June 10, 1952 J. LYSOBEY 2,600,254

WALL TREATMENT OF TUBING

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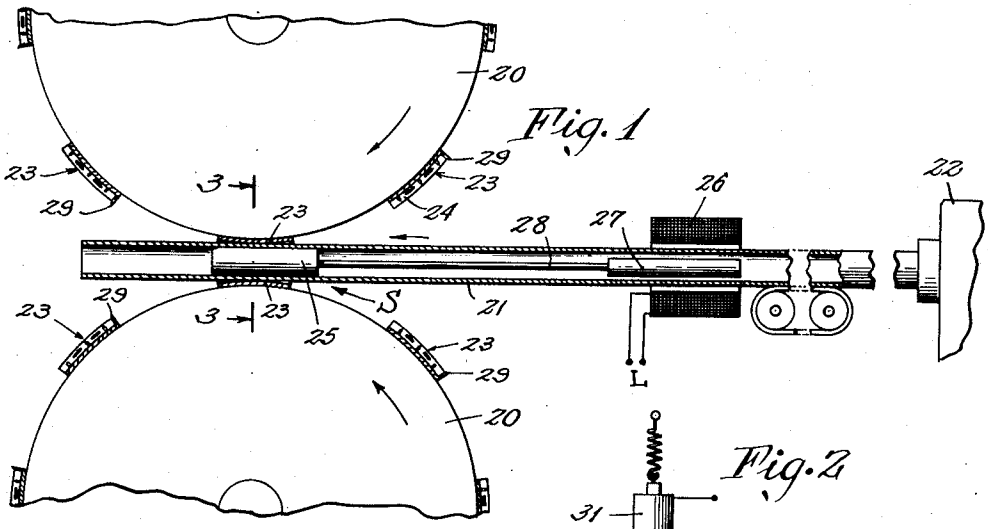


Fig. 1

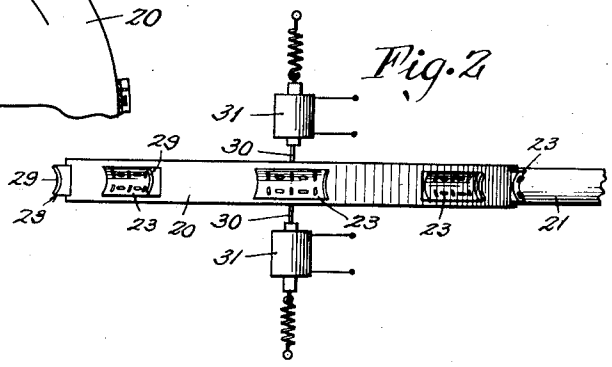


Fig. 2

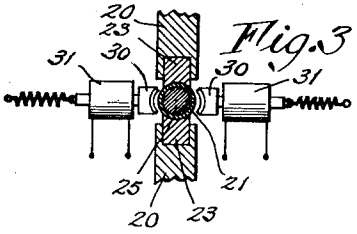


Fig. 3

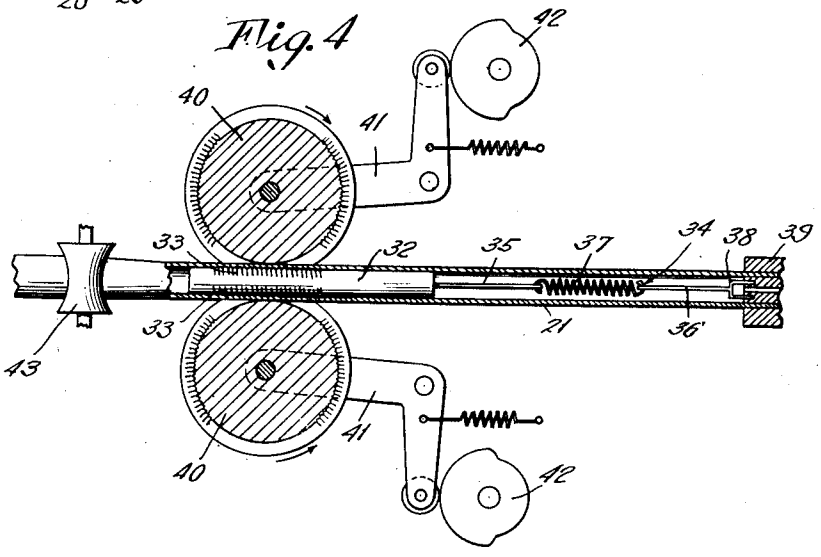


Fig. 4

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Fig. 5

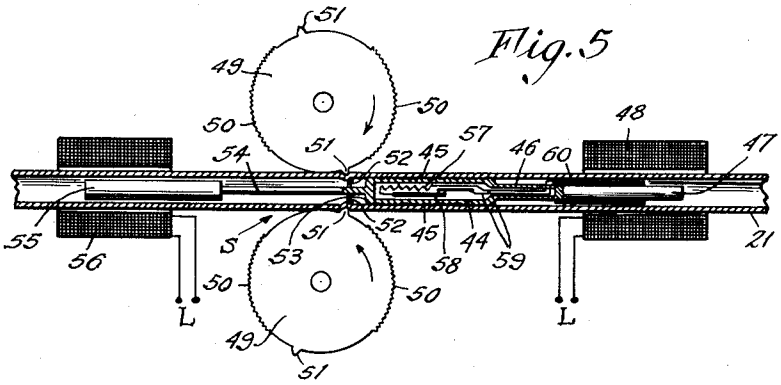


Fig. 6

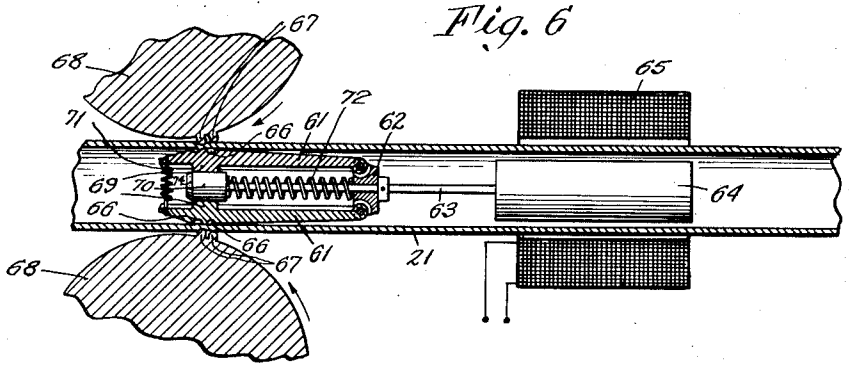


Fig. 7

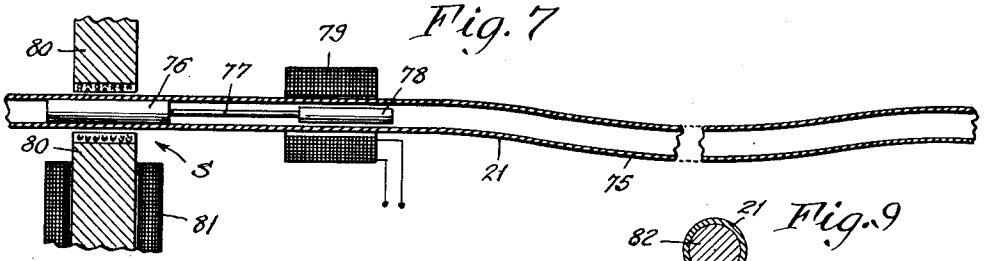


Fig. 8

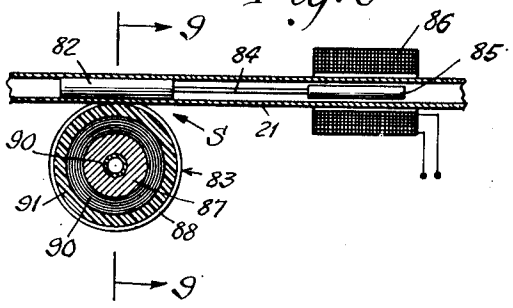
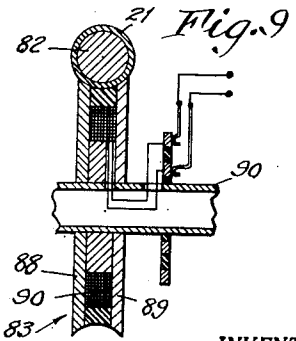


Fig. 9



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Fig. 10

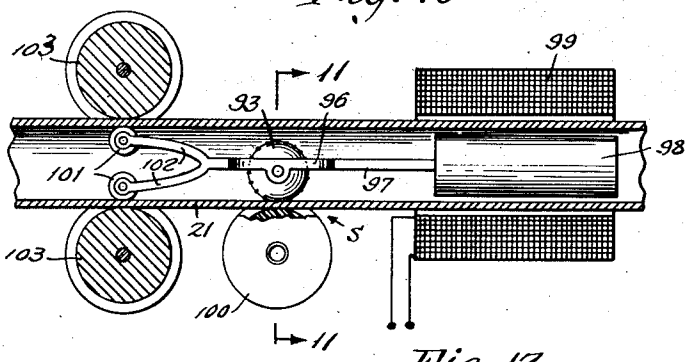


Fig. 11

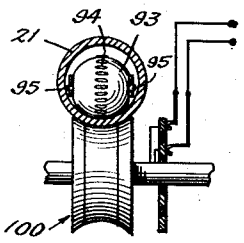


Fig. 12

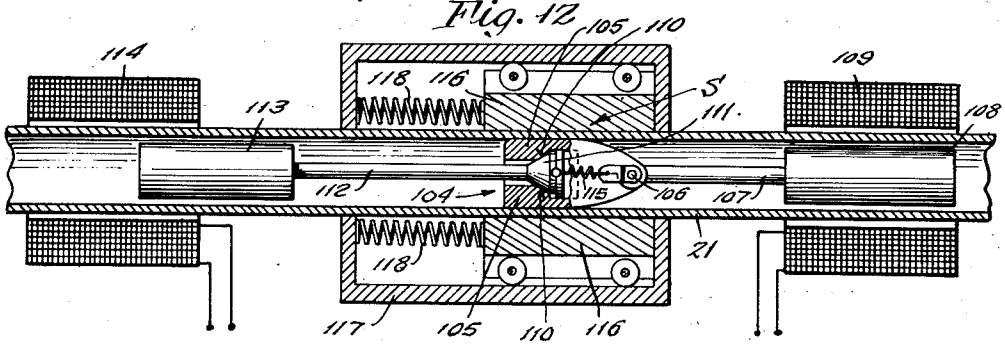


Fig. 13

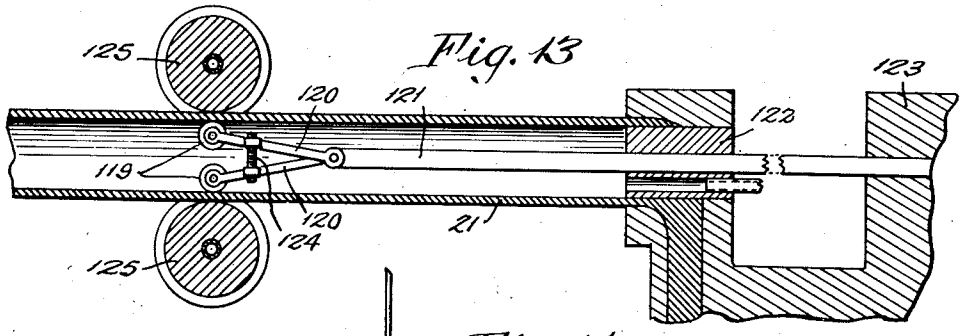
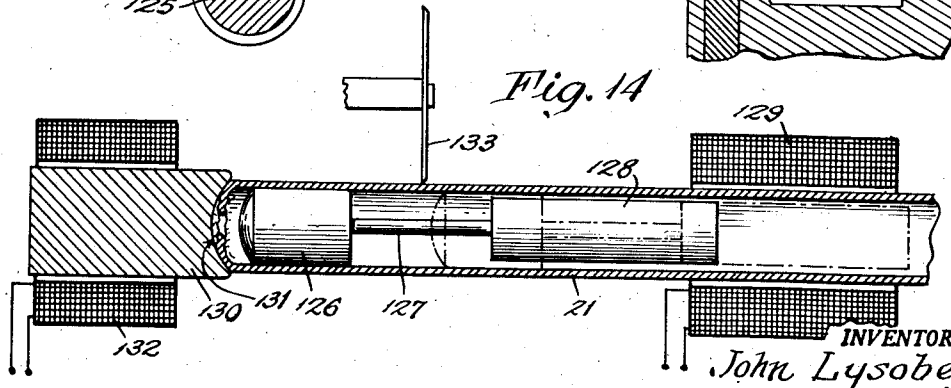


Fig. 14



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WALL TREATMENT OF TUBING

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Application March 20, 1947, Serial No. 735,836

20 Claims. (Cl. 101—35)

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This invention relates to the art of performing operations on or treating the walls of continuous tubing after it has emerged from a tube-forming machine.

The invention is shown as applied to extruded plastic tubing, although it is not to be limited thereto since it is applicable to other tubing, as for instance drawn aluminum and the like.

An object of the invention is to provide an improved efficient and effective method and apparatus for marking, imprinting forming and/or cutting the walls of tubing having continued axial travel whereby such operations may be extremely quickly and economically carried out.

Another object of the invention is to provide an improved method and apparatus as above, by which a plurality of walls or surfaces of the tubing may be operated on simultaneously and without additional time being required, thereby providing for further economy.

A further object of the invention is to provide improved methods and apparatus as characterized above and whereby a large variety of different operations may be effectively performed on the tubing, including imprinting and/or engraving on either the inside, outside or both inside and outside of the tubing, including both shallow and deep forming of the tubing walls, closing of the end of the tubing, and also cut-off.

A still further object of the invention is to provide an improved method and apparatus for operating on the walls of tubing having continued axial travel, whereby a large portion of the wall, measured circumferentially, may be worked or imprinted.

Yet another object of the invention is to provide an apparatus as above, which may be quickly and easily set up, and changed over for different jobs, and different size tubing.

Still another object of the invention is to provide apparatus as characterized above, which is simple and economical to produce, requires little maintenance and is reliable in operation.

These and other objects are accomplished, according to the invention, by the provision of a novel, and simple organization which includes cooperable die members located one continually within the tubing at an operation-performing station located beyond the tube-forming machine and the remainder on the exterior of the tubing adjacent the location of the inner die member.

In the embodiments of the invention illustrated herein the inner die members are held or maintained at their operation-performing stations within the tubing by several different devices, one

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comprising a linkage which is anchored to the tube-forming machine and another comprising a solenoid having cooperable parts located one inside and one outside of the tubing, the latter part having an anchorage and the solenoid operating in such a manner that no mechanical connection whatsoever need be made from the inner die member to any anchorage device.

For each type of holding device of the inner die member the latter and the outer cooperable die means may be maintained in substantially fixed positions at the operation-performing station, or may repeatedly move an extent with the tubing and return between limits. In either case the tubing may move continuously without stoppage, this being accomplished where the die means are in fixed positions by the use of rotary dies the peripheral surfaces of which can travel with the tubing while performing the operations thereon. Or the tubing may be stopped in its travel periodically to enable the die means to act thereon, by providing a shock-absorbing loop in the tubing between the die means and tube-forming machine, such loop preventing damage or permanent deformation to the tubing. In the latter case the tubing after being operated on will have an intermittent travel the average speed of which is the same as if the tubing did not stop, and therefore in all cases the invention provides a fast means for operating on tubing, and an economical one since repeated handlings of the tubing are obviated.

Where rotary external die members are used, the treating of a large portion of the tubing wall, measured circumferentially, is conveniently and economically effected by the provision of die members of adequately large radius, which minimize the slippage occurring at the side edge portions of the tube-engaging surfaces of the die members. The same problem of slippage does not occur when non-rotary die members are used, and therefore where space is an important factor the treatment of large circumferential portions of the tubing wall can be carried out with the latter-type members.

The die member within the tubing may have a plurality of parts, cooperable respectively with a plurality of die parts on the tubing exterior, and therefore multiple operations may be performed, on several walls simultaneously, providing for desirable economy.

The die members may be conveniently used for printing operations, and where the tubing is of relatively soft material or in a semi-plastic state, the walls of the tubing may be engraved by the

die members; and may also be deep or shallow formed, including closing-in of the end of the tubing. Pressures may be applied to the die members for transmission to the tubing wall by mechanical means, or as shown in several embodiments of the invention, by novel magnetic means either directly or indirectly associated with the members.

Due to the simplicity of the cooperable die members and of their respective mountings, set-up time is held to a low value, and interchangeability is easily effected, making it possible to quickly change over a job and to adapt it to different size tubing.

Other features and advantages will hereinafter appear.

In the accompanying drawings:

Figure 1 is an elevational view, partly in section, of apparatus made in accordance with the invention for performing operations on continuous tubing after emergence of the latter from the tube-forming machine and while the tubing is traveling from said machine.

Fig. 2 is a fragmentary top view of the apparatus, taken at the operation-forming station thereof.

Fig. 3 is a fragmentary vertical section taken on line 3—3 of Fig. 1.

Fig. 4 is an elevational view, partly in section, of apparatus comprising another embodiment of the invention showing modified die members for engraving the walls of the tubing, and showing modified anchorage means for the inner die member.

Fig. 5 is a view partly in side elevation and partly in section of still another embodiment of the invention wherein the apparatus is adapted to provide registering formations or indicia on inside and outside walls of the tubing.

Fig. 6 is a view partly in side elevation and partly in section of apparatus made in accordance with the invention for producing deep indentations or corrugations in the walls of continuous tubing.

Fig. 7 is a view partly in section and partly in side elevation of apparatus illustrating another modification of the invention wherein the cooperable die members do not travel with the tubing, instead the latter having a shock-absorbent loop between the die members and tube-forming machine.

Fig. 8 is a view partly in section and partly in side elevation of yet another embodiment of the invention wherein a rotary outer die member is provided, adapted to exert magnetic force on the inner die member for operating on the tubing wall.

Fig. 9 is a section taken on line 9—9 of Fig. 8.

Fig. 10 is a view partly in section and partly in side elevation of still another embodiment of the invention wherein the inner die member is of the rotary type.

Fig. 11 is a section taken on line 11—11 of Fig. 10.

Fig. 12 is a view partly in section and partly in side elevation of yet another embodiment of the invention wherein the inner die member is made to periodically apply the pressure, both inner and outer die members being of the non-rotary type and being adapted to travel periodically a slight extent with the tubing.

Fig. 13 is a view, partly in side elevation and partly in section of a further embodiment of the invention wherein the cooperable die means

are pairs of rotary members which apply continual pressure to the walls of the tubing, and

Fig. 14 is a view, partly in side elevation and partly in section of another embodiment of the invention wherein the cooperable die members operate to close over the end of the tubing.

The apparatus of the present invention shown in Figs. 1, 2 and 3 comprises a pair of rollers 20 geared for opposite rotation at equal speeds and mounted on opposite exterior sides of continuous tubing 21 which is shown as emerging from a tube-forming machine 22. The rollers 20 are of large diameter compared with the diameter of the tubing 21, and carry on their peripheries sets of spaced die plates 23 which are of segmental shape and have exterior concave surfaces of revolution 24 provided with type or other impression-forming or indicia-applying means adapted to engage the opposite exterior surfaces of the tubing 21 as the latter travels from right to left and as the rollers 20 turn in opposite directions, as indicated by the arrows.

The tubing 21 may be formed of various compositions. For example, it may be of plastic, in which case it could be advantageously extruded from the tube-forming machine 22. Or the tubing 21 may be of aluminum or other metal. Where the operations to be performed on the tubing are in the nature of engraving, or forming or embossing the walls of the tubing, the material of which the tubing is made should be relatively soft, like aluminum, plastic, etc. Where operations such as printing and the like are to be performed on the tubing 21 the material thereof may obviously have any degree of hardness since the operation being performed does not depend on bending, indenting or flowing the material of the tubing.

Herein the tubing 21 will be considered as extruded of plastic material, although it should be understood that the invention is not to be limited to such, since as pointed out above other materials may be worked on, depending on the particular nature of the operations to be performed.

In accordance with the invention die means are provided, located continually within the tubing 21 for cooperation with the die plates 23 carried by the rollers 20. As shown in Fig. 1 this cooperable die means within the tubing 21 comprises a member 25 located between the adjacent peripheral portions of the rollers 20 and having a loose or sliding fit with the inside of the tubing 21. The member 25 may advantageously be in the form of a smooth-surfaced cylindrical plug, and is maintained substantially at the location shown within the tubing (such location being designated S and termed an "operation-performing" station) by means of a retainer device which comprises an electric solenoid coil 26 surrounding the tubing 21 at a point ahead of the operation-performing station, and which comprises a magnetic core 27 located within the tubing 21 and also within the coil 26. A tie-rod or link 28 mechanically connects together the die plug 25 and core 27.

The opening in the coil 26 is large enough to permit the continuously moving tubing 21 to travel therethrough without hindrance; likewise, clearance is provided between the core 27 and the inside of the tubing, and as a result of this organization when the coil 26 is energized by applying a proper voltage to the leads L thereof the resulting magnetic attraction will act on the core

27 and prevent the latter and the die plug 25 from traveling with the tubing. Due to the nature of the magnetic attraction, a certain amount of travel of the core 27 and die plug 25 with the tubing is possible if the die plug should tend to adhere to the tubing, such travel occurring only until the restraining magnetic pull increases enough to overcome the pull caused by the traveling tubing.

Use is made of this action to enable an advantageous cooperable relationship to be obtained between the die plug 25 and the die plates 23 of the rollers 20. During the intervals that a pair of die plates 23 is in engagement with the tubing 21, as shown in Fig. 1, the pressure of said die plates will be transmitted through the tubing walls to the die plug 25, which acts to back up the said walls. By virtue of the walls being backed up by the die plug 25 impressions or indicia may be formed, either printed, engraved or otherwise, on the exterior of the tubing 25 by the die plates 23.

During such operation-performing intervals the die plug 25 will be seized by the tubing 21 and will travel therewith and with the die plates 23, and this will cause the core 27 to be pulled partially out of the coil 26. Upon the die plates 23 leaving the operation-forming stations and separating from the tubing 21 the latter will release the die plug 25 and the plug will be pulled back to an initial or starting position by the core 27. This sequence of operations is repeated each time that a pair of die plates 23 approaches and passes through the station S.

The die plates 23 may be adapted to merely print impressions on the exterior of the tubing 21, or may engrave or emboss the wall of the tubing if the latter is sufficiently soft. Engraving or embossing may be readily carried out if the tubing 21 is extruded from plastic, since such tubing retains its plasticity for a period of time and does not immediately harden after leaving the tube-forming machine 22.

Where is is desired to operate on a large portion of the exterior of the tubing 21, measured circumferentially, this may be accomplished by causing the die plates 23 to extend further around the circumference of the tubing and engage larger portions of the tubing surface. For such arrangement due to the large diameter of the rollers 20 the slippage occurring between the tubing and side edge portions of the die plates is held to a minimum which is permissible from the practical standpoint.

If desired, the die plates 23 may be provided with cutting edges 29 as shown, which will pierce through opposite arcuate portions of the tubing after the operations have been performed thereon. Referring to Figs. 2 and 3, the remaining arcuate portions of the tubing wall may be pierced through by blades 30 actuated by solenoids 31, the stroke or travel of the blades 30 being substantially parallel to the axis of the rollers 20. Also, the blades 30 and solenoids 31 may be mounted so as to enable these to travel a limited extent with the tubing 21 during the cut-off interval.

By the above organization it is possible to quickly and economically imprint, engrave, form or emboss, or provide with indicia the walls of continuous tubing after the latter has left the tube-forming machine, inasmuch as these various operations may be performed while the tubing is having continued axial travel and preferably while traveling from the tube-forming machine so as to not require extra time or handling.

The apparatus of the invention has utility in operating on long cut lengths of tubing travelled axially either with a continuous or an intermittent motion, as well as on tubing which is continuous.

While in the foregoing description the die plates 23 have been referred to as the members which operate on the tubing, and the die plug 25 has been described as having a substantially smooth surface, obviously this arrangement may be reversed and the die plug 25 provided with the operation-performing means, whereupon the inner wall of the tubing will be operated on instead of the outer wall. Also, if desired, both of the cooperable die parts may have operation-performing means, so that both the inner and outer walls of the tubing are operated on.

While the apparatus shown in Figs. 1, 2 and 3 is shown as having a pair of die members located outside of the tubing for operating on opposite surfaces thereof, it should be understood that additional exterior members may be provided, whereby three, four or more portions of the tubing may be worked on simultaneously.

The die plates 23 may be mounted on the rollers 20 in such a manner as to be easily and quickly removable and replaceable, and therefore a changeover from one job to another, involving different impressions or indicia, may be quickly effected. Where a new job involves a different sized tubing, this may be provided for by substituting for the die plug 25 and core 27 a similar unit of different diameter, and where necessary by replacing the coil 26 with one of different diameter, suited to the new size of tubing.

Due to the simplicity of the apparatus described above it may be quickly and economically fabricated, and will require but little maintenance and upkeep.

In the embodiment of the invention shown in Fig. 4 a generally cylindrical die plug 32 is provided having opposite impression-forming surfaces 33 each consisting of a plurality of narrow ribs located side by side whereby portions of the inner wall surface of the tubing 21 may be ribbed. The die plug 32 is retained in operative position in the tubing 21 by a spring linkage 34 comprising a pair of tie-rods 35 and 36 connected together by an extension spring 37, the tie rod 35 being joined to the plug 32 and the tie rod 36 having a bifurcated end 38 anchored in the extruding die 39 from which the tubing 21 emerges. The right-to-left traveling movement of the tubing normally takes up any lost motion in the spring linkage and the spring 37 has normally closed coils so that the plug 32 is maintained in a generally fixed starting position, when not operating on the tubing.

Outer die members in the form of rollers 40 are provided, the said rollers being rotatably mounted on the extremities of arms 41 which are pivotally supported and are actuated by cams 42. The operation is such that the rollers 40 are periodically advanced into engagement with the traveling tubing 21 and held in such engagement for a short interval of time during which the tubing is slightly ovalized and the tubing walls caused to engage the die plug 32, the latter traveling with and simultaneously forming the inside of the tubing. Upon the rollers 40 being separated from the tubing 21 by further action of the cams 42, the seizing of the die plug 32 by the tubing will cease, whereupon the die plug will be returned to its initial or starting position by the spring 37 which during the travel of the plug with the tubing had

become extended. To facilitate the release of the plug 32 from the tubing 21 rollers 43 are provided on opposite sides of the tubing 21 at a point just beyond the operation-performing station S, the function of the rollers 43 being to ovalize the tubing 21 in an opposite direction to the initial ovalizing, so as to separate the tubing walls from the ribbed portions 33 of the die plug 32.

Another embodiment of the invention, wherein the walls of continuous tubing may be provided with inside and outside formations which are in registration with each other, is shown in Fig. 5. In this embodiment the die member inside of the tubing 21 is in the form of a cylindrical plug 44 having opposite impression-forming surfaces 45 extending longitudinally thereof. The plug 44 is connected through a link 46 with a magnetic core 47 cooperable with a solenoid coil 48 located exteriorly of the tubing, and by this organization the die plug 44 is maintained in position adjacent the operation-performing station S regardless of travel of the tubing 21.

For cooperation with the die plug 44 a pair of rollers 49 is provided, located on opposite exterior sides of the tubing 21, the rollers being geared for simultaneous rotation in opposite directions. The rollers 49 have impression-forming surfaces 50 thereon, which are related to the surfaces 45 of the die plug 44 in such a manner that when the cooperable die members comprising the rollers and die plug are brought together in predetermined relative positions formations will be produced on the inner and outer walls of the tubing 21 which are in registration with each other.

For the purpose of insuring the repeated attainment of the said pre-determined relationship between the surfaces 50 and 45 of the rollers 49 and die plug 44 respectively, the rollers are provided with projections 51 located ahead of the impression forming surfaces 50 thereof and adapted to provide indentations 52 of an appreciable depth in the opposite walls of the tubing 21. These indentations 52 are so arranged as to provide abutments for engagement with the leading peripheral edge 53 of the die plug 44 if the latter, after the indentations have been formed, should be axially shifted forward or from right to left as viewed in the figure.

For the purpose of rapidly accomplishing the forward shifting of the die plug 44 the latter is connected by a link 54 to a magnet core 55 located in the tubing 21 ahead of the die plug and cooperable with a second solenoid coil 56 located externally of the tubing adjacent the core 55.

In the operation of the apparatus, the die plug 44 is normally maintained in a starting position as shown in the figure, wherein it is not cooperable with the rollers 49, by the magnetic attraction between the core 47 and the coil 48. As the rollers 49 turn in the directions indicated by the arrows the projections 51 thereof will engage the walls of the tubing 21 and form the indentations 52 therein. Immediately upon this occurring the solenoid coil 48 is deenergized and the coil 56 energized, whereupon the die plug 44 will be forcibly axially shifted ahead or from right to left until the foremost peripheral edge 53 thereof engages the indentations 52 in the tubing. The die plug 44 will by this means be accurately located with respect to the rollers 49 and the location will be such that the impression forming portions 45 and 50 of the die plug and rollers respectively will advance with the tubing 21 in registration with each other, thereby to form the walls of the tubing with designs or configurations on the inside and outside which are in registration with each other. As a consequence, the wall thickness of the tubing may remain substantially constant and uniform after being formed. Upon completion of the wall-forming operation, the solenoid coil 56 is deenergized and the coil 48 again energized, whereupon the die plug 44 will be returned to the starting position shown.

Where it is desired to utilize heat in the formation of the walls of the tubing 21, such heat may be applied by the die plug 44 by making the latter hollow as shown and locating an electric heating coil 57 therein, together with a thermostatic switch 58, lead wires 59 being brought out through the link 46 and connected with an energizing pick-up coil 60 carried by the core 47. By energizing the coil 48 with an alternating or fluctuating current a voltage will be induced in the pick-up coil 60, which may be utilized for energizing the heating element 57 within the die plug 44.

If it is intended to deeply form the walls of continuous tubing, an organization such as that shown in Fig. 6 may be advantageously employed. As shown, the inner die member has a pair of opposite, wall-engaging parts 61 which are pivotally carried by a collar 62 slidable on a link rod 63 connected with a magnetic core 64 in turn cooperable with a solenoid coil 65. The parts 61 of the die member have wall forming recesses 66 in diametrically opposite locations, the said recesses being cooperable with projections 67 on rotary die members 68 located on exterior opposite sides of the tubing 21.

Adjacent the recesses 66 and on the inner surfaces of the die parts 61 a pair of lands 69 is provided for engagement with a cam plug 70 secured to the forward extremity of the link rod 63. The die parts 61 are urged toward each other and the land 69 thereof held in engagement with the cam plug 70 by a spiral extension spring 71, and a spiral compression spring 72 is carried on the link rod 63 between the plug 70 and sleeve 62 thereof to yieldably hold the die parts 61 in their normal or starting positions shown, as determined by engagement of the sleeve 62 with a collar 73 rigidly secured to the link rod.

Prior to forming the wall of the tubing 21 the parts are in the positions shown. As the rotary die members 68 rotate in unison in the directions indicated by the arrows, and as the tubing 21 travels from right to left, the projections 67 of the rotary die members will engage and indent the walls of the tubing and cause the indented portions to project into the recesses 66 of the inner die member. This latter will then become engaged with the walls of the tubing 21 and the parts 61 thereof will travel with the tubing. During such travel the walls of the tubing will have deep indentations formed therein. Upon completion of the forming of the indentations in the tubing, the latter will continue to shift the die parts 61 from right to left until the lands 69 thereof ride down on the tapered nose 74 of the cam plug. This will enable the die parts 61 to become disengaged from the tubing 21, whereupon the compression spring 72 will return the die parts 61 to the position shown, in readiness for a repeat of the operation just described.

The magnetic core 64 and coil 65 are preferably so arranged that substantially little relative movement occurs between these during the forming of the tubing wall.

Another embodiment of the invention is shown

in Fig. 7, wherein cooperable die members having impression-forming means are provided which do not shift or travel with the traveling movement of the tubing 21 on which they operate. Instead, the tubing 21 is provided with a large bend 75 at a point beyond the tube-forming machine and ahead of the operation-performing station S at which the die members are located. The bend 75 enables the tubing 21 to be stopped for short intervals at the operation-performing station without halting the emergence of the tubing from the tube-forming machine, and depending on the nature and rigidity of the tubing, the bend 75 may have either a relatively great or relatively short length, it being only necessary to have sufficient length to prevent permanent deformation of the tubing where the bending occurs in the loop.

This non-traveling die arrangement is of advantage where slippage of impression-forming means on the outer die members in a direction longitudinally of the tubing would be undesirable.

The inner die member 76 may be in the form of a cylindrical plug, connected by a link bar 77 with a magnetic core 78 operatively associated with a solenoid coil 79 energized from a suitable source, all for the purpose of retaining the die plug 76 at the operation-performing station S.

For cooperation with the die plug 76 a pair of opposed die members 80 are provided, mounted for reciprocatory movement toward and away from the die plug 76. The members 80 may be conveniently mounted in a suitable type of punch press (not shown) to effect such reciprocatory movement.

During the intervals that the members 80 are brought together and are in engagement with the tubing 21 to form impressions thereon the tubing will be stopped in its travel, and the loop 75 will absorb the shock of such stoppage and enable the tubing which is leaving the tube forming machine to continue its travel without causing permanent deformation. Upon the die members 80 being separated from the tubing 21 the latter will again be enabled to continue its travel past the operation-performing station S. During such travel of the tubing the die plug 76 will be maintained at the station S by the magnetic core 78 and solenoid coil 79.

If desired, one of the die members 80 may be dispensed with and the other die member formed into a magnet, as by the provision of a magnet coil 81 around said other member, and the die plug 76 may be formed of magnetic material. With this arrangement, when the remaining die member 80 having the coil 81 is brought into close proximity with the tubing 21 and the coil 81 energized, the magnetic attraction will pull the die plug 76 toward the die member 80 with such force as to cause an impression to be formed in the wall of the tubing 21. The current through the magnetizing coil 81 is thereupon shut off, and the die member 80 may be withdrawn from the tubing 21 so that the latter is again free to continue its travel. Where magnetic attraction is utilized to provide the die pressures on the walls of the tubing, the mere shutting off of the magnetizing current without withdrawal of the external die member 80 is sufficient to effect release of the inner die member 76 from the tubing 21, and therefore a reciprocatory mounting for the external member 80 may be dispensed with if desired.

In the embodiment of the invention shown in Figs. 8 and 9, which is characterized by extreme simplicity and smallness of the parts, a generally cylindrical die plug 82 is cooperable with a single rotary die member 83 located exteriorly of the tubing, the die member 83 being adapted to function as a magnet and the die plug 82 being of magnetic material whereby magnetic attraction which may be produced between the dies to provide a pressure for forming impressions in the wall of the tubing 21. Either the die plug 82, or the rotary die member 83, or both may be provided with impression or indicia forming means. The die plug 82 is maintained at the operation-performing station S by being connected through a link bar 84 with a magnetic core 85 associated with a solenoid coil 86.

The rotary die member 83 comprises a cylindrical magnetic core 87 mechanically and magnetically connecting together a pair of magnetic flanges 88 and 89 between which a magnetizing coil 90 is wound to encircle the core 87. A non-magnetic band 91 of bakelite, brass or the like is provided to encircle the coil 90 and form a continuous surface with the outer perpheries of the flanges 88 and 89 as shown in Fig. 9. Leads for the coil 90 may be brought out through a hollow shaft 92 to slip rings in the usual well-known manner.

In operation of the apparatus, the coil 90 is preferably intermittently energized, and during its period of energization it attracts the die plug 82 to cause impressions to be formed in the wall of the tubing 21. During the impression forming intervals the die plug 82 may travel with the tubing 21, since the magnetic attraction between the retaining core 85 and the solenoid coil 86 enables a limited amount of movement before such attraction builds up to an excessive value. Or, the coil 86 may be deenergized during the impression forming intervals, and energized during the remaining intervals to retract the die plug 82 to a starting position.

Another modification of the invention is shown in Figs. 10 and 11 wherein the continuous tubing 21 may be operated on continually instead of intermittently, this being accomplished by a rotary die member 93 located continually within the tubing, the said die member being in the form of a sphere having an annular impression-forming surface 94 thereon located midway between pivots 95 which are journaled in a yoke 96 in turn connected through a tie rod 97 to a magnetic core 98. A solenoid coil 99 is associated with the core 98 so as to maintain the rotary die member 93 at the operation-performing station S as shown, regardless of travel of the tubing 21.

An exterior rotary die member 100 is provided for cooperation with the inner die member 93, the said exterior die member being preferably adapted to function as a magnet similar to the exterior rotary die member shown in Figs. 8 and 9. Magnetic attraction between the die members 93 and 100 provides for these to apply enough pressure on the wall of the tubing 21 to form impressions therein.

For the purpose of preventing the yoke 96, which rotatably carries the die member 93, from turning axially within the tubing 21 a pair of rollers 101 of magnetic material are rotatably carried by arms 102 connected with the said yoke, and are respectively cooperable with magnetized rollers 103 on exterior opposite sides of the tubing 21. The magnetic attraction between the rollers 101 and 103 maintain these in

alignment and prevent improper positioning of the inner rotary die member 93.

Still another embodiment of the invention is shown in Fig. 12, wherein an inner die member 104 has a pair of oppositely located separable portions 105 carried by a pivot 106 secured to a tie rod 107 which is in turn connected with a magnetic core 108 associated with a solenoid coil 109 whereby the inner die member 104 is retained at the operation-performing station S. The portions 105 of the inner die member have inner camming surfaces 110 cooperable with a cam plug 111 carried by a link bar 112 connected with a magnetic core 113 associated with a second solenoid coil 114.

The cam plug 111 is normally held in inoperative position as shown by an extension spring 115 connecting it with the pivot 106. However, when both solenoid coils 109 and 114 are simultaneously energized the cores 108 and 113 will be forced axially apart, thereby causing the cam plug 111 to spread apart the die portions 105 of the inner die member 104. Upon this occurring these die portions will exert pressure on the inside of the tubing 21 for the purpose of forming impressions therein. For cooperation with the portions 105 of the inner die member 104, a pair of external die members 116 is provided, the said members being carried in a housing 117 and being slidable therein to travel a limited extent with the traveling movement of the tubing 21. The die members 116 are normally held in retracted or starting position by compression springs 118 engaging the members and the inner end walls of the housing 117. Either the die members 116 or the die member 104, or both may have operation-performing means theron.

In operation of the apparatus prior to the forming of impressions in the tubing 21 the solenoid coil 109 is energized and the coil 114 deenergized. When it is desired to form an impression in the tubing the coil 114 is energized, causing an expansion of the inner die member 104. This causes an impression to be formed in the tubing wall by causing the outer die members 116 to be engaged thereby so that the wall is gripped betwen the die members. The outer members 116 travel with the tubing during the impression-forming interval. The solenoid coil 114 is then deenergized, resulting in a contraction of the inner die member 104 and release thereof from the tubing 21 whereupon it will be retracted to its starting position by the core 108 and solenoid coil 109, after which the operation is repeated as desired. In the embodiment of Fig. 12 relatively deep impressions may be made in either or both inner and outer wall surfaces of the tubing 21 without difficulty being encountered with release of the die members from the tubing after the forming of the impressions.

In Fig. 13 another embodiment of the invention is illustrated wherein a pair of rotary die members 119 are mounted within the tubing 21 on arms 120 which are pivotally connected with a link bar 121 passing through the extruding die 122 of the tube forming machine and anchored in the frame 123 of said machine.

The rotary die members 119 may be adjusted for separation by a screw 124 threaded into lugs carried by the arms 120.

For cooperation with the inner die members 119 a pair of outer rotary die members 125 is provided on opposite exterior sides of the tubing 21. Either or both sets of die members may carry operation-performing means.

It will be seen that as the tubing 21 emerges from the extruding die 122 it will pass between the cooperable rotary die members 119 and 125 and be operated on thereby.

The embodiment shown in Fig. 13 is of especial advantage where the tubing 21 has a relatively thick wall, since either the outer or the inner pair of die members may be dispensed with, depending on which wall is to have impressions, the remaining pair meeting enough resistance in its engagement with the wall of the tubing to provide impressions therein.

Apparatus made in accordance with the invention for closing-in the end of continuous tubing is shown in Fig. 14. The tubing 21 emerging from the tube forming machine has mounted within it a die plug 126 connected through a link 127 with a magnetic coil 128 operatively associated with a solenoid coil 129 by means of which the die plug may be maintained at a given position within the tubing, and may be repeatedly returned to said position after leaving it to perform operations on the tubing wall. An external die member 130 is provided, adapted for being aligned with the tubing 21 and having a dished, forming surface 131 shaped to close-in the end of the tubing upon engagement therewith. The die member 130 is formed of magnetic material and is provided with a magnetizing coil 132 whereby it may be strongly magnetized to attract the die plug 126, which is also made of magnetic material.

A saw 133 is mounted just beyond the position normally occupied by the inner die plug 126 and is arranged to cut through the tubing and sever the end portion thereof from the remainder of the tubing.

The apparatus operates as follows: The solenoid coil 125 is normally energized, maintaining the die plug 126 in the inoperative position shown, and the tubing 21 is traveling from left to right toward the external die member 130. Upon the end of the tubing 21 reaching and engaging the die member 130 the walls thereof will be turned in, inasmuch as the tubing is in a semi-plastic state. The solenoid coil 129 is deenergized approximately at the time that the tubing 21 first engages the die member 130, and subsequent travel of the tubing carries with it the inner die plug 126, bringing the latter in close proximity with the outer die member 130 as the turning in of the tubing walls progresses. The magnetic coil 132 is now energized, causing a strong magnetic attraction between the die members 126 and 130 and driving the latter forcibly against the inturned end walls of the tubing 21 whereupon the said walls are sealed closed. The coil 132 is now deenergized and the coil 129 energized again, whereupon the die plug 126 is withdrawn to the retracted position shown. The saw 133 is then made operative to cut off the tubing, whereupon the preceding operation may be repeated.

In connection with this apparatus it is contemplated that the tubing 21 be provided with a loop between the apparatus and the tube forming machine, as is shown in connection with Fig. 7, for the purposes set forth above.

Variations and modifications may be made within the scope of this invention and portions of the improvements may be used without others.

I claim:

1. A device for performing operations on continuous tubing emerging from a tube-forming machine, comprising a pair of cooperable die members located one continually within the tubing and the other outside of the tubing; means

including mechanism for causing the die members to engage the wall of the tubing at an operation-performing station beyond the tube-forming machine, for altering predetermined portions only of the cross section of said wall; and means independent of formation of the tube by said tube-forming machine for maintaining said one die member in the tubing substantially at said operation-performing station irrespective of the travel of the tubing.

2. A device for forming impressions in the wall of continuous tubing emerging from a tube-forming machine, comprising a pair of cooperable die members located one continually within the tubing and the other outside of the tubing; means, including mechanism for causing the die members to apply pressure to the wall of the tubing at an impression-forming station beyond the tube-forming machine, for forming impressions in said wall at predetermined points only; and means independent of formation of the tube by said tube-forming machine for maintaining said one die member in the tubing substantially at said impression-forming station irrespective of the travel of the tubing.

3. A device for performing operations on tubing, comprising a pair of cooperable die members located one within the tubing and the other outside of the tubing; means for causing the die members to engage the wall of the tubing under pressure at an operation-performing station, and to operate on said wall; and means including a magnetic core within the tubing and a magnetic-field producing device outside of the tubing for maintaining said one die member in the tubing substantially at said operation-performing station irrespective of axial travel of the tubing.

4. A device for performing operations on continuous tubing emerging from a tube-forming machine, comprising a pair of cooperable die members located one continually within the tubing and the other outside of the tubing; means for causing the die members to engage the wall of the tubing under pressure at an operation-performing station beyond the tube-forming machine, and to operate on said wall; and means including a magnetic core within the tubing and a magnetic-field producing device outside of the tubing for maintaining said one die member in the tubing substantially at said operation-performing station irrespective of axial travel of the tubing.

5. A device for performing operations on tubing, comprising a pair of cooperable die members, one being located within the tubing and being movable in response to axial travel of the tubing and the other being located outside of the tubing; means for causing the die members to engage the wall of the tubing at an operation-performing station, and to operate on said wall, said member within the tubing having a surface traveling with the tubing during the performing of operations thereon; and means for maintaining said one die member in the tubing substantially at said operation-performing station irrespective of axial travel of the tubing.

6. A device for performing operations on tubing, comprising a pair of cooperable die members, one being located within the tubing and being movable therewith, and the other being located outside of the tubing; means for causing the die members to intermittently engage the wall of the tubing at an operation-performing station, and to operate on said wall, said member within the tubing traveling therewith during the operation-performing intervals; and means for repeatedly automatically returning said one die member in the tubing to a predetermined starting position during the intervals alternating with the operation-performing intervals and while the tubing is traveling axially.

7. A device for performing operations on continuous tubing emerging from a tube-forming machine, comprising a pair of die members located on opposite exterior sides of the tubing, and a third die member cooperable with said pair of members and located within the tubing; means, including mechanism for causing the die members to engage opposite side walls of the tubing at an operation-performing station beyond the tube-forming machine, for altering predetermined portions only of the cross section of said walls; and means independent of said tube-forming machine for maintaining said third die member in the tubing substantially at said operation-performing station irrespective of travel of the tubing.

8. A device for performing operations on tubing, comprising a pair of cooperable die members, one of said members being located within the tubing and the other comprising a roller mounted externally of the tubing and engageable with the outside wall thereof; means for causing the die members to engage the wall of the tubing at an operation-performing station, and to operate on said wall; and means for maintaining said one die member in the tubing substantially at said operation-performing station irrespective of axial travel of the tubing.

9. A device for performing operations on tubing, comprising a pair of cooperable die members, one of said members being located within the tubing and the other comprising a roller mounted externally of the tubing and having projecting portions engageable consecutively with the outside wall thereof; means for causing the die members to engage the wall of the tubing at an operation-performing station, and to operate on said wall; and means for maintaining said one die member in the tubing substantially at said operation-performing station irrespective of continued axial travel of the tubing.

10. A device for performing operations on tubing, comprising a pair of cooperable die members located one within the tubing and the other outside of the tubing; means for causing the die members to engage the wall of the tubing at an operation-performing station, to operate on both sides of said wall; and means for maintaining said one die member in the tubing substantially at said operation-performing station irrespective of continued axial travel of the tubing.

11. A device for performing operations on tubing having continued axial travel, comprising a pair of cooperable die members one of which is located within the tubing and the other of which is located outside of the tubing; means for causing the die members to engage the wall of the tubing at an operation-performing station, to operate on said wall, said one die member comprising a roller having a surface traveling with the tubing during the performing of operations thereon; and means for maintaining said one die member in the tubing substantially at said operation-performing station irrespective of travel of the tubing.

12. A device for performing operations on tubing having continued axial travel, comprising a pair of cooperable die members in the form of rollers located one continually within the tub-

ing and the other outside of the tubing; means for causing the rollers to engage the wall of the tubing at an operation-performing station, to operate on said wall, the surfaces of said rollers traveling with the tubing during the performing of operations thereon; and means for maintaining said roller in the tubing substantially at said operation-performing station irrespective of travel of the tubing.

13. A device for performing operation on tubing having continued axial travel, comprising a pair of cooperable die members in the form of rollers located one within the tubing and the other on the outside of the tubing; means including magnetic attraction between the rollers for causing the latter to engage the wall of the tubing at an operation-performing station, to operate on said wall, the surfaces of said rollers traveling with the tubing during the performing of operations thereon; and means for maintaining said roller in the tubing substantially at said operation-performing station irrespective of continued travel of the tubing.

14. A device for performing operations on tubing having continued axial travel, comprising a pair of cooperable die members one of which is located within the tubing and the other of which is located outside of the tubing; means for causing the die members to engage the wall of the tubing at an operation-performing station, to operate on said wall, said one die member comprising a roller having a surface traveling with the tubing during the performing of operations thereon; means for maintaining said roller in the tubing substantially at said operation-performing station irrespective of travel of the tubing; and means for holding the roller in the tubing against turning about an axis parallel with the axis of the tubing.

15. A device for performing operations on tubing having continued axial travel, comprising a pair of cooperable die members one of which is located within the tubing and the other of which is located outside of the tubing; means for causing the die members to engage the wall of the tubing at an operation-performing station, to operate on said wall, said one die member comprising a roller having a surface travelling with the tubing during the performing of operations thereon; means for maintaining said roller in the tubing substantially at said operation-performing station irrespective of travel of the tubing; and means including magnetically attracted parts inside and outside of the tubing for holding the said roller against turning about an axis parallel with the axis of the tubing.

16. The method of performing operations on continuous tubing emerging from a tube-forming machine, which includes the steps of maintaining cooperable die members one on the inside and one on the outside of the tubing at an operation-performing station beyond the tube-forming machine, and moving the outer of said die members toward the inner member with a wall of the tubing between them, to operate on said wall while simultaneously supporting an opposite wall of the tubing to prevent lateral movement of the tubing.

17. The method of performing operations on continuous tubing emerging from a tube-forming machine, which includes the steps of maintaining cooperable die members one on the inside and one on the outside of the tubing at an operation-performing station beyond the tube-forming machine, and periodically moving said die members toward and away from each other with the wall of the tubing between them, to periodically operate on said wall.

18. The method of performing operations on continuous tubing emerging from a tube-forming machine, which includes the steps of maintaining cooperable die members one on the inside and one on the outside of the tubing at an operation-performing station beyond the tube-forming machine, and holding said die members respectively in engagement with the inner and outer wall surfaces of the tubing to operate on the tubing.

19. The method of performing operations on continuous tubing emerging from a tube-forming machine, which includes the steps of maintaining die members on opposite exterior sides of the tubing at an operation-performing station beyond the tube-forming machine, maintaining die members inside the tubing at said station, to cooperate with said exterior die members, and causing said exterior die members to engage the tubing and force it against the inside die members so as to operate on the tubing.

20. A device for performing operations on continuous tubing which emerges from a tube-forming machine and has a bend in it adjacent said machine, comprising a pair of cooperable die members located one continually within the tubing and the other outside of the tubing, both said members being disposed at an operation-performing station beyond the bend of the tubing; means for causing the die members to engage the wall of the tubing and to operate on said wall, said die members being immovable longitudinally of the tubing during their operation thereon; and means for maintaining said one die member in the tubing substantially at said operation-performing station irrespective of travel of the tubing.

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