was sometimes customary to have a separate switch for the electrical circuits and this should be turned on before starting the engine and turned off after stopping the engine.

### Starting the Engine (Alternative Method)

With some engines, a different starter switch is provided and the cold start aid is operated by means of a separate push button switch.

The cold starting procedure however is the same, i.e.

Switch on by turning the starter switch in a clockwise direction to the first position.

Press the heater button for fifteen to twenty seconds and then, with the heater button still pressed, turn the starter switch in a further clockwise direction to engage the starter motor. As soon as the engine starts, release both starter switch and heater button.

### Starting the Engine (P3.152(M) Engines)

The engine starting equipment for P3.152(M) Engines comprises two electric push button switches marked "Heater" and "Starter", and a small hand pump, all of which are mounted on the engine control panel or somewhere conveniently near to the engine controls.

An excess fuel device is also provided and is operated by pressing a button on the fuel pump stop control lever (see 2, fig.11(c)). This excess fuel device will automatically return to the off position as soon as the engine starts.

In normal circumstances, when the engine or weather is warm, use the excess fuel device and press starter button to engage starter motor only.

In cold weather, ensure that cold start tank contains fuel oil and operate excess fuel device.

Unscrew handle of cold start hand pump and give pump plunger one stroke of about half an inch in order to prime.

Press the heater button for half a minute. (Count forty-five very slowly).

Then with the heater button still pressed and the engine speed control in the fully open position, engage the starter motor and give short strokes on the hand pump.

The engine should then start. If it does not, wait half a minute and then try again. If the engine does not start at the third attempt, some fault is present and an examination should be made to discover it.

Always be sure that the starter motor has stopped revolving before re-engaging the motor otherwise the starter ring and pinion may be damaged.

NOTE: After using the hand pump, always make sure that the plunger is screwed down, otherwise a leakage of fuel oil into the engine may occur with damaging results. **The hand pump should never be used whilst the engine is running.**

### Starting the Engine (TV8.510 (see fig. 5(c))

Ensure that the stop control is in the run position.

Switch on by turning the start switch to position "R".

Position the engine speed control to a quarter open if the engine or weather is warm, or to the fully open position if cold, ensuring that the gearbox control remains in neutral.

Engage the starter motor by turning the switch to position "S".

As soon as the engine starts, release the switch which should return to position "R".

Always ensure that the starter pinion and engine have stopped rotating before re-engaging the starter motor, otherwise the flywheel starter ring or the starter pinion may be damaged.

NOTE: With the TV8.510 engine, the fuel injection pump incorporates an automatic excess fuel device which assists in easy starting.

### Starting the Engine (V8.510 (see fig. 5(c)).

Ensure stop control is in the run position.

Switch on by turning the start switch to position "R".

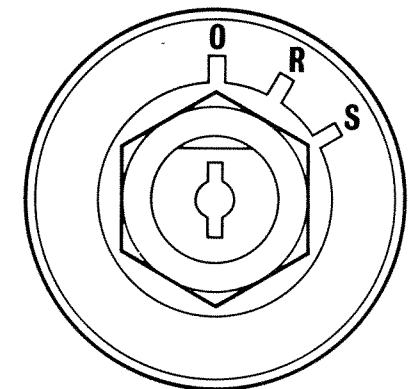


Fig. 5(c)

Open engine speed control fully, ensuring that gearbox remains in neutral.

If the engine or weather is warm, engage starter motor by turning switch to position "S".

As soon as the engine starts, release the switch which should return to position "R".

Always ensure that the starter pinion and engine have stopped rotating before re-engaging the starter motor, otherwise the flywheel starter ring or starter pinion may be damaged.

### Cold Starting

Ensure that stop control is in the run position.

Switch on by turning switch to position "R".

Open speed control fully, ensuring that gearbox remains in neutral.

Operate excess fuel control.

Engage starter by turning switch to "S" position.

As soon as the engine starts, release the switch which should return to position "R".

### TO STOP ENGINE

A spring loaded stop control is located near the normal engine controls and functions by cutting off the fuel at the fuel injection pump.

To operate, pull the knob and hold in this position until the engine ceases to rotate. Ensure that the control returns to the run position, otherwise difficulty may be experienced in restarting the engine.

Switch off by turning switch to position "O".

### Things to Note

When the engine starts, check the following points:

- (a) That oil pressure is registered on gauge(s).
- (b) That charging rate is indicated on ammeter/generator light goes out.
- (c) That coolant is discharging overboard (does not apply with keel cooled engines).
- (d) With turbocharged engines, that boost pressure is registered on gauge. This pressure will vary according to engine speed and load. It may be interesting to note boost pressure will not be obtained under 1,800 rev/min (engine speed).

Care should be taken not to operate the engine at maximum speed for long periods. The following table gives maximum intermittent and continuous speeds for the respective engine types except TV8.510(M) engines. For TV8.510(M) engines, see separate heading.

Engines should not be operated at maximum intermittent speed for periods in excess of one hour after which, the engine speed should be reduced by 150 rev/min for at least fifteen minutes before returning to maximum speed.

Where engines are loaded down to speeds less than maximum intermittent when on full throttle, then the same procedure applies and the maximum continuous or cruising speed is 150 rev/min below maximum possible engine speed.

Engine Type	Maximum Intermittent Speed (rev/min)	Maximum Continuous Speed (rev/min)
4.107(M)	3,600	3,000
4.108(M)	3,600 4,000 (special rating)	3,000
P3.152(M)	—	2,000
4.236(M)	2,500	2,250
6.354(M) H6.354(M)	2,800	2,400
T6.354(M) HT6.354(M)	2,400	2,250
V8.510(M)	2,800 (special rating)	2,500 (medium duty rating) 2,000 (heavy duty rating)

## TV8.510(M) Engines

Maximum intermittent speed 2,600 rev/min (Pleasure craft — Planing and Light Displacement).

These engines may be operated at full throttle (2,600 rev/min) for not more than a period of one hour after which a reduced cruising speed of 2,400 rev/min must be used for two hours. This cycle may then be repeated.

Maximum intermittent speed 2,400 rev/min (Light Commercial Craft).

These engines may be operated at full throttle (2,400 rev/min) for not more than a period of one hour after which a reduced cruising speed of 2,200 rev/min must be used for fifteen minutes. This cycle may then be repeated.

## INSTRUMENTS (see fig. 6)

These serve to give the operator important information about the running of the engine, fuel state, temperature etc.

Generally speaking instruments have not the accuracy that a laboratory meter has and this should be borne in mind when reading them; nevertheless they may be used to ensure correct functioning of the engine(s).

### Engine Oil Pressure Gauge

This is one of the most important instruments and should be checked for correct operation as soon as the engine starts. Normal oil pressure is 30/60 lbf/in<sup>2</sup> (2,1/4,2 kgf/cm<sup>2</sup>) at maximum engine speed and normal operating temperature. However it should be remembered that during the life of the engine there will be a gradual drop in oil pressure. This is perfectly normal as bearing surfaces wear. There will also be a slight drop in pressure when the oil is hot or if the wrong grade of oil is used in certain climatic conditions. See page 66 for correct oil grades.

### Gearbox Oil Pressure Gauge

Where this is fitted the pressure should be within the ranges given on pages 67, 68 and 69.

Here again there will be a slight pressure drop when the oil is hot.

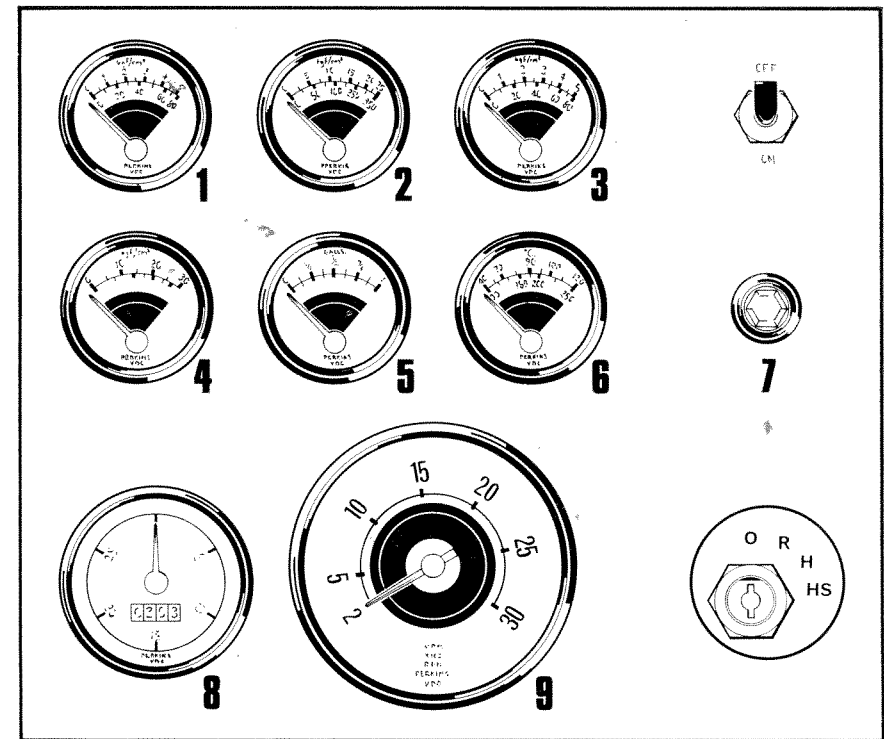


Fig. 6. Typical Instrument Panel.

- |                                    |                                   |
|------------------------------------|-----------------------------------|
| 1. Engine Oil Pressure Gauge       | 6. Engine Water Temperature Gauge |
| 2. Gearbox Oil Pressure Gauge      | 7. Generator Warning Light        |
| 3. Turbocharger Oil Pressure Gauge | 8. Hourmeter                      |
| 4. Boost Pressure Gauge            | 9. Tachometer                     |
| 5. Fuel Contents Gauge             |                                   |

### Turbocharger Oil Pressure Gauge

Oil pressure must show on the gauge within three to four seconds of the engine firing. The minimum oil pressure when the engine is on load must be 30 lbf/in<sup>2</sup> (2,1 kgf/cm<sup>2</sup>). Under idling conditions the pressure should not fall below 10 lbf/in<sup>2</sup> (0,7 kgf/cm<sup>2</sup>). It must be appreciated that the above pressures have to be maintained because the turbocharger rotor assembly bearing is supported by oil pressure.

### Boost Pressure Gauge — Turbocharged Engines

This is an indication of air pressure in the inlet manifold. As the boost is controlled by exhaust gas pressure the reading will vary according to load and speed.

## Tachometer

This provides the operator with the engine revolutions per minute (rev/min). The number indicated has usually to be multiplied by one hundred to give engine rev/min. e.g. 20 x 100 = 2,000 rev/min.

## Water Temperature Gauge

This indicates the normal running temperature of engine coolant or in the case of V8 engines the coolant temperature in each bank of cylinders. Coolant temperatures should remain within the ranges given on page 61. If high temperatures are experienced investigate the cause immediately (see page 76).

## periodical attentions

If a Perkins marine diesel engine is to give long and trouble free service, it is imperative that it be maintained in accordance with the following Periodical Attentions:—

### 4.107(M) and 4.108(M) Engines

#### Daily

Check coolant in header tank (closed circuit cooling only).  
Check sump oil level.  
Check oil pressure (where gauge fitted).  
Check gearbox oil level.

#### Every 150 hours or 3 months (whichever occurs first).

Drain and renew lubricating oil (see page 63).  
Renew lubricating oil filter element.  
Clean air intake gauze.  
\* Check drive belt tension.  
Clean water trap.  
Check engine for leakage of oil and water.  
Lubricate dynamo rear bush (where fitted).

#### Every 400 hours or 12 months (whichever occurs first).

Renew final fuel filter element.  
Check hoses and clips.  
Drain and clean fuel tank.  
Change gearbox oil.

#### Every 2,400 hours

Arrange for examination and service of proprietary equipment, i.e. starter motor, generator, etc.  
Service atomisers.  
Check and adjust valve tip clearances.

An operator is usually familiar with the type of water he is operating in. It is therefore left to his own discretion to check the weed trap, in the water intake, at appropriate intervals.

\*Drive belt tension should be checked monthly on engines rated above 3,000 rev/min.

### P3.152(M) Engines

#### Daily

Check coolant in header tank (closed circuit cooling only).  
Check sump oil level.  
Check oil pressures (where gauge fitted).  
Check gearbox oil level.

#### Every 150 hours or 3 months (whichever occurs first).

Clean air intake gauzes or screens.

#### Every 200 hours or 4 months (whichever occurs first).

Oil chain drive and bushes of hand starting equipment and pawl assembly at rear of crankshaft pulley (where fitted).  
Drain and renew lubricating oil (see page 63).  
Check drive belt tension.  
Clean lift pump pre-filter (where fitted).  
Renew lubricating oil filter element.  
Clean water trap.  
Check engine for leakage of oil and water.  
Lubricate dynamo rear bush (where fitted).

#### Every 400 hours or 12 months (whichever occurs first).

Renew fuel filter element.  
Check hoses and clips.  
Drain and clean fuel tank.  
Change gearbox oil.

#### Every 2,400 hours

Arrange for examination and service of proprietary equipment, i.e. starter motor, generator, etc.  
Service atomisers.  
Check and adjust tappets.

#### **4.236(M) Engines**

##### **Daily**

Check coolant level in header tank.  
Check sump oil level.  
Check oil pressure (where gauge fitted).  
Check gearbox oil level.

##### **Every 150 hours or 3 months (whichever occurs first).**

Clean air intake gauze or screen.  
Grease tachometer angle drive connections (where nipple fitted).

##### **Every 200 hours or 4 months (whichever occurs first).**

Drain and renew engine lubricating oil (see page 63).  
Renew lubricating oil filter element.  
Check drive belt tension.  
Check engine for leakage of oil and water.  
Clean water trap.  
Lubricate dynamo rear bush (where fitted).

##### **Every 400 hours or 12 months (whichever occurs first).**

Renew final fuel filter element.  
Check hoses and clips.  
Clean lift pump sediment chamber.  
Drain and clean fuel tank.  
Renew gearbox lubricating oil.

##### **Every 2,400 hours**

Arrange for examination and service of proprietary equipment, i.e. starter, generator, etc.  
Service atomisers.  
Check and adjust valve tip clearances.

#### **6.354(M), H6.354(M), T6.354(M) and HT6.354(M) Engines**

##### **Daily**

Check coolant level.  
Check sump oil level.  
Check oil pressure (where gauge fitted).  
Check gearbox oil level.  
Check boost pressure (where gauge fitted).

##### **Every 150 hours or 3 months (whichever occurs first).**

Clean air intake gauze or screen.  
Grease tachometer angle drive connections (where nipple fitted).

##### **Every 200 hours or 4 months (whichever occurs first).**

Drain and renew engine lubricating oil (see page 63).  
Renew lubricating oil filter element.  
Check drive belt tension.  
Clean water trap.  
Check engine for leakage of oil and water.  
Lubricate dynamo rear bush (where fitted).

##### **Every 400 hours or 12 months (whichever occurs first).**

Clean lift pump gauze strainer.  
Renew final fuel filter element.  
Check hoses and clips.  
Drain and clean fuel tank.  
Renew gearbox lubricating oil. (Borg-Warner).

##### **Every 800 hours**

Clean turbocharger impeller, diffuser and oil drain pipe.  
Renew gearbox lubricating oil. (MRF 350).

##### **Every 2,400 hours**

Arrange for examination and service of proprietary equipment, i.e. starter, generator, etc.  
Service atomisers.  
Check and adjust valve tip clearances.  
**NOTE** for engines fitted with air charge coolers see page 63.

#### **TV8.510(M) Engines**

##### **Daily**

Check coolant level.  
Check sump oil level.  
Check gearbox level.  
Check oil pressure (where gauge fitted).  
Check boost pressure (where gauge fitted).

##### **Every 50 hours or monthly (whichever occurs first).**

Clean air cleaner element.

**Every 200 hours or 4 months (whichever occurs first).**

Drain and renew lubricating oil (see page 63).  
Renew lubricating oil filter elements.  
Check drive belt tension.  
Service Atomisers.  
Drain water traps.  
Check engine for leakage of oil and water.

**Every 400 hours or 12 months (whichever occurs first).**

Renew final fuel filter elements.  
Check and adjust valve tip clearances.  
Check hoses and clips.  
Drain and clean fuel tanks.

**Every 800 hours**

Clean turbocharger impeller, diffuser and oil drain pipe.  
Check sea water pump impeller.  
Renew gearbox lubricating oil.

**Every 2,400 hours**

Arrange for examination and service of proprietary equipment, i.e., starter motor, etc. See page 63 for Air Charge Cooler servicing.

**V8.510(M) Engines**

**Daily**

Check coolant level.  
Check sump oil level.  
Check oil pressure (where gauge fitted).  
Check gearbox oil level.

**Every 150 hours or 3 months (whichever occurs first)**

Clean air intake gauzes or screens.

**Every 200 hours or 4 months (whichever occurs first).**

Drain and renew lubricating oil (see page 63).  
Renew lubricating oil filter elements.  
Check drive belt tension.  
Clean water trap.  
Check engine for leakage of oil and water.

**Every 400 hours or 12 months (whichever occurs first).**

Lubricate dynamo rear bush (where fitted).  
Renew final fuel filter element.  
Service atomisers.  
Check and adjust valve tip clearances.  
Check hoses and clips.  
Drain and clean fuel tanks.  
Renew gearbox lubricating oil (Borg-Warner).

**Every 800 hours**

Check sea water pump impeller.  
Renew gearbox lubricating oil (MRF 350 and Twin Disc MG-506).

**Every 2,400 hours**

Arrange for examination and service of proprietary equipment, i.e. starter, etc.

**post delivery checkover**

After a customer has taken delivery of his Perkins Marine Diesel engine, a general checkover of the engine must be carried out after the first 25/50 hours in service.

The checkover should comprise the following:—

1. Drain lubricating oil, renew lubricating oil filter and refill sump to full mark on dipstick with new oil.
2. Remove rocker assembly and check cylinder head nuts and/or setscrews are to the correct torque. (See fig. 7). Does not apply with TV8.510(M) and V8.510(M) engines.
3. Refit rocker assembly and set valve clearance to 0.012 in (0,30 mm) cold.
4. Check coolant level in header tank and inspect for coolant leaks.
5. Check external nuts, setscrews, mountings, etc. for tightness.
6. Check water pump drive belt tension.
7. Check electrical equipment and connections.

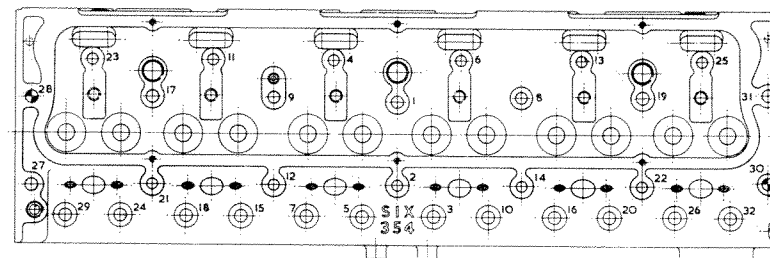


Fig. 7(a). Tightening Sequences for Cylinder Head Nuts and/or Setscrews. 6.354(M), H6.354(M), T6.354(M), HT6.354(M)

8. Check for lubricating and fuel oil leaks.
9. Check engine idling speed (see page 57).
10. Check general performance of engine.

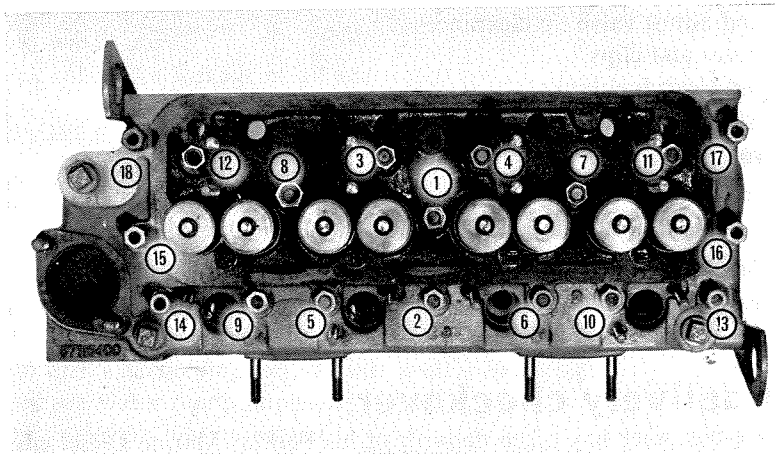


Fig. 7(b). 4.107(M) and 4.108(M).

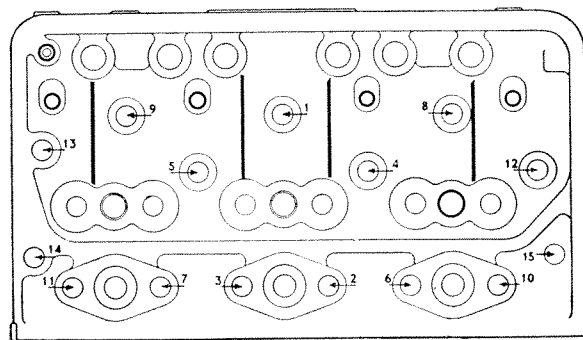


Fig. 7(c). P3.152(M).

Cylinder Head Nuts and/or Setscrews	Torque Tension	
	lbf ft	kgf m
4.107(M)	42	5,8
4.108(M)	60	8,3
P3.152(M)	60	8,3
4.236(M)	95	13,1
6.354(M), H6.354(M), T6.354(M), HT6.354(M) }	85	11,7

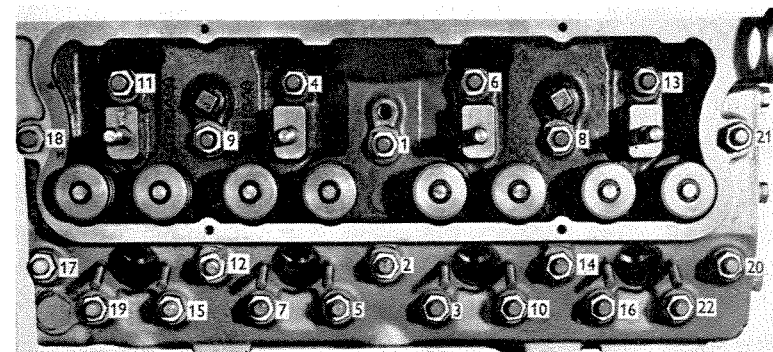


Fig. 7(d). 4.236(M).

## preservation of laid up engine

Where a boat is to be laid up for several months, the engine should be protected as follows:—

1. Clean all external parts.
2. Run engine until warm. Stop and drain the lubricating oil sump.
3. Throw away paper element(s) in the lubricating oil filter, clean bowl and fit a new element. Part fill bowl(s) with new oil of an approved grade, a list of which appears on page 66.
4. Clean out engine breather pipe(s).
5. Fill lubricating oil sump to correct level with new oil of an approved grade.
6. Drain all fuel oil from fuel tanks and filters. Put into the fuel tank at least one gallon of one of the oils listed under "Recommended Oils for the Fuel System" (see page 50). If, because of the construction of the fuel tank, this quantity of oil is inadequate, break the fuel feed line before the first filter and connect a small capacity auxiliary tank. If the fuel tank(s) cannot be drained they should be filled.
7. Prime the system as detailed on page 51.
8. Start engine and run it at half speed for 15 minutes when the oil will have circulated through the injection pump, pipes and atomisers.
9. Seal the air vent in the tank or filler cap with waterproof adhesive tape.

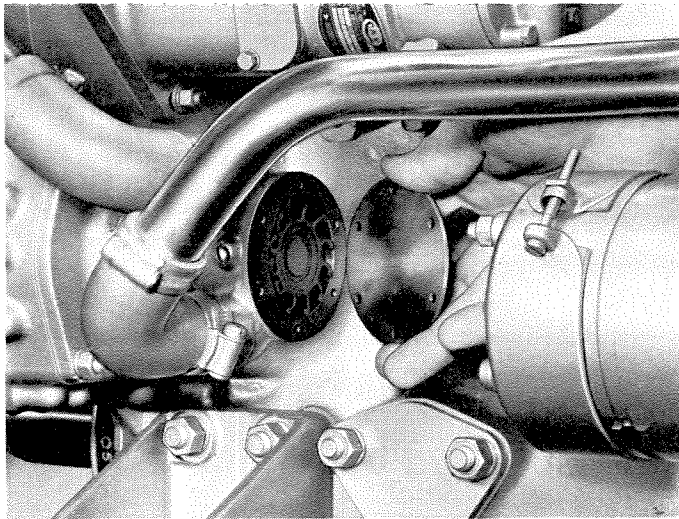


Fig. 8(a)

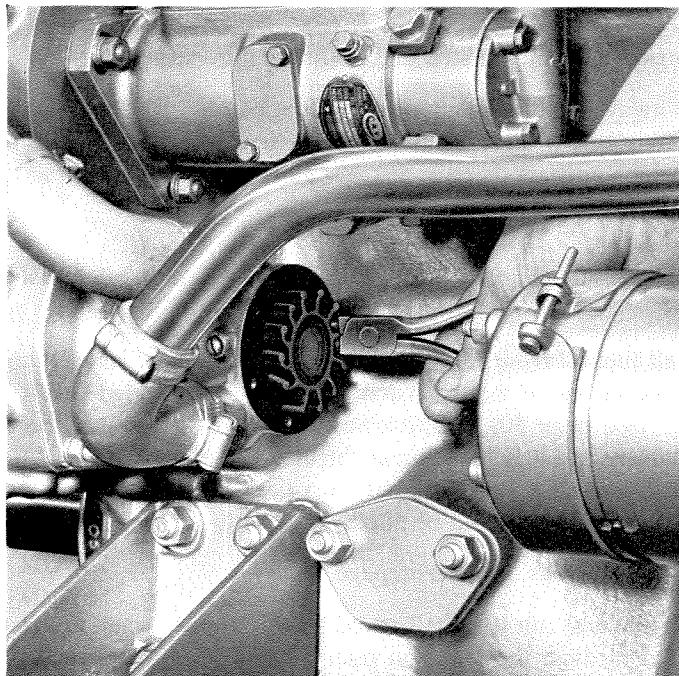


Fig. 8(b)

10. Drain water from heat exchanger and engine cylinder block. The heat exchanger should be removed and serviced; the cylinder block may be flushed back through the drain points with the thermostat removed. If it is decided to refill the fresh water system with antifreeze the precaution on page 49 should be followed. For 4.107 and 4.108 engines venting is necessary when filling the cooling system, see page 47.
11. Remove end plate from the sea water circulating pump and lubricate the interior of the pump body with Glycerine or MARFAK 2HD grease (see figs. 8(a) and 8(b), or remove impeller for lay-up period.
12. Remove the atomisers and spray into the cylinder bores  $\frac{1}{4}$  pint (0,14 litre) of lubricating oil divided between all cylinders. Rotate the crankshaft one complete revolution and replace atomisers.
13. Remove the air cleaner(s) and any piping. Seal the air intake with water-proofed adhesive tape.
14. Remove the exhaust pipe(s) and seal the manifold port.
15. Remove cylinder head cover(s), lubricate the rocker assembly and replace cover(s).
16. Remove water pump driving belt(s).
17. **Batteries**
  - (a) Remove the batteries and top up cells with distilled water.
  - (b) Recharge.
  - (c) Clean the terminals and lightly smear with petroleum jelly.
  - (d) Store in a cool, dry, dust free place. Avoid freezing risk.
  - (e) Recharge once a month.
18. **Starters and Generators**  
Clean terminals and lightly smear with petroleum jelly. The generator, starter and control board must be protected against rain.

#### OILS RECOMMENDED FOR PRESERVATION OF FUEL SYSTEM

##### Lowest Temperature to be expected during lay-up

Esso IL815	25°F (— 4°C)
Esso IL1047	0°F (—18°C)
Shell Calibration Fluid "C" (U.K.)	0°F (—18°C)
Shell Calibration Fluid "B" (Overseas)	—70°F (—57°C)
Shell Fusus "A"	—15°F (—26°C)
Shell Fusus "A" R1476 (Old Type)	25°F (— 4°C)



No attempt should be made to restart the engine until the temperature has been at least 15°F (9°C) above that shown in the table, for not less than 24 hours, otherwise there may be difficulty in obtaining a free flow of fuel.

The proprietary brands of oils listed are recommended for the purpose by the oil companies. They may not be available in all parts of the world, but suitable oils may be obtained by reference to the oil companies. The specification should include the following:—

Viscosity: Should not be greater than 22 centistokes at the lowest ambient temperature likely to be experienced on re-starting.

Pour Point: Must be at least 15°F (9°C) lower than the lowest ambient temperature to be experienced on restarting and should be lower than the lowest temperature likely to be met during the lay-up period.

The oils selected are not necessarily suitable for calibrating or testing pumps.

#### **PREPARING THE ENGINE FOR RETURN TO SERVICE**

When the engine is to be returned to service, the following procedure must be observed:—

1. Thoroughly clean all external parts and refit sea-water pump impeller (where applicable).
2. Remove adhesive tape from the fuel tank vent or filler cap.
3. Drain fuel tank to remove any remaining oil and condensed water and refill the tank with fuel oil. If tanks have been filled, drain water from trap if this has been provided by the boat builder.
4. Fit new filter element and vent the filter (see page 55).
5. Vent and prime the fuel injection pump (see page 51).
6. Close all coolant drain taps and fill the system with clean coolant. Check for leaks. Remember that if a coolant solution of 25% anti-freeze manufactured to BS3151 has been left in the system, then a life expectation of one year can be expected of the solution.
7. Rotate fresh water pump by hand to ensure freedom of water pump seals. If the pump will not rotate with a reasonable amount of persuasion then it will have to be removed to determine the cause.
8. Refit water pump driving belt(s).
9. Remove the rocker cover(s), lubricate rocker assembly with engine oil. Replace cover(s).

10. Remove adhesive tape from the air intake(s), refit the air cleaner and any intake pipe. Clean the gauze and if it is the oil bath type, fill with engine oil to the correct level.
11. Remove adhesive tape from the exhaust manifold port and refit exhaust pipe(s).
12. **Starter and Generator**  
Wipe the grease from the terminals and check that all connections are sound. If the starter is fitted with a Bendix type of drive, lubricate with a little light engine oil. CA45 co-axial starters, except where they are fitted with dust covers, should be given the same treatment.
13. Connect the batteries.
14. Check the level and condition of the oil in the sump. Change the oil if necessary. Attend to oil levels in in-line fuel injection pumps, see page 28.
15. Start the engine in the normal manner checking for oil pressure and electrical rate of charge. Whilst the engine is reaching its normal running temperature, check that it is free from water and oil leaks.

#### **Note:**

If the foregoing instructions are observed, the laying-up and returning to service should be carried out efficiently and without adverse effect on the engine. However, Perkins Engines Ltd., cannot accept liability for direct or consequential damage that might arise following periods of lay-up.

#### **4.107(M) and 4.108(M) Keel Cooled and Heat Exchanger Cooled Engines**

With the above engines, the following instructions should be adhered to when putting an engine back into service following the winter lay-up period, or at any time the fresh water cooling system has to be refilled. The initial "bleeding" of the cooling system will have been attended to when the engine is first installed by the boat builder, but the air venting check is desirable following complete or partial draining for lay-up, top overhaul or other engine repairs.

Dealing first with 4.107(M) or 4.108(M) keel cooled engines, it should be known that under certain conditions of outboard pipe installation, an air lock can occur where the pipes bridge the keel at their ends farthest from the inlet and outlet connections. This air should be cleared and the pipes left completely full of water before the engine is started and where possible, treated as a separate entity, and the following procedure adopted:—

1. Disconnect the pipe hose (water outlet to keel pipe) at the lower stub at the forward end of the exhaust manifold and the pipe connection (water inlet to engine) below the generator on the right hand forward end of the cylinder block.
2. Fill the pipe through the connection taken from the exhaust manifold by means of a funnel, filling until pipes are full to the cylinder block connection, and then making good this joint. When, after further water has been added to fill the pipe to the manifold connection, this pipe can also be re-connected. In the event of a bridge connection between the keel pipes being inside the hull, and the connections being of the type that can be loosened, air can be cleared more easily by loosening an inboard connection on the pipe bridge, topping through the pipe as above and re-tightening the connection when free of air at this point.

To ensure that no air is trapped in the cylinder block or cylinder head on fresh water cooled engines, the following procedure should be adopted on heat exchanger cooled units and in addition to the above on keel cooled units.

1. Remove the square headed plugs in the top faces of the cylinder head and exhaust manifold marked 1, 2, and 3 in fig. 9 and add water steadily to the cooling system header tank.

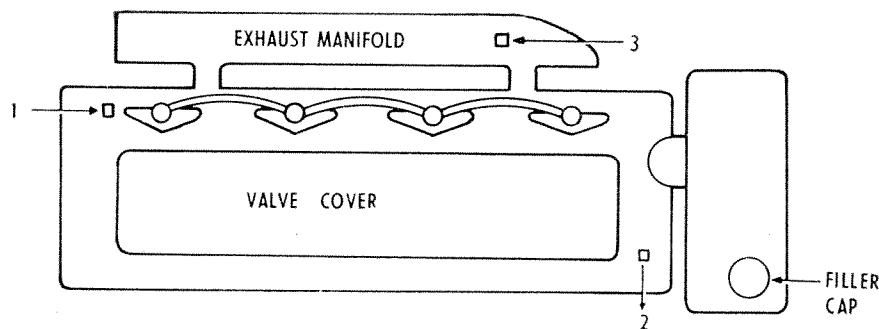


Fig. 9. Coolant Bleeding Points on Cylinder Head and Exhaust Manifold.

2. Replace plug 1 at rear end of cylinder head when water appears at this point.
3. Start engine and run in neutral at about 700 - 800 rev/min.
4. Continue topping up header tank, replacing plug 2 at forward end of cylinder head, and later plug 3 at forward end of exhaust manifold as the water appears at these points in turn. Finally top up the header tank to a level approximately 1 in below the pressure cap sealing flange.

5. Recheck for the presence of air at plugs 2 and 3 by gently unscrewing after engine has been run at about half throttle for a period of a few minutes or if a tendency to overheat is observed on the first run under normal load conditions.

## frost precautions

Precautions against damage by frost should be taken if the engine is to be left exposed to inclement weather either by adequately draining the cooling system or where this is not convenient, an anti-freeze of reputable make and incorporating a suitable corrosion inhibitor may be used.

Should it be the policy to protect engines from frost damage by adding anti-freeze to the cooling system, it is advisable that the manufacturers of the relevant mixture be contacted to ascertain whether their products are suitable for use in Perkins Engines and also to ensure that their products will have no harmful effect on the cooling system generally.

It is our experience that the best results are obtained from anti-freeze which conforms to British Standard 3151.

When draining the water circulating system, the tap on the cylinder block must be opened. There may be other drain taps on exhaust manifolds, oil coolers etc., all of which must be opened.

With 4.107(M) and 4.108(M) engines, the clips securing the hose between the cylinder block connection and the copper pipe to the header tank (keel cooled applications), or between the cylinder block connection and the copper pipe to the exhaust manifold (heat exchanger applications) should be slackened and the hose pulled away from the connection to drain this area.

When the engine is drained, the fresh water pump is also drained but the rotation of the pump may be prevented by:—

- (a) locking of the impeller by ice due to the pump hole being blocked by sediment.
- (b) locking of the seal through the freezing of globules of moisture between the seal and the gland.

Operators are therefore advised to take these precautions when operating in temperatures below freezing point.

1. Before starting the engine turn the fresh water pump by hand: this will indicate if freezing has taken place. If freezing has taken place, this should free any ice formation.
2. If it is impossible to turn the pump by hand, the engine should be filled with warm water.

- To avoid this trouble, it is advisable when all water has been drained to run the engine for a few seconds at idling speed, thus dispersing any moisture remaining in the pump.

After an anti-freeze solution has been used, the cooling system should be thoroughly flushed in accordance with the manufacturers instructions before refilling with normal coolant.

If the foregoing action is taken, no harmful effects should be experienced but Perkins Engines Ltd., cannot be held responsible for any frost damage or corrosion which may be incurred.

## **fuel system**

The importance of cleanliness in all parts of the fuel system cannot be overstressed. Dirt and sludge are killers to the engine life blood.

### **FUEL OIL SPECIFICATION**

The fuel oil used in Perkins Marine Engines should conform to the following specifications:—

#### **United Kingdom**

BS.2869 : 1967 — Class A1 and A2.

#### **United States**

A.S.T.M/D.975 — 66T — Nos. 1-D and 2-D.

Federal Specification VV - F - 800a : Grades DF-A, DF-1 and DF2 (according to operating ambient temperature).

#### **Germany**

DIN-51601 (1967).

#### **France**

J.O. 14/9/57 Gas Oil or Fuel Domestique.

#### **Italy**

Cuna-Gas Oil NC-630-01 (1957).

#### **India**

IS : 1460/1968 — Grade Special and Grade A.

#### **Sweden**

SIS. 15 54 32 (1969).

#### **Switzerland**

Federal Military Specification 9140-335-1404 (1965).

Fuel oils available in territories other than those listed above which are to an equivalent specification may be used.

## **BLEEDING THE FUEL SYSTEM**

Should the operator be unfortunate enough to run out of fuel, or whenever any part of the system between the fuel tank and fuel injection pump has been disconnected, the fuel system will have to be bled.

### **Engines fitted with C.A.V. DPA rotary type fuel injection pumps**

Ensure there is sufficient fuel in tank and **that the fuel tank cock, where fitted, is turned on.**

- Slacken air vent valve on side of control gear housing (see figs. 10(a)(b)(c)). For later engines see fig. 13(d).
- Slacken vent valve fitted on one of the two hydraulic head locking screws (see figs. 10(d)(e)(f)). Unscrew vent plug on top of fuel filter where fitted.
- Operate priming lever on fuel feed pump (if this is not possible, the camshaft driving the lift pump lever may be on maximum lift; turn engine one revolution) and when fuel, free from air bubbles, issues from each venting point, tighten the screws in the following order:—
  - Fuel filter cover vent screw.
  - Head locking screw.
  - Governor vent screw.
- Slacken the pipe union nut (see figs. 10(g)(h)(j)) at the pump inlet, operate the priming lever and retighten when fuel, free from air bubbles, issues from around the threads.
- Slacken unions at atomiser ends of two of the high pressure pipes.

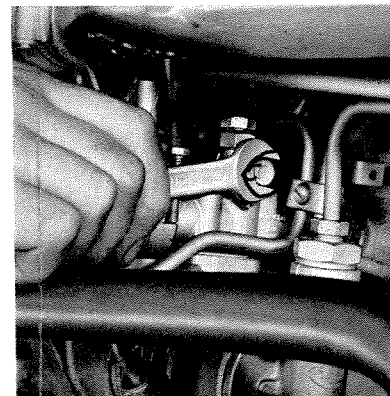


Fig. 10(a). 4.107 and 4.108  
(for later engines see fig. 13(d)).

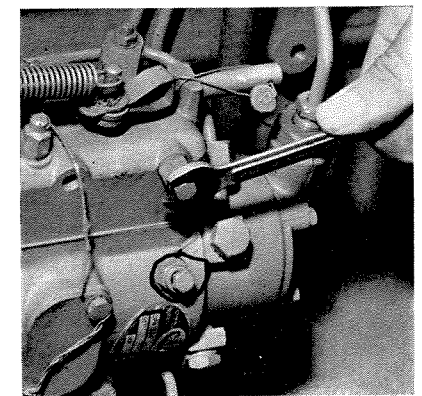


Fig. 10(b). 4.236.

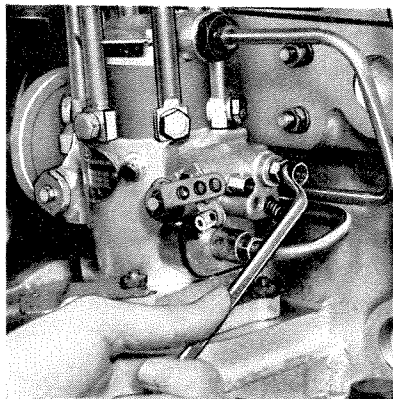


Fig. 10 (c) 6.354.

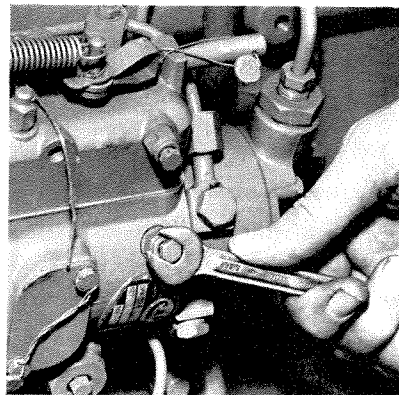


Fig. 10(e). 4.236.

6. Set accelerator to the fully open position ensuring that the stop control is in the "run" position.
7. Turn engine until fuel, free from air bubbles, issues from both fuel pipes.
8. Tighten the unions on both fuel pipes, and the engine is ready for starting. In the unhappy event of the batteries becoming flattened during the above operation, look to your flare locker (did you check its contents before leaving port?). If in any doubt about battery condition the load on the battery can be eased during cranking by preventing air being drawn into the air intake. Remove air filter and close off intake by pressing a large sheet of stiff cardboard or similar over intake, or remove atomisers.

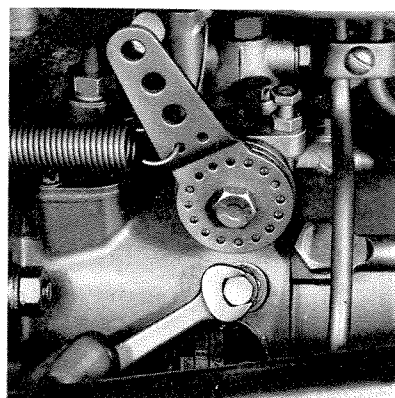


Fig. 10(d). 4.107 and 4.108

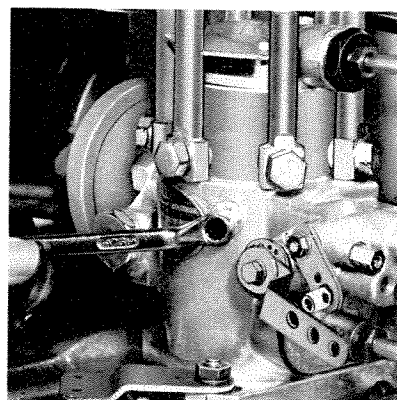


Fig. 10(f). 6.354.

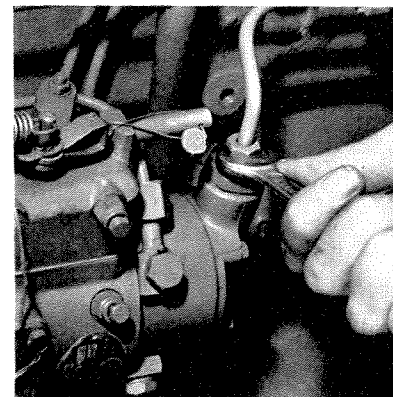


Fig. 10(g). 4.236.

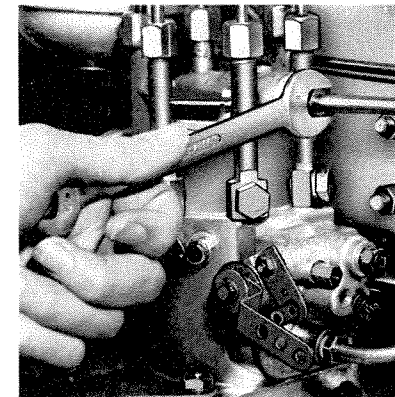


Fig. 10(j). 6.354.

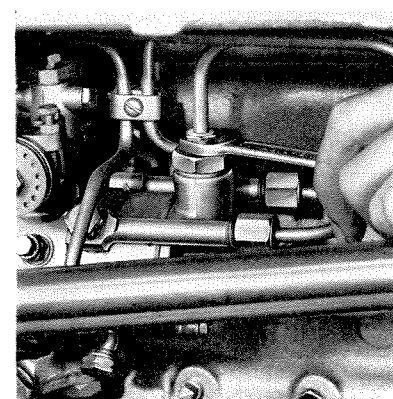


Fig. 10(h). 4.107 and 4.108.

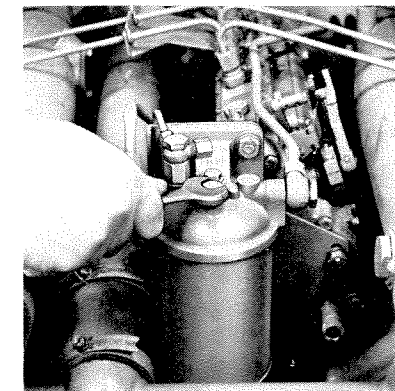


Fig. 11(a)

#### Engines fitted with in-line fuel injection pumps

1. Unscrew final filter vent plug (see fig. 11(a)).
2. Unscrew the two vent plugs or vent screws on the fuel injection pump by two or three turns. These plugs are fitted each side of the fuel inlet connection on the right hand side of the pump (see figs. 11(b)(c)).
3. Operate priming lever on the fuel lift pump. If the lift pump driving cam is on maximum lift, it will not be possible to operate the hand primer. If so, turn the engine through one revolution.

When fuel, free from air bubbles, issues from the venting points, tighten the fuel filter vent plug and then the fuel injection pump vent plugs.

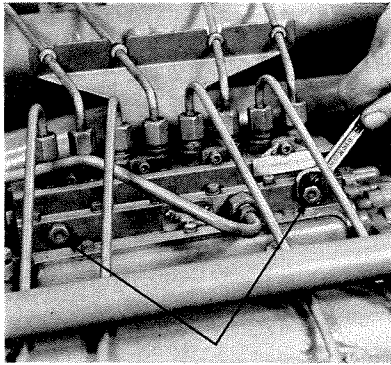


Fig. 11(b)

Key to fig. 11(c). P3.152(M).

1. Fuel Injection Pump Bleed Screw.
2. Excess Fuel Device Button.
3. Idle Speed Adjusting Setscrew

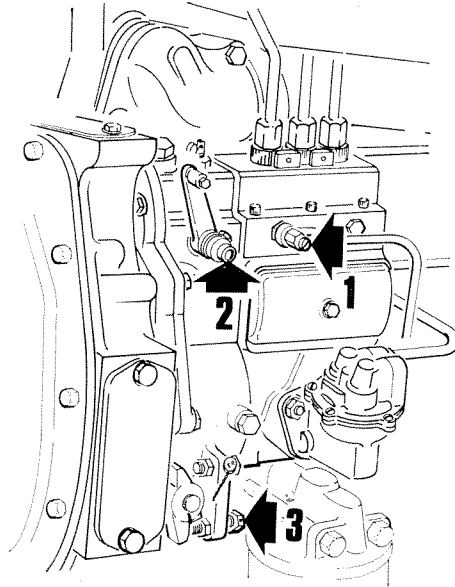


Fig. 11(c)

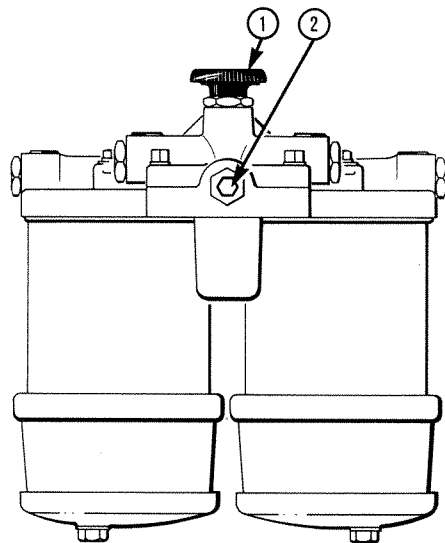


Fig. 11(d)

Key to fig. 11(d) TV8.510(M).

1. Priming Pump Handle.
2. Fuel Filter Vent Plug.

1. Idling Speed Adjusting Screw.
  2. Fuel Pump Return Connection.
- Key to fig. 11(e) TV8.510(M).

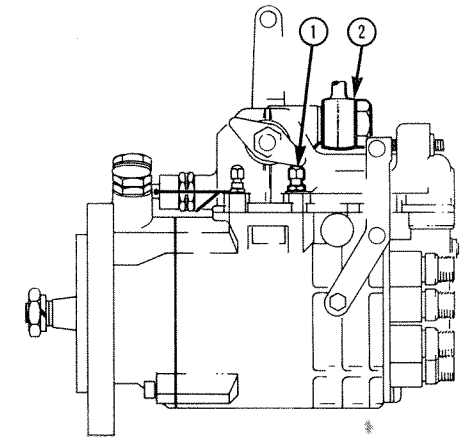


Fig. 11(e)

#### Engines fitted with S.I.G.M.A. rotary type fuel injection pumps

1. Unscrew the vent plug on the front of the fuel filter (see fig. 11(d) by two or three turns.
2. Unscrew the priming pump handle on the top of the filter and operate the pump until fuel, free from air bubbles, issues from the venting point. Tighten filter vent plug.
3. Unscrew the fuel injection pump return connection (see fig. 11(e) and operate the priming pump until fuel, free from air bubbles, issues from the connection. Tighten the connection.
4. Screw the priming pump handle securely back into the filter head casting.
5. Slacken the unions at the atomiser end of two of the high pressure pipes.
6. Place the accelerator in the fully open position, ensure that the stop control is in the "run" position and turn the engine until fuel, free from air bubbles, issues from both pipes.
7. Tighten the unions of the fuel pipes and the engine is ready for starting

#### FUEL FILTERS

Two fuel filters are usually fitted to Perkins Marine Engines, one in the fuel lift pump and the other, a self contained unit with renewable element, mounted on the engine. 4.107 and 4.108 engines do not have a filter in the fuel lift pump. A fine mesh gauze filter should always be fitted to the fuel tank filler.

#### To renew filter elements

1. Clean exterior of filter assembly.

2. Unscrew setscrew at top of filter bowl. (see figs. 12(a)(b)).
3. Either lower filter bowl clear and discard element or lower base and discard element. (see figs. 12(c)(d)).
4. Clean filter head and bowl or base in suitable cleaning fluid.
5. Check sealing rings and, if damaged, renew.
6. Fit new element to filter bowl or new element to base.
7. Place square against filter head and tighten setscrew.
8. Bleed fuel system as described previously.

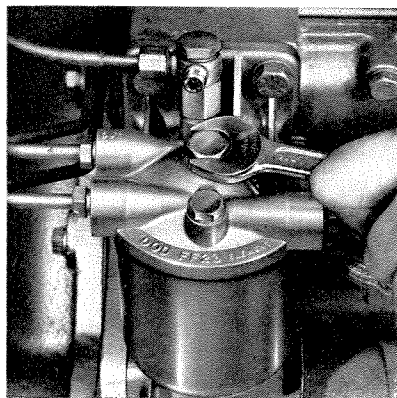


Fig. 12(a)

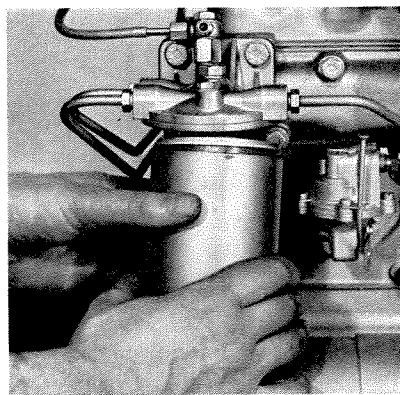


Fig. 12(c)

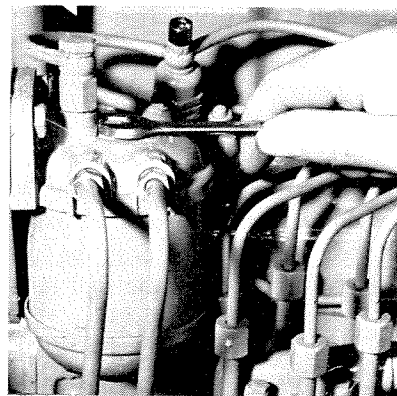


Fig. 12(b)

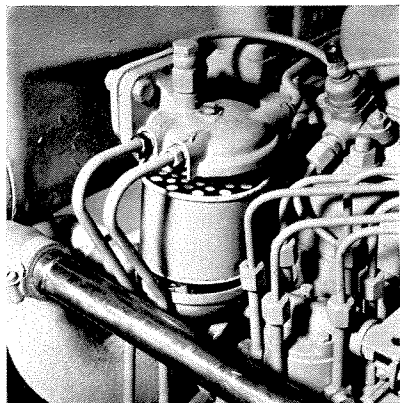


Fig. 12(d)

## IDLING SPEED SETTING

### C.A.V. Rotary type pumps

On D.P.A. pumps there are three types of adjustment. One is on a spring loaded screw (6.354) the second is on the reversible governor head which consists of a setscrew and locknut. The third type is on the governor housing on a mechanically governed type pump, and consists of a nut and setscrew.

On the first type turn the screw clockwise to increase engine speed or anti-clockwise to decrease (see fig. 13(a)).

On the second type undo locknut and set required speed (see figs. 13(c)(d)). This must be done in conjunction with the setting of the anti-stall device (see page 58).

On the third type undo locknut and set required speed.

### S.I.G.M.A. Rotary type pumps (TV8.510(M))

The slow running adjustment screw is shown in fig. 11(e).

### In-line pumps

The slow running adjustment screw is the **upper** of the two adjustable stop screws situated at the right hand side of the rear of the fuel injection pumps, on V8.510 engines fig. 13(b). On 3.152 engines the slow running adjustment screw is the **lower** of the two, fig. 11(c).

The idling speed will vary according to application. For details, apply to the nearest Perkins, C.A.V. or Simms distributor, alternatively Technical Service Department, Perkins Engines Ltd., Peterborough.

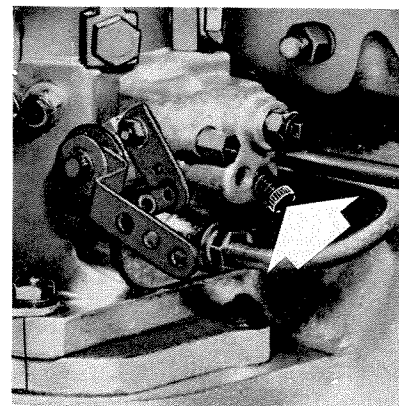


Fig. 13(a)

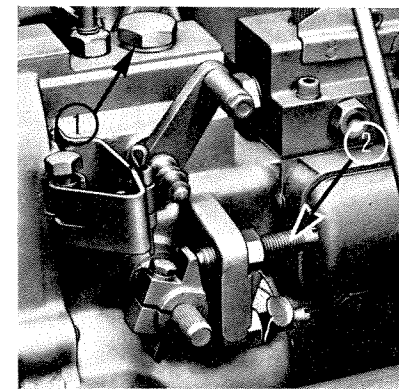


Fig. 13(b)

## ANTI-STALL DEVICE

### S.I.G.M.A. Rotary type pump (TV8.510(M))

There is no anti-stall device incorporated in this type of fuel injection pump.

### C.A.V. Rotary type pumps

(see figs. 13(c)(d) 4.107 and 4.108 engines).

- Slacken locknut (2) sufficiently to enable the anti-stall device body (1) to be unscrewed two complete turns.
- Adjust idling speed to 625 rev/min\* with idling adjustment screw (4).
- Screw down anti-stall device body (1) until there is a very slight increase in engine speed, bring back half a turn and lock with lock nut (2).
- Accelerate engine to maximum no load rev/min and immediately return to idling.

Should the period of return from maximum rev/min to idling exceed three seconds the device has been screwed in too far.

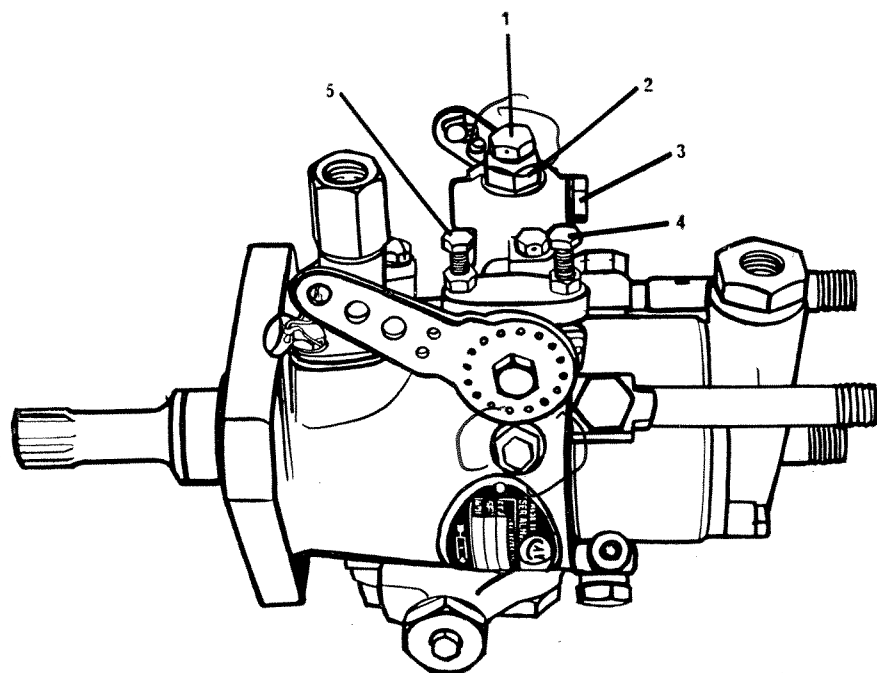


Fig. 13(c). Earlier Fuel Pump.

- |                                   |                          |
|-----------------------------------|--------------------------|
| 1. Anti-stall device body         | 4. Idle adjustment screw |
| 2. Anti-stall device body locknut | 5. Maximum speed screw   |
| 3. Air vent screw                 |                          |

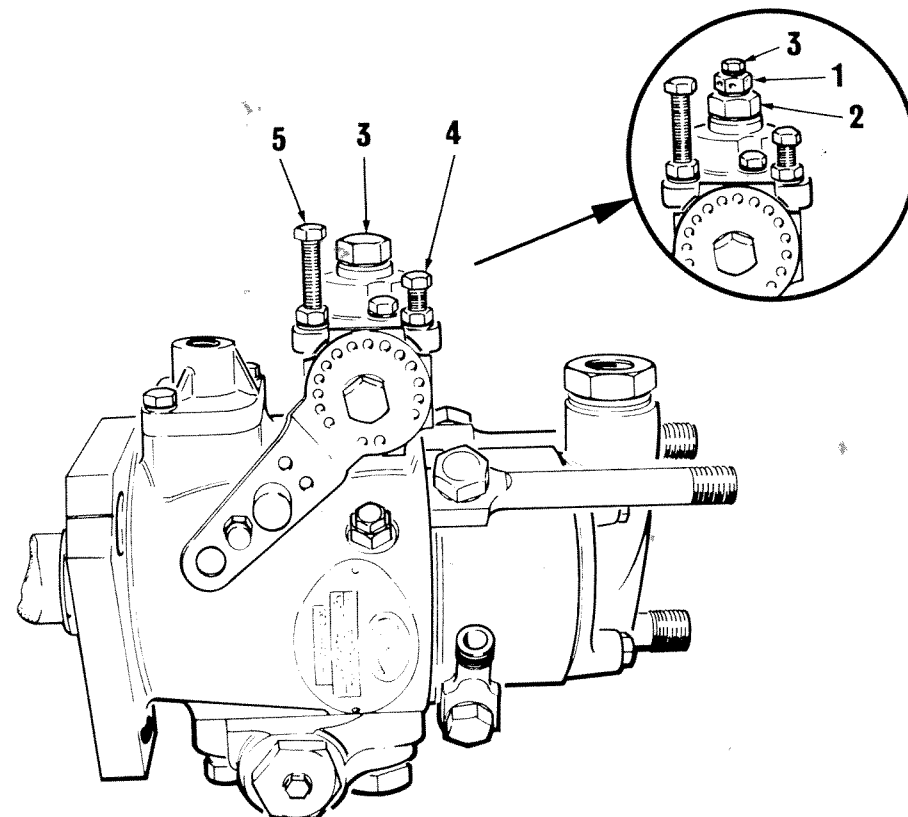


Fig. 13(d). Later Fuel Pump (anti-stall device shown inset).

- |                                    |                           |
|------------------------------------|---------------------------|
| 1. Anti-stall device body.         | 4. Idle adjustment screw. |
| 2. Anti-stall device body locknut. | 5. Maximum speed screw.   |
| 3. Air vent screw.                 |                           |

However should stalling occur, then the device has not been screwed in far enough. Therefore the necessary adjustment should be made to suit whichever is the case.

\*This idling speed may vary according to application. If in doubt, refer to one of the Perkins Distributors listed on pages 79 to 91.

### In-line pumps (see fig. 13(e) V8.510 engine).

Screw out anti-stall device by two or three turns.

With engine warmed up, adjust idling speed to 500 rev/min, by means of idling adjustment screw.

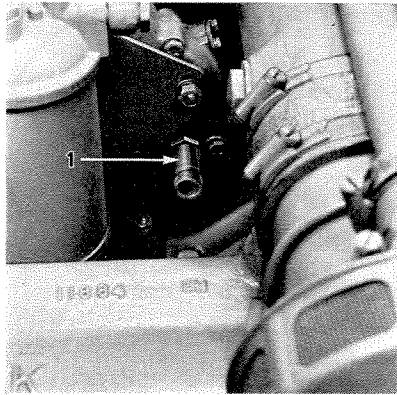


Fig. 13(e)

Screw in anti-stall device until it just affects idling speed. Screw out  $\frac{3}{4}$  turn and lock with locknut.

Operate speed control lever and check that anti-stall device is not influencing idling speed setting and engine does not stall out when lever is quickly closed.

### ATOMISER TESTING AND REPLACEMENT

Often a particular atomiser or atomisers causing trouble may be determined by releasing the pipe union nut on each atomiser in turn, with the engine running at a fast "tick-over". This will prevent fuel being pumped through the nozzle to the engine cylinder, thereby altering the engine revolutions. If after slackening a pipe union nut, the engine revolutions remain constant, this denotes a faulty atomiser.

When fitting a replacement atomiser it should be noted that the joint between the atomiser and cylinder head is made by a special copper washer. Care should be taken to ensure that only this type of copper washer is used. The recess in the cylinder head, the faces of the copper washer and the corresponding face of the nozzle holder cap must be perfectly clean if a leakproof joint is to result. Fit new copper washers each time an atomiser is replaced. The nuts on the flange should be tightened down evenly to prevent the atomiser nozzle being canted and so nipped in the cylinder head. Uneven tightening will almost certainly result in blowby. Over tightening high pressure fuel pipe nuts will result in split olives.

## cooling system

There are three types of cooling employed on Perkins engines. Direct, indirect and keel cooling.

**Direct Cooling.** In this system raw water is drawn through a suitable sea cock by a rubber impeller type pump, circulated round the engine and discharged overboard again. Although it has a lower initial cost it has little to recommend it. It is not practicable to operate engines cooled by this method at their normal working temperatures and even with a special thermostat and by-pass fitted the temperature may not be raised above 140°F (60°C) due to scale which will be formed in the water passages. This will in turn bring about local overheating and atomiser troubles. Engine wear is considerably heavier, and oil sludging is increased. Also engines running too cold are noisier than when running at the correct temperature.

**Indirect Cooling.** This system incorporates a heat exchanger, cooling water in a closed circuit, using raw water as the cooling medium. The raw water discharge can be used for normal water injection into the silencing system. A thermostat fitted into the closed circuit system keeps the engine at optimum temperature of 150 - 180°F (65 - 82°C) for 4.107 and 4.108 engines and 168 - 197°F (75 - 91°C) for the rest of the marine engine range except for the P3.152 engine which is 125 - 150°F (52 - 65°C). Two water pumps are used.

**Keel Cooling.** This is the same system as above except the heat exchanger is now comprised of pipes fitted outside the hull, usually in an angle between the keel and the garboard strake, and of length and diameter to suit the particular engine.

### Coolant Capacities. Engine only

#### 4.107, 4.108

10.5 Imp. pts (6 litres)  
12.6 U.S. pints

#### 6.354, H6.354, HT6.354, T6.354

36 Imp. pts (20,5 litres)  
43.2 U.S. pints

#### P3.152

12.5 Imp. pts (7,1 litres)  
15.0 U.S. pints

#### V8.510, TV8.510

62 Imp. pts (35 litres)  
74.4 U.S. pints

#### 4.236

26 Imp. pts (14,8 litres)  
31.2 U.S. pints



## Cooling System Maintenance

### Rubber Impeller Type Water Pump

This type of pump is used for raw water circulation and in the case of the P3.152 engine for fresh water circulation as well.

The pump should **never** be run in a dry condition (impeller blades will tear) and if the engine is to be withdrawn from service for any length of time, it will be necessary to pack the water pump with MARFAK 2HD grease. (Where this is not available, glycerine may be used). This is effected by removing the pump end plate, giving access to the interior of the pump, which can then be packed with grease, or glycerine introduced through the top-most pipe connection after removing the rubber hose. Turn engine over to spread the lubricant.

### ALWAYS CARRY A SPARE IMPELLER

This treatment is usually effective for about three months, and should be repeated prior to recommencement of service if laid up for a longer period than this.

### Air Cleaner Element (TV8.510(M))

The element should be cleaned every 50 hours with fuel oil. If dust particles are particularly adhesive, a domestic soap powder can be used. The element should then be washed with fuel oil and allowed to dry.

### Heat Exchangers, Oil Coolers and Air Charge Coolers

A heat exchanger usually consists of a casing used as a header tank and contained in this a tube stack which is the heat exchanger. The oil cooler usually has a smaller tube stack and is sometimes part of the marine engine fresh water heat exchanger.

Heat exchanger tube stacks can be removed for servicing by unscrewing the tie rod nut in the end cover and removing both end covers. Both "O" Seals can now be removed and the tube stack withdrawn from the casing.

If the tube stacks are badly choked the best method of cleaning is to place the assembly in a boiling caustic soda solution. This will loosen all foreign matter adhering to the unit. Generally speaking, however, the fresh water side i.e. the outside of the tubes, should be fairly clean as these are on the closed circuit. The inside of these tubes which may have salt water passing through them are more likely to require cleaning. If these are not badly scaled enough to require the caustic soda solution treatment described above, they can be cleaned by pushing a length of  $\frac{1}{8}$  in (3,2 mm) diameter steel rod down the tubes to dislodge any foreign matter. It is **IMPORTANT** when doing this, that the rod is pushed through the tubes in the opposite direction to that in which the water flows also that the rod does not damage tube walls. When replacing tie rods, do not overtighten nut. Torque to 25 lbf ft (3,46 kgf m).

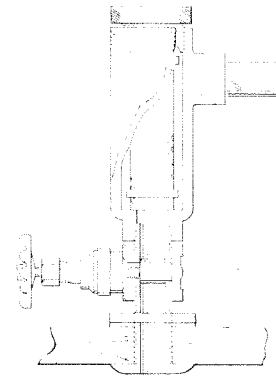


Fig. 14

**Air Charge Coolers** should be serviced every season in the same way as heat exchangers. However, it is stressed that according to operating conditions, this period may have to be reduced.

### Seacocks and Strainers

Ensure that seacocks are open prior to starting the engine and that, after the engine has started, there is a flow of water from the discharge pipe. The operator knows his home water so cleaning of the strainer is left to his discretion, but regular checks should be made of the engine water temperature gauge. Fig. 14 shows a typical seacock position.

## lubricating system

The importance of correct and clean lubrication cannot be stressed too highly and references to engine oil should be taken to mean lubricating oil which falls within the specification given in this section. Care should be taken that the oil chosen is that specified for the climatic conditions under which the engine is operated. The sump should be filled to the correct level but **DO NOT** overfill above the full mark.

Due to the variance in delivery of the lubricating oil pump and scavenge pump, the following procedure is recommended with horizontal 6.354 engines when renewing the lubricating oil.

1. Fill engine sump well to full mark on dipstick.
2. Run engine until oil temperature is at normal operating temperature, idle engine for two minutes and shut down.
3. Top up sump well to full mark on dipstick. This replaces residual oil remaining in the crankcase.

For routine oil level checks, horizontal engines should be idled for two minutes and then shut down before reading the dipstick.

The oil level should not be checked with the engine running at speeds in excess of 1,000 rev/min, or if the engine has been shut down from speeds of over 1,000 rev/min without the two minutes idling period.

As, in most cases, the sump cannot be drained by unscrewing the drain plugs due to the installation, a sump pump can be provided if it is not already fitted, to facilitate removal of sump oil.

### Renewing oil filter elements

Filter elements are contained in a detachable bowl and should be serviced as follows:—

1. Clean exterior of filter bowl.
2. Unscrew filter bowl securing setscrew (this is either on the head casting or at the base of the bowl).
3. Lower filter bowl clear (see figs. 15(a)(b)), remove element and discard
4. Clean inside bowl before fitting new element.
5. Renew bowl to head casting sealing ring.
6. Offer bowl to head casting squarely and firmly, locate securing setscrew and tighten carefully.
7. After the engine has been run and the filter assembly checked for leaks, restore oil in sump to its correct level.

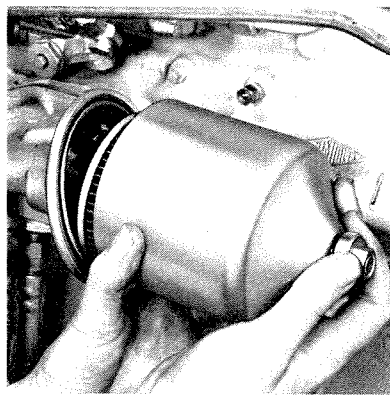


Fig. 15(a)

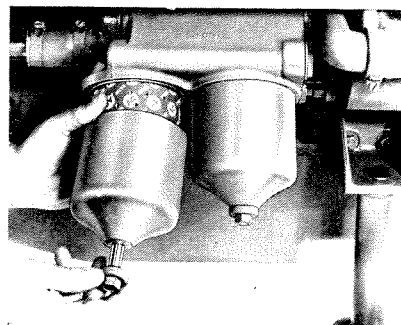


Fig. 15(b)

### SCREW TYPE OIL FILTER

Certain engines employ a screw type oil filter. This filter is a combined casing and filter element into which is screwed a standpipe. The standpipe is threaded at its lower end which screws into the filter head.

#### To Renew Screw Type Oil Filter

1. Unscrew filter from filter head complete with standpipe.
2. Remove standpipe from filter and discard filter.
3. Clean standpipe and fit it to new filter.
4. Refit filter assembly **HAND TIGHT ONLY** to filter head.
5. Run engine for a few seconds at idling speed, to enable filter to fill before increasing speed.

#### Oil Pressure

This should be 30/60 lbf/in<sup>2</sup> (2,1/4,2 kgf/cm<sup>2</sup>) at normal working speed and temperature. The pressure will drop whilst the engine is idling also a slight drop will be experienced when the oil is hot, this is quite normal.

#### Oil Coolers

Under normal circumstances, oil coolers will require little attention, providing the sea water inlet strainer is efficient and kept clean.

After a lengthy period of service it may be necessary to clean the tube stack and this may be effected in a similar manner to that given for the heat exchanger. Servicing of the earlier horizontal 6.354 engine oil cooler entails removal of the sump.

## Lubricating oils

Lubricating oils for normally aspirated engines should meet the requirements of the U.S. Ordnance Specification MIL-L-2104B and below we list some of these oils. Any other oils which also conform to this specification, are, of course, also suitable.

Lubricating oils for turbocharged engines should conform to the Series 3 or MIL-L-45199B specification and some of these oils are listed separately. Here again, any other oils which also conform to this specification are also suitable. Where Series 3 oils are not available for turbocharged engines, then MIL-L-2104B oils may be used *providing* the oil change period as used for Series 3 oils is halved.

Normally aspirated engines must not be operated on Series 3 oils unless they also meet the MIL-L-2104B specification.

Lubricating oils for use in Perkins Diesel engines should have a Minimum Viscosity Index of 80.

### MIL-L-2104B OILS

Company	Brand	S.A.E. Designation		
		0°F(-18°C) to 30°F(-1°C)	30°F(-1°C) to 80°F(27°C)	Over 80°F (27°C)
B.P. Ltd.	B.P. Vanellus	10W	20W/20	30
	B.P. Vanellus	10W/30	10W/30	10W/30
Castrol Ltd.	B.P. Vanellus S3	10W	20W/20	30
	Castrol/Deusol CRB	10W	20W/20	30
	Castrol/Deusol CRD	10W	20W/20	30
	Agricastrol HDD	10W	20W/20	30
A. Duckham & Co. Ltd.	Fleetol 3	3/10	3/20	3/30
Esso Petroleum Co. Ltd.	Essolube D3.HP	10W	20W	30
	Essolube HDX		20W/50	20W/50
	Essolube HDX	10W/30	10W/30	10W/30
Mobil Oil Co. Ltd.	Delvac 1200 Series	1210	1220	1230
	Delvac 1300 Series	1310	1320	1330
Shell	Shell Rotella SX	10W	20/20W	30
	Shell Rimula CT	10W	20W/20	30

### SERIES 3 OILS

Company	Brand	S.A.E. Designation		
		0°F(-18°C) to 30°F(-1°C)	30°F(-1°C) to 80°F(27°C)	Over 80°F (27°C)
B.P. Ltd.	B.P. Vanellus S.3	10W	20W/20	30
	Castrol Ltd.	Castrol C.R.D.	20W/20	30
A. Duckham & Co. Ltd.	Deusol C.R.D.	10W	20W/20	30
	Agricastrol HDD	10W	20W/20	30
	Fleetol 3	3/10	3/20	3/30
	Essolube D3.HP	10W	20W	30
Esso Petroleum Co. Ltd.	Essolube D3.HP	10W	20W	30
Mobil Oil Co. Ltd.	Delvac 1300 Series	1310	1320	1330
	Shell	Rimula CT	10W	20W/20

The above specifications are subject to alteration without notice

## GEARBOXES

The following types of gearboxes are fitted to Perkins engines.

4.107	NICOR TMP 12000 Series.	Parsons DA.
4.108	NICOR TMP 12000 Series.	Parsons DA.
P3.152	Parsons DA.	Borg-Warner 71C.
4.236	Borg-Warner 71 CR.	Self Changing Gears MRF 350.
6.354	Borg-Warner 72 CR.	Self Changing Gears MRF 350.
H6.354	Borg-Warner 72 CR.	Self Changing Gears MRF 350.
T6.354	Borg-Warner 72 CR.	Self Changing Gears MRF 350.
HT6.354	Borg-Warner 72 CR.	Self Changing Gears MRF 350.
V8.510	Borg-Warner 73 CR.	Twin Disc MG-506

### BORG-WARNER

**Filling** *A.T.F. DEXTRON II OR ENG OIL BELOW 4,000 R.P.M.*  
Transmission oil should be added until it reaches the full mark on the dipstick. The unit should be turned over at idling speed for a short time to fill all circuits.

#### Procedure for checking oil level

The oil level should be checked immediately after shut-down and sufficient oil added to bring the level to the full mark on the dipstick. The dipstick assembly need not be threaded into the case to determine oil level.

#### Oil Capacities

Type	Level			Inclined		
	U.S. Quarts	Imp. Pints	Litres	U.S. Quarts	Imp. Pints	Litres
<b>71C &amp; CR</b>	1.8	3.0	1.71	1.3	2.2	1.2
1.523 : 1	2.5	4.2	2.36	2.7	4.5	2.56
1.91 : 1	2.5	4.2	2.36	2.7	4.5	2.56
2.10 : 1	2.5	4.2	2.36	2.7	4.5	2.56
2.57 : 1	2.5	4.2	2.36	2.7	4.5	2.56
2.91 : 1	2.5	4.2	2.36	2.7	4.5	2.56
<b>72CR</b>	2.1	3.5	2.00	1.7	2.8	1.55
1.523 : 1, 1.91 : 1,						
2.100 : 1	2.7	4.5	2.56	2.8	4.6	2.55
2.57 : 1, 2.91 : 1	2.7	4.5	2.56	2.8	4.6	2.55
<b>73CR</b>	2.6	4.3	2.38	1.5	2.5	1.42
1.5 : 1, 2.0 : 1,						
3.0 : 1	2.0	3.3	1.89	2.2	3.6	2.04

## Oil Temperatures and Pressures

Oil pressure 110 - 150 lbf/in<sup>2</sup> (7,73 - 10,55 kgf/cm<sup>2</sup>) at normal operating temperatures of 150 - 165°F (65,55 - 73,8°C). At low temperature or excessive speeds, pressures of 200 - 250 lbf/in<sup>2</sup> (14,06 - 17,58 kgf/cm<sup>2</sup>) may be obtained. A maximum transmission oil temperature of 190°F (87,6°C) is recommended. On the 73CR gearbox oil pressure is 115 - 140 lbf/in<sup>2</sup> (8,08 - 9,84 kgf/cm<sup>2</sup>) at 2,000 engine rev/min with oil temperature 140 - 190°F (60 - 88°C).

## SELF CHANGING GEARS

### Filling

Stop the engine. After unit number UM1212 fill gearbox to "full" mark on the dipstick with SAE 90 EP gear oil for tropical and temperate regions, and SAE 80 EP gear oil for arctic regions. Earlier gearboxes should be filled with any high grade engine oil of SAE 30 specification.

### Oil Capacity

Imp. Pints	U.S. Pints	Litres
12	14.4	6,81

### Oil Pressure

Standard Control	110 lbf/in <sup>2</sup> (7,73 kgf/cm <sup>2</sup> ) approx.
Sequent Control	90 lbf/in <sup>2</sup> (6,33 kgf/cm <sup>2</sup> ) approx.

## NICOR TMP Type 12000 Mk II

### Filling

Run engine for a short time and shut down. Immediately remove dipstick and wipe blades. Re-insert dipstick and check oil level.

If oil is showing between mark and bottom of dipstick rod, there is sufficient oil in the box. If oil does not show on rod, top up until bottom of rod is touched.

The mark on the rod indicates oil level when engine has been stationary for a period not less than 20 minutes. SAE 20 lubricating oil is recommended.

### Oil Capacity

Direct Drive	2.25 Imp. pints	2.7 U.S. pints	1,28 litres
Reduction Box	1 Imp. pints	1.2 U.S. pints	0,57 litres

## Oil Pressure and Temperature

96 lbf/in<sup>2</sup> (6,75 kgf/cm<sup>2</sup>) at 3,500 rev/min.  
Maximum running temperature 180°F (82°C).  
Normal running temperature 160°F (71°C).

## PARSONS "DA"

### Filling

Stop the engine. Fill gearbox to "full" mark on the dipstick with engine oil. If a reduction box is fitted fill to level plug.

### Oil Capacities

Reverse gear	1 Imp. pint	1.2 U.S. pint	0,57 litres
2 : 1 Reduction gear	0.25 Imp. pint	0.3 U.S. pint	0,14 litres
3 : 1 Reduction gear	0.5 Imp. pint	0.6 U.S. pint	0,28 litres

Lubrication is by controlled splash.

## TWIN DISC MG-506

### Filling

Stop the engine. Fill gearbox to "full" mark on the dipstick with engine oil. oil for water inlet to heat exchanger temperature of more than 85°F (29,5°C), or SAE 20 HD oil for water inlet temperature less than 85°F (29,5°C).

Gearbox oil level should always be checked with engine running at idling speed.

### Oil Capacity

8 Imp. pint	9.6 U.S. pints	4,55 litres
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### Oil Pressure

Normal 300 - 320 lbf/in<sup>2</sup> (21,1 - 22,5 kgf/cm<sup>2</sup>) at 1,800 rev/min and 180°F (82°C). Minimum 270 lbf/in<sup>2</sup> (18,98 kgf/cm<sup>2</sup>) at cruising speed.

## PROPELLER SHAFT TRAILING (auxiliary yacht installations)

When oil operated reverse gears are used on auxiliary yacht installations care must be exercised when trailing the propeller with the engine or engines out of use.

On the NICOR TMP Type 12000 and the Self Changing Gears gearboxes, it is necessary to run the engine after trailing the propeller for 12 hours to lubricate the gearbox.

With the Borg Warner gearbox it is permissible to trail for 8 hours providing the following shaft speeds are not exceeded:

Direct Drive	1,500 rev/min
1.5	1,000 rev/min
1.9	790 rev/min
2.0	750 rev/min
2.1	715 rev/min
2.5	600 rev/min
2.9	520 rev/min
3.0	500 rev/min

Transmissions incorporating reduction gear must have means of stopping the transmission output shaft from prolonged or continuous freewheeling. This is because the engine, being stopped, does not drive the oil pump in the gearbox. The box therefore is not being properly lubricated.

Propeller shaft brakes are available and the boat builder or stern gear specialist should be contacted for further details.

The Parsons type "DA" gearbox may be trailed for any length of time provided the gearbox oil is maintained to the top dipstick mark.

#### CHECKING TAPPET CLEARANCES fig. 16(b)

##### P3.152 Engines

Turn crankshaft until No. 1 piston is on T.D.C. compression stroke (both valves fully closed).

Check and adjust clearances as necessary on Nos. 1, 2, 3 and 5 valves.

Turn crankshaft one revolution (360°) and repeat for Nos. 4 and 6 valves. Tappet clearances for both inlet and exhaust should be set to 0.012 in (0,30 mm) cold.

##### 4.107, 4.108 and 4.236 Engines

This is set between the top of the valve stem rocker and arm and should be 0.012 in (0,30 mm) cold.

When setting valve clearances the following procedure should be adopted:—

1. With the valves rocking on No. 4 cylinder (i.e. the period between the opening of the inlet valve and the closing of the exhaust valve), set the valve clearances on No. 1 cylinder.
2. With the valves rocking on No. 2 cylinder, set the valve clearances on No. 3 cylinder.
3. With the valves rocking on No. 1 cylinder, set the valve clearances on No. 4 cylinder.
4. With the valves rocking on No. 3 cylinder, set the valve clearances on No. 2 cylinder.

##### 6.354, H6.354, T6.354 and HT6.354 Engines

This is set between the top of the valve stem and rocker arm and should be 0.012 in (0,30 mm) cold.

When setting valve clearances the following procedure should be adopted:—

1. With the valves rocking on No. 6 cylinder (i.e. the period between the opening of the inlet valve and the closing of the exhaust valve), set the valve clearances on No. 1 cylinder.
2. With the valves rocking on No. 2 cylinder, set the valve clearances on No. 5 cylinder.
3. With the valves rocking on No. 4 cylinder, set the valve clearances on No. 3 cylinder.
4. With the valves rocking on No. 1 cylinder, set the valve clearances on No. 6 cylinder.
5. With the valves rocking on No. 5 cylinder, set the valve clearances on No. 2 cylinder.

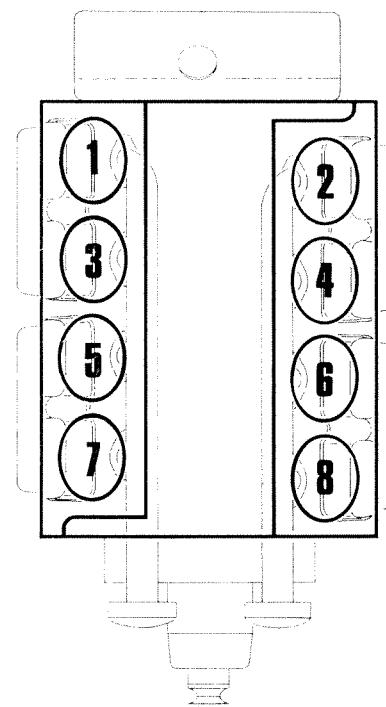


Fig. 16(a)

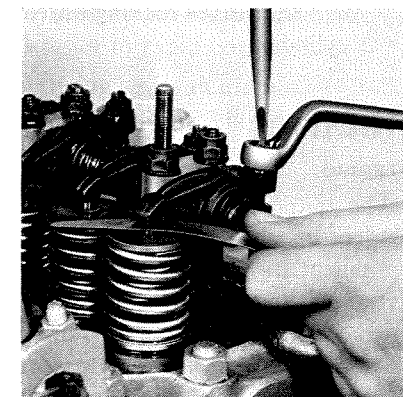


Fig. 16(b)

6. With the valve rocking on No. 3 cylinder, set the valve clearances on No. 4 cylinder.

**For contra-rotating engines** the engine should be turned against the normal direction of rotation i.e. clockwise, looking from the front.

### TV8.510 and V8.510 Engines

This is set between the top of the valve stem and rocker arm and should be 0.012 in (0,30 mm) cold.

When setting valve clearances the following procedure should be adopted:—  
Cylinder numbering as fig. 16(a).

#### Left Bank

1. With the valves rocking on No. 4 cylinder (i.e. the period between the opening of the inlet valve and the closing of the exhaust valve), set the valve clearances on No. 1 cylinder.
2. With the valves rocking on No. 6 cylinder, set the valve clearances on No. 7 cylinder.
3. With the valves rocking on No. 2 cylinder, set the valve clearances on No. 5 cylinder.
4. With the valves rocking on No. 8 cylinder, set the valve clearances on No. 3 cylinder.

#### Right Bank

1. With the valves rocking on No. 3 cylinder, set the valve clearances on No. 8 cylinder.
2. With the valves rocking on No. 1 cylinder, set the valve clearances on No. 4 cylinder.
3. With the valves rocking on No. 7 cylinder, set the valve clearances on No. 6 cylinder.
4. With the valves rocking on No. 5 cylinder, set the valve clearances on No. 2 cylinder.

## electrics

### Dynamo

The output of the dynamo is controlled by the regulator unit and is dependent on the state of charge of the battery and the loading of the electrical equipment in use. When the battery is in a low state of charge, the dynamo gives a high output, whereas if the battery is fully charged, the dynamo gives only sufficient output to keep the battery in good condition without any possibility of over-charging. An increase in output is given to balance the current taken by lamps and accessories when in use. The type can be found stamped on the dynamo body e.g. C40A.

### Alternator

The alternator has two parts, a stator and a rotor. When the rotor rotates inside the stator windings, alternating current (AC) is produced. This is unsuitable for charging the battery so a rectification unit comprising of diodes is built into the alternator. These are connected in such a manner that the alternator output is direct current (DC) when it is delivered to the battery. The alternator output is controlled by a fully transistorised regulator which requires no servicing and is non-repairable. The alternator type can be found stamped on the alternator body or identification plate e.g. AC5.

### Starter Motors

The starter motor is of a similar construction to the dynamo with the solenoid and main switch assemblies contained inside the drive end-shield. No maintenance is required between periodic overhaul (see page 36). The machine type is stamped on the body or identification plate e.g. CA45.

### Electronics Screening (radar etc.)

Many pieces of equipment on board generate interference signals and these are picked up by the radio receiver indiscriminately. It is therefore desirable to screen these signals if possible. Radio interference suppression is a very wide and variable subject and it is suggested that a specialist is contacted to advise on this sometimes difficult problem.

### Electrolytic Corrosion

This can occur when two dissimilar metals are brought together in the presence of sea water. Care is taken to avoid this in the design of the engine although different metals are necessary, but a brass or bronze pipe fitting attached to aluminium parts for example will result in rapid corrosion.

Particular care is necessary when installing an engine in an aluminium hull. Zinc anodes can be fitted to hulls where corrosion cannot be entirely avoided, and specialist firms will advise on the use of these.

Corrosion can also be caused by current leaking from the battery and other parts of the electrical system to the hull via the engine or metal fittings.

### Battery Maintenance

**WARNING.** Batteries under charge give off an **explosive** gas. Ensure therefore that the batteries are properly and securely sited with plenty of ventilation and have access for maintenance. Isolate battery when not in use (isolation switch) and maintain correct electrolyte level i.e. just above top of separators.

Keep battery clean and dry to avoid possible corrosion and current leakage.

Ensure connections are clean and tight and that cable size is adequate for the installation, to avoid overheating.

Any component that may cause arcing must not be fitted in the battery space.

## GENERAL PRECAUTIONS

When alternators are used in the charging circuit the following precautions must be taken:—

NEVER disconnect the battery or switch 'off' at the starter switch whilst the alternator is running. This will cause a voltage surge in the system damaging diodes and transistors.

NEVER disconnect any electrical lead without first stopping the alternator and turning all switches to the 'OFF' position. ALWAYS identify a lead to its correct terminal before disconnection. A short circuit or reversed polarity will destroy diodes and transistors.

NEVER connect a battery into the system without checking for correct polarity and correct voltage.

NEVER 'Flash' connections to check for current flow. No matter how brief the 'flash', the transistors may be destroyed.

NEVER experiment to try and adjust or repair the system unless you have had training on alternators and you have the correct test equipment and technical data.

NEVER earth the field circuit.

NEVER run the alternator on an open circuit.

NEVER attempt to polarize an alternator. When using a battery charger disconnect battery cables.

NEVER apply a battery voltage direct to the regulator or alternator field terminals as this will damage the transistors.

Disconnect the alternator terminals before carrying out any electrical welding on the boat as the intense magnetic field created by the 'make' and 'break' of the arc may cause damage to the diodes.

Do not check for continuity of the alternator or regulator with an insulation tester, such as a 'Wee Megger' etc.

Always disconnect the battery before connecting test instruments (except voltmeter) or before replacing any unit or wiring.

## fault finding chart

Fault	Possible Cause
Low cranking speed	1, 2, 3, 4.
Will not start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 31, 32, 33.
Difficult starting	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 29, 31, 32, 33.
Lack of power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33.
Misfiring	8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 25, 26, 28, 29, 30, 32.
Excessive fuel consumption	11, 13, 14, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33.
Black exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31, 32, 33.
Blue/white exhaust	4, 16, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56.
Low oil pressure	4, 36, 37, 38, 39, 40, 42, 43, 44, 58.
Knocking	9, 14, 16, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 59.
Erratic running	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 59.
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 48, 49.
High oil pressure	4, 38, 41.
Overheating	11, 13, 14, 16, 18, 19, 24, 25, 45, 47, 50, 51, 52, 53, 54, 57.
Excessive crankcase pressure	25, 31, 33, 34, 45, 55.
Poor compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 59.
Starts and stops	10, 11, 12.

## KEY TO FAULT FINDING CHART

- Battery capacity low.
- Bad electrical connections.
- Faulty starter motor.
- Incorrect grade of lubricating oil.
- Low cranking speed.
- Fuel tank empty.
- Faulty stop control operation.
- Blocked fuel feed pipe.
- Faulty fuel lift pump.
- Choked fuel filter.
- Restriction in air cleaner.
- Air in fuel system.
- Faulty fuel injection pump.
- Faulty atomisers or incorrect type.
- Incorrect use of cold start equipment.
- Faulty cold starting equipment.
- Broken fuel injection pump drive.
- Incorrect fuel pump timing.
- Incorrect valve timing.
- Poor compression.
- Blocked fuel tank vent.
- Incorrect type or grade of fuel.
- Sticking throttle or restricted movement.
- Exhaust pipe restriction.
- Cylinder head gasket leaking.
- Overheating.
- Cold running.
- Incorrect tappet adjustment.
- Sticking valves.

- Incorrect high pressure pipes.
- Worn cylinder bores.
- Pitted valves and seats.
- Broken, worn or sticking piston ring(s).
- Worn valve stems and guides.
- Overfull air cleaner or use of incorrect grade of oil.
- Worn or damaged bearings.
- Insufficient oil in sump.
- Inaccurate gauge.
- Oil pump worn.
- Pressure relief valve sticking open.
- Pressure relief valve sticking closed.
- Broken relief valve spring.
- Faulty suction pipe.
- Choked oil filter.
- Piston seizure/pick up.
- Incorrect piston height.
- Open circuit strainer or weed trap blocked.
- Faulty engine mounting (housing).
- Incorrectly aligned flywheel housing or flywheel
- Faulty thermostat.
- Restriction in water jacket.
- Loose water pump drive belts.
- Gearbox or engine oil cooler choked.
- Faulty water pump.
- Choked breather pipe.
- Damaged valve stem oil deflectors (if fitted).
- Coolant level too low.
- Blocked sump strainer.
- Broken valve spring.



## hints on running

If the engine stops the first thing to do is check that the fuel supply is ON. If the fuel valves or taps are open then check level in fuel tank. If the engine has been run until the fuel tank is completely empty there is a very good chance that there is a lot of dirt in the fuel lines. Change the fuel filter and having refuelled, bleed the system and re-start the engine.

If the engine slows down or loses power there could be something wrapped round the propeller. Always check this first. Check air intake for obstruction and engine compartment for good supply of air. The air intake mesh on turbo-charged engines may be clogged with foreign matter sucked from a dirty engine compartment or hose and clips may be loose, causing low boost and high exhaust temperatures.

If the engine coolant boils ease down the throttle and try to ascertain the cause. The first check here is at the sea cock to ensure adequate cooling water supply, if satisfactory, check raw water pump operation, perhaps the impeller has failed; if so, replace with the spare impeller which should **always** be carried as an on board spare.

Should one engine be shut down on a twin engined installation ensure that the propeller shaft of the shut down engine is braked so that the speeds given for the type of gearbox are not exceeded (see page 66).

If a serious leak occurs on a high pressure fuel pipe, disconnect and direct flow into a can or other receptacle and run on remaining cylinders. On NO account attempt to flatten the pipe as this will ruin the fuel injection pump. Leaks in low pressure fuel pipes can be temporarily repaired by the use of adhesive tape, hose and clips.

Auxiliary yacht installations may require the engine to be run while beating to windward. Under these conditions the boat may heel up to 30° without adverse effect on the lubrication system providing the boat is righted occasionally, in order to lubricate the valve gear.

Coolant leaks can normally be dealt with by adhesive tape, hose and clips.

If a serious oil leak occurs shut down the engine immediately and try to find the cause. Oil leaks are a lot harder to cure temporarily, because of the pressure involved. However if the main flow can be stemmed to a drip or dribble place a can underneath the leak and replenish the engine with new oil (from the spare oil can) at the same rate as the loss.

Drip trays of metal or glass fibre should be used beneath the engine to stop lubricating oil or fuel oil dripping into the bilges. Care must be taken to avoid galvanic action with the drip tray e.g. a copper tray should not be used under an aluminium alloy sump. Remember to keep the drip tray clean as this gives an early indication of leakages.

## ON BOARD TOOLS

An "on board" tool kit for engine work is available but the following tools are suggested to supplement the tool kit:—

- Hose clips, assorted.
- Hose, assorted (convoluted type useful).
- Wire (20 SWG).
- Insulating tape.
- Jointing compound.
- Magnet (keep away from compass).
- Mechanical fingers.
- Self-gripping wrench.
- Asbestos lagging.
- Low pressure fuel pipe olives.
- Small hacksaw with spare blade.
- Assorted files.

For some engines an on board spares kit can be purchased from your Perkins Marine Distributor.

## PERKINS U.K. AND OVERSEAS MARINE DISTRIBUTORS AND COMPANIES

This list is correct at the date of publication but is subject to alteration without notice.

### U.K. Perkins Marine Distributors

<b>BANFFSHIRE</b> Banff	AGRA MOTOR ENGINEERS Quayside. Tel. 2156.
<b>BRISTOL</b> Bristol BS3 4AY	INDUSTRIAL & MARINE ENGINEERING LTD. Whitehouse Street. Tel. 667571/2.
<b>DORSET</b> Poole BH14 8RN	E. GILLAM LTD. Pottery Road, Parkstone, Tel. Parkstone 4421/2.
<b>KENT</b> Ramsgate	WALKERS MARINE LTD. Royal Harbour. Tel. Thanet 51949 and 52176.
<b>LANARKSHIRE</b> Glasgow	MOODIE & CO. LTD. 27-29 Colston Road, Bishopbriggs. Tel. Bishopbriggs 1051/3 (STD 041-772)
<b>LANCASHIRE</b> Manchester 3	PIBROCH MOTORS LTD. 5 Cheetham Hill Road, Tel. 061-834 9345.

<b>LINCOLNSHIRE</b> Lincoln	C. W. GREEN & SONS (LINCOLN) LTD. Brayford North. Tel. 27313.
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