OIL-MIST-DETECTOR

VISATRON
SYSTEM VN 115

Crankcase supervisory device for diesel engines

MANUAL

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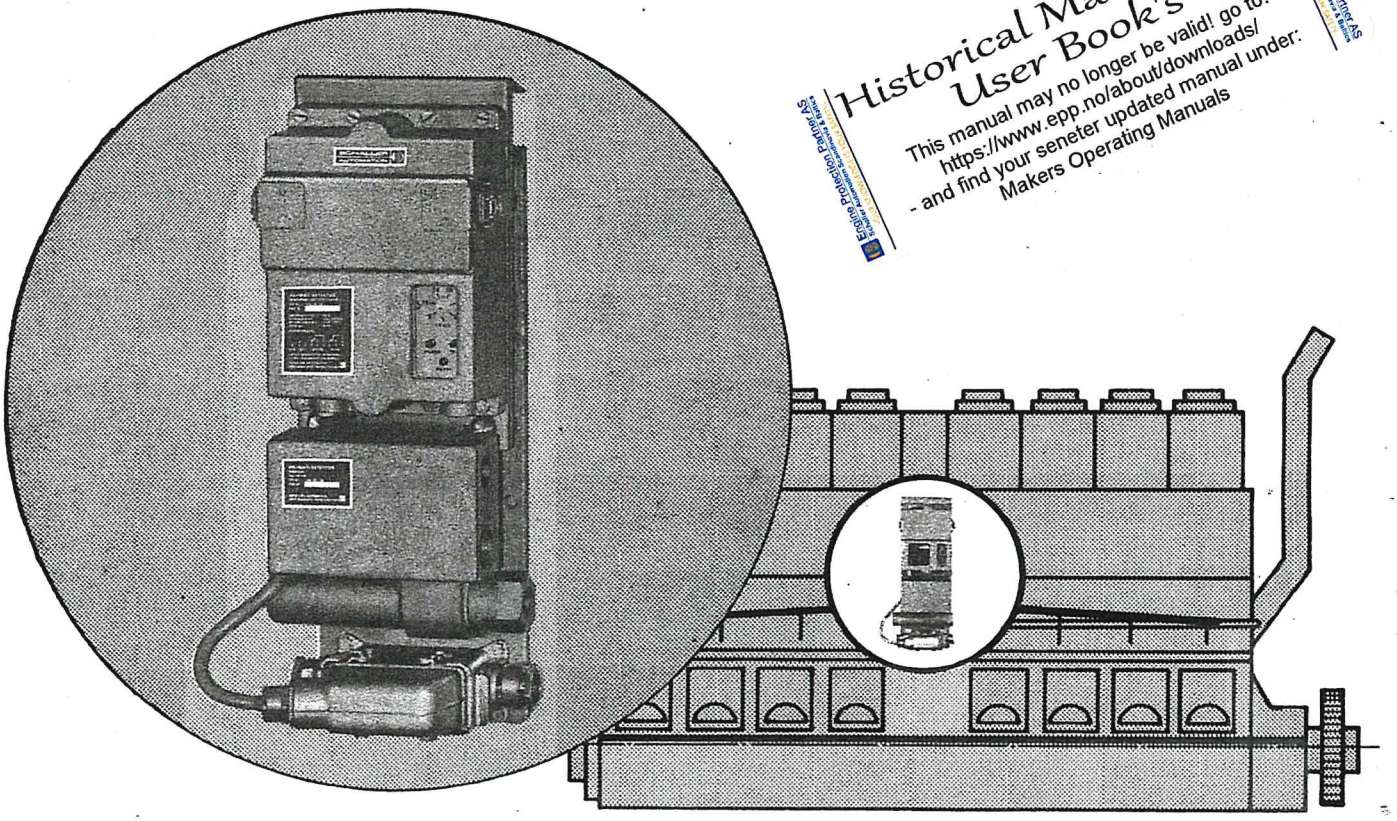

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** Supplement to the manual

1. Introduction

1.1 In General

The trend to automatic process control and monitoring observed in recent years has also been advancing constantly in the shipbuilding industry. The use of suitable controlling and monitoring instruments has rendered the constant presence of operating and supervisory personell needless.

The classification societies have prescribed which automatic equipment for such "off-duty" operation must me monitored by control instruments. This equipment includes, especially, diesel-engines and diesel-auxiliaries. Whether or not the specific classification certificates are granted depends upon the efficiency of the monitoring facilities.

The VISATRON Type VN 115 crankcase surveillance instrument was developed from more than ten years extensive experience with the previous models VISATRON VN 114 and VN 114S. In close cooperation with engine manufacturers, shipyards, using agencies and classification societies, an instrument has been developed which incorporates optimum characteristics.

With the help of the crankcase supervisory device, it is possible to detect excessive temperature rise in individual components of diesel-engines (for example bearing damage) and to implement suitable measures (for example emergency engine stop) to avoid subsequent damage.

The use of this instrument is not limited to marine diesel-engines. It can be used as well for any and all other mobil and stationary diesel-engines.

1.2 Principles of Operation

If machine oil, as used for lubricating engines, is heated, a mixture consisting of oil fumes and oil smoke is created, hereafter referred to as oil mist. This is the case when an excessive local heat build-up occurs in any part of a diesel-engine crankcase. Due to the motion of the crankshaft, connecting rods and pistons, the oil mist is distributed to the appropriate crankcase sections or through the entire crankcase, depending upon engine design. A portion of the oil mist is precipitated as "spray oil". The remainder becomes a constituent of the crankcase atmosphere.

One characteristic of oil mist is that it absorbs light. For a given wave length, the absorption can be ascertained, depending upon the turbidity of the oil mist (hereafter referred to as opacity) and upon the length of the photoelectric path. If the wave length and the length of the photoelectric path remain constant, the amount of light absorption is proportional to the opacity.

This characteristic is put to use for crankcase surveillance. The oil mist in the crankcase is extracted by means of suitable devices, which will be described more fully in a later chapter, and led to the crankcase supervisory device mounted externally on the engine. Here, the flow of oil mist passes through a light barrier consisting of a light emitting diode (LED) and a photistor. The photistor measures the intensity of the oil mist causes a portion of the light to be absorbed, reducing the intensity at the photistor. This change is then evaluated and initiates an alarm if a predetermined threshold is exceeded.

By means of a suitable calibrating facility, the interrelationship between the oil mist concentration (proportion of oil in the air) and the absorption of light (opacity) can be ascertained. Figure 1 illustrates the dependancy, using the oil combustion and vaporizing temperature T as a parameter. The diagram shows that the opacity of a strong oil mist concentration is relatively indepent of this value and tends to a saturation point.

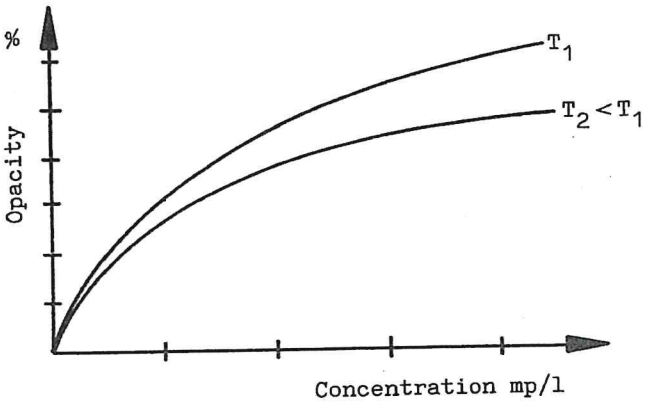


Fig. 1

This dependence makes it possible to collect the crankcase atmosphere extracted from the individual crankcase sections and containing varying percentages of oil mist into a common header. With this arrangement, which requires no moving mechanical parts, as are necessary, for example, for a sequential pick-up of the individual extraction points, a prerequisite for a rapid alarm is fulfilled. The header is constructed in such a manner, that its cross-section is considerably larger than those of the branch lines leading from the crankcase extraction points. This ensures that the pressure drop in the header can be neglected so that, in a given time, equal quantities of crankcase atmosphere are extracted by all branch lines.

If the concentration of oil mist in any crankcase section increases due to damage, it will be mixed in the header with the oil mist from the other extraction points. Due to the aforementioned non-linear relationship between concentration and opacity, the opacity is not decreased by the same amount as the concentration.

In figure 2, an example demonstrates this relationship. While the concentration is reduced to 1/8, the opacity decreases, for example by only fifty percent. This characteristic can be well utilized if the surveillance zone is situated in the steep part of the curve by appropriate dimensioning of the light barrier.

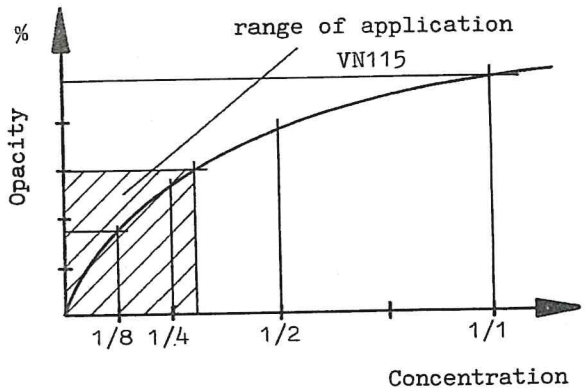


Fig. 2

1.3 Granted Classifikation Certificates

The crankcase supervisory device VN 115 is approved under the following registrations (copy on request)

a) Germanischer Lloyd — No. 71214 HH8/76
for diesel engines with trunk type pistons

b) Lloyd's Register of Shipping — No. LRS/SAR 000169
for high and medium speed engines

c) Det Norske Veritas — No. A-1600
(no special requirements)

d) Bureau Veritas — No. 10.199/214 A-CN.3 RIC/CS
for engines with more than 6 crankcase compartments and more than 3 m between centre lines of exterior cylinder use of the hot spot locating device section 6.1, item 5, code no. 150 196 00 is required.
In addition BV requires the use of pressure controle units section 7, item 9, code no. 150 191 00 .
previous No. 641/214-A-BM.3-RIC/EN

e) USSR Register of Shipping — No. 21/A-2.12.8.1

1.4 Important Advice and Requirements of Classification Societies

1.4.1 All Classification Societies require that the suction pressure drawing gases from the crankcase does not exceed 25 mm water column. This requirement is satisfied by fitting a pressure reducing valve upstream of the suction pump. This valve is set in such a way that 10-15 mm water column depression is used under normal operating conditions.

BV also require a flow control valve to be fitted before the pressure reducer so that in the event of this latter valve failing the suction pressure is still limited to less than 25 mm water column. The pressure regulator unit code no. 150 191 00 meets these requirements.

1.4.2 BV requires that for engines with more than 6 crankcase compartments and/or more than 3m between centrelines of end cylinders a defect locating device be fitted. Our simplest recommendation is the oil mist detector fitted with left/right locator code no. 150 196 00 and termed VN 115 L.

For slow speed and larger engines a Visatron cylinder selector can be supplied from mid 1977.

2. Functional characteristics

As described in section 1, the alarm signal is dependent upon the determination of the opacity in the crankcase atmosphere. Therefore, a small amount of crankcase atmosphere is continuously extracted from the crankcase or from the individual crankcase sections and led to the surveillance unit VN 115. The instruments arrangement and mode of operation are shown in figure 3 and explained in the following sections.

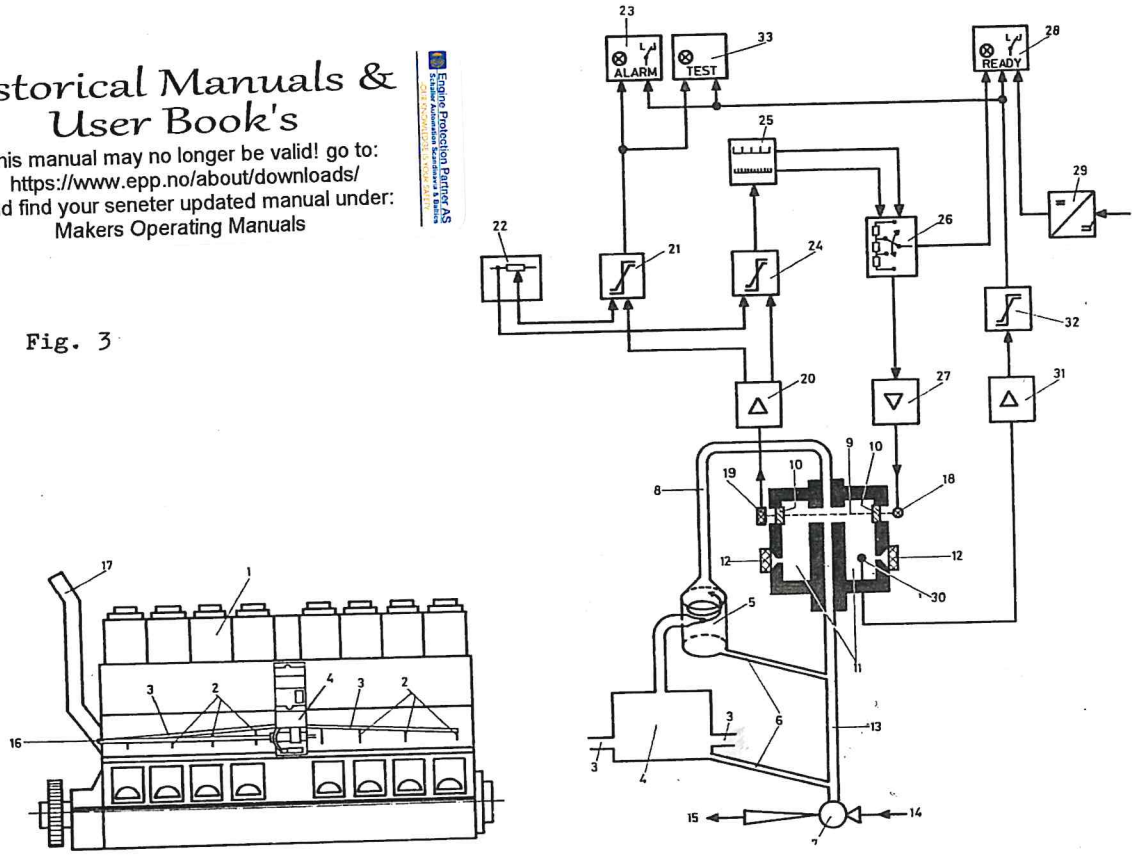


Fig. 3

2.1 Suction System for Continuos Extraction of Crankcase Atmosphere to be monitored

The diesel-engine (1) to be monitored is provided with connections (2) for extracting crankcase atmosphere at appropriate locations. These connections are arranged in such a manner that, if damage occurs at any location in the crankcase, the resulting oil mist will be extracted at a least one connection (2) and led to the header (3). A maximum of two headers discharge into the chamber (4) of the VN 115. The crankcase atmosphere is then led through a separator (5). Course oil particles suspended in the extracted atmosphere due to moving machine components in the crankcase are separated here due to the effects of centrifugal force. The oil separated in the chamber (4) and in the separator (5) is led through the oil drain lines (6) directly to the air draft pump (7), that is, discharged from the instrument. This step considerably decreases soiling of the instruments.

The atmosphere to be monitored leaves the separator (5) and travels through the channel (8) to the optical measuring track (9) in the measuring unit of the VN 115. In order to keep soiling as low as possible in this area, especially on the windows (10) of the light barrier, a small amount of fresh air is brought through the air filter (12) and blown passed the windows (10) of both chambers (11).

The crankcase atmosphere flows through the channel (13) to the air draft pump (7) which creates the necessary partial vacuum in the aforementioned suction system. Driving air (14) is necessary for operating the air draft pump. The mixture (15) expelled out of the air draft pump consists of crankcase atmosphere, driving air and oil. It can be led directly to the bilge or through a tube (16) into the crankcase ventilation (17).

2.2 System for Measuring the Opacity of the Crankcase Atmosphere and for Initiating Alarm

A light source (18) and a light receiver (19) comprise the optical measuring track. The light source is a (infra-red) light emitting diode which generates a certain light intensity at the receiver (19). The light receiver, a photistor, converts the light intensity to a proportionale electrical signal which is then led to the amplifier (20). Light source and light receiver are semi-conductors with appropriately long service life and operational dependability for the given environmental conditions.

A portion of the light is absorbed by the crankcase atmosphere in the measuring track (9), decreasing the electrical signal. The threshold switch (21) compares the measuring signal arriving from the amplifier (20) with the reference voltage set on the potentiometer (22) and actuates the alarm output stage (23) as soon as the measured signal falls below the reference voltage. This is the case if the opacity of the crankcase atmosphere in the measuring track is increased due to crankcase damage. The two signal outputs of the amplifier (20) show differing dynamic behaviour. The output to the control threshold switch (24) carries a signal proportional to the input signal of the amplifier. The output to the threshold switch (21) carries a signal with proportional and differential input signal components. The differential component is generated by a rapid rise in opacity in case of crankcase damage. This causes the alarm to be more rapidly initiated for increasing opacity.

2.3 Automatic Sensitivity Control

Assuming that the intensity of the light source (18) has a defined value, the system described in section 2.2. is sufficient to initiate alarm. In practice, though, influences arise which excessively deteriorate the exactitude of alarm initiation. Among others, these influences are fatigue and temperature drift in structural components and a by no means negligible instrument soiling due to deposits of the crankcase atmosphere in the area of the windows (10).

In order to negate these influences, the intensity of the light source (18) is not held at a constant level, as is normally the case, but is varied by the control system, consisting of modules 24,25,26 and 27, in such a manner that the light intensity at the receiver (19) is held constant. The automatic control itself reacts so slowly that the rapid opacity increase in case of damage cannot be compensated for by the increased intensity of the light source (18). The intensity of the light source (18) is determined by the current originating from the amplifier (27). The input signal for this amplifier comes from an electronic stepping switch assembly (26) and can be increased or decreased in steps of approx. 0.5 %. The stepping switch assembly is controlled by a pulse generator (25) with an extremely low frequency pulse for increasing the intensity as deposition occurs. A second pulse with a higher frequency results in an intensity decrease as would be necessary after cleaning. This ensures that excessive intensity, which would reduce the sensitivity of the instrument, can be corrected in a very short time.

2.4 Malfunction Signals

In order to prevent the crankcase supervisory device VN 115 from becoming inoperable due to malfunction, without being detected, several means of monitoring have been provided which initiate malfunction signals through the output (28). The relay at the output (28) operates according to the closed circuit principle so that the change-over contact is actuated if the operating voltage is interrupted or a power supply (29) failure occurs. The relay is also actuated if the automatic flow control (30) signals through the amplifier (31) and the threshold switch (32) that no fresh air is flowing into the chambers (11). This is the case of the partial vacuum is not maintained in the instrument (leak, no pumped air, instrument cover open) or if the fresh air filters (12) are too dirty. The relay is also actuated if the stepping switch assembly (26) attains a certain position, that is, if the intensity of the light source (18) can only be increased a negligible amount. In this case, the windows (10) must be cleaned.

2.5 Power Supply

The crankcase supervisory device, type VN 115, operates on DC-voltage. The power supply module (29) maintains the internal operating voltage at a constant level in spite of the inevitable supply voltage deviations. Special measures also prevent instruments damage or disturbance due to peak voltages superimposed on the supply voltage.
Longer lasting overload will blow the fuse and interrupt the power supply. A diode protects the equipment against false polarity of power supply up to 400 V.

The large range of power supply from 18 to 30 V allows the use of battery power.

2.6 Extension for Opacity Display and "hot spot localisation"

2.6.1 Opacity Display

For "hot spot localisation" (see 2.6.2) a analog opacity display is needed at the crankcase supervisory device. Also for other reasons this display can be profitable.
This display can be realised by a plug-in electrical analog opacity display mounting between the lower plugs and the plug of measuring unit (see section 7 item 10). Function and performance is described in data sheet 18009500.

2.6.2 "hot spot localisation"

The crankcase supervisory device VN 115L (see 6.1 item 5) allows the sectionalization of a damage in the crankcase upon one of two ranges. At large engines the error detection is facilitated by that. During normal operation the equipment sucks crankcase atmosphere through two collecting pipes out of the engine. By a hand gag however it is possible to close one collecting pipe. Watching the opacity display (see 2.6.1) at the same time one can find out by the defection of pointer out of which collecting pipe the crankcase atmosphere with the higher opacity comes to the crankcase supervisory device. Function and performance differing from the statments in this manual are described an a additional information sheet (see 6.1 item 5).

3. Technical data

Construction :	Compact instrument consisting of assembly connection plate (with air draft pump) for all pneumatic and electrical connections; for mounting directly onto the engine and a flexibly mounted platform for the measuring unit
Operating voltage :	18-30 V DC (usable for 24 V battery-networks) (other voltages upon request)
Permissible residual ripple :	max. 1 V_{ss}
Overvoltage protection :	installed and effective up to 60 V for 1 second, up to 250 V for 5 ms
Revers polarity protection:	by means of a blocking diode up to - 400 V
Current consumption :	max. 0.25 A
Excess current protection :	by means of a 0,5A slow-blowing fuse (by means of an extern 0,315A quick-action fuse a disengaging of the intern mounted fuse can be prevented)
Suction system :	2 headers (instrument connections are R 1/2" and R 3/4") with a max. of 9 branch lines (engine connection R 1/8" through R 1/4 ") for 9 cylinder in-line engines or 18 cylinder V-engines.
Partial vacuum for suction :	10-15 mm WS at instrument inlet, measured against atmosphere, generated by an air draft pump
Driving air supply for the air draft pump :	taken from compressed air supply and led through a pressure reducer (in special cases, from the load air channel (receiver) and compressed air supply with changeover contact; upon request) Consumtion: approx. 0.5 Nm^3/h (standard cubic meters per hour) at an absolute pressure of 6-12 bar
Sensitivity :	Adjustable for absorption values between 5 and 30%, relating to an oil mist concentration of approx. 1 to 10 mp/l. (lower limit for explosive mixture: approx. 50 millipond oil per liter of air)
Signal outputs :	
General alarm for automatic engine stop :	1 potential-free relay change-over contact; make contact bridged with 33 kohm resistor for detecting external line breaks Mode of operation : Relay excited by general alarm
Secondary alarm for inherent instrument surveillance (fail safe control)	1 potential-free relay change-over contact. Mode of operation : Relay is excited during normal operation. Excitation cut-out by secondary alarm.(The relay advices also an interruption of the operating voltage)

Contact load :	Voltage : max. 60 V/AC/DC Current : max. 1 A DC, 4 A AC, (with inductiv load L/R max. 40 ms) Power : max. 30 W, 200 VA (sufficient for auxiliary relais up to 15 VA locking power)
Permissible operating temperature :	0 to +75°C
Permissible temperature of intake oil mist :	max. +70°C at instrument inlet
Permissible storage temperature:	-25 through +85°C
Humidity :	tested to 90 % relative humidity
Vibration, impact :	tested with 6 g
Protective system :	IP 54 according to IEC 144
Materials :	mounting and connection part, case of the measuring unit are of cast aluminium, vibration free mounting plate are of sheet steel
Surface :	hammertone enamel, color aluminium
Weight:	7,0 kp
Maximum dimensions:	Width 175 mm, Height 435 mm, Depht 122 mm (refer also to fig. 4)

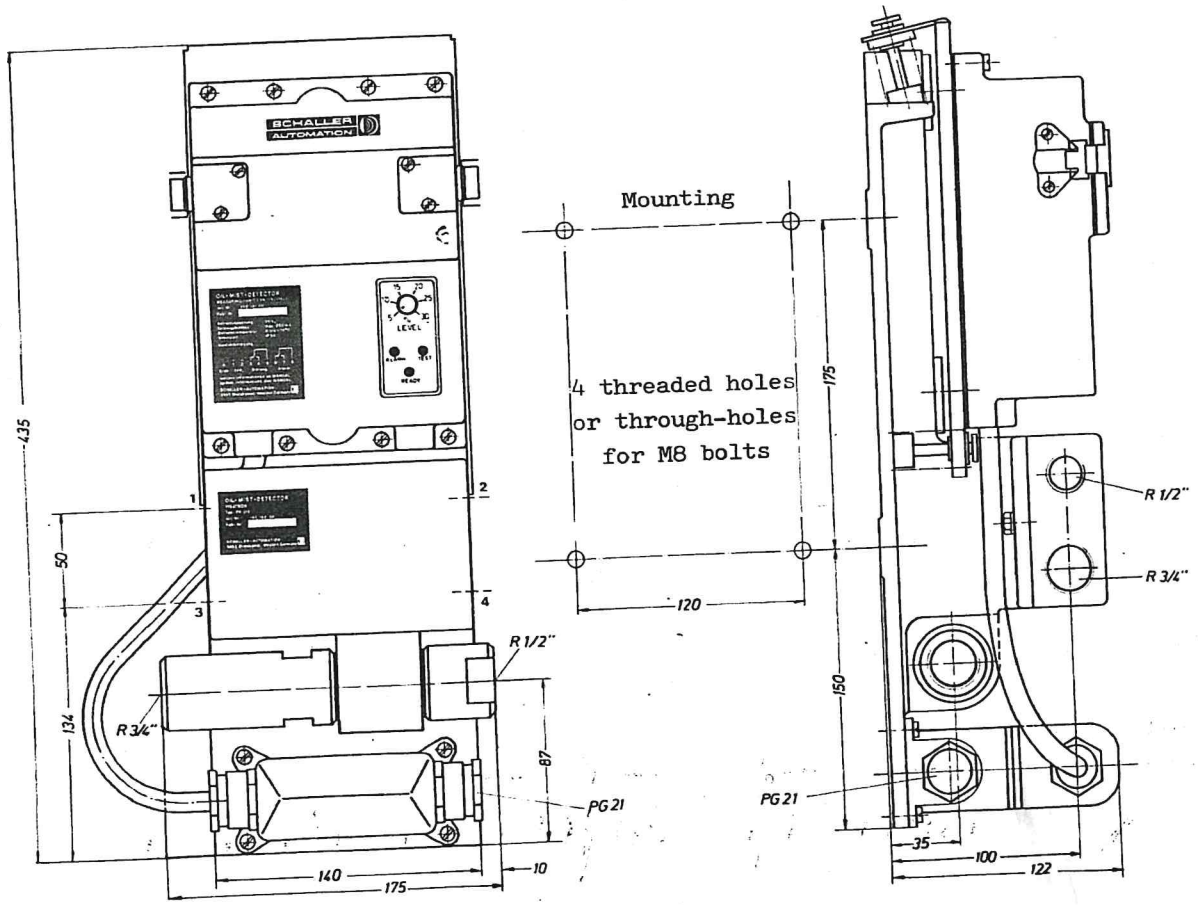


Fig. 4

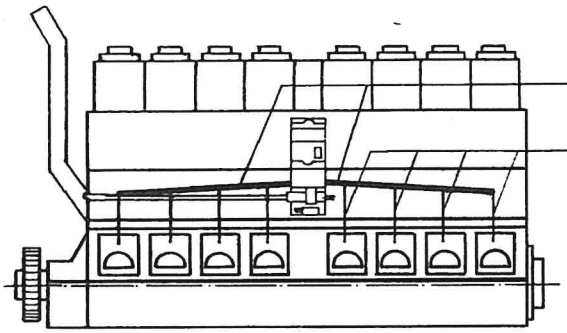
4. Assembly and initial setting

I m p o r t a n t :

For assembling and setting the directions and regulations of the specific registrations, specified under point 1.4, had to be attended.

4.1 Mechanical Assembly - Suction Lines to the Engine

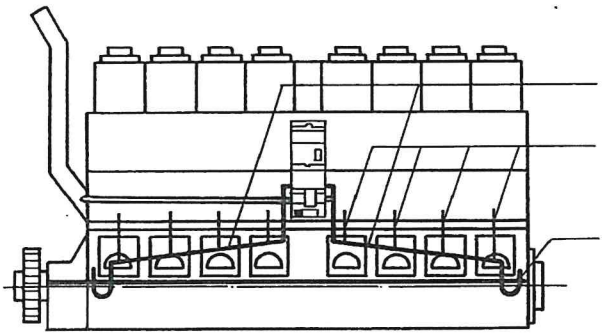
The crankcase surveillance instrument VN 115 is designed to be fitted directly onto the engine. This allows short suction lines, necessary for rapid alarm initiation.
The arrangements shown in figures 5 and 6 have proven themselves in practical experiments to be the most suitable.



header pipes (min. inside diameter 18 mm)

branch lines (diameters according table 1)
(fig. 8)

Fig. 5 (rising suction pipes, according to fig. 7a and 7c)



header pipe (min. inside diameter 18 mm)

branch lines (diameters according table 1)
(fig. 8)

siphon on the end of the header pipes
for the oil-return line to the engine

Fig. 6 (falling suction pipes, according to fig. 7b)

The instrument can be vertically attached to the engine with 4 M8 bolts. It should be positioned so that both headers have approx. the same length and slope away from the instrument. A slope is necessary to ensure the return of oil precipitated in the tubes. A slope of at least 1 : 30 is sufficient. Before mounting the transport lock, which fixed the vibration free mounted measuring unit on the mounting plate, had to be removed.

The headers should be made of tubes with smooth inside surfaces and an inside diameter of a least 18 mm. The length of each header should not exceed 6 m. For the connection of the headers on the collecting case of the VN 115; the unions of R 1/2" or R 3/4" can be used according the choosen diameter. Not used connections on the collecting case had to be tightened.

The arrangement in to fig. 6 necessitates a siphon at the end of each header to return the precipitated oil to the crankcase. During the initial operation, the siphon should be filled with oil so that no air can enter the header. The oil column in the siphon must be at least 40 mm high.

Short branch lines run from the headers to the extraction points on the individual crankcase sections. In principle, there should be one extraction point for each crankcase section. It is allowed to connect up to 9 crankcase section to one oil-mist-detector. The extraction points should be apportioned equally to the two headers (e.g. 4 and 5).

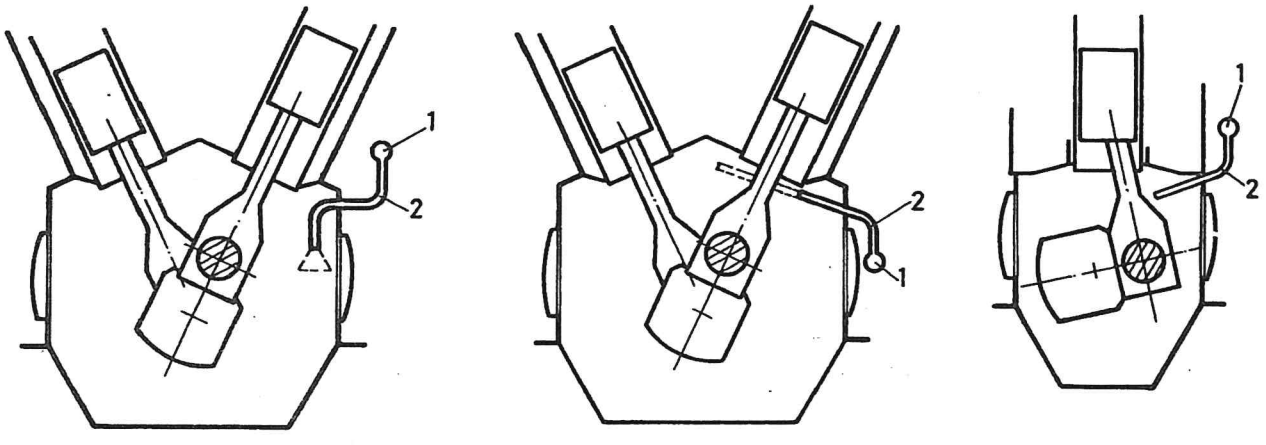
The branch lines can be introduced to the crankcase through the crankcase covers. Care should be taken to determine the most favourable position for the intakes in the crankcase. The following points are to be especially considered:

- The intakes should be positioned so that as little oil as possible can be thrown directly into it. If the intakes are pointed downwards, oil can run along the tube and form a drop in front of the orifice, causing a partial or complete closure. A small funnel could possibly be of help, eventually it's enough, to cut the pipe diagonally.

- The intake orifice must be installed in a position at which oil mist can be expected in case of damage. This is generally the case in the upper zone of the crankcase. If especially endangered areas are known to the engine manufacturer, the intake orifice should be suitably placed in the vicinity of this area. Positions should be avoided, which are subjected to a strong flow, in running conditions or during a defect, e.g. the opening between two crankcase sections.

Examples for the arrangement in the crankcase are shown in fig. 7 .

The simplest installation (a) is also the most disadvantaged one. By sucking at the outer wall of the crankcase only a part of the in case of a damage occuring oil mist will be picked up. Tests have shown, that the installations (b) and (c) are more satisfactory.



a) b) c)

1 = header 2 = branch line

Fig. 7

- New engines designs should be checked to determine extraction points which could possibly be more favourable and could then be directly integrated in the engine block. Eventually it is possible to locate the headers inside the crankcase, so that only in the near of the VN 115 two leadings for the headers are necessary.

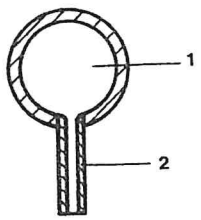
The branch lines between the extraction points and the header must be dimensioned in such a manner that the same amount of oil vapour is extracted at each extraction point. The branch lines should therefore be dimensioned in accordance with the following table 1.

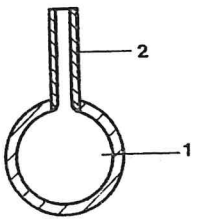
Table 1

Number of extraction points	Length of branch line	Inside diameter of branch line	Inside diameter of headers
less than 5	200 - 400 mm	8 mm	18 - 20 mm
	400 - 800 mm	10 mm	
5 to 9	200 - 400 mm	6 mm	
	400 - 800 mm	7 mm	

Fig. 8

All branch lines in one installation should be of the same length. In order to compensate for differences in length, they may be installed at varying slopes. Care must always be taken, though, that no oil locks can form, except for the two siphons as shown in arrangement fig. 6. No more than 5 branch lines may be led into 1 header for each supervisory device. Table 1 allows for two 90^{o} bends in each branch line, as would be necessary for an extraction point according to fig. 7a. The branch line junction to the header should be constructed according to fig. 9 a) and b).





1 = header
2 = branch line

a) ascending extraction tubes

b) descending extraction tubes

Fig. 9

The branch lines must not be allowed to project into the header and cross-section contractions are to be avoided. Oil mist would otherwise partially condense, reducing the opacity. Through there changes in the velocity of flow are impossible, which causes the oil-mist partially to condense and therefore to reduce the opacity.

4.2 Driving Air Connection

The partial vacuum necessary for extracting the oil mist from the crankcase is generated by an air draft pump installed in the instrument. The driving air pressure for the air draft pump must be adjusted so that a partial vacuum amounting to 10-15 mm water column results. This partial vacuum is measured against atmosphere at the instrument's oil mist collector (4, fig. 3) with the help of a U-tube manometer. It must be ensured that the partial vacuum cannot exceed 25 mm of water under any circumstances. This can be reliably attained by an arrangement using a special pressure reducer with an integrated throttle according to fig. 10.

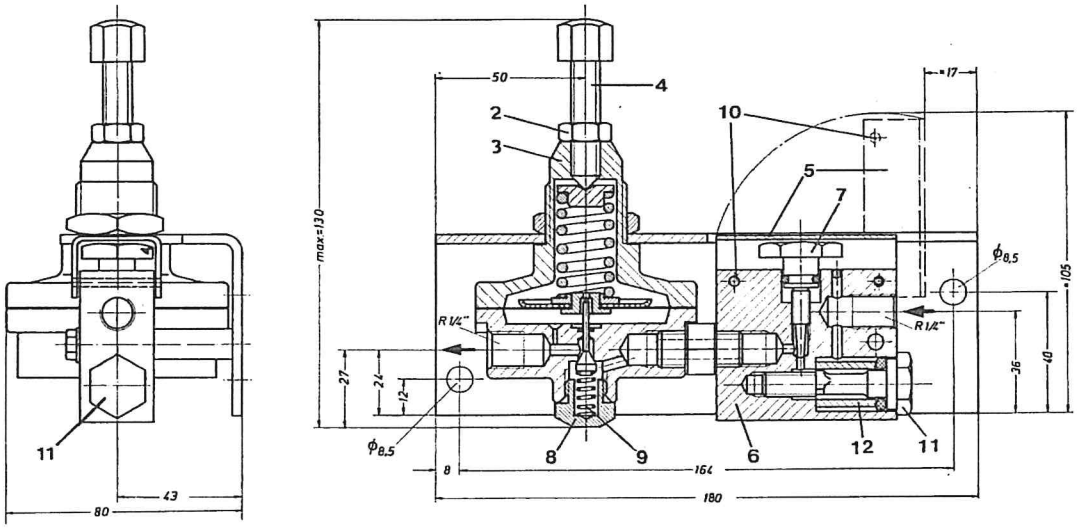


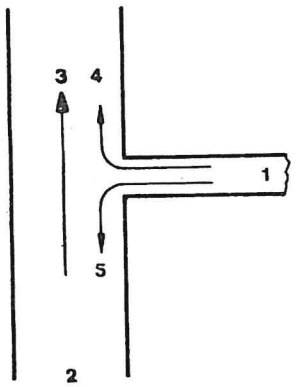
Fig. 10

If the pressure reducer with throttle (code no. 150 191 00) is used, its setting is to be made according to following instruction. At an unused connection at the collecting box of the VN 115 join a U-manometer (section 7, item 11). The measuring height should be at least 50 mm. Afterwards loosen counter nut (2) at the pressure reducer (3) and turn setscrew clockwise till the torque increases evidently. Open locking plate (5) at the throttle (6) and turn setscrew (7) clockwise by hand up to an evident resistance is to feel. Then connect compressed air with a prepressure of 6-12 bar. At the U-manometer no deflection may occur. Turn setscrew (7) anti-clockwise as far as vacuum of 20 mm water (less than 25 mm water) is indicated on the U-manometer. Close locking plate. Afterwards turn setscrew (4) anti-clockwise as far as the vacuum has gone between 10 and 15 mm water. Fasten setscrew (4) by tightening the counter nut (2). For testing open locking screw (8) at the pressure reducer and remove the spring (9). By that the pressure reducer becomes ineffective. After closing the locking screw (8) - without spring - the vacuum in the header will increase up to 20 mm WS. Eventually a correction has to be made by the setscrew (7). At last insert the spring (9) and fasten the locking plate. After a last check (10-15 mm WS) remove the U-manometer.

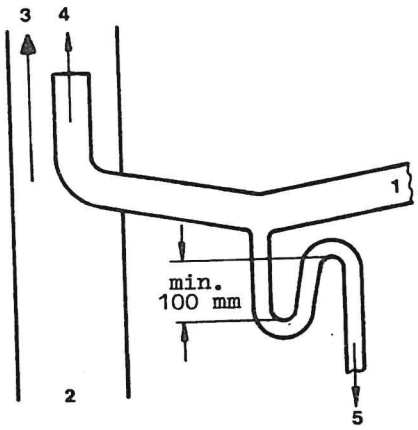
By turning out the screw (11) the filter (12) for the driving air supply becomes accessible and can be cleaned or exchanged.

4.3 Exhaust Air Connection

The mixture emerging from the exhaust side of the air draft pump may be expelled directly into the atmosphere or connected to the crankcase ventilation through a tube with an inside diameter of at least 25 mm. This pipe may not ascend up to his end on the crankcase ventilation. The intake into the crankcase ventilation must be constructed so that no ventilation back draft can occur. An oil lock (siphon) must be avoided in this pipe. If it isn't possible to avoid ascended or sagging pipes a oil outlet by means of a syphon on the deepest place had to be provided. Before initial setting the syphon must be filled with oil. (The oil level in the syphon must be more than 100 mm). Examples for the connection to the crankcase ventilation shows fig. 11a and b.



a)



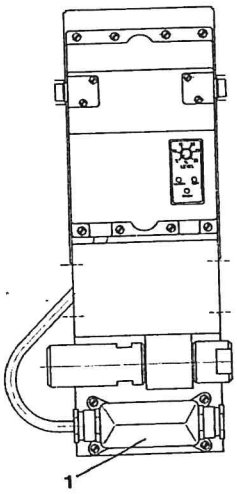
b)

1 = Exhaust pipe from VN 115
2 = crankcase ventilation
3 = Exhaust from the crankcase
4 = Exhaust from VN 115
5 = oil-return to the crankcase

Fig. 11

4.4 Electrical Connections

The electrical connections are made directly into the female connectors of the assembly and connection plate 2 unions joints PG 21 are available for the cable inlets.



a) Remove male connector (1).

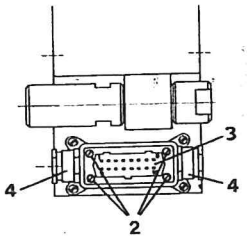
b) Loosen bolts (2) and remove female connector (3).

c) Pull the connecting cable through the desired union or unions (4) and fasten the conductor to the female connector insert (3).

d) Tighten the union joints (4).

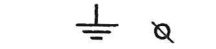
e) Re-install the female connector insert (3) being careful of the position, numeral 1 = upper left.

f) Plug unused union joints.

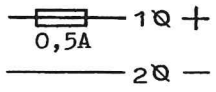


Use of contacts :

A T T E N T I O N :
The contacts 3 to 16 are not protected against external overvoltage and excess current. The contacts 1 and 2 for connecting the operating voltage are protected against revers polarity and overvoltage in accordance with section 3. technical data.

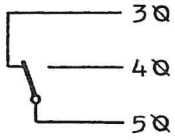


Earthed conductor



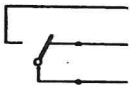
Operating voltage

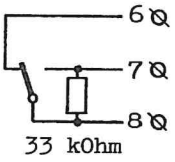
18-30 V DC, protection by a quick action fuse of 0,315 A according IEC-Publ. 127 specification II or similar fuse type.



Secondary alarm

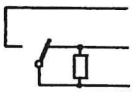
The contact position shown at left indicates secondary alarm.
During normal operation, the relay for contact actuation is excited and the contact assumes the following position:

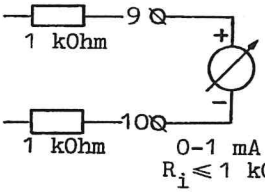




General alarm

The contact position shown at left indicates: no general alarm.
For a general alarm, the relay for the contact actuation is excited and the contact assumes the following position:





Analog signal

The analog signal reproduces the difference between the measured value and the threshold for initiating the general alarm.
1 mA corresponds thereby to an absorption value of 30%. The deviations are due to the automatic sensitivity control.
Attention: use only a potentialfree measuring device.

Contacts 11 - 16 are reserved for special applications and may not be used.

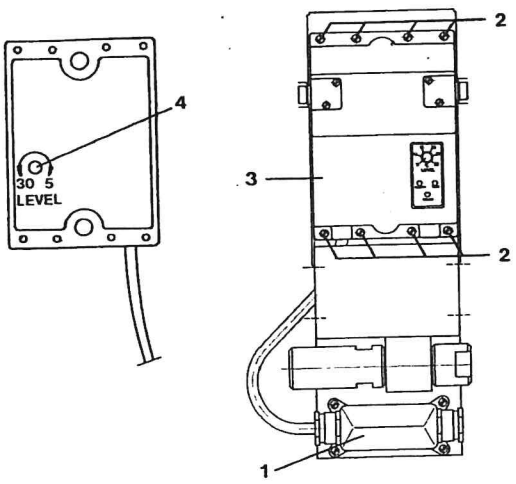
4.5 Initial Setting and Examination

The initial setting and examination had to be done in the sequence called in the items 4.5.1 to 4.5.5 .

4.5.1 Adjusting the Switching Threshold

The switching threshold of the instrument can be adjusted for absorption values between 5 and 30 %. The adjustment value is to be determined by the engine manufacturer in accordance with classification society regulations. It should be as little as possible above the normal operational deviations of absorption (e.g. load cycles). These deviations depends on the engine type and on there condition (wear). A to small adjusted switching threshold can lead to false alarm, especially during load cycles. In this case it had to be proofed, whether a upper switching threshold can be adjusted, without an unallowable reducing of the effectiveness of the crankcase survaillance.

The switching threshold adjustment is to be performed according to the following diagram:



a) Unplug the male connector (1).

b) Loosen the bolts (2) and measuring unit (3) and remove along with cable and male connector (1).

c) Insert a screw driver in the bore (4) on the rear side of the measuring unit and set the potentiometer to the necessary position (observe indication in the window of the front panel).

d) Re-install the measuring unit (3) on the assembly plate, using the bolts (2). Make sure that the bellows are in the right position.

e) Plug in the male connector (1).

4.5.2 Switch on Driving Air Supply

(see section 4.2)

4.5.3 Switch On Operating Voltage

Electrical Connections see section 4.4

4.5.4 Function Test

Initial setting should be completed with a function test. The following check list ensures that all functions are checked:

a) Interrupt the operating voltage for a short time (for example, pull out the male connector and re-insert it).
Results : "Ready" lamp is extinguished and lights up again after approx. 30 seconds. The "test" and "alarm" lamps should not light up. If the "ready" lamp does not light up, check the driving air supply.

b) Open the cover of the measuring unit (quick closers).
Results : After approx. 30 seconds, the "ready" lamp is extinguished. The "test" and "alarm" lamps should not light up.

c) Close the cover of the measuring unit.
Results : After approx. 30 seconds, the "ready" lamp will again light up; the "test" and "alarm" lamps should not light up.

A T T E N T I O N :
The following test could result in an engine stop.

d) Re-open the cover and immediately interrupt the optical measuring track (for example by inserting a finger or a non-transparent object).
Results : The "alarm" lights up immediately and goes out after approx. 30 seconds and the "ready" lamp is simultaneously extinguished and the "test" lamp lights up.

e) Unblock the optical measuring track.
Results : "Test" lamp is extinguished.

f) Close the cover.
Results : After approx. 30 seconds, the "ready" lamp lights up.

I M P O R T A N T :
It is possible, that the automatic sensitivity control of the VN 115 could be disturbed during this test due to the effects of extraneous light, causing the "test" or "alarm" lamps to illuminate although the cover is closed.
In this case the instrument can be returned to normal operation by briefly switching off the operating voltage. Pulling the male connector briefly and re-inserting it should suffice.
Checking the threshold adjustment is described in para. 5.4.4

4.5.5 Function Test with Cigarette Smoke

A T T E N T I O N :
This test could result in an engine stop.

The operability of the instrument can be checked under operating conditions by a cigarette smoke test.
For this purpose, a branch line is disconnected from the extraction point on the crankcase and cigarette smoke blown into it. This should be done in such a manner, that smoke is induced uniformly into the branch line for a period of 3-4 seconds. If the switching threshold is adjusted to a maximum value of approx. 10%, the induced smok will initiate an alarm.

5. Operational maintenance

5.1 Normal Operation

No regular service is necessary during normal operation. Due to the appropriate design of the instrument and the automatic sensitivity control, all routine checks can be omitted. Disturbances during normal operation are reported by the "secondary alarm"-signal. This signal simultaneously causes changes in the function of the instrument in order to avoid errors in the "general alarm"-signal.
The "ready" lamp is illuminated during normal operation. The relay for the "secondary alarm"-signal is excited (closed circuit principle). The general alarm is initiated by adequately dense oil mist as result of crankcase damage.

5.2 Operational Malfunction - Secondary Alarm

The "ready" lamp goes out in case of malfunction and the relay for the "secondary alarm"-signal is released.

"Secondary alarm" is initiated:

a) for an interruption of operating voltage. No "general alarm"-signal is possible.

b) immediately after the operating voltage is switched on, lasting until the automatic flow control is actuated and the automatic sensitivity control goes into effect, that is, approx. 30 seconds. No "general alarm" signal is possible.

c) if the intensity of the light source attains a level of more than approx. 50% of its maximum value due to the automatic sensitivity control. In this case, the windows of the measuring track must be cleaned. If they remain soiled, general alarm will be initiated as maximum light intensity is attained.

Up to the point of maximum light intensity, the normal initiation of "general alarm" is ensured in case of crankcase damage.

d) if the flow of air past the automatic flow control is interrupted. This is the case if:

da) driving air is interrupted.

db) the cover of the measuring unit is open (for example during cleaning procedures).

dc) the air filters are soiled (clean or replace air filters).

dd) if there is instrument leakage (check the gasket of the cover and between the measuring unit, assembly plate and bellows).

No "general alarm" signal is possible.

5.3 General Alarm

The "general alarm" signal is always initiated if sufficient light is absorbed along the measuring track that the switching threshold is not attained.
Exceptions are listed under item 5.2 under the indication: "No general alarm signal possible".

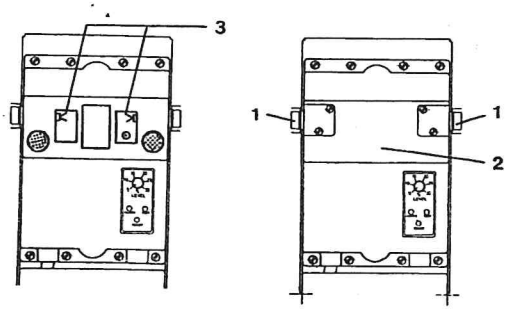
The "general alarm" signal can be utilized to automatically stop the engine or to effect speed reduction.

5.4 Maintenance

No regular instrument maintenance is necessary. The checks and/or procedures listed under item 5.2 must only be performed if the instrument initiates a secondary alarm due to malfuctions. The individual maintenance procedures are described in the following sections:

A T T E N T I O N :
Do not interfere with the function of the measuring track as long as the ready lamp is illuminated. Otherwise, general alarm could be initiated.

5.4.1 Cleaning the Optical Elements



a) Loosen the clamps (1). Tilt the cover (2) to the side.

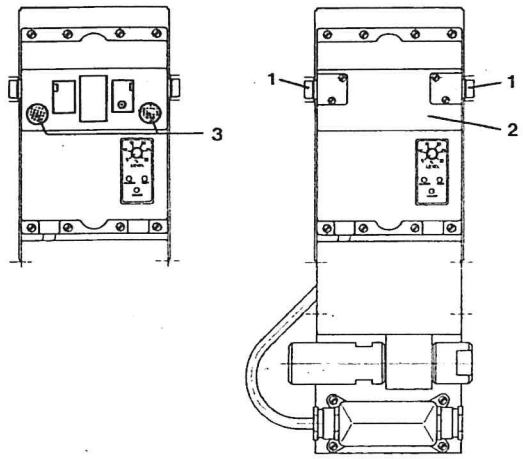
b) Wait until " ready" lamp is extinguished.

c) Clean the surfaces (3) with a soft piece of cloth (soaked in petrol if necessary).

d) Close the cover (2).

Secondary alarm will be initiated during the cleaning procedures because the cover (2) is open. The general alarm is switched-off.

5.4.2 Cleaning the Air Filter of the Fresh Air Supply.
(a soiled air filter can initiate secondary alarm)



a) Loosen the clamps (1). Tilt the cover (2) to the side.

b) Wait until the "ready" lamp is extinguished.

c) Remove the sintered bronze filter discs (3) underneath.
Clean the discs in petrol and re-install them.
If cleaning is no longer possible, replace the filter discs.

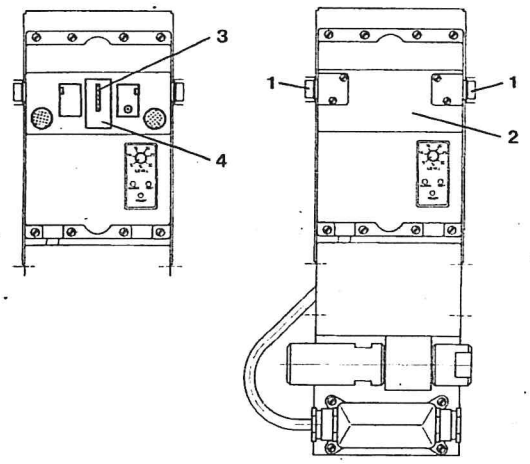
d) Close cover (2)

Secondary alarm will be initiated during cleaning procedures because the cover (2) is open. The general alarm is switched-off.

5.4.3 Cleaning the Air Filter in the Pressure Governor

If the pressure governor with throttle is used, the incorporated filter has to be cleaned or exchanged if required (malfunction by break down of driving air). For that purpose turn out the screw (11) according to section 4.2 and remove the filter (12) out of the borehole. It is suitable to shut off the pressure air supply during this operation. The assembly of the filter follows in revers sequence, but take care of the right insertion of the O-ring for sealing.

5.4.4 Checking the Switching Threshold Adjustment



a) Loosen the clamps (1). Tilt the cover (2) to the side.

b) Wait until "ready" lamp is extinguished.

c) Hold a filter glass (3) in front of the center recess (4) of the measuring unit. If the absorption of light due to the filter glass is larger than the switching threshold adjustment level, the "test" lamp will illuminate.

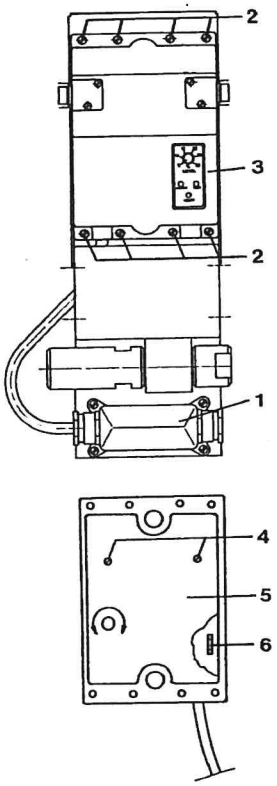
d) Close cover (2).

A T T E N T I O N :
If this test is done direct after switching in the supply voltage, a delay of min. 1 minute has to be observed before opening the cover.

5.4.5 Exchanges of Fuse

The incorporated fuse can only work if the external fuse (see 4.4) fails. Then the fuse to change according following instructions.

A T T E N T I O N
Only use micro fuse 0,5A according IEC-Publ. No. 127, leaflet III.



a) Pull plug (1)

b) Loosen screws (2) and remove measuring unit (3) with cable and plug (1)

c) At the rear loosen screws (4) and remove cover (5)

d) Exchange fuse (6)

e) Mount cover (5)

f) Fit measuring unit (3) with screws (2) onto the mounting plate. Thereby look for the right position of the bellows and good sealing

g) Insert plug (1)

6. List of Components

6.1 Instruments and Complete Sub - Assemblies

Pos. 1 Crankcase Supervisory Device VISATRON Typ VN 115
Operation and design as described under item 2 and 3

code no. : 150 180 00
nett weight 7,0 Kp

A space-saving, compact device for mounting on diesel engines with a maximum of 9 crankcase compartments (9 cylinder in-line engines or 18 cylinder V-engines) for detection of oil mist caused by overheating of the engine components.

This practically maintenance-free device, has no moving parts and can be used to signal alarm, shut down or reduced speed in case of abnormal increase in opacity of the oil mist in the crankcase, above normal working conditions.

The signalled alarm can be located directly on the device or on the main bridge. Failure of the device will be automatically signalled through an independent circuit.

The modular crankcase supervisory device consists of parts A + B.

A. Mounting and Connection Part

consists of

- a sturdy base plate of cast aluminium with fixing holes for mounting to the engine
- a non-wearing suction pump for connection to the ships compressed air supply. Air consumption 0,5 cbm/hour at 0,8 bar above atmospheric pressure
- a flexibly suspended, vibrationfree mounting plate for the measuring unit
- a pipe connecting unit - designed for ease of fitting and saving cost - to be fitted on site - with a maximum of 9 connections, which will be connected according section 4.1 without any flexible and vibrationfree components.
- a waterproof electrical connector plate with plugs and terminals for connection to the trouble-free 24 V DC ship's batteries, supplying power for the main and signal circuits

B. Electronical Measuring Unit in a Cast Aluminium Case

with cable and plug
(Spare part Code No.: 150 181 00)

easily exchangeable, simple plug-in connection with screw fastening.

Two instruction manuals in German, English or French will be supplied with each crankcase supervisory device (6.4, item 2,3 or 4)

Item 2,3 and 4 see under point 6.4

Item 5 Crankcase Supervisory device VISATRON Type VN 115 L, as item 1 but with additional hot spot locating device (= additional letter L)

Code-no. 150 196 oo
nett-weight 7,5 Kp

additionally equipped with:

a) the right/left manually operated selector valve incorporated in the pipe connecting unit

b) a plug-in electrical analog opacity display mounting between the lower plugs and the plug of the measuring unit

In addition to the manual an information sheet (2 copies) will be supplied with the operating instructions,

In German	code no. :	180 091 00
In English	code no. :	180 092 00
In French	code no. :	180 093 00

6.2 Spare Parts (according classification requirements for 'long voyage').

Item 6a) Electronic Module
for installation in the measuring unit

code-no.: 210 198 00
nett weight 0,2 Kp

alternatively if there is no skilled electronic engineer available

Item 6b) complete measuring unit in cast aluminium case with cable and plug as in items 1 and 5

code-no. : 15o 181 oo
nett-weight 2,2 Kp

Item 7 Set of small spare parts

code-no. : 150 197 00
nett-weight 0,2 Kp

comprising :

6 off fuses 0.5A, delayed action	no. 436 615
2 off sintered bronze airfilters	no. 365 197
2 off lock-washers for airfilter	no. 365 198
2 off flexible bellows for connecting the suspended mounting plate to the base plate	no. 365 193

6.3 Replacement Parts

Item 8 Set of Spare Parts

code-no. : 150 198 00
nett-weight 0,5 Kp

comprising :

1 off inspection cover packing	no. 330 481
1 off measuring unit packing	no. 330 482
2 off spring systems (upper)	no. 200 211
2 off spring systems (lower)	no. 200 212

6.4 Foreign Language Manuals

Item 2 Manual in German
code-no. : 180 085 00

Item 3 Manual in English
code-no. : 180 087 00

Item 4 Manual in French
code-no. : 180 089 00

7. Supplementary components and accessories

Item 9 Pressure Governor

(According to data sheet no. 180 094 00)

code no. : 150 191 00
nett weight 2,0 Kp

For connecting between the ship's compressed air system and the suction pump of item 1 and 5,

with contamination-free safety valve via easily cleaned sintered bronze filter (code no.: 365 206 00)

Primary pressure : max. 12 bar, minimum 1,2 bar above atmospheric pressure

Secondary pressure: adjustable to a max. of 0,8 bar above atmospheric pressure

In case of failure of the pressure governor, the throttle prevents the suction pressure in the collecting pipe system exceeding 25 mm water.

(Further information regarding the instructions for adjustments is contained in the manual para. 4.2)

1 sintered bronze filter (no. 365 206 00) will be supplied as a spare.

Item 10 Electrical analog opacity display, mounting between the lower plugs and the plug of the measuring unit (as contained in item 5)

code no. : 150 199 00
nett weight 0,5 Kp

Item 11 Equipment Set, for calibrating VN 115

code no. : 150 192 00
nett weight 0,8 Kp

comprising :

1, 5% grey filter
for controlling the pre-set alarm level in accordance with manual para 5.4.3

1, small screwdriver
for setting the alarm level

1, U-pressure gauge with 1/2" B.S.P. Connection
for setting and controlling the suction pressure in accordance with manual para 4.2

1, box (approx. 330 x 240 x 90 mm) with carrying handle and Pu-foam insert with additional space for 1 set spare parts item 7 and item 8, i.e. filter, fuses, packings, springs etc.

Item 12 10% Grey Filter

code no. : 330 313 00

Additional equipment to item 11 for setting the alarm level to 10% or 15% opacity

Item 13 Service Equipment Set for VN 115 and VN 115 L

code no. : 150 200 00
nett weight 1,5 Kp

comprising :

d. 11r. 1981,-

a) box (330 x 240 x 90 mm) with carrying handle and Pu-foam insert containing:
b) calibrating set as item 11
c) 1 set of small spare parts item 7
d) 1 set spare parts as item 8
e) 1 manual, in either German, English or French as item 2, 3 or 4

8. Agencies and service stations

see seperate list

9. Changes and completions

no entry

All instructions given in this manual corresponds to the technical statement of the day of issue. Modifications which serves for an improvement of the equipment will be reserved. In cases of doubt request for further inquiry.

Auswechseln der Elektronikplatte im Meßaufsatz für VN 115

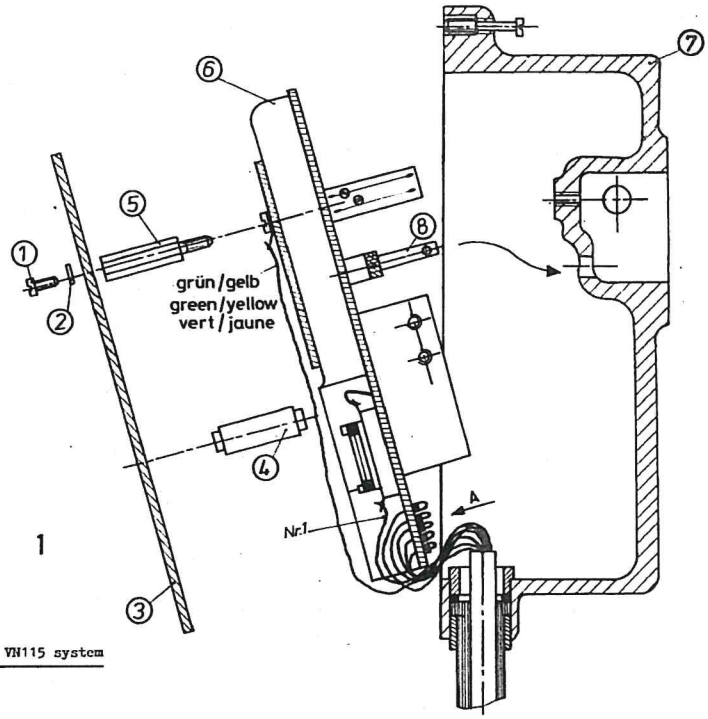
1. Ausbau

1.1 2 Schrauben ① und Scheiben ② entfernen
1.2 Abdeckplatte ③ und Führungshülse ④ abnehmen
1.3 Sechskantbolzen ⑤ lösen
1.4 Elektronikplatte ⑥ vorsichtig aus dem Gehäuse ⑦ ziehen; nur wenig kippen, da sonst die Gefahr besteht, daß der Strömungswächter ⑧ beschädigt wird.
1.5 13 Kabeladern (Nr. 1–12 schwarz, 1 Ader grün/gelb) ablöten.
1.6 Adern mit den Nummern 2–12 durch die Bohrung in der Elektronikplatte ⑥ ziehen und Elektronikplatte wegnehmen.

2. Einbau

2.1 Elektronikplatte ⑥ in geeignete Position bringen und die Adern 2–12 des Anschlußkabels durch die Bohrung führen.
2.2 Adern an entsprechende Lötstellen führen und anlöten: Ader grün/gelb an die Lötfahne, Ader Nr. 1 an den Sicherungshalter (siehe Bild 1), Adern Nr. 2–12 an die Lötstifte auf der Elektronikplatte (siehe Bild 2)
2.3 Elektronikplatte vorsichtig in das Gehäuse einsetzen. Darauf achten, daß der Strömungswächter ⑧ nicht beschädigt wird.
2.4 Sechskantbolzen ⑤ einschrauben.
2.5 Führungshülse ④ und Abdeckplatte ③ einsetzen.
2.6 Schrauben ① und Scheiben ② anbringen.

(Bild 3 zeigt die richtig montierte Elektronikplatte)



1

Replacement of the electronic module contained in the measuring unit of the VN115 system

1. Dismounting

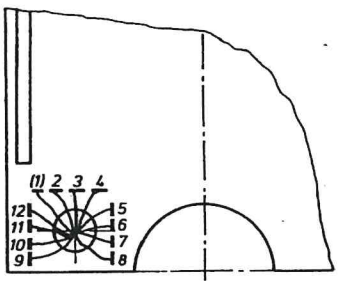
1.1 Remove the 2 screws ① and the washers ② .
1.2 Take off the cover ③ and the guide bearing ④ .
1.3 Unscrew the hexagonal bolts ⑤ .
1.4 Pull the electronic module ⑥ carefully out of the housing ⑦ ; tilt it just a little, as otherwise the flow control ⑧ may be damaged.
1.5 Unsolder the 13 cable wires (Nr. 1–12: black; 1 wire: green/yellow).
1.6 Draw the wires Nr. 2–12 through the borehole in the electronic module ⑥ , and remove the electronic module.

2. Mounting (reversed sequence of procedure 1.)

2.1 Put the electronic module ⑥ in a proper position and draw the wires Nr. 2–12 of the connection cable through the borehole.
2.2 Solder the wires on the corresponding soldering points: green/yellow wire on the soldering lug; wire Nr. 1 on the fuse-carrier (see fig. 1); wires Nr. 2–12 on the soldering pins on the electronic module (see fig. 2).
2.3 Insert the electronic module carefully in the housing. Take care of not damaging the flow control ⑧ .
2.4 Screw on the hexagonal bolts ⑤ .
2.5 Put in the guide bearing ④ and the cover ③ .
2.6 Fit the screws ① and the washers ② .

(The properly mounted electronic module is shown in fig. 3)

Verdrahtung Ansicht A
wiring view A
câblage vue A



2

Remplacement de la carte électronique montée dans le coffret de mesure de l'appareil VN115

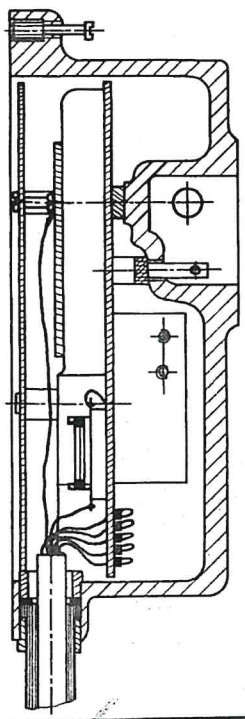
1. Démontage

1.1 Enlever les 2 vis ① et les rondelles ② .
1.2 Retirer la plaque de protection ③ et la douille de guidage ④ .
1.3 Desserer les boulons 6 pans ⑤ .
1.4 Retirer la carte électronique ⑥ du boîtier ⑦ avec précaution; ne la basculer que légèrement, afin de ne pas endommager le contrôleur de circulation ⑧ .
1.5 Dessouder les 13 conducteurs de câble (Nos 1–12: noir; 1 conducteur: vert/jaune).
1.6 Tirer les conducteurs Nos 2–12 au travers du percage dans la carte électronique ⑥ , et retirer la carte électronique.

2. Montage (ordre inverse de 1.)

2.1 Mettre la carte électronique ⑥ correctement en place; faire passer les conducteurs 2–12 du câble de raccordement au travers du percage.
2.2 Ressouder les conductuers aux points de soudure respectifs: conducteur vert/jaune, à la cosse à souder; conducteur No 1, au porte-fusible (voir fig. 1); conducteurs 2–12, aux broches à souder fixées sur la carte électronique (voir fig. 2).
2.3 Remettre en place dans le boîtier, avec précaution, la carte électronique. Veiller à ce que contrôleur de circulation ⑧ ne soit pas endommagé.
2.4 Visser les boulons 6 pans ⑤ .
2.5 Insérer la douille de guidage ④ et la plaque de protection ③ .
2.6 Poser les vis ① et les rondelles ②

(La fig. 3 montre le montage correct de la carte électronique)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