

# **Workshop manual**

**Group 21-26, 30**

|             |
|-------------|
| <b>A</b>    |
| <b>2(0)</b> |

**D1-13, D1-20, D1-30, D2-40**

# Group 21–26, 30

## Marine diesel engines

### D1-13 A, D1-20 A, D1-30 A, D2-40 A

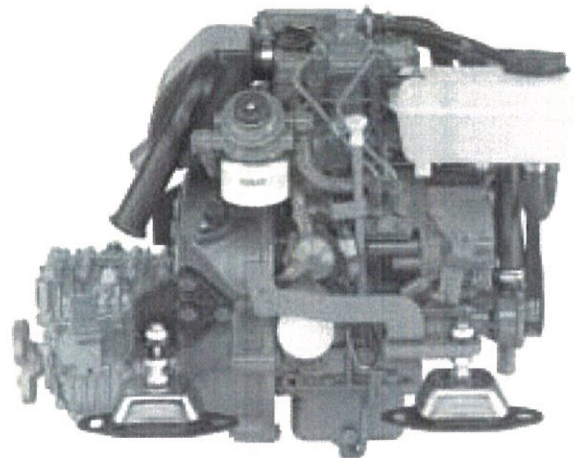
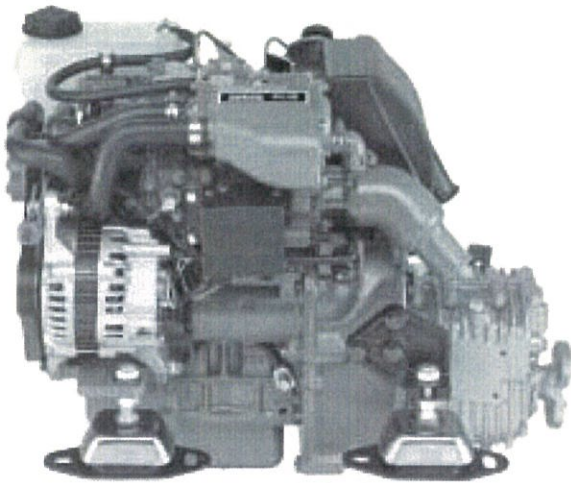
## Contents

|                                            |    |                                                            |       |
|--------------------------------------------|----|------------------------------------------------------------|-------|
| <b>Safety information</b> .....            | 3  | <b>Repair instructions</b>                                 |       |
| <b>General information</b> .....           | 6  | When working with chemicals, fuel and lubricating oil      | 29    |
| About this Workshop Manual .....           | 6  | Before working in a boat .....                             | 29    |
| Spare parts .....                          | 6  | Before lifting the engine .....                            | 29    |
| Certified engines .....                    | 6  | Condition test, engine .....                               | 30    |
| <b>Repair instructions</b> .....           | 7  | Compression test .....                                     | 30    |
| Our common responsibility .....            | 7  | Actions after lifting the engine .....                     | 30    |
| Torque .....                               | 7  | Cooling system, draining .....                             | 31    |
| Torque-angle tightening .....              | 8  | Engine oil, draining/changing .....                        | 31    |
| Lock nuts .....                            | 8  | Engine fixture, fixing .....                               | 32    |
| Strength classes .....                     | 8  |                                                            |       |
| Sealant .....                              | 8  |                                                            |       |
| Safety rules for fluorocarbon rubber ..... | 9  |                                                            |       |
|                                            |    | <b>Group 21 Short block</b>                                |       |
| <b>Special tools</b> .....                 | 10 | Short block, disassembly .....                             | 33    |
|                                            |    | <b>Inspection, component change, overhaul and</b>          |       |
| <b>Design and function</b>                 |    | <b>assembly of the short block engine</b> .....            | 37-53 |
| <b>Group 21 Short block</b>                |    | Inspecting the engine block .....                          | 37    |
| Engine, general .....                      | 12 | Inspecting the cylinder head .....                         | 38    |
| Engine block .....                         | 16 | Changing the valve seats .....                             | 38    |
| Cylinder head .....                        | 16 | Grinding of valve and valve seats .....                    | 39    |
| Crankshaft .....                           | 17 | Checking the valve guides .....                            | 40    |
| Timing gear .....                          | 18 | Renovating the rocker arm mechanism .....                  | 41    |
| Crankcase breather .....                   | 18 | Inspecting the crankshaft .....                            | 42    |
| <b>Group 22 Lubrication system</b>         |    | Inspection of the and crankshaft bushing and               |       |
| Lubrication oil system .....               | 19 | crankshaft journal .....                                   | 42    |
| Oil valves .....                           | 20 | Inspection of main and big end bearings. ....              | 42    |
| Oil pump .....                             | 20 | Checking the big end bearing clearance: .....              | 43    |
| Oil filter .....                           | 20 | Piston ring inspection and fits .....                      | 44    |
| <b>Group 23 Fuel system</b>                |    | Inspection and measurement of piston and cylinder          |       |
| Fuel system .....                          | 21 | bore. ....                                                 | 44    |
| Injection pump .....                       | 22 | Inspecting the con rod .....                               | 45    |
| Centrifugal regulator .....                | 22 | Changing the gudgeon pin bushing .....                     | 45    |
| Injectors .....                            | 22 | Assembling the piston, piston rings and con rod. ....      | 46    |
| Fuel filter .....                          | 23 | Camshafts and valve lifters, inspection .....              | 47    |
| Feed pump .....                            | 23 | Measuring the camshaft .....                               | 47    |
| <b>Group 26 Cooling system</b>             |    | Installing the crankshaft .....                            | 49    |
| Cooling system .....                       | 24 | Installing the piston in the cylinder and the oil pan .... | 50    |
| Thermostat .....                           | 25 | Installing the timing gear and injection pump .....        | 51    |
| Heat exchanger .....                       | 25 | Flank clearance, checking .....                            | 52    |
| Sea water pump .....                       | 25 | Measuring the piston height, installing the cylinder       |       |
| Coolant pump .....                         | 25 | head and other assembly .....                              | 53    |
| <b>Group 30 Electrical system</b>          |    |                                                            |       |
| Electrical system .....                    | 26 |                                                            |       |
| Alternator .....                           | 27 |                                                            |       |
| Starter motor .....                        | 27 |                                                            |       |
| Distribution box .....                     | 27 |                                                            |       |
| Electrical components .....                | 28 |                                                            |       |

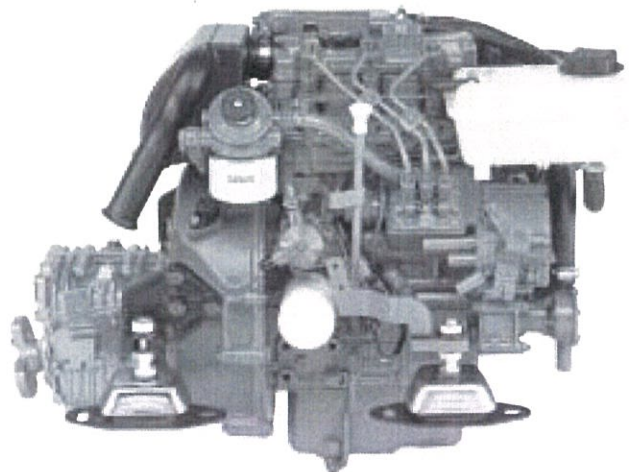
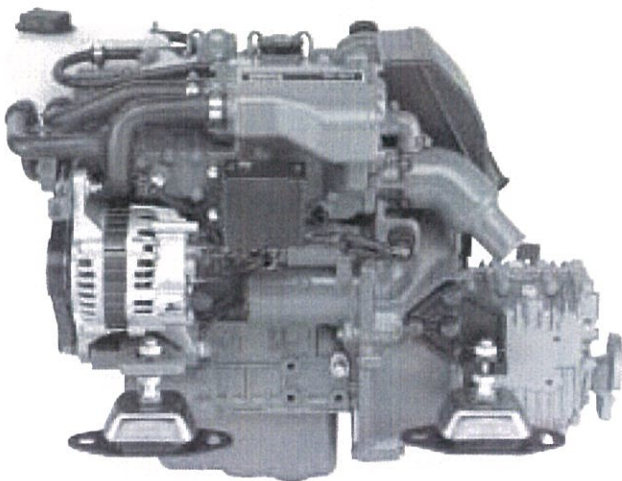
Continued on next page

## Table of contents

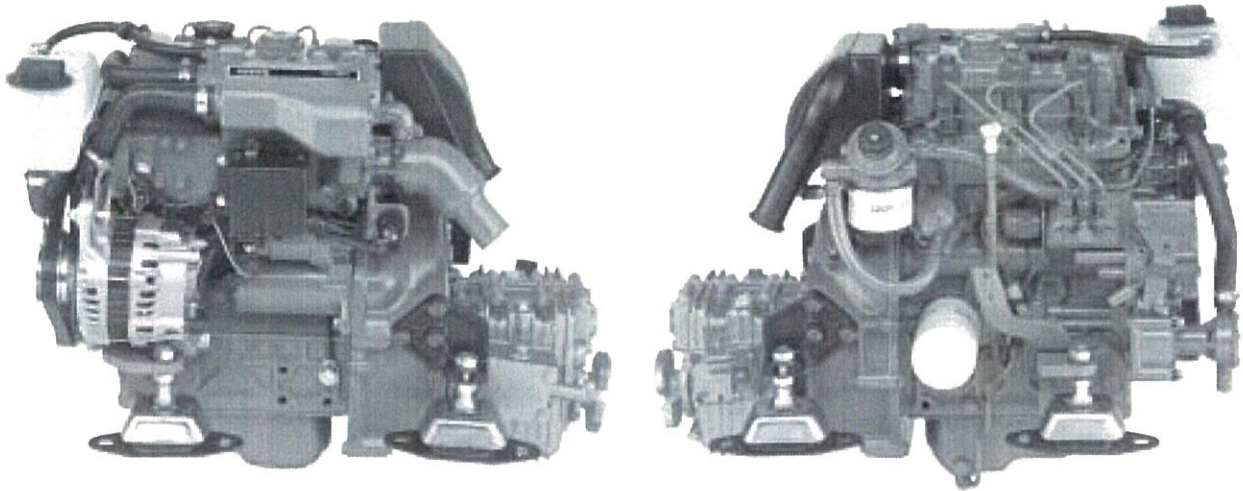
|                                      |    |                                                 |     |
|--------------------------------------|----|-------------------------------------------------|-----|
| Cylinder head, removal .....         | 56 | <b>Group 26 Cooling system</b>                  |     |
| Valves, removing .....               | 58 | Coolant .....                                   | 90  |
| Valves, installation .....           | 58 | Pressure valve in filler cap, checking .....    | 91  |
| Cylinder head, installation .....    | 59 | Fault causes, cooling system .....              | 91  |
| Timing gear, removing .....          | 61 | Thermostat, change .....                        | 92  |
| Timing gear, installation .....      | 64 | Heat exchanger, cleaning .....                  | 93  |
| Pistons, removal .....               | 67 | Heat exchanger/exhaust manifold, changing ..... | 94  |
| Big end bearing, change .....        | 68 | Seawater pump, impeller change .....            | 95  |
| Pistons, change .....                | 68 | Sea water pump, change .....                    | 96  |
| Pistons, installation .....          | 69 | Coolant pump, change .....                      | 97  |
| Crankshaft, remove .....             | 70 | <b>Group 30 Electrical system</b>               |     |
| Main bearings, change .....          | 71 | Alternator, changing .....                      | 98  |
| Crankshaft, assembly .....           | 73 | Starter motor, changing .....                   | 99  |
| Flywheel, change .....               | 74 | <b>Wiring diagram</b> .....                     | 100 |
| Crankcase seal rear, change .....    | 75 | <b>Technical data</b> .....                     | 103 |
| Crankshaft seal, front, change ..... | 76 | <b>References to Service Bulletins</b> .....    | 116 |
| Valves, adjustment .....             | 77 |                                                 |     |
| Drive belt, change .....             | 79 |                                                 |     |
| <b>Group 22 Lubrication system</b>   |    |                                                 |     |
| Oil pump bearing, changing .....     | 80 |                                                 |     |
| <b>Group 23 Fuel system</b>          |    |                                                 |     |
| Injection pump, changing .....       | 81 |                                                 |     |
| Injectors, changing .....            | 83 |                                                 |     |
| Injectors, testing .....             | 85 |                                                 |     |
| Injectors, check .....               | 85 |                                                 |     |
| Setting the engine speed .....       | 86 |                                                 |     |
| Feed pump, changing .....            | 87 |                                                 |     |
| Hand pump, changing .....            | 88 |                                                 |     |
| Fuel system, venting .....           | 89 |                                                 |     |



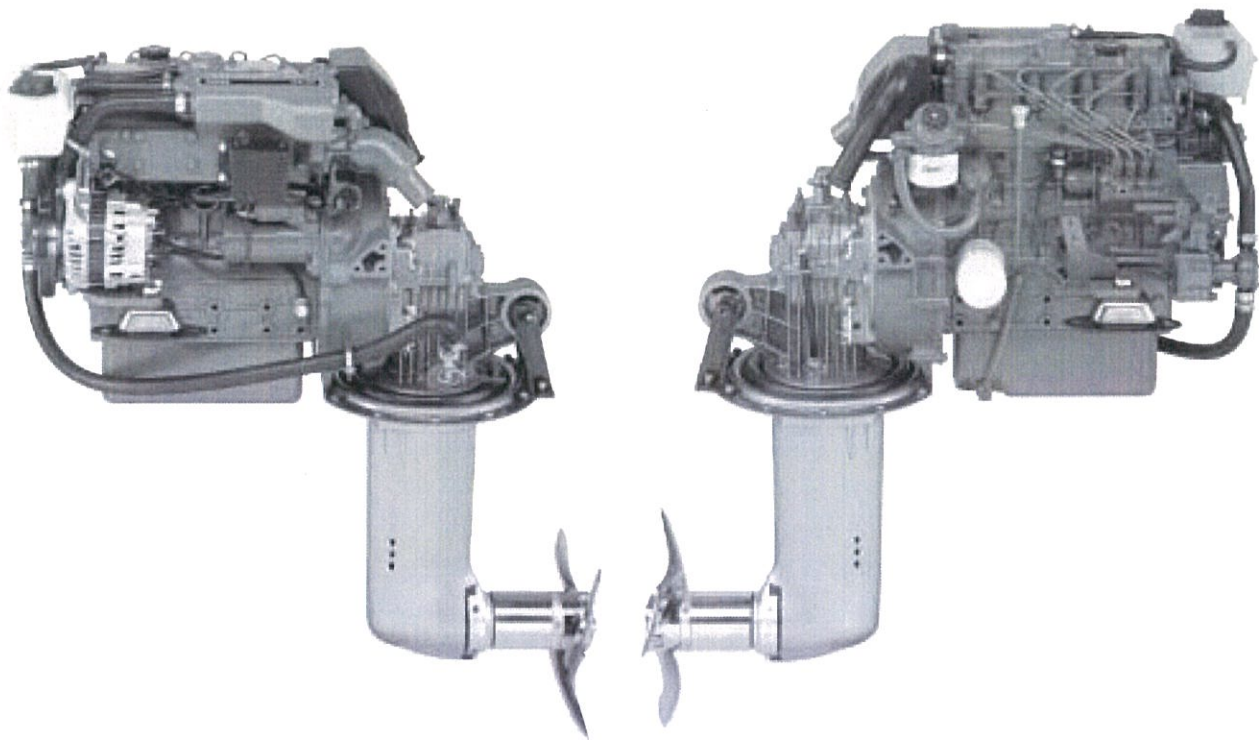
D1-13 A with MS10A reversing gear



D1-20 A with MS10A reversing gear



D1-30 A with MS15A reversing gear



D2-40 A with 130S sailboat drive

## Group 23 Fuel system

### Fuel system

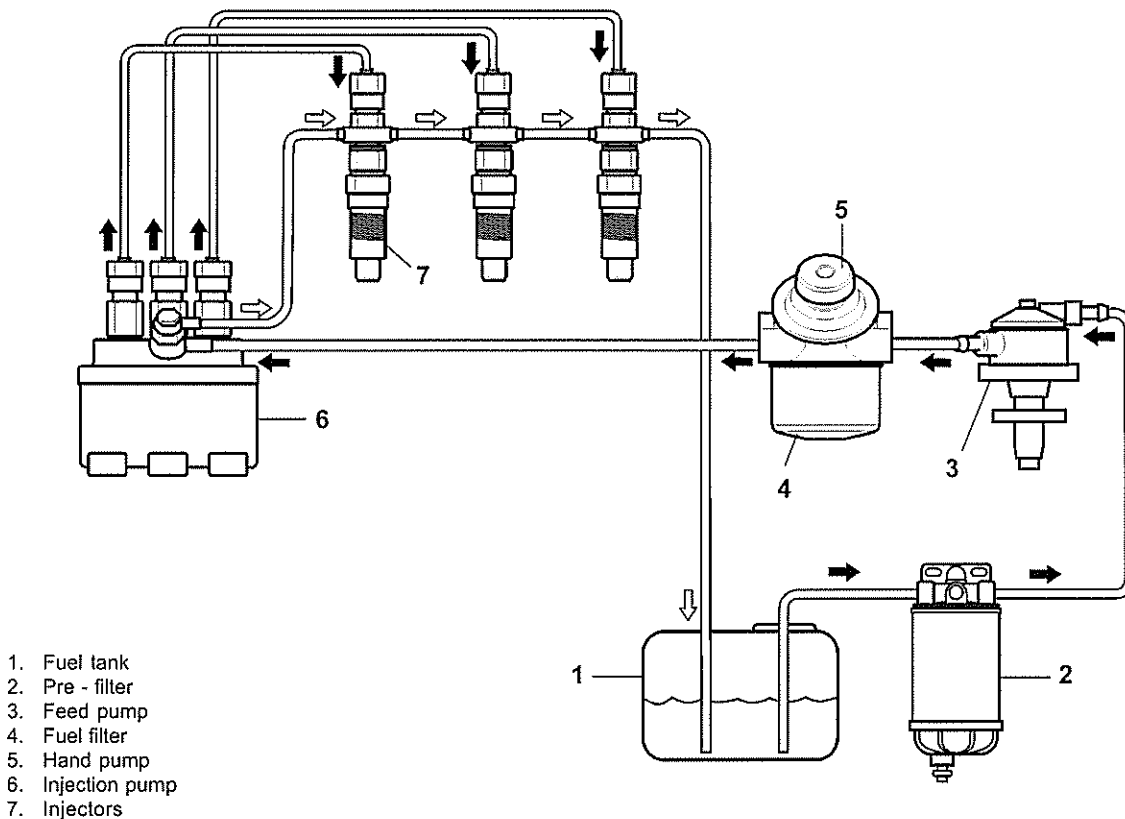
A mechanical feed pump sucks the fuel up from the fuel tank, possibly through a water separation filter (optional equipment), and the fuel is then forced through the secondary filter to the injection pump.

The injection pump, which is driven by the camshaft, then distributes fuel of specific quantity and timing to the injectors.

Fuel which returns from the injectors is returned to the base of the fuel tank. The air in the fuel system can be transported back to the fuel tank via a connection between the injection pump and the return fuel pipe.

The fuel is then forced through the injector nozzles into a pre-combustion chamber in the cylinder head at high pressure and then enters the combustion chambers in the pistons, where high speed air rotation contributes to even combustion. A glowplug in the pre-combustion chamber pre-heats the fuel mixture for cold starting.

The secondary filter in the engine removes contamination which might be left in the fuel, despite the primary filter.

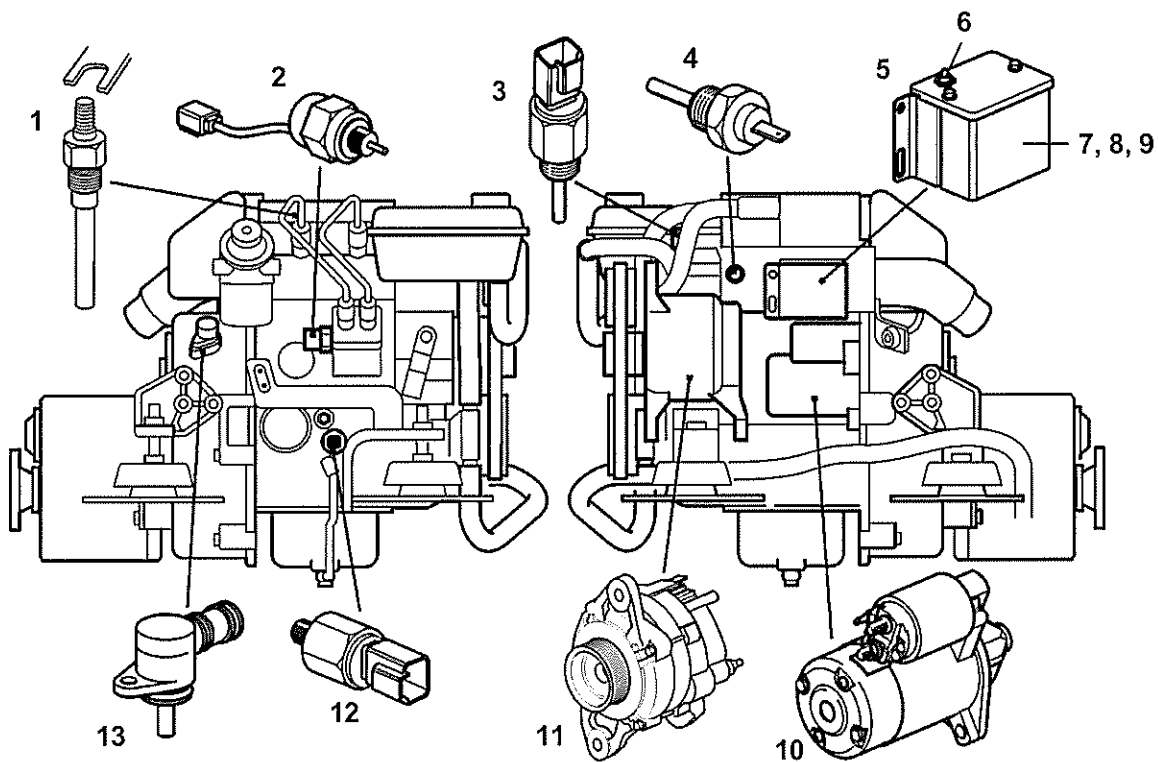


# Group 30 Electrical system

## General

The engines have an alternator which supplies electric current of 115 A. System voltage is 12 V and the electrical system is single-pole.

The electrical system contains sensors for monitoring the engine coolant temperature and oil pressure. A distribution box contains a circuit breaker, and there are two relays under the heat exchanger.



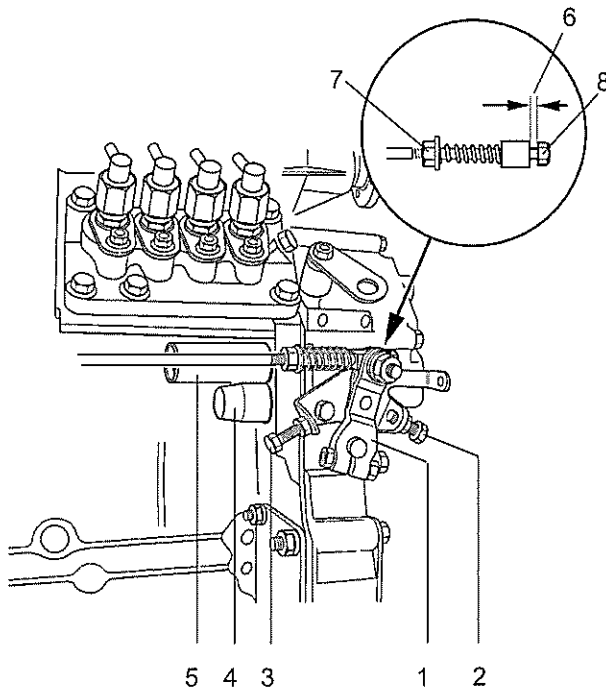
1. Glow plugs
2. Stop solenoid
3. Coolant temperature monitor
4. Coolant temperature sensor
5. Distribution box
6. Circuit breaker
7. Starter relay
8. Glowplug relay
9. Charge sensing resistor
10. Starter motor
11. Alternator
12. Oil pressure monitor
13. Engine speed sensor

## Setting the engine speed

Check that the accelerator control functions normally, i.e. the actuator arm (1) is pressed against the low idle stop (2) when the accelerator control is at idle, and is pressed against the full throttle screw (3) when the accelerator control is at full throttle. Adjust the control if necessary. Also check that the air filter is not blocked, and that the air inlet is not blocked.

**⚠ IMPORTANT!** The engine's fuel volume and speed are set at the factory to give highest power and least environmental impact. These settings must not be disturbed.

**NOTE!** Seals on injection equipment may only be broken by authorized personnel. Seals which have been broken must be re-sealed.



1. Actuator arm
2. Adjustment screw, low idle
3. Stop screw, full throttle
4. Adjustment screw, racing speed
5. Adjustment screw, max. fuel volume
7. Lock nut

### Low idle

1. Check that the gap (6) is about 3 mm when the accelerator is in the idle position. If necessary: Undo lock nut (7) and adjust screw (8) to give the correct gap.
2. Warm the engine up and check the idling speed with a tachometer (please refer to Technical data for correct idling speed).
3. Use adjustment screw (2) to adjust to give the correct idling speed.
4. Check the gap (3) again as in item 1.

### Racing speed (high idle)

Warm the engine up and check the racing speed with a workshop tachometer when the engine is unloaded at full throttle (please refer to "Technical data" for correct racing speed).

### Adjust the following as necessary

1. Loosen the stop screw (3) so that it does not limit the movement of the actuator arm (1).
2. Run the engine without load at full throttle and adjust the racing speed to the correct value with adjustment screw (4). Remember to seal the screw afterwards.
3. Adjust stop screw (3) to give a clearance of 0.1 mm between stop screw (3) and the actuator arm (1) when the throttle control is at the full throttle position.