

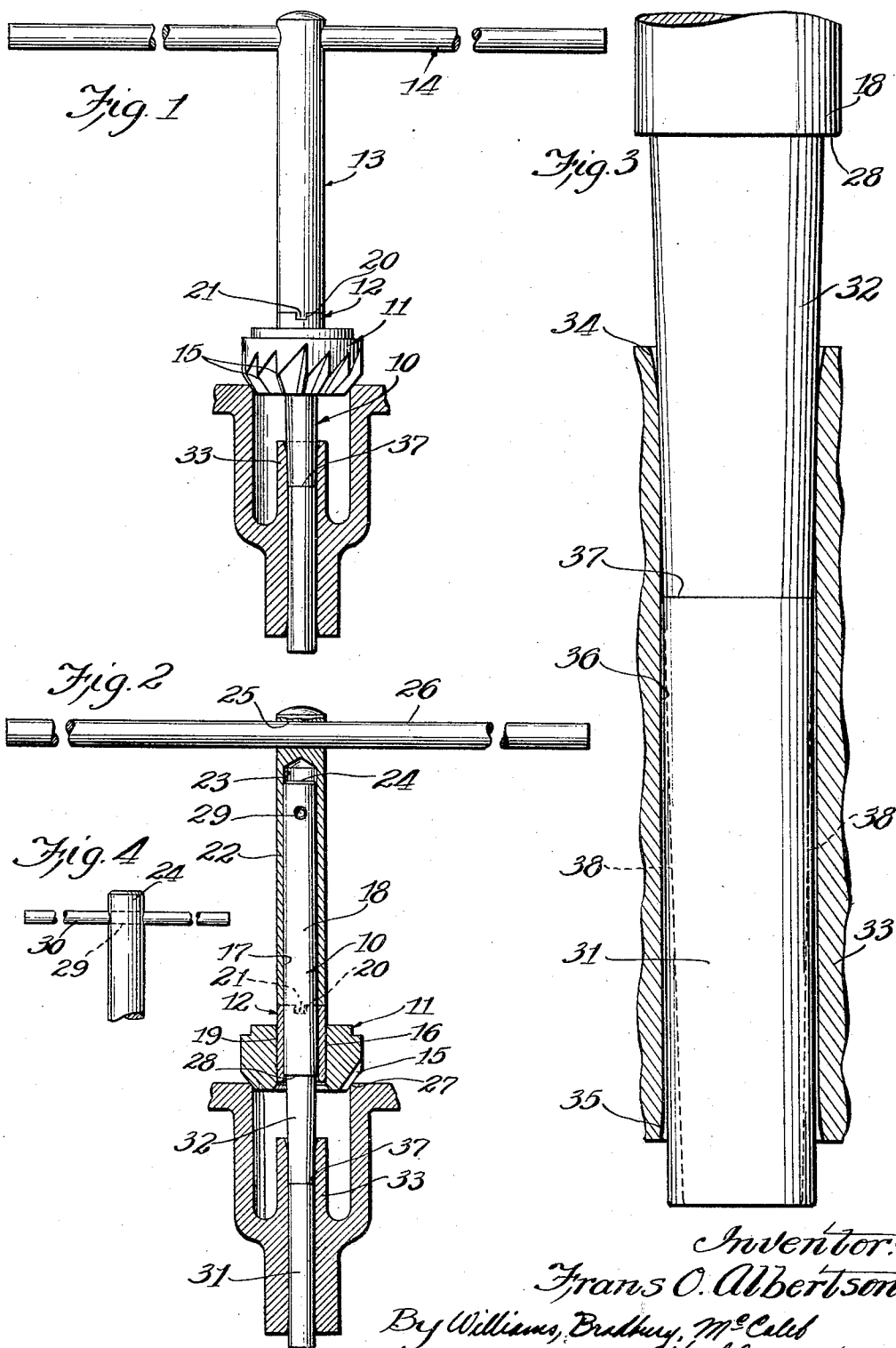
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VALVE SEAT TOOL

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UNITED STATES PATENT OFFICE

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VALVE SEAT TOOL

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The present invention relates to valve seat tools and is particularly concerned with the provision of improved tools for truing or reconstructing the valve seats of internal combustion engines.

One of the objects of the invention is the provision of an improved pilot stem which is adapted to center the valve seat tools with a higher degree of accuracy than the pilot stems of the prior art.

Another object of the invention is the provision of an improved pilot stem which is adapted to be more expeditiously installed in the valve guide and which is also adapted to center and support the cutting tools in proper position for cutting or truing operations, with a higher degree of accuracy.

Another object of the invention is the provision of an improved pilot stem which displays improved characteristics with regard to accuracy, rigidity and stiffness by virtue of the fact that the pilot stem may be constructed of an integral solid piece of metal.

Another object of the invention is the provision of an improved pilot stem which is particularly adapted to cooperate with that portion of the valve guide which is most nearly cylindrical in performing its centering function, thereby locating the valve cutting or truing tool axially with respect to that portion of the valve guide which actually guides the stem of the valve.

Another object of the invention is the provision of an improved pilot stem which is provided with a tapered wedging portion having such a gradual taper that the pilot may be fixedly secured in the valve stem guide by merely forcing the pilot into the guide.

Another object is the provision of an improved pilot stem of the class described in which the gradually tapered portion is so located as to perform the function of securing the pilot stem in place, but in which the function of centering the pilot stem is performed by an accurately cylindrical part of the pilot located to engage the cylindrical part of the guide.

Another object is the provision of an im-

proved method of reconstruction of valve seats of internal combustion engines.

Another object is the provision of an improved valve seat reconstruction assembly which is capable of producing more accurate results than the devices of the prior art.

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

Referring to the single sheet of drawing:

Fig. 1 is an elevational view of the improved valve seat tool assembly showing a valve port and valve stem guide in section.

Fig. 2 is a sectional view with the tool handle in partial elevation, the section being taken on a plane passing through the axis of the pilot stem with the pilot stem in elevation.

Fig. 3 is an enlarged view of the lower end of the pilot stem in elevation with a fragmentary section of the valve stem guide, the portions of the parts with respect to taper being exaggerated for the purpose of illustration.

Fig. 4 is a fragmentary view of the upper end of the pilot stem provided with a pin for use in forcing down and rotating the stem in the guide to secure the pilot stem in place.

Referring to the drawing, the present valve seat tool assembly preferably includes a pilot stem indicated in its entirety by the numeral 10, a cutter or reamer 11, a tool holder 12, and a tool shaft 13 having a handle 14. It should be understood, however, that the present pilot stem is adapted to be used with all of the different kinds of reamers or cutters including the roughing reamers as well as finishing reamers, and the cutters of the type used to cut an annular recess for insertion of a new valve ring as disclosed in my prior application, Serial No. 340,770, filed February 18, 1925, which has become Patent No. 1,882,689.

The cutter 11 illustrated and which is preferably employed in the present improved method of reconstructing valve seats comprises a valve seat reamer which is disclosed

in my prior application, Serial No. 479,590 filed September 4, 1930, which has become Patent No. 1,882,692 and which is peculiarly adapted to effect the cutting of a finished valve seat without the necessity for lapping in the valve on the seat. This type of reamer is preferably employed to secure the best results because this reamer accomplishes the highest degree of accuracy in the formation of the valve seat and the best results depend on the use of an accurate cutter as well as an accurate pilot.

The reamer 11 is provided with a multiplicity of teeth 15 which are located at the proper angle with respect to the axis of the cutter for the particular valve seat in question, and the reamer body is provided with a centrally located bore 16 having sufficient taper so that the reamer 11 may be fixed on the tool holder 12 by wedging the tool holder 12 into the reamer 11.

The tool holder 12 comprises a sleeve preferably formed of the best tool steel, having an axially extending circular bore 17 which is accurately machined to be slidably and rotatably mounted on the cylindrical portion 18 of the pilot stem 10. The tool holder 12 is provided with a tapered or frusto conical portion 19 at its lower end adapted to be wedged into the bore 16 of cutter 11 and the sleeve 12 is preferably provided with one or more slots 20 extending into its upper end and adapted to receive the complementary lugs 21 which are carried by the actuating shaft 22.

The shaft 22 may comprise a substantially cylindrical member also provided with an axially extending circular bore 23 which is adapted to be rotatably and slidably received upon the cylindrical portion 18 of the pilot and the bore 23 is of sufficient length to give a clearance between the upper end 24 of the pilot and the end of the bore, for any valve seat operation.

The tool shaft 22 is provided with a transverse bore 25 for receiving the handle 26 which may consist of a rod or cylindrical metal member and the lower end of the shaft 22 may be substantially flat except for the longitudinally projecting lug or lugs 21 which engage in the grooves 20 of the tool holder 12.

The tool holder 12 is preferably made as short as possible so as to locate the point of application of force to the cutter or reamer, as near to the valve seat 27 as possible.

The application of rotating forces to the cutter 11 is inevitably accompanied by the application of some force tending to bend the pilot stem and the highest degree of accuracy can be attained by applying the rotating force as near to the valve seat or body of the cutter as possible, thereby lessening the bending moment of the pilot stem over the

moment which would be applied farther up on the pilot stem.

One of the most important features of the present invention is the improved pilot stem by means of which the present cutter assembly is centered in proper position and secured during the operation of truing or cutting a valve seat.

The pilot stem 10 preferably comprises a solid metallic member made of one integral piece of the best tool steel and accurately formed as described hereinafter. The upper end of the pilot stem comprises a substantially cylindrical portion 18 which is accurately formed and ground to slidably and rotatably receive the tool holder 12 and shaft 22. In the present embodiment the cylindrical portion 18 is substantially larger than the lower end of the pilot stem, thereby forming an annular shoulder 28 at the lower end of the cylindrical part 18 but in some embodiments of the invention no such annular shoulder may be visible where the cylindrical portion 18 is of smaller size.

The upper end 24 of the pilot stem is preferably provided with a flat ground surface which is accurately at right angles to the axis of the pilot stem 10, for the purpose of cooperating with certain valve seat gauges or measuring tools such as those disclosed in my prior application, Serial No. 487,134 filed October 8, 1930 which has become Patent No. 1,891,364. The cylindrical part is preferably provided with a transverse circular bore 29 adapted to receive a pin 30 of substantially cylindrical shape as illustrated in Fig. 4.

The present pilot stems are preferably provided with a lower cylindrical portion 31 which preferably extends over the major portion of the lower end of the pilot. That part of the pilot stem between the lower cylindrical portion 31 and the shoulder 28 comprises a tapered portion 32 having such a gradual taper that the pilot stem may be fixedly secured in place by forcing the tapered portion 32 into the valve stem guide 33.

The ratios of the lengths of the tapered portion 32 and the cylindrical portion 31 may be varied considerably within the scope of the present invention provided the pilot is adapted to operate as described herein so that the pilot is accurately centered by the cylindrical portion and fixedly secured by the tapered portion.

In the preferred embodiment of the invention the tapered portion has been made about one and one half inches in length and the cylindrical portion about two and one-half inches in length, but much variation may be made in these portions without departing from the spirit of the invention.

The present pilot stems are provided in sets of the various standard sizes of pilots for standard valve guides, but a series of differ-

ent pilots is provided for each standard valve guide, each series consisting of pilots which vary in size by an extremely small increment. For instance, the five sixteenths inch pilot series may consist of one pilot having a cylindrical portion 31 which is accurately machined and ground to a diameter of five sixteenths of an inch and a number of other pilots slightly smaller and slightly larger. For instance, the next smaller pilot may be five sixteenths minus one thousandth of an inch in diameter at the cylindrical portion 31 and the next larger pilot five sixteenths plus one thousandth of an inch in diameter.

An exemplary specification of the sizes of tapered pilots which are capable of producing good results on the standard valve guides used on most internal combustion engines is as follows:

Tapered pilots

Size in inches	
$\frac{5}{16} - .001$	$\frac{11}{32} + .002$
$\frac{5}{16} - .002$	$\frac{11}{32} + .003$
$\frac{5}{16}$	$\frac{11}{32} + .004$
$\frac{5}{16} + .001$	.368
$\frac{5}{16} + .002$	.369
$\frac{5}{16} + .003$	.370
$\frac{5}{16} + .004$	.371
.326	$\frac{3}{8} - .001$
.327	$\frac{3}{8} - .002$
.328	$\frac{3}{8}$
.329	$\frac{3}{8} + .001$
.330	$\frac{3}{8} + .002$
$\frac{11}{32} - .001$	$\frac{3}{8} + .003$
$\frac{11}{32} - .002$	$\frac{3}{8} + .004$
$\frac{11}{32}$	$\frac{19}{32}$
$\frac{11}{32} + .001$	$\frac{19}{32} + .001$

It will thus be observed that it is preferable to provide not only a pilot which is accurately formed to the standard size for a standard valve guide, but to provide pilots of the improved form, the cylindrical portions of which are slightly over size and others which are slightly under size, differing only by extremely small increments such as one thousandth of an inch in diameter.

It should be understood, however, that the differences in diameter between the cylindrical portions of these tapered pilots may be varied within the scope of the invention and if it is desired to operate with closer limits of tolerance and greater accuracy, the pilots may differ in size by less than one thousandth of an inch. The purpose of the provision of the series of pilots of different size for each valve guide is to provide a pilot adapted to effect the most accurate fit possible with the various types of worn guides that are found in practice and consequently the accuracy of the pilot depends upon the accuracy attainable in providing a pilot to fit any guide.

This accuracy is subject to the physical limitation that the cost of the pilot set increases with the number of pilot stems provided in each set, and also with a decrease in the permissible tolerance. A tolerance or change in size of the cylindrical portions of the pilots to the amount of one thousandth of

an inch has been selected as a practical standard for commercial use, but lesser tolerances may be employed if cost is not an important factor or if it appears desirable to seek a higher degree of accuracy in spite of the increase in cost.

The most accurate portion of the valve stem guide is that portion which is not located at the upper end nor at the lower end, but intermediate the ends of the valve stem guide. Every guide tends to become worn during use, by the reciprocation of the valve stem and the extreme ends of the valve stem guide tend to be rounded out as shown at 34 in Fig. 3. The lower end 35 also tends to be rounded out, but the intermediate portion 36 is most nearly and accurately cylindrical. The cylindrical portion 31 of the present pilot stem is adapted to engage the intermediate and cylindrical part of the valve stem guide and performs the centering function very accurately by virtue of the close fit of the cylindrical portion 31 of the pilot with the cylindrical portion 36 of the guide. This fit is preferably made as closely as possible, but a tolerance of one thousandth of an inch between the respective pilots of a series has been found to effect highly accurate results.

The tapered portion 32 of the guide is preferably very gradually tapered and is preferably within the limits of fifteen to thirty thousandths of an inch taper per foot of length, and preferably about twenty-two thousandths of an inch per foot, that is, the diameter of the pilot decreases twenty-two thousandths of an inch for each foot of its length. The preferred taper as measured on the pilots manufactured by the applicant is .0213" per foot.

The taper is preferably such that the pilot stem may be forced into and secured in the valve stem guide by grasping the pin 30 with the hand and rotating and pushing the pilot stem downward into the guide. This wedges the tapered portion 32 in the upper portion of the guide after which the pilot may be given a slight tap with a brass hammer to secure it more firmly, but the tapered portion 32 does not perform the function of centering so much as the function of securing the pilot stem in place. As a matter of fact the force applied to the pilot stem may cause the tapered portion 32 to form a complementary surface at the upper end of the valve stem guide but the centering and location of the pilot in the guide depends upon the accurately fitting cylindrical portion 32 which engages the most nearly cylindrical part of the guide.

Referring to the drawing, the line 37 appearing in Figs. 1, 2 and 3 between the tapered portion 32 and cylindrical portion 31 represents the end of the tapered portion and the end of the cylindrical portion, but

as a matter of fact this line which represents the juncture of a frusto conical surface and a cylindrical surface is not visible on the surface of the pilot stem on account of the extremely gradual taper of the surface 32.

The present pilot stem is adapted to give more accurate results than pilots which have appeared on the market subsequent to my invention and which have a taper throughout the entire length of the guide for the reason that the latter pilots may tend to become lined up with one side or the other of the valve stem guide thereby throwing the entire pilot off by an amount which is equal to the clearance between the valve stem guide and the pilot at its lower end.

Referring to Fig. 3, the dotted lines 38 represent continuations of the elements of the tapered surface 32 and it will be observed that the clearance between the lower end of the pilot and the valve stem guide 33 would be many times that which is actually shown if the taper of the pilot continued to the lower end. It has been found that pilots which taper all the way to the lower end tend to line up with one side or the other of the guide thereby assuming a position which is not accurately centered and even if such pilots happen to approximate a central position such as that illustrated by the dotted lines 38 there is a tendency to wobble within the guide and the amount of wobble permitted depends on the clearance between the tapered lower end of the pilot and the internal cylindrical surface of the guide.

It is a physical impossibility for a frusto conical surface to engage a cylindrical surface and the metal of which valve stem guides are made is not sufficiently elastic to permit a tapered pilot to fit a cylindrical guide over the entire length of the guide.

The method of truing valve seats according to the present invention is practiced as follows:

A pilot stem is selected which fits most closely the worn valve stem guide of the valve to be treated and such a pilot stem may be selected within a thousandth of an inch or less from the set of tapered pilots provided by the applicant. The pin 30 is inserted in the bore 29 of the pilot and grasped by the hand, and the cylindrical portion 31 having been inserted in the guide 33, the pilot is rotated and forced downward by hand after which it may be tapped lightly with a brass hammer or other light tool.

The cutter 11 mounted on the tool holder 12 is rotatably mounted on the upper cylindrical portion 18 of the pilot and the tool holder is engaged by the shaft 22. The cutting tool 11 is thus accurately centered by the cylindrical portion 31 of the pilot and the pilot is fixedly secured in place by the wedging portion 32. The operation of locating and securing the pilot thus consumes only a small fraction

of the time necessary with the expanding devices of the prior art, yet the present pilot stems are more accurate and have the characteristic of increased rigidity on account of the fact that they may be made of a solid integral piece.

The cutting tool 11 may then be rotated by means of the handle 26, the pressure being applied by the hand or by means of a valve seat tool of the type disclosed in one of my prior applications, Serial No. 340,770 filed February 18, 1925, and the cutting tool 11 will form an accurate frusto conical seat which is axially located with respect to the intermediate cylindrical portion 36 of the valve stem guide.

While I have illustrated and described a specific 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 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 as new and desire to secure by Letters Patent of the United States is:

Apparatus for truing a valve seat aligned with a valve stem guide including; a stationary arbor formed with a cylindrical portion on its lower end adapted to substantially fit the cylindrical portion of the valve stem guide and having a long gradually tapered portion above said cylindrical portion, said tapered portion and cylindrical portion being of sufficient length to engage substantially the entire length of a valve stem guide, said tapered portion being adapted to be firmly wedged in the upper part of the guide, and the cylindrical portion substantially fitting in the valve stem guide throughout substantially the entire length of the guide, said tapered portion and cylindrical portion serving to hold the arbor against wobbling, the upper end of the arbor extending above the guide when the lower end is wedged in the valve stem guide, said tapered portion being tapered between the limits of fifteen to thirty thousandths of an inch taper per foot of length.

In witness whereof, I hereunto subscribe my name this 14 day of May, 1931.

FRANS O. ALBERTSON.