



1

3,115,127

## REMOVABLE INSERT FOR INTERNAL COMBUSTION CHAMBERS

Charles O. Spencer and Boyd L. Spencer, both of  
440 S. Tyler, Gladewater, Tex.  
Filed Oct. 2, 1961, Ser. No. 142,420  
7 Claims. (Cl. 123—41.82)

This invention relates to internal combustion engines and is specifically directed to novel combustion chamber inserts therefor.

This application is a continuation-in-part of application Serial No. 115,764, filed June 8, 1961.

It is well known that internal combustion engines, particularly heavy duty engines, are plagued by the existence of thermal stress concentrations which frequently manifest themselves by the appearance of cracks, fissures and the like. When such damage occurs, operating efficiency suffers and in most cases, serious damage will ultimately occur.

The aforementioned cracks or fissures usually occur around the valve ports because they are subject to the greatest thermal stresses, as well as to wear by the valves of the valve seats around the ports. To compensate for the wear of the valve seats, and at least partially for the thermal stresses, it is the usual practice to employ valve seat inserts formed of high quality metal. These inserts are mounted by a press fit into the bottom wall of the cylinder head from the combustion chamber surface thereof. As a result, it frequently occurs that these inserts are subject to loosening and subsequent separation which is, in itself, a source of serious mechanical failures exhibited at times by destruction of an associated piston, cylinder head breakage, cylinder wall breakage, connecting rod damage, crankshaft damage and the like, as well as substantially simultaneous occurrence of several or all of these.

In our Patent No. 2,949,901, we disclose the use of separate inserts within the critical combustion chamber areas for relieving the foregoing condition, relying upon the use of high quality material in the inserts and clearance for the expansion thereof to withstand the otherwise excessive thermal stress concentrations. In this way, a practical solution is offered in contrast to the economically prohibitive alternative of having the entire cylinder head, engine block or both, as the case may necessitate, of sufficiently high quality material as to withstand the thermal stresses which may be encountered. However, in some instances, it may be desirable to provide a still higher quality material for the valve seat area or, in contrast, to provide the major portion of the insert from material of lesser quality and lower cost.

Having in mind the foregoing situation, it is the primary object of the present invention to provide a valve seat insert assembly that will substantially eliminate the possibility of displacement thereof during use and operation.

It is another object of the invention to provide an insert assembly that will absorb thermal stresses and virtually preclude damage to cylinder heads.

It is a further object of the invention to provide an insert assembly that will facilitate removal and replacement of valve seat inserts.

It is a still another object of the invention to provide an insert assembly having simplicity of design and will provide maximum efficiency in service with minimum cost of construction and servicing.

Briefly, the basic concept of the present invention resides in the provision of an insert of any of the types shown in Patent No. 2,949,901 and the aforementioned application, Serial No. 115,764, with valve seat inserts;

2

literally, an insert within an insert. More specifically, a combustion chamber insert has valve seat inserts incorporated therein with the secondary inserts so related to the primary insert as to positively prohibit separation of the two during service. To accomplish the latter, the valve seat inserts are mounted in the combustion chamber inserts so that when the latter are removably mounted in the cylinder head, the valve seat inserts are positively locked between the combustion chamber insert and the cylinder head.

The novel features that are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawing, wherein like reference characters indicate like parts throughout the several figures and in which:

FIG. 1 is a cross-sectional view taken vertically through a portion of an internal combustion engine illustrating one form of the present invention;

FIG. 2 is a sectional view similar to FIG. 1, but showing a modification;

FIG. 3 is a sectional view similar to FIG. 2, but showing a further modification;

FIG. 4 is a sectional view through a portion of a hollow combustion chamber insert using a valve seat insert of the same general type as shown in FIG. 3, and

FIG. 5 is a sectional view through a portion of a modified form of hollow combustion chamber insert and valve seat insert.

Referring now in detail to the accompanying drawing, and specifically to FIG. 1, the structure shown therein includes a portion of a cylinder head assembly 10 operatively associated with an engine block assembly 12 having a cylinder 14, the upper portion of which defines a combustion chamber. The cylinder head 10 is attached to the block 12 by any suitable means as may be desired and, as is usual, a cylinder head gasket 16 is interposed between the head and block to not only seal against the leaking of coolant from the engine water jacket between the block and head into the cylinder, but also to contain the products of combustion within the combustion chamber. The head is conventionally provided with valve ports 18 and 20 having associated valves 22 and 24 reciprocally mounted in valve guides 26 and 28.

The present invention is similar to those embodied in the aforementioned patent and application in that the bottom wall of the cylinder head 10 is provided with a recess 30 in the critical area thereof exposed to the cylinder 14 and surrounding at least the valve ports 18 and 20. This recessed area encompasses that area which is subject to the greatest thermal stresses and may include only a portion of the cylinder exposed area or the whole of said area. Within this recess 30 is removably mounted a primary or combustion chamber insert 32. Preferably, both the recess 30 and insert 32 are of circular form, the insert 32 being of slightly smaller diameter than the recess to provide peripheral clearance 34 therebetween to accommodate expansion of the insert without transmitting stress to the cylinder head 10.

As shown in our aforementioned patent, the recess and insert may be of any selected size relative to the bore of the cylinder 14, depending upon the size of cylinder bore and/or type of engine. For simplicity of illustration, however, the primary or combustion chamber insert 32 is shown as having a diameter exceeding that of the bore of cylinder 14. Moreover, the insert 32 and the recess 30 in the cylinder head may be provided either as original equipment in the head or as an addition thereto, in which case, the recess 30 is machined in the original head. In

3

any event, the insert 32, as shown, marginally seats upon the head gasket 16 and is largely held in place by the means for securing the cylinder head to the engine block. However, to facilitate assembly and to guard against warpage, the insert 32 may be provided with one or more additional securing means.

In the present instance, the securing means may constitute one or more bolts 36 which is shown in FIG. 1 as extending completely through the head and threaded into the insert 32 from the rear thereof to facilitate heat transfer to the head water jacket. Conversely, the securing means may comprise a fuel injector nozzle assembly or countersunk bolts inserted from the face of the insert 32, as shown in the aforementioned patent. On the other hand, to preclude the possibility of the latter bolts becoming loosened and falling into the cylinder, a novel form of bolt 36' is shown in FIG. 3 as comprising a short bolt insertable from inside the water jacket of the cylinder head 10', and having a wrench socket 38 in the end of its shank for engagement by an Allen type wrench or the like. The bolt 36' may be initially inserted into the head water jacket through a tapped bore 40 in the top wall of the head 10 by means of a socket wrench and the bore 40 subsequently sealed by a threaded plug 42. The wrench socket 38 may be employed for loosening the bolt 36' in the event that it is necessary to remove the insert.

The basic concept of the present invention resides in the provision in the primary or combustion chamber insert 32 of bores 44 and 46 for the reception of secondary or valve seat inserts 48 and 50 which project completely through the primary insert 32 and merge smoothly with the ports of the valve ports 18 and 20 so as to afford minimum flow restriction. In the form shown in FIG. 1, the entire outer surfaces of the valve seat inserts are provided with a degree of draft or taper so that they are of frusto-conical configuration. The bores 44 and 46 in the primary insert 32 are correspondingly tapered so that the valve seat inserts fit snugly therein, the valve seat inserts and receiving bores being accurately dimensioned so that the upper faces 52 and 54 of the seat inserts are flush with or project very slightly above the upper face of the primary insert 32. In this way, the valve seat inserts bear against the head 10 and are prevented from working within the primary insert 32. Also, because the seat inserts are inserted from the upper or rear side of the primary insert, the seat inserts cannot become dislodged during service as is the case with conventional valve seat inserts.

Thus, it will be seen that the dual insert assemblage in accordance with this invention provides a beneficial manner of retaining the valve seat inserts, even in the absence of the necessity for higher quality material for the remainder of the combustion chamber walls. That is, in an instance where design considerations dictate the necessity for high quality valve seats but do not require any special material for the combustion chamber walls, the instant invention still provides the advantage of superior valve seat retention even though the material of the primary insert is identical with the material from which the head is made.

Modified forms of insert assembly are shown in FIGS. 2 and 3 wherein it will be seen that the valve seat bores 44', 44'' and 46', 46'' of the primary insert 32', 32'', and the mating surfaces of the valve seat inserts 48', 48'' and 50', 50'' are cylindrical rather than conical. The bores 44', 44'' and 46', 46'' are provided with counterbores 56 from the inner or upper sides of the primary inserts 32', 32'' and the secondary inserts 48', 48'' and 50', 50'' have annular collars or flanges 58 mating with the counterbores 56.

As shown in FIG. 2, the secondary or valve seat inserts may be substantially the same depth as that of the primary insert. Conversely, as shown in FIG. 3, the depth of the secondary inserts may be greater than that of the primary insert to accommodate a gasket 60 between the primary insert and the bottom of the head recess 30. However,

4

the uncompressed thickness of gasket 60 is somewhat greater than the height of the rear face of the secondary inserts above the rear face of the primary insert so that the gasket is sealingly compressed during service while still permitting the secondary inserts to bottom against the head recess to prevent working of the secondary inserts within the primary insert.

In the foregoing embodiments, the primary insert is constituted by a solid plate but these primary inserts may be hollow for the reception of fluid coolants, such as disclosed in applications, Serial Nos. 115,764, filed June 8, 1961, and 140,315, filed September 25, 1961. These hollow inserts may be of integral construction as shown in the aforementioned applications, but for purposes of illustration, sectional or separable inserts are shown in FIGS. 4 and 5.

According to the modification shown in FIG. 4, the primary insert 32a comprises a body portion 62 including a front wall 64 having integral upstanding bosses or valve seat sleeve portions 66, only one of which is shown, and side walls, not shown. The body portion 62 is closed by a back plate 68 and gasket 70 which have cylindrical openings 44b which register with the cylindrical bores 44a of the bosses or sleeve portions 66 for the reception of secondary or valve seat inserts 48a. The bores 44a have countersunk portions 56a and the openings 44b register with the countersunk portions, while the secondary inserts 48a have collar portions 58a for mating therewith. The dimensions are such that the gasket 70 is under compression when the rear faces of the secondary inserts 48a are flush with the rear face or the rear surface of the back plate 68.

A modified separable primary insert 32b is shown in FIG. 5 as comprising a body portion 62' including a front wall 64' and side walls 72, a back plate 68' and gasket 70'. The front wall 64' is provided with openings 74 which are countersunk from the inner side of the wall and a valve seat insert 76 having a stepped flange 78 is mounted within the body 62' with the flange 78 nested in one of the openings 74 with a gasket 80 between the overlapping portions of the wall 64' and flange 78. The rear end of the secondary insert 76 bears against the gasket 70' with an opening 82 in the back plate 68' in registry with the bore 84 of the insert 76. The whole assembly is secured together by a plurality of bolts 86 countersunk into the back plate 68' and side walls 72.

In all of the foregoing examples, the insert assembly not only affords the advantage of providing a combustion surface area more highly resistant to thermal stress concentrations, but also provides the advantage of substantially foolproof valve seat insert retention.

Although certain specific embodiments of the invention have been shown and described, it is obvious that many modifications thereof are possible. The invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

What is claimed is:

1. In an internal combustion engine having an engine body provided with a cylinder and associated combustion chamber portion having a flat bottom recess therein, a primary insert received in said recess and having a flat rear face for pressure bearing relationship to the flat bottom of said recess, said recess being slightly larger than said primary insert to provide peripheral clearance between said primary insert and said body, a pair of valve seat inserts snugly received in the main body portion of said primary insert in offset relation to either side of a central region of said primary insert, fastening means fixedly securing the central region of said primary insert to said combustion chamber portion leaving the surrounding and main body portion of said primary insert, including the peripheral region thereof free to expand and contract within the stated peripheral clearance to minimize in-plane stresses and distortions in said primary

5

insert, each valve seat insert being enlarged at that end thereof adjacent to the flat bottom of said recess and being engaged at its enlarged end against said engine body by said fastening means.

2. In an assembly according to claim 1 wherein said combustion chamber portion comprises spaced inner and outer walls defining a coolant jacket, said recess being in said inner wall, and said securing means comprises a bolt inserted through said inner wall through a tapped opening in said outer wall, and a plug removably sealing the opening in the outer head wall.

3. In an assembly according to claim 2 wherein said bolt has a wrench socket in the shank end thereof to enable releasing said bolt from the exterior of said coolant jacket.

4. In the assembly as defined in claim 1 wherein said primary insert is hollow and includes spaced front and rear walls, said front wall having a pair of openings therein and sleeve portions extending from such openings to said rear wall with the rear wall having openings aligned with said sleeve portions, said valve seat inserts being nested within said sleeve portions and said rear wall openings.

6

5. In the assembly as defined in claim 1 wherein each valve seat insert is of frusto-conical configuration.

6. In the assembly as defined in claim 1 wherein each valve seat insert is provided with an annular flange constituting the enlarged end thereof.

7. In an assembly according to claim 1 wherein said securing means comprises a bolt extending through said combustion chamber portion.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

|           |                |               |
|-----------|----------------|---------------|
| 1,260,860 | Bie            | Mar. 26, 1918 |
| 1,479,129 | Feilner        | Jan. 1, 1924  |
| 1,621,560 | Regenbogen     | Mar. 22, 1927 |
| 1,756,337 | Bowler         | Apr. 29, 1930 |
| 2,672,856 | Wagner         | Mar. 23, 1954 |
| 2,949,901 | Spencer et al. | Aug. 23, 1960 |

##### FOREIGN PATENTS

|         |               |               |
|---------|---------------|---------------|
| 165,232 | Austria       | Feb. 10, 1950 |
| 180,302 | Great Britain | Jan. 18, 1923 |
| 283,944 | Germany       | Apr. 28, 1915 |