

Feb. 27, 1968

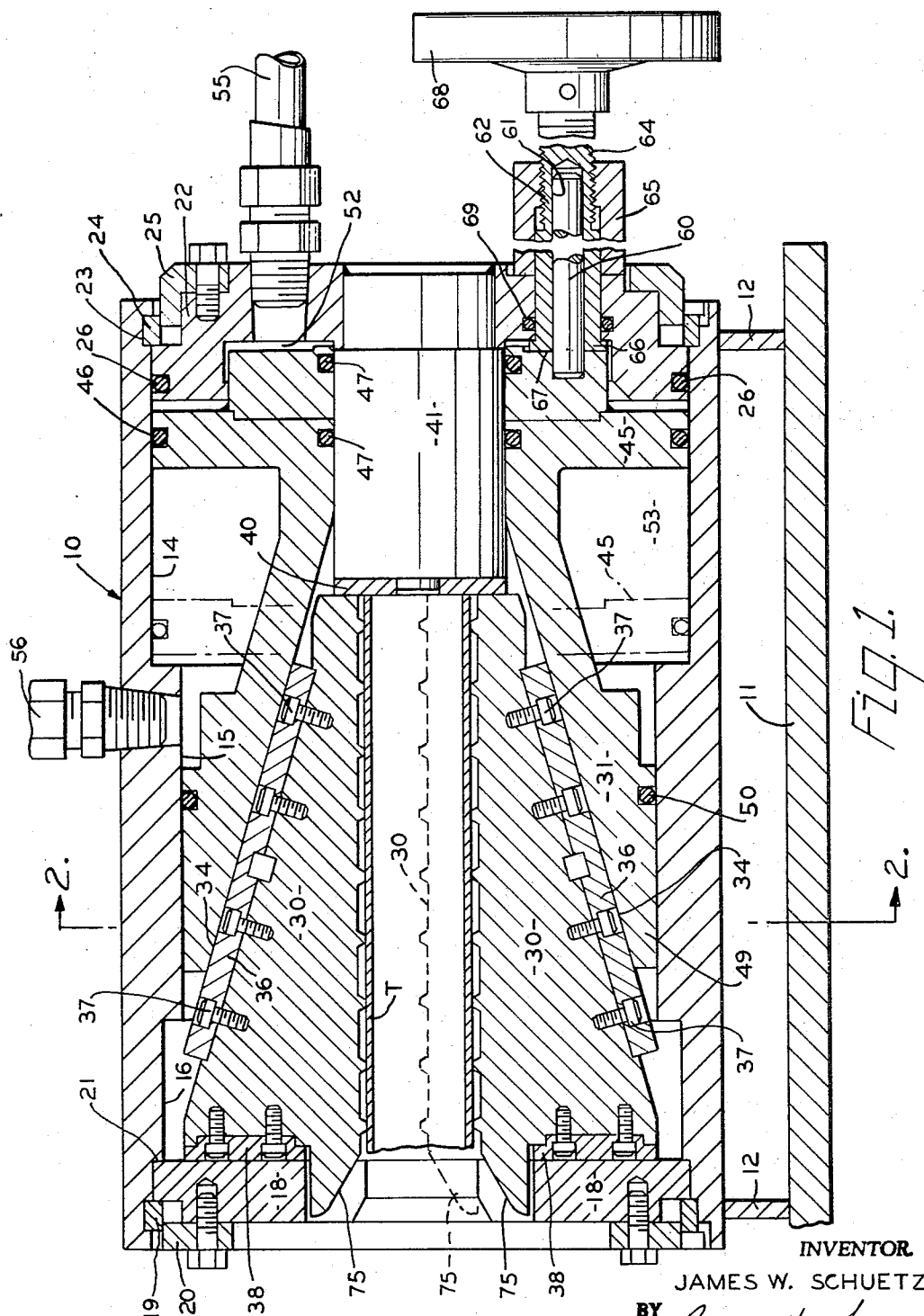
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3,370,451

APPARATUS AND METHOD FOR POINTING TUBES

Filed June 28, 1965

4 Sheets-Sheet 1



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EDWARDS LIFESCIENCES EX. 1222

Edwards Lifesciences v. Boston Scientific Scimed
U.S. Patent No. 6,915,560

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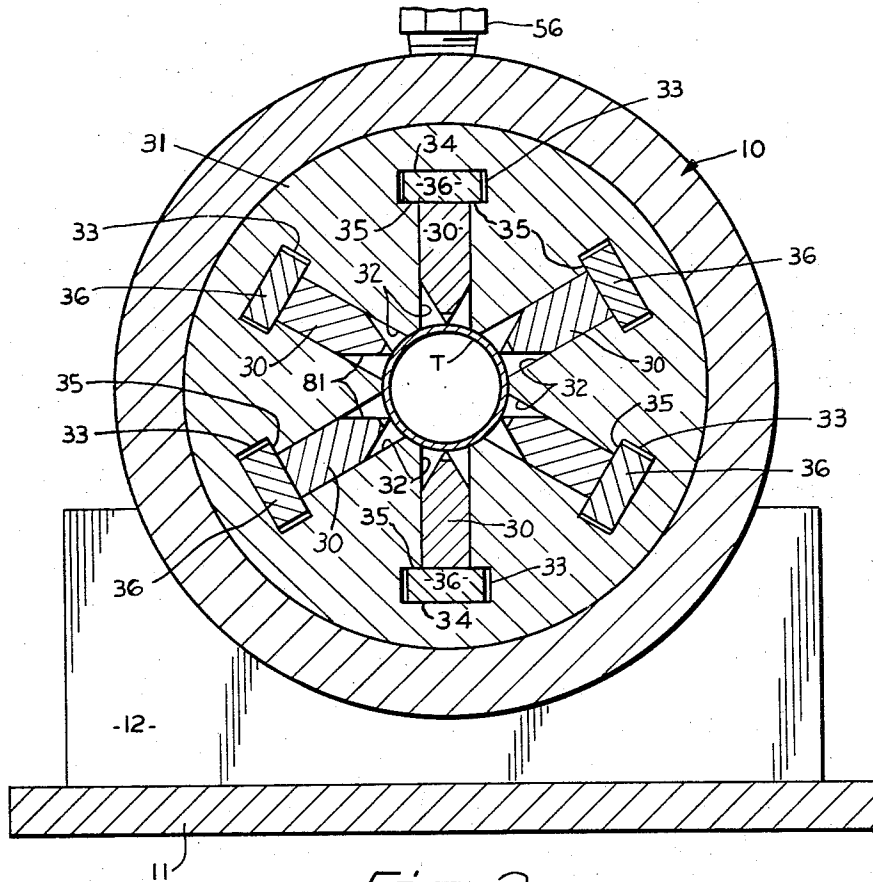


Fig. 2.

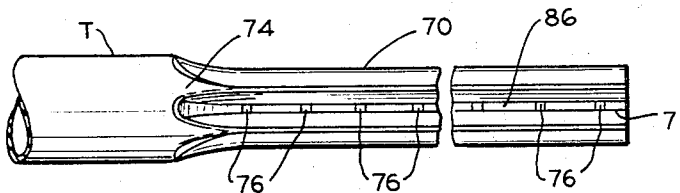


Fig. 3.

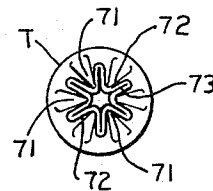


Fig. 4.

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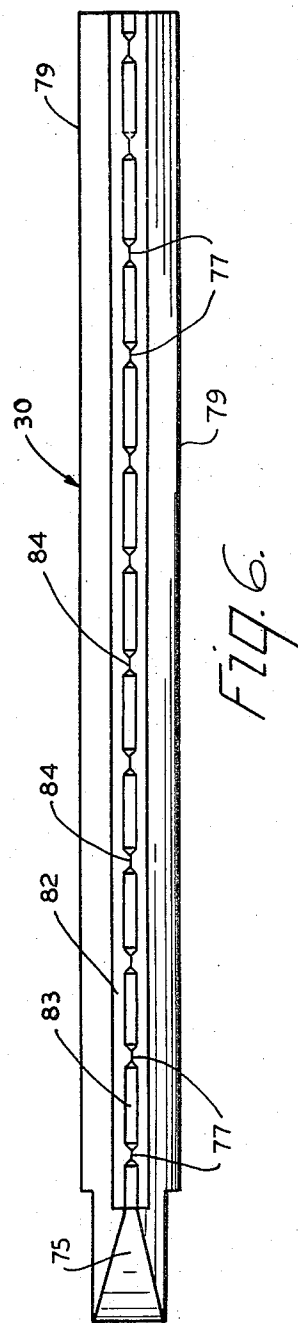
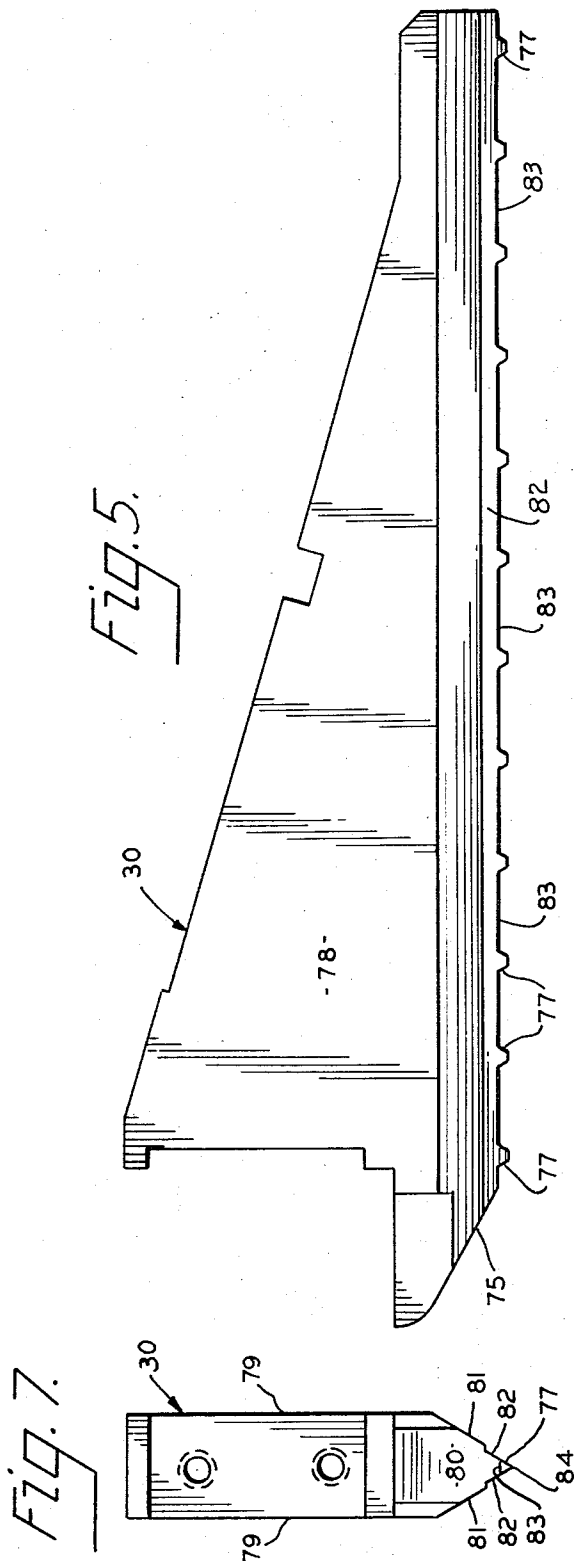
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4 Sheets-Sheet 3



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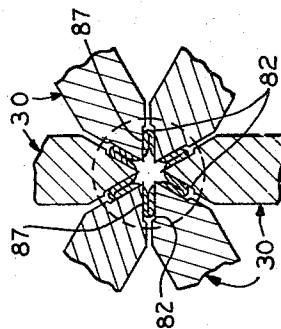
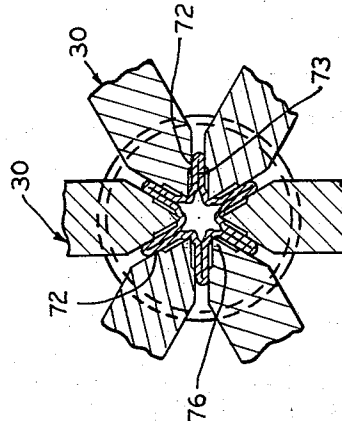
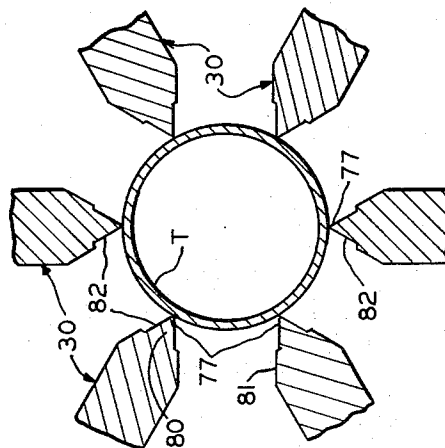
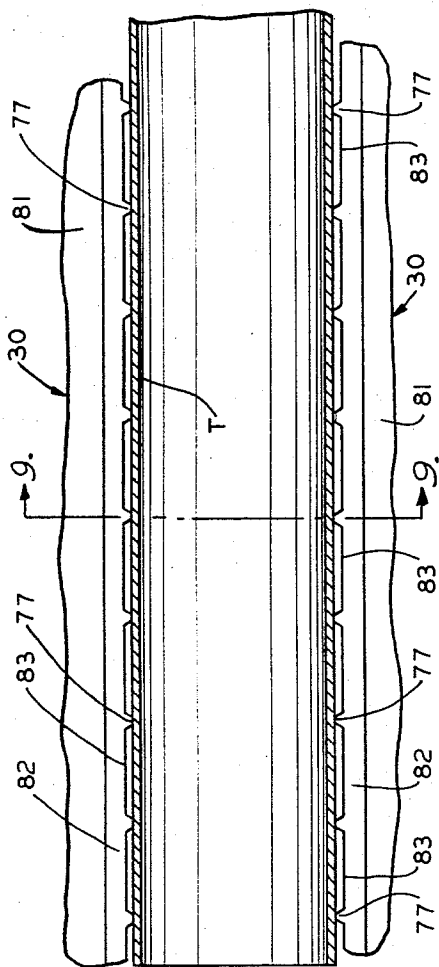
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4 Sheets-Sheet 4



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3,370,451 APPARATUS AND METHOD FOR POINTING TUBES

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8 Claims. (Cl. 72—402)

ABSTRACT OF THE DISCLOSURE

Apparatus for pointing metal tubes preparatory to drawing them through a die embodying jaw members angularly spaced apart about a central axis and adapted to fold the walls of a tube inwardly to produce a tube having an end of reduced diameter made up of longitudinally extending ribs separated by intervening flutes. The jaws are V-shaped and have sharp, longitudinally spaced projections that first come into engagement with the wall of the tube and hold the tube properly centered during the pointing operation which takes place in one continuous inward stroke of the jaws.

This invention relates to an apparatus and method for pointing tubes so that they may be inserted into dies for drawing the tubes to reduce their diameter.

It is necessary to provide what is known as a point on the end of a tube before it can be drawn through a die to reduce its diameter; the point must have an overall transverse dimension such that it readily can be inserted through the die and must be long enough so that the projecting end of the point can be grasped by gripper tongs or jaws or the like on the other side of the die. If the drawing operation is to be carried out satisfactorily, the point and the juncture between the point and the remainder of the tube must be nearly as strong as the tube itself so that the metal will not be pulled apart during the drawing operation, and the point should be accurately centered with respect to the tube to prevent distortion of the tube during drawing. Also, the pointing operation should be accomplished quickly and without requiring skill on the part of the operator and the apparatus for carrying out the pointing operation should be sturdy, simple and capable of being manufactured at reasonable cost.

A general object of the present invention is to provide a machine and method for pointing tubes that meets the foregoing requirements. Other objects and advantages of the invention will become apparent from the following description of a preferred form thereof, reference being made to the accompanying drawings in which:

FIGURE 1 is a vertical axial section illustrating a preferred form of apparatus embodying the present invention.

FIGURE 2 is a transverse section taken along line 2—2 of FIGURE 1.

FIGURES 3 and 4 are side elevation and end views, respectively, of a typical tube that has been pointed in the illustrated apparatus.

FIGURES 5 and 6 are side and end elevations, respectively, of one of the gripper jaws used to deform the tube.

FIGURE 7 illustrates the inner or working face of the gripper jaw illustrated in FIGURES 5 and 6.

FIGURE 8 is a fragmentary elevation showing the initial engagement between the gripper jaws and a tube to be pointed.

FIGURE 9 is a section taken as indicated by line 9—9 of FIGURE 8.

FIGURE 10 is a similar section, but showing the jaws in their innermost position.

FIGURE 11 is similar to FIGURE 10, but shows a smaller tube, the tube being of the size shown in FIGURES 3 and 4.

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Briefly, a preferred form of apparatus comprises a fluid operated chuck or similar mechanism that is adapted to urge a series of V-shaped gripper jaws or dies radially inwardly into engagement with the length of tube to be pointed. The jaws each have a series of longitudinally spaced points that first engage the tube and thus hold the tube against slippage with respect to the dies. As the jaws move inwardly, they fold the tube into a fluted form having a maximum dimension sufficiently smaller than the original outer diameter of the tube to permit the end of the tube readily to be inserted into the drawing die. The folding operation is completed in one continuous movement of the jaws and as soon as the inward movement of the jaws is completed, they are automatically retracted so that the tube can be removed from the apparatus ready for drawing through a die.

As shown in FIGURES 1 and 2 of the drawings, a preferred form of apparatus comprises a cylinder 10 supported on an appropriate base made up of a horizontal plate 11 and vertical plates 12 disposed at either end of the cylinder 10 and having arcuate saddle portions to receive the cylinder. The vertical members 12 preferably are welded to the base member 11 and the cylinder 10 may be welded to the vertical members 12. The internal bore of the cylinder 10 has a rear portion 14 of greatest diameter, an intermediate portion 15 of reduced diameter and a forward end portion 16 of enlarged diameter as compared to the intermediate portion 15. At the front end of the cylinder there is a front cylinder head 18 that is held in place by a key 19 and an annular ring 20 and is prevented from inward movement by a shoulder 21 in the cylinder bore. There is also a rear cylinder head 22 that is held in place against a shoulder 23 in the cylinder bore by a key 24 and a ring 25. The rear cylinder head is sealed to the cylinder as by a conventional O-ring 26.

In order to form the required points on tubes, a plurality of angularly spaced gripper jaws 30 are disposed within the cylinder. Six jaws are shown in the drawings, but fewer or more jaws can be employed if desired. A tube T is shown in FIGURES 1 and 2 to illustrate the initial engagement between the jaws and the tubes. In order to move the jaws 30 inwardly to deform the tube to provide the desired flutes and reduce the diameter thereof, a hydraulically operated chuck 31 is disposed within the cylinder 10. Chuck 31 is provided with radial slots 32 in which the jaws 30 are slidably mounted and in order to move the jaws inwardly and outwardly upon axial movement of the chuck, the slots 32 are T-shaped as shown, with enlarged head openings 33 that are defined by sloping outer camming surfaces 34 and inner camming surfaces 35 that are parallel to the surfaces 34. The jaws 30 are provided with T heads 36, preferably composed of a material such as bronze in order to reduce friction the strips being secured to the jaws by cap screws 37. The forward ends of the jaws are provided with wear plate 38 that bear against the inner surface of the forward cylinder head 18 while the rear ends of the jaws bear against a washer 40 that is supported by a plug 41 that projects inwardly from the rear cylinder head 22. The jaws are prevented from longitudinal movement by the rotating movement of the chuck 31 within the cylinder 10 will cause the dies to move radially inwardly and outwardly. The jaws and the chuck are shown in full line in FIGURE 1 in their fully retracted position; the broken lines in the lower part of FIGURE 1 indicate the innermost position of the jaws and the corresponding forward position of the chuck.

In order to reciprocate the chuck 31 within the cylinder 10, the chuck is provided with a rear piston portion that operates within the bore 14 and also slides along the plug 41, the piston portion 45 being sealed to t

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cylindrical surface 14 and the outer surface of plug 41 by appropriate packings such as the O-rings 46 and 47, respectively. The chuck is also provided with a forward piston portion 49 that fits within the intermediate bore 15 of the cylinder, the required seal being provided by a packing such as the O-ring 50. With this arrangement, admission of fluid under pressure to the space 52 in back of the piston 45 will urge the chuck in the forward direction toward the front cylinder head 18 and cam the jaws inwardly to deform a tube disposed within the jaws. Also, since the area of piston 45 is greater than the area of piston 49, admission of fluid to the space 53 between the two piston portions of the chuck will cause the chuck to move rearwardly in the cylinder and thus retract the jaws from the tube with which they have been engaged.

Suitable fluid conduits 55 and 56 leading to the spaces 52 and 53, respectively, are provided. These conduits are connected to a source of fluid under pressure through appropriate controls which can take any convenient form. Preferably, the controls are arranged so that the operator only has to push a button whereupon fluid under pressure will be admitted to the space 52 while flow of fluid from the space 53 to a sump will be permitted, thus moving the chuck in the forward direction and urging the jaws inwardly to point the tube. Preferably, the control is such that fluid under pressure is applied to the space 52 until the back pressure builds up to a predetermined degree, whereupon the connections are reversed to supply fluid under pressure to the space 53 through the conduit 56 and permit fluid to be discharged from the space 52 to the sump. This operation continues until a predetermined back pressure is built up in the conduits leading to the space 53, whereupon the pressure is shut off and the apparatus is then in condition for another operation. Controls capable of performing this type of sequence of operations are well known to those skilled in the art and are not described herein.

In order to limit the retracting stroke of the chuck and thus to limit the outward movement of the jaws to a position in which their inner edges define a circle having approximately the external diameter of the tube to be pointed, an adjustable stop is provided on the rear end of the chuck 31. This comprises a guide bar 60 that is pressed into an opening in the rear of the piston portion 45 of the chuck and extends rearwardly into a bore 61 formed in an adjustment shaft 62 that is threaded as at 64 in a hollow boss 65 secured to the rear cylinder head 22. The inner end of the adjustment shaft 62 has a flange 66 that engages the rear surface 67 of piston portion 45 of the chuck and the outer end of the adjustment shaft 62 is provided with a hand wheel 68 so that the position of the shaft in the boss can be readily adjusted. The shaft is sealed against leakage where it passes through the cylinder head 22 by an O-ring 69. With this arrangement, rearward movement of the chuck is stopped by engagement of the chuck with the end flange 66; the position of the flange can be adjusted by the hand wheel 68. The position of maximum retraction of the jaws is shown in FIGURE 1. The guide bar 60 prevents relative rotation between the chuck and the cylinder 10.

The gripper jaws 30 are designed so as to accurately form strong pointed portions of the type shown in FIGURES 3 and 4 on the ends of tubes of a wide range of sizes without requiring any change in the gripper jaws and without requiring any adjustment of the apparatus other than the adjustment of the retracted position of the jaws by the hand wheel 68. As shown in FIGURES 3 and 4, a tube T is provided with a pointed portion 70 having a maximum overall transverse dimension such that the point can be inserted readily into a conventional drawing die. Depending upon the wall thickness of the tube and the outer diameter of the original tube, the maximum transverse dimension of the point preferably is in the range of from about 75% to about 80% of the outer diameter of the tube. The reduced diameter of the point

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is formed by folding the wall of the tube inwardly upon itself to provide flutes 71. It will be noted that the ribs 72, which define the flutes or recesses, extend substantially radially and are substantially equally angularly spaced, and that the wall of the tube at the outer edge of each rib is bent through a sufficient angle that adjacent portions of the tube wall substantially contact each other as shown at 73. The inward folding of the tube wall does not substantially elongate the tube in the axial directions, and therefore the cross-sectional area throughout the point is substantially the same as the cross-sectional area of the original tube and has nearly the same tensile strength. The point merges into the original tube as shown at 74, the merging portion being formed by the outwardly flared end portions 75 of the gripper jaws 30. The bottom of each flute has a series of deeper indentations 76, these being formed by the sharp V-shaped projections 77 on the gripper jaws 30.

Jaw members 30 of a preferred form adapted to produce points such as shown in FIGURES 3 and 4 are illustrated in FIGURES 1 and 2, and on a larger scale, in FIGURES 5, 6 and 7. Each jaw member preferably comprises a body portion 78 having parallel side walls 79 that are adapted to slide in the radial slots 32 of the chuck. The outer surfaces of the body portions are slanted as shown to support the T heads 36. The inner portions of the jaws extend parallel to the common axis of the chuck, the cylinder 10 and the tube to be pointed. The inner portions of the jaws are formed into V-shape as shown at 80, with the V's pointing radially inwardly toward the common axis and their apexes parallel to the common axis. The included angle of the V's is preferably equal to the angular spacing between the radial slots 32 in the chuck and between the jaws 30 when they are in position within the chuck. Thus, in the example given, the angular spacing between the jaw members is 60 degrees and the included angle of the V-shaped portion of each of the jaw members is preferably also 60 degrees. With this arrangement, each side 81 of a V-shaped portion lies parallel to a side 81 of an adjacent jaw member. The jaw members, when moved inwardly by the chuck, fold the wall of the tube into the form shown, each rib 72 being made up of two thicknesses of tube wall folded substantially into contact with each other as shown at 73.

In order to provide clearance for the walls of light gauge and relatively small diameter tubes, the V-shaped points 80 of the jaws are relieved adjacent the apexes of the V's as shown at 82. The relieved portions make it possible to use the same jaws for the tubes of quite small diameter as are used for tubes of the maximum capacity for which the apparatus is designed. For example, with this arrangement a single machine can form points on tubes with a range of outside diameters from 1.750 inch to 0.625 inch, without requiring adjustment except of the retracted position of the jaws by the hand wheel 68.

As noted above, the tubes to be pointed are first engaged by the projections 77 of the jaws. These are longitudinally spaced along the apexes of the V's and are formed simply by cutting away or relieving the inner edges of the jaws as shown to provide flat surfaces 83, leaving V-shaped points formed by the intersection of the plane surface 82. The projections preferably are slightly elongated in the direction parallel to the axis of the tube and present sharp edges 84 to a tube disposed within the jaws. As shown in the drawing, the projections 77 are axially short as compared to the intermediate surfaces 83.

The manner in which the jaws form the desired point on a tube is illustrated in FIGURES 8, 9 and 10. As shown in FIGURES 8 and 9, the hand wheel 68 is employed to adjust the stop provided by the adjustment shaft 62 so that the points 77 of each of the jaws 30 engages a tube when the tube is inserted within the chuck. Preferably, the stop is adjusted so that the points of each jaw member engage the outer surface of the tube with sufficient firmness that the tube is accurately centered within

the chuck. The tube is inserted into the chuck until the end of the tube engages the washer 40. Then, as previously described, the chuck is actuated to move the jaw members radially inwardly.

Inasmuch as the first engagement between the jaw members and the tube is with the points 77, the sharp edges 84 of the points first indent the tube and thus prevent slippage of the tube with respect to the jaw members. Continued inward movement of the jaw members then simply folds adjacent portions of the tube wall toward each other until, as shown in FIGURE 10, these wall portions are substantially in engagement with each other. When this position is reached, no further inward movement of the jaw members can take place by merely bending the metal; the metal would have to be compressed to permit the surfaces 81 of adjacent jaw members to come closer together and to permit the jaw members to move nearer to the center line of the chuck. The pressure in the cylinder in back of the piston portion 45 of the chuck therefore increases and, as previously described, the chuck is returned to its initial position with the rear surface 67 of the chuck in engagement with the flange 66 of the adjusting shaft. This occurs when the parts have reached the position shown in FIGURE 10.

It will be noted that the sharp points 77 of the jaws somewhat penetrate the bottoms of the flutes thereby producing the indentations indicated at 76 in FIGURE 3. Also, the outwardly flared portions 75 of the jaws produce the merging areas 74 between the point and the body of the tube. The bottoms of the fluted portions between the indentations 76 are rather flat as shown at 86, having been formed by the flat intermediate areas 83 of the jaws. The point is accurately centered with respect to the tube and accurately formed because the initial adjustment of the retracted position of the jaws insures that the tube will be properly centered with respect to the jaws when the operation is commenced and because the sharp points on the jaws substantially eliminate the possibility of slippage between the metal of the tube wall and the jaws. The chuck moves the jaws inwardly uniformly and thus provides the required accurate point in a single operation. After the jaws have been automatically retracted by the chuck, the operator only has to remove the pointed tube from the chuck and insert it through the drawing die in the usual manner.

FIGURE 11 illustrates the conclusion of a pointing operation as applied to a tube of smaller diameter and thinner wall. In carrying out this operation, the hand wheel is operated to screw the adjusting shaft inwardly and thus limit retracting movement of the jaws to the smaller outer diameter of the tube. The folding operation occurs as before. However, it will be noted that the ribs 87 of this smaller lighter gauge tube are disposed within the relieved portions 82 of the jaws. If the jaws were not relieved, it would not be possible to point tubes of such small diameter using the same machine and the same jaws that are capable of pointing tubes of larger diameter and heavier wall. As noted above, a present type of machine is capable of pointing tubes having a wide range of outside diameters and of wall thicknesses. With tubes of thinner wall thickness, the points 77 frequently penetrate through the tube wall at the face of the indentations 76. This insures accurate holding of the tubes and centering of the tubes with respect to the chuck and the jaws and any weakening of the point that this action creates is inconsequential.

From the foregoing, it will be evident that the invention provides a method and apparatus whereby tubes of a wide range of sizes and wall thicknesses can be rapidly and accurately pointed by a single operation in a simple, sturdy and relatively inexpensive machine. The points are accurately centered with respect to the tube, the reduction in dimension is adequate for ordinary drawing operations and the strength of the points and the connection between the points and the tube is adequately maintained

so that the tension exerted on the points during the drawing operation can be sustained without breakage.

The essential characteristics of the invention are set forth in the appended claims.

I claim:

1. Apparatus for pointing metal tubes preparatory to drawing them through a die, comprising a plurality of jaw members angularly spaced about a central axis; means for moving all of the jaw members simultaneously and at the same speed in radial directions toward said axis and for retracting said jaw members away from said axis to a definite position at which the jaw members are substantially radially equidistant from said axis, each of said jaw members having an inner V-shaped portion provided by plane surfaces extending parallel to said axis and adapted to engage the wall of a tube to be pointed, the V-shaped portions pointing radially inwardly toward said axis, the apexes of the V-shaped portions of said members each having a plurality of longitudinally spaced, sharp, tube-engaging projections and the jaw members having tube-wall engaging surfaces between the projections, the projections being axially short as compared to the length of the surfaces between the projections.

2. Apparatus according to claim 1 wherein the projections have sharp, tube-engaging edges formed by the intersection of the plane surfaces of the jaw members.

3. Apparatus according to claim 2 wherein the surface of the V-shaped jaw members is relieved adjacent the apexes of the V's to provide clearance for the material of the wall of a tube being pointed.

4. Apparatus according to claim 1 wherein the jaw members are substantially equiangularly spaced about the axis and the included angle of each V-shaped portion is substantially equal to the angular spacing between adjacent jaw members.

5. Apparatus according to claim 1 wherein the means for moving the jaw members comprises a cylinder coaxial with said axis, a chuck mounted in said cylinder, said jaw members being radially slidable in said chuck and said chuck and said jaw members being provided with cooperating camming surfaces whereby longitudinal movement of said chuck within said cylinder in a forward direction moves said jaw members radially inwardly and toward said axis and movement of said chuck in a rearward direction causes said jaws to retract outwardly, and hydraulic means for moving said chuck longitudinally with respect to said cylinder.

6. Apparatus according to claim 5 wherein an adjustable stop is provided to limit the rearward movement of said chuck thereby limiting the retracting movement of said jaws.

7. Apparatus for pointing tubes comprising a cylinder having an open end, a chuck mounted in said cylinder and coaxial therewith, hydraulic means for moving said chuck axially with respect to said cylinder; a plurality of jaw members substantially equiangularly spaced about the axis of said cylinder, said jaw members being radially slidable in said chuck and being restrained against axial movement within said cylinder, said jaw members and said chuck being provided with cooperating camming surfaces whereby axial movement of said chuck within said cylinder in a forward direction moves said jaw members radially inwardly toward said axis and movement of said chuck in a rearward direction causes said jaws to retract outwardly from said axis; an adjustable stop disposed at the end of said cylinder opposite said open end to limit the rearward movement of said chuck thereby limiting the retracting movement of said jaw members, each of said jaw members having an inner V-shaped portion adapted to engage the wall of a tube to be pointed, the V-shaped portions pointing radially inwardly toward said axis and being formed by plane surfaces extending parallel to said axis and each of said members having a series of axially spaced, sharp, tube-engaging projections formed by the intersection of said planes, the

jaw members being relieved between said projections to provide substantially flat tube wall engaging surfaces between the projections.

8. The method of cold-forming points on metal tubes which includes the steps of disposing a plurality of jaw members about an axis with the members substantially equiangularly spaced about the axis, the jaw members having radially inwardly pointing V-shaped portions adapted to engage a tube, the jaw members each having a series of longitudinally spaced projections separated by relieved portions, disposing the jaw members with the spaced projections on the members radially spaced from the axis a distance substantially equal to the outside radius of a tube to be pointed, inserting the end of a tube to be pointed into the space between said jaw members with said projections engaging the outer surface of the tube and locating the tube concentric with said axis, then moving the jaw members inwardly toward said axis simultaneously and at the same rate of speed, the projections of said jaw members initially forming indentations in

said tube and retaining said tube substantially concentric with said axis, and continuing the inward movement of said V-shaped members without interruption to fold adjacent portions of the tube wall toward each other until the wall portions are substantially in engagement with each other without substantially reducing the wall and provide radially extending ribs defining intermediate flutes, and thereafter retracting said jaw members and releasing said tube therefrom.

References Cited

UNITED STATES PATENTS

2,211,622	8/1940	Hunziker	72—402
2,997,911	8/1961	Woolley	72—402
2,999,405	9/1961	Ewart	72—402
3,154,978	11/1964	Baker	72—402

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