June 18, 1957 E. A. ARP 2,795,904

ARBOR AND SLEEVE FOR MOUNTING SAME

Filed Feb. 16, 1955 2 Sheets-Sheet 1

FIG. 1

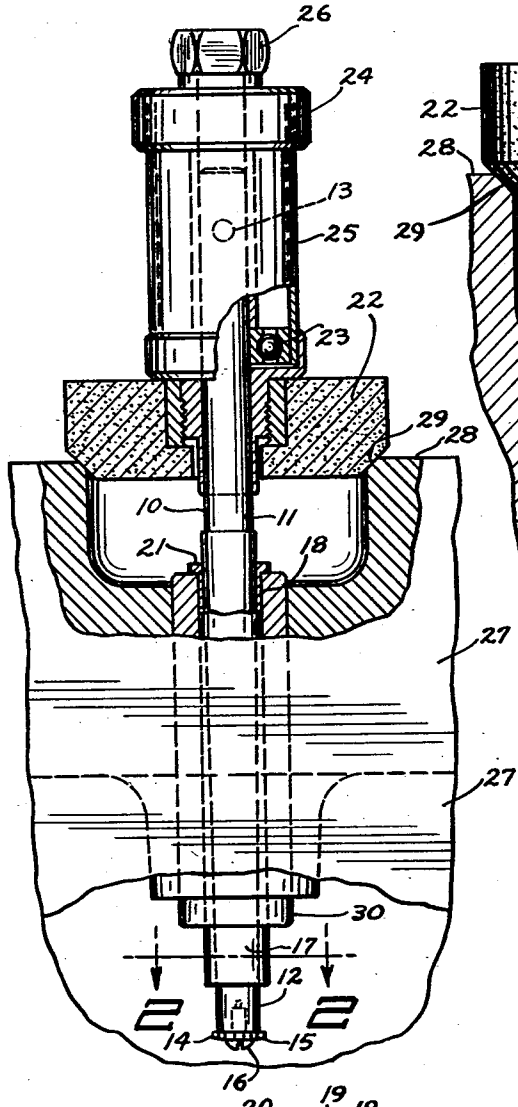


FIG. 3

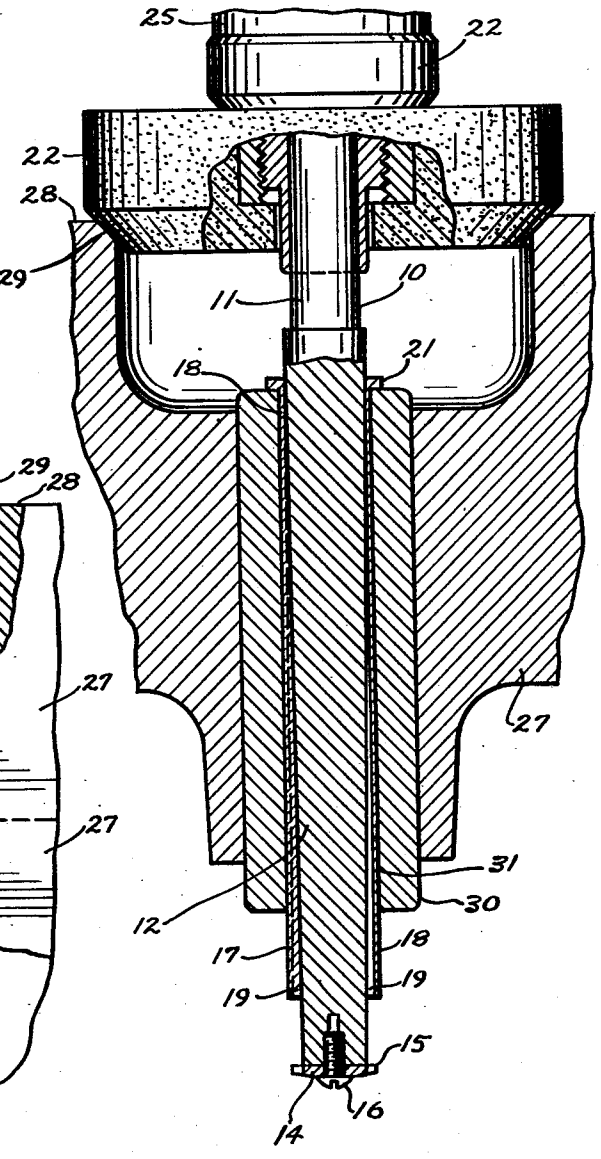
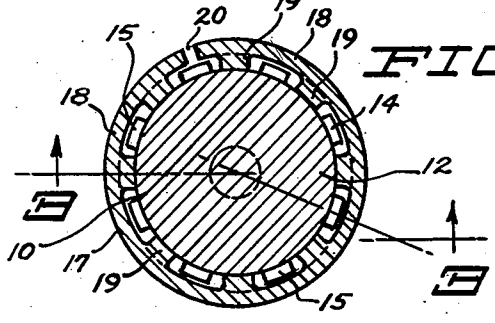


FIG. 2



INVENTOR.
EWALD A. ARP
BY
Braddock and Braddock
ATTORNEYS

June 18, 1957 E. A. ARP 2,795,904

ARBOR AND SLEEVE FOR MOUNTING SAME

Filed Feb. 16, 1955 2 Sheets-Sheet 2

FIG. 4

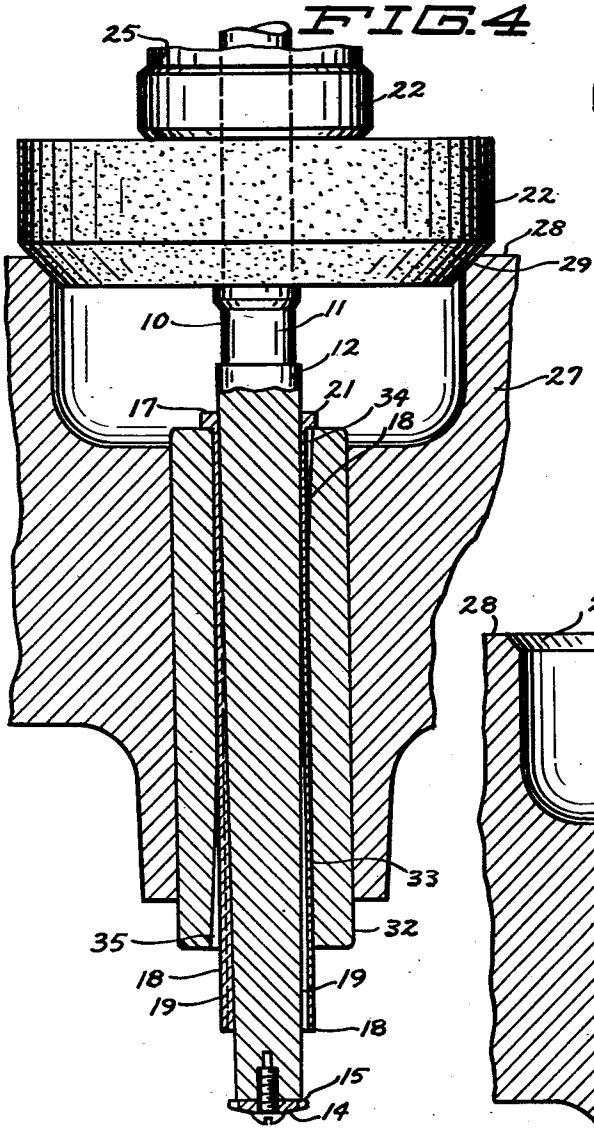


FIG. 5

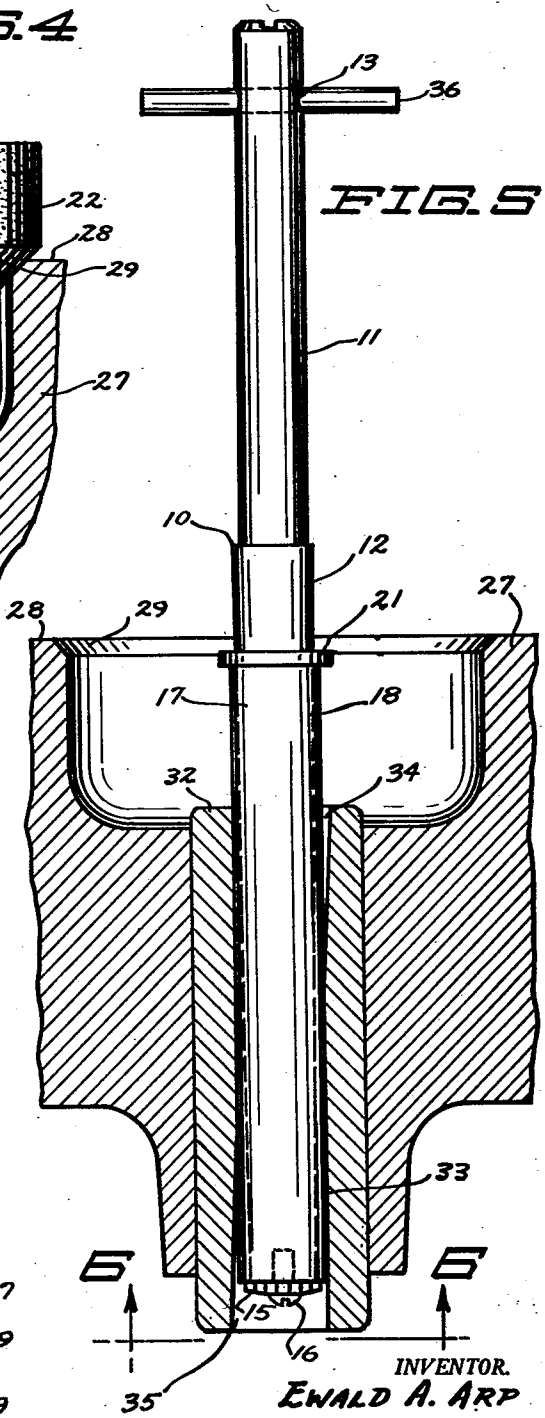
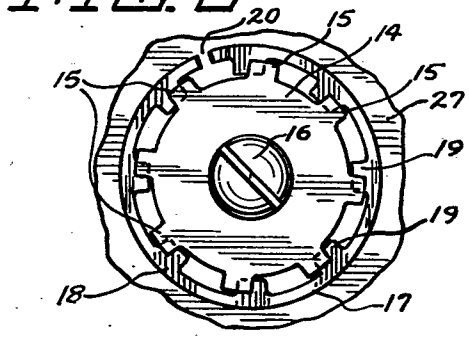


FIG. 6



INVENTOR.
EWALD A. ARP
BY
Braddock and Braddock
ATTORNEYS

United States Patent Office 2,795,904 Patented June 18, 1957

2,795,904

ARBOR AND SLEEVE FOR MOUNTING SAME

Ewald A. Arp, Minneapolis, Minn., assignor to Tobin-Arp Manufacturing Company, Minneapolis, Minn., a corporation of Minnesota

Application February 16, 1955, Serial No. 488,588

4 Claims. (Cl. 51—241)

This invention has relation to a tapered arbor and an expanding sleeve for mounting the arbor.

The invention will find use wherever it is desirable to mount an arbor in a generally cylindrical opening to have the axis of the arbor coincident with the axis of the opening. It will be particularly useful, however, where the arbor is to be supported by means of the expanding sleeve in a valve stem guide for locating a grinding wheel to be used in grinding a valve seat of an internal combustion engine.

When it becomes desirable or necessary to regrind a valve seat in an automobile engine or other internal combustion engine, it is usually the case that the valve stem guide has become worn. In some cases, the guide will be so worn that it must be removed and replaced; and in some cases, it will not be replaced. Whichever of these situations prevail, it is imperative that the valve seat be ground by a grinding wheel which is supported on an axis coincident with the axis of the valve stem which will later operate in the valve stem guide.

The arbor and the expanding sleeve for mounting the same must be such that the grinding wheel can be supported on the arbor in this position regardless of whether the valve stem guide is worn and the bore therethrough is no longer exactly cylindrical or whether the valve stem guide is a new replacement with an exactly cylindrical bore therethrough.

In order to accomplish the desired result, a tapered arbor is employed in conjunction with a sleeve having a thin flexible outer wall and a plurality of tapered longitudinal ribs extending radially inwardly from said wall. The sleeve is designed so that the outer surface thereof will always be cylindrical. There is a longitudinally extending gap in the wall of the sleeve to allow for expansion thereof.

When the expanding sleeve has been placed in the bore of a valve stem guide or in a similar opening with the thin ends of the tapered ribs uppermost, the tapered arbor will be placed inside of the sleeve with its thin end down. The arbor is "rung" into place to force the ribs outwardly to cause the outer wall of the sleeve to be expanded as a perfect cylinder of ever increasing diameter until it comes in contact with the inner surface of the valve stem guide bore. Since the axis of the arbor is always coincident with the axis of the sleeve, when the arbor and sleeve are tightly in said opening or bore the arbor will be positioned so that the grinding wheel can be supported thereon and the valve seat grinding action commenced.

Since it is often difficult or impossible to gain access to the area adjacent the end of the valve stem opposite the valve seat, a spider is provided on the outer end of the tapered arbor which has outwardly extending teeth thereon which can be brought in contact with the ribs of the sleeve to pull the sleeve out of the valve stem guide when the valve seat grinding operation is completed.

Since the diameters of the bores through valve seat guides may vary over a considerable range from guide to guide and from engine to engine, a number of expanding sleeves having tapered ribs of differing radial dimension can be utilized with a single arbor to cover a variety of different bores.

In the drawings,

Fig. 1 is a side elevational view of a portion of an internal combustion engine block with parts in section and parts broken away showing the relationship of an arbor and sleeve for mounting the same made according to the present invention to a valve stem guide in said engine block and to a valve seat grinding wheel mounted on said arbor;

Fig. 2 is an enlarged horizontal sectional view taken on the line 2—2 in Fig. 1;

Fig. 3 is an enlarged fragmentary sectional view taken on the line 3—3 in Fig. 2 and disclosing a new valve stem guide which is not worn and which has an exactly cylindrical bore therethrough;

Fig. 4 is an enlarged fragmentary sectional view taken on the line 3—3 in Fig. 2, but disclosing a valve stem guide which has become worn;

Fig. 5 is a vertical sectional view of the parts as seen in Fig. 4 but omitting the grinding wheel and disclosing the relative positioning of the parts when the arbor is being used to remove the expanding sleeve from the valve stem guide; and

Fig. 6 is an enlarged fragmentary bottom elevational view taken on the line 6—6 in Fig. 5.

Referring to the drawings and the numerals of reference thereon, an arbor 10 consists of a cylindrical shaft 11 and a tapered shank 12 integral with and in alinement with said shaft. An end portion of said cylindrical shaft 11 is spaced from said shank 12 and is provided with a hole 13 therethrough. A spider 14 having radially outwardly extending teeth 15 is fastened to an end of the tapered shank 12 opposite said cylindrical shaft 11 by the cap screw 16.

An expanding sleeve 17 consists of a thin flexible wall 18 having a cylindrical outer surface and a plurality of tapered longitudinal ribs 19 extending radially inwardly from said wall. The wall 18 is broken by a gap 20 which extends longitudinally the entire length thereof. A shoulder 21 extends outwardly from the entire periphery of the wall 18 at an end of said sleeve 17 opposite the thickest portion of the ribs. The taper of the ribs 19 from their thickest portion to the shoulder 21 at the opposite end of the sleeve is exactly the same as the taper of the tapered shank 12. The main body of the spider 14 is of diameter less than the smallest diameter circumscribed by the inner most edges of the ribs 19 while the outer dimension of the teeth 15 on said spider is less than the diameter of the inner surface of the wall 18 and greater than the smallest diameter circumscribed by said inner most edges of said ribs. The width of each tooth 15 is less than the distance between each of the ribs 19.

A rotary grinding wheel 22 is connected through the outer shell 25 to a hexagonal coupler head 26. The shell 25 is mounted on bearings 23 and 24 and these bearings are slidably supported on the cylindrical shaft 11 of the arbor 10. A driving socket of an electric motor (not shown) can be fitted down over the hexagonal coupler head 26 to cause the rotary grinding wheel 22 to be rotated.

An engine block 27 of the internal combustion engine presents a surface 28 at which valve seats such as 29 are formed. A usual valve stem guide 30 having a bore 31 therethrough is illustrated in Figs. 1 and 3 and a similar valve stem guide 32 having a bore 33 therethrough is illustrated in Figs. 4 and 5. The valve stem guide 30 is illustrated as being as yet unused and the bore 31 is con-

sequently exactly cylindrical in shape while the valve stem guide 32 is illustrated as being one which has seen considerable wear and the bore 33 therethrough is no longer exactly cylindrical in shape.

As seen in Figs. 4 and 5, a portion of the valve stem guide 32 adjacent the valve seat 29 on the right side of each figure has been worn away leaving a void designated 34. Since this void was worn into the valve stem guide 32 by the action of an originally cylindrical valve stem, as would be expected, a corresponding void 35 has been formed at the opposite end of the guide and on the left side of each of the figures.

As has been previously stated, in order to mount the arbor 10 in bores of varying size and varying degrees of wear, it is necessary to utilize one of a number of expanding sleeves such as 17. The normal exterior dimension of the cylindrical wall 18 of each of these sleeves 17 will be different from that of other sleeves but this will be compensated for by using ribs 19 of sufficient thickness so that the normal interior dimensions of each sleeve will be the same as the outer surface of the tapered shank 12.

In order to mount the arbor 10 to have its axis coincident with the axis of a valve stem which will later operate in the valve stem guide, and expanding sleeve 17 is chosen which has dimension such that it can be slid into the valve stem guide to allow the shoulder 21 to come in contact with the outer end of said guide. With the sleeve in this position, arbor 10 is inserted into the sleeve until the outer surface of the tapered shank 12 is in contact with the inner surfaces of the tapered longitudinal ribs 19. To do this, the teeth 15 must be alined with the space between the ribs 19 until the lower end of the tapered shank is below the lower end of the expanding sleeve. A rod 36 is inserted in the hole 13 of the cylindrical shaft 11 of the arbor and this rod is used as a grip to manually "ring" the arbor tightly into place. This means that the rod 36 is used to push the arbor in direction toward the valve stem guide while at the same time rotating or attempting to rotate it. The action of the tapered shank 12 on the tapered longitudinal ribs 19 is to cause these ribs to force the thin cylindrical wall 18 of the expanding sleeve 17 outwardly. Since the force on all of the ribs is identical, the outer surface of the wall 18 will be caused to expand as a perfect cylinder of ever increasing diameter.

In the case of the valve stem 30 which has an exactly cylindrical bore 31 therethrough, the sleeve 17 will quit expanding when the outer surface of the cylindrical wall 18 is everywhere in contact with the inner surface of the bore 31. When this condition is reached, the axis of the arbor 10 will be exactly coincident with the axis of the bore 31. Since the grinding wheel 22 is rotated and supported about the same axis, the axis of the valve seat 29 will also be coincident therewith. It is then obvious that when the arbor and sleeve are removed and a valve is positioned to have the valve stem thereof in the valve stem guide 30, the valve will seat exactly with the valve seat 29.

In the case of the valve stem guide 32, however, the outer surface of the thin wall 18 will continue to expand as a perfect cylinder until some part of that surface comes into contact with the non-cylindrical bore 33. Since wear is generally effected in the valve stem guide because of a sideways tipping of the valve stem, it is to be expected that portions of the valve stem bore 33 of the valve stem guide 32 will be virtually unworn and will still be cylindrical in shape. As the outer surface of the cylindrical wall 18 comes into contact with the unworn or virtually unworn portions of the bore 33, the outward expansion of the sleeve 17 will stop and the arbor will then be positioned with its axis coincident with the axis of a valve stem which will later operate in the valve stem guide.

In the event that the valve stem guide 32 is so worn that the bore 33 does not have sufficient cylindrical areas left to cause the arbor to be positioned coincident with its original axis the arbor will still be positioned coincident with the axis of a valve stem which will later operate in the valve stem guide. In other words, the outer surface of the thin wall 18 will expand outwardly as a perfect cylinder of ever increasing diameter until it comes into contact with enough surface of the bore 33 to determine the position of the largest perfect cylinder which can fit into the worn bore and to permanently position it to have its axis coincident with the axis of such a cylinder and, at the same time, to permanently so position said arbor. The grinding wheel 22 will be supported on the arbor as described above and the valve seat 29 will then be ground. When the arbor and the expanding sleeve have been removed, a valve will be placed to have its valve stem in the valve stem guide 32. This valve will have a valve stem larger than the original valve stem since the bore 33 has been enlarged through wear. The surfaces of the bore 33 which limited the expansion of the sleeve 17 and determined the positioning of the axis of the arbor 10 will be exactly the same surfaces which determine the positioning of the valve stem as it reciprocates in the valve stem guide 32. This means that the valve will be properly positioned with respect to the valve seat 29 and the fact that this is coincident or not coincident with the axis of the original bore of the valve stem guide is in no way important since a perfect fit has again been obtained.

Before the present invention, it was the usual practice to attempt to properly position arbors such as 10 by locating various forms of tapered shanks in the bores of valve stem guides. These older methods have been found objectionable since they do not make use of a cylindrical shape in determining the axis about which the valve seat is to be ground. It is to be understood that only an ever expanding cylindrical shape can locate the arbor to have its axis coincident with the axis of the valve stem which is later to operate in the valve stem guide since the valve stem is also cylindrical in shape. This failure to so locate the two axes caused the grinding of a valve seat which was not coincident with the axis of a valve operating thereon. This causes such troubles as oil pumping, noisy tappets, lazy engines and valve stem friction.

When the valve seat 29 has been properly ground as described in the specification, the rotary grinding wheel 22 and its associated mechanism is removed from the cylindrical shaft 11 of the arbor 10 and the rod 36 is reinserted into the hole 13 of said shaft. With the use of the rod 36, the arbor 10 is rotated and moved in direction away from the valve stem guide. Once the arbor 10 has been loosened, it is alined in such a way that the teeth 15 of the spider 14 are in adjacent contacting relationship with the bottom edges of the ribs 19 and the arbor 10 is again moved in direction away from the valve stem guide to cause the sleeve 17 to be removed from the valve stem guide.

What is claimed is:

1. The combination with a guide having an approximately cylindrical opening therethrough of an arbor having a cylindrical shaft and a tapered shank concentric with said shaft tapering from a larger portion adjacent said shaft to a smaller outer end portion, an expanding sleeve having a flexible wall provided with an outer cylindrical surface, a shoulder at one end thereof extending outwardly from said wall, and a plurality of spaced apart, parallel, tapered longitudinal ribs integral with and extending radially inwardly from said wall, the inner surface of said ribs being of configuration and dimension to exactly contact the outer surface of said tapered shank throughout their length, there being a longitudinally extending gap in said thin wall from end to end thereof, said wall being capable of being expanded outwardly to preserve the outer surface thereof as a perfect cylinder of increasing diameter, said outer expansion being caused by the

force of said tapered shank on said tapered ribs as the tapered shank is moved into the said sleeve in direction toward the smaller outer end portion of said shank to cause an outer surface of said wall to contact at least a portion of said inner surface of said opening, a plurality of teeth extending outwardly from said outer end portion of said shank, outer edges of said teeth extending to a diameter less than the diameter of the inner surface of said wall and greater than the smallest diameter of said ribs, the width of said teeth being less than the space between said teeth.

2. The combination with a guide having an approximately cylindrical opening therethrough of an arbor having a cylindrical shaft and a tapered shank concentric with said shaft tapering from a larger portion adjacent said shaft to a smaller outer end portion, an expanding sleeve having a flexible wall provided with an outer cylindrical surface, a shoulder at one end thereof extending outwardly from said wall, and a plurality of spaced apart, parallel, tapered longitudinal ribs integral with an extending radially inwardly from said wall, the inner surface of said ribs being of configuration and dimension to exactly contact the outer surface of said tapered shank throughout their length, there being a longitudinally extending gap in said thin wall from end to end thereof, said wall being capable of being expanded outwardly to preserve the outer surface thereof as a perfect cylinder of increasing diameter, said outer expansion being caused by the force of said tapered shank on said tapered ribs as the tapered shank is moved into the said sleeve in direction toward the smaller outer end portion of said shank to cause an outer surface of said wall to contact at least a portion of said inner surface of said opening, a plurality of teeth extending outwardly from said outer end portion of said shank, outer edges of said teeth extending to a diameter less than the diameter of the inner surface of said wall and greater than the smallest diameter of said ribs, the space between said teeth being greater than the width of said ribs.

3. The combination with a guide having an approximately cylindrical opening therethrough of an arbor having a cylindrical shaft and a tapered shank concentric with said shaft tapering from a larger portion adjacent said shaft to a smaller outer end portion, an expanding sleeve having a flexible wall provided with an outer cylindrical surface, a shoulder at one end thereof extending outwardly from said wall, and a plurality of spaced apart, parallel,

tapered longitudinal ribs integral with and extending radially inwardly from said wall, the inner surface of said ribs being of configuration and dimension to exactly contact the outer surface of said tapered shank throughout their length, there being a longitudinally extending gap in said thin wall from end to end thereof, said wall being capable of being expanded outwardly to preserve the outer surface thereof as a perfect cylinder of increasing diameter, said outer expansion being caused by the force of said tapered shank on said tapered ribs as the tapered shank is moved into the said sleeve in direction toward the smaller outer end portion of said shank to cause an outer surface of said wall to contact at least a portion of said inner surface of said opening, and a projection extending outwardly from said outer end portion of said shank, outer edges of said projection extending to a diameter less than the diameter of the inner surface of said wall and greater than the smallest diameter of said ribs.

4. The combination with a guide having an approximately cylindrical opening therethrough of an arbor having a cylindrical shaft and a tapered shank concentric with said shaft tapering from a larger portion adjacent said shaft to a smaller outer end portion, an expanding sleeve having a flexible wall provided with an outer cylindrical surface, a shoulder at one end thereof extending outwardly from said wall, and a plurality of spaced apart, parallel, tapered longitudinal ribs integral with and extending radially inwardly from said wall, the inner surface of said ribs being of configuration and dimension to exactly contact the outer surface of said tapered shank throughout their length, there being a longitudinally extending gap in said thin wall from end to end thereof, said wall being capable of being expanded outwardly to preserve the outer surface thereof as a perfect cylinder of increasing diameter, said outer expansion being caused by the force of said tapered shank on said tapered ribs as the tapered shank is moved into the said sleeve in direction toward the smaller outer end portion of said shank to cause an outer surface of said wall to contact at least a portion of said inner surface of said opening.

References Cited in the file of this patent

UNITED STATES PATENTS

1,775,898	Fleming	Sept. 16, 1930
1,777,047	Meon	Sept. 30, 1930
1,950,522	Seelert	Mar. 13, 1934
2,044,474	Groetchen	June 16, 1936