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LAPPING TOOL

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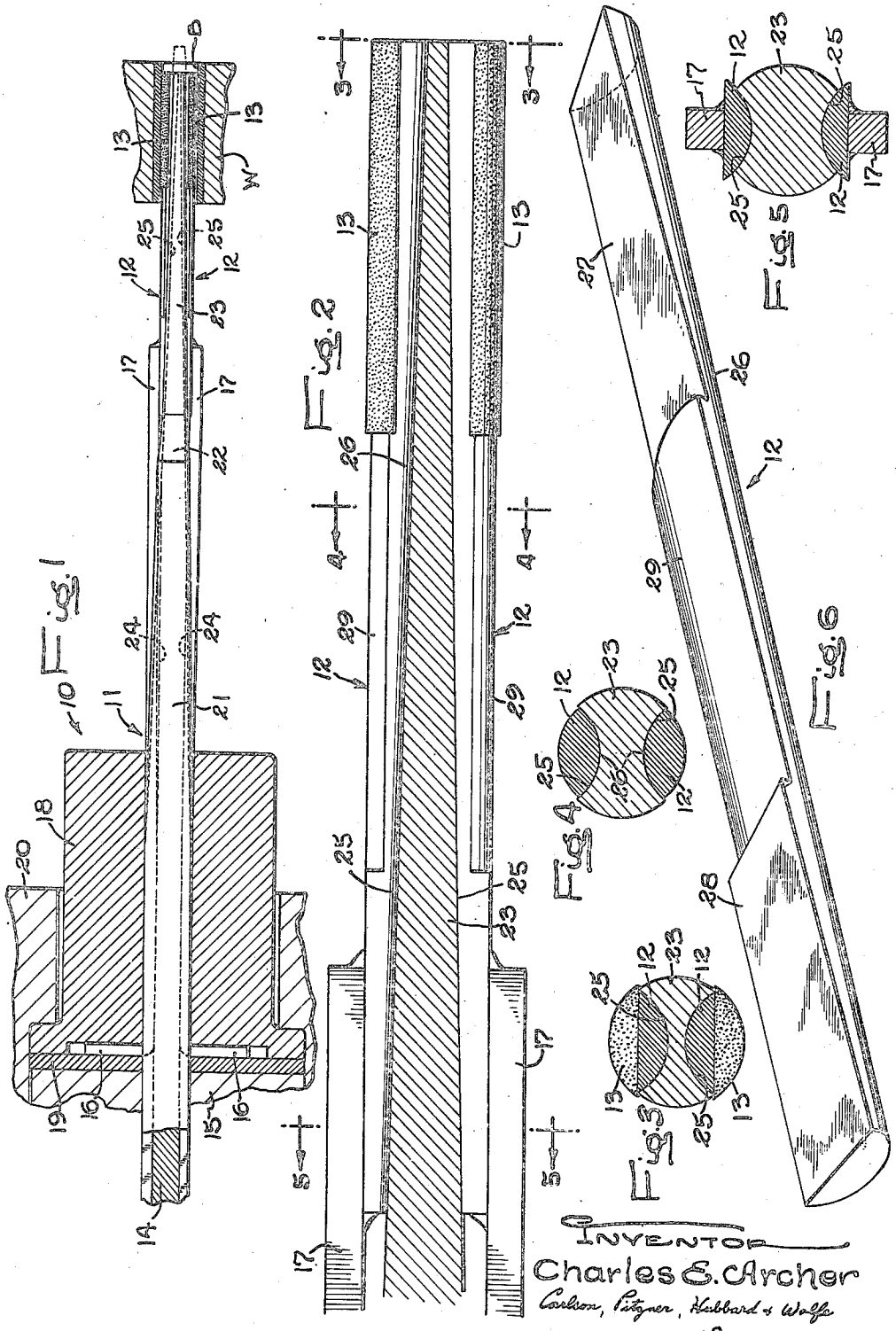


Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

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LAPPING TOOL

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The present invention relates to abrading or lapping tools for removing material from cylindrical bores, and is specifically applicable to a tool assembly comprising a tapered mandrel associated with a plurality of abrading members which are adjustable radially in response to axial displacement of the mandrel with respect thereto. In a device of this character, the work is generally positioned on the tool while the latter is contracted radially, whereupon the tool is expanded to size for the lapping operation.

One of the objects of the invention is to provide a lapping tool of the foregoing type which will be particularly well suited for use on small diameter work where a high degree of accuracy is required.

Another object is to provide a lapping tool of the type described comprising novel and improved means for mounting abrading elements of uniform size and shape throughout their lengths.

A further object of the present invention is to provide a new and improved lapping tool of the foregoing character which is light in weight and strong, yet susceptible of easy and economical manufacture.

Other objects and advantages will become apparent as the following description proceeds, and from the accompanying drawings, in which:

Figure 1 is an axial sectional view of an assembled tool embodying the features of the invention together with the essential portions of the supporting means.

Fig. 2 is an enlarged axial sectional view of the projecting end of the tool, showing in detail the holding shoes, the abrasive elements, and the tool-carrying portion of the mandrel.

Figs. 3, 4 and 5 are transverse sectional views, taken along lines 3—3, 4—4, and 5—5 respectively of Fig. 2.

Fig. 6 is a perspective view of one of the abrasive holding shoes per se.

Although an exemplary embodiment of the invention has been illustrated and described in some detail, it should be understood that there is no intention to limit the invention to the specific form disclosed, the intention being, on the contrary, to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

Referring more specifically to the drawing, the invention is there exemplified in a tool adapted for coaxial mounting in a rotary tool support such as a chuck 10 after the manner shown in

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U. S. Patent No. 2,268,479 to Paul R. Gjertsen. Broadly, the device comprises an elongated mandrel 11, together with a pair of abrasive holding shoes 12 and associated abrading elements 13. The mandrel has a shank end 14 which may be slidably keyed in the spindle 15 of the chuck for driving engagement therewith. Limited axial adjustment of the mandrel with respect to the remaining parts of the tool is obtained by clamping against the end of the spindle 15 a pair of retaining lugs 16 comprising the bent ends of adjusting wires or rods 17 for the holding shoes 12. In the present instance, this is accomplished by positioning the lugs 16 between a sleeve 18 and a washer 19, and urging these parts tightly against the end of the spindle by means of a retaining nut 20 threaded thereon. Both the sleeve and the washer are provided with central bores of proper size to obtain a sliding fit on the mandrel.

Means is provided whereby the tool may be used for work of relatively small diameter although supported in a chuck adapted to handle tools of substantially greater diameter. This is accomplished in the preferred embodiment by utilizing a stepped construction in the elongated rod comprising the mandrel 11. Accordingly, the mandrel is divided longitudinally into three portions or steps, namely, a body 21, a conically tapered transition portion 22, and a tool-carrying portion 23. The diameter of the mandrel body 21 is proportioned so as to be easily inserted into the chuck 10. In keeping with this purpose, the body is provided with a pair of diametrically opposed longitudinal grooves 24 for receiving the adjusting rods 17 which are slidably keyed therein. The mandrel body may also taper gradually toward the transition portion or step 22 as shown in Figure 1. The taper of the transition step 22 which connects the body 21 and the outermost portion 23, is greater than that of the portion 21 due to the substantial difference between the diameters of the mandrel body and the portion 23.

The outermost or projecting end portion 23 of the mandrel is basically an elongated cylinder provided with diametrically opposed, longitudinal grooves 25, mutually inclined at a small angle to the mandrel axis and disposed in alinement with the grooves 24 of the mandrel body. The grooves 25 are adapted to drivingly support the abrasive holding shoes 12, which are slidably keyed therein, and at the same time to enable the shoes to expand radially in response to an axial displacement of the mandrel. Each of the grooves is given the contour of an elongate secantial cylindrical segment, creating within this portion of

the mandrel an elongated wedge with laterally curved, inclined surfaces. The profile of this wedge, taken on a longitudinal plane passing through the mandrel axis and the center lines of the grooves, is clearly shown in Fig. 2. Profiles taken along other planes, parallel to the foregoing but laterally offset therefrom will also be wedge-shaped. The closer such profiles are taken to the edges of the grooves, the greater will be the thickness of the wedge sections, due to the lateral concavity of the surfaces of the wedge. Referring to Figs. 3, 4, and 5, it will be seen that transverse sections through the portion **23** define circular areas in which other circles have been partially inscribed at diametrically opposite points. Although the transverse cross-sectional area of the mandrel generally decreases toward the projecting end, it is evident that the greatest possible amount of stock has been allowed to remain in the portion **23**, and that such stock has been disposed in a manner providing a maximum of resistance to lateral flexure. The behavior of the portion **23** in resisting bending or lateral flexure is somewhat analogous to that of a cantilever-supported I-beam.

Closely associated with the tool-carrying portion **23** of the mandrel **11**, and having tapered surfaces **26** adapted to enter into complemental engagement with those of the grooves **25**, are the abrasive holding shoes **12**. Due to the fact that these surfaces are all taken from segments of the same cylinder, the longitudinal geometrical elements of the abutting grooves and shoe surfaces at each side of the axis of rotation are parallel with each other. Free longitudinal sliding movement between such surfaces is therefore readily obtainable and is utilized in the operation of the tool. It will be appreciated from the foregoing that the abrasive holding shoes may be spread apart radially in response to an axial displacement of the mandrel with respect to the shoes, or they may be permitted to move toward each other in response to an axial displacement of the mandrel in the opposite direction.

Near the outermost or larger ends of the holding shoes **12**, means is provided for receiving and carrying the abrasive elements **13** which are of uniform cross-section throughout their length. In the present instance, such means comprises a step portion **27** having a plane surface parallel to the mandrel axis and to which an abrasive element **13** may be bonded in any suitable manner. Preferably, the elements **13** are given the shape of cylindrical segments of uniform thickness, their dimensions being determined in proportion to the size of the bore B in the workpiece W.

At their innermost or smaller ends, the external surfaces of the shoes **12** are each formed with a raised step portion **28** to which the associated one of the adjusting rods **17** is rigidly attached. In the embodiment illustrated, the step **28** has a flat surface and the rod is secured thereto as by welding or brazing, the point of attachment being within or facing the arc defined by the tapered surface of the shoe.

Intermediate the steps **27** and **28** each shoe **12** has an outer rounded off portion **29**. The radius of curvature of this portion is slightly less than that of the abrading element **13** in order to allow sufficient clearance between the shoe structure and the bore of the workpiece.

In operation, a workpiece having a bore to be lapped is positioned on the tool while the latter is in the radially contracted position. The mandrel **11** is thereupon shifted axially toward the workpiece W, gradually moving the holding shoes **12** radially outward and bringing the abrading elements **13** into lapping engagement with the internal surface of the bore B. The tool is then rotated while the work is held stationary, until the bore has been lapped to the diameter for which the mandrel has been set. At this point, the mandrel may be shifted axially in the opposite direction and the shoes, together with their abrading elements thereupon will be permitted to move radially inward.

I claim as my invention:

1. In a radially expandible abrading device of the type which is expanded or contracted in response to relative axial movement between its parts, the combination comprising a mandrel having an elongated body portion of suitable cross-sectional area to permit said mandrel to be slidably keyed in a tool support, said mandrel also having a projecting end portion in the form of an elongated wedge with laterally concave and longitudinally inclined surfaces formed by diametrically opposed mutually inclined grooves in the shape of secantial cylindrical segments, abrasive holding shoes having surfaces adapted for complemental and abutting engagement with said surfaces of said grooves, abrading elements carried by said holding shoes near their outermost ends and bonded thereto, said abrading elements being in the form of cylindrical segments of uniform thickness, and adjusting rods recessed in said body portion of said mandrel and rigidly attached to said holding shoes adjacent the innermost ends thereof, said rods having bent ends engageable by said tool support.

2. A radially expandible lapping tool having a mandrel comprising the combination of an elongated body portion adapted to be slidably keyed in a tool support, a conically tapered transition portion adjacent said body portion, a projecting end portion of substantially smaller cross-sectional area than said body portion and located adjacent said transition portion, said projecting end portion including an elongate wedge having laterally concave and longitudinally inclined surfaces defined by a pair of diametrically opposed grooves in the form of secantial cylindrical segments.

3. In a radially expandible lapping device of the type wherein abrasive holding shoes are slidably keyed to a grooved mandrel, the combination comprising a shoe having an elongate tapered surface adapted for sliding and abutting engagement with a complemental groove in said mandrel, said surface being in the form of a secantial cylindrical segment, a flat step portion in said shoe adjacent the larger end thereof for receiving an abrading element, a raised step portion on said shoe adjacent the smaller end thereof and adapted to be rigidly secured to an adjusting rod, and a rounded off portion intermediate said step portions.

4. In a radially expandible lapping device of the type wherein a pair of abrasive holding shoes are slidably keyed to a grooved mandrel, the combination comprising an abrasive holding shoe having an elongate tapered surface adapted for sliding and abutting engagement with a complemental groove in said mandrel, said surface being in the form of an elongated cylindrical segment, a flat step portion in said shoe adjacent one end thereof for receiving an abrading element, a raised step portion in said shoe adjacent the

opposite end thereof for engagement with an adjusting rod, a rounded off portion disposed intermediate said step portions, an abrading element in the form of a cylindrical segment of uniform thickness and adapted to be bonded to said flat step portion, the radius of curvature of said abrading element being slightly greater than that of said rounded off portion, and an adjusting rod rigidly secured to said raised step portion.

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