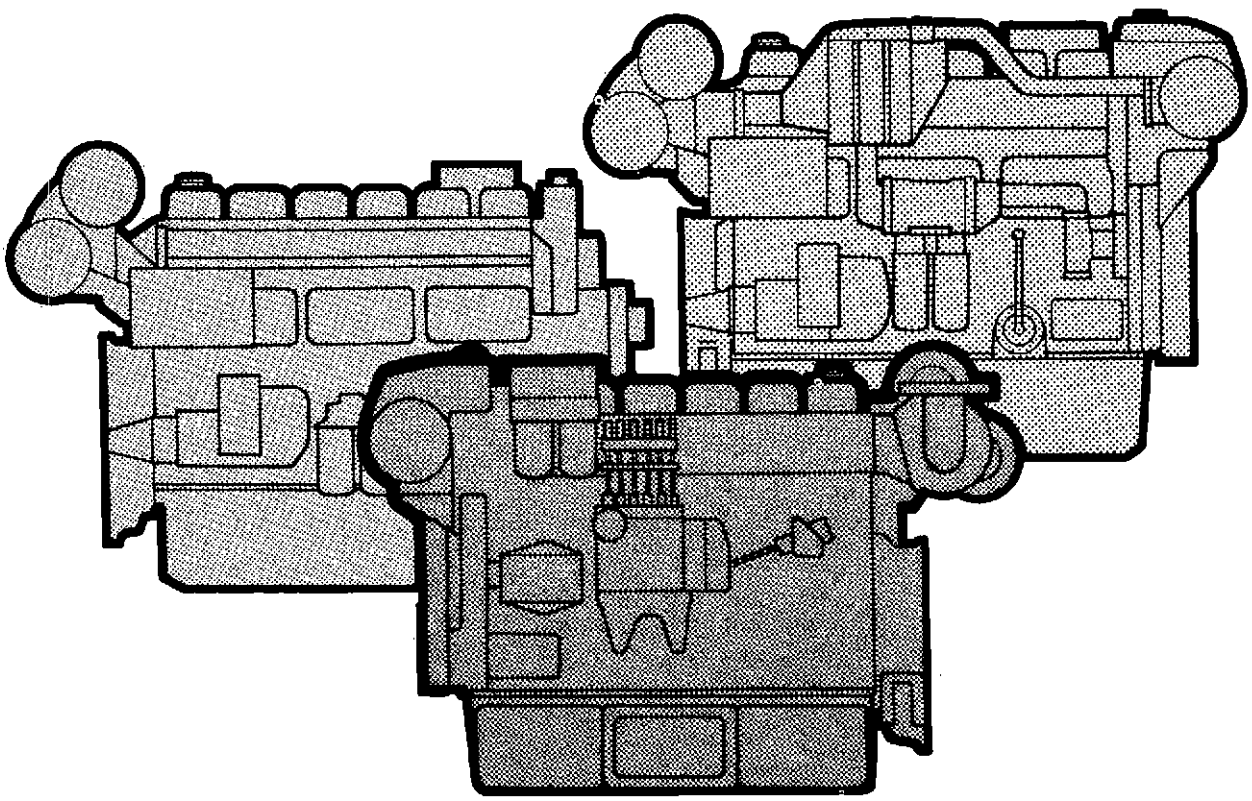
Publ. nr. 3975
6–1981

Workshop manual

Monitoring system – Function, Connection, Fault finding.

Engines for auxiliary and emergency sets.



D70CRC
TD70CRC

D100BRC
TD100ARC

TD120ARC

D70CHC
TD70CHC

D100BHC
TD100AHC

TD120AHC
TAD120BHC

VOLVO PENTA

Foreword

This manual deals with the function, connection and fault finding concerning monitoring systems of engines in the 70, 100 and 120 series for auxiliary and emergency sets. To provide general information a description has been included at the beginning of the book.

Note that this manual describes engines having all the monitoring components in accordance with completely classifiable versions. In the case of those engines fitted with only part of this equipment these instructions apply to the same restricted extent.

This description does not constitute a valid specification. Each individual engine is equipped in accordance with the agreement which applies to the delivery.

AB VOLVO PENTA
Technical Publications

Contents

VOLVO PENTA

SUPPLEMENT TO THE WORKSHOP MANUAL, PUBL. NO. 3975 ENG.

10-1983

AUXILIARY AND EMERGENCY SET ENGINES

TEMPERATURE SWITCHES

- For the alarm
- For the automatic stop

REVISED CHECKING INSTRUCTIONS

When checking the switches the following instructions must be followed. The recommendations issued earlier on pages 12 and 13 do not apply.

Temperature switches setting values	
Temperature switch for the lube oil alarm Marking: Green dot	The contacts shall open at 110°±2°C (230°±3.6°F)
Coolant temperature switch for alarm Marking: Blue dot	The contacts shall open at 88°±2°C (190°±3.6°F)
Coolant temperature switch for automatic stop Marking: Red dot	The contacts shall open at 92°±2°C (198°±3.6°F)

Checking

To be able to carry out a correct check of the switches it is important to keep as even temperature in the bath as possible. The bath must therefore be stirred by automatic driven stirrer or a pump. The volume of the bath should be about 10 ltr (2 Imp.gals/2 US gals). Glycol (anti-freeze) for cooling systems is a suitable fluid for the bath.

1. Immerse the temperature switch's sensor into the bath.
2. Heat the fluid to a temperature of about 5° below the temperature switch's nominal setting value (see the table) and maintain this temperature for 10-15 min.
3. Increase the temperature of the fluid slowly until the contacts change. Read off the temperature. The heating process should take 3-5 min.

NOTE! The tolerance of the temperature switch's setting value is ±2°C (±3.6°F). Remember that a thermometer usually reacts quicker than the temperature changes in a temperature switch.

If the setting is incorrect the temperature switch is to be replaced and returned to Volvo Penta. The adjusting screw's seal should not be broken.

Engines for auxiliary and emergency sets
DESCRIPTION

General

Engines intended for auxiliary or emergency sets (classifiable) are fitted with extensive electrical monitoring systems, according to the following description.

Engine type designation	Executions
D70CHC TD70CHC D100BHC TD100AHC TD120AHC TAD120BHC	**Auxiliary and emergency set engines with heat exchangers (in conformity with propeller engines)**
D70CRC TD70CRC D100BRC TD100ARC TD120ARC	**Auxiliary and emergency set engines without heat exchangers. Intended for radiator coolers, etc.**

Explanation of engine designations

T = Turbo-compressor (1st. letter of designation)

D = Diesel engine

70, 100 or 120 = Swept volumes (7, 10 or 12 litres)

A = Aftercooler – (2nd. letter of designatoin)

A, B and C = Series designations (placed after the volume figures)

R = Radiator

H = Heat exchanger

C = Classifiable (last letter of designation)

All engines are in-line six cylinder diesel engines of the direct injection type. For outputs, refer to sales literature and sales agreement for each engine.

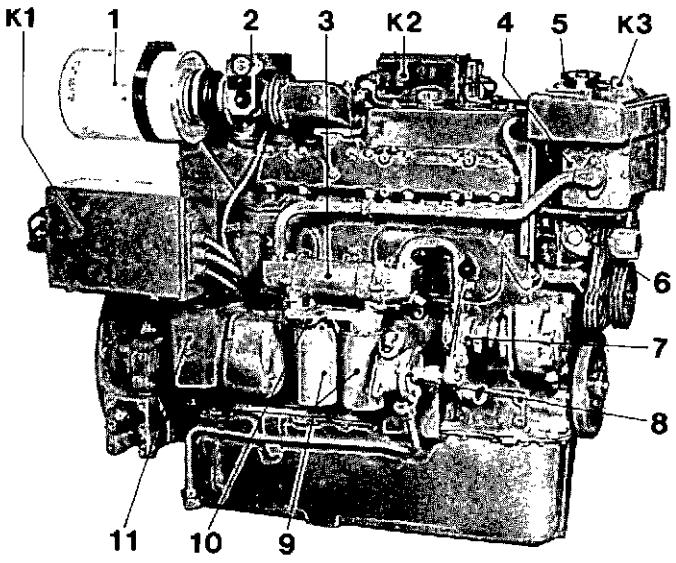


Fig. 1. D70CHC engine

K1. Electrical terminal (in protective box)
1. Air cleaner
2. Emergency stop (opt. equipment)
3. Oil cooler
K2. Switches and senders for the cooling system (in protective case)
4. Heat exchanger
5. Coolant cap
K3. Switch for coolant level (in protective case)
6. Coolant pump
7. Sea-water pump
8. Oil scavenger pump
9. Lubricating oil filters
10. Shift valve
11. Connections for starter motor, encased.

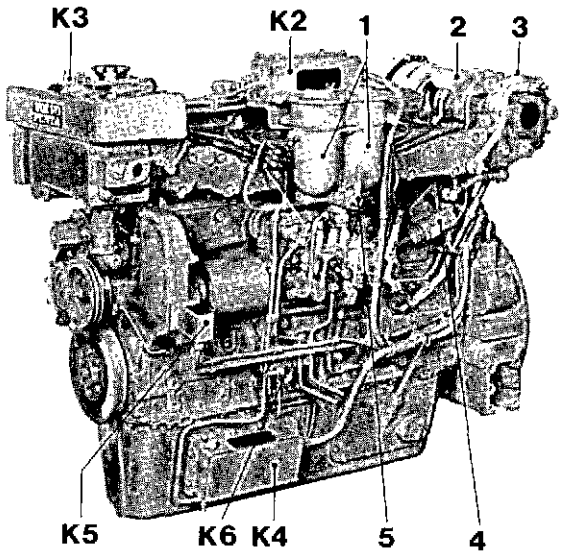


Fig. 2. TD70CHC engine

K3. Switch for coolant level (in protective case)
K2. Switches and senders for the cooling system (in protective case)
1. *Fuel fine filters*
2. Emergency stop (opt. equipment)
3. Turbo-compressor
4. Stop solenoid
5. Shift valve
K4. Switches and senders for lubricating and fuel systems (in protective case)
K5. Sender for engine revs. (in protective case)
K6. Connection for check pressure gauge (oil pressure)

The engines can be ordered from Volvo Penta with all the monitoring components required by the classification societies. Volvo Penta are responsible for the components which are factory-fitted to the engine in respect of these societies.

Monitoring system

The automatic system monitors engine speed, fuel, cooling and lubricating functions. The system comprises of a number of switches and senders which, in the event of abnormal conditions, connects, via an electrical system containing printed circuit boards etc, with alarms or stopping devices. Automatic start can also be connected.

The checking and alarm functions can be installed in such a manner that they can be read off from the bridge or control station. Alarm panels are not, however, supplied by Volvo Penta.

Engines which are completely classifiable are provided with all the monitoring components, described in the following text, at the factory. Other engines have a limited amount of equipment.

This book describes all components, but in the case of those engines fitted with only part of the monitoring system these instructions apply to the same limited extent.

This description does not constitute any specification. Each engine is equipped and adjusted in accordance with the agreement applying to delivery.

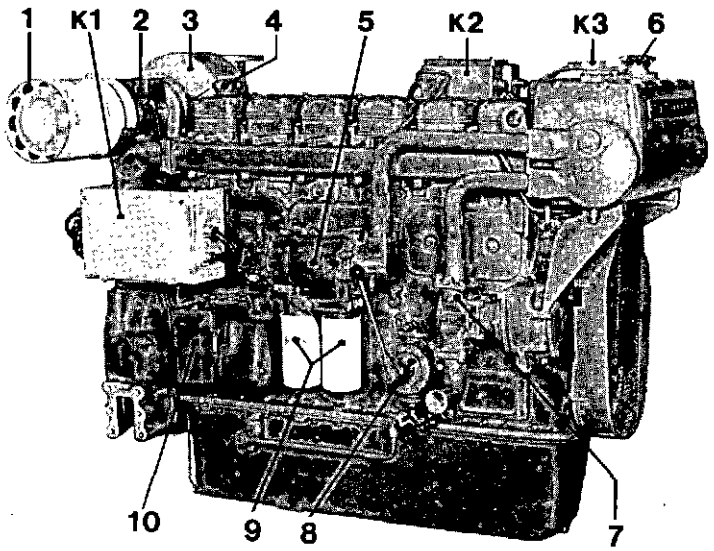


Fig. 3. TD100AHC

1. Air cleaner
K1. Electrical terminal (in protective box)
2. Emergency stop (opt. equipment)
3. Turbo-compressor
4. Oil filler cap
5. Oil cooler
K2. Switches and senders for the cooling system (in protective case)
K3. Switch for coolant level (in protective case)
6. Coolant cap
7. Sea-water pump
8. Oil scavenger pump
9. Oil filters
10. Starter motor connections, encased.

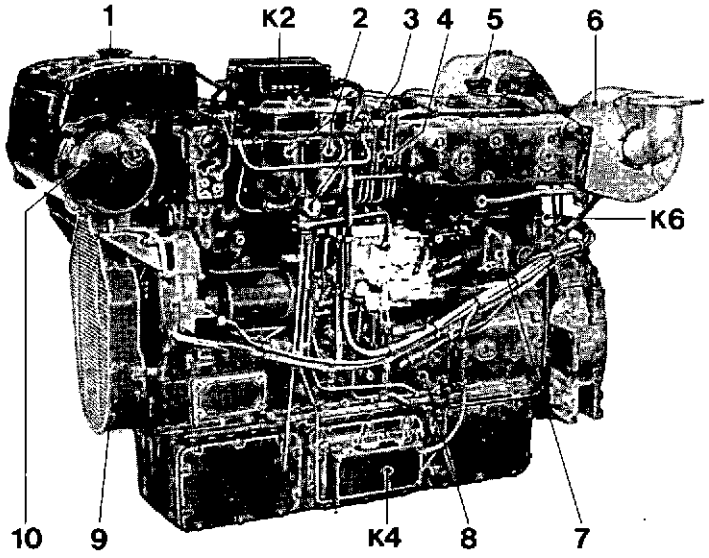


Fig. 4. TD120AHC engines

1. Coolant cap
K2. Switches and senders for the cooling system (in protective case)
2. Fuel fine filters
3. Shift valve
4. Sheathed delivery pipes (opt. equipment)
5. Oil filler cap
6. Turbo-compressor
K6. Connection for check pressure gauge (oil pressure)
7. Stop solenoid
8. Oil dipstick
K4. Switches and senders for lubricating and fuel system (in protective case)
9. Safety guard
10. Heat exchanger

Switches and senders

A switch closes (or breaks) a circuit at a definite pre-set value, whilst a sender provides continuously variable indication of pressure or temperature.

The switches for abnormally high cooling water temperature and fresh-water circulation as well as the temperature sender are grouped together in a splash-proof case (K2) located above the front section of the water-cooled exhaust manifold. The cooling water is fed from the warmest part of the engine through a duct in the case, to the suction side of the cooling water pump.

The switches and senders sense the temperature of the water which flows through the duct. If the cooling water stops circulating due to broken belts for example, or the failure of the fresh-water pump, the temperature switch is normally unable to react in time. For this reason a circulation switch has been included in the monitoring system.

A level switch is fitted in the heat exchanger expansion tank.

The switches for low lubricating oil pressure, high lubricating oil temperature as well as fuel leakage are gathered together in another splash-proof case (K4.) built into one of the lubricating oil sump inspection covers. A pressure gauge can be connected via a three-way cock (fig. 14) to check the setting pressure of the pressure switches for the lubricating oil pressure.

Overrun monitor. Emergency stop (optional equipment)

If the engine speed rises to more than 15 % above the nominal highest speed a stop device is engaged. The impulse comes from the speed monitor (overrun monitor) which is fed by the speed sender.

The separate emergency stop which is fitted in the inlet pipe can be used independently of the normal stop device. When this stop is engaged it cuts off the supply of air to the engine, whereupon the engine stops due to lack of oxygen. This emergency stop can be actuated by hand directly from the engine room or by remote control from the control station.

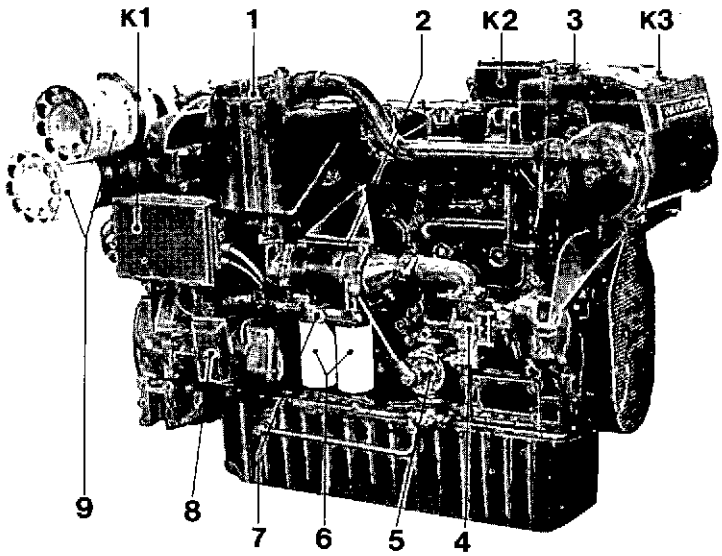


Fig. 5. TAD120BHC engine

K1. Electrical terminal (in protective box)
1. Aftercooler (for intake air)
2. Oil cooler
K2. Switches and senders for the cooling system (in protective case)
3. Coolant cap
K3. Switch for coolant level (in protective case)
4. Sea-water pump
5. Oil scavenger pump
6. Oil filters
7. Shift valve
8. Starter motor connections, encased
9. Air cleaners (two)

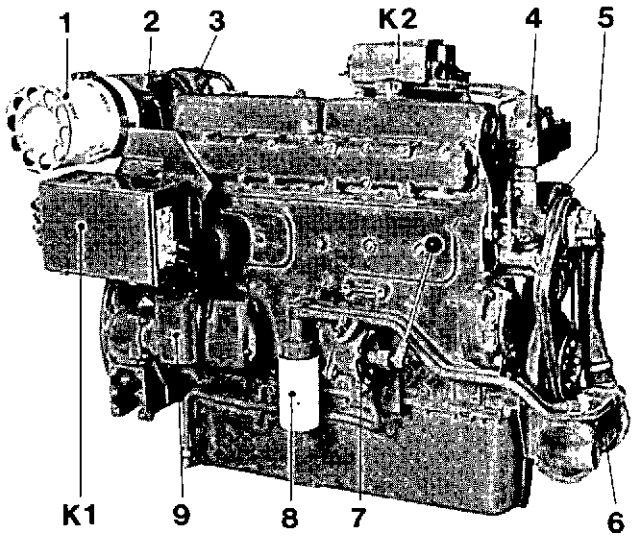


Fig. 6. TD70CRC engine

1. Air cleaner
2. Emergency stop (opt. equipment)
3. Turbocompressor

K2. Switches and senders for the cooling system (in protective case)

4. Thermostat housing with pipe for departing cooling water
5. Coolant pump
6. Engine oil cooler
7. Oil scavenger pump
8. Oil filter
9. Starter motor connections, encased

K1. Electrical terminal (in protective box)

The emergency stop is actuated automatically in cases where the speed monitor comes into operation in the event of excessively high engine speed.

The speed monitor also controls the blocking of the switches for low oil pressure and circulation in the fresh-water system.

Exhaust temperature sender (not Volvo Penta equipment)

An exhaust temperature sender can be connected to the engine's exhaust system. The sender indicates the exhaust gas temperature and provides an impulse that triggers an alarm if the exhaust temperature becomes too high. The sender is also used to provide continuous exhaust temperature information to an exhaust temperature gauge.

Starter motor blocking

The speed monitor which monitors the engine speed is also used to block the electrical starter motor, when the diesel engine is operating.

Battery controls

The battery controls provide impulses to an alarm when the starter batteries are insufficiently charged. The controls are blocked when starting the engine.

Electrical terminal

All control, alarm and stop impulses are forwarded to an electrical terminal (K1). It is placed in a splashproof case above the electrical starter motor. The terminal box comprises a circuit board with an electronic control unit (engine speed monitor), a starter battery control, diodes, relays and terminals. The relays, engine speed monitor and start battery control are of the plug-in type. All relays are of identical type which simplifies trouble shooting and repairs. The terminals in the lower section of the terminal box are intended for the connection of alarm panel, start, stop and control currents.

If the automatic stop is triggered due to an engine fault a secondary fault impulse can occur. For example, if the engine is stopped because of overspeed, an oil pressure fault indicates once the engine has stopped. Such secondary fault impulses are automatically blocked in the electrical terminal.

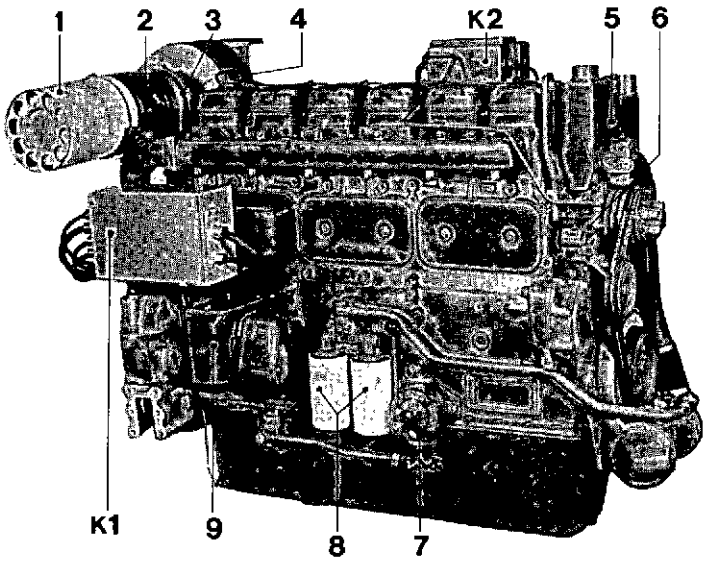


Fig. 7. TD100ARC engine

1. Air cleaner
2. Emergency stop (opt. equipment)
3. Turbo-compressor
4. Oil filler cap

K2. Switches and senders for the cooling system (in protective case)

5. Thermostat housing
6. Coolant pump
7. Oil scavenger pump
8. Oil filter
9. Starter motor connections, encased

K1. Electrical terminal (in protective case)

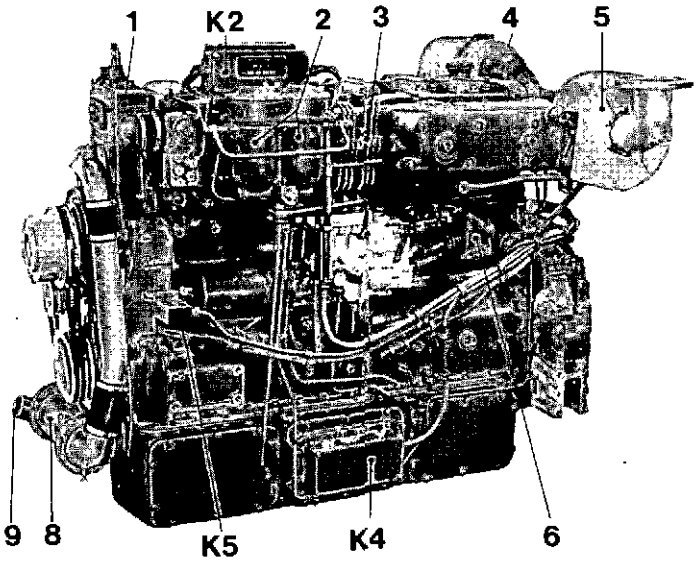


Fig. 8. TD120ARC engine

1. Thermostat housing
K2. Switches and senders for the cooling system (in protective case)
2. Fuel fine filters
3. Sheathed delivery pipes (opt. equipment)
4. Air cleaner
5. Turbo-compressor
6. Stop solenoid
K4. Switches and senders for lubricating and fuel system (in protective case)
K5. Sender for engine revs (in protective case)
8. Engine oil cooler
9. Pipe connection for incoming water

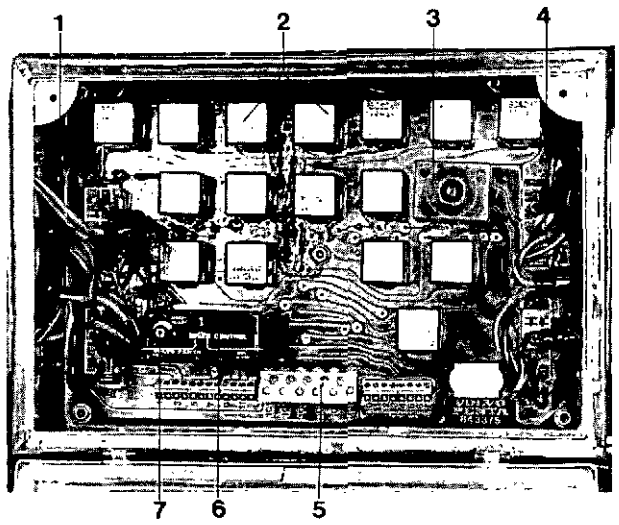


Fig. 9. Electrical terminal box (K1) with cover folded down. See also fig. 21.

1. Cables from engine
2. Relays (all identical and with switching function)
3. Voltage monitor (T)
4. Cables from engine
5. Terminal block
6. Speed monitor (S)
7. Adjuster screw

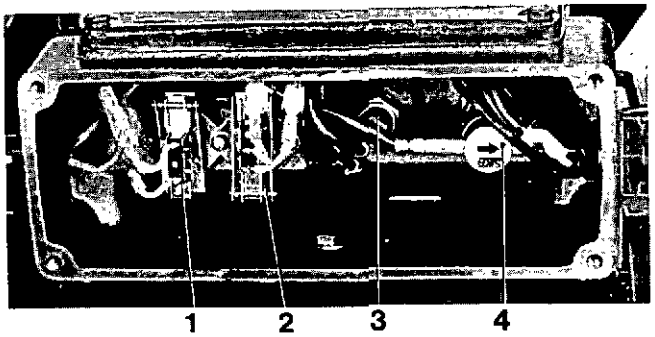


Fig. 10. Protective case (K2) for cooling system switches and senders (cover removed)

1. Temperature switch (for alarm)
2. Temperature switch, automatic stop
3. Sender for temperature gauge
4. Circulation switch (103L) (for alarm)

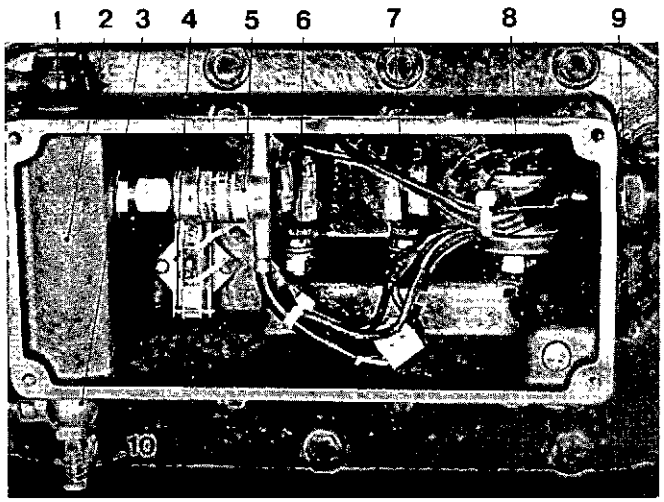


Fig. 11. Protective case (K4) for senders and switches in the lubricating and fuel systems.

1. Leak line, departing fuel
2. Float housing
3. Inlet, leakage line
4. Temperature switch, lubricating oil (50L) alarm
5. Leakage switch, fuel (46L/B) alarm
6. Pressure switch (14L) for oil pressure (alarm)
7. Pressure switch (14S) for oil pressure (automatic stop)
8. Oil pressure sender (10)
9. Oil pressure inlet pipe
10. Drainage valve for float housing.

In certain cases the emergency set is also used as a port set. **Unlike the port set the emergency set must not be stopped automatically** in the event of faulty operating comprising excessively high temperature or excessively low oil pressure (only the alarm should be triggered). For this reason the electrical terminal is so constructed as to allow changing between these two modes of operation. See page 9, "Automatic starting and stopping".

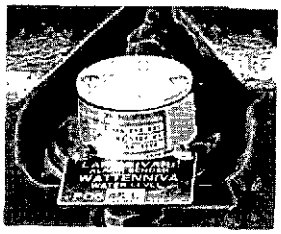


Fig. 12. Level switch (K3) for coolant

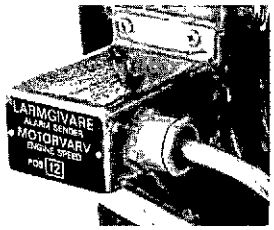


Fig. 13. Sender (K5), engine speed (12)

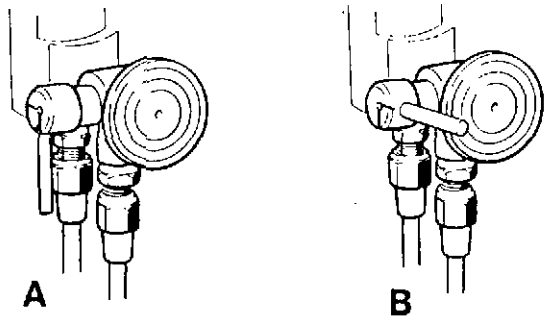


Fig. 14. Cock (K6) for checking the oil pressure switches

A. Normal operating position, lever downwards
B. The pressure switches can be checked in this position. The pressure connection and pressure gauge are connected to the plate during checking. *For setting pressure, see page 19.*

Instruments

The engines are supplied in a number of different variants and are intended for electrical connection to the alarm and control system used by the customer.

The instrumentation which can be supplied with the engine from Volvo Penta comprises only the most important instruments for the operation of the engine, i.e.:

Electrical tachometer (rev. counter)
Electrical temperature gauge for cooling system
Electrical oil pressure gauge

The instruments are connected as shown in the wiring diagram at the end of the book.

The normal engine operating temperature (for the cooling system) should be 65–90°C (149–194°F). The alarm is triggered if the temperature exceeds the set value. The oil pressure during operation should be 3–5 kp/cm^2 (43–71 p.s.i.). The alarm is triggered if the pressure falls below the set value. See page 19 for setting.

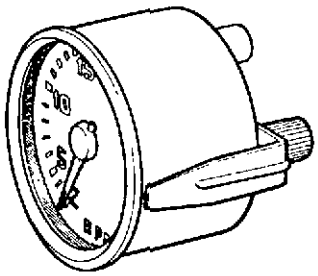


Fig. 15.

Electrical tachometer (rev. counter).

Installation diameter = 80 mm (3.15")

Measurement range 200–3000 r/min

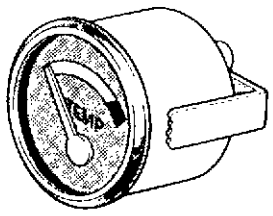


Fig. 16.

Electrical temperature gauge for cooling system.
Installation diameter = 52 mm (2.05")

Measurement range
40–50°C (104–122°F) = white area
50–100°C (122–212°F) = green area
90–120°C (194–248°F) = red area

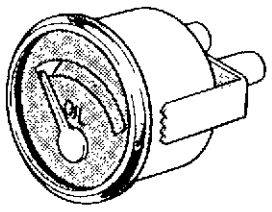


Fig. 17.

Electrial oil pressure gauge.
Installation diameter = 52 mm (2.05")

Measurement range 0–1.5 kp/cm^2 (0–21 p.s.i.) = red area
1.5–5 kp/cm^2 (21–71 p.s.i.) = green area

STOPPING DEVICES

Stopping normally

When stopping normally, the stop solenoid is engaged (17 in wiring diagram) whereby the injection pump control rod is moved to zero feed, thus causing the engine to stop due to lack of fuel supply.

Emergency stop

When the emergency stop is engaged, electrically or mechanically, the air supply is cut off by means of a flap in the emergency stop housing. The engine stops thereafter due to oxygen starvation.

The emergency stop can be engaged automatically if an impulse is released from the engine speed monitor.

Before starting the emergency stop must be re-set to the normal running position. This is done by pushing the lever (2) to the OPEN position. The flap is held in the open position by means of a catch.

If the emergency stop has been engaged electrically or automatically (via the overrun monitor) the key switch or equivalent must first be re-set (switched off and on again).

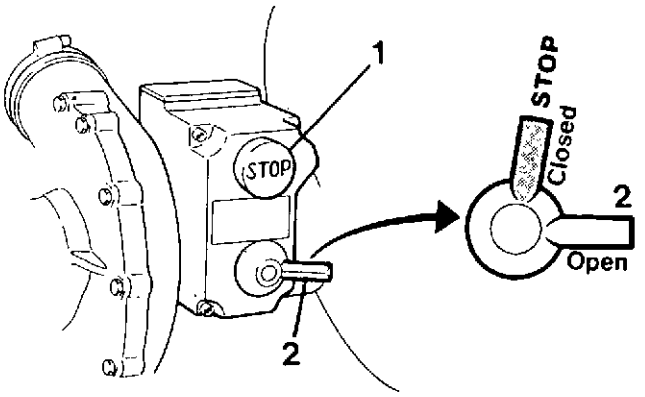


Fig. 18. Emergency stop on engine

To engage, press "STOP" button (1).

To disengage, turn the lever (2) to the operating position "OPEN" (from the "CLOSED" stopping position).

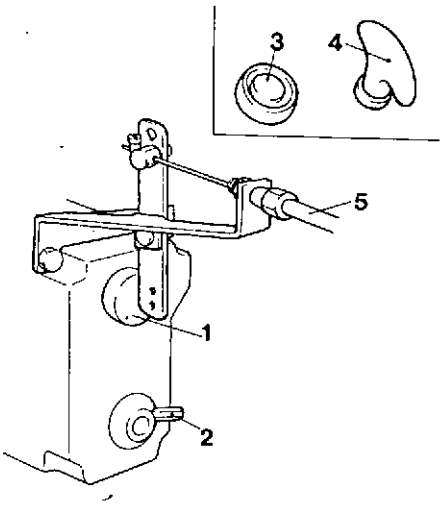


Fig. 19. Remote control for emergency stop (opt. equipment)

1. Stop button
2. Lever for disengaging the emergency stop, turn to the "Open" position
3. Stop button for electrical engagement of emergency stop from the control panel
4. Pull control for engaging the emergency stop from the control panel
5. Cable for connecting to control (4)

ELECTRICAL SYSTEM

Connection principles

Switches and senders for cooling, lubricating and fuel systems, fitted in splash-proof cases and the speed monitoring components are shown on pages 5 and 6.

The electrical system connection principles are shown in figure 20. The underlined figures refer to components and 15L thus means "Temp switch, cooling water, alarm".

The ringed figures refer to the number which is marked on the particular cable and the vertical group of figures (not marked on the cable) indicates where the cable is to be connected to. For example the figure (2) for the cable which connects from the temperature switch to the terminal 206 and I indicates that the cable connects to group I in the electrical terminal box. The terminal numbers for the groups I, II, III and IV are not marked in the terminal box, it is therefore necessary to refer to the wiring diagram.

The terminals for the cables which are to be connected to the alarm panel, control and instrument circuits are situated in the lower edge of the terminal box, see fig. 21.

Detailed wiring diagrams are to be found at the end of this book.

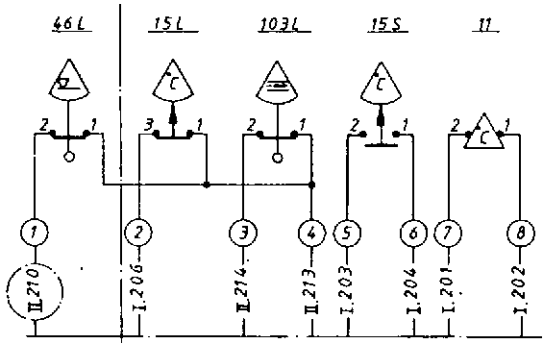


Fig. 20. Part of the wiring diagram

Number (underlined)	Refers to
46L	LEVEL SWITCH, ALARM
15L	TEMP. SWITCH, COOLING WATER, ALARM
103L	CIRCULATION SWITCH, COOLING WATER, ALARM
15S	TEMP. SWITCH, COOLING WATER, STOP
11	TEMP. SENDER, COOLING WATER

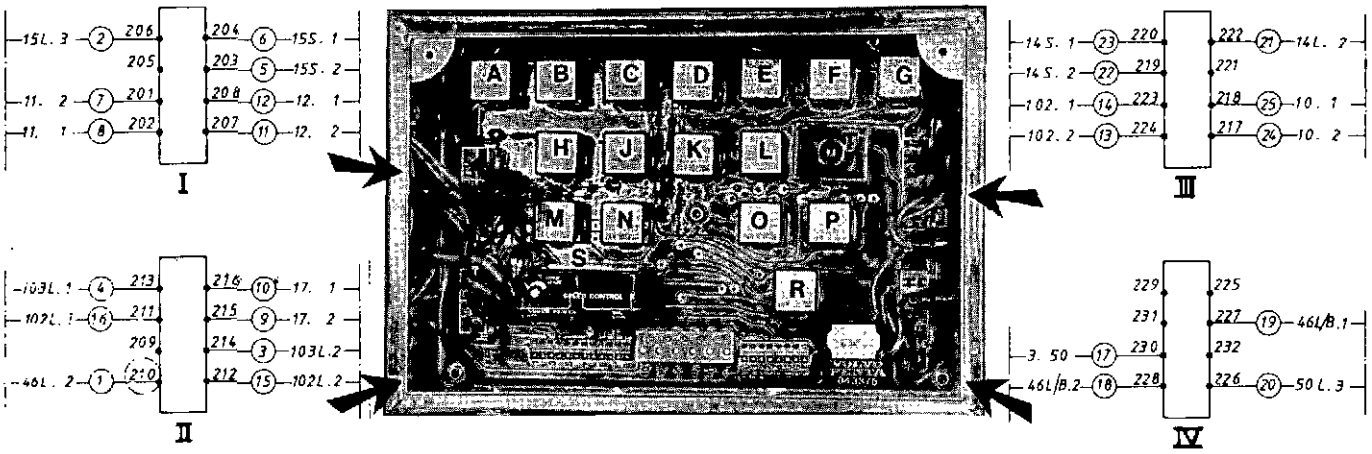


Fig. 21. Electrical terminal box (K1).
Terminals 1 to 12 and 100–116 are situated in the lower section.

The cables from the engine are connected to group I and II according to the partial diagram shown above. The terminal numbers are not shown on the printed circuit in the terminal box. Only the group numbers are marked.

A. Blocking relay
B. Blocking relay
C. Blocking relay
D. Blocking relay
E. Alarm start fault
F. Alarm low voltage
G. Stop relay
H. Alarm overrun
J. Alarm autostop
K. Blocking relay-alarm
L. Blocking relay-alarm
M. Emergency stop relay
N. Blocking relay, autostop
O. Blocking relay
P. Stop relay
R. Start relay
S. Speed monitor
T. Voltage monitor, start battery

The cables from the engine are connected to group III and IV according to the partial diagram shown above. The terminal numbers are not shown on the printed circuit in the terminal box. Only the group numbers are marked.

Connection of alarm panels, control and instrument circuits to the electrical terminal box

Terminals 1 to 12 and 100 to 116 should be connected according to the table shown below.

Terminal no.		Intended for	Terminal no.	Intended for
1		Alarm impulses (+) Connection to battery (+)	100	Current (+) for stop solenoids (Fuse 8A delayed)
2	Alarm impulses 2 to 12	Engine has not started	101	Control current (+) for relays (Fuse 8A)
3		Low battery voltage	102	Control current (+) for starter motor (Fuse 8A)
4		Insufficient coolant	103	Impulse, manually controlled or automatic start
5		Emergency stop engaged	104	Control current (–) for relays and stop solenoids (Fuse 8A)
6		Interuption in coolant circulation	105	Control current (–) for starter motor (Fuse 8A)
7		High coolant temperature	110	Impulse for manually controlled or automatic stop + (Max 1A)
8		Low lubricating oil pressure	111	Oil pressure (to gauge)
9		Excessive engine speed	112	Coolant temperature (to gauge)
10		Automatic stop engaged	113	To lamp ("Engine ready to start") (Max 5W)
11		Delivery pipe breakage (fuel leakage)	114	To emergency stop switch (+) max 0.5A
12		Excessive lubricating oil temperature	115	To lamp ("Engine running") Max 5W
			116	To switch for blocking of the automatic stop.

Battery cables

In order to avoid abnormal drops in voltage in the cables it is important to select cables between the starter motor and the battery which have a sufficiently large cross-section. Cables with insufficient cross-section cause a high drop in voltage resulting in poor starter motor output. The electrical system for all engines is 2-pole which is why positive and negative cables have the same length and cross-section. With cable lengths of 4.5, 6 and 7 metres it is advisable to install double cables as shown in the table, for both positive and negative cables, since it is difficult to handle single cables of large cross-section.

Battery cables. Area

Greatest cable length, metres	2	3	4	4.5	6	7
Smallest cross-section, mm^2	70	95	120	2x70	2x95	2x120

Using the system

For simplification, when seeking components, the wiring diagram has been divided up into a co-ordinate system. Fold out the diagram at the back of the book. After the component designation, in the text below, is a designation indicating the co-ordinate square in which the component is to be found. For example the cooling water temperature switch 15S (H5). This is found by looking for the letter H along the lower or the upper edge of the wiring diagram and then by following up (or down) until the figure 5 is found at the right or left hand edge.

General

The system voltage is 24V D.C. The wiring diagram is at the back of the book.

Remember!

The control current must never be allowed to exceed 8A. The relays and other components in the control circuit will be damaged if loaded with a current exceeding 8A, which results in extensive and unnecessary repair costs.

The control current for relays (8A fuse) connects with positive (+) to terminal 101 and negative (–) to terminal 104 (**E1** and **E2**). The current for stop solenoids, 8A fuse (delayed) connects with positive (+) to terminal 100 (**E2**). Negative (–) connects to terminal 104 (**E2**). The alarm system connects with positive (+) to terminal 1 (**E8**) and the respective alarm functions to terminal 2–12 (**E6–8**).

If an electric starter motor is used the start battery connects to the respective positive (+) and negative (–) connections on the starter motor (**H1**). The starter motor control circuit connects to the start battery via an 8A fused positive cable (+) to terminal 102 (**F1**) and negative (–) to terminal 105 (**G1**). For dimensions of starter battery cables, see page 8.

This system permits the connection to one, two or three alternative sources of current.

All relays are drawn in the no-current condition.

All switches (**H4 to H8**) are drawn in the normal position when the engine is running, i.e. switches which are drawn closed, open in the event of a fault and switches which are drawn open, close in the event of a fault.

An arrow indicates that switching occurs when the set values are exceeded and a ring means that switching occurs when the actual value falls below the set value. The oil pressure switch 14L (**H6**) has a ring below the symbol and thus switches when the actual value falls below the set value. The oil temperature switch 50L (**H8**) has, on the other hand, an arrow mark which means that switching occurs when the set value is exceeded.

Starting the engine

A. Manually controlled start

1. The start impulse (0.5 Amp) connects to the terminal 103 (**E6**). Whereupon the contact R (**F2**) switches and supplies the start impulse to the starter motor at the same time as the voltage monitor T (**F2**) disconnects and blocks the alarm for low voltage across the switch F (**F8**).
2. Since the engine has no oil pressure or cooling water flow when stationary, it is necessary to block the relevant switches. This is achieved by the opening of the switch S2 in the speed monitor S (**F5**) until the engine has reached normal operating speed. The voltage across the oil pressure switch 14S (**H4**) is broken when the switch in the relay O (**F5**) is in the at rest position. Current (+) is supplied to terminal 113 (**E5**) where a lamp of max 5W can be connected to indicate that the engine is ready for starting.
3. The alarm switches 14L (**H6**) and 103L (**H7**) are blocked by switch K (**F7**).
4. After starting, when the engine speed is higher than approx. 300 r/min the switch S1 (**G6**) opens. Switch R (**F2**) switches and blocks the engagement of the starter motor and connects the voltage monitor T (**F2**). Approximately 6 seconds after the switch S1 has opened the switch S2 closes and the relay O switches (**F5**). The oil pressure and cooling water flow have then reached their normal values, the switches 14L (**H6**) and 103L (**H7**) have closed and 14S (**H4**) has opened. When switch S2 closes, the alarm switch E (**F8**) also closes.
5. A lamp, 5W, can be connected to terminal 115 (**E5**) to indicate that the engine is running.

B: Automatic starting and stopping

1. The selector switch for manual control or automatic start should, when in the **automatic** position, block the manually controlled start. The automatic start impulse connects to terminal 103 (**E6**). If the engine is also connected for automatic stop, then the selector switch, when in the automatic position, should also block the manually controlled stop. External automatic stop impulses connect to the terminal 110 (**E4**).
2. If the engine, when set for automatic starting, does not start, the alarm impulse for failure to start can be obtained at terminal 2. This alarm impulse is obtained by breaking the connection between the terminals 1 and 2 after the end of the starting period by using a time relay or similar.

Blocking. Automatic starting and stopping

The automatic internal stop for high temperature and low oil pressure can be blocked by connecting the control current, for example from the selector switches (C5) automatic position to terminal 116 (E5) whereupon the switch N (F3) opens.

This blocking possibility can, for example, be utilised when an automatically started emergency set (where automatic stop for high temperature and low oil pressure is not permitted) is also used as a port set with manually controlled start. The internal automatic stop is blocked in this way when the selector switch is in the automatic position and connects when the selector switch is in the manual control position.

C. Starter motor disengagement Extra safety precaution

If a fault occurs in the switch S1 (**G6**) in the speed monitor, causing the starter current not to be broken, the starter motor remains engaged during the whole starter impulse period, even after the engine has started.

To prevent starter motor damage it is recommended that, as an extra safety precaution, a relay (**D5**), be connected which is controlled by the alternator voltage and which breaks the starter current to terminal 103 (**E6**) or 102 (**F1**).

Engine running

All alarm switches and contacts are closed when the engine is running. The switches 14S and 15S (**H4–5**) together with switch S3 (**F5**) for automatic stop are open. The blocking switch S2 (**F5**) is closed and the switch S1 (**G6**) for disengaging the starter motor is open.

Stopping the engine

The stop impulse (1 Amp) is fed in to terminal 110 (**E4**). Switch P (**F3**), which is connected with self holding, controls the stop relay G (**G3**) whose switch (**F2**) closes and the stop solenoid 17 (**H2**) adopts the stop position.

At the same time the alarms for low oil pressure, automatic stop and cooling water flow are blocked by the switch L (**F4**) switching, connecting with self holding and disconnecting the relay coil K (**G4**) so that its switch closes. The switch K remains open during normal running due to the relay O (**F5**).

Emergency engine stop

The stop impulse (0.5 Amp) is fed in to terminal 114 (**E5**). When stopping the switch M (**F2**) closes and the emergency stop solenoid 102 (**H2**) adopts the stop position. The switch 102L (**H7**) opens whereupon the alarm impulse to terminal 5 is obtained.

Fault conditions

A. Low oil pressure

1. If the oil pressure falls below the set alarm value the oil pressure switch 14L (**H6**) for the alarm opens and the alarm impulse is obtained at terminal 8 (**E6**). If the engine stops after the alarm is triggered, the alarm impulse is re-set by switch K (**F7**). See under, **Stopping the engine.**
2. If the oil pressure falls below the lowest set stop value, the oil pressure switch 14S (**H4**) closes for automatic stop. The switch J (**F7**) switches and the alarm impulse for automatic stop is obtained at terminal 10 (**E7**) at the same time as the alarm for low cooling water flow is blocked. The switches P and G (**F2 and 3**) actuate the stop solenoid 17 (**H2**) which adopts the stop position. The switch A (**F6**) switches and blocks the alarm for high cooling water temperature, since, in the event of sudden stop of the engine under load, a short-term temperature rise can occur in the cooling system. At the same time the switch B (**F4**) breaks the control current to relays C and D (**G4**).

B. High cooling water temperature

1. If the cooling water temperature rises above the set alarm value the temperature switch 15L (**H7**) opens for alarm and the alarm impulse is obtained at terminal 7.

   Note that when the engine has stopped and the oil pressure switch 14S (**H4**) has closed, the alarm impulse is blocked by the relay A (**G4**).
2. If the cooling water temperature rises above the set stop value, the temperature switch 15S (**H5**) closes for automatic stop. The switch J (**F7**) switches and the alarm impulse for automatic stop is obtained at terminal 10 at the same time as the alarm for low cooling water flow is blocked. The switches P and G (**F2 and 3**) then actuate the stop solenoid 17 (**H2**) which adopts the stop position. The switch D (**F6**) switches and blocks the alarm for low oil pressure. At the same time the switch C (**F4**) breaks the control current to relays A and B (**G4**).

C. Excessive engine speed

If the engine speed exceeds the set value by more than about 15 % the switch S3 (**F5**) in the overrun monitor, S, closes. The switch H (**F6**) switches and the alarm impulse for overspeed is obtained at terminal 9 (**E6**). The alarms for high cooling water temperature, low oil pressure and low cooling water flow are simultaneously blocked. The switch M (**F2**) closes, so that the emergency stop solenoid 102 (**H2**) adopts the stop position. The switch 102L (**H7**) opens and the alarm impulse is obtained at terminal 5.

The emergency stop is completely independent of the normal stop and consists of a spring-loaded flap which is located in the air intake between the air cleaner and the inlet manifold (before the turbo-compressor on turbo engines). The flap is held in the open position by a catch which is actuated by an electromagnet.

The emergency stop can be engaged electrically (stop impulse connects to terminal 114) or manually by means of a control cable or directly on the engine by pushing the catch which activates the flap.

When the flap is closed the air supply is cut off and the engine stops.

The flap can be opened by turning a lever clockwise until the catch is engaged.

The speed monitor S senses engine speed via the sender 12 (**H2**). The monitor has three functions as follows:

S1 (G6) remains closed while the engine speed is below 300 r/min. When the engine speed exceeds 300 r/min the switch opens and breaks the start control. The switch also prevents unintentioned engagement of the starter motor whilst the engine is running.

S2 (F5) closes approximately 6 seconds after the switch S1 has opened. The engine has thus reached operating speed and blocking of the oil pressure and cooling water flow switches can be disengaged.

S3 (F5) closes at a given engine speed which can be set between 1560–2040 r/min and engages the emergency stop if the engine exceeds the pre-set speed.

The switch is connected with self holding and is re-set with an impulse in the control cable, terminal 101 (**E1**).

D. Starting fault

The starting fault alarm is intended for automatically started engines. If the engine does not start the switch S2 (**F5**) remains open and the relay E (**G5**) does not close its switch E (**F8**). An alarm impulse is then obtained at terminal 2. Since the switch E is always open when the engine is not running it should be short circuited to prevent the alarm from being triggered when the engine is not running or during the start period. Short-circuiting can be effected by connecting terminals 1 and 2 via a relay switch or similar.

E. Low battery voltage (starter battery)

If the voltage in the starting circuit falls below 23.5 V (which means that the battery is approximately half charged), the switch T (**F2**) closes and the switch F (**F8**) opens. An alarm impulse is obtained at terminal 3.

F. Low level in cooling system expansion tank

The level switch 46L (**H7**) opens. An alarm impulse is obtained at terminal 4.

G. Fault in coolant circulation

The circulation switch 103L (**H7**) opens. An alarm impulse is obtained at terminal 6.

H. Automatic stop actuated

Switch J (**F7**) switches and an alarm impulse is obtained at terminal 10.

I. Fuel leakage

The level switch 46L/B (**H8**) opens and an alarm impulse is obtained at terminal 11.

J. High lubricating oil temperature

The temperature switch 50L (**H8**) opens and an alarm impulse is obtained at terminal 12.

Re-setting of relays and speed monitor

A switch should be fitted in the control cable to terminal 101 (**E1**) for re-setting the relays and speed monitor.

Oil pressure and temperature gauges

Current from the control system is connected to the respective plus (+) and minus (–) connections on the gauges. The connection G on the gauge is connected to terminal 111 (**E2**) in the case of the oil pressure gauge and terminal 112 (**E2**) in the case of the temperature gauge.

Cables

All cables are of the FEO type, consisting of a cable insulation of EP-rubber and a protective sheath of oil and weather-resistant material.

The cable through-fittings to the electrical terminal and other connection boxes are sealed in such a way as to release the cable from mechanical loading.

Protective casing

All electrical components are encased according to IP44.

ADJUSTING AND CHECKING

Switches and stopping devices

Lubricating system

Oil pressure switch-alarm 14L, fig. 22.

Marking: Blue dot.

NOTE! The break point should be checked whilst the pressure is **falling.**

1. Connect the pressure-testing device to the plate and turn the cock (fig. 23).
2. Set the cock lever to the horizontal position (B) and pump the pressure up to a set value which exceeds the break point.
3. Lower the pressure and check that the break point is correct. **Break point: 1.7–2.0 kp/cm^2 (24.2–28.5 p.s.i.).** The contacts should open when the pressure falls below this value.
4. Disconnect the pressure-testing device and turn the cock lever downwards (A).

Oil pressure switch-automatic stop 14S, fig. 22.

Marking: Red dot.

The check is carried out in the same way as for the oil pressure switch *(alarm) above.*

Break point: 1.1–1.4 kp/cm^2 (15.6–19.9 p.s.i.). The contacts should close when the pressure falls below this value.

Temperature switch, lubricating oil – alarm 50L, fig. 22.

Marking: Green dot.

The temperature switch can be removed without it being necessary to drain the lubricating oil. Function check:

NOTE! The temperature reading shall be made whilst the temperature is **rising.** Remove the temperature switch and immerse its sensor into liquid as shown in fig. 25. The contacts should open at a temperature of 110°±2°C (230°±3.6°F). Adjust, if necessary, by unscrewing the lock nut and turning the adjuster screw (2). Screwing in raises the opening temperature. Re-lock the screw after adjustment.

Cooling system

Coolant temperature switch – alarm 15L, fig. 24.

Marking: Blue dot.

The switch can be removed without it being necessary to drain the coolant. Engine stopped. Function check:

NOTE! The temperature reading shall be made whilst the temperature is **rising.**

Remove the temperature switch and immerse its sensor into liquid as shown in fig. 25. The contacts should open at a temperature of 88°±2°C (190.4°±3.6°F). Adjust if necessary, by unscrewing the lock nut and turning the adjuster screw (2). Screwing in raises the opening temperature. Re-lock the screw after adjustment.

Fig. 24. Protective case (K2) for senders and switches in the cooling system (cover removed).

1. Temperature switch (alarm) – 15L
2. Temperature switch, automatic stop – 15S
3. Sender for temperature gauge – 11
4. Circulation switch (alarm) – 103L

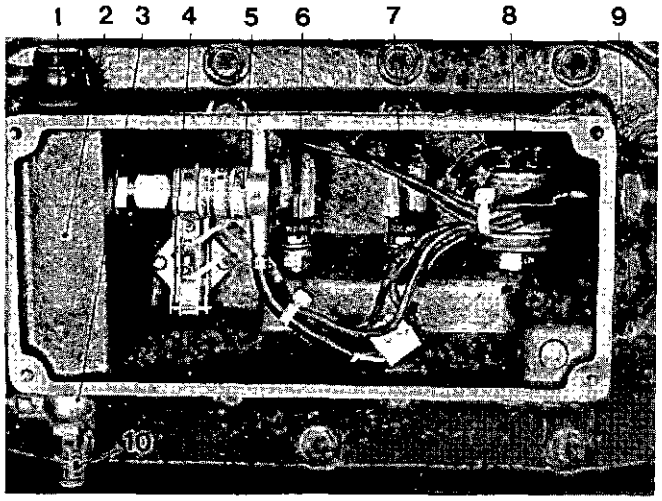


Fig. 22. Protective case (K4) for senders and switches in the lubricating and fuel systems (cover removed).

1. Leak line, departing fuel
2. Float housing
3. Inlet, leakage line
4. *Temperature switch, lubricating oil (alarm)* – 50L
5. Leakage switch, fuel (alarm) – 46L/B
6. Oil pressure switch (alarm) – 14L
7. Oil pressure switch (automatic stop) – 14S
8. *Oil pressure sender*
9. Oil pressure inlet pipe
10. Drainage valve

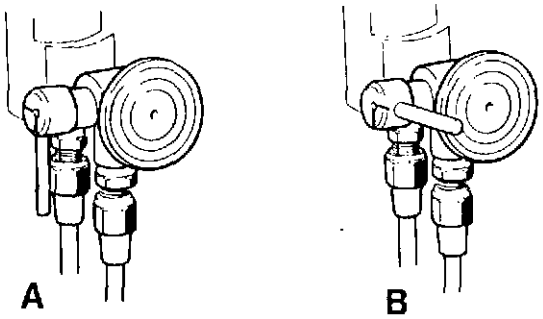
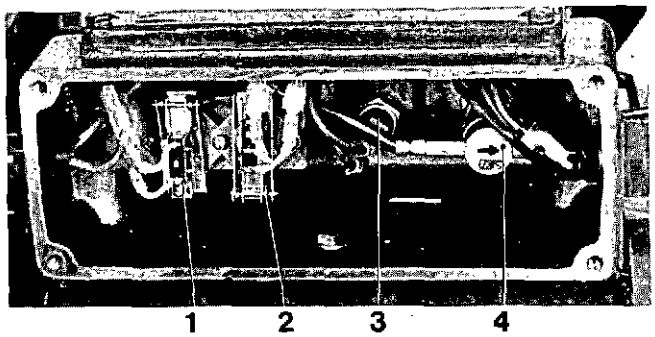


Fig. 23. Cock (K6) for checking the oil pressure switches

A. Normal operating position, lever downwards.
B. The pressure switches can be checked in this position. The pressure connection and pressure gauge are connected to the plate during checking. For setting pressures, see page 19.



Coolant temperature switch – automatic stop 15S, fig. 24.

Marking: Red dot.

The check is carried out in the same way as for the temperature switch (alarm), see previous text.

The contacts should close at a temperature of 92°±2°C (197.6°±3.6°F).

Coolant circulation switch – alarm 103L, fig. 24.

The engine should be stopped before removing the switch.

Note when removing/fitting the switch that the lock nut (5) is **left-hand threaded** against the nipple (6) – but **right-hand threaded** against the circulation switch, fig. 26. The nipple (6) is left-hand threaded at both ends.

NOTE! The circulation switch should be set to the **red arrow** (3, fig. 26). Loosen the lock screw (1), if necessary, and adjust to correct position. (The switch becomes increasingly more sensitive the nearer the setting is to the point of the red arrow).

The circulation switch contacts open if circulation stops.

The circulation switch should be installed with the arrow (2) horizontal and pointing rearwards (towards the flywheel). The circulation switch lever is actuated by a piston in the housing. Push the piston forward before fitting the switch so that the lever goes free.

Level switch, coolant – alarm 46L, fig. 27.

Function check:

The contacts open when the dimension 'L', fig. 28, exceeds 58–63 mm (2.28–2.48"), which occurs hen the coolant level is too low.

Fuel system

Leakage switch, fuel – alarm 46L/B, fig. 22.

Note when removing/fitting the leakage switch that the lock nut (5) is **left-hand threaded** against the nipple (6) – but right-hand threaded against the leakage switch. The nipple (6) is left-hand threaded at both ends. See fig. 26.

The leakage switch contacts open in the event of fuel leakage.

NOTE! The leakage switch should be set to the **blue arrow** (4, fig. 26). Loosen the lock screw (1), if necessary, and adjust to correct position. (The switch becomes increasingly sensitive the nearer the setting is to the point of the arrow).

The leakage switch should be installed with the arrow (2) pointing upwards. Empty the float housing of any leakage fuel by pushing in the valve (10, fig. 22) under the inlet line before fitting the switch.

Electrical system

Voltage monitor – starter battery check marked T in the electrical terminal box

Function check:

The contacts should close after 5–10 seconds when the voltage has fallen to 23.5±0.1 V. See wiring diagram.

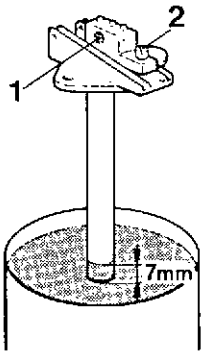


Fig. 25. Temperature switch for alarm and automatic stop. When testing, the sensor body should be immersed 7 mm (0.28") into the warm liquid.

1. Colour marking
2. Adjusting screw

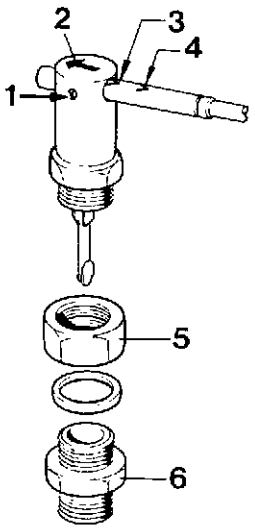


Fig. 26. Leakage switch/circulation switch disassembled. The pipe with the arrow mark can be moved in or out when the lock screw (1) is loosened. Only the setting differentiates the coolant circulation switch from the leakage switch.

1. Lock screw
2. Arrow indicates direction of liquid flow
3. Red arow
4. Blue arrow
5. Lock nut
6. Nipple

Fig. 27. Level switch 46L for coolant

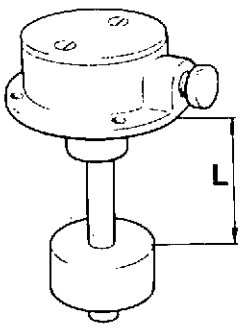


Fig. 28. Level switch 46L removed

L = 58–63 mm (2.28–2.48")

Stopping devices and overrun monitor

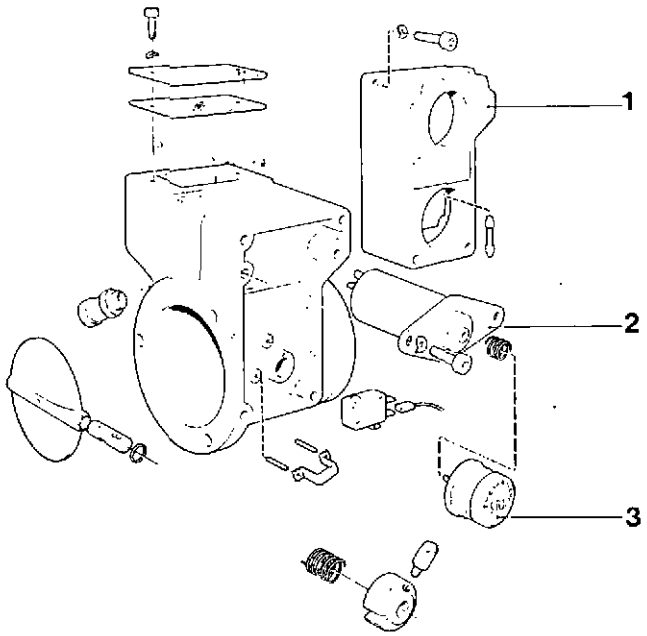


Fig. 29. Emergency stop, exploded illustration

1. Cover
2. Control solenoid
3. Stop button

Emergency stop

When assembling the emergency stop it is important that the stop button (3, fig. 29) is centrally located in the cover (1) so that it does not jam.

Fit the control solenoid (2) and tighten the screws loosely. Fit the stop button (3) with spring and the cover (1). Check that the button is properly centralised and does not jam. Remove the cover and tighten the solenoid.

Fit the remaining components.

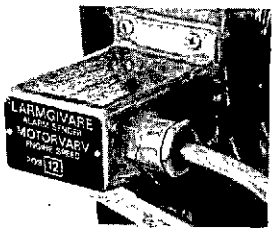


Fig. 30. Sender 12 for engine speed

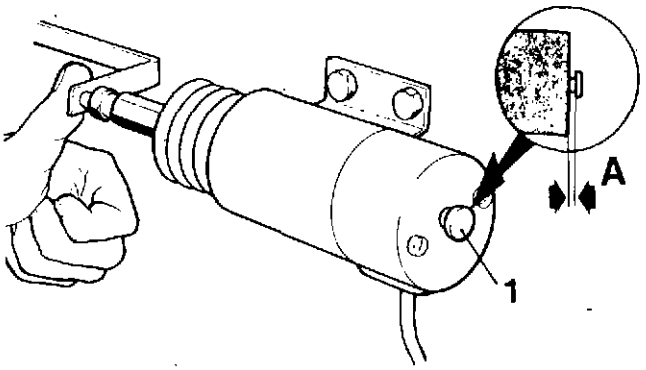


Fig. 31. Checking the contact gap, SEM-stop solenoid

1. Stop position indicator (pin)
A. Approx. 1.5–2 mm (0.06–0.08")

Stop solenoid for normal stopping

If the stop solenoid is removed or replaced, the following check should be made after fitting.

1. Break the current
2. Push the solenoid pull rod in by hand and check that the stop position indicator (the pin) 1, fig. 31 at the rear end of the solenoid protrudes 1,5–2 mm (0.06–0,08") when the pull rod is pushed back fully.
3. Adjust, if necessary, by screwing the pull rod adjusting nut in or out.

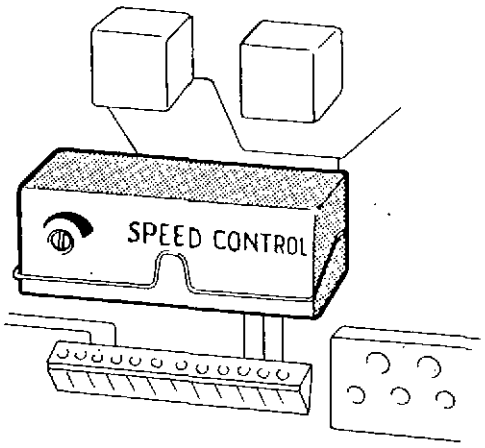


Fig. 32. Speed monitor (S) with adjusting screw

Speed monitor (Overrun monitor) – in the electrical terminal box

The maximum speed can be set with the screw on the speed monitor S. Clockwise rotation increases the speed whilst anti-clockwise reduces it. The setting should be made so as to allow the operating speed to be exceeded by 15 % before the stop is activated.

The speed sender 12 can be checked by measuring the voltage across its contacts. At an engine speed of 1500 r/min the voltage (alternating voltage) should be approximately 10V.

Fault finding

The following scheme describes the methods for rectifying certain faults. Whereas it is not possible to include every eventuality, we feel that the instructions provide a good basis to enable possible faults and abnormal conditions to be quickly remedied.

Speed monitoring

Fault symptom	Check	Result of investigation Repair remedy
Lamp "Engine running" does not light when engine is running.* Breakage of voltage to terminal 115	Check the cables and connections between the sender 12 and the terminals 207 and 208. Check the lamp.	Not fault in connections or lamp.
	Check connection plug for speed monitor S and connection socket.	No fault
	Check the sender 12 by measuring the voltage across its contacts (A. C. voltage approx. 10V at 1500 r/min) or by replacing the sender	Correct voltage from sender. Speed monitor is faulty. Replace.
Alarm indicates "Starting fault"* despite fact that engine is running Alarm indication at terminal 2	Is there voltage at terminal 115 when engine is running (does the lamp "Engine running" light)?	No voltage. (Lamp does not light). The fault lies in the speed monitor. Remedy as above. Voltage exists. (The lamp lights.) Relay E is faulty. Replace.
Lamp "Engine ready for start"* does not go out after start Voltage exists at terminal 113 when the engine has started.	Is there voltage at terminal 115 when the engine has started (does the "Engine running" lamp light)?	No voltage at terminal 115 (The lamp does not light). Faulty speed monitor. Remedy as in the text above. Voltage exists at terminal 115. Relay O faulty. Replace.
Alarm indicates excessive speed despite fact that engine is running normally (terminal 9).	Check the function by replacing relay H.	Alarm ceases to indicate. Relay H was faulty. Fault remedied.
Alarm indicates automatic stop (terminal 10) despite fact that engine is running normally.	Check the function by replacing relay J.	Alarm ceases to indicate. Relay J was faulty. Fault remedied.

* Note! If the first 3 fault symtoms above occur simultaneously, then this indicates a fault in the speed monitor which means that:

- the re-start cut-out for the starter motor does not work.
- blocking for autostop and alarm switches is not disengaged. Possible faults regarding oil pressure and cooling water circulation will therefore not be indicated.
- the alarm and autostop for overspeed does not work.

Overrun and automatic stop

First check the speed monitor, as described in the previous text, and the mechanical function of the emergency stop flap, see page 14.

The engine does not stop when the max speed setting on the speed monitor is adjusted down below the limit position.	Connect in 24V, max 0,5A stop impulse to terminal 114. Check connection of stop solenoid.	The engine stops. The fault lies in the speed monitor. The engine does not stop. Replace relay M. The engine stops and the fault is remedied.
The engine does not stop when the emergency stop is electrically connected to terminal 114.	Check relay M by replacing it.	The engine stops for stop impulse when the relay M has been replaced Fault remedied.

Fault symptom	Check	Result of investigation, Repair remedy.
Engine does not stop for stop impulse at terminal 114 even after relay M has been replaced.	Measure the control current at the emergency stop solenoid (102) contacts.	Control current is non-existant. Contact fault at the connections or at terminal 223 and 224. Remedy. Control current exists at connections for 102. Emergency stop solenoid 102 faulty. Replace.
Alarm indicates automatic stop without engine stopping.	Check the connections for terminal 10.	Connections properly made. Relay J faulty. Replace. NOTE! The alarm for coolant circulation (terminal 6) is blocked.
Alarm indicates overrun despite fact that engine is running at normal speed.	Check the connections for terminal 9. Check relay H by replacing.	Connections properly made. Relay H faulty. Replace. NOTE! The alarms for coolant circulation (terminal 6), coolant temperature (terminal 7) and low oil pressure (terminal 8) are blocked.

LUBRICATING SYSTEM

Low oil pressure

Check first the oil pressure switches with respect to setting pressure and function according to the description on page 12.		
No alarm indication (terminal 8) if the switch 14L is disconnected when the engine is running.	Check the speed monitor according to the description on page 15.	No fault in speed monitor. Relay K or D faulty. Replace.
Alarm indication at terminal 8 when stopping engine normally.	Check function by fitting a new relay K.	No further alarm indication. Fault remedied. Alarm cotinues to indicate. Refit the original relay K. The fault lies in relay D or L. Replace either one or both relays as necessary.
The engine fails to stop despite triggering of automatic stop.	Short-circuit the oil pressure switch 14S whilst engine is running. Connect a 24V max 1A stop impulse to terminal 110.	The engine does not stop. The engine stops when stop impulse is connected to terminal 110. Ensure that the automatic stop is connected so that terminal 116 is dead. The engine does not stop for stop impulse at terminal 110. Replace relay P and/or G.
The fault remains (the engine does not stop despite triggering of stop) despite replacement/checking of relay P and/or G.	Measure the control current at the stop solenoid (17) contacts.	There is no control current. Check the connections to the stop solenoid and terminals 215 and 216. Control current exists. Stop solenoid faulty. Replace.

COOLING SYSTEM

High coolant temperature

Check first the temperature switches with respect to setting temperature and function, page 12 and 13.		
Fault symptom	**Check**	**Result of investigation, Repair remedy.**
No alarm indication (at terminal 7) despite excessively high temperature.	Disconnect switch 15L whilst engine is running.	No alarm indication. Relay A faulty. Replace.
The automatic stop does not function despite excessively high temperature.	Short-circuit the temperature switch 15S whilst the engine is running.	The engine does not stop. Look for fault under heading "Overrun and automatic stop", page 15.

Interruption of coolant flow

Check first the circulation switch function, page 13.		
No indication from the alarm (at terminal 6) when switch 103L is disconnected whilst engine is running.	Check speed monitor, page 15.	Speed monitoring correct. Relay K faulty. Replace.
Alarm indication (terminal 6) when engine stops normally.	Check if the alarm indicates after replacement of relay K.	Alarm indication even after replacement of relay K. Replace relay L and refit original relay K. No alarm indication after replacement of the relays K/L. Fault remedied.

Start functions

The starter motor does not rotate when attempting to start.	Check, clean and tighten the connections at the battery and starter motor.	Connections correct. Relay R faulty. Replace.
The starter motor does not rotate when attempting to start. Relay R checked and correct.	Check if start impulse is received at terminal 103.	Start impulse exists.
	Check if there is contact between terminals 103 and 104.	Contact exists. Adjust connections on the starter motor and on terminal 230. There is no contact between terminals 103 and 104. Speed monitor S faulty. Replace. Replace starter motor if necessary.

Stop functions

Fault symptom	Check	Result of investigation, Repair remedy.
The engine does not stop when the normal stop button is pushed.	Check the cables and connections to the stop solenoid (17) and terminals 215, 216.	Connections and cables correct. Relay P or G faulty. Replace one at a time. If the fault is not remedied by replacement of relays then the stop solenoid (17) must be replaced.
The engine does not stop when the emergency stop is engaged electrically.	Check the mechanical function of the emergency stop (air flap).	Remedy any faults, page 14.
	Check the cables and connections for the stop solenoid 102 and terminals 223, 224.	Connections are correct. Relay M faulty. Replace. If the fault remains, replace the stop solenoid 102.

TECHNICAL DATA

General information

	70-series	100-series	120-series
Type designation engines with heat exchanger	D70CHC	D100BHC	TD120AHC
weight	800 kg (1760 lb)	1160 kg (2560 lb)	1350 kg (2980 lb)
	TD70CHC	TD100AHC	TAD120BHC
	820 kg(1810 lb)	1180 kg (2600)	1380 kg (3040 lb)
Type designation engines without heat exchanger	D70CRC	D100BRC	TD120ARC
weight	800 kg (1760 lb)	910 kg (2000 lb)	1280 kg (2820 lb)
	TD70CRC	TD100ARC	
	820 kg (1810 lb)	960 kg (2120 lb)	
Direct injected diesel	yes	yes	yes
Capacity dm^3 (litres/cu.in.)	6.73/410	9.6/585	11.98/730
Bore mm (in)	104.77/4.13	120.65/4.75	130.175/5.12
Stroke mm (in)	130/5.12	140/5.51	150/5.91
Overhead valves	yes	yes	yes
Firing order (no. 6 nearest flywheel)	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Valve clearances (engine stationary. Cold or at operating temp)			
Inlet mm (in.)	0.40 (0.016")	0.40 (0.016")	0.40 (0.016")
Exhaust mm (in.)	0.45 (0.018")	0.70 (0.028")	0.70 (0.028")
	TF70 0.55 (0.022")		

Electrical system

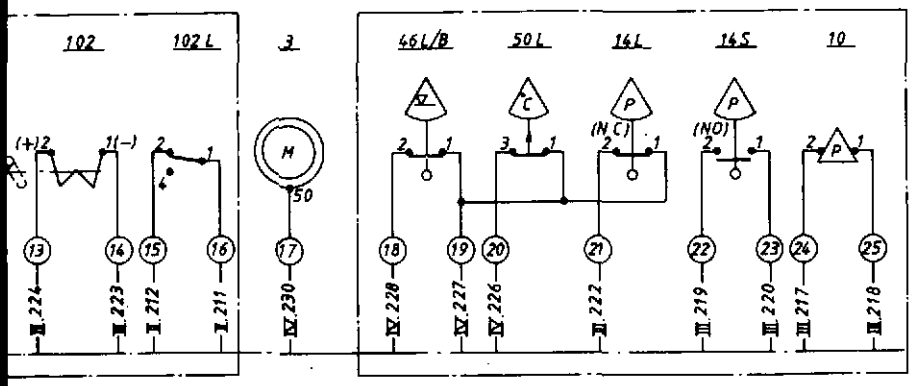
System voltage	24 volt	24 volt	24 volt
Recommended starting battery (2x12V) capacity	110 Ah	152 Ah	152 Ah

Setting and test values for switches

Function	Switches		Instruction
	Opens at	Closes at	
Lubricating system			
Pressure switch (alarm)	1.7–2 kp/cm^2 (24.18–28.45 p.s.i.)		Test schould be carried out while pressure is falling.
Pressure switch (autostop)		1.1–1.4 kp/cm^2 (15.65–19.9 p.s.i.)	
Temperature switch (alarm)	108–112°C (226.4–233.6°F)		Test should be carried out while temperature is rising.
Cooling system			
Temperature switch (alarm)	86–90°C (187–194°F)		Tested while temperature is rising.
Temperature switch (autostop)		90–94°C (194–201°F)	
Circulation switch (alarm)	Opens in the event of interruption of flow.		Setting, red arrow.
Level switch	Dimn. "L" greater than 58–63 mm (2.28–2.48")		
Fuel system			
Leakage switch	Opens in the event of leakage.		Setting, blue arrow.
Electrical system			
Voltage monitor		23.4–23.6V	Time delay 5–10 secs.
Speed monitor		15 % above set max. speed.	

EMERGENCY STOP

LUBRICATING OIL AND FUEL

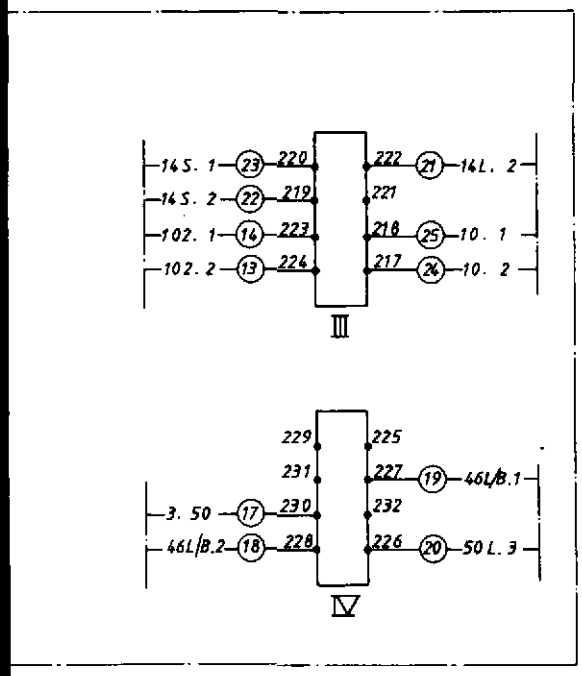


Cable cross-section areas

Cable no. 9, 10, 13, 14 = 2,5 mm^2

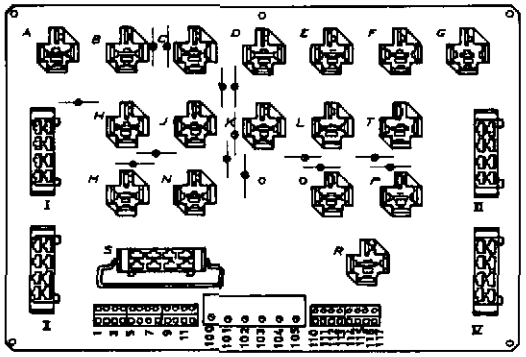
Others = 1,5 mm^2

NTED CIRCUIT



For figures and text, the following explanation applies.

No.	Refers to
3.	Starter motor
10.	Oil pressure sender – engine
11.	Cooling water temperature sender
12.	Speed sender
14S.	Oil pressure switch – stop
14L	Oil pressure swith – alarm
15S.	Cooling water temperature switch – stop
15L	Cooling water temperature switch – alarm
17.	Stop solenoid
46L	Cooling water level switch – alarm
46L/B.	Fuel leakage – level switch – alarm
50L	Oil temperature switch – alarm
102.	Emergency stop
102L.	Emergency stop switch – alarm
103L.	Cooling water flow switch – alarm

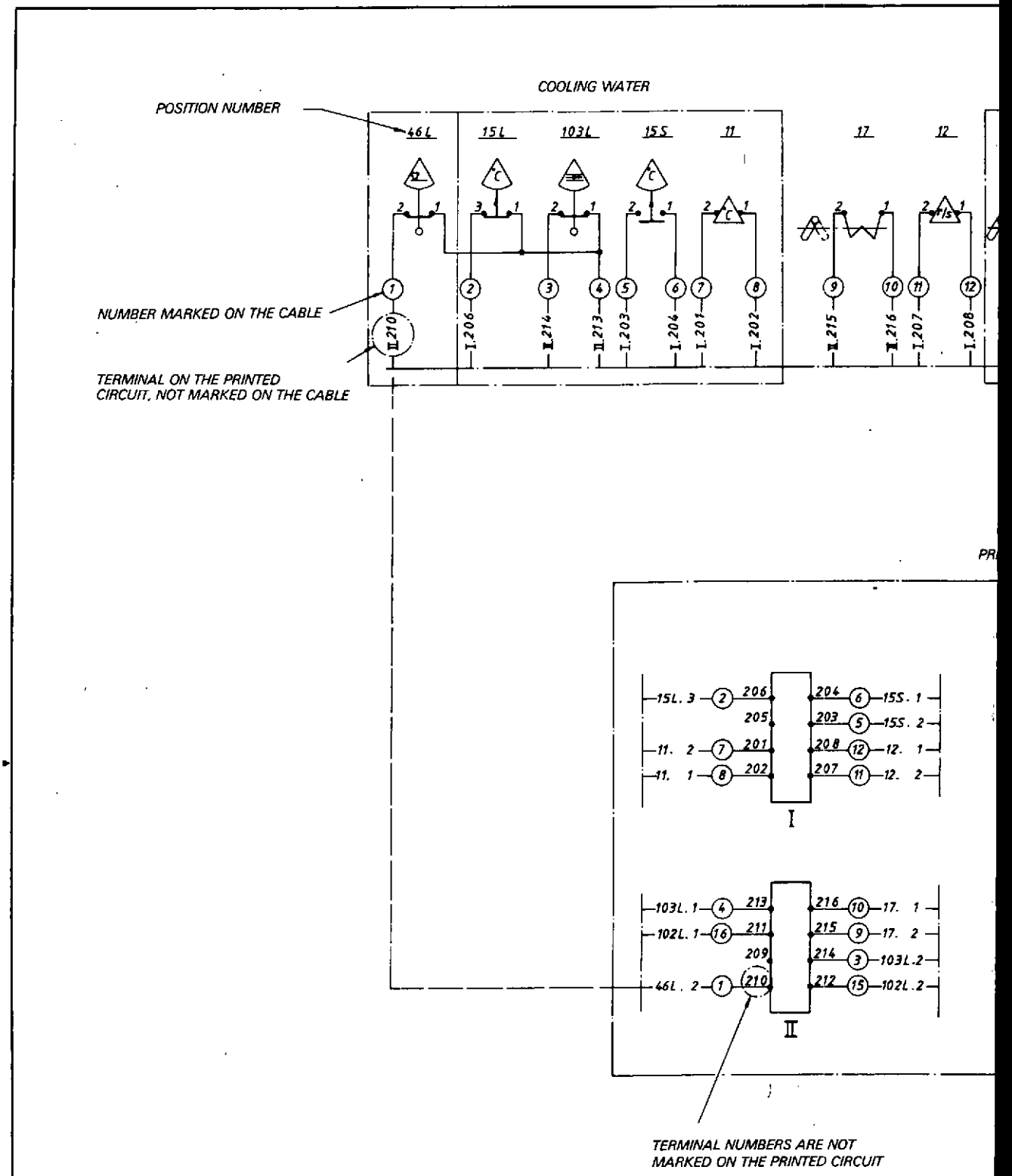


PRINTED CIRCUIT

VOLVO PENTA

WIRING DIAGRAM, CLASSIFIED ENGINE

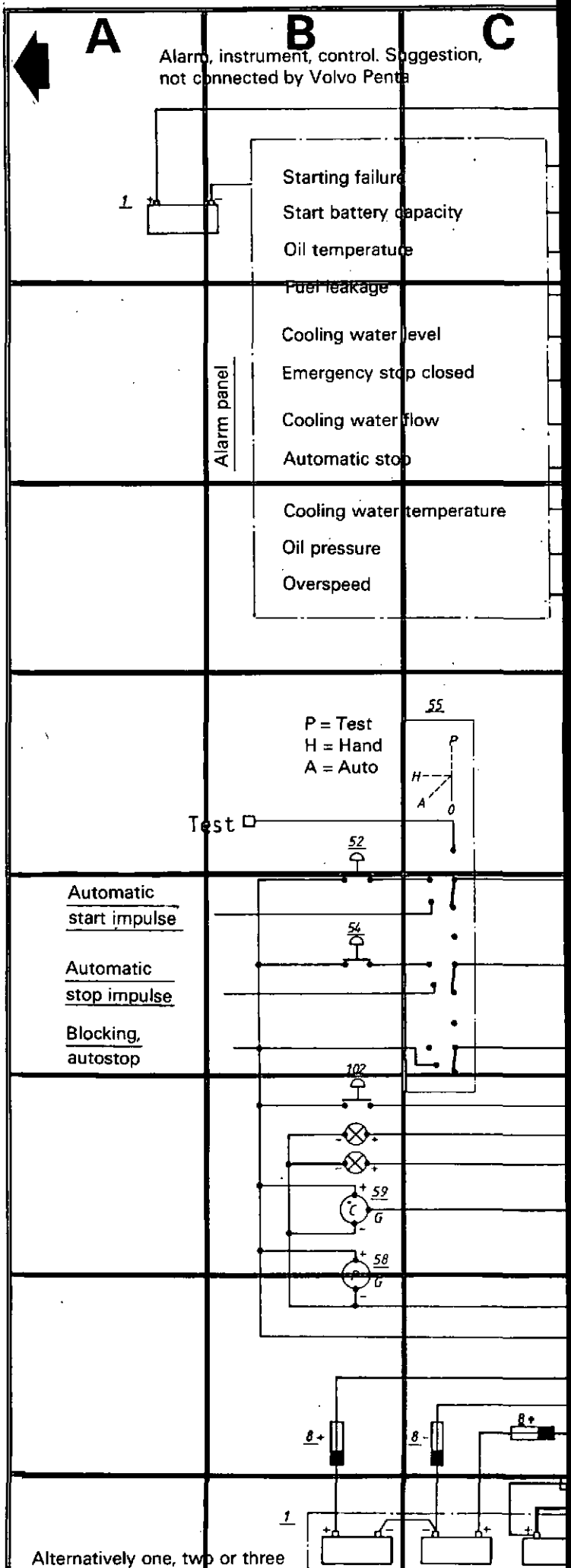
(DRG. NO. 892827 AS REF.)


COOLING WATER
POSITION NUMBER
46L
15L
103L
15S
11
17
12
NUMBER MARKED ON THE CABLE
TERMINAL ON THE PRINTED CIRCUIT, NOT MARKED ON THE CABLE
II.210
I.206
I.214
II.213
I.203
I.204
I.201
I.202
II.215
II.216
I.207
I.208
15L. 3
11. 2
11. 1
206
205
201
202
204
203
208
207
15S. 1
15S. 2
12. 1
12. 2
I
103L. 1
102L. 1
46L. 2
213
211
209
210
216
215
214
212
17. 1
17. 2
103L.2
102L.2
II
TERMINAL NUMBERS ARE NOT MARKED ON THE PRINTED CIRCUIT

For figures and text, the following explanation applies.

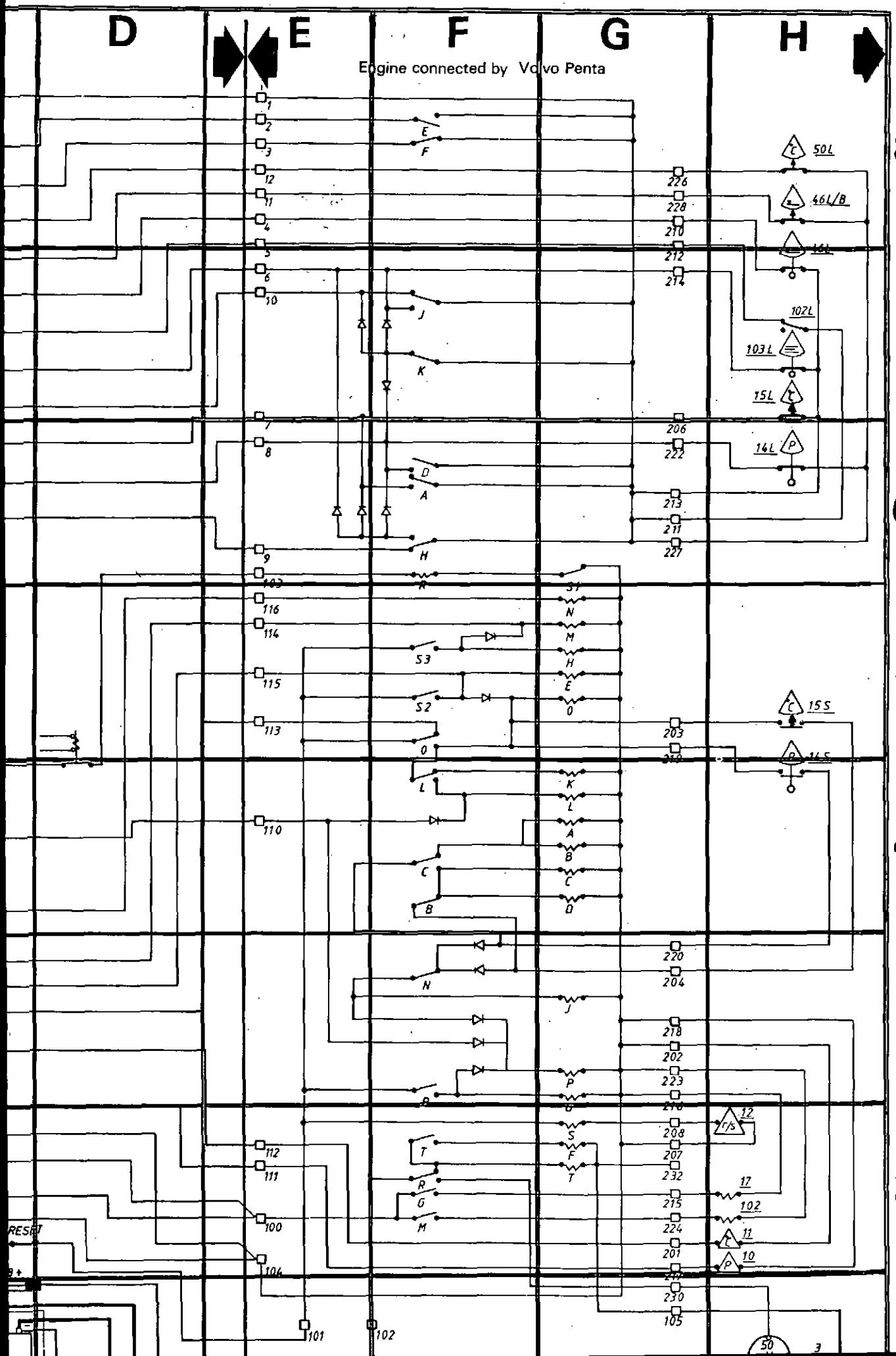
No.	Refers to
1.	Battery (B1, C1 and A8 in the co-ordinate system)
3.	Starter motor (H1)
8.	Fuse (C1,2 B2)
10.	Oil pressure sender – engine (H2)
11.	Cooling water temperature sender (H2)
12.	Speed sender (H2)
14S.	Oil pressure switch – stop (H4)
14L	Oil pressure switch – alarm (H6)
15S.	Cooling water temperature switch – stop (H5)
15L	Cooling water temperature switch – alarm (H7)
17.	Stop solenoid (H2)
46L	Cooling water level switch – alarm (H7)
46L/B.	Fuel leakage – level switch – alarm (H8)
50L	Oil temperature switch – alarm (H8)
52.	Start button (B5)
54.	Stop button (B4)
55.	Control switch (C5)
58.	Oil pressure gauge (B3)
59.	Cooling water temperature gauge (B3)
102.	Emergency stop (B3)
102L	Emergency stop switch – alarm (H7)
103L	Cooling water flow switch – alarm (H7)

Letter	Refers to
A.	Blocking relay
B.	Blocking relay
C.	Blocking relay
D.	Blocking relay
E.	Alarm, starting failure
F.	Alarm, low voltage
G.	Stop relay
H.	Alarm, overrun
J.	Alarm, autostop
K.	Blocking relay – alarm
L.	Blocking relay – alarm
M.	Emergency stop relay
N.	Blocking relay, autostop
O.	Blocking relay
P.	Stop relay
R.	Start relay
S.	Speed monitor
T.	Voltage monitor, start battery



VOLVO PENTA

SKELETON DIAGRAM WITH SUGGESTED CONNECTIONS.


D
E
F
G
H
Engine connected by Volvo Penta
8
7
6
5
4
3
2
1
50L
46L/B
16L
102L
103L
15L
14L
15S
14S
12
17
102
11
10
RESET
101
102
105
50
3

Publ. nr. 3975
6–1981

VOLVO PENTA

S-405 08 GOTHENBURG, SWEDEN