

METHOD FOR REPAIRING DAMAGE TO A WATER-COOLED CYLINDER HEAD
IN 4-CYCLE INTERNAL COMBUSTION ENGINES, AND CYLINDER HEAD

The invention relates to a method according to the preamble of Patent Claim 1.

Such a method is known from US 2751671 A.

On ships, internal combustion engines with outputs of approx. 4 MW are used as what are known as auxiliary engines for generating electricity, in which wear phenomena can occur in the region of the cylinder heads, as has been found in practice. Such wear phenomena are generally known in the technical field. They occur particularly in the seat ring pockets which hold the valve seat rings in the cylinder head of inlet or outlet valves. They are wear phenomena caused by cavitation in the region of the cooling channels formed by the seat ring pockets. The hole-like damage observed in the cylinder head and material disintegration in the cast material of the cylinder head with cavities which sometimes extend deep into the material can be so serious that replacement of the entire cylinder head is unavoidable. More slight wear phenomena are also observed in the valve seat rings themselves.

According to a method known from DE 10156196 C1 for producing a valve seat for a cylinder head of an internal combustion engine, it is provided for an alloy to be fused onto the cylinder head at the point of the valve seat, by means of which the valve seat is formed. This known production method is not intended as a repair method.

This object is achieved in a method of the type mentioned in the introduction by the following consecutive repair steps:

- a) largely boring out the damaged seat ring pockets in such a manner that, in addition to surface damage, deeper cavities in the material of the cylinder head are substantially removed;
- b) inserting one matching valve seat ring consisting of a wear-resistant material into each of the bored-out seat ring pockets;
- c) connecting existing cooling channels to valve seat rings to be cooled in such a manner that an initially closed cooling channel (3) of a valve seat ring (2) is drilled from the outside after the insertion of the latter in order to produce the connection to the cooling channels present in the cylinder head (6).

Accordingly, the method according to the invention makes use of the finding that the damaged seat ring pockets must be bored out to a great extent in both depth and the radial direction in order to include deeper cavities which typically arise as a result of the observed cavitation damage.

In configurations with valve seat rings which need cooling, the valve seat rings used for replacement are connected to the existing cooling channels. In this case it can be expedient to enlarge the flow cross sections of the existing cooling channels.

The valve seat rings used for replacement are configured in such a manner that they form a closed cooling channel which is drilled from the outside after insertion in order to produce the connection to the cooling channels present in the cylinder head.

To this end, it is advantageously provided for bushings for sealing the transitions from the cooling channels of the cylinder head to the respective valve seat ring to be inserted into the bore holes.

In configurations with valve seat rings which do not need cooling, it is proposed according to the invention to seal the cooling channels present in the cylinder head towards the valve seat rings used for replacement by means of stoppers.

A particularly rational configuration of the repair method according to the invention consists in the seat ring pockets being bored out until predefined dimensions have been reached, so that the valve seat rings used for replacement can be prefabricated. The repair process can in this manner be standardised to a certain extent, which contributes considerably to the cost reduction of the repair method according to the invention.

As is known per se, it is proposed as part of a further design to connect the valve seat rings provided for replacement to the cylinder head by shrink-fitting.

With regard to the cause of damage, it is to be assumed that cavitation damage in the seat region of the valve seat rings arises because unfavourable flow conditions prevail in the cooling channels and/or seat ring pockets, which among other things result in excessive pressure variations,

A ring-shaped cooling chamber 21 which widens towards the top is available for cooling the receiving bushing 14.

The inlet valve 9 also has a valve seat ring 1 which is fitted into the cylinder head and has a solid configuration, in contrast to the valve seat ring 2 of the outlet valve 8. On the inlet side, namely through an inlet channel 15, cool combustion air flows into the cylinder so that sufficient cooling of the valve seat ring 1 is generally provided. It is therefore suggested that any flow of coolant to the valve seat ring 1 of the inlet valve 9 is prevented as part of repair work. In the drawing, an outer stopper 23 and an inner stopper 24 can be seen, with which originally present cooling channels have been sealed.

Fig. 3 and 4 show the solid valve seat ring 1 for the inlet valve 9 and the two-part valve seat ring 2 of the outlet valve 8, forming the ring-shaped cooling channel 3. As the valve cones are not drawn, a reinforcement 25 of the valve seat faces 26 on the side of the valve seat rings 1, 2 can clearly be seen.

CLAIMS

1. A method for repairing damage to a water-cooled cylinder head in 4-cycle internal combustion engines, in the seat ring pockets of valve seat rings (1, 2) of inlet or outlet valves thereof, which are connected to cooling channels, comprising the following consecutive steps:
 - a) largely boring out the damaged seat ring pockets in such a manner that, in addition to surface damage, deeper cavities in the material of the cylinder head (6) are substantially removed;
 - b) inserting one matching valve seat ring (1, 2) consisting of a wear-resistant material into each of the bored-out seat ring pockets;
 - c) connecting existing cooling channels to valve seat rings (2) to be cooled in such a manner that an initially closed cooling channel (3) of a valve seat ring (2) is drilled from the outside after the insertion of the latter in order to produce the connection to the cooling channels present in the cylinder head (6).
2. The method for repairing damage to a water-cooled cylinder head in 4-cycle internal combustion engines, in the seat ring pockets of valve seat rings (1, 2) of inlet valves thereof, comprising the following consecutive steps:
 - a) largely boring out the damaged seat ring pockets in such a manner that, in addition to surface damage, deeper cavities in the material of the cylinder head (6) are substantially removed;

- b) inserting one matching solid valve seat ring (1; 2) consisting of a wear-resistant material into each of the bored-out seat ring pockets;
 - c) sealing originally present cooling channels by means of stoppers (23, 34).
3. The method according to Claim 1, characterised in that bushings for sealing the transitions from the cooling channels of the cylinder head (6) to the respective valve seat ring (2) are inserted into the bore holes.
 4. The method according to Claim 1 or 2, characterised in that the seat ring pockets are each bored out until predefined dimensions are reached, so that the valve seat rings (1; 2) used for replacement can be prefabricated.
 5. The method according to Claim 1 or 2, characterised in that the valve seat rings (1; 2) provided for replacement are connected to the cylinder head (6) by shrink-fitting.
 6. A valve seat ring as a replacement part for insertion in a repair method according to Claim 1, characterised in that it (2) is produced from at least two ring parts (4, 5), with a closed cooling channel (3) formed therebetween, by circumferential welding of the ring parts (4, 5).