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ADAPTER FOR PRESSURE SENSORS**Technical field**

5 The invention relates to an adapter for pressure
sensors for monitoring long-term cylinder pressures in
internal combustion engines said adapter comprising a
housing with a gas duct, a connection to a cylinder
cover of an internal combustion engine, a rear opening
10 of the gas duct from the housing having an apparatus
for closing this rear opening in a gastight manner as
well as a connection for inserting a pressure sensor
with a sensor membrane.

15 **Prior art**

Adapters for mounting pressure sensors at internal
combustion engines are for example used on large diesel
engines, such as marine vessel diesel engines, for
20 carrying out long-term pressure monitoring. Such
adapters are attached on cylinder covers with a
connection provided for this purpose, said adapters
themselves having an opening towards the cylinder. The
adapters comprise a housing as well as a gas duct which
25 in the mounted state can exchange gas with the gas in
the cylinder and, thus, is in particular exposed to the
gas pressure within the cylinder.

Furthermore, such adapters have a connection for
30 inserting a pressure sensor with a sensor membrane
wherein the sensor membrane in the inserted state
reaches the gas duct and is exposed to the gas pressure
within the gas duct.

35 Conventional adapters have recesses, necks and/or
pockets at sites close to the sensor at which deposits
accumulate after extended operation periods that affect

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the measurement results. In the lubricating oil operation of marine vessel diesel engines these deposits comprise for example lubricating oil residues as well as scale and soot.

5

To ensure good measurement results it is necessary to dismount the sensor and to clean the adapter nearly every other day. This means an enormous maintenance effort because for this purpose the operation of the engine, for example the marine vessel diesel engine, must be shut off during the cleaning operation.

A pressure monitoring sensor with a membrane known from prior art is described in EP 0715159, which is mounted on an indicator or indicating valve of an internal combustion engine and is connected with the combustion chamber. Due to a constant blocking of the pressure channel and the service work connected with it the so-called C sensor was finally introduced in the said document, which can be used reliably for the same purpose. It comprises a sensor body with a pressure measurement hole, which is in turn connected with the combustion chamber. An expansion measuring element is inserted into an expansion measuring hole near this pressure measuring hole tangentially to the same, which reliably measures the expansion of the sensor body. Unfortunately the measurement is however falsified by outside influences, which are often difficult to compensate. Apart from temperature influences this in particular involves vibration, fluctuations and acceleration. The accuracy of such sensors is therefore limited during use.

US 5325720 shows a pressure sensor which can be mounted mainly gap-free in an opening of a wall. For this a membrane of the pressure sensor is coated with metal and the metal is radially and axially removed in a targeted way, so that the pressure sensor is flush with

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a test surface of the wall following installation via a thread bore in the opening in the wall.

5 Description of the invention

It is an object of the present invention to describe an adapter for attaching a pressure sensor having a sensor membrane at an internal combustion engine wherein said
10 adapter offers a low-maintenance operation.

This object has been achieved by the characterizing part of the independent claim.

15 The idea underlying the invention is that the transition line of the opening in the gas duct which is reached by the sensor membrane in the inserted state to be exposed to the gas pressure in the gas duct lies on a plane. The transition line forms the transition
20 between the contour of the gas duct and the connection to the sensor.

The planar form of the transition line of the opening ensures that the sensor membrane which is usually
25 embodied with a planar edge itself and, in the inserted state, forms a portion of the contour of the gas duct forms an as continuous transition as possible into the direct circumference of the gas duct. This prevents the formation of pockets due to edges and recesses at which
30 contaminations preferentially form deposits and affect the pressure measurements in an adverse manner.

Short description of the Figures

35 In the following the invention will be explained in more detail with respect of the drawings which show

Fig. 1 a perspective representation in cross-section

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- of an adapter according to the invention with sensor;
- Fig. 2 a perspective representation in cross-section of an adapter according to the invention with sensor in an alternative embodiment;
- Fig. 3 a representation in cross-section of an adapter according to the invention with sensor in an alternative embodiment;
- Fig. 4 a representation in cross-section of an adapter according to the invention with sensor in an embodiment with a bend.

Ways of carrying out the present invention

The reference numerals have been kept the same in both
5 drawings.

Figs. 1 and 2 each show a perspective representation in cross-section of an adapter according to the invention into which a pressure sensor 5 has been inserted. An
10 adapter of this type is particularly suitable for carrying out long-term cylinder pressure measurements and monitoring at internal combustion engines, in particular at large diesel engines, such as marine vessel engines. The adapter comprises a housing 1
15 defining the contour of a gas duct 2 by its inner walls.

The housing 1 further has a connection 3 to a cylinder cover of an internal combustion engine. In the mounted
20 state, a gas connection from the cylinder to the gas duct 2 is ensured by this connection 3.

At the other end of the housing 1 opposite to the connection 3 to a cylinder cover there is provided a
25 rear opening 11 of the gas duct 2 having an apparatus 12 for gastight sealing of this rear opening 11. This apparatus 12 can for example be an internal thread

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within this opening into which an indicator valve can be inserted. Thus, the adapter can be inserted in the cylinder cover at the site that is provided for the attachment of an indicator valve. The indicator valve
5 is then attached at the adapter at the apparatus 12 provided therefore. All connections to the adapter must ensure gastight connections to cause no pressure loss at the cylinder.

10 Furthermore, the adapter comprises a connection 4 for inserting a pressure sensor 5 with a sensor membrane 6. In the inserted state the sensor membrane 6 reaches until the gas duct 2 whereby the sensor membrane 6 is exposed to the pressure within the gas duct 2 and the
15 pressure within the cylinder for carrying out pressure measurements. For this purpose an opening 7 is provided in the gas duct 2 for the advancing of the membrane with a transition line 8 that forms the transition from the contour of the gas duct 2 to the connection 4 of
20 the pressure sensor 5. According to the invention, the transition line 8 of the opening 7 is on a plane. Thus, the sensor membrane 6 usually being provided with a planar edge itself can be fitted flush to the transition line 8 of the opening 7 without forming
25 pockets in which contaminations such as soot can accumulate. In this way, the surface of the sensor membrane 6 remains clean so that the measurements performed with the pressure sensor 5 can provide reliable values.

30 In first Examples represented in Figs. 1 and 2 the contour of the gas duct 2 forms a planar surface in the circumference 9 of the transition line 8 of the opening 7.

35 This planar surface in the circumference 9 of the sensor membrane 6 can be formed by an elongated through hole 13 as represented in Fig. 1 extending until the

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connection 3 to the cylinder cover. Alternatively, as represented in Fig. 2, this planar surface can also be achieved by a local elongated hole 14. This is for example achieved by local cutting at this position.

5

To remove contaminations which nevertheless form at the different sites within the adapter the indicator valve can be opened briefly from time to time during engine operation so that contaminations at the adapter are
10 blown away by the pressure generated. Arrows in the Figures represent the flow that is generated when the indicator valve is opened. If there is no indicator valve present also the rear opening 11 can be opened for a short time by opening the apparatus 12 for
15 gastight sealing. It has been found that this cleaning is sufficient as long as the dirt cannot adhere too firmly to the edges. In arrangements according to the prior art a cleaning of this type would not be sufficient to clean the sensor membrane 6.

20

In particular, one embodiment of the present invention is formed by the adapter described herein with a pressure sensor 5 inserted therein that has a sensor membrane 6 which reaches until the gas duct 2 together
25 with which it forms a common planar surface.

By the devices described herein long-term cylinder pressure measurements and monitoring can be performed on internal combustion engines without much maintenance
30 effort.

Further Examples are shown in Figs. 3 and 4. These embodiments are particularly suitable for front sealing pressure sensors 5. In this application, front sealing
35 pressure sensors 5 have the advantage compared to pressure sensors 5 with a seal at the rear end that there is no gap between the sensor membrane 6 and the adapter at the transition line 8 of the opening 7. Soot

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may accumulate in this gap and block the sensor membrane 6 impeding its free oscillation. Front sealing pressure sensors 5 have no gap since they can be pressed at a frontal zone directly on a pressing surface 16 to the housing 1 of the adapter. The pressing surface 16 surrounds the opening 7 on the side of the housing and is defined by the transition line 8. Also in this Example, the transition line 8 of the opening 7 lies on a plane.

10

In this Example, the circumference 9 of the transition line 8 on the side of the gas duct 2 forms a funnel shaped surface 10. Thus, the housing 1 forms an acute angle around the transition line 8. Particularly, the slopes of the funnel can be straight or curved. It is important that the transition from the contour of the gas duct 2 to the sensor membrane 6 which in the inserted state forms part of this contour forms a continuous transition in the region of the transition line 8 so that no pockets are formed in which contaminations such as soot can accumulate.

20

To optimize the flow characteristics in the region of the sensor membrane 6 the gas duct 2 can have a bulge 17 opposite of the funnel shaped surface 10. This ensures that during rinsing of the adapter, as described for the Examples in Figs. 1 and 2, a flow is generated in the circumference 9 of the sensor membrane 6 that results in thorough cleaning.

30

Constructive advantages in the fabrication of such an adapter according to the invention are achieved if the connection 4 for the pressure sensor is arranged in a bend of the gas duct 2 as represented in Fig. 4. In a bend the funnel shaped surface 10 as well as the bulge 17 are innately present. In this case, the connection 4 for the pressure sensor 5 is mounted on the outer surface of said bend.

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Preferably, for these assemblies shown in Figures 3 and 4 front sealing pressure sensors are mounted. Such pressure sensors 5 preferably have a sensor membrane 6 with a concave surface 15 so that a continuous transition from the contour of the gas duct 2 to the surface of the sensor membrane is ensured without the formation of pockets. This continuous transition can be seen from Figures 3 and 4.

10

Both Examples of the adapters described herein have advantages. The first ones represented in Figs. 1 and 2 are easier to fabricate, the others represented in Figs. 3 and 4 ensure better functionality due to the front seal of the pressure sensor 5 because the membrane circumference that lacks a gap can be kept cleaner.

20

List of reference numerals

- 1 housing
- 2 gas duct, contour of gas duct
- 3 connection to a cylinder cover
- 4 connection for inserting a pressure sensor
- 5 pressure sensor
- 6 sensor membrane
- 7 opening for sensor membrane
- 8 transition line
- 9 circumference of the transition line
- 10 funnel shaped surface
- 11 rear opening
- 12 apparatus for gas-tight sealing
- 13 elongated hole, cut through
- 14 elongated hole, local
- 15 concave surface
- 16 pressing surface
- 17 bulge

ADAPTER TIL TRYKSENSORER

Patentkrav

1. Adapter til tryksensorer til udførelse af langsigtet cylindertrykovervågning på forbrændingsmotorer omfattende et hus (1), der indvendigt definerer en kontur af en gaskanal (2), en tilslutning (3) til et cylinderdæksel til en forbrændingsmotor for at frembringe en gasforbindelse mellem det indre af en cylinder og gaskanalen (2), en bagåbning (11) af gaskanalen (2) ud fra huset (1) med en anordning (12) til gastæt tætning af denne bagåbning (11), en tilslutning (4) af en tryksensor (5) til isætning af en tryksensor (5) med en sensormembran (6), hvor sensormembranen (6) i den isatte tilstand når frem til en åbning (7) i gaskanalen (2) og eksponeres for et gastryk i gaskanalen (2), og hvor denne åbning (7) har en overgangslinje (8), der danner overgangen fra en kontur af gaskanalen (2) til tilslutningen (4) af tryksensoren (5), kendetegnet ved, at overgangslinjen (8) for åbningen (7) ligger i et plan, ved, at sensormembranen (6) i den isatte tilstand danner en del af konturen af gaskanalen (2), og ved, at overgangen fra konturen af gaskanalen (2) til sensormembranen (6) danner en kontinuerlig overgang i området for overgangslinjen (8).
2. Adapter ifølge krav 1, kendetegnet ved, at en indikatorventil kan fastgøres på denne anordning (12).
3. Adapter ifølge et af de foregående krav, der omfatter en tryksensor (5) med en sensormembran (6).
4. Adapter ifølge et af de foregående krav, kendetegnet ved, at konturen af gaskanalen (2) i området for (9) overgangslinjen (8) af åbningen (7) danner en flad overflade.
5. Adapter ifølge krav 4, kendetegnet ved, at den flade overflade er en del af en gennemgående aflang spalte (13).
6. Adapter ifølge krav 4, kendetegnet ved, at den flade overflade er en del af en lokal aflang spalte (14).
7. Adapter ifølge et af kravene 1 til 3, kendetegnet ved, at konturen af gaskanalen (2) i området (9) for overgangslinjen (8) af åbningen (7) danner en tragtformet flade (10), hvor flankerne navnlig kan være lige eller kurvede.

8. Adapter ifølge krav 7, kendetegnet ved, at tilslutningen (4) er til en fronttættende tryksensor.

5 9. Adapter ifølge krav 7 eller 8, kendetegnet ved, at gaskanalen (2) i området, der ligger over for den tragtformede flade (10), har en udbuling.

10. Adapter ifølge et af kravene 7 til 9, kendetegnet ved, at forløbet for gaskanalen (2) i området for tilslutningen (4) til tryksensoren (5) beskriver en bøjning, hvor tilslutningen (4) er
10 placeret på ydersiden af bøjningen.

11. Adapter ifølge et af kravene 7 til 10, der viser tilbage til krav 3, kendetegnet ved, at sensormembranen (6) har en konkav overflade (15).

15 12. Adapter ifølge krav 11, kendetegnet ved, at den konkave overflade (15) danner en kontinuerlig overgang til den tragtformede flade (10).



