

Annular seal

The invention relates to an annular seal on an internal combustion engine for sealing the annular gap on a valve shaft of an inlet valve or outlet valve, wherein the annular seal is accommodated in a circumferential demountable mount.

For example in marine engines there is a demand for such seals to have a particularly long service life until replacement becomes necessary. Premature changing of seals means that the components seated on the valve housing need to be removed completely so that the annular seal for the guide bush becomes freely accessible and can be replaced.

A further requirement of such annular seals consists of their sealing effect being able to be maintained without any change as far as possible over the entire service life; for any replacement of the annular seal should be unnecessary for at least such time as the engine needs to be dismantled anyway due to other maintenance work, e.g. on the outlet valves.

In known heavy-duty annular seals, preferably comprising Teflon, at times premature replacement of seals can become necessary if combustion gases rise in the annular gap of the guide bush, thus overcoming the annular seal, with the consequence that the oil film for lubricating the guide bush is interrupted.

Exchanging the annular seal as a rule is tantamount to a lengthy and thus expensive interruption in the use of an engine, because replacing the seals requires deinstallation of all the components arranged above the guide bush, in which components the valve shaft is accommodated. In the case of ship propulsion systems with large two-stroke diesel engines this means at least deinstallation of the

air cylinder for closing the outlet valve, of the hydraulic cylinder for opening the outlet valve, and of all the associated assemblies; in the case of four-stroke engines this means at least the removal of the valve springs and the dismantling of the cylinder head cover because the annular seal is usually located in that position between the flange of the guide bush and the cylinder head cover.

The annular seals to be replaced are frequently destroyed to such an extent that in order to remove all the residual materials deinstallation of the complete outlet valve, or in the case of a four-stroke engine of the complete cylinder head including the connections for hydraulics, coolant and the exhaust gas line, is unavoidable.

Starting from this, in a known annular seal of the type mentioned in the introduction (GB 273590 A) a mount is provided that is split across the shaft axis so that it can be dismantled. Each annular seal comprises four segments whose end regions mutually interlock.

Furthermore, an annular seal in a separate housing with sealing elements arranged therein, which sealing elements comprise segment components, is known (US 688790 A1), which sealing elements are arranged in three annular layers and can be elastically clamped together.

In this context it is the object of the present invention to create an annular seal that interacts with a guide bush, makes possible simple replacement, and is distinguished by an unchanging sealing effect.

According to the invention this object is met in an annular seal of the type mentioned in the introduction according to the characteristic of claim 1.

Advantageously the mount according to the invention is designed as an annular element with an angular cross section, whose limb that extends right to the valve shaft forms a flange as a support for the annular seal, and whose limb that axially points away from the guide bush forms a flange for the screw fastening arrangement of the annular element. This limb of the mount, which limb extends in axial direction, in a first embodiment is screwed to the flange of the guide bush, and in another embodiment is screwed to a component that is situated opposite the flange, in other words in the case of a four-cylinder engine to the cylinder head cover, or in the case of a two-cylinder engine to the associated end wall of the air cylinder.

The mount according to the invention ensures that the annular seal is safely held in its place between the components that adjoin on both sides in axial direction, while these components are moved away from each other for dismantling the annular seal. In order to deinstall the annular seal, after removal of the components it is only necessary to unscrew the mount in order to obtain access to the annular seal.

As a result of the annular seal being composed of segment components in a way that is known per se, it is possible to deinstall it in radial direction relative to the longitudinal axis of the valve shaft.

A preferred embodiment of the annular seal provides for three segment components for each annular layer with a total of three annular layers to be provided, and for the segment components of the middle layer on the outer circumference to comprise rims that project on the outer circumference on both sides in axial direction, within which rims the segment components of two outer annular layers are gripped. In this way the relative mobility of

the segment components and thus their non-diminishing sealing effect remains ensured.

Expediently, a certain delimitation of the movement of the segment components is advantageous; therefore, according to a further embodiment of the invention it is provided for each segment component of the middle annular layer to comprise limit stops that project approximately in the segment middle on both sides in axial direction, which limit stops delimit rotation in the sense of movement of the segment components of the outer annular layers in circumferential direction.

After installation of the annular seal, holding together the segment components is ensured in that the segment components encompass the valve shaft, and in axial direction on both sides are accommodated within the mount with little play, and are axially supported between said mount and an adjacent component.

By means of the elastic tension ring provided according to the invention the sealing effect is automatically maintained, wherein a lubricating oil film between the seal and the valve shaft ensures an extended service life of the annular seal. Oil lubrication takes place from above, traverses the seal before continuing in the annular gap of the guide bush. In two-stroke diesel engines in which the air cylinder is arranged opposite the flange of the guide bush, the oil collected in the air cylinder flows over a gap seal through the annular gap of the cylinder bottom from where it reaches the guide bush by way of the annular seal.

Finally, a particularly advantageous method according to the invention for dismantling or exchanging the annular seal accommodated in a mount in an outlet valve of a two-

stroke diesel engine with a compressed-air cylinder seated on a valve housing comprises the method-related steps of:

- a) undoing the connection between the compressed-air cylinder and the valve housing;
- b) lifting the compressed-air cylinder on the valve shaft by a stroke length that at most corresponds to the valve lift;
- c) exposing the annular seal by undoing and lifting its mount;
- d) laterally deinstalling or installing the annular seal comprising segment components.

It is understood that especially when the annular seal according to the invention is used on a two-stroke motor of the type mentioned, particular advantages can be achieved, namely insofar as in this application the components provided above the guide bush need only be undone and lifted in axial direction along the valve shaft, and consequently there is no need to completely deinstall said components, so that quick lateral replacement of the annular seal becomes possible.

Below, the invention is explained with reference to two exemplary embodiments. The following are shown:

Fig. 1 an axial section of an annular seal whose mount is connected to the guide bush;

Fig. 2 the annular seal according to Fig. 1 with components that have been lifted off one another;

Fig. 3 an axial section of an annular seal whose mount is screwed to the housing of the air cylinder;

Fig. 4 the annular seal according to Fig. 3 with components that have been lifted off one another;

Fig. 5 a top view of the annular seal;

Fig. 6 an axial view of the annular seal;

Fig. 7 a segment component of a middle annular layer of the annular seal; and

Fig. 8 a segment component of an outer annular layer of the annular seal.

Fig. 1 shows a section of a valve shaft 1 of an outlet valve in a two-stroke diesel engine for ship propulsion systems. The valve shaft 1 runs in a guide sleeve 2, which in the drawing is broken off towards the bottom, which guide sleeve 2 at its upper rim ends in a circumferential flange 3. The flange 3 of the guide sleeve 2 is seated on a turned recess 4 of a valve housing 5 on whose top 6 rests an end wall 7 of an air cylinder that is arranged above it. At its centre the end wall 7 of the air cylinder comprises a turned groove 8 in which a metal sealing ring 9 is accommodated. The latter forms a defined gap seal with the valve shaft 1, which gap seal makes possible the flow of oil to produce an oil film for lubricating the guide bush 2 and in particular of an annular seal 10 arranged above it. The annular seal 10 is accommodated in a circumferential mount 11 that comprises an angular cross section. Said mount 11 is sealed by means of an O-ring 14 towards its circumferential seat surface 12 on the one hand, and towards the underside of a cover plate 13 on the other hand. Circumferentially the covering plate 13, the mount 11 and the flange 3 of the guide sleeve 2 are interconnected by means of several connecting screws 15. By means of several fastening screws 16, which are distributed

circumferentially and which are arranged so as to be recessed in the flange 3 of the guide bush 2, said guide bush 2 is also screwed to the valve body 5. The sealing ring 9, too, by means of several connecting screws 17 that are arranged so as to be recessed in the end wall 7, that pass through the latter and that engage threaded holes 18 of the sealing ring 9, at several circumferential positions is connected to the end wall 7 of the air cylinder.

The design unit described in total is connected to form a design unit by means of tensioning screws (not shown) which clamp together the air cylinder and the oil cylinder that is arranged above the aforesaid, with the valve housing 5.

Fig. 2 shows the design unit according to Fig. 1 with the end wall 7 of the air cylinder lifted off, after corresponding undoing of the tensioning screws. In this lifted-off position of the air cylinder the mount 11 and thus the annular seal 10 is accessible for their dismantling. In this arrangement the maximum lift of said lifting-off corresponds to the maximum valve lift of the outlet valve on the valve shaft 1. A borehole 19, which extends across the valve housing 6, is designed to remove unused lubricating oil that collects in the circumferential gap 20 between the flange 3 of the guide bush 2 and the turned recess 4 of the valve housing 6.

For dismantling the annular seal 10, in the lifted-off position of the components according to Fig. 2 the connecting screws 15 are undone, thereafter the cover plate 13 is pushed away towards the top, and the annular seal 10 is thus fully accessible for replacement of the seal. Said replacement will be described in detail in connection with Figures 5-8.

Figures 3 and 4 show a slightly different arrangement of the annular seal 10 when compared to the embodiment

according to Figures 1 and 2. In the embodiment according to Figures 3 and 4 the mount 11 and thus the annular seal 10 are screwed to the underside of the end wall 7 of the air cylinder, as shown in the lifted-off position according to Fig. 4. By means of the connecting screws 21 that have been provided for this purpose the sealing ring 9 is also affixed, whose outer circumference is sealed off by an O-ring 22 against the turned groove 8 in the end wall 7 of the air cylinder. When viewed in cross section the mount 11 comprises a limb 24 that extends towards the valve shaft, and a limb 23 that extends perpendicularly to the aforesaid, in which limb 23 the connecting screws 21 are accommodated so as to be recessed. On the limb 24 there is the annular seal 10 where in axial direction it is accommodated in a defined manner in the annular space between the limb 24 of the mount 11 and the bottom 25 of a turned recess in the underside of the end wall 7 of the air cylinder.

A further O-ring 26 is provided in a corresponding groove in the top of the flange 3 of the guide bush 2. In the region of its flange 3 the guide bush 2 is connected by means of several circumferentially distributed connecting screws 16 to the valve housing 6 in a manner similar to that in the exemplary embodiment according to Figures 1 and 2.

In order to deinstall or replace the annular seal 10, in the position according to Fig. 4 the mount 11 is removed downwards by undoing the fastening screws 21 so that the annular seal 10 is also freely accessible and for replacement can be pushed downwards.

Figures 5-8 show the design of the annular seal 10 in detail. Said annular seal 10 comprises three annular layers, namely a middle annular layer whose segment components 27 comprise rims 28 that project in axial

direction on both sides, as well as two outer annular layers, each comprising three single segment components 29. In the same manner the middle annular layer comprises three segment components 27, each comprising limit stops 30 arranged in the segment middle, which limit stops 30 project on both sides in axial direction and in this way delimit sliding of the segment components 29 of the outer annular layers in circumferential direction.

Corresponding to the explained composition of the annular segments comprising individual segment components 27, 29, there is the option of simple disassembly of the annular seal 20 and of laterally deinstalling its segment components, as well as in identical manner the installation of a new annular seal from the side around the circumference of the valve shaft.

An important characteristic of the annular seal consists of its automatic readjustment in radial direction so that it always rests at a slight pressure against the outside of the valve shaft 1. In order to cause this radial readjustment, Figures 1-4 each show an elastic tension ring 31 which by its tension clamps the loose segment components 27, 29 inwards towards the circumference of the valve shaft. Such a tension ring 31, e.g. in the form of an elastomer ring or an annular sleeve comprising a helical spring, is accommodated in a circumferential groove 32 of the segment components 27 of the middle annular layer. Said tension ring 31 ensures that the annular seal automatically readjusts towards the valve shaft 1, thus ensuring maintenance of the full sealing effect over the entire service life of the annular seal 10.

CLAIMS

1. An annular seal on an internal combustion engine for sealing the annular gap on a valve shaft (1) of an inlet valve or outlet valve, wherein the annular seal (10) is accommodated in a circumferential demountable mount (11),

characterised in that

the mount (11) is firmly screwed to a guide bush (2) of the valve shaft (1) or to a component that is axially opposite said guide bush (2); in that the mount (11) is designed as an annular element with an angular cross section whose limb (24) that extends right to the valve shaft (1) forms a flange as a support for the annular seal (10), and whose limb (23) that axially points away from the guide bush (2) forms a flange for the screw fastening arrangement of the annular element; and in that the annular seal (10) comprises segment components (27; 29) that can be disassembled, which in circumferential direction overlap and in axial direction are arranged in at least two annular layers and are clamped together so as to be automatically readjustable towards the valve shaft (1).

2. The annular seal according to claim 1, characterised in that three segment components (27; 29) for each annular layer with a total of three annular layers are provided and in that the segment components (27) of the middle annular layer at the outer circumference comprise rims (28) that on both sides project in axial direction, within which rims (28) the segment components (29) of two outer annular layers are gripped.

3. The annular seal according to claim 2, characterised in that each segment component (27) of the middle annular layer comprises limit stops (30), arranged approximately in the segment middle, that project on both sides in axial direction, which limit stops (30) delimit rotation of the segment components (29) of the outer annular layers in circumferential direction.
4. A method for dismantling or exchanging an annular seal (10) according to claims 1 to 3, which seal (10) is accommodated in a mount in an outlet valve of a two-stroke diesel engine with a compressed-air cylinder (7) seated on a valve housing (5), comprising the steps of:
 - a) undoing the connection between the compressed-air cylinder (7) and the valve housing (5);
 - b) lifting the compressed-air cylinder (7) along the valve shaft (1) by a stroke length that at most corresponds to the valve lift;
 - c) exposing the annular seal (10) by undoing and lifting its mount (11);
 - d) laterally deinstalling or installing the annular seal (10) comprising segment components (27; 29).