Dec. 18, 1962 D. W. ROWELL 3,068,929

TUBE POINTER

Filed April 22, 1960 2 Sheets-Sheet 1

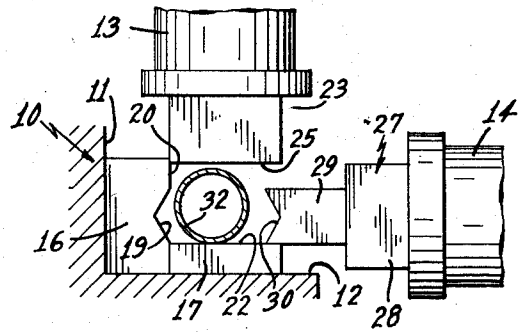



FIG. 1

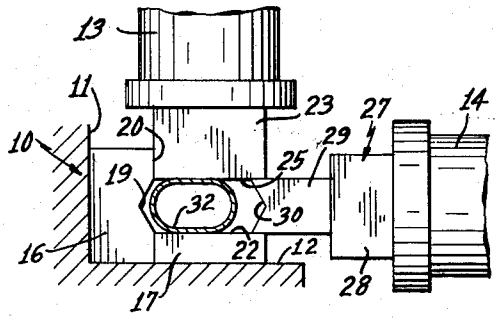



FIG. 2

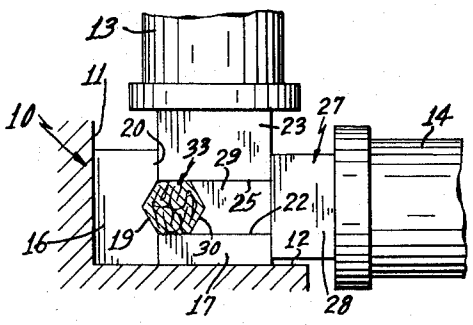



FIG. 3

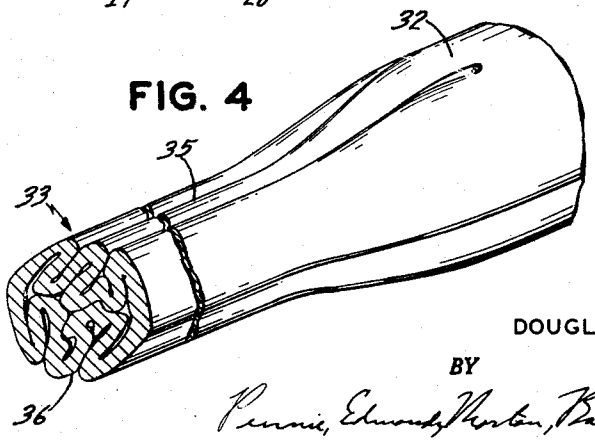



FIG. 4

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TUBE POINTER

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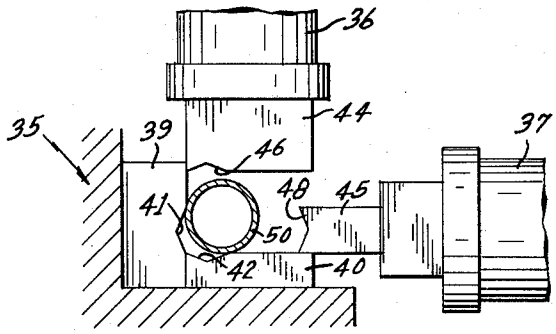



FIG. 5

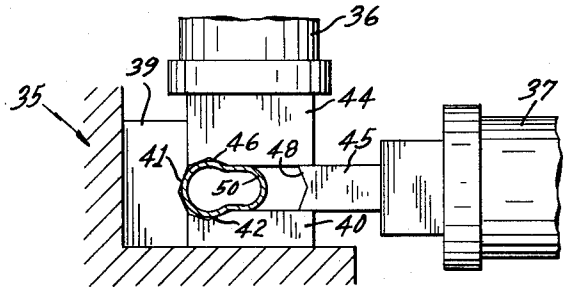



FIG. 6

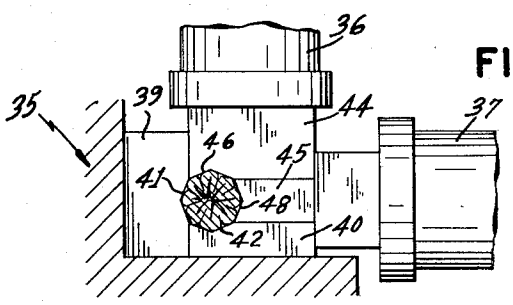



FIG. 7

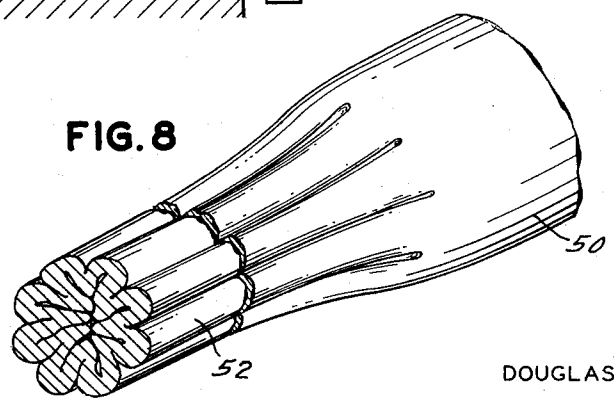



FIG. 8

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# TUBE POINTER

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9 Claims. (Cl. 153—34)

This invention relates to the pointing of tubes and, more particularly, to a new method and apparatus for pointing tubes wherein cooperating movable and stationary dies deform and compact an end portion of the tube in two strokes into a polygonal cross section substantially smaller than the across section of the tube.

Before a tube is drawn, it is necessary to "point" or reduce the diameter of the end portion of the tube so that it can be inserted through the die and be grasped by tongs or other gripping device of the drawing apparatus. Though such reduction in diameter has often been accomplished by necking down the end portion of the tube in a swaging operation, it has been found to be quicker and easier to collapse the tube end portion without upsetting the wall or substantially displacing the metal as in swaging. However, presently available methods of collapsing the end portion of tubes entail considerable die wear and produce collapsed portions which are either lacking in symmetry or are too large to be repeatedly inserted through a considerable number of successively smaller dies. Asymmetry in a tube point gives rise to stress concentrations which often cause breakage of the pointed portion of the tube during drawing. Short die life and the relatively large size of the tube points are disadvantages which increase operating costs and scrap losses.

The major purpose of the present invention is to provide a new method and apparatus for pointing tubes by the wall-collapsing method which overcomes these various shortcomings in the means presently available. According to the invention, a pointed end portion of polygonal cross section is formed on the tube by two rapid immediately successive strokes of cooperating movable and stationary dies. (The term "polygonal" is used here and throughout the specification and claims in its accepted meaning of more than four sides.) The walls of the tube are compressed solidly into this polygonal shape without causing substantial flow of metal and thus the work required to accomplish the operation is minimal. It has been found in practice that the resulting point can be made sufficiently small in size relative to the original tube diameter to permit the tube to be inserted into and drawn through a considerable series of successively smaller dies before it need be repointed. At the same time, the polygonal shapes themselves possess good symmetry, and can readily be formed symmetrically with respect to the cylindrical tube, so as to minimize the risk of concentrations of stress during the drawing operation which might cause fracture of the point. The point is formed without reducing the thickness of the tube walls, so the point remains as strong for pulling through the dies as the main body of the tube. Furthermore, the polygonal point is formed in a fashion which increases die life by substantially reducing the wear to which the forming dies are subjected.

The tube pointing apparatus of the invention comprises a frame and a stationary die affixed to the frame. First and second movable dies are displaceable between open and closed positions relative to the stationary die. Means are included for forcibly displacing the movable dies between their open and closed positions. The dies together partially define an opening sufficiently large to receive the tube to be pointed when the movable dies are in their open position. When the movable dies are in closed



position, the dies together define a cavity of polygonal cross section which is substantially less in maximum width (corner to corner) than the outside diameter of the tube. In this cavity, the stationary die defines at least two adjoining sides of the polygon and the first and second movable dies define the remaining sides thereof.

In a preferred form of the apparatus, the cavity is of hexagonal cross section. The stationary die then defines three adjoining sides of the hexagonal cavity, the first movable die defines one side, and the second movable die defines the remaining two adjoining sides.

The tube may first be deformed by one movable die and then by the other in two immediately successive strokes. Preferably, the first movable die in actuated before the second movable die to partially flatten the tube. The tube is thus prepared for actuation of the second movable die whereby the partially flattened configuration is collapsed into an almost solid polygonal point. There is very little sliding contact between the tube and the dies in forming the point in this manner and hence die wear is minimized. Also, a great amount of compression of the collapsed wall is made possible so that the polygonal point is exceptionally compact, without reducing the thickness of the tube walls.

The invention also provides a new method which is carried out by means of the apparatus. In general, the method comprises the steps of partially flattening the portion of the tube to be pointed into substantially oblong cross sectional shape having rounded ends. The rounded ends are then compressed toward one another while the remainder of the portion is constrained from outward displacement. Hence, the greater part of the portion of the tube being pointed is collapsed inwardly. The compression is ceased when the end portion of the tube is substantially fully compacted into a polygonal cross section.

A preferred embodiment of the new apparatus illustrating the steps of the method is shown in the accompanying drawings, wherein

FIG. 1 is a schematic fragmentary elevation of the apparatus partly in section showing the movable dies in open position with a tube to be pointed into hexagonal cross section received between the dies;

FIG. 2 is a similar view showing the first movable die after it has reached its closed position and the second movable die still in its open position;

FIG. 3 is a similar view showing both movable dies in their closed position and the tube pointed in hexagonal shape;

FIG. 4 is a fragmentary perspective view partly broken away showing the resulting hexagonal end portion of the tube;

FIG. 5 is a view similar to FIG. 1 showing dies for forming an octagonal point on the tube;

FIG. 6 is a view similar to FIG. 2 of the apparatus of FIG. 5;

FIG. 7 is a view similar to FIG. 3 showing the dies fully closed and the tube pointed in octagonal shape; and

FIG. 8 is a fragmentary perspective view partly broken away showing the resulting octagonal end portion of the tube.

Referring first to the embodiment of FIGS. 1–4, a stationary frame 10 is provided to define adjoining vertical and horizontal die supporting surfaces 11 and 12 respectively. Vertical and horizontal plungers 13 and 14 are also provided. The vertically movable plunger 13 is disposed over the horizontal surface 12 of the frame and the horizontal plunger 14 is disposed opposite the vertical surface 11. Both plungers are actuated by suitable hydraulic or pneumatic cylinders so that they may be

forcibly displaced toward the respective vertical and horizontal surfaces of the frame.

Affixed to the frame **10** is a stationary die which (in the form shown) is made up of two blocks **16** and **17**. One die block **16** rests on the horizontal surface **12** and abuts the vertical surface **11** of the frame, and the other die block **17** also rests on the horizontal surface **12** of the frame and adjoins the lower portion of the first die block **16**. The die blocks **16** and **17** are disposed in opposition to the horizontal plunger **14** and vertical plunger **13** respectively. Each die block has a length perpendicular to the axes of both plungers which is at least equal to the length of the pointed portion to be formed on the tube.

Formed in the vertical surface of the first die block **16** which faces the horizontal plunger **14** is a concave V-shaped groove **19** extending perpendicular to both plunger axes throughout the length of the die block **16**. The groove is defined by two flat surfaces of equal dimension which converge at an included angle of substantially 120°. Adjoining and extending upwardly from the top edge of the groove **19** is a vertical sliding surface **20** on the die block **16**. The upper surface **22** of the second die block **17** adjoins the lower edge of the groove **19** and is flat and horizontal. Thus, it is perpendicular to the first sliding surface **20** on the die block **16**, and forms an included angle of substantially 120° with the lower of the two flat surfaces defining the groove **19**.

Affixed to the face of the vertically movable plunger **13** is a first movable die **23**. The movable die **23** is formed with a working face **25** which is flat and horizontal and which is therefore parallel and opposed to the surface **22** of the lower stationary die block **17**. This first movable die **23** extends into contact with and slides against the first sliding surface **20** on the die block **16**. In the retracted position of the plunger **13** shown in FIG. 1, the distance between the working face **25** of the first movable die **23** and the surface **22** of the die block **17** is greater than the outside diameter of the tube to be pointed.

A second movable die **27** is affixed to the face of the horizontally movable plunger **14**. This die **27** includes a base portion **28** and a projecting portion **29** which extends therefrom between the first movable die **23** and the die block **17**. Formed in the outer face of the projecting portion **29** of the second movable die **27** is a V-shaped groove **30** defined by two flat surfaces of equal dimension which converge at an angle of substantially 120°. The dimensions of the groove **30** are equal to those of the groove **19**, which is directly opposite thereto. The vertical dimension of the projecting portion **29** is equal to the edge-to-edge dimension of the groove **30** formed in its outer face; and this projecting portion **29** is adapted to slide along the surface **22** of the die block **17**. The outermost end of the projecting portion **29** extends from the shoulder of the base portion **28** a distance such that in the forward position of the plunger **14** the projecting portion **29** stops short of the nearest point on the die block **16** a distance equal to the width of the flat surfaces defining the grooves **19** and **30**. In that forward position of the plunger **14**, the shoulder of the base portion **28** abuts the sides of the first movable die **23** and the stationary die block **17**, which serve as stops to limit the forward motion of the horizontally movable die **27**.

Each of the movable dies **23** and **27** has a dimension perpendicular to the axes of both plungers which is equal to that of the stationary dies. In their open position shown in FIG. 1, the movable dies partly define an opening sufficiently large to receive the tube to be pointed.

In the operation of the new tube-pointing apparatus, the end portion of a tube **32** is inserted between the dies when the plungers **13** and **14** are in their open position. The tube **32** should be small enough to fit between the open dies but should be substantially wider than the edge-to-edge width of the grooves **19** and **30**. The plunger **13** is then actuated to move the first movable die **23** downwardly to its closed position shown in FIG. 2. In this closed position, the working face **25** of the first movable die **23** stops at the upper edge of the groove **19** formed in the die block **16**. As shown in FIG. 2, this causes the tube **32** to be flattened into oblong cross sectional shape having substantially parallel sides and rounded ends. It will be noted that the working face **25** of the first movable die **23** also abuts against the end of the projecting portion **29** of the second movable die **27** when this initial stroke is completed.

Next, the plunger **14** is moved forwardly into its closed position shown in FIG. 3. This causes the projecting portion **29** of the second movable die **27** to slide between the first movable die **23** and the lower stationary die block **17** into a position where the dies together define a cavity of regular hexagonal shape. The groove **19** in the stationary die block **16** defines two sides of this hexagonal cavity and a portion of the surface **22** of the stationary die block **17** defines a third side adjoining thereto. Opposite the die block **17**, a portion of the working face **25** of the first movable die **23** defines one other side of the hexagonal cavity, and the remaining two adjoining sides are defined by the groove **30** in the projecting portion **29** of the second movable die **27**.

While moving into its closed position shown in FIG. 3, the second movable die **27** first compresses the rounded ends of the tube **32** toward one another between the wedge-shaped grooves **19** and **30**. At the same time, the parallel sides of the tube **32** are constrained between the first movable die **23** and the die block **17**. This causes the parallel sides of the oblong cross section to collapse inwardly as shown in FIG. 4, and the previously rounded ends thereof are formed into a triangular shape conforming to the shape of the grooves **19** and **30**. Compression of the tube in this manner ceases when the shoulder of the base portion **28** of the second movable die member **27** abuts the first movable die member **23** and the lower die block **17**; and at that point the cavity formed by the dies is of the desired regular hexagonal shape.

The collapsed portion of the tube between the dies is formed into the shape shown in FIG. 4 with a definite hexagonal cross section. Two opposite sides **35** and **36** of this cross section are marked by folds where the walls of the tube were collapsed inwardly, but the remaining four sides are substantially flat. It will be noted that the collapsed walls of the tube **32** are substantially unchanged in thickness, but are compressed together to such a degree that the point is almost solid. The maximum width of the hexagonal cross section of the pointed portion **33** (measured from corner to corner) is considerably less than the original outside diameter of the tube **32**. The length of the pointed portion **33** can be varied, of course, as desired, by correspondingly varying the length (in the direction perpendicular to the plane of the drawing) of the dies in the apparatus.

Turning now to the embodiment of the new apparatus shown in FIGS. 5–8, a frame **35** is associated with vertical and horizontal plungers **36** and **37** as in the embodiment described above. Mounted on the frame **35** is a stationary die made up of two blocks **39** and **40** which are supported in the same manner as the die blocks **16** and **17**. The first die block **39** has a concave V-shaped groove **41** formed in its vertical surface opposite the horizontal plunger **37**. This groove defines an included angle of 135°. The second block **40** also includes a 135° V-shaped groove **42** opposite the vertical plunger **36** and the immediately adjoining surfaces of these two grooves also define an included angle of 135°.

First and second movable dies **44** and **45** are mounted on the vertical and horizontal plungers **36** and **37** respectively to slide against the die blocks **39** and **40** as in the previous embodiment. However, a V-shaped groove **46** is formed in the first movable die **44** and defines an included angle of 135°. Similarly, the second movable die **45** defines a 135° V-shaped groove **48**. Hence, when the

dies 44 and 45 are brought together they define a regular octagonal cavity with the stationary die blocks 39 and 48.

The end portion of a tube 50 which is to be pointed is first inserted between the stationary and movable dies as shown in FIG. 5. The vertical plunger 36 is then actuated to bring the first movable die 44 down onto the end of the tube 50 to flatten it into the substantially elongated shape shown in FIG. 6. The ends of this oblong cross section are rounded. Next, the horizontal plunger 37 is actuated to bring the second movable die 45 against the flattened end portion of the tube so that the tube is collapsed as shown in FIG. 7. Upon retraction of the dies, the tube is withdrawn and formed with a pointed portion 52 as shown in FIG. 8. The portion 52 is of substantially regular octagonal shape with the greater part of the tube walls collapsed inwardly in a substantially solid fashion.

It is evident that the regular polygonal portions of the tubes pointed by these embodiments of the new apparatus are of symmetrical shape and thus are not susceptible to extreme stress concentrations when grasped by tongs during drawing. Also, the polygonal pointed portions are of small size compared to the original tube and thus can be received in a wide size range of grips. Such flat-sided configurations on the tube points need not be specially matched to the gripping jaws as is the case with conventional round points. By collapsing a tube into the polygonal shapes shown, very little wear is exerted on the dies of the apparatus because there is a minimum of sliding contact between the walls of the tubes and the dies. Furthermore, there is virtually no reduction in thickness of the metal in deforming the walls of the tubes in the manner described, so that the new pointing operation can be performed quickly with a minimum of work and without reducing the tensile strength of the tube at its point in comparison with the cylindrical body of the tube.

I claim:

1. Tube pointing apparatus comprising a frame, a stationary die affixed to said frame, first and second movable dies displaceable at right angles to one another between open and closed positions relative to said stationary die, means for forcibly displacing said movable dies between their open and closed positions, said dies together partially defining an opening sufficiently large to receive the tube to be pointed when said movable dies are in open position, said dies together defining a cavity of polygonal cross section substantially less in maximum width than the maximum width of said tube when said movable dies are in closed position, said first and second movable dies defining at least three adjoining sides of said cavity.

2. Tube pointing apparatus according to claim 1 wherein said cavity is of hexagonal cross section, said stationary die defining three adjoining sides of said cavity, said first movable die defining one side of said cavity, and said second movable die defining two adjoining sides of said cavity.

3. Tube pointing apparatus according to claim 1 wherein said cavity is of octagonal cross section, said stationary die defining four adjoining sides of said cavity, said first movable die defining two adjoining sides of said cavity, and said second movable die defining two adjoining sides of said cavity.

4. Tube pointing apparatus comprising a frame, a stationary die affixed to said frame, first and second movable dies displaceable at right angles to one another between open and closed positions relative to said stationary die, said stationary die defining a first surface against which said first movable die is adapted to slide between its open and closed positions, said stationary and first movable dies defining parallel second surfaces perpendicular to said first surface against which said second movable die is adapted to slide from its open to its closed position, means for forcibly displacing said movable dies between their open and closed positions, said dies together partially defining an opening sufficiently large to receive the tube to be pointed when said movable dies are in open position, said dies together defining a cavity of regular polygonal cross section substantially less in maximum width than the maximum width of said tube when said movable dies are in their closed position, said stationary die defining at least two adjoining sides of said cavity, said first movable die defining at least one side of said cavity, and said second movable die defining at least two adjoining sides of said polygonal cavity.

5. Tube pointing apparatus comprising a frame, a stationary die affixed to said frame, first and second movable dies displaceable at right angles to one another between open and closed positions relative to said stationary die, said stationary die defining a first surface against which said first movable die is adapted to slide between its open and closed positions, said stationary and first movable dies defining parallel second surfaces perpendicular to said first surface against which said second movable die is adapted to slide from its open to its closed position, means for forcibly displacing said movable dies between their open and closed positions, said dies together partially defining an opening sufficiently large to receive the tube to be pointed when said movable dies are in open position, said dies together defining a cavity of regular hexagonal cross section substantially less in maximum width than the maximum width of said tube when said movable dies are in their closed position, said stationary die defining three adjoining sides of said cavity, said first movable die defining one side of said cavity, and said second movable die defining two adjoining sides of said hexagonal cavity.

6. Tube pointing apparatus according to claim 5 wherein said parallel second surfaces on said stationary and first movable dies respectively are coplanar with and adjoin diametrically opposite parallel sides of the regular hexagonal cavity defined by said dies when the movable dies are in closed position.

7. Tube pointing apparatus comprising a frame, a stationary die affixed to said frame, first and second movable dies displaceable at right angles to one another between open and closed positions relative to said stationary die, said stationary die defining a first surface against which said first movable die is adapted to slide between its open and closed positions, said stationary and first movable dies defining parallel second surfaces perpendicular to said first surface against which said second movable die is adapted to slide from its open to its closed position, means for forcibly displacing said movable dies between their open and closed positions, said dies together partially defining an opening sufficiently large to receive the tube to be pointed when said movable dies are in open position, said dies together defining a cavity of regular octagonal cross section substantially less in maximum width than the maximum width of said tube when said movable dies are in their closed position, said stationary die defining four adjoining sides of said cavity, said first movable die defining two adjoining sides of said cavity, and said second movable die defining two adjoining sides of said octagonal cavity.

8. A method of pointing tubes which comprises initially partially flattening the portion of the tube to be pointed with a single flattening stroke into substantially oblong cross sectional shape having rounded ends, compressing at least part of said rounded ends toward one another with a single compression stroke along a single side section of the tube while constraining the remainder of said portion of the tube from outward displacement, thereby collapsing inwardly the greater part of said portion of the tube, and ceasing said compression when said portion of the tube is substantially fully compacted into a polygonal cross section.

9. A method of pointing tubes which comprises initially partially flattening the portion of the tube to be pointed with a single flattening stroke into oblong cross sectional shape having substantially parallel sides and rounded ends,

compressing said rounded ends toward one another between concavely wedge-shaped dies with a single compression stroke along a single side section of the tube while constraining said parallel sides from outward displacement thereby forming each of the rounded ends of said oblong cross section into triangular shape and collapsing inwardly a portion of the parallel sides of said oblong cross section, and ceasing said compression when said portion of the tube is substantially fully compacted into a regular hexagonal cross section.



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