Feb. 9, 1937. F. O. ALBERTSON 2,069,933

METHOD OF RECONSTRUCTING VALVE SEATS

Filed Dec. 14, 1931

Fig. 2.

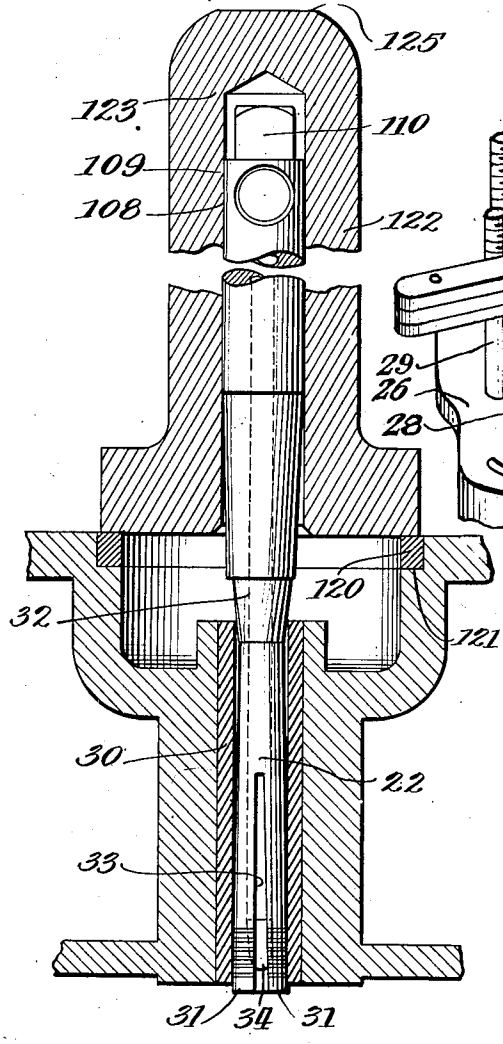


Fig. 1.

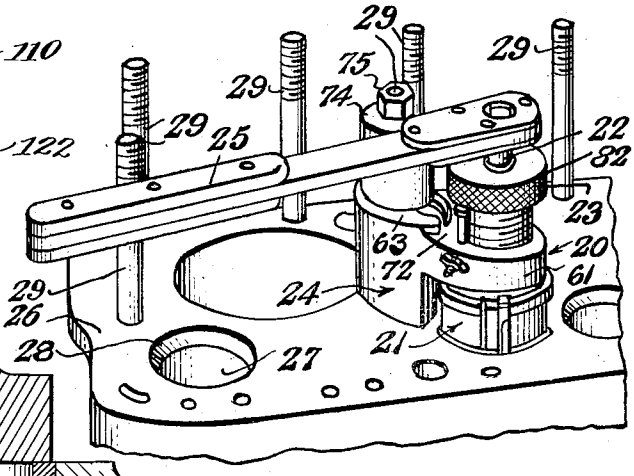
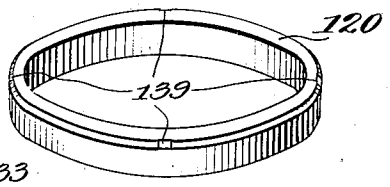


Fig. 3.



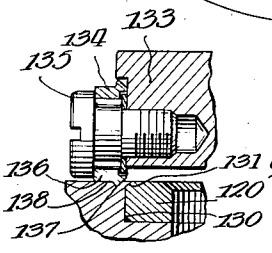


Fig. 4.

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METHOD OF RECONSTRUCTING VALVE SEATS

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Application December 14, 1931, Serial No. 580,967

1 Claim. (Cl. 29—156.7)

The present invention relates to methods of reconstructing valve seats and is a continuation in part of my prior application, Serial No. 340,770, filed February 18, 1929, for Valve seat reconstruction tools, which issued as U. S. patent No. 1,882,689 on October 18, 1932.

One of the objects of the present invention is the provision of an improved method for the reconstruction of valve seats.

Another object of the invention is the provision of an improved method of valve seat reconstruction.

Another object is the provision of an improved method of valve seat reconstruction, in which the alignment and support of the cutting members is accomplished principally by a pilot stem which is accurately and fixedly secured in a valve seat guide.

Another object of the invention is the provision of an improved method of installing or driving valve seat rings of the class described.

Other objects and advantages of the invention will be apparent from the description and from the accompanying drawing in which similar characters of reference indicate similar parts throughout the several views.

Referring to the drawing, of which there is one sheet:

Fig. 1 is a view in perspective of a valve seat reconstruction tool applied to the block of an internal combustion engine and used in carrying out the method.

Fig. 2 is a vertical sectional view taken on a plane passing through the axis of the pilot, showing the assembly of tools used for installing a valve seat ring.

Fig. 3 is a view in perspective of a valve seat ring.

Fig. 4 is a fragmentary sectional view of the valve seat ring showing the preferred mode of locking the ring in place.

The present method of reconstructing valve seats is adapted to be carried out by the apparatus described and covered by my prior application above mentioned, and therefore this apparatus will be described in so far as it is helpful to the practice of the method of reconstructing valve seats.

In the embodiment chosen to illustrate the invention (referring to Figs. 1, 2 and 4), 20 indicates the valve seat reconstruction tool assembly in its entirety. The tool preferably includes a cutter 21, a pilot stem 22, a bearing 23, a tool holder 24, and means for actuating the cutter which may consist of a ratchet lever 25, or other actuating devices. The ratchet lever 25 may be of any conventional type, and, as any type of actuating device may be used, the ratchet lever will not be described in detail.

Many of the advantages of the invention may be realized without employing all of the elements shown in the complete assembly, and it should be understood that the invention includes the use of the various sub-combinations and permutations of all of the elements described, wherever such combinations will be advantageous, and the scope of the invention is to be limited only by the terms of the appended claims.

Referring to Fig. 1, the conventional internal combustion engine block 26 is provided with a plurality of valve openings 27, having valve seats 28 formed therein, and with a plurality of stud bolts 29 for securing the motor head to the block. The valve seat tool assembly 20 is illustrated in the operation of reconstructing a valve seat 28 by cutting a recess adapted to receive a metal member forming a new valve seat.

The valve seat tool is preferably provided with a pilot stem 22 of the type illustrated in the prior application of Frans O. Albertson, Serial No. 310,600, filed October 5, 1928, which is peculiarly adapted to accurately center itself axially of any valve stem guide such as the guide 30, and adapted to be fixedly mounted in the valve guide 30 by expanding the parts 31 of a tripartite end.

The pilot stem 22 is provided with a frustoconical portion 32 spaced from the end 31 and adapted to engage the inner and upper edge of the cylindrical valve guide 30, automatically centering the pilot stem at this point. The lower end of the pilot stem 22 is split three ways as at 33, forming three split portions 31 of equal thickness and adapted to be cammed apart by a camming member 34, which extends longitudinally of the pilot stem in the bore 35. The camming member 34 is provided with threads 36 adjacent its upper end adapted to be received in complementary threads carried by the bore 35 and the camming member is provided with a noncircular head 37.

The functions of such a pilot stem are fully set forth in the application above mentioned, so that it will suffice to say that since three points determine the location of a circle, the tripartite end is peculiarly adapted to accurately center the lower end of the pilot stem 22 axially of the valve guide 30 in a manner which cannot be accomplished by any pilot stem not constructed according to the present invention. As the pilot stem is already centered at the point 38 of the

valve guide 30 by the cone 32, it will be observed that the pilot stem is accurately located with its axis coinciding with the axis of the valve guide 30, and the pilot stem is thus adapted to accurately support a cutter 21, or other resurfacing tool, so that it may form a valve seat having its axis accurately located in the axis of the valve guide.

The pilot stem 22 is also peculiarly adapted to have the camming member 34 placed in a state of compression with the pilot stem 22 in a state of tension, so that the pilot stem becomes extremely stiff when located within a valve guide 30, as shown in Fig. 4.

The pilot stem which is selected to illustrate the apparatus is merely exemplary of one of the types of pilot stems which may be coupled to carry out the method. Another form of pilot stem which may be used is shown in my prior application, Serial No. 538,504 filed May 19, 1931, for valve seat tools.

It will thus be observed that the pilot stem of the present invention is peculiarly adapted to be accurately centered and fixedly secured axially within a valve guide 30, so that the pilot stem may guide a cutter or surfacing tool for accurately forming or resurfacing a valve seat 28. As the valve seats 28 are surfaces of revolution, it is of the utmost importance that the seats be formed with their axes accurately located in the axis of the valve stem guide, so that the valves will seat equally at every point upon the seat.

It should be noted that in the present invention the pilot stem 22 is adapted to perform the function of alignment, support and guidance of the cutter 21 upon the tool holder 24, as distinguished from devices in which the pilot stem is merely employed for determining the approximate axial position of the cutter, and it should also be noted that the present method of operation is capable of mathematical accuracy as distinguished from the methods in which a pilot stem is loosely rotated until it assumes the most free position. The latter method merely locates a pilot stem in the approximate axial position, and the accuracy of the latter method depends upon the play between the pilot stem and a worn valve guide.

The tool assembly shown in Fig. 1 can be used for cutting a recess of substantially rectangular form in the valve seat, as shown at 121 in Fig. 2. This recess is slightly smaller than the valve seat ring 120, which is to be installed in the recess, and the ring therefore has a close frictional fit inside of the recess.

The pilot stem 22 is also adapted to be used with the assembly of parts shown in Fig. 2 for inserting a new valve seat ring 120 in the recess 121 formed by the cutting tool 21. The ring 120 comprises an annular metal member which may be constructed of tempered steel or any other material desirable for a valve seat. The body of the ring 120 is preferably of substantially rectangular cross-section and adapted to be secured by close frictional fit within the complementary annular recess 121, made by cutting tool 21.

The ring 120 is preferably installed by using a driving tool 122 and comprising a substantially cylindrical metal member having an accurately machined, axially extending and centrally located bore 123, adapted to slidably receive the cylindrical portion 108 of the tool holder 24.

The body of the driving member 122 forms a handle which may be knurled as at 124 for convenient manipulation, and the upper end of the driving tool forms an impact surface 125 to be engaged by a hammer or other driving tool. The lower surface 126 of the driving tool is substantially flat and may be enlarged, if necessary, to correspond to the diameter of the ring 120, forming an annular flange 127, adapted to extend over and to engage above the top of the ring 120.

The method of use of the driving tool 122 will be explained in detail hereinafter, but it should be noted that the pilot stem 22 is highly advantageous for guiding the driving member 122 in driving a ring 120 into a close frictional fit in the recess 121. The pilot stem is adapted to support the driving tool axially of the recess 121, so that the ring is forced in at all sides of the recess simultaneously, without trouble or without damaging the ring, an operation which is rendered much more difficult without the use of the pilot stem. When an effort is made to insert a ring without the use of the pilot stem, the tendency is to drive the ring in at an angle so that the walls of the recess may be damaged, or the ring seated at a tilt, or the ring may be so damaged that it will not properly seat in the recess thereafter.

The present valve seat tool may be employed with roughing reamers or other surfacing tools for accurately resurfacing valve seats and the operation of resurfacing a valve seat is greatly simplified and the labor lessened by the use of the present tool. The feeding device is adapted to permit a heavy force to be brought to bear upon the roughing reamer, so that the operation may be done in a small portion of the time otherwise necessary, and the universal bearing provided is adapted to permit the feeding operation without disturbing the alignment determined by the pilot stem fixed in the valve guide.

The preferred practice of the method preferably includes the use of a finishing reamer of the type shown in my prior application, Serial No. 407,877, filed November 18, 1929. Such a reamer has its cutting edges converging toward a center, which center is eccentric with respect to the axis of the reamer, the teeth being irregularly spaced whereby chattering is eliminated and the plates are given a uniform shearing action. Such a reamer is capable of producing a finished valve seat without the necessity of any lapping-in operation.

It will thus be observed that the present device is adapted to effect a rapid and accurate resurfacing of valves with a minimum of effort.

The device may also be employed for entirely removing the metal surface of an old valve seat, forming a recess adapted to receive a new metal ring for forming a new valve seat.

When the reconstruction tool is to be used for installing a new ring, a recess is first cut with the tool set up as shown in Fig. 1, the depth of the recess being shown in Fig. 2. The tool fixture 24 may then be removed, leaving the pilot in place for use in guiding the driving tool 122.

The driving tool 122 may then be placed with its bore 123 about the cylindrical portion 108 of tool holder 24, and the ring 120 may be located with the fingers, directly above the annular groove 121 and held flatly against the bore surface 126 of driving tool 122. The ring may then be quickly driven into the recess 121 by a few blows of a hammer upon impact surface 125 of driving tool 122, during which time the pilot

stem 22 will hold the driving tool 122 axially of the annular groove 121, so that the ring may be driven in axially with a few blows until it seats itself against the bottom of the groove 121.

It should be noted that since the valve seat ring 120 is constructed of relatively hard resilient metal, such as tool steel or an iron alloy having the qualities of heat resistance and uniform hardness, the ring ordinarily tends to spring back out of the annular groove 121 until it has been well started and the operation of driving the ring without the driving tool 122 or pilot stem 22 is a very difficult matter, consuming more time and tending to damage the ring.

If the valve seat ring protrudes above the surface of the block, the ring may be faced off flush with the block by using the cutter 21, after which the valve seat may be cut in the usual manner with a reamer or surfacing tool, to form the usual valve seat.

Referring to Fig. 4, this is a fragmentary sectional view of one side of the valve seat structure, showing the preferred method of locking the valve seat ring in place. While the most simple method so far provided is the pressed fit or drive fit, with the close frictional engagement between the ring and the walls of the recess, and many valves have been successfully reseated by this method, it is preferable to provide additional means for locking the valve seat ring in its recess and also for preventing the spinning of the ring and securing it against rotation.

Such valve seats are subjected to tremendous pressure and impact of valves, which are made of very hard material, and consequently the desirability of a more permanent or secure method of locking the ring in place has become apparent in many cases. The valve ring shown in Fig. 12 may be made with a simple rectangular cross section, as shown in Fig. 10, but it preferably is formed with a slight chamfer 130 at its lower outside corner for the purpose of assuring a definite seating of the ring in its recess in every case. When the recess is cut with a tool of the type shown having the pair of cutting edges at right angles, it is desirable to have the recess made slightly smaller than the diameter of the ring so as to have a tight fit. This prevents the leakage of gases past the ring and prevents the ring from becoming loose.

It will be evident, however, that the maximum amount of wear on the cutting tool comes at the corner, and therefore it is often difficult to assure the cutting of an accurate square corner at the bottom of the recess. If the corner is not cut accurately square, due to the wear of the cutter, it will be difficult and practically impossible to seat the ring against the bottom of the recess. Therefore, it has been found desirable to provide the chamfer 130, which makes allowance for the wear on the corner of the cutter and permits a ring to be seated against the bottom of the recess in every case.

The ring 120 is also preferably provided with the chamfer 131 at its upper outside corner for the purpose of providing a space into which the metal of the cylinder block may be forced to secure the valve seat ring in place. In some embodiments of the invention the valve seat ring 120 may be seated below the top of the surface of the block and the metal of the block may be forced out over the top of the ring for the purpose of securing the ring in place. Under such conditions it would not be necessary to provide the chamfer 131.

It is desirable, however, to seat the ring flush with the top of the engine block, and after the ring has been driven into place the ring is preferably locked in place by the use of the tool shown in Fig. 4, which is described in greater detail in my copending application, Serial No. 597,082, filed March 5, 1932, on a valve seat ring securing tool and method of making the same.

Since an understanding of the tool is necessary to the description of the method, the principal features of the tool will be described in brief as follows:

The tool comprises a body 133 of metal which may be similar in shape to the body of the cutter 42 previously described in that it is substantially cylindrical and provided with a tapered bore to be received on a tool holder, which is slidably mounted on the pilot stem. The body 133 is, however, provided with a flat side 134 having a trunnion 135 for rotatably supporting a roller 136. The roller 136 has a rib or ridge 137 adapted to engage in the metal of the internal combustion engine block just outside and adjacent the chamfer 131 so as to form a groove in the block and work the metal outward into the space provided by the chamfer 131 or over a part of the valve seat ring. The substantially cylindrical surface 138 on roller 136 acts as a stop in limiting the depth to which the ridge 137 can be forced with a reasonable amount of pressure, and indicates to the operator when the operation is finished. The metal of the engine block is thus spun over the upper surface of the valve seat ring, and the ring is locked in its recess.

The ring 120 also preferably is provided with a plurality of notches 139 in the chamfer 131 into which the metal is forced in the locking operation to prevent the rotation of the ring during the completion of the locking operation, and after the operation has been completed. These notches 139 comprise interlocking or anchoring formations for engaging the complementary formations in the metal of the internal combustion engine block, and they also prevent spinning of the ring during the use of the tool of Fig. 4.

The present method of reconstructing valve seats comprises the following steps when the entire method is employed, although various subcombinations of the steps may also be used with advantageous results: A pilot member is first placed in a valve guide and located axially of the valve guide at one point of the length of the pilot member, after which another point in the pilot member is centered in the valve guide by expanding the tripartite end of the valve guide to engage the walls of the guide. The pilot member is now accurately and mathematically centered with its axis in the axis of the guide.

The pilot member may then be placed under the state of tension to stiffen the same and fixedly secure it within the valve guide, after which the cutter with its tool holder may be placed upon the pilot stem, the complementary surfaces of these parts accurately aligning the cutter with its axis in the axis of the valve guide. The cutter is now guided by the pilot stem to perform a cutting operation, which will either cut a recess for a new valve seat ring or resurface a valve seat, and in either case, the surface formed will be a surface of revolution having its axis at the center of the valve guide.

The cutter may also be guided by the auxiliary support provided by bearing 23, since the bearing 23 is a universal bearing it can only provide an

auxiliary support against lateral movement of the tool holder or pilot and a thrust bearing against which the feeding member may react, so that the bearing **23** only assumes a position which is determined and maintained by the pilot member. The cutter may then be fed axially of the pilot stem by means of the supporting body with its feeding member and rotated about the axis of the pilot stem by any convenient source of power to cut a groove or resurface a valve seat.

If a groove has been cut, the next steps in the reconstruction of a valve seat are the placing of a ring above the recess, guiding a driving tool by means of a pilot member, and driving the ring into frictional engagement with the walls of said recess to seat the ring in the recess.

The valve seat ring is then preferably locked in place by forcing a portion of the metal of the internal combustion engine block over an anchoring formation of the ring or over the top of the ring in such a manner that the ring is locked against reciprocation and rotation. The preferred method is to force the metal uniformly over the ring about its circumference by means of a tool of the type shown in Fig. 4. This also makes the joint between the ring and the internal combustion engine block absolutely gas tight and capable of withstanding greater pressures and impact without loosening.

The ring may then be cut down to form a valve seat by means of a roughing reamer of the type disclosed in one of my prior patents, and the roughing reamer preferably is not intended to cut the seat to the accurate angle that is desired. For instance, if a 45 degree seat is desired, the roughing reamer will cut the seat down to the approximate size or width but it will be slightly off the 45 degree angle.

The seat is then finished with one of my valve seat finishing reamers of the type referred to and covered by my prior application, which cuts the seat to an accurate 45 degree angle in the example cited. It is only necessary for the finishing reamer to take off a small portion of the metal, and this should preferably be done with a very light pressure on the finishing reamer to prevent any deflection whatever of the valve stem, since heavy pressures naturally tend toward causing a deflection. By this method the valve seat may be brought to a finished surface so that no lapping-in operation is required.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claim.

Having thus described my invention, what I claim is new and desire to secure by Letters Patent of the United States, is:

The method of reconstructing valve seats for internal combustion engines which comprises cutting a substantially cylindrical recess in the engine block surrounding the valve seat opening, placing above said opening a metal ring slightly larger than said recess but substantially complementary in shape to said recess, said ring having its lower outer corner beveled, guiding said ring into said recess while forcing said ring into said recess by impact, said ring being retained in said recess by frictional engagement of its periphery with the wall of said recess, the upper outer corner of said ring being beveled to form a groove with the wall of said recess and forcing the metal of said engine block over the top of said ring adjacent its outer edge to secure said ring in said recess, said ring being formed with a plurality of radially extending slots on the beveled surface of its upper outer corner and the metal of said engine block being forced into said slots to prevent rotation of said ring.

FRANS O. ALBERTSON.