May 23, 1933. A. T. COLWELL 1,911,173

EXHAUST VALVE SEAT INSERT

Filed May 12, 1932

Fig. 1.

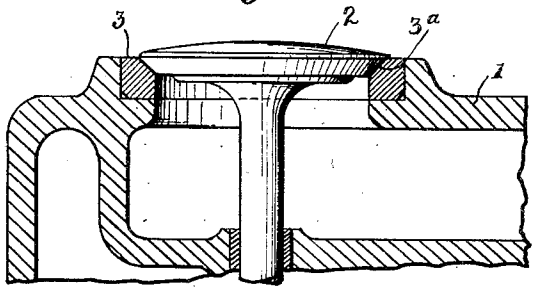


Fig. 2.

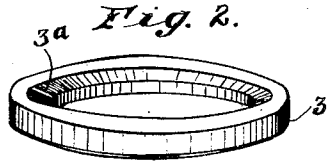


Fig. 3.

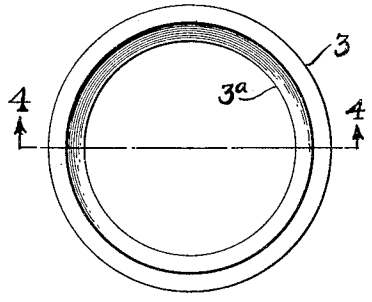
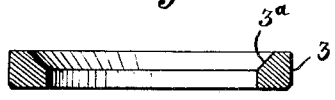


Fig. 4.



INVENTOR
ARCHIE T. COLWELL.

Milburn & Milburn.

ATTORNEYS.

Patented May 23, 1933 1,911,173

UNITED STATES PATENT OFFICE

ARCHIE T. COLWELL, OF CLEVELAND HEIGHTS, OHIO, ASSIGNOR TO THOMPSON PRODUCTS, INC., OF CLEVELAND, OHIO

EXHAUST VALVE SEAT INSERT

Application filed May 12, 1932. Serial No. 610,954.

This invention relates to the art of internal combustion engines and more specifically to an improved form of valve seat insert for the exhaust valves of the engine.

Heretofore, as is well known, the seats for the exhaust valves of an internal combustion engine have been formed integrally with the cylinder block which is a gray iron casting, and hence the seat for the exhaust valve has been formed of the same material.

It is also a well known fact that, due to the heat of the exhaust of the engine, the seats of the exhaust valves as well as the valves themselves are subjected to a comparatively excessive degree of temperature and it has been found that ordinary gray cast iron (180 to 212 Brinell hardness) used in cylinder blocks will not withstand such excessive heat without very objectionable results. The gray iron casting does not possess sufficient hardness to withstand the effect of such heat, is not metallurgically stable at engine-operating temperatures, and is lacking also in other requirements which are necessary for the highest degree of efficiency under such heat condition.

For instance, with excessive engine heat, it has been found that there is a softening of the cast iron valve seat, and the constant impact of the exhaust valve upon its seat results in distortion of the seat and sinking of the valve into the same. Thus, the valve seat not only loses its true and correct form but yields to such an extent that the valve stem is lowered so as to then constantly ride upon the tappet, and the normal clearance between the valve stem and the tappet is taken up and the valve no longer has proper seating engagement.

When the exhaust valve fails to have proper seating engagement, it will be readily understood that there is no longer obtained proper degree of compression of the explosive fuel within the cylinders and, as a result, the temperature is increased by virtue of the fuel being burned rather than exploded. Thus, there is a loss of power and there is produced also a lack of uniform compression throughout the cylinders, with the attendant roughness of operation, difficulty in starting, as well as other serious disadvantages. Such abnormal and inefficient operation, with over-heating of the engine block as well as the valves themselves, causes also objectionable scaling and warping of the valves as well as annealing of the valve seats.

An attempt has been made to correct this condition by adding chrome-nickel alloy to the cylinder iron with a resulting increased hardness of forty (40) or fifty (50) points Brinell, which, however, only partially relieves the situation, the valve seat still being distorted.

Attempts have also been made to provide a valve seat constructed as a separate member and inserted in an annular recess provided about the exhaust valve opening. These attempts have included various compositions of bronze as well as steel, but all of them are open to certain objections due either to their failure to meet the necessary requirements of operation or to their excessive high cost of production.

In order to meet the necessary requirements for successful operation, the metal adopted for such an insert must possess hardening properties and must possess sufficiently high physical hardness to resist distortion and deformation from the hammering action of the valve. Such an exhaust valve seat insert must also possess a very high degree of stable hardness under red heat corresponding to the excessive heat developed by the engine under extreme conditions. Also, such a seat insert must have substantially the same co-efficient of expansion as the cast-iron of the block itself into which the insert is placed. Furthermore, the insert must be proof against softening, tempering, or change in volume under the extreme temperature to which subjected during actual use; and the composition of metal selected for such an insert must be proof against scaling and warping as well as against disintegration or segregation of the constituent elements under the heating and cooling conditions of the engine, and must be uniformly and constantly homogeneous under all such varying conditions. Also, such a composition of metal must possess good casting properties and must be capable of flowing

properly at casting temperatures so that such inserts can be formed efficiently in individual molds, and must be proof against any tendency toward porosity or the formation of blow-holes. Finally, the cost of the constituent elements in raw state must be comparatively low and such materials must be readily available so as to render it feasible and practical to manufacture such form of insert in quantity production for the market.

With these necessary requirements in mind, I have found that nearly all of the former attempts at a separate form of insert are altogether impractical since they lack the necessary physical requirements for successful and satisfactory performance in the several respects already mentioned. In view of these considerations, the field of selection of a material which could be depended upon for successful operation has been limited to a certain class of steel, for instance high speed steel, which, however, has proved to be not at all practical as a marketable product because of its high cost and for other reasons.

Moreover, in the actual manufacture of such inserts from the composition of steel just mentioned, there has been followed the practice of forging the inserts in the form of rings from the end of bar stock by the successive operations of piercing, expanding, and shearing off the ring in an attempt to avoid the waste of material. However, the final cost of such a product constructed from such material and in such a manner is entirely too high for practical purposes.

Therefore, the object of the present invention is to devise an improved composition of metal for an insert which may be adopted for the purpose herein stated and which will not only fulfill all of the various requirements from the standpoint of efficient operation but which may also be manufactured and sold at a comparatively low cost, and the constituent elements of which are readily available for such manufacture.

More specifically, it is the object of the present invention to devise an exhaust valve seat insert in the form of a semi-steel casting comprising an alloy of constituent elements which are readily available upon the market at a comparatively low cost and which will produce an insert having substantially the same co-efficient of expansion as the gray iron of the engine block, and which will withstand the excessive heat of the engine and will also possess all of the requisite characteristics and none of the objectionable features, as above mentioned.

Other objects will appear from the following description and claims.

Fig. 1 is a sectional view of a portion of the block of an internal combustion engine and illustrates an exhaust valve seat in the form of an insert;

Fig. 2 is a perspective view of such an insert;

Fig. 3 is a top plan view of the same; and

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3.

Referring to the accompanying drawing, the engine block is indicated by reference numeral 1, the exhaust valve is indicated by reference numeral 2, and the valve seat which, according to the present invention is in the form of an insert, is indicated by reference numeral 3. This insert is beveled at 3^a so as to provide the proper form of seat for engagement by the exhaust valve in the usual manner. Such insert is in the form of a closed ring, as clearly indicated in the drawing, and is inserted in any suitable manner into an annular recess provided about the end of each exhaust opening.

As above explained, there have already been attempts to provide exhaust valve seats in the form of inserts and the present form of illustration is therefore intended to indicate this same general combination of insert in the engine block. The novelty in the present case, as will more fully appear hereinafter, consists in the specific composition of alloy adopted in the insert itself, and consists also in the combination of this particular metallic composition of insert and the block itself by virtue of the peculiar co-relation between my present improved alloy and the gray iron of the block casting.

As a means of accomplishing the desired results in the present case, I have discovered several forms of alloys which may be adopted for use in the insert form of exhaust valve seat, and all of which are capable of producing the satisfactory results as herein specified. It is to be understood that the present disclosure may be varied within the range of equivalents so far as the selection of specific elements is concerned and also within the range of various relative proportions as may be dictated or discovered by actual experimentation, all in accordance with the principle of invention as herein set forth.

Accordingly, I have below indicated several different combinations of elements with several alternatives and have also indicated approximate ranges of percentage composition of the several alloys. Therefore, it is to be understood that the scope of the present invention is not limited exactly to any particular specimen herein set forth, either with respect to the elements themselves or the percentage composition. As a means of convenience in the claims, I have referred to the percentages and ranges as being approximate so as to afford suitable scope of protection.

One specific composition of semi-steel casting which has by actual test proved satisfactory in fulfilling all of the exacting re-

quirements herein specified for such an insert, was found by actual analysis to be as follows, the percentages given being by weight:

	Percent
Carbon	2.00
Molybdenum	5.00
Chromium	3.00
Silicon	1.25

Remainder principally iron.

This alloy was heat-treated by subjecting the same to approximately twelve hundred degrees (1200°) Fahrenheit, this degree of heat being in excess of that to which the ring would ordinarily be subjected during actual use under extreme heat conditions in an internal combustion engine, and the ring insert was formed as a semi-casting which was then finished by grinding and provided with the usual form of bevel seat 3^a.

This form of ring may be inserted into place, as indicated in Fig. 1 of the drawing, in any suitable and well known manner.

As already stated, it is to be understood that the above specific composition of semi-steel casting is intended to illustrate only one particular alloy which may be employed for this purpose. The percentage composition of this alloy may be varied, approximately within the following ranges, these percentages being by weight:

	Percent
Carbon	.50 to 3.50
Molybdenum or tungsten	.50 to 10.00
Chromium	.50 to 10.00
Silicon	.50 to 3.00

Remainder principally iron.

Other modified forms of alloys with the approximate range of percentage composition (by weight) of the constituent elements, will now be indicated:

(1)

	Percent
Carbon	.50 to 3.50
Molybdenum or tungsten	.50 to 10.00
Silicon	.50 to 3.00

Remainder principally iron.

(2)

	Percent
Carbon	.50 to 3.50
Titanium	.50 to 5.00
Molybdenum or tungsten	.50 to 10.00
Silicon	.50 to 3.00

Remainder principally iron.

Thus, I have devised an insert form of ring seat for the exhaust valve of an internal combustion engine which possesses all of the desired advantages as above enumerated and which is free of the features which heretofore have proved objectionable and which made the insert form of seat wholly impractical. With my improved form of insert, not only is the life of the valve seat itself doubled or trebled as compared with the old form of seat which was integral with and therefore of the same metallic composition as the gray iron casting of the block, but also there is herein obtained a corresponding increase in the efficiency of operation of the engine because of the improved conditions as regards certain vital factors and considerations above explained and as will be readily understood by those who are familiar with the art of internal combustion engines.

Furthermore, the composition of metal herein adopted is one which may be produced at a comparatively low cost and is therefore rendered practical for adoption in all popular forms of automobile engines, and the constituent elements of the composition of metal herein disclosed may be readily obtained for such use.

What I claim is:

1. In an internal combustion engine, the combination of a cast-iron engine block having exhaust valve openings and having a cut-out portion about the upper end of each exhaust valve opening so as to form an annular seat, and a separately formed valve seat member inserted in each annular seat and adapted for seating engagement by the exhaust valve, said valve seat insert being in the form of a semi-steel casting including carbon, a metal of the molybdenum-tungsten group, chromium, and silicon, the remainder being principally iron.

2. In an internal combustion engine, the combination of a cast-iron engine block having exhaust valve openings and having a cut-out portion about the upper end of each exhaust valve opening so as to form an annular seat, and a separately formed valve seat member inserted in said annular seat and adapted for seating engagement by the exhaust valve, said valve seat insert being in the form of a semi-steel casting including approximately from one-half of one per cent (.50%) to three and one-half per cent (3.50%) by weight of carbon, approximately one-half of one per cent (.50%) to ten per cent (10.00%) by weight of a metal of the molybdenum-tungsten group, approximately from one-half of one per cent (.50%) to ten per cent (10.00%) by weight of chromium, and approximately from one-half of one per cent (.50%) to three per cent (3.00%) by weight of silicon, the remainder being principally iron.

3. In an internal combustion engine, the combination of a cast-iron engine block having exhaust valve openings and having a cut-out portion about the upper end of each exhaust valve opening so as to form an annular seat, and a separately formed valve seat member inserted in each annular seat and adapted for seating engagement by the exhaust valve, said valve seat insert being in the form of a semi-steel casting including ap-

proximately two per cent (2.00%) by weight of carbon, approximately five per cent (5.00%) by weight of a metal of the molybdenum-tungsten group, approximately three per cent (3.00%) by weight of chromium, and approximately one and one-fourth per cent (1.25%) by weight of silicon, the remainder being principally iron.

4. In an internal combustion engine, a valve seat insert adapted for seating engagement by the exhaust valve and being in the form of a semi-steel casting, comprising approximately from one-half of one per cent (.50%) to three and one-half per cent (3.50%) by weight of carbon, approximately from one-half of one per cent (.50%) to ten per cent (10.00%) by weight of a metal of the molybdenum-tungsten group, approximately from one-half of one per cent (.50%) to ten per cent (10.00%) by weight of chromium, and approximately one-half of one per cent (.50%) to three per cent (3.00%) by weight of silicon the remainder being principally iron, said valve seat insert being preliminarily heat-treated to a degree corresponding at least to excessive engine heat.

5. In an internal combustion engine, an exhaust valve seat insert adapted for seating engagement by the exhaust valve and being in the form of a semi-steel casting, comprising approximately two per cent (2.00%) by weight of carbon, approximately five per cent (5.00%) by weight of a metal of the molybdenum-tungsten group, approximately three per cent (3.00%) by weight of chromium, and approximately one and one-fourth per cent (1.25%) by weight of silicon the remainder being principally iron, said valve seat insert being preliminarily heat-treated to approximately twelve hundred degrees (1200°) Fahrenheit.

6. In an internal combustion engine, a valve seat insert adapted for seating engagement by the exhaust valve and being in the form of a semi-steel casting, comprising approximately from one-half of one per cent (.50%) to three and one-half per cent (3.50%) by weight of carbon, approximately from one-half of one per cent (.50%) to ten per cent (10.00%) by weight of a metal of the molybdenum-tungsten group and approximately from one-half of one per cent (.50%) to three per cent (3.00%) by weight of silicon, the remainder being principally iron, said valve seat insert being preliminarily heat-treated to a degree corresponding at least to excessive engine heat and having substantially the same coefficient of expansion as cast iron.

7. In an internal combustion engine, a valve seat insert adapted for seating engagement by the exhaust valve and being in the form of a semi-steel casting, comprising approximately from one-half of one per cent (.50%) by weight of carbon, approximately from one-half of one per cent (.50%) to five per cent (5.00%) by weight of titanium, approximately from one-half of one per cent (.50%) to ten per cent (10.00%) by weight of a metal of the molybdenum-tungsten group, and approximately from one-half of one per cent (.50%) to three per cent (3.00%) by weight of silicon, the remainder being principally iron, said valve seat insert being preliminarily heat-treated to a degree corresponding at least to excessive engine heat and having substantially the same coefficient of expansion as cast iron.

In testimony whereof, I hereby affix my signature.

ARCHIE T. COLWELL.