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VALVE SEAT CUTTER

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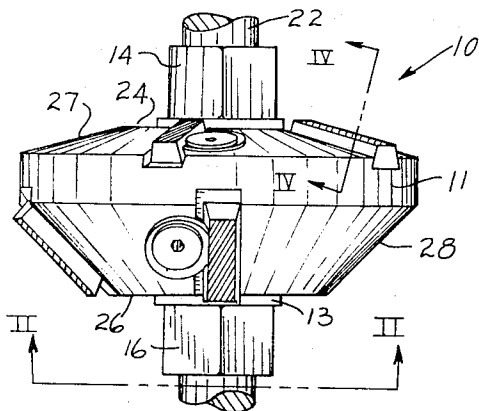


Fig. 1

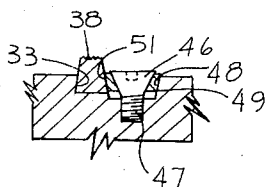


Fig. 4

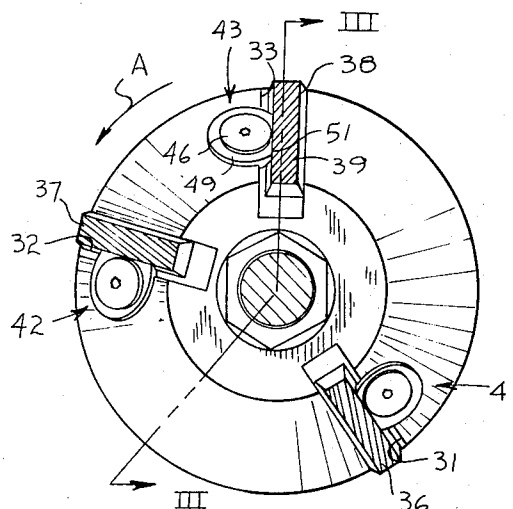


Fig. 2

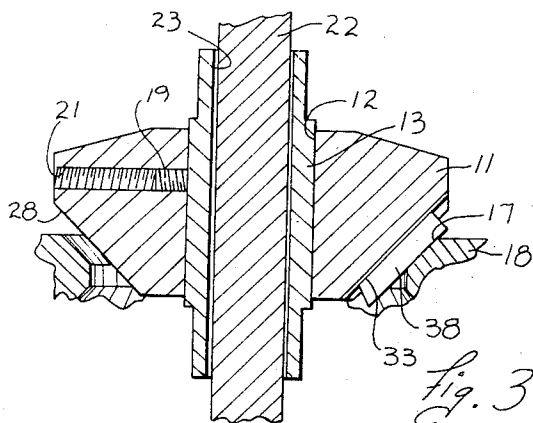


Fig. 3

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VALVE SEAT CUTTER

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2 Claims. (Cl. 29—105)

This invention relates to a valve seat cutter and more particularly refers to a cutter having irregularly spaced cutting members.

The valve seats and poppet valves widely used in gasoline and diesel engines tend to lose their initial sealing qualities after extended use. Thus, it is common practice to periodically refinish the sealing faces of the poppet valves, generally by a grinding operation, and of the valve seats.

A variety of methods for refinishing the valve seats have been used heretofore but generally have been less than completely satisfactory. Valve seats have been refinished, for example, by rotatable lapping with the ground valve a suitable lapping abrasive being interposed between the valve and seat to bring the sealing surfaces thereof to the same contour. This method cannot, however, in a practical amount of time, return a badly distorted seat to its proper angle and to coaxiality with its associated valve guide and if only partially completed may result in binding of the valve stem in its guide when the valve is closed.

Grinding of the seat has not been desirable as badly distorted seats quickly change the contour of the grinding wheel which must be frequently redressed. This is a time consuming and, hence, expensive operation.

In the more recent past, a circular metal cutting head using several removable cutters has been used. Three evenly spaced carboloy cutters have been used and such an arrangement has been found to eliminate the above-mentioned disadvantages of other prior devices. However, it has been found that a cutter head equipped with evenly circumferentially spaced cutter members tends to reproduce a depression occurring at a given point on the valve seat at further points 120 degrees on either side of such given point. This result is believed due to the increased axial pressure on the two remaining cutters when the first cutter is suspended or only lightly bearing on the depressed area and the pressure normally imposed of the first cutter is divided and added to the normal pressure on the remaining pair of cutters. Thus, the remaining pair of cutters tends to cut a little deeper when the first cutter is over the depression, thereby beginning the additional pair of depressions. Since one cutter is over the original depression and the others are over the additional depressions once in every 120 degrees of cutter rotation, the additional depressions quickly approach the depth of the original depression. At this point, the original depression and the additional ones tend to perpetuate themselves since full pressure is applied to the cutter as it now moves through each depression, the other cutters being unable to lift it from the depression since they also are in depressions at this time. The prior device tended to stick when rotated, particularly when rotated by hand, such sticking being believed to be a result of the above-mentioned effect.

In an attempt to eliminate this problem, the cutters were shifted somewhat away from this even circumferential spacing. In one device, for example, one of the cutters was shifted 10 degrees from its previous evenly spaced position, the cutters then being arranged to pass a fixed point on the guide in the sequence 130, 120 and 110 degrees. Although, this improved somewhat the device's ability to remove depressions in the valve seat and lessened its tendency to reproduce each depression at other

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pairs of locations on the seat, the modified apparatus still tended to stick and cock somewhat at times.

To prevent such cocking, the cutter head was mounted on a pilot fixed to the valve guide in engine block or head bearing the valve seat which also tended to insure concentricity of the seat and valve guide associated therewith. Even then, the rotative force required to maintain the prior device at a constant speed of rotation would vary. The prior tool is frequently hand rotated and imparts at times a rather jerky resistance to rotation onto the hand of the user whereas a smooth or constant resistance would be more desirable, from the standpoint of assuring the user that a smooth, well-refinished valve seat would result and for producing a smoother valve seat.

Considerable time and effort have been expended in experiment to find an angular spacing of the cutters capable of producing a smoother finished seat and smoother, less jerky resistance to rotation. The result of this experimentation is a tool in which the cutter spacings are markedly different from those previously used and which allow the tool to be rotated by hand much more smoothly than previously.

As a result, it is an object of this invention to provide a valve seat cutter having a plurality of irregularly spaced cutting members.

A further object of this invention is to provide a valve seat cutter, as aforesaid, in which three valve seat cutters are provided, such cutters being circumferentially spaced within 5 degrees of 140, 75 and 145 degrees, respectively.

A further object of this invention is to provide a valve seat cutter, as aforesaid, capable of providing a smoother, finished valve seat surface than prior cutters from which it was developed, which will not tend to reproduce depressions occurring in the unfinished valve seat and which readily eliminates such depressions.

A further object of this invention is to provide a valve seat cutter, as aforesaid, which is free from tendencies to snag or cock exhibited by prior devices, which will operate smoothly and will rotate at a constant speed when a relatively constant rotational force is exerted thereupon and which imparts fewer and less intense shocks to the user, thus reducing operator fatigue and increasing operator confidence that the seat is being smoothly and properly renewed.

A further object of this invention is to provide a valve seat cutter, as aforesaid, which will rapidly cut away the desired portion of the valve seat to be renewed even when rotated by hand.

A further object of this invention is to provide a valve seat cutter, as aforesaid, which can use the same cutter bars, cutter bar holding means and cutter body blanks as previous cutter head constructions from which the present cutter was developed, when can use much of the existing tooling used to manufacture previous cutters and which further can be produced without increasing costs over its predecessors.

A further object of this invention is to provide a valve seat cutter as aforesaid, which is capable of a long operating life under harsh operating conditions with little or no maintenance and which is readily maintainable by the user.

A further object of this invention is to provide a valve seat cutter, as aforesaid, in which the smoother cutting action thereof tends to result in fewer and less intense shocks to the cutter head during a cutting operation and thus tends to result in a longer operating life with less maintenance and reduces any tendency for the cutter bars or cutter bar holding means to loosen during operation.

Other objects and purposes of this invention will be apparent to persons acquainted with apparatus of this general type upon reading the following description and upon inspecting the accompanying drawings.

In the drawings:

FIGURE 1 is a side elevational view of a valve seat cutter embodying the invention.

FIGURE 2 is a sectional view taken along the line II—II of FIGURE 1.

FIGURE 3 is a sectional view taken on the line III—III of FIGURE 2.

FIGURE 4 is a fragmentary sectional view taken on the line IV—IV of FIGURE 1.

Certain terminology will be used in the following description for convenience in reference only and will not be limiting. The words "upwardly," "downwardly," "rightwardly" and "leftwardly" will refer to directions in the drawings to which reference is made. The words "inwardly" and "outwardly" will refer to directions toward and away from, respectively, the geometric center of the device and designated parts thereof. Said terminology will include the words above specifically mentioned, derivatives thereof and words of similar import.

Description

Turning now to the drawings there is disclosed a valve seat cutter 10 embodying the present invention. The valve seat cutter 10 includes a generally cylindrical body 11. The body 11 is provided with a central opening 12 (FIGURES 2 and 3) in which is snugly but slidably disposed a generally cylindrical, hollow and elongated hub 13. In the particular embodiment shown, the ends of the hub 13 are of hexagonal cross section as indicated at 14 and 16 in FIGURES 1 and 2. The ends 14 and 16 extend axially beyond the body 11 and are suited for engagement by a suitable wrench or the like, not shown, to cause rotation of the cutter 10 and to urge same axially against the valve seat 17 (FIGURE 3) to be cut and thereby renewed, such valve seat being disposed in the head or in the block of a gasoline or diesel engine or similar device employing poppet valves. A fragment of the engine surrounding the valve seat is here indicated at 18. The hub 13 is movably affixed within the body 11 by a generally radially aligned set screw 19 threaded in a radial opening 21 in the intermediate portion of the body 11. A suitable pilot 22, such as that disclosed in my copending application Ser. No. 529,029, is insertable through the central opening 23 in the hub 13 for supporting said hub and the body 11 for rotation thereupon.

Ends 24 and 26 of the body 11 are beveled to form frusto-conical surfaces 27 and 28, respectively. The angles such frusto-conical surfaces make with the axis of said body correspond to the angle of the valve seat to be ground. In the particular embodiment shown, the surfaces 27 and 28 make 75 degree and 45 degree angles, respectively, with the axis of the body 11.

In its position of use shown in FIGURE 3, the body 11 is arranged with the frusto-conical surface 28 in coaxial opposition to the valve seat 17. The frusto-conical surface 28 has three elongated and radially extending grooves 31, 32 and 33 cut therein and extending from the periphery of the body 11 to points closely adjacent the central opening 12. The grooves 31, 32 and 33 are preferably identical and are of constant cross section substantially throughout their length. In the particular embodiment shown, the grooves 31, 32 and 33 are somewhat undercut and have outwardly convergent side walls.

Preferably identical cutter bars 36, 37 and 38 are disposed in the respective grooves 31, 32 and 33. The cutter bars 36, 37 and 38 are each of trapezoidal cross section, the base angles thereof corresponding to the angles at which the side walls of the grooves are undercut. The width of the cutter bars is somewhat less than the width of their corresponding grooves to allow same to be readily placed within the grooves. The outer or cutting face of each of the cutter bars parallels the bottom of its corresponding groove.

The outer face of each cutter bar is provided with parallel elongated cutting teeth generally indicated at 39,

preferably similar to teeth on a file, which teeth are diagonally arranged on the cutter bar and as seen from the center of the body 11 extend rightwardly and radially away from the hub 13. The teeth 39 are, in the particular embodiment shown, pitched so that their cutting edge faces leftwardly and radially outwardly as seen from the axis of the body 11 and, hence, are arranged for cutting when the cutter body 11 is rotated in a counterclockwise direction as seen from the valve seat and indicated by the arrow A. Such cutting rotation would therefore appear as a clockwise rotation when viewed from the end of the body away from the valve seat and toward the operator, that is, the upper end of the valve cutter construction 10 as seen in FIGURES 1 and 3.

The cutter bars 36, 37 and 38 are normally wedged against the trailing side wall of their respective grooves by preferably identical holding means generally indicated at 41, 42, and 43. Such holding means each comprises a flat head machine screw (FIGURE 4) threadedly received in the body 11 as indicated at 47 at a point spaced from the leading side of the groove and located intermediate the ends thereof. A frusto-conical recess 48 coaxially surrounds the screw 46 and communicates partially with the adjacent one of the grooves 31, 32 and 33 and is preferably somewhat deeper than said groove 33. A frusto-conical washer 49 corresponding generally in shape to the recess 48 and receivable therewithin, has a flattened chordal surface 51 which fits snugly against the opposed side of the adjacent cutter bar, when the screw 46 is tightened, to hold the cutter bar firmly immobile on the body 11.

It has been found through experiment by wide variation of the circumferential distance between the cutter bars 36, 37 and 38 that the optimum angles therebetween, that is, those angles producing the smoothest operation of the tool and smoothest refinishing of the valve seat are 140, 75 and 145 degrees, respectively. Thus, as seen in FIGURE 2, the cutter bar 36 is circumferentially spaced from the cutter bar 37 by an angle of 140 degrees, cutter bar 37 is angularly spaced from cutter bar 38 by an angle of 75 degrees and cutter bar 38 is circumferentially spaced from cutter bar 36 by an angle of 145 degrees.

Further, it has been found that smoother cuts are obtained when these angles are arranged in the manner shown in FIGURE 2 with respect to the direction of cutter rotation during cutting. More particularly, it has been found that at a given point P (FIGURE 2) adjacent the valve seat, optimum cutting results if, as the cutter bars rotate therepast, the angular spacing of such cutter bars follows in the sequence 140, 75 and 145 degrees. It has also been found that a variation of 5 degrees may be tolerated in the angles shown before objectionable roughening of the cutting action occurs and that variations of the above-mentioned preferred angles exceeding 5 degrees have been found to produce noticeable roughening of the cutting operation as felt by the operator during operation thereof. Although, the reasons why the preferred 140, 75 and 145 degree sequence above mentioned produces the smoothest cutting action are not known completely, experience indicates that smoothest cutting does result with these angles taken in sequence. The smoothness of cutting is attributed in part to the fact that the six locations of the remaining cutters, when succeeding ones of the cutter bars are positioned at a given depressed point on the unfinished valve seat are, except for two of said locations, relatively widely and evenly spaced.

The cutter bars on the upper frusto-conical surface 27 preferably appear in the same angular spacing discussed hereinbelow with respect to the frusto-conical surface 28 and shown in FIGURE 2.

Considering the operation of the device 10 more specifically, same is located in coaxial alignment with the seat 17 to be refinished and lowered thereonto so that the cutters support the body 11 on the valve seat 17. Thereupon, rotation of the cutter 10 in a direction to

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move the cutting edges of the cutter bars 36, 37 and 38 along the face of the valve seat in a cutting direction is initiated along with an axial force urging the cutter against the valve seat 17, such rotational and axial forces being normally manually initiated through any convenient means, not shown, which may be similar to those disclosed in my copending application Ser. No. 529,029.

Although a particular preferred embodiment of the invention has been disclosed above for illustrative purposes, it will be understood that variations and modifications thereof which lie within the scope of the appended claims are fully contemplated.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A cutting head for renewing a valve seat for a poppet valve, comprising the combination:

a body member and means centrally located thereon for rotatably driving same;

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three cutter members fixed to said body and radiating outwardly thereon, said centers being sloped on said body in a manner corresponding to the slope of the valve seat to be refinished, the angles between said cutter members being 5 degrees of arc or less away from the respective angles 140, 75 and 145 degrees.

2. The device defined in claim 1 in which the cutter members having cutting edges facing in one circumferential direction for cutting when said body is rotated in said direction and in which the sequence of said angles past a fixed point of the valve seat is 140, 75 and 145 degrees as said body rotates in said direction.

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