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C. B. McDONALD

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METHOD OF FORMING VALVE SEAT INSERTS

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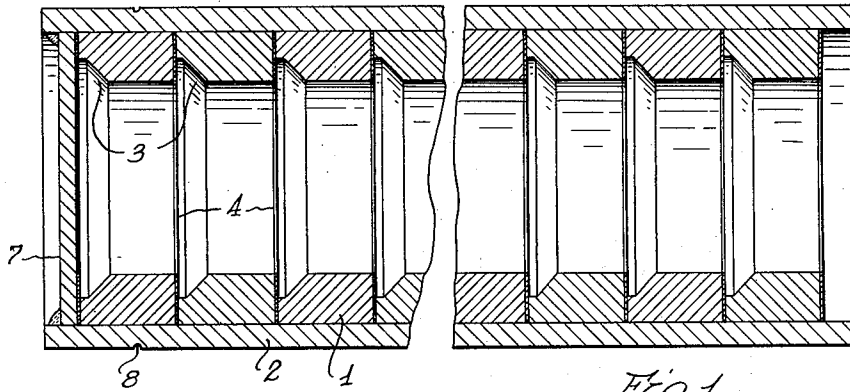


Fig. 1.

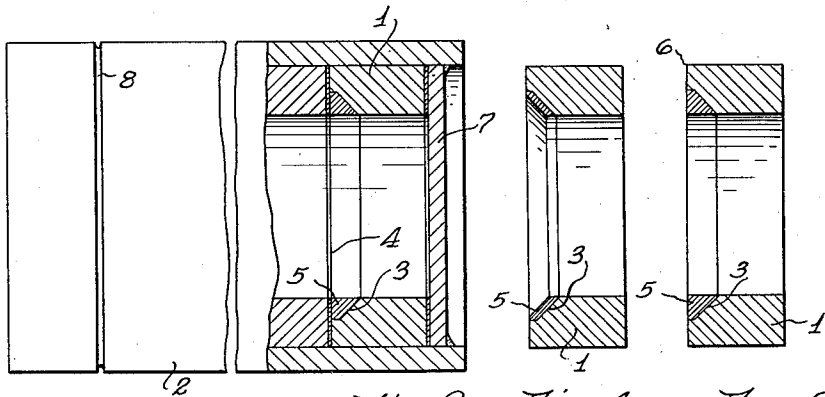


Fig. 2.

Fig. 4.

Fig. 3.

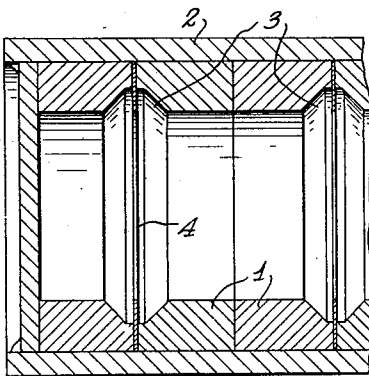


Fig. 5.

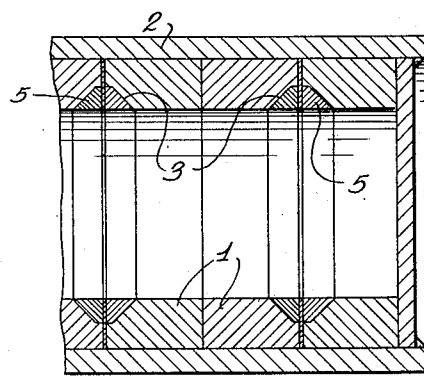


Fig. 6.

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METHOD OF FORMING VALVE SEAT
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6 Claims. (Cl. 29—156.7)

This invention relates to valve seat rings or inserts, and more especially to the construction of and methods for forming novel types of such rings or inserts in practice.

Valve seat inserts are employed in internal combustion engines to minimize pitting of the poppet valve seats and reduce the frequency at which such valve seats have to be re-ground or re-dressed. The valve seat inserts provide a valve seat surface of hard and refractory metals or alloys, or similar facing material, which does not pit or flake under the extreme conditions of heat, impact, and gas flow encountered during engine operation.

The present invention is an improvement on the constructions and methods described in the patent to McDonald, No. 1,987,784, issued January 15, 1935, and assigned to the same assignee as is the present invention, and in the present instance, the valve seat inserts or rings include body portions of greater cross-sectional area than that of the facing metal or alloy valve seat portion. The body portion is preferably of a metal or alloy having essentially the same co-efficient of thermal expansion as that of the engine block, or other elements in which the rings or inserts may be secured, so that the inserts or rings may be press fitted or chill shrunk or otherwise secured within annular recesses in the engine cylinder. By making the cross-sectional area of the facing metal or alloy portion small as compared with that of the body portion of the rings or inserts, the expansion and contraction of the facing material has little effect upon the expansion and contraction of the inserts. The facing metal or alloy is the most expensive material employed so that the use of a minimum amount of such material is desirable in order to effect economy.

The principal object of the invention is to improve the art of valve seat inserts or rings.

Another object is to provide a valve seat insert or ring with a hard or non-pitting and non-flaking valve seating portion, and at the same time employing a minimum amount of such valve seating material.

A further object is to provide a method of fabricating composite valve seat inserts or rings in large numbers while obviating the necessity of cutting directly through hard metal or alloy portions thereof in order to form the separate insert blanks.

Other objects, features and advantages will become apparent from the following description and appended claims.

For the purpose of illustrating the genus of the invention, various concrete embodiments and methods involved in effecting the same are shown in the accompanying drawing, in which:

Figs. 1, 2 and 3 are central longitudinal sections showing various steps employed in forming valve seat inserts such as that depicted in Fig. 4.

Figs. 5 and 6 are also similar views of an optional variation of the method illustrated in Figs. 1, 2 and 3 of fabricating valve seat inserts or rings.

Referring to Figs. 1 to 4 inclusive, there is illustrated a method of forming a valve seat insert. According to this method, a plurality of inserts or ring blanks 1, similar to the valve seat insert of Fig. 4 except that the valve seat portion 5 has not been applied, are assembled in a tube 2, each blank 1 being provided with a beveled face 3. The inserts or ring blanks 1 are assembled with the beveled surface 3 facing in the same axial direction and mica washers 4, or similar separating means, are interposed between the inserts or ring blanks. Thus the tube 2 serves as a holder for the composite ring blanks assembled as indicated in Figs. 1 and 2. As shown in Fig. 2, facing material 5 is centrifugally cast in the grooves formed between the beveled faces 3 and the mica washers or separators 4, and bonded to the body portion of the insert. When the casting of the facing material 5 has been completed and securely bonded to the body portion of the insert, the insert blanks 1 are removed from the tube 2 and are of the form indicated in Fig. 3. The blanks may then be dressed down to provide valve seat inserts of the general form indicated in Fig. 4.

The ring blanks 1 may be of any desired metal or alloy having the requisite hardness and strength and approximately the same coefficient of thermal expansion as the engine block or cylinder element in which the valve seat insert is to be secured. These ring blanks may be constructed by casting, forging, welding, machining, or otherwise forming the same to effect the shape illustrated in Fig. 1. When the ring blanks are assembled with the interposed separators in the tube, a generally hollow triangular groove is defined by the assembled relationship of the parts, with the bevel wall 3 making an angle of approximately 45° with reference to the axis of the tube, and the other wall formed by the mica washer 4 being essentially normal with reference to the longitudinal axis of the tube. In internal combustion engine practice, a 45° bevel

on the valve face and seat is the usual practice. When other valve seat angles are to be employed, it is to be understood that the angle at which the beveled face 3 makes with reference to the longitudinal axis of the tube will be varied to correspond with the valve seat angle.

After the ring blanks 1 have been so constructed, a hard refractory or non-pitting and non-flaking but impact resisting material, which may be of any hard, heat-resisting alloy steel, bronze or other alloy, such as stellite or even a softer material which could be re-faced by cutting as distinguished from grinding is integrally bonded to the ring blanks and fills the triangular space defined by the beveled face 3 and the mica washer 4. The annular rings of valve seat material 5 are preferably centrifugally applied, as before mentioned, in a manner well known in the centrifugal casting art, preferably in an atmosphere of reducing gas. The method of casting the valve seating material 5 on the beveled faces 3 of the ring blanks 1 may be that disclosed in the Brown Patent No. 1,923,075 issued August 22, 1933, in which two metals of different composition and having a melting point of above 1000° F. are united by placing one metal in solid state but divided condition, within a tube of dissimilar metal having a somewhat higher fusing temperature than that of the first mentioned metal, sealing the openings at both ends of the tube by annular disks 7, heating the tube to a temperature sufficient to melt the first mentioned metal but not sufficient, i. e. below 2400° F., to cause the tube to melt or lose its stiffness, rapidly rotating the tube to cause the molten metal to fill the triangular sections defined by the assembled ring blanks and mica washers and bond itself to the ring blanks, producing a uniform distribution of the molten metal on the bevelled faces in the triangular sections and cooling the tube until said included molten metal is solidified.

An example of a suitable material from which the ring blanks 1 may be made is a mild steel such as an SAE 1040 steel consisting of 0.35-0.45 carbon; 0.60-0.90 manganese; 0.045 maximum phosphorus; 0.055 maximum sulphur and the balance essentially iron. Stellite alloys of the following analysis:

Grade	Cobalt	Chromium	Tungsten	Other elements
No. 1.....	Per cent 1-43	Per cent 29-34	Per cent 11-14	Per cent 2.9
No. 6.....	1-55	27-33	3-6	2.7-5

¹ Minimum.

² Maximum.

may be used as the hard type of facing material which forms the valve seat material 5. An example of a softer alloy which does not readily pit or flake under severe impact and heat conditions, has the following analysis:

Ni	C	Ch	W	Mo	Si	Fe
Per cent 60-65	Per cent 2.5-3.0	Per cent 11-13	Per cent 2.5-3	Per cent .25-.4	Per cent 1.-2	Per cent 13.-16

The softer alloy will permit re-facing of valve seat inserts by means of reaming, facing or other cutting tools while stellite faced inserts would have to be re-faced by a grinding operation. The valve seat material 5 is bonded to the bevelled faces 3 of the ring blanks but not to the adjacent

normal face of the mica washer 4 which tends to disintegrate in the casting process. After the ring blanks 1 have had the facing material 5 integrally bonded thereto as above indicated, or by any other suitable method of bonding one metal to another, the sealed tube 2 is divided into sections by any suitable tool means, using the peripheral groove 8 on the tube 2 as a reference marking to form the initial cutting of the tube, thereafter the separate points at which the tube is desired to be cut so as not to cut through the seat material 5 may be determined from the open end of the tube; or, alternatively, the tube may be cut away completely with a tool by a turning operation. This obviates the necessity of providing a tool capable of cutting through hard refractory material such as that of which the facing material may be composed.

A single ring blank 6 as removed from the tube is illustrated in Fig. 3. The blank 6 is then dressed down to provide valve seat inserts of ultimate size and shape desired, for example as illustrated in Fig. 4, a valve seating surface being dressed down and arranged substantially parallel with the bevelled wall surface 3. It will be noted that the cross-section of the body portion of the insert which is derived from the ring blank 1 is considerably greater than that of the valve seat portion 5. This is desirable, since a small section of the valve seat material as compared with a much larger section of the body portion of the valve seat insert will prevent the valve seat portion 5 from having any greater effect upon the total expansion or contraction of the valve seat insert. Thus the valve seat portion 5 may be of a material which has a somewhat different co-efficient of expansion from that of the body portion. This permits the valve seat insert to be secured within a recess in the engine block or cylinder element of the engine by a press or shrink fit. It will also be noted that but a small amount of valve seat material is used to provide the valve seat portion 5, thus effecting economy since the material constituting the valve seat portion is the more expensive material employed. It will also be noted that there is very little waste of the valve seat material since practically all the valve seat material is used except that cut away to provide the angularly disposed valve seat proper.

Figs. 5 and 6 indicate a somewhat different arrangement of the ring blanks 1 and separators 4 within a holding tube 2. According to this method, the bevelled faces 3 of pairs of ring blanks 1 are axially opposed to each other and seating material 5 centrifugally cast and bonded to the inserts or ring blanks as before. The valve seat inserts produced by this method are the same as that illustrated in Fig. 4.

As many changes could be made in the above constructions and methods, and many apparently widely different embodiments, constructions and methods could be utilized in practicing this invention without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What I claim is:

1. The method of making valve seat inserts which includes the steps of, preforming a plurality of like annular metal blanks each of predetermined size and shape having an enlarged opening at one end, assembling two or more of said blanks in parallel relation in a supporting

tube having a bore substantially the same as the outer diameter of the blanks, with means comprising an element non-fusible with the blanks or tube at casting temperatures disposed therebetween to separate the blanks, said separating means disposed to form one face of a groove with the enlarged opening in one end of the blanks forming another face of the groove, disposing by centrifugal casting a metal annulus bonded to the blanks within said grooves and of a predetermined amount sufficient to substantially fill said grooves without effecting bonding between adjacent blanks, and separating from the supporting tube the assembled blanks and metal annuli bonded thereto.

2. The method of making valve seat inserts which includes the steps of, preforming a plurality of like annular metal blanks each of predetermined size and shape having an enlarged opening at one end, assembling two or more of said blanks in parallel relation in a supporting tube having a bore substantially the same as the outer diameter of the blanks, with means comprising an element non-fusible with the blanks or tube at casting temperatures therebetween to separate the blanks, said separating means disposed to form one face of a groove with the enlarged opening in one end of the blanks forming another face of the groove, disposing by centrifugal casting a metal annulus of a different composition from that of the blanks bonded to the blanks within said grooves and of a predetermined amount sufficient to substantially fill said grooves without effecting bonding between adjacent blanks, and operating upon the tube with a cutting tool to separate from the supporting tube the assembled blanks and metal annuli bonded thereto.

3. The method of making valve seat inserts which includes the steps of, preforming a plurality of like annular metal blanks each of generally rectangular cross-section except for an inner peripheral surface at one end thereof beveled at a predetermined angle with reference to the longitudinal axis of the blanks, assembling two or more of said blanks in parallel relation in a supporting tube having a bore substantially the same as the outer diameter of the blanks, with means comprising an element non-fusible with the blanks or tube at casting temperatures disposed therebetween to separate the blanks, said separating means disposed to form one face of a groove with the beveled surface in one end of the blanks forming another face of the groove, disposing by centrifugal casting a metal annulus bonded to the blanks within said grooves and of a predetermined amount sufficient to substantially fill said grooves without effecting bonding between adjacent blanks, and separating from the supporting tube the assembled blanks and metal annuli bonded thereto.

4. The method of making valve seat inserts which includes the steps of, preforming a plurality of like annular metal blanks each of generally rectangular cross-section except for an inner peripheral surface at one end thereof beveled

at a predetermined angle with reference to the longitudinal axis of the blanks, assembling two or more of said blanks in parallel relation with said beveled surfaces facing in the same axial direction in a supporting tube having a bore substantially the same as the outer diameter of the blanks, with means comprising a mica element disposed therebetween to separate the blanks, said separating means disposed to form one face of a groove with the beveled surface in one end of the blanks forming another face of the groove, disposing by centrifugal casting a metal annulus bonded to the blanks within said grooves and of a predetermined amount sufficient to substantially fill said grooves without effecting bonding between adjacent blanks, and separating from the supporting tube the assembled blanks and metal annuli bonded thereto.

5. The method of making valve seat inserts which includes the steps of, preforming a plurality of like annular metal blanks each of generally rectangular cross-section except for an inner peripheral surface at one end thereof beveled at a predetermined angle with reference to the longitudinal axis of the blanks, assembling two or more of said blanks in parallel relation with said beveled surfaces facing in opposite directions in a supporting tube having a bore substantially the same as the outer diameter of the blanks, with means comprising a mica element disposed between the opposed beveled surfaces of adjacent blanks to separate the same, said separating means disposed to form one face of a groove with the beveled surface in one end of the blanks forming another face of the groove, disposing by centrifugal casting a metal annulus bonded to the blanks within said grooves and of a predetermined amount sufficient to substantially fill said grooves without effecting bonding between adjacent blanks, and separating from the supporting tube the assembled blanks and metal annuli bonded thereto.

6. The method of making valve seat inserts which includes the steps of, preforming a plurality of like annular metal blanks each of predetermined size and shape having an enlarged opening at one end, assembling two or more of said blanks in parallel relation with said enlarged openings in the blanks facing in the same axial direction in a supporting tube having a bore substantially the same as the outer diameter of the blanks, with means comprising a mica element therebetween to separate the blanks, said separating means disposed to form one face of a groove with the enlarged opening in one end of the blanks forming another face of the groove, disposing by centrifugal casting a metal annulus of a different composition from that of the blanks bonded to the blanks within said grooves and of a predetermined amount sufficient to substantially fill said grooves without effecting bonding between adjacent blanks, and operating upon the tube with a cutting tool to separate from the supporting tube the assembled blanks and metal annuli bonded thereto.

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