

STUFFING BOX SEAL FOR PISTON RODS

The present invention concerns a stuffing box seal for piston rods for internal combustion engines with an upper, piston-side sealing region and a second, crankcase-side sealing region. Stuffing box seals of this kind are known, in particular for marine diesel engines. In this connection reference is made particularly to DE-B-21'14'152 of the Maschinenfabrik Augsburg-Nürnberg AG. A variant is described in EP-A-0'138'443 and DE-1-27 02 428.

The performance specification of every stuffing box seal contains several main requirements, e.g. optimal separation of crankcase and cylinder oil, i.e. good scraping of clean crankcase oil from below and good scraping of contaminated cylinder oil from above, to prevent entrainment of the oil, and good sealing of the scavenging air pressure above, durability, good operation in extreme conditions, e.g. fire in the scavenging air chamber, reduction of oil losses and the lowest possible wear on the piston rod.

To achieve high gas-tightness and a good scraping effect the packing and stripper rings must fit exactly around the piston rod. This can be achieved by making the rings out of relatively flexible material, which fits even underdimensioned piston rods exactly and without running-in. In addition, the split joints must be so arranged that no direct flow across the ring is possible.

Traditional stripper rings are made of metal, in several parts and with straight split joints. Such rings fit the exact form of the piston rod badly and only with strong spring pressure, thus causing heavy wear to rings and rod, especially during start-up and running in, above all at bottom dead centre and top dead centre. In addition, this metal abrasion leads to certain scratch marks which further reduce sealing.

The durability of such seals is especially dependent on lubrication. Here, lubrication is effected by corresponding seepage along the piston rod. This seepage, essential to lubrication, leads, however, to considerably increased oil consumption. Usually, metal packing rings have three or more split joints. This again further reduces gas-tightness.

In DE-A-23'51'850 (G. Espey) it was first proposed to make stripper rings in one piece in flexible material. In particular, packing and stripper rings following EP-A-0'139'965 were used in stuffing box seals for piston rods. Such packing and stripper rings were used only in small numbers in stuffing boxes, and only in the lower, crankcase-side sealing region. Although gas-tightness was thereby improved, this solution was not widely adopted, as the

durability of the metallic, upper stuffing box seals was unsatisfactory and the wear on the rods was increased.

It is the object of the present invention so to improve stuffing box seals of the type mentioned at the outset that, while maintaining or even improving gas-tightness, the durability even of under-dimensioned rods is increased, oil consumption reduced, wear on rings and rods diminished, while assembly, maintenance and spare parts stocking are simplified.

This demanding task is performed by a stuffing box seal of the type mentioned at the outset with the characterising features of Claim 1.

From considerations of strength and temperature, it has been assumed up to now that it is appropriate to make the seals nearest to the crankcase of plastic. Tests have now shown, however, that stuffing box seals of this kind have an inexplicably short life, and that the corresponding running surface is also subject to heavy wear. The applicant has found through correspondingly elaborate measurements that the sealing effect of one-piece plastic packing and stripper rings is so great that the metal packing and stripper rings located above them are insufficiently lubricated.

This gave rise to increased wear, increased leakage and thus shorter life of the stuffing box seal. Contrary to the expectations of specialists it has now been demonstrated that a stuffing box seal with the features of Claim 1 leads to especially high efficiency and durability and thus causes very low oil consumption, which is explained on one hand by the good sealing of the stuffing box seal and on the other by the reduced lubrication requirement of the rings.

The attached drawings show two embodiments of the object according to the invention, as well as some details, which are explained by the following description.

- Fig. 1 shows a vertical section through the stuffing box seal of a diesel engine with guide ring and separate lower and upper sealing; and
- Fig. 2 shows a partial longitudinal section through a variant of a stuffing box for a different marine diesel engine without a guide ring;
- Fig. 3 shows a three-part fire-retardant ring, in top view; and
- Fig. 4 a cross section in enlarged scale;
- Fig. 5 shows a diametral section through a stripper ring; and

- Fig. 6 again shows a cross-section in enlarged scale in the region of the ring joint;
- Fig. 7 shows again a diametral section through a packing ring;
- Fig. 8 shows an enlarged cross-section in the region of the ring joint.

Fig. 1 shows an embodiment of a stuffing box seal for a marine diesel engine in vertical section. The arrangement corresponds to a marine diesel engine by the Company Gebrüder Sulzer AG in Winterthur. At the centre is seen the vertical piston rod 1, which leads from the crankcase 3 to the piston-side scavenging air chamber 2. From the construction two sealing zones are clearly recognised, namely, a first, piston-side sealing region 10 and a second, crankcase-side sealing region 20. In other models by the Sulzer Company the number of rings, for example, is changed while the principle remains the same.

In the upper, piston-side sealing region 10 a top coarse stripper 12 is seen, which acts as a fire-retardant ring and is made of metal. This ring is described in more detail by means of Figs. 3 and 4. The fire-retardant ring rests at its periphery on a chamber ring 13. Below the coarse stripper 12 is an upper, so-called "floating" stripper seal 17. Below the upper stripper seal 17 is a guide ring 14 located in a groove in the chamber ring 13. Clamps 15 hold this upper sealing packing together. The multi-part, here three-part, coarse stripper is held together in the radial direction by a one-piece or multi-part tension spring. Similar tension springs to the tension spring 11 just described are also fitted around the guide ring 13 and cross the clamps 15.

In the traditional Sulzer system the inner side of the chamber ring 13 is lined with white metal and machined, and thus acts as a guide ring. Although only this zone is subject to wear, the whole ring must be replaced each time and sent to the service centre; the white metal layer is removed by machining and re-cast, involving considerable expense. To circumvent this cost, these rings are usually discarded and replaced by new ones, which again is very expensive.

The idea underlying the invention is based on the use of a one-piece guide ring which can be replaced simply on site, is made of a self-lubricating material and fits into a corresponding groove, so that the steel chamber ring (13) can be used again and again.

Below this first sealing packing a further stripper seal 19 is provided. A similar stripper seal 19 is located uppermost in the lower, crankcase- or crosshead-side sealing region 20. Below this stripper seal 19 several stripper rings 21, again pressed together by tension springs 22, are arranged. Figs. 7 and 8 show in detail an example of a stripper seal

corresponding to those with the reference numbers 17 and 19. A detailed illustration of the stripper rings 21 is seen in Figs. 5 and 6.

The principle of the second embodiment as in Fig. 2 corresponds to an application suited to marine engines, e.g. by the companies Burmeister & Wain, Kobe, MAN, etc. The piston rod 1 slides through the intermediate bottom 7, which separates the crankcase 3 from the piston-side scavenging air chamber 2. Here, too, as in the first-mentioned example, if less clearly, a first sealing region 10 and a second, crankcase-side sealing region 20 can be seen. The whole stuffing box seal is contained in a two-part packing housing bolted rigidly to the intermediate bottom 7. Above this housing, and resting on it, another multi-part, metal coarse stripper 12 is arranged, with a stripper seal 17 below it. The coarse stripper 12 is again made of metal and, together with the retaining ring 15', protects the plastic stripper seals 17 and 19 located below it from the heat and possible flames in the scavenging air chamber 2. The coarse stripper used here, which acts as a fire-retardant ring, has a different cross-sectional form, as compared to Figs. 3 and 4. The packing rings 17 and 19, and the stripper rings 21 in the second sealing region 20, have exactly the same form as those used in the embodiment according to Fig. 1.

The coarse stripper 12 shown in top view in Fig. 3 consists of three segments 121. The internal diameter of the coarse stripper 12 is somewhat larger than the diameter of the piston rod 1. When the coarse stripper 12 is mounted in the stuffing box seal, it does not rest on the piston rod 1 anywhere, but surrounds it with slight play. The coarse stripper 12 which acts as a fire-retardant ring has an L-shaped cross-section. The flank 122 running parallel to the piston rod has two stripping edges 123 running parallel to each other a distance apart. Between the two stripping edges 123 [original: 122] several outwardly-directed drain holes 124 are provided at regular intervals. These holes 124 allow the stripped oil and dirt particles to drain away. The flank 122 has an outer groove 125, which has a semicircular cross-section. A one-piece or multi-piece tension spring, by which the different segments 121 are held and pressed together, is located in this annular groove. In Figs. 1 and 2 these springs can be seen in section. To increase the sealing effect the stripper edges 123 can be provided with concentric grooves which act like a labyrinth seal.

The stripper ring 21, shown in Fig. 5 in diametral section, is made entirely of plastic. Polytetrafluor ethylene (PTFE) is used preferably for this. Here the ring is in one piece and split only on one side by a joint 221. The known one-piece construction of stripper rings is preferred in particular because assembly is easier and assembly time therefore shortened. The split joint 221 is closed by two overlapping parts 222. Between the two parts 222, therefore, is a joint

face 222'. The joint face 222' opens on the inside into the region between two annular stripping lips 226 which extend to the edge of the stripper ring. On its outer side the joint face 222' opens into an annular groove 225 running round the ring, in which groove the tension spring 22 is located. It is important that the joint face 222' runs outside the centre between the two sealing lips 226 and thus outside the centre of the groove 125. It is thereby avoided that the tension spring 22 presses the two parts 222 apart, thus destroying the sealing effect of the ring and causing a binding in the groove.

The stripper seal 17, shown again in diametral section in Fig. 7, is exactly like the stripper ring 21, as previously described, in construction, with the exception that the joint is gastight. This ring, too, is made of PTFE. Here, too, the split joint 171 can be seen, which is sealed by the two overlapping parts 172. Here, the joint face 172 runs within a middle stripping edge 176. The wider packing ring 17 has three parallel stripping edges 176. Around its periphery are two annular grooves 175, in which corresponding springs 18 are located. Between each pair of adjacent stripping edges 176 oil drain holes 177 are again provided. The packing ring 17 actually represents a combination of a packing and a stripper ring. The right side in the drawing is the stripper side with the oil drain holes, while the left side is the sealing side, in which no holes are provided. So that the stripped oil can drain away even with a tight packing of several stripper rings, recesses 178 running obliquely backwards are provided on the outer face.

CLAIMS

- 1 Stuffing box seal for piston rods (1) of 2-stroke diesel engines with an upper, piston-side sealing region (10) and a lower, crosshead or crankcase side sealing region (20), characterised in that the upper sealing region is bounded on the piston side by a metallic, multiple-part coarse stripper (12) acting as a fire-retardant ring and surrounding the piston rod without spring loading and with slight play, while the packing rings (17,19) located below it and the guide ring (14) are made of plastic, and in that all the packing and stripper rings (19,21) in the lower sealing region are also of plastic.
- 2 Stuffing box seal according to Claim 1, characterised in that the sliding surface of the guide ring (14) facing towards the piston rod (1) has several bypass grooves running in the longitudinal direction of the piston rod.
- 3 Stuffing box seal according to Claim 1, characterised in that the packing rings (17,19) are made in one piece.



face 222'. The joint face 222' opens on the inside into the region between two annular stripping lips 226 which extend to the edge of the stripper ring. On its outer side the joint face 222' opens into an annular groove 225 running round the ring, in which groove the tension spring 22 is located. It is important that the joint face 222' runs outside the centre between the two sealing lips 226 and thus outside the centre of the groove 125. It is thereby avoided that the tension spring 22 presses the two parts 222 apart, thus destroying the sealing effect of the ring and causing a binding in the groove.

The stripper seal 17, shown again in diametral section in Fig. 7, is exactly like the stripper ring 21, as previously described, in construction, with the exception that the joint is gastight. This ring, too, is made of PTFE. Here, too, the split joint 171 can be seen, which is sealed by the two overlapping parts 172. Here, the joint face 172 runs within a middle stripping edge 176. The wider packing ring 17 has three parallel stripping edges 176. Around its periphery are two annular grooves 175, in which corresponding springs 18 are located. Between each pair of adjacent stripping edges 176 oil drain holes 177 are again provided. The packing ring 17 actually represents a combination of a packing and a stripper ring. The right side in the drawing is the stripper side with the oil drain holes, while the left side is the sealing side, in which no holes are provided. So that the stripped oil can drain away even with a tight packing of several stripper rings, recesses 178 running obliquely backwards are provided on the outer face.

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- 4 Stuffing box seal according to Claim 1, characterised in that the packing rings (17,19) have a single or double-acting gas-tight joint (172).
- 5 Stuffing box seal according to Claim 1, characterised in that the stripper rings (21) have two stripping edges (226).
- 6 Stuffing box seal according to Claim 1, characterised in that the stripper rings (21,22) have an overlapping joint at their split joints.
- 7 Stuffing box seal according to Claim 4, characterised in that the split face (172') of the joint in the overlap area is located in the middle sealing lip (176).
- 8 Stuffing box according to Claims 5 and 6, characterised in that the split face (222') of the joint in the overlap area is located off-centre between the two stripping edges (226).
- 9 Stuffing box seal according to Claim 1, characterised in that the coarse stripper (12) has two parallel stripping edges (123) in which are grooves forming a labyrinth seal, and in that drain holes (124) are provided between the stripping edges (123).
- 10 Stuffing box seal according to Claim 1, characterised in that the packing and stripper rings (17,19,21) have oil drain holes (177, 223) between their stripping edges (176, 226), and have on their outer sides recesses (178) running obliquely towards the back to provide drainage for the stripped oil.