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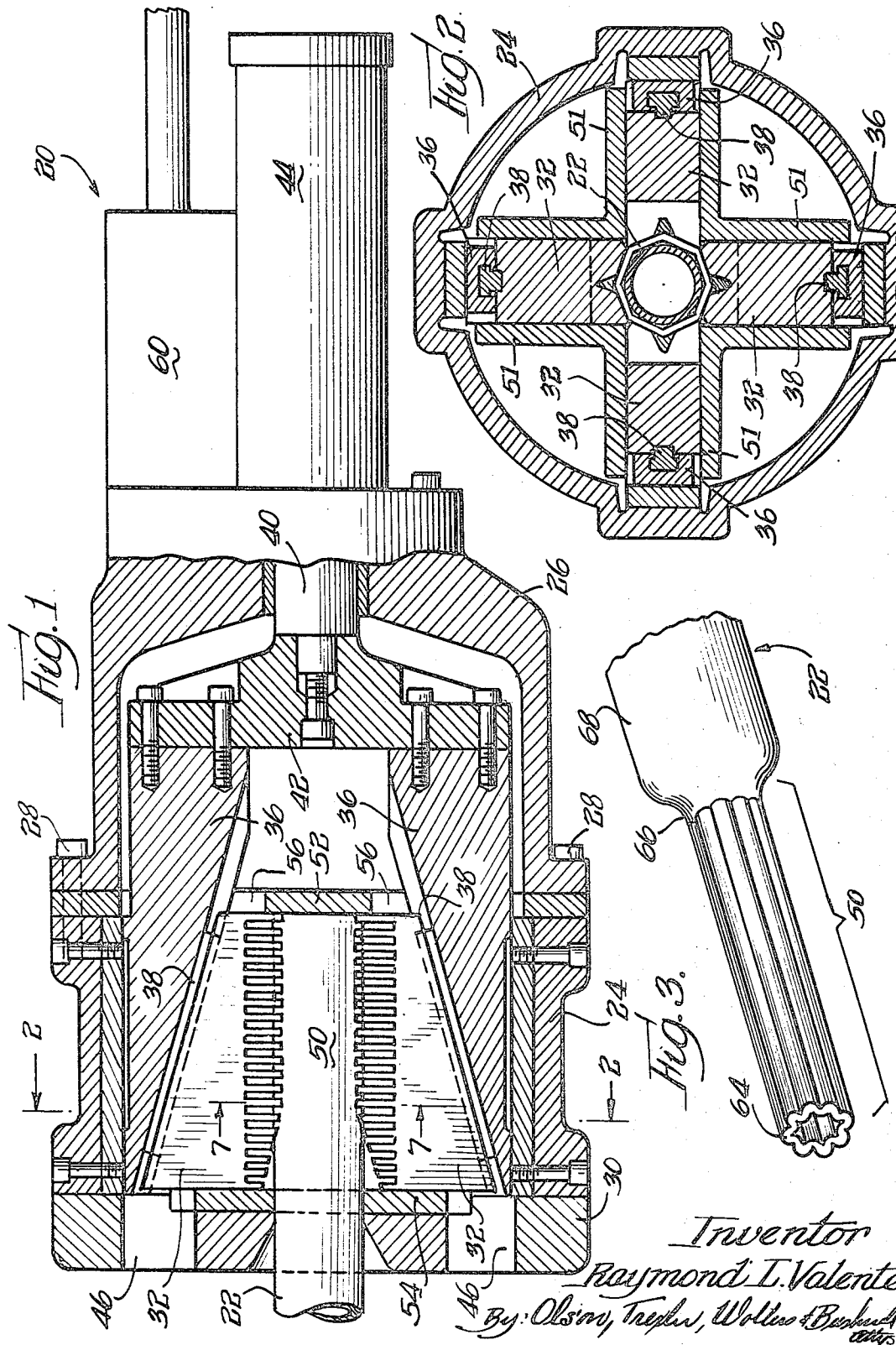
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APPARATUS FOR POINTING WORK PIECES

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3 Sheets-Sheet 1



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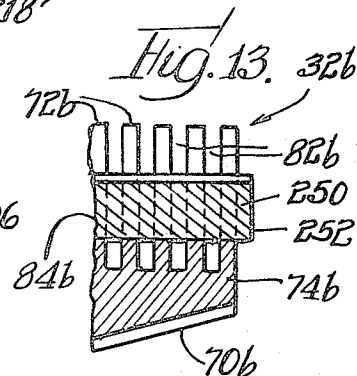
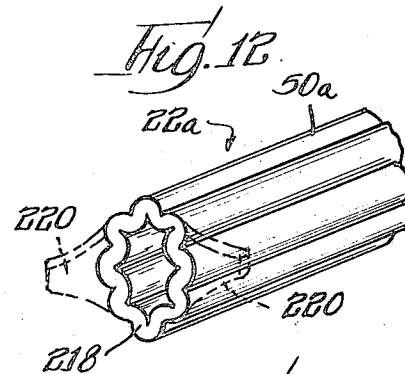
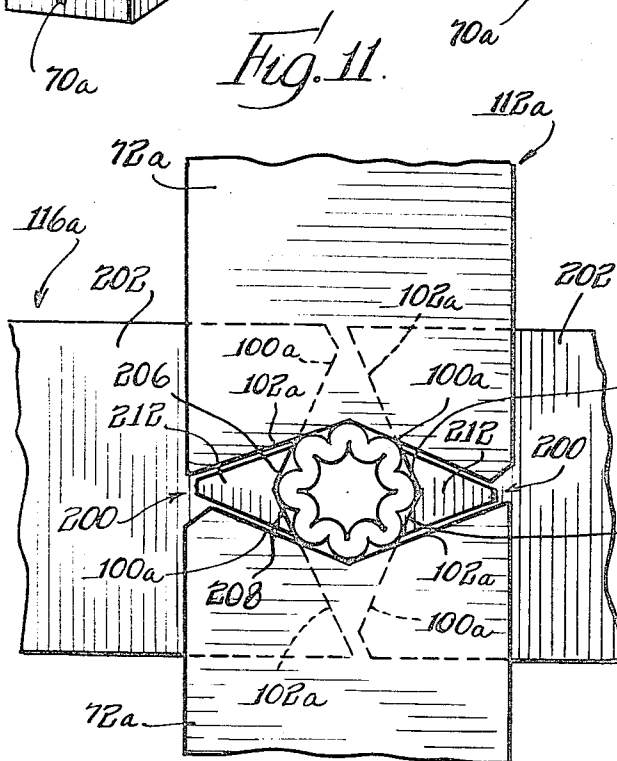
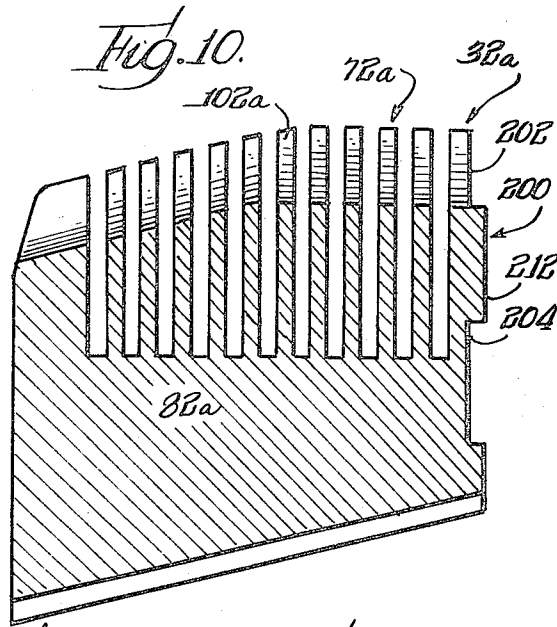
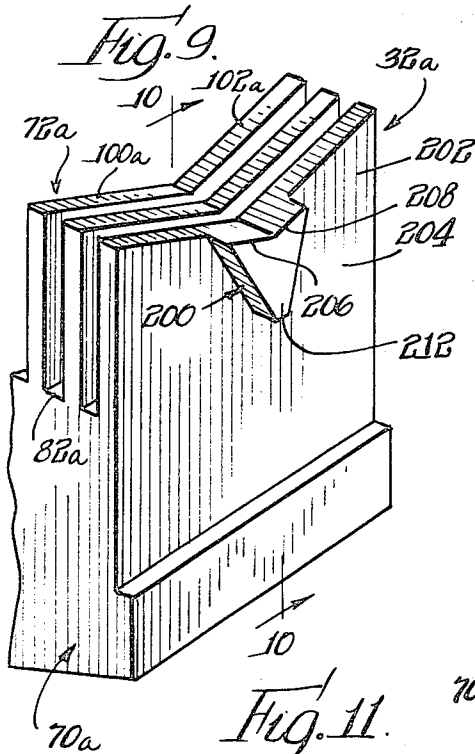
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3 Sheets-Sheet 3



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## APPARATUS FOR POINTING WORK PIECES

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17 Claims. (Cl. 72—383)

This invention relates generally to a workpiece shaping machine and more particularly to a die for a tube pointing machine.

The fabricators of tubes often reduce the diameter of the tube by forcing the tube through a drawing machine. It is a common practice to facilitate inserting the tube in the drawing machine by first pointing or reducing the diameter of an end portion of the tube. Tube pointing machines generally use a plurality of relatively movable forming dies to reduce the diameter of an end portion of a tube. These forming dies are mounted with work engaging ribs or blades in an interleaved arrangement. The diameter of the tube is reduced by moving the dies radially inwardly relative to the tube while increasing the interleaved relationship between the outwardly projecting workpiece engaging die ribs or blades.

The widespread industrial usage of such pointing machines clearly indicates their generally satisfactory performance. However, difficulty is frequently encountered in using the machines due to relative movement between the outwardly extending blades of a die. The relative movement between the work-engaging blades of a die is caused by the extrusion of small ridges of metal between the blades of the die as the end portion of the tube is compressed. Since the tube tends to elongate slightly in an axial direction as the end portion is compressed, the ribs are stretched and deflected axially by the ridges of metal. This deflection often, after a period of use, breaks the die blades necessitating the replacement of the relatively expensive dies.

Another problem which is frequently encountered in using prior art tube pointing machines is the formation of nibs or flashes at an outermost end portion of a tube, due to the interleaved or intermeshing arrangement of the forming dies. The nip or flash is formed between the two outermost ribs or blades and the adjacent laterally inwardly displaced intermeshing blades of the adjacent dies. Since these nibs or flashes tend to catch on the dies of a drawing machine when the end portion of a tube is inserted in the drawing machine, these nibs or flashes impede rapid insertion of a tube member into a forming machine.

Therefore, it is an object of this invention to provide a tube pointing machine die which eliminates nibs or flashes at the end of a pointed tube and which has a relatively long service life.

Another object of this invention is to provide a pointing machine die which is constructed to prevent metal from being extruded between load engaging ribs or blades of the die.

Another object of this invention is to provide a tube pointing die having load engaging blades which are not deflected when a tube is compressed.

Another object of this invention is to provide an interleaved tube pointing die assembly which circumscribes an outermost end portion of a tube to eliminate the formation of flashes or nibs when the tube is shaped.

These and other objects and features of the invention will become more apparent upon a reading of the following detailed description taken in connection with the accompanying drawings, wherein:

FIG. 1 is a partial sectional view of a tube shaping machine in which a die assembly forming a first embodiment of the invention is mounted;

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FIG. 2 is a sectional view, along the line 2—2 of FIG. 1, illustrating the inter-relationship of a plurality of pairs of relatively movable tube shaping dies for forming a point on a tube;

FIG. 3 is an enlarged perspective view of a tube member which has been pointed or shaped by the machine of FIG. 1;

FIG. 4 is an enlarged perspective view of a tube shaping die utilized in the machine of FIG. 1;

FIG. 5 is an enlarged sectional view, taken along the line 5—5 of FIG. 4, illustrating the relationship of a longitudinally extending bar member to a vertically extending blade of a die;

FIG. 6 is an enlarged sectional view, taken along the line 6—6 of FIG. 4, illustrating the relationship of the longitudinally extending bar to the die;

FIG. 7 is an enlarged sectional view, taken along the line 7—7 of FIG. 1, illustrating in solid lines the initial relationship of a plurality of pairs of tube forming or pointing dies to a tube member and, in dashed lines, the relationship of the dies to the tube member as the tube is radially compressed by the dies;

FIG. 8 is an enlarged sectional view illustrating the relationship of the dies of FIG. 7 to each other and a tube member at the completion of a tube shaping or forming process;

FIG. 9 is an enlarged perspective view of a tube forming or pointing die illustrating a second embodiment of the invention;

FIG. 10 is an enlarged sectional view, taken along the line 10—10 of FIG. 9, illustrating the construction of the die of FIG. 9;

FIG. 11 is an enlarged view of a pair of dies, similar to the die of FIG. 9, at the completion of a tube forming and pointing operation;

FIG. 12 is a perspective view of a forwardmost end portion of a tube member shaped or pointed by the dies of FIG. 11; and

FIG. 13 is an enlarged sectional view of a die illustrating a third embodiment of the invention.

Referring now to the drawings in greater detail, there is shown in FIG. 1 a tube shaping machine 20 for pointing or otherwise shaping a cylindrical tube 22. The machine 20 includes a cylindrical outer housing or frame 24 to which an end housing 26 is connected by bolts 28. A face plate 30 is mounted on a rear or tube receiving end of the housing 24. A plurality of forming or pointing dies 32 are mounted in sliding engagement with a longitudinally rearwardly extending wedge members 36. The wedge members 36 are connected to the dies by means of a suitable key and slot arrangement 38 (see FIG. 2 also). The wedges 36 are moved rearwardly toward the face plate 30, by means of a ram 40 which is formed with a head 42 for engaging a forwardmost end portion of the wedges 36. The ram 40 is moved rearwardly by means of fluid pressure in a hydraulic cylinder 44.

As the wedges 36 are moved rearwardly, they extend through apertures 46 formed in the face plate 30. During this rearward movement, the dies 32 slide on the key and slot structure 38 and contemporaneously therewith move radially inwardly relative to the tube 22 to compress a forwardmost end section 50 of the tube. Radially inwardly extending guide walls 51 are provided for guiding the dies 32 radially inwardly (see FIG. 2). The dies 32 are retained in the longitudinal position shown in FIG. 1 by a forward positioning wall 52 and a rear plate 54 against which opposite end portions of the dies 32 are placed in an abutting relationship. The positioning wall 52 is formed with a plurality of suitably shaped apertures 56 for receiving the wedges 36. The rearward movement of the wedges 36 and inward movement of the dies 32

is regulated by a control assembly 60. Tube shaping machines similar to the one illustrated are well known to those skilled in the art, and, therefore, it is believed that a further disclosure of the structural details of the machine is not necessitated at this time. However, United States Patent No. 3,154,978 to Baker is herein incorporated by this reference as setting forth in some detail the structure of such a tube shaping machine.

The structure of a tube member 22 which has been shaped or pointed by the machine 20 is illustrated in FIG. 3. A shaped or pointed end portion 50 of the tube 22 is of a substantially reduced diameter. The end portion 50 includes a plurality of arcuate ridges 64 which are formed in the end portion 50 by the dies 32. The arcuate ridges 64 extend longitudinally rearwardly of the tube until an arcuate radially outwardly extending shoulder 66 is encountered which separates the pointed end portion 50 of the tube from a larger body section 68. The pointed or shaped tube 22 can be readily inserted in a forming machine by inserting the foremost end or pointed portion 50 into the drawing machine and pulling the relatively large diameter body section 68 of the tube through dies in the drawing machine.

Referring now to FIG. 4, taken in conjunction with FIGS. 5 and 6, it can be seen that the dies 32 include a truncated base block 70 from which a plurality of spaced-apart parallel work-engaging blades or ribs 72 extend. The die 32 has a vertically extending forward end surface 74 which engages the positioning wall 52 (FIG. 1) of the tube shaping machine 20 and a vertically extending rectangular rear surface 76 which engages the rear plate 54 (FIG. 1) of the tube shaping machine 20. This engagement of the forward and rear surfaces 74 and 76 of the die 32 positions the die longitudinally in the tube shaping machine 20. The die is positioned for radial movement relative to a tube by sliding engagement of trapezoidal side surfaces 78 (only one of which is shown in FIG. 4) of the die with the guide walls 51.

The fins or blades 72 are integrally formed with the base block 70 and extend radially inwardly from the base block to engage a cylindrical outer surface of a tube which is to be shaped. The blades 72 are spaced apart by transversely extending slots 82 which have a width of the same dimension as the thickness of the blades 72. The blades 72 are interconnected by a longitudinally extending bar member 84 which is centrally positioned intermediate outer edge surfaces 86 of the blades 72. The bar member 84 has a series of transversely extending slots 88 (see FIG. 6) which engage a base section 90 of the outwardly extending blades 72 to securely interconnect the blades.

The longitudinally extending bar member, as is perhaps seen in FIG. 5, has a substantially triangular cross-section. A base of the triangle is formed with a pair of inwardly converging work engaging surfaces 94 and 96 which intersect at a central axis 98 of the die 32. The blades 72 are formed with a pair of inwardly converging work engaging surfaces 100 and 102 which are substantially coplanar with the surfaces 94 and 96 of the bar member 84. The inwardly converging surfaces 94, 96, 100 and 102 form a generally V-shaped outer work engaging surface of the die 32 (as is best seen in FIG. 7) engages an outer surface of a tube member 22 which is to be formed to position the tube member with its longitudinally extending axis in substantial alignment with the central axis 98 of the die 32. It should be noted that a line of intersection 106 of the work engaging surfaces 94 and 96 is coincident with a line of intersection of the work engaging surfaces 100 and 102 of the blades 72. As is perhaps best seen in FIGS. 4 and 6, a rearward end surface 108 of the bar 84 is sloped longitudinally outwardly in a forward direction to form the shoulder 68 on a tube.

Four sets of juxtaposed blades 72 are shown in FIG. 7 in working engagement with an outer surface of a tube

22. Two sets of blades are associated with a vertical pair of dies 112 which are movable radially inwardly toward each other along a central axis 114 which is coincident with the central axis 98 of the dies. The two remaining sets of blades are associated with a second pair of dies 116. The dies 116 are mounted for radial inwardly movement along a horizontally extending axis 118. The work engaging surfaces 100 and 102 of the two pairs of dies 112 and 116 position the tube 22 with its central longitudinally extending axis coincident with the intersection of the vertical axis 114 and horizontal axis 118 of the dies. The vertical pair of dies 112 are mounted in a longitudinally forwardly offset relationship relative to the horizontal pair of dies 116. The vertical pair of dies 112 is offset relative to the horizontal pair of dies 116 by a distance equal to the thickness of a single blade or rib 72. Blades 72 of the longitudinally offset dies 112 are, therefore, mounted in an intermeshing or interleaved relationship juxtaposed with the blades of the horizontal dies 116. The blades of the dies 116 are located in an interleaved relationship rearwardly of the blades of the dies 112. This interleaved or intermeshing relationship between the pairs of dies 112 and 116 results in the two pairs of dies substantially circumscribing or surrounding the tube 22. As the dies 112 and 116 are moved simultaneously radially inwardly by the wedge members 36 (see FIG. 1), the tube 22 is deformed from the position indicated in solid lines in FIG. 7 toward the position indicated in dashed lines in FIG. 7.

As the radially inwardly movement of the dies is continued, the tube 22 is gradually compressed by the two pairs of dies to the position indicated in FIG. 8. The radially inward movement of the pairs of dies 112 and 116 is limited by the bar members 84. As is apparent from an inspection of FIG. 8, the outer upper edges of the bar member 84 just engage each other at a longitudinally extending line of intersection 122 to limit the inward movement of the pairs of dies. At the limit of inward movement of the pairs of dies 112 and 116, the tube 22 is circumscribed by the longitudinally extending, inwardly converging, outer surfaces 94 and 96 of the bar members 84. Since the outer surfaces 94 and 96 extend for substantially the entire length of the die, the tube 22 is not extruded between the juxtaposed blades of the dies to form ridges on the tube which engage and deflect the blades 72. Therefore, the longitudinally extending bar members increase the structural rigidity of the dies 32 by interconnecting the blades 72 to prevent relative movement between the blades and by preventing the tube member 22 from being extruded between juxtaposed intermeshing blades as the tube is shaped or pointed. It will also be apparent that a tube which is shaped or pointed, by the dies 32, has a relatively smooth longitudinally extending outer surface which is substantially free from transversely extending ridges of tube material.

Referring now to FIGS. 9 through 13 in which several modified embodiment of the invention are illustrated. In these modified forms of the invention, like numerals have been used to designate like parts, with the suffix letter *a* being employed to distinguish the elements associated with FIGS. 9 through 12, and the suffix letter *b* being used to distinguish the elements associated with FIG. 13.

Referring now to FIG. 9, in which a second embodiment of the forming or pointing die 32a is illustrated, the die 32a includes a longitudinally extending base block 70a from which a plurality of work engaging blades or ribs 72a extend. As in the embodiment of the invention illustrated in FIGS. 1 through 8, the blades are separated by slots and have inwardly converging work engaging surfaces 100a and 102a. However, from an inspection of FIGS. 9 and 10, it can be seen that the blades 72a are not interconnected by a bar member, as are the blades of the embodiment of FIGS. 1 through 8. Since the blades 72a are not interconnected by a bar member, the blades can be deflective relative to each other. There-

fore, the die 32a is intended for shaping or pointing relatively soft materials, such as aluminum or copper, wherein relatively low working stresses occur. The die 32 of the embodiment of FIGS. 1 through 8 is intended for use in shaping or pointing relatively hard material, such as steel tubing, wherein relatively high working stresses occur.

The die 32a includes a work-engaging projection or block 200 which is integrally formed with a forwardmost blade 202 of the die 32a. The block 200 extends forwardly from a forwardmost surface 204 of the blade 202 for a distance which is substantially the same as the thickness of a blade 72a. The block 200 includes a pair of inwardly converging work-engaging surfaces 206 and 208 which are positioned in a coplanar relationship with the work-engaging surfaces 100a and 102a of the forwardmost blade 202. The block 200 terminates at a forwardmost surface 212 which extends parallel to the forwardmost surface 204 of the block 202. The surface 212 is, of course, offset longitudinally forwardly from the surface 204 by a distance which is equal to substantially the thickness of a blade 72a.

Referring now to FIG. 11, there is shown a pair of vertically positioned dies 112a. The dies 112a are similar to the dies 32 and 32a in all respects, except that the vertical pair of dies 112a do not have a longitudinally extending bar member, as in the embodiment of FIGS. 1 to 8, or a projecting block 200 similar to the embodiment illustrated in FIGS. 9 and 10. Thus, the vertical pair of dies are formed with uniform blades 72a which are interconnected by only the base block 70a from which they extend.

A horizontally disposed pair of dies 116a are formed as illustrated in FIGS. 9 and 10. The forwardmost rib 202 of the horizontally positioned pair of dies 116a includes the work-engaging projection or block 200. The blocks 200 are positioned intermediate forwardmost blades of the vertical pair of dies 112a. Since the vertical dies 112a are offset relative to the horizontal dies 116a to provide an interleaving or intermeshing relationship between the two pairs of dies, the blocks 200, which have substantially the same thickness as a die blade, project intermediate the forwardmost blades 72a of the vertical pair of dies 112a. The blocks 200 of the horizontal pair of dies 116a is positioned with an outer surface 212 in substantially a coplanar relationship with a forwardmost outer surface of the blades 72a of the dies 112a. Therefore, the blocks 200 engage an outer surface of a tube member 22a to prevent the tube member from being extruded between the spaced apart blades 72a of the vertical pair of dies 112a.

Referring now to FIG. 12 in which a tube 22a is illustrated, it can be seen that the tube has a generally longitudinally extending pointed or shaped end portion 50a. The longitudinally extending end portion 50a is generally cylindrical in shape and is continuous outwardly to a forwardmost end 218 of the tube. A pair of transversely extending generally triangular nibs or flashes 220 have been illustrated in an exaggerated form by dashed lines adjacent to the forward surface 218 of the tube 20a. The outwardly projecting blocks 200 eliminate the nibs 220 by filling the generally triangular shaped area intermediate the blades 72a of the vertical dies 112a. The forwardly projecting blocks 200 engage the outer surface of the tube 22a to form a continuous uniform end portion 50a on the tube 22a.

A forwardmost end portion of a die 32b is illustrated in FIG. 13. The die 32b includes a base block 70b from which ribs or blades 72b project. The blades 72b are spaced apart by a plurality of slots 82b. The blades 72b are interconnected by a longitudinally extending bar 84b. The bar 84b is substantially similar to the bar 84 of the embodiment of FIGS. 1 to 8. However, from an inspection of FIG. 13, it can be seen that the bar 84b extends forwardly of a forwardmost surface 74b of a forwardmost blade 72b. A forwardly extending end section 250 of the bar 84b

engages a tube member which is to be shaped in much the same manner as the blocks 200 of the dies 32a engage the tube 22a (see FIG. 11). The forwardly extending bar member 84b terminates at a surface 252 which is substantially parallel with the forwardmost surface 74b of the blades 72b. The forwardmost surface 252 of the bar 84b is spaced from the surface 74b by a distance which is substantially the same as the thickness of a blade 72b. Therefore, the forward surface 252 extends in a coplanar relationship with a forwardmost surface of a longitudinally forwardly offset intermeshing pair of dies in a manner similar to that illustrated in FIG. 11 for the pairs of dies 112a and 116a. The end sections 250 eliminate nibs or flashes, similar to those illustrated in dashed lines at 220 of FIG. 12, on a shaped or pointed tube.

For purposes of affording a more complete understanding of the invention, it is advantageous now to provide a description of the mode in which the component parts cooperate. Tubes, similar to the tubes 22, are shaped or pointed at an outer or forwardmost end position 50 by inserting the tube into a tube pointing machine 20 between two pairs of relatively movable dies 32.

The relatively movable dies 32 will be moved axially inwardly to compress the forward end portion of the tube as illustrated in FIG. 3. The tube will tend to extrude between juxtaposed intermeshing or interleaved blades 72 of the dies 32. However, by providing a longitudinally extending bar member 84 which is mounted in a longitudinally extending recess in the blades 72, the blades will be fixedly retained against movement relative to each other and the tube is prevented from extruding between the ribs by the longitudinally extending work surfaces 94 and 96 of the bar member 84. The forming effect of the work surfaces 94 and 96 is particularly apparent during the last part of the tube shaping or forming operation wherein the surfaces will substantially circumscribe the tube and will prevent the forming of radially extending ridges on the surface of the tube by extrusion of the tube material between the blades (see FIG. 8).

In the embodiment of the invention illustrated in FIGS. 9 through 13, the longitudinally rearwardly offset dies 116 are provided with longitudinally extending work engaging surfaces or blocks 200 which extend between the longitudinally forwardly offset dies 112 with which the dies 116 are intermeshed. The forming blocks or extensions 200 will engage the outer surface of a tube between the dies 112 and prevent the formation of flashes or nibs at a forwardmost end of the tube 22 during the shaping process. As is illustrated in FIG. 13, it is contemplated that the forwardly extending tube working surface could, if desired, be formed by the longitudinally extending bar member 84.

Although the dies 32 have been shown with generally V-shaped working surfaces 100 and 102, it will be apparent to those skilled in the art that the working surfaces could have other shapes. It will also be apparent to those skilled in the art that the forwardly extending blocks or projections 200 could have other cross-sectional shapes. In the preferred embodiment of the invention, the bar member 84 is mounted in notches formed in the blades 72 in a spaced-apart relationship relative to the base 70 of the die. It will be apparent that the bar member 84 could, if desired, be integrally formed with the base 84. Therefore, while particular embodiments of the invention have been shown, it should be understood, of course, that the invention is not limited thereto and it is contemplated to cover by the appended claims any such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A die for a tube shaping machine, said die including: a plurality of spaced-apart rib members extending from a base means for engaging a work piece; and bar means interconnecting said rib members, said bar means retaining said rib members against deflection relative to each other.

2. A die as set forth in claim 1 wherein: said bar means has a longitudinally extending surface means for engaging a work piece as the work piece is formed by the die.

3. A die as set forth in claim 1 wherein: said bar means is centrally positioned relative to said rib members with an outer surface of said bar means located in a coplanar relationship with an outer surface of said rib member.

4. A die as set forth in claim 1 wherein: said bar means extends longitudinally outwardly of an end portion of said die.

5. A die as set forth in claim 1 wherein: said rib members have diverging outwardly extending upper surfaces, and said bar means is positioned with a longitudinal axis parallel to a line of intersection of said surfaces.

6. A die as set forth in claim 5 wherein: said bar means has an outer surface means which is outwardly divergent and has longitudinally extending end portions which are coplanar with the upper surfaces of said rib members.

7. A die as set forth in claim 1 wherein: said bar means is positioned in an outwardly opening recess means formed in said rib members.

8. A die as set forth in claim 7 wherein: a series of recesses are formed in said bar means to engage said rib members.

9. A tube shaping machine including: a housing means; a plurality of die means mounted in said housing means, each of said die means including a plurality of rib means extending outwardly from a base means and a bar member interconnecting said rib means; and a hydraulic means for moving said die means from a first relatively spaced-apart position to a second position in which the rib means associated with adjacent die means are interleaved and the bar members are positioned adjacent to each other, said die means being moved from said first position to said second position to shape a tube.

10. A machine as set forth in claim 9 wherein: said bar members substantially circumscribe a longitudinally extending portion of the tube when said die means is in said second position.

11. A machine as set forth in claim 9 wherein: said plurality of die means are positioned in the machine with transversely extending end planes of said bar members in a substantially coplanar relationship with each other, said bar member being positioned to engage a tube with the transversely extending end planes of the bar member adjacent to an outermost end of the tube.

12. A tube shaping machine comprising: a housing means; a plurality of pairs of die means mounted in said housing means, said die means including a plurality of ribs extending outwardly from a base, a first pair of said die means being longitudinally forwardly offset relative to a second pair of said die means to enable the ribs of

said first pair of die means to intermesh with ribs of said second pair of die means, said second pair of die means including work piece engaging means extending longitudinally forwardly of forwardmost ribs of said second pair of die means, said work piece engaging means having a forwardmost transversely extending surface in a substantially coplanar relationship with a forwardmost rib surface of said first pair of die means; and a hydraulic means for moving said plurality of pairs of die means relative to each other to shape a tube.

13. A machine as set forth in claim 12 wherein: said work piece engaging means is integrally formed with the forwardmost ribs of said second pair of die means.

14. A machine as set forth in claim 12 wherein: said work piece engaging means includes bar means associated with each die means of said second pair of die means and said bar means extends longitudinally for substantially the entire length of said second pair of die means.

15. A tube shaping machine as set forth in claim 12 wherein: said hydraulic means moves said plurality of pairs of die means from a first relatively spaced-apart position to a second position in which the forwardmost ribs of said first pair of die means is adjacent to said work piece engaging means extending from the foremost ribs of said second pair of die means, with said plurality of pairs of die means substantially circumscribing an end portion of a tube when said second pair of die means is in said second position.

16. A die for a tube shaping machine, said die including: a plurality of spaced-apart rib member extending from a base section, said rib members having an outer surface means for engaging a work piece, and a work piece engaging extension means projecting longitudinally outwardly from an outermost rib, said extension means having an outer surface means which is subsequently coplanar with the outer surface means of said rib members.

17. A die as set forth in claim 16 wherein: said extension means is integrally formed with said outermost rib and said outermost rib has a thickness which is substantially equal to the distance which said extension means projects outwardly relative to said outermost rib.

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U.S. Cl. X.R.

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