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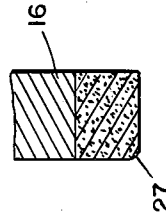
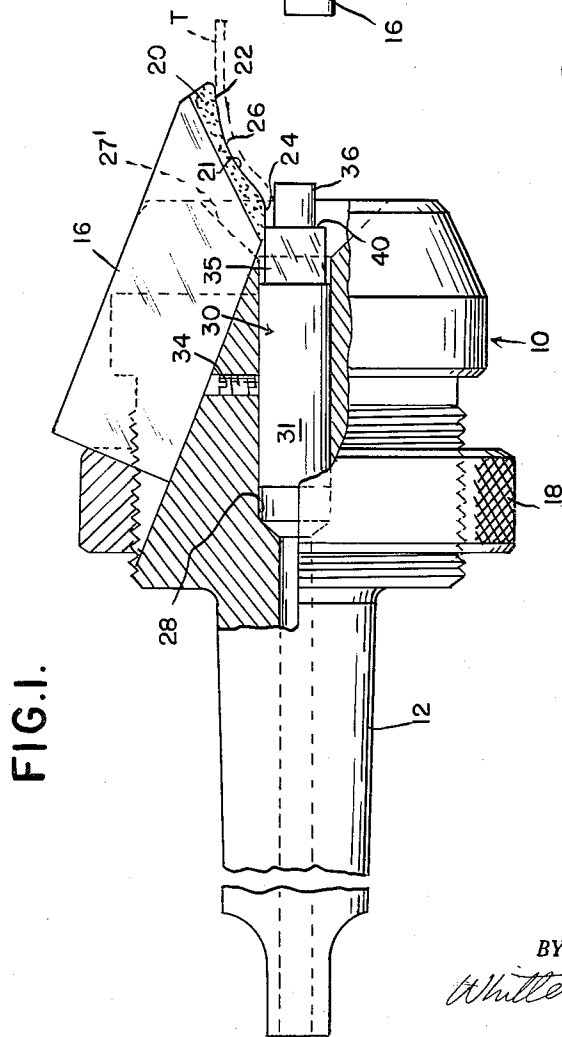
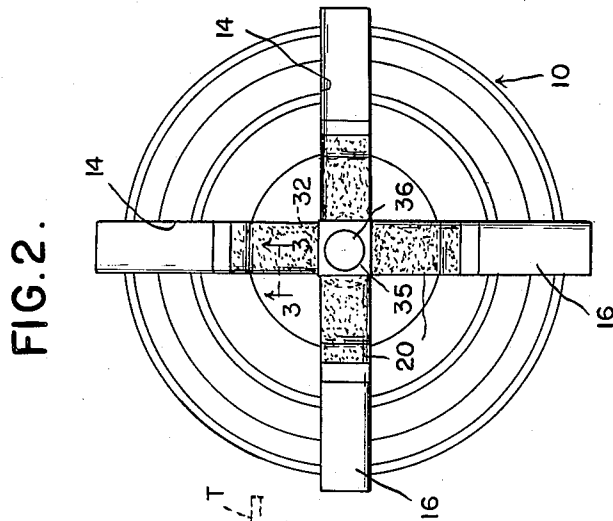
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2,965,059

SPINNING TOOL.

Filed May 21, 1956

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

FIG. 5.

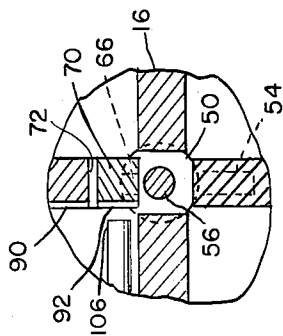
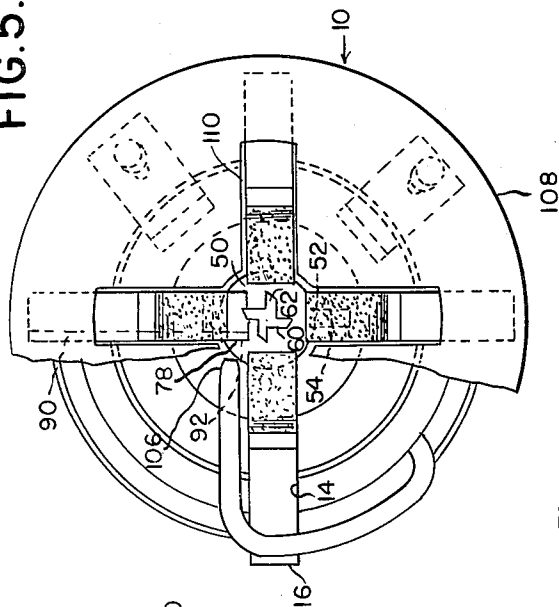


FIG. 6.

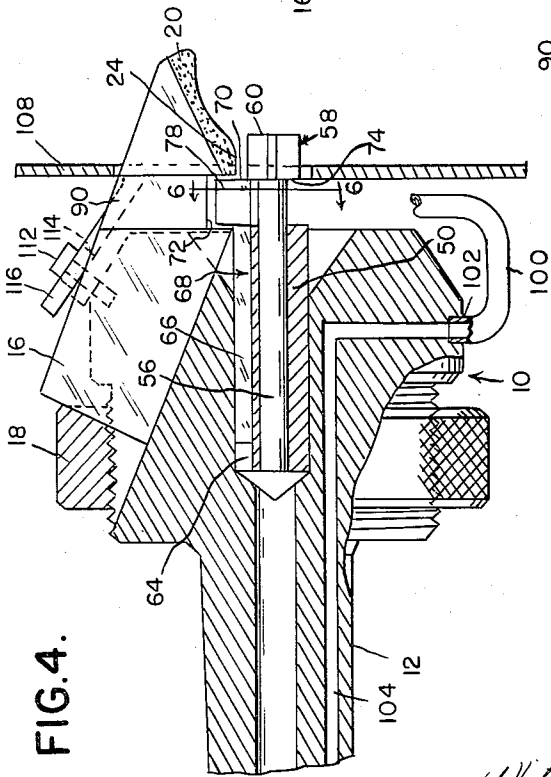


FIG. 4.

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1

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SPINNING TOOL

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Filed May 21, 1956, Ser. No. 586,089

3 Claims. (Cl. 113—52)

This invention relates to apparatus for reducing a tube end and refers more particularly to a spinning tool.

One object of this invention is to provide a spinning tool which may be employed for reducing the end of a tube and having means in the form of a pilot adapted to enter the end of the tube to guide and locate the latter during the spinning operation.

Another object of the invention is to provide means forming an abutment engageable with the end of the tube being spun to limit the axial movement of the tube toward the tool. The abutment may desirably be employed in connection with the pilot.

Another object of the invention is to provide a spinning tool with a reamer adapted to enter the end of the tube being reduced to locate and guide the tube end, as well as to shape and control the opening thereof.

Still another object of the invention is to provide a spinning tool having a cutter for facing the end of the tube being spun, and having means for clearing the tool of cutting.

A still further object of the invention is to provide a spinning tool having a circular array of individual forming blades which are spaced apart circumferentially and which have spinning surfaces facing generally radially inwardly, the leading edges of the spinning surfaces being rounded on a radius of approximately $\frac{1}{16}$ of an inch. By thus rounding the leading edges of the spinning surfaces, it is possible to substantially increase the amount of feed of the tool, resulting in greater production rates. In instances where the spinning surfaces present sharp leading edges, the spinning surfaces are apt to shear the tube end being reduced if the rate of feed is not held within limits. The rate of feed may be substantially increased by rounding the leading edges.

Other objects of the invention will become apparent as the following description proceeds, especially when considered in connection with the accompanying drawings, wherein:

Figure 1 is a side elevational view, partly in section, of a spinning tool constructed in accordance with the invention.

Figure 2 is an end view of the tool shown in Figure 1.

Figure 3 is a sectional view taken along the line 3—3 on Figure 2.

Figure 4 is a view similar to Figure 1 but showing a modification.

Figure 5 is an end view of the tool shown in Figure 4.

Figure 6 is a sectional view taken along the line 6—6 on Figure 4.

Referring now more particularly to the drawings and especially to Figures 1-3, the spinning tool illustrated comprises a holder 10 having a tapered shank 12 for engagement in a driving chuck of any type. The holder is provided with a plurality of radially disposed inclined slots 14 which receive removable spinning blades 16. The particular means for mounting the blades is not of critical importance but, in the presently illustrated embodiment of the invention, the holder is provided with

2

a threaded backup ring 18 engageable with the rear ends of the blades and adjustable to feed the blades forwardly after resharpening to maintain size. The diagrammatic illustration of the holder is merely illustrative of the type of holder which may be employed. It will be understood that suitable means (not shown) will be provided to lock the spinning blades in adjusted position. Only one of the four blades is shown in the holder in Figure 1 in the interest of clarity. However, it will be understood that the blades are symmetrically arrayed, as shown in Figure 2, and project axially beyond the holder equal distances and are arrayed at the same angle to the axis thereof.

The blades preferably are formed of rectangular stock and are provided with a spinning end portion or tip indicated at 20 formed of a suitable hard material adapted to withstand high temperatures without injury. A material suitable for such purpose is tungsten carbide.

The slots and hence the blades are arrayed in a circular arrangement in circumferentially spaced relation about the longitudinal axis of the holder. The slots and blades are also arranged in pairs with the slots and blades of each pair arranged in diametrically opposed relationship.

The spinning surfaces of the tips 20 are indicated at 21 and these surfaces are composed of straight elements in planes perpendicular to the axis of the holder. In other words, the spinning surfaces are straight in any cross section taken perpendicular to the axis of the holder. The contour of the spinning surfaces in planes through and including the longitudinal axis of the holder may vary but, as seen in Figure 1, the spinning surfaces include the straight flat zones 22 and 24 and an intermediate concave zone 26. The concave zone 26 blends into the flat zone 24 by a convex cylindrical surface as shown.

The leading edges 27 of the spinning surfaces are rounded somewhat throughout the longitudinal extent thereof. The purpose of rounding the leading edges of the spinning surfaces is to eliminate the tendency of the spinning surfaces to shear the material of the tube being reduced and hence make it possible to run the spinning operation at a much higher rate of feed, thereby increasing production rates accordingly. The leading edge is, of course, determined by the direction of rotation of the tool with respect to the tube being reduced. Referring to Figure 2, it is assumed that the direction of intended rotation is counterclockwise. It will be understood that the tube rather than the tool may be rotated, it only being necessary that relative rotation exists between the tool and tube during the spinning operation.

It will be noted that the holder has a conical recess 27' in its outer end into which the end of a tube is inserted for spinning. The slots 14, of course, open into the conical recess so that the blades may also extend into the recess and act upon the tube to reduce the same.

At the base or bottom of the conical recess is a cylindrical bore 28 which is concentric with the axis of the holder. The conical recess 27' is also concentric with the holder axis. A member 30 has a cylindrical portion 31 closely received in the cylindrical bore 28. The cylindrical portion 31 has a longitudinally extending flat surface 32 along one side which is engaged by a set screw 34 threaded into the holder to hold the member 30 in selected positions of longitudinal adjustment for rotation as a unit with the holder.

Integrally connected to the outer end of the cylindrical portion 31 is a square portion 35 which is axially aligned with the cylindrical portion. The flat sides of the square portion 35 oppose and are engageable with the flat surfaces 24 of the respective blades.

Axially connected to the free end of the square por-

tion is a cylindrical portion 36 likewise axially aligned with the square portion and the cylindrical portion 31, being of a smaller diameter than the cylindrical portion 31. It will be seen from the drawings that the cylindrical surface of the portion 36 is spaced radially inwardly toward the axis of the holder from the flat surfaces 24 of the blades. The flat surfaces 24 of the blades determine the outer diameter of the reduced neck of smallest cross section at the reduced end of the tube and the cylindrical portion 36 will extend into the tube end being reduced and will act as a pilot to locate and guide the reduced end during the spinning operation.

The elements of the spinning surfaces of the blades taken in any plane perpendicular to the holder axis are disposed equal distances from the holder axis, or are tangent to a circle in the given plane, and therefore the spinning surfaces of the blades cooperate in reducing the end of a tube inserted from right to left as viewed in Figure 1 in concentric relation to the holder and into operative relationship with the spinning surfaces.

The operation of the device will be readily apparent from the foregoing. The wall of a tube is indicated in dotted lines by the reference character T. The tube to be reduced and the holder are arranged coaxially with respect to one another and are then moved relatively toward one another to insert an end of the tube into the cup-shaped cavity defined by the spinning surfaces at the right-hand end of the holder. Either the holder or the tube is rotated about its axis to provide a relative rotation necessary to effect the reduction of the tube end. As the tube is moved relatively toward the tool, the tube end is gradually reduced by the spinning surface of the blades. The rate of feed of the tube and tool toward one another may be substantially increased by the fact that the leading edges of the blades are rounded as indicated at 27. In this connection, it should be pointed out that the holder rotates in a counterclockwise direction relative to the tube so that the rounded edges 27 of the blades are the leading edges.

The relative axial movement of the holder and the tube continues until the end of the tube being reduced engages the abutment provided by the transverse shoulder 40. The shoulder 40 is defined by the free end surface of the square portion 35 of the surface which extends at right angles to the holder axis. The cylindrical projection 36 extends into and guides and locates the tube end during the spinning operation, and also to some extent forms and determines the opening of the tube which is in a somewhat plastic condition due to the heat developed during the spinning operation. The abutment 40 also tends to shape the end of the tube to an annular surface at right angles to the tool axis due to the plastic condition of the tube end.

Referring now to Figures 4-6, another form of the invention is illustrated in which corresponding parts are identified by the same reference numerals as employed in the first embodiment. In accordance with the construction of Figures 4-6, a cylindrical plug 50 is closely received in the cylindrical bore 28 of the holder. This plug has a longitudinally extending flat surface 52 engaged by a set screw 54 to hold the plug in selected positions of axial adjustment and also to prevent relative rotation between the plug and the holder. The plug is tubular and has a central longitudinally extending through passage concentric with the holder axis and receiving the shank 56 of a reamer 58. The shank of the reamer is secured in the passage of the plug in any suitable manner, as by a set screw not shown, preventing relative movement therebetween. The head of the reamer is indicated at 60 and has the radially outwardly extending blades 62 which provide axially extending cutting edges at their radially outer extremities. The maximum radius of the reamer head is somewhat less than the radius of the flat surface 24 of the spinning surface of each blade with respect to the holder axis as seen in the drawings.

The plug has a longitudinally extending groove 64 along its outer surface which extends from end to end of the plug and closely, slidably receives the shank 66 of a cutter 68. The cutter head 70 at the outer end of the shank 66 is enlarged and extends into one of the blade slots 14, the associated blade being notched as indicated at 72 to receive the cutter head. The cutter head is held against axially outward movement by engagement of the outer end of its head with the transverse shoulder 74 at the axially inner end of the head, and the cutter is held against axially inward movement by the engagement of the inner transverse surface of the cutter head with the outer end of plug 50.

The cutter head 70 presents at its outer edge a radially extending cutting edge 78 against which the end of the tube being reduced abuts during the spinning operation.

The operation of this device is similar to that of the device previously described. The reamer will extend into the end of the tube being reduced and acts as a pilot to locate and guide the tube during the spinning operation, and will also shape and control the opening of the tube by cutting it to the specified internal diameter.

The end of the tube being reduced will abut the cutting head 70 and will be cut by the cutting head to a transverse annular surface extending at right angles to the axis of the holder.

The blade 16 associated with the cutter head 70 has a radial groove 90 in one side thereof which extends from the notch 72 to its radially outer extremity. The cutter head 70 also has a radial groove 92 extending from its inner to its outer extremity at the same side thereof as the groove 90 and in alignment with the latter and inwardly of the cutting edge 78. These grooves 90 and 92 provide passages for cuttings from the cutter head, the cuttings passing radially outwardly therethrough and clear of the tool. Preferably, the tool is rotated during spinning to expel the cuttings by centrifugal force.

The tool is also provided with means for clearing away cuttings produced by the action of the cutter on the end of the tube. Such means include a flexible pipe or conduit 100 which has one end attached in any suitable manner to the holder 12, as indicated at 102. A passage 104 in the holder communicates with the conduit 100 and is provided for conducting a stream of air or other fluid medium to the conduit. Any suitable means (not shown) may be employed for supplying air under pressure to the passage 104.

The conduit 100 has its discharge end 106 spaced from and pointing toward the cutting edge 78 of the cutter. The stream of air emitted from the discharge end of the conduit during cutting operation is effective to break up the cuttings and chips produced during the spinning operation and to blow them away from the tool. The stream of air discharged from the conduit 100 is preferably expelled generally tangentially of the holder axis and in a direction opposite to the direction of rotation of the tool. It is also feasible to direct the stream of air in the opposite direction, that is, in the direction of rotation of the tool, but it has been found that results are more satisfactory if the air stream is discharged in the direction opposite the direction of rotation.

A shield 108 is provided in the form of a circular plate formed with four equally spaced radially extending slots 110 which open into a central hole through the plate, the slots being provided for clearing the forming blades 16 and the central hole in the plate for clearing the reamer and tube being spun. This plate extends at right angles to the axis of the holder and is located slightly axially outwardly of the cutter head and also axially outwardly of the conduit 100. The purpose of the plate 108 is to shield the tube being spun for cuttings cleared by the stream of air.

The plate 108 is connected to the holder by tabs 116 which have their outer ends secured to the plate at cir-

5

cumferentially spaced points thereon and which extend inwardly for attachment to the holder. Suitable fastening elements, such as bolts 112, thread into the holder, and the shanks of the fastener elements extend through elongated slots 114 in the tabs. The plate may thus be adjusted axially of the holder by merely loosening the fastener elements.

The drawings and the foregoing specification constitute a description of the improved spinning tool in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. A spinning tool for reducing the end of a tube comprising a holder, circumferentially arranged forming blades carried by said holder and having spinning surfaces thereon facing generally radially inwardly for engagement with the outer surface of the end of the tube to reduce the same, a reamer located centrally of said spinning surfaces engageable within the end of a tube positioned in operative relation to said blades to locate and guide said tube end during a spinning operation as well as to shape and control the opening of said tube end, a support and means for securing said support on said holder in selected positions of axial adjustment, said reamer being mounted on said support, and a cutter mounted on said support radially outwardly from said reamer adapted to trim the annular transverse surface at the end of the tube, said support and reamer having axially opposed shoulders, said cutter having a portion between and engaging said shoulders to be axially located thereby.

2. A spinning tool for reducing the end of a tube comprising a holder, circumferentially arranged forming blades carried by said holder and having spinning surfaces thereon facing generally radially inwardly for engagement with the outer surface of the end of the tube to reduce the same, an abutment on said holder in position to engage the end of the tube being spun to limit axial movement of the tube relative to said spinning surfaces, said abutment being in the form of a cutter adapted to cut the annular transverse surface at the end of the tube, and means for clearing said tool of cuttings produced by the action of said cutter including a groove in one of said blades extending in a generally radial direction in general alignment with said cutter, a groove in said cutter aligned with the first-mentioned groove, said grooves being on the side of said one blade and cutter

6

in the direction of intended rotation of the tool, and a conduit carried by said holder for directing a stream of fluid in the vicinity of said cutter, the discharge end of said conduit being disposed to direct the stream of fluid issuing therefrom toward the groove in said cutter in a direction opposite the direction of intended rotation of the tool.

3. A spinning tool for reducing the end of a tube comprising a holder, circumferentially arranged forming blades carried by said holder and having spinning surfaces thereon facing generally radially inwardly for engagement with the outer surface of the end of the tube to reduce the same, an abutment on said holder in position to engage the end of the tube being spun to limit axial movement of the tube relative to said spinning surfaces, said abutment being in the form of a cutter adapted to cut the annular transverse surface at the end of the tube, and means for clearing said tool of cuttings produced by the action of said cutter including a groove in a side of one of said blades extending in a generally radial direction in general alignment with said cutter, a groove in the same side of said cutter aligned with the first mentioned groove, and a conduit carried by said holder for directing a stream of fluid in the vicinity of said cutter, the discharge end of said conduit being disposed to direct the stream of fluid issuing therefrom toward the groove in said cutter tangentially with respect to the direction of rotation.

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