June 28, 1955 F. R. WILSON 2,711,774

FLARING CONE

Original Filed March 1, 1952 3 Sheets-Sheet 1

Fig. 1

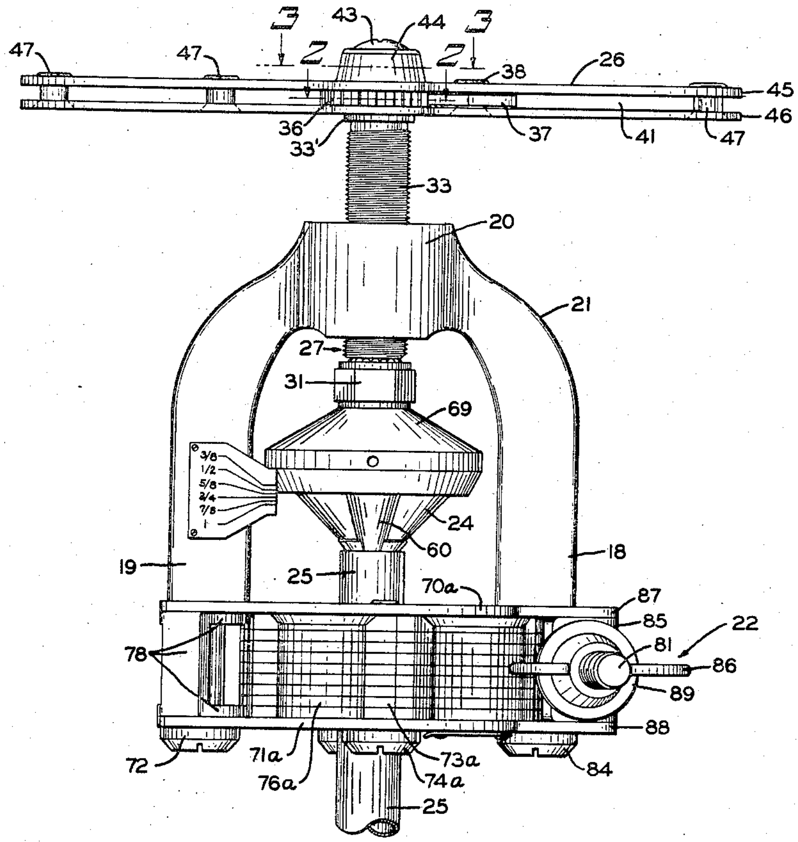

Fig. 2

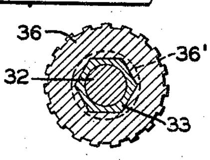

Fig. 3

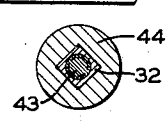

Fig. 4

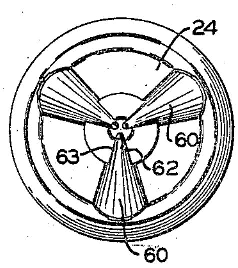

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Fig. 5

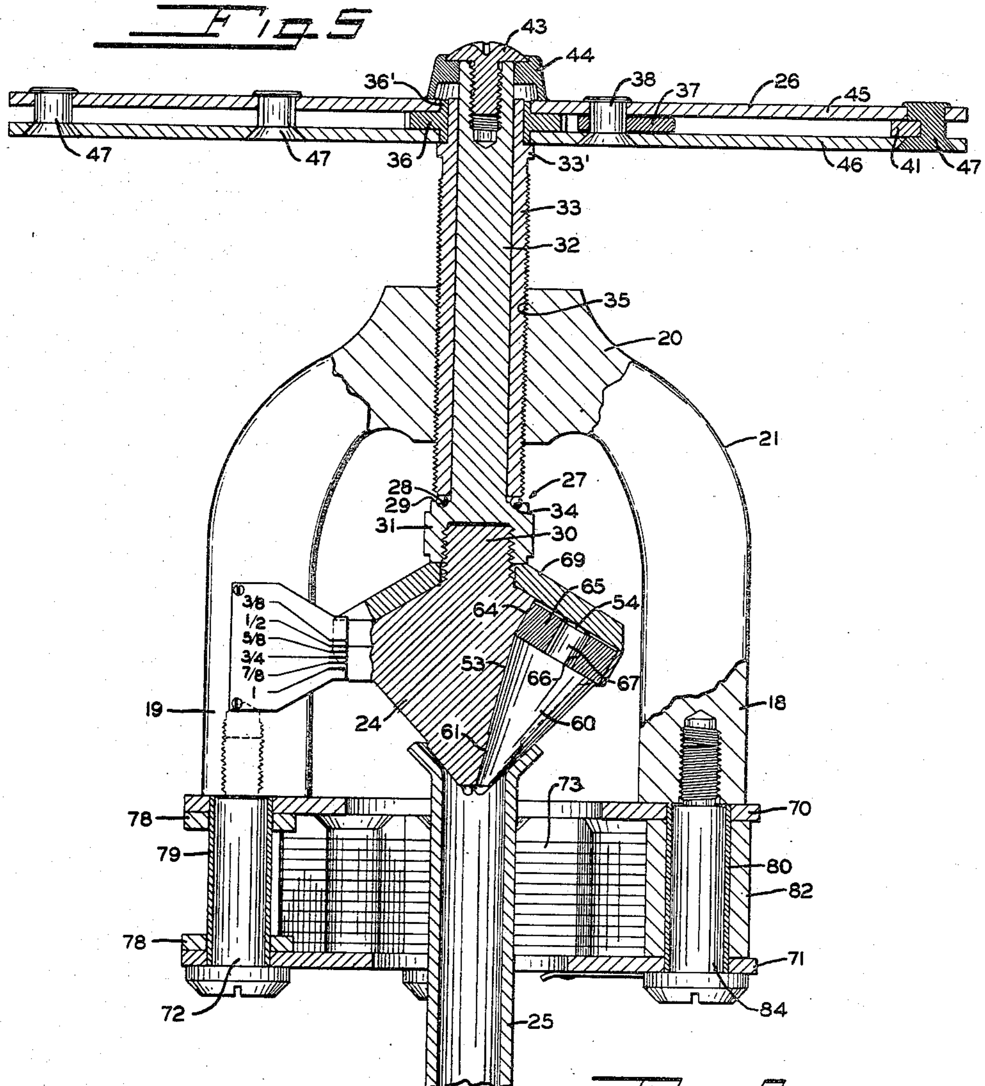


Fig. 8

Fig. 6

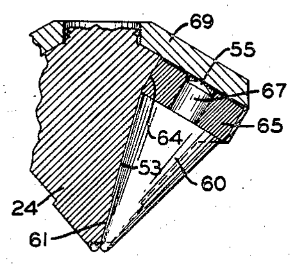
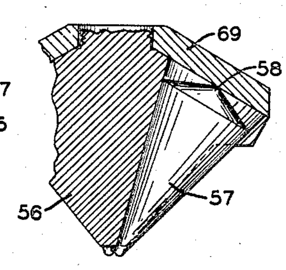


Fig. 7



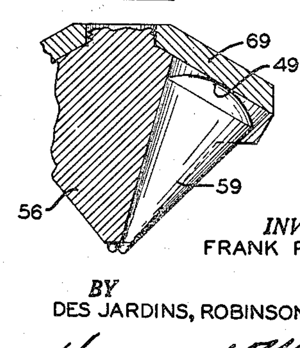


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Fig. 9

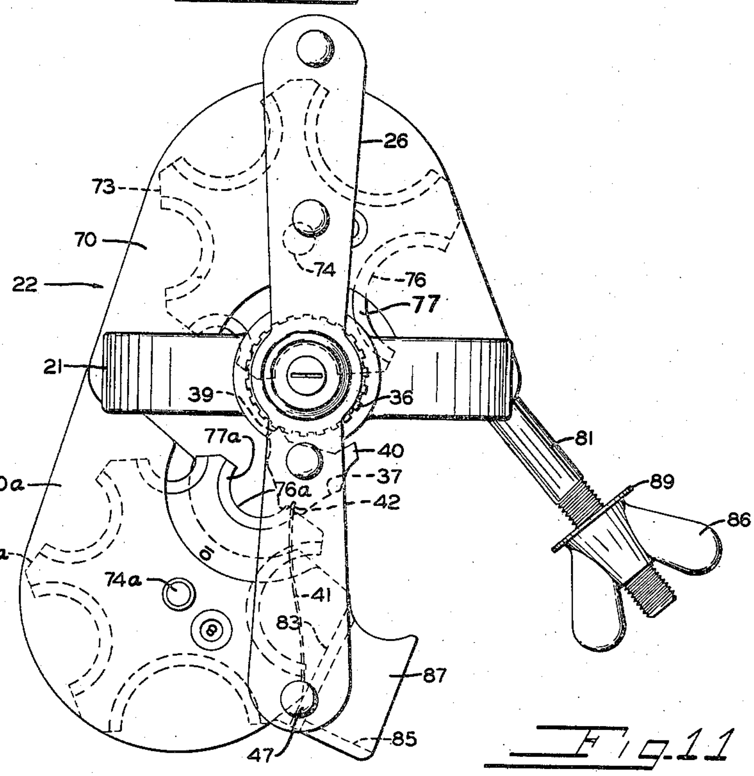


Fig. 11

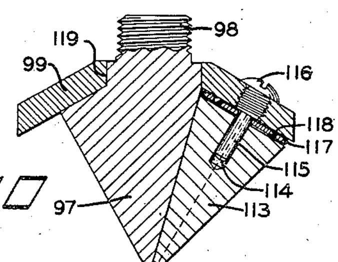
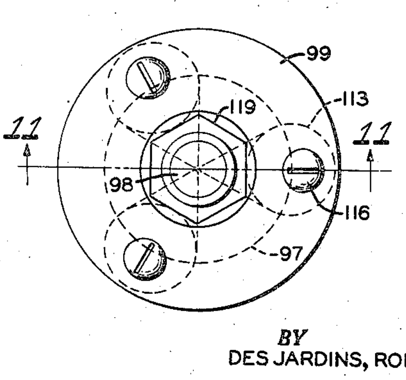


Fig. 10



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FLARING CONE

Frank R. Wilson, Memphis, Tenn.

Original application March 1, 1952, Serial No. 274,403. Divided and this application October 16, 1953, Serial No. 386,445

14 Claims. (Cl. 153—81)

This invention relates to a hand tool for flaring the end of a tube and, more particularly, to improvements in the flaring cone for such tool.

This application is a division of my co-pending application Serial No. 274,403 for Tube Flaring Tool, filed March 1, 1952.

In the prior art tube flaring devices of the hand tool type, it has been customary to cause a cone-shaped plug to be forced into the end of the tube to be flared so as to spread the tube and form a bell-shaped mouth or flare on the end thereof. In the performance of this operation, the tube is usually held in place by means of a split clamping block which grips the tube and holds it stationary while the plug is being forced into the end of the tube. This method of flaring the ends of tubes is slow and inefficient and results in an inferior product since the flare thus formed is dimensionally inaccurate and the surface of the flare portion of the tube will be left in a rough, unfinished condition.

It is, therefore, an object of the present invention to provide a tube flaring tool of the hand-operated type which is adapted to spin a flare on the end of a tube and, thereafter, burnish the interior face of the flare so as to produce a flare having an accurate, polished surface. To accomplish this result, I have devised a tool having a flaring cone of novel construction and having novel means for enabling the operator of the tool to burnish the interior surface of the flare at the conclusion of the tube flaring operation.

Another object of the invention is to provide a tube flaring tool having a flaring cone provided with a body containing a plurality of conical recesses for receiving a number of rotatable, conical rollers which are adapted to engage with the end of a tube to roll a flare on the same.

Another object of the invention is to provide a flaring cone provided with a body having a plurality of conical recesses for receiving a number of rotatable, conical rollers for rolling a flare on the end of a tube, and wherein each roller is provided with an anti-friction bearing for absorbing the end thrust produced on the roller by the tube during tube flaring operations.

Other and further objects of the invention will become apparent from the following description and drawings, in which:

Fig. 1 is a side elevation of one form of flaring tool which may be utilized in carrying out my invention.

Fig. 2 is a cross-sectional view taken along the line 2—2 of Fig. 1.

Fig. 3 is a cross-sectional view taken along the line 3—3 of Fig. 1.

Fig. 4 is an end view of the flaring cone shown in Fig. 1.

Fig. 5 is an enlarged, cross-sectional view of the tool shown in Fig. 1.

Fig. 6 is a detailed cross-sectional view showing a modified form of roller.

Fig. 7 is a detailed cross-sectional view showing still another form of roller.

Fig. 8 is a detailed cross-sectional view showing a further form of roller.

Fig. 9 is a top plan view of the flaring tool shown in Fig. 1, the clamping means being shown in the open position in this view.

Fig. 10 is a plan view of a modified form of flaring cone.

Fig. 11 is a cross-sectional view taken along the line 11—11 of Fig. 10.

While my invention is susceptible of embodiment in any different forms, I have shown in the drawings and shall hereinafter describe in detail several specific embodiments, with the understanding that the present disclosure is to be considered merely as an exemplification of the principles of my invention and is not intended to limit the invention to the particular embodiments illustrated. The scope of the invention will be pointed out in the appended claims.

As shown in the drawings, the flaring tool comprises in general a U-shaped fitting or yoke member **21**, a tube clamping means **22**, and a tube flaring means including a flaring cone **24**. The cone **24** is adapted to be rotated by a handle **26** and to be advanced against the upper end of a tube **25** which is held firmly in place in the clamping means **22**.

The tube flaring tool of the present invention is so designed as to provide means for advancing the flaring cone **24** against the end of a tube to produce the required degree of flare on the tube, and then to permit the flaring cone to be rotated against the flared end of the tube without further advancement so as to burnish or otherwise smooth and polish the flare. In the specific form of tool chosen for illustrating the invention, the advancement of the flaring means is accomplished by rotating a threaded member relative to a threaded carrying element mounted upon or forming a part of the yoke member. When the desired degree of flare has been achieved, relative rotation between such members is prevented whereupon the flaring means may be rotated without simultaneously being advanced. The ratchet means is so designed that when the burnishing operation has been completed, the handle **26** may be rotated to withdraw the flaring means from the flared end of the tube and thus permit removal of the tube, and simultaneously to condition the tube flaring tool for the next flaring operation.

Referring now to Fig. 5 of the drawings, the base of the cone **24** is provided with a threaded extension or projection **30** which is located diametrically opposite the apex of the cone and is adapted to be received within a threaded hole provided in an enlarged head **31** formed on the lower end of a spindle or shaft **32** which is rotatably supported within an externally threaded member or sleeve **33**. The head **31** is hexagonal in shape, as shown in Fig. 1, so that a wrench may be applied thereto to hold the shaft **32** stationary when the threaded extension **30** on the flaring cone **24** is screwed onto the bottom of the shaft. As shown in Figs. 1 and 5, an anti-friction thrust bearing **27** is provided between the flaring cone and the lower end of the sleeve **33** for the purpose of absorbing the upward thrust produced on the cone during tube flaring operations with a minimum of frictional restraint between the cone and the sleeve. As shown in Fig. 5, this bearing may take the form of a series of small, steel balls **34** running in a raceway **28** provided in a flange or shoulder **29** which defines the top edge of the head **31** formed on the bottom of shaft **32**, though it may also take the form of any other suitable device for reducing friction between the shoulder **29** and the bottom of the sleeve **33**. The sleeve **33** is supported in a carrying member or element comprising, in the embodiment herein disclosed, an internally threaded opening **35** provided in the cross-arm **20** of the yoke **21**.

At its upper end, the sleeve 33 is provided with an annular flange 33' which lies just beneath the operating handle 26. The sleeve 33 extends a short distance above the flange 33' and this portion of the sleeve is provided with a hexagonal conformation as is clearly illustrated in Fig. 2. A clutch means is provided for connecting the sleeve with the shaft 32, this means including a ratchet 36 mounted on the upper end of the sleeve 33, this ratchet having a hub 36' formed thereon provided with a hexagonal opening which is adapted to mate with the hexagonally shaped upper extremity of the sleeve 33. Consequently, the ratchet 36 is keyed to the sleeve 33 and is non-rotatable with respect thereto. The notched periphery of the ratchet 36 is adapted to cooperate with either of the teeth 39 or 40 of a double-acting pawl 37 mounted for pivotal movement on a rivet 38 mounted in the handle 26. The pawl 37 is held either in the position shown in Fig. 9, in which the tooth 39 engages with the ratchet 36, or in a shifted position in which the tooth 40 engages with the ratchet, by means of a toggle spring 41 having one end secured to the handle 26 and the other end received within a notch 42 provided in the rear end of the pawl 37. The upper end of the shaft 32 is provided with a portion which is of square cross-section. As illustrated in Figs. 3 and 5 of the drawings, this portion of the shaft is received within a square opening provided in a cap 44 which is welded or otherwise secured to the handle 26. The handle is thus keyed to the shaft 32 so as to constrain these two parts to rotate together. The handle 26 is retained on the upper end of shaft 32 by means of a cap screw 43 which is received within a threaded hole provided in the upper end of the shaft.

The handle 26 is formed of two similar plates 45 and 46 which are held together in spaced relation by means of rivets 47 as shown in Fig. 5. The ratchet 36 lies between the plates 45 and 46 and the hub 36' thereof is received in circular openings provided in the plates. The pawl 37, like the ratchet 36, lies between the plates 45 and 46 and is thereby held in alignment with the ratchet 36.

With the pawl 37 in the position shown in Fig. 9, i. e., with the tooth 39 engaged with the ratchet, clockwise rotation of the handle produces clockwise rotation of the shaft 32 and, through the medium of the ratchet 36 and pawl 37, produces clockwise rotation of the sleeve 33 to advance the flaring cone 24 toward and against the end of the tube 25 to be flared. After the flaring cone has been advanced sufficiently to produce the desired flare, the direction of rotation of the handle may be reversed to rotate the flaring means without causing further rotation of the sleeve. Since the frictional restraint of the threads on the sleeve 33 with the threads provided in the opening 35 in the yoke is much greater than the frictional restraint between the bottom of the sleeve 33 and the head 31 on the shaft 32 due to the anti-friction bearing 27, the sleeve will remain stationary while the cone 24 rotates. Hence, the flared end of the tube will be burnished while the tooth 39 of the pawl 37 ratchets over the teeth provided on the ratchet 36. When the burnishing operation is completed, the flaring cone may be retracted by merely shifting the pawl whereupon the tooth 40 of the pawl will cause the sleeve 33 to rotate in unison with the shaft 32 and cause upward feeding movement of the cone. The flared and burnished tube 25 may then be removed from the device and replaced with the next tube to be flared after which the pawl may again be flipped to the position shown in Fig. 9 so that clockwise rotation of the handle will again cause downward feeding movement of the flaring cone 24.

The flaring cone 24 is so constructed as to provide rolling contact, as contrasted with sliding contact, between the cone and the end of the tube to be flared. To this end, the cone is provided with a body in which a plurality of conical rollers 60 (Fig. 5) are fitted with the apex of each of the rollers located adjacent the apex of the cone. The body of the cone 24 is provided about

its periphery with a series of conical recesses within which the rollers 60 are received. Each recess is provided near its apex with a bearing surface 61 for supporting the apex end of its associated roller 60. Above the bearing surface 61, each recess is relieved so as to provide a clearance 53 between the recess and the upper portion of the roller and this portion of the body, i. e., the portion between bearing surface 61 and the top of the roller, may be entirely cut away if desired. The bearing surface 61 of each recess extends more than half way around its related roller so as to provide overhanging lips 62 and 63 (Fig. 4) which overlie, in part, the apex end of the roller and hold it in place within the recess. That is, the recesses extend through an arc of more than 180° but substantially less than 360° so as to retain the rollers therein and, at the same time, allow a substantial portion of each roller to project beyond the peripheral face of the cone.

Each of the conical recesses provided in the body of the cone 24 is provided at its base with a cylindrical portion 64 (Fig. 5) within which an annular bushing 65 may be received. Each bushing 65 is provided with a bore 66 within which is journaled a stub shaft or tenon 67 formed on the base end of each roller 60. The rollers and their associated bushings 65 may be inserted in the cone by dropping them through the openings 64 whereupon the lower or apex end of each roller will seat in its respective bearing surface 61 and the upper end thereof will be supported for rotation in the bore 66 of bushing 65. The rollers and bushings are retained in place within the recesses by an annular end cap 69 which is apertured to fit over the threaded extension 30 of the cone 24. This cap is held in place on the end of the cone 24 by the head 31 on shaft 32 which engages the cap when the cone is screwed in place on the lower end of the shaft.

Each tenon 67 of the rollers 60 is provided with a rounded end 54 (Fig. 5) which is adapted, during tube flaring operations, to make contact with the bottom face of the end cap 69 and thereby overcome the upward thrust produced on the rollers 60 by the end of the tube being flared. By thus rounding the end of each tenon 67, point contact is provided between the tenon 67 and the substantially flat bottom face of the cap 69. Hence, very little resistance to the rotation of rollers 60 will be offered by the thrust bearing provided by the rounded end 54 and the bottom of the end cap 69 and free rolling movement of the rollers against the end of the tube being flared will be insured.

Various other means may be used for providing an anti-friction thrust bearing between the base ends of the rollers 60 and the bottom face of the end cap 69, some of which are shown in Figs. 6, 7 and 8. As shown in Fig. 6, the tenon 67 of the roller 60 may be provided with a conical point 55 in place of the spherical surface 54. By this means also, point contact may be provided between the upper end of the tenon and the bottom face of the cap 69 so as to provide for minimum, frictional resistance between the roller and the end cap when end thrust is applied on roller 60 during tube flaring operations. In Fig. 7 a slightly modified form of flaring cone 56 is provided. In this instance the cone is provided with a series of true conical recesses for receiving conical rollers 57. In the case of the cone 56, the bearing surface 61 is dispensed with as is also the clearance 53 so that the roller 57 is supported throughout its length by the face of the recess. The upper end of each roller 57 is provided with a conical point 58 so as to afford point contact between the upper end of the roller and the bottom face of the end cap 69 during tube flaring operations. In Fig. 8 a similar cone 56 is provided but, in this case, the recesses in the cone are adapted to receive conical rollers 59, the base ends of which are rounded as indicated at 49 so as to provide point contact between the upper end of the roller and the bottom face of the cap 69.

The means for clamping the tube to be flared in position beneath the flaring cone is best shown in Figs. 5 and 9 and comprises a first pair of base plates **70** and **71** which are hingedly connected by a bolt **72** to a second pair of base plates **70***a* and **71***a* (Fig. 1) which are similar to the first pair of plates **70** and **71**. Between each pair of base plates is a polygonal tube clamping member **73** and **73***a* (Fig. 9), respectively, each of which is rotatable about a pivot bolt **74** and **74***a* mounted in the base plates. The members **73** and **73***a* are provided with semi-cylindrical slots **76** and **76***a*, respectively. These slots are provided at their upper ends with countersunk portions **77** and **77***a*, respectively, to afford a back-up face for supporting the flared end of the tube in case the particular clamping means shown herein should be used with a conventional flaring cone. This face is not required, however, when my improved style of tube flaring cone is used.

The number and size of the slots **76** provided in the clamping member **73** are, of course, equal in number to and matching in size with the slots **76***a* provided in the member **73***a* so that each clamping member may be rotated about its respective pivot bolt to bring together matching, semi-cylindrical slots and thereby form a cylindrical tube clamping opening when the two pairs of base plates are swung from the open position, shown in Fig. 9, to the closed position shown in Fig. 1.

As mentioned earlier herein, the second pair of base plates **70***a* and **71***a* are hinged on the bolt **72** so that this pair of plates may be swung from the closed position shown in Fig. 1 to the open position shown in Fig. 9, and vice versa. The base plates **70***a* and **71***a* are hinged on the bolt **72** by means of a U-shaped bracket **78** (see Fig. 1) which lies between and is welded to the base plates **70***a* and **71***a*. The laterally turned ears of the bracket are bored to receive a sleeve **79** (Fig. 5) which is adapted to be received in similar holes provided in base plates **70** and **71**. The hinge bolt **72** is provided with a shank which fits within the sleeve **79** and also with a threaded tenon adapted to screw into the lower end of leg **19** of the yoke **21**. Thus, the second pair of base plates **70***a* and **71***a* may be swung about the pivot provided by the bolt **72** and the bushing **79**, the ears of the bracket **78** being adapted to rotate on the sleeve **79** which is clamped tightly in place by the bolt **72**.

The two pairs of base plates are adapted to be clamped together in their closed positions by means of a swing-bolt **81** (Fig. 9) which is hinged on a bolt **84** screwed into the lower end of the leg **18** of the yoke **21**. The inner end of the bolt **81** is secured to a sleeve **82** (Fig. 5) which is rotatably journaled on a bushing **80** which is received at either end in holes provided therefor in base plates **70** and **71**. Hence, the bolt **84**, screwed into the tapped hole provided therefor in the bottom leg **18** of the yoke, will retain the bushing **80** in said holes in the plates **70** and **71** and provide a pivot for the bolt **81** secured to the sleeve **82**. A U-shaped bracket **83** (Fig. 9) is welded between the ears **87** and **88** (see also Fig. 1) provided on the base plates **70***a* and **71***a* and a slotted plate **85** is welded between the top and bottom flanges of the bracket **83** at the outer end thereof to provide a surface against which a wing nut **86** threaded on the bolt **81** may be tightened. If desired, a washer **89** may be interposed between the wing nut **86** and the slotted plate **85** to facilitate the clamping action of the wing nut against the plate. By loosening the wing nut **86**, the bolt **81** may be swung outwardly to the position shown in Fig. 9 after which the pair of base plates **70***a* and **71***a* may be swung away from the base plates **70** and **71** so as to permit removal of the tube which has been flared and the insertion of another tube in the clamping device. The pair of base plates **70***a* and **71***a* is then swung to the closed position whereupon the clamping bolt **81** may be swung inwardly, the shank of the bolt being received within the slot provided in the end plate **85**. The wing nut **86** is then tightened so as to clamp the two pairs of base plates together and securely clamp the tube to be flared within the aperture provided by the semi-cylindrical slots **76** and **76***a* provided in the clamping members **73** and **73***a*.

In Figs. 10 and 11 I have shown a modified form of flaring cone which may be used in place of the flaring cone **24** previously described. In this modification, a flaring cone **97** is formed of a body provided with a threaded shank **98** by means of which it may be screwed into the head **31** on the shaft **32** in the same manner as the flaring cone **24**. The body of the cone **97** is provided with a plurality of conical recesses spaced evenly about its periphery, each recess being in the form of a half-cone, i. e., a conical recess whose cross section at any point is that of a half-circle, or 180°. Received within each conical recess formed in the body of the cone **97** is a conical roller **113** having axial bore **114** provided in the base end thereof. Received within the bore **114** is a tenon **115** formed on a screw **116** which is adapted to be received within a tapped hole provided in the end cap **99**. Interposed between the base of the roller **113** and the under side of the cap **99** is an anti-friction bearing comprised of a thin retaining washer **117** having a central aperture for loosely receiving the tenon **115**, and a series of spaced apertures for loosely receiving and retaining a plurality of small, steel balls **118**. Hence, the upward thrust produced on the roller **113** by the tube being flared will be absorbed by the anti-friction thrust bearing provided by the balls **118** so as to facilitate free rolling movement of the roller **113** during tube flaring operations. If desired, any other suitable anti-friction bearing might be used in place of the retaining washer **117** and balls **118** for absorbing the upward thrust on the roller. In order to maintain the tenon **115** of each screw **116** centrally located within its respective conical recess, the end cap **99** is provided with a hexagonal aperture **119** which is adapted to be received on a corresponding hexagonal shank provided on the base end of the cone **97**. The tenons **115** will thus be lined up with the axes of the conical recesses and will therefore retain the rollers in axial alignment with the recesses.

Having now described my invention in considerable detail in connection with the embodiments illustrated in the accompanying drawings, and having, in connection with such description, utilized certain specific terms and language herein, it is to be understood that the present disclosure is illustrative rather than restrictive and that changes and modifications may be resorted to without departing from the spirit or scope of the claims appended hereto.

I claim:

1. In a tube flaring tool having means for clamping a tube therein and a rotatably mounted shaft, the combination of tube flaring means comprising a cone having a projection on its base removably secured to the shaft, an annular end cap surrounding the base of said cone and having an opening for receiving said projection, a plurality of elongated recesses in the side surface of the cone and equally spaced therearound with each elongated recess extending from the base of the cone to the apex thereof, a bearing surface at the apex end of each recess, a bearing recess at the base end of each elongated recess, a bearing member in each bearing recess having a circular bearing opening aligned with the axis of the elongated recess and adapted to be closed at its outer end by said end cap, a conical roller in each elongated recess having its apex end rotatably supported by said bearing surface at the apex end of the cone, and a stud shaft secured to the base end of each roller and riding in the bearing opening.

2. A tube flaring tool of the character recited in claim 1 wherein the bearing surface of the apex end of each recess consists of a conical surface having more than 180° of arc but substantially less than 360° of arc whereby the apex portion of the roller will be retained

therein with a substantial portion of its peripheral surface projecting beyond the surface of the cone.

3. A flaring cone comprising a body, a plurality of conical flaring rollers, and means on said body for supporting each of said rollers for rotation about its axis of symmetry with the tip of each roller lying substantially in contact with the tips of the other rollers and with the symmetrical axes of the rollers coinciding with the surface of a cone whose apex coincides with the apices of the rollers, said means including a plurality of open-sided recesses in said body each having a conical surface complementary to the conical surface of its associated roller to form a bearing surface for supporting the roller for rotation on said body.

4. The flaring cone of claim 3 wherein the conical surface of each of said recesses consists of more than 180° of arc but substantially less than 360° of arc whereby each of said rollers will be retained within its associated recess with a substantial portion of its conical surface projecting beyond the confines of the recess.

5. The flaring cone of claim 3 wherein said recesses are equally spaced around the rotational axis of said body.

6. The flaring cone of claim 3 wherein the conical bearing surface of each of said recesses extends along only a portion of the length of its associated roller thereby providing support for only a limited portion of the roller.

7. The flaring cone of claim 6 wherein said conical bearing surface of each of said recesses is limited to the apex portion of its associated roller only, and including a bearing for supporting the base end of each of said rollers on said body whereby said rollers are supported for rotation on said body at both ends and are unsupported intermediate their ends.

8. The flaring cone of claim 3 including means on said body for holding said rollers against axial displacement within said recesses.

9. The flaring cone of claim 8 wherein said means includes an end cap removably mounted on said body.

10. The flaring cone of claim 7 wherein said end cap is provided with a frusto-conical inner surface which is inclined with respect to the rotational axis of said body

so as to lie substantially perpendicular to the symmetrical axes of said rollers.

11. The flaring cone of claim 10 wherein the ends of said rollers lying adjacent the inner surface of said end cap are shaped to provide substantially point contact therewith and thereby reduce the frictional restraint on the rollers resulting from the end thrust produced on the rollers by the tube being flared thereby.

12. The flaring cone of claim 9 including means for transmitting in a substantially frictionless manner the end thrust applied to each of said rollers by the tube being flared thereby to the inner face of said end cap so as to permit free rolling movement of the rollers during tube flaring operations.

13. The flaring cone of claim 12 wherein said last-recited means includes a bushing fitted in the base of each of said recesses, and a tenon on the base of said roller journaled in said bushing, the end of said tenon being shaped to provide substantially point contact between said roller and the inner face of said end cap during tube flaring operations.

14. The flaring cone of claim 9 including an axial bore in the end of each roller, means on said end cap extending into each of said bores for retaining said rollers in said recesses, and an antifriction bearing interposed between the end of each roller and the inner face of said end cap for absorbing the axial thrust produced on the rollers by the tube being flared.

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