Fig. 1

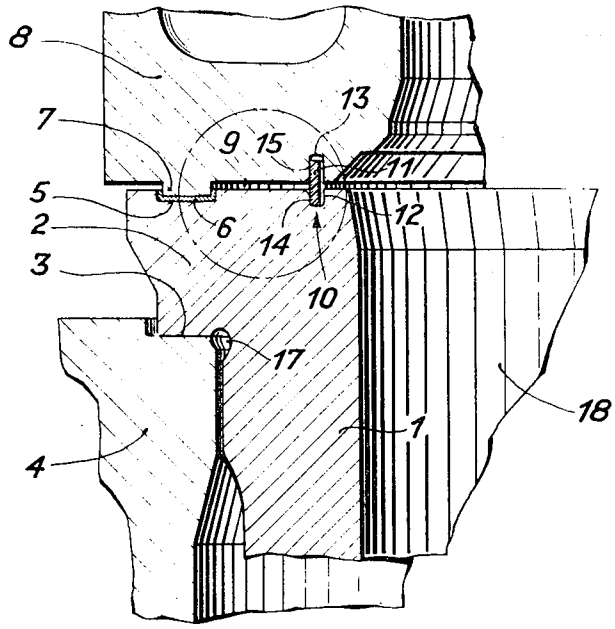


Fig. 2

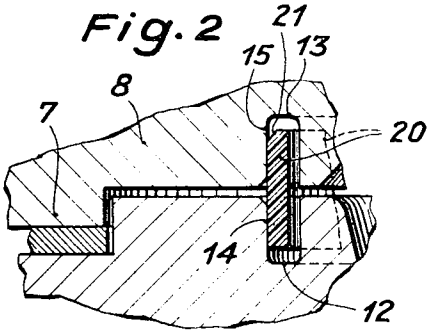


Fig. 4

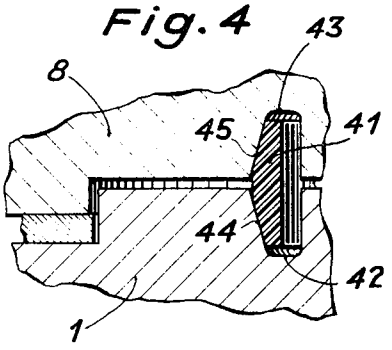


Fig. 3

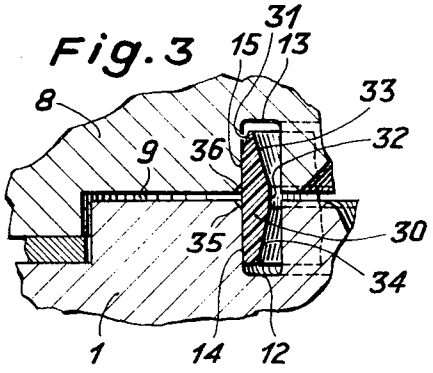
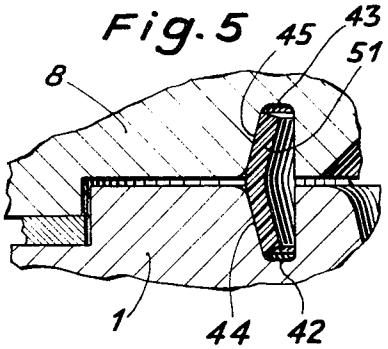


Fig. 5



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United States Patent

Weiss

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[54] WET CYLINDER LINER FOR PISTON-TYPE INTERNAL COMBUSTION ENGINES

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[51] **Int. Cl.**.....**F16j 15/08**

[58] **Field of Search**.....123/193, 193 C, 193 CH; 92/171

[56] **References Cited**

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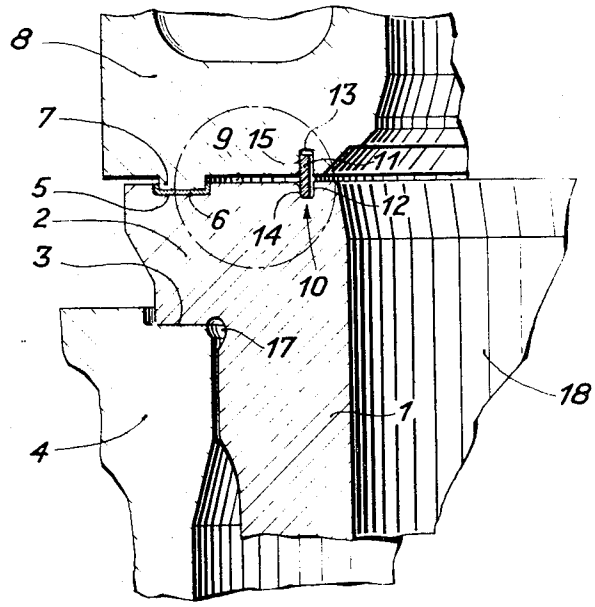
[57] **ABSTRACT**

There is disclosed for piston-type internal combustion engines a replaceable wet liner construction in which an annular packing fits into coaxial open grooves, one in a flange at the top of the liner and the other in the cylinder head, facing each other across a gap between the head and liner which extends from the inside wall of the liner radially out across the top of the flange of the liner to a location at which the flange is compressed between the engine block and head. Particular shapes are shown for the packing ring.

6 Claims, No Drawings



WET CYLINDER LINER FOR PISTON-TYPE INTERNAL COMBUSTION ENGINES

The present invention pertains to a piston-type internal combustion engine having replaceable cylinder liners wherein the liners include a flange which is compressed between the cylinder block and the cylinder head, a clearance being left between the liner and head which extends over a part of the top of the flange from the inside limit thereof out to the location at which the flange is compressed between the engine block and head.

The invention provides an engine of this character including a packing which closes this clearance, the packing being disposed at that end of the clearance adjacent the interior of the liner.

In piston-type engines having replaceable liners the liners are provided with a flange which bears against a plane surface of the engine block. In order to avoid the imposition of a bending moment on the flange by the stress of the cylinder head bolts, the head bears against the liner of each cylinder, via a gasket, at a location having the same radial distance from the center of the cylinder as the location at which the liner flange bears against the engine block.

The consequence of this construction is that, because of the unavoidable thickness of the liner a clearance is left between the liner and the engine head extending from the bore of the liner out to the liner-head gasket. The pressures developed by the gases of combustion in the cylinder are operative in this space. These gas pressures produce forces which exert an axial stress on the liner and which subject the flange to a bending or shearing effect. These pressures may, especially in supercharged engines, reach for short periods of time values of the order of 150 atmospheres, and they operate intermittently. The result is the appearance of high pulsating tensile stresses at the junction between the flange and the outer cylindrical wall of the liner, which are likely sources for the development of cracks.

It is an object of the invention to suppress the dynamic effect of gas pressures in the clearance between the liner and the cylinder head so as to avoid or greatly reduce the danger of the formation of cracks.

In accordance with one preferred embodiment of the invention, the packing provided by the invention in the headliner flange clearance takes the shape of a ring disposed in coaxial grooves, one in the head and the other in the liner flange, the packing ring having a certain amount of axial play in these grooves. The packing ring bears against the radially outer walls of these grooves. This makes it possible to employ a simple shape for the packing, the gas pressures exerting an additional sealing pressure thereon by means of which, with the aid of the elastic properties of the ring, it is pressed against the outer walls of the grooves and its sealing effect thereby improved. The seal thus obtained does not exert any axial stress on the liner.

Advantageously, in accordance with the invention, the radially outer side of the packing ring and the radially outer walls of the grooves which receive it are bevelled outwardly toward the mid-height of the ring, i.e. toward the clearance across which the two coaxial grooves face each other. With such a construction, the ring can be oversized and forced into the grooves upon assembly, when the head is drawn down against the liner flanges, in order further to improve its sealing properties.

In accordance with another feature of the invention, a bevelling is provided on at least one of the axial ends of the ring on the radially outer face thereof, to facilitate insertion of the ring into the corresponding groove or grooves in the course of engine assembly.

In accordance with a further feature of the invention the ring is made with a stiff center portion, i.e. at the middle of the short axial length of the ring, and is given a greater compliance in the upper and lower end portions thereof. The middle portion receives the gas pressures, which are operative in the region of the clearance, and it must consequently be stiff enough to withstand expansion into that clearance. The compliant end portions can then be deformed under the gas pressure in order to improve sealing operation.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be further described in terms of a number of non-limitative exemplary embodiments and with reference to the accompanying drawings in which:

FIG. 1 is a fragmentary axial section through the upper end of a wet liner construction in accordance with the invention together with the adjacent portions of the engine block and cylinder head;

FIG. 2 is a reproduction of part of FIG. 1 at an enlarged scale, but showing a modified shape for the sealing or packing ring;

FIGS. 3 to 5 are further detailed views similar to that of FIG. 2, but showing still further modified shapes for the sealing ring and for the grooves of the liner and cylinder head which receive it.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1, reference character 1 identifies the upper end of a wet cylinder liner in a supercharged diesel engine. The liner 1 is provided with a flange 2 having a plane or flatly conical lower surface 3 bearing against a plane surface of an engine block 4. At the upper side thereof the flange 2 is provided with a groove 5 in which lies a gasket 6. Against the gasket there bears an annular advance or ridge 7 of a cylinder head 8. The head 8 is fastened to the block 4 by means of screws not shown. The stress exerted by the screws serves to squeeze the flange 2 together with the gasket 6 between the head 8 and the engine block 4. By suitable dimensioning of the groove 6 and ridge 7, a clearance 9 is left between the head 8 and the liner 1. At the junction between the flange lower surface 3 and the cylindrical exterior surface of the liner there is provided a channel or fillet 17.

In accordance with the invention, a supplementary packing generally indicated at 10 is provided at the radially inner end of the clearance 9, as closely as possible to the combustion chamber 18 inside the liner. The supplementary packing 10 comprises in the embodiment of FIG. 1 a ring 11 disposed in part in a groove 12 in the liner 1 and in part in a groove 13 in head 8, the grooves 12 and 13 being coaxial. The ring 11 is preferably complete, that is to say it is not a split ring, and it bears against the radially outer walls or sides 14 and 15 of the grooves 12 and 13, these being the sides away from the combustion chamber 18. An axial clearance is left for the packing in those grooves.

During operation of the engine, high gas pressure peaks appear in the combustion space between the liner and the head. These pressure peaks may in supercharged diesel engines reach levels of the order of 150 atmospheres and more. These pressures are prevented by the ring 11 of the packing 10 from penetrating into the portion of the clearance 9 behind, i.e. radially outside, that ring. The beneficial action of the ring is further increased by the fact that the ring is elastically stressed against the groove walls 14 and 15 by the gas pressure whereas the ring allows passage of the gases radially inward from the clearance into the cylinder. Behind, i.e. radially outside of, the ring 11 there is established in operation an average pressure which is dependent on the average pressure in the cylinder and which may amount to some 10 to 20 atmospheres. In this way, the pressure which operates axially on the upper plane end surface of the liner flange bounding the clearance 9 is greatly reduced, and the pulsations of gas pressure inside the liner cannot operate effectively on the portion of that surface radially outside the packing 10. The consequence of this is that the tensile stress operative in the channel 17 is much reduced and contains only a small varying or alternating component. As a result, the danger of crack formation at this location is much reduced, if not entirely eliminated.

FIG. 2 shows a construction generally similar to that of FIG. 1, like reference characters being employed for like parts of

structure. The sealing ring **20** of FIG. **2** however is provided with a bevel **21** at the radially outer edge of one axial end thereof. The bevel **21** facilitates introduction of the ring into the groove **13** of the cylinder head.

FIG. **3** shows a sealing ring **30** having a bevel **31** similar to the bevel **21** of FIG. **2**. The ring **30** possesses in addition an inner surface comprising a cylindrical central portion **32** and two bevelled end portions **33** and **34**. The middle portion **32** is made thick enough to be able, even under the load of the gas pressures, to bridge over the clearance **9** and also over the bevelled portions **35** and **36** provided at the mouth of the grooves **12** and **13** on the walls **14** and **15** thereof, all without sustaining excessive stresses. The axial ends of the ring **30** are weakened or made more compliant by the bevels **33** and **34**, and can consequently be better sealed against the side walls **14** and **15** under influence of the gases than in the case of a ring having the same radial thickness throughout its height.

The embodiments of FIGS. **4** and **5** differ from those hereinabove described in that the liner **1** and the cylinder head **8** are provided with grooves **42** and **43** whose radially outer side walls **44** and **45** are outwardly bevelled toward the mouth of those grooves, as shown in those figures. A sealing ring **41** is disposed in the grooves **42** and **43** in FIG. **4**, the inner surface of this ring being cylindrical and the outer surface thereof having bevels matching those of the grooves.

The embodiment of FIG. **4** has the advantage that the ring **41** can be provided with a slight oversize, and is then prestressed upon assembly into the grooves **42** and **43**. In this way the sealing effect of the ring is further improved. In addition, assembly is facilitated by the bevelled surfaces of the ring and of the grooves.

The grooves **42** and **43** of FIG. **5** are the same as the grooves **42** and **43** of FIG. **4**. The ring **51** of FIG. **5** moreover corresponds substantially to the ring **41** of FIG. **4**. Its inner surface however is not cylindrical, but rather bevelled and extends substantially parallel to the exterior surfaces which lie against the surfaces **44** and **45** of the grooves **42** and **43**. Such a ring has the advantage that it can be manufactured easily, for example, by welding together the ends of a strip and has, nevertheless, the advantages of the construction of FIG. **4**.

The invention of course is not limited to the particular embodiments herein. Thus the ring of the seal **10** need not be disposed in grooves. The ring can be disposed in radial recesses or notches open toward the combustion space. In this way it is possible, for example, to bring the ring even closer to the inner end of the clearance than in the constructions illustrated. The ring can also be provided with a split like a piston ring, or be divided into more than two parts. In general however any other sort of sealing can be employed at the inner end of the clearance, for example, one which does not employ a ring at all, but which would correspond to the ring **12**. Thus there can be employed for the purposes of the invention seals having compressible edges deformable on dis-assembly, or seals of labyrinth type. Soft seals can also be employed.

Thus the invention includes all modifications on and departures from the embodiments hereinabove described properly falling within the spirit and scope of the appended claims.

I claim:

1. An internal combustion engine comprising a cylinder block, a cylinder head, a wet liner having an outwardly extending flange at the head end thereof, a gasket stressed between the flange and head exteriorly of the inside diameter of the liner to preserve a gap between the head and flange, said gap extending radially outwardly from said inside diameter, said head and flange having coaxial annular grooves formed therein facing each other across said gap, and an annular packing fitting within said grooves and extending across said gap.

2. An engine according to claim **1** wherein said packing fits with axial play in said grooves.

3. An engine according to claim **2** wherein said grooves are bevelled on the radially outer walls thereof.

4. An engine according to claim **2** wherein said ring is bevelled at at least one axial end thereof on the radially outer surface thereof.

5. An engine according to claim **2** wherein said ring possesses greater compliance at the axial ends thereof than at the middle.

6. An engine according to claim **2** wherein said ring extends uninterruptedly over 360° about the axis of said liner.

* * * * *