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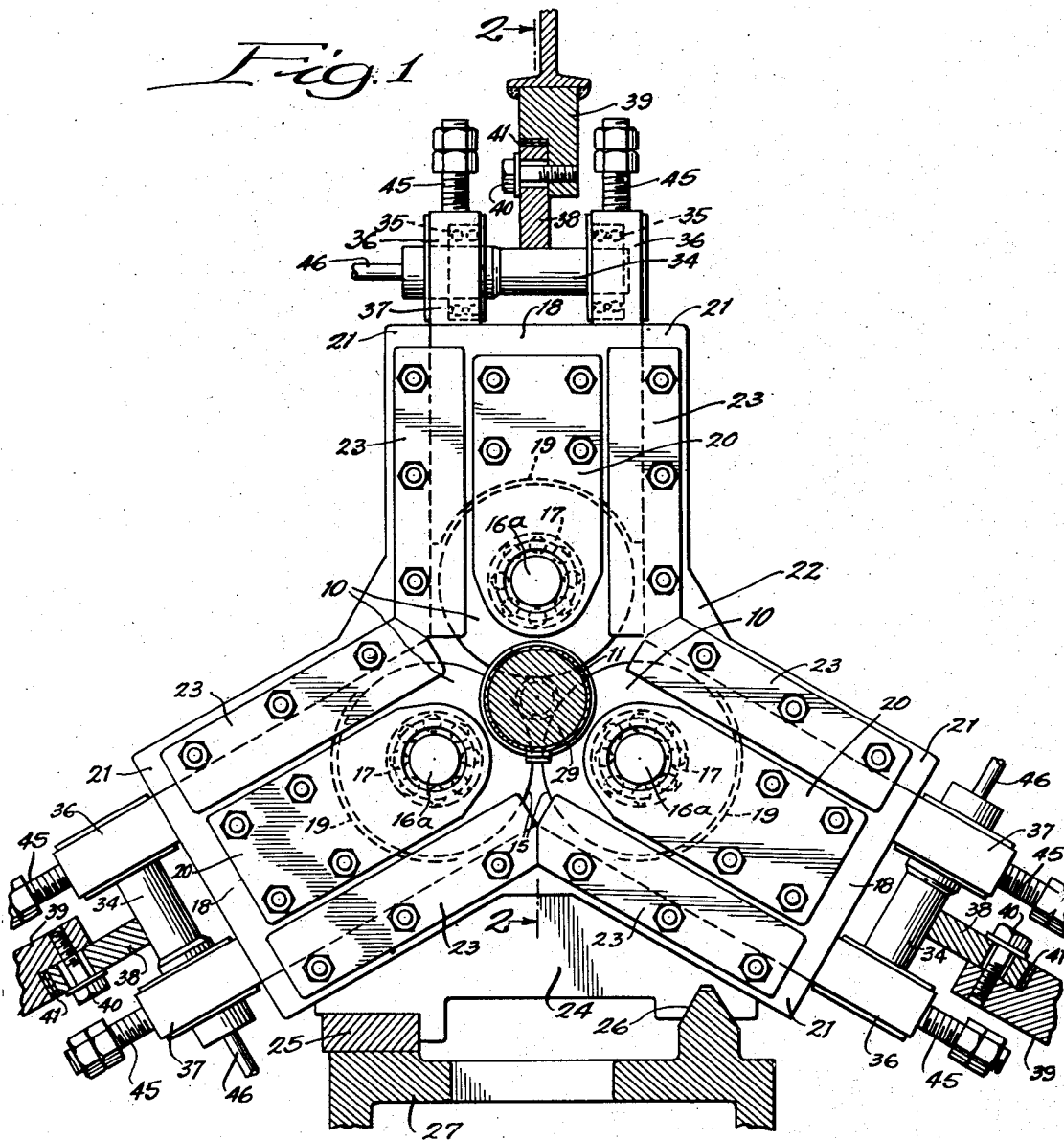
C. L. DEWEY

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METAL TUBE SHAPING MACHINE

Filed Aug. 29, 1942

2 Sheets-Sheet 1



Inventor:
Clarence L. Dewey,
By Danning Danning
Attorneys.

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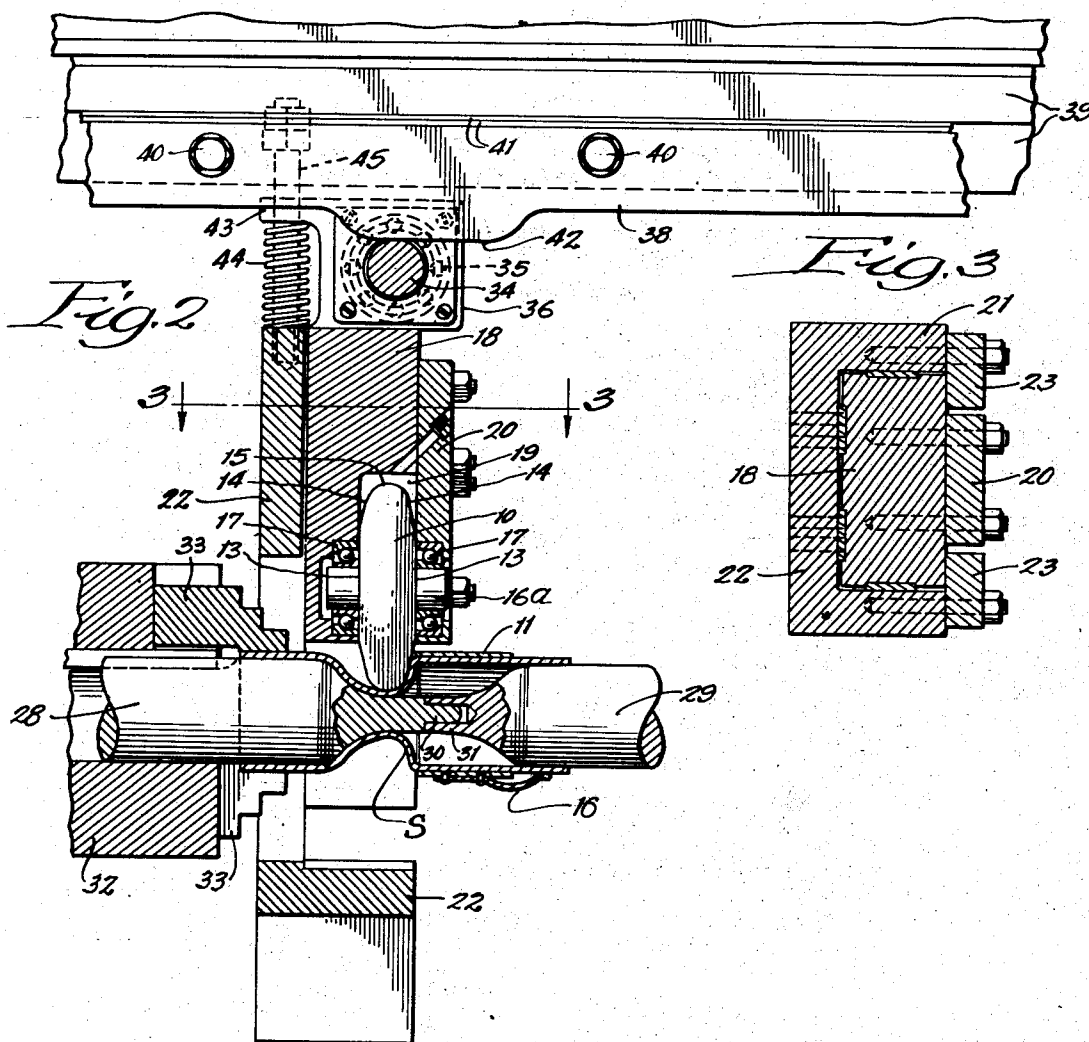
C. L. DEWEY

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Inventor:
Clarence L. Dewey,
By *Banning Banning*
Attorneys.

UNITED STATES PATENT OFFICE

2,368,973

METAL TUBE SHAPING MACHINE

Clarence L. Dewey, Elkhart, Ind.

Application August 29, 1942, Serial No. 456,586

10 Claims. (Cl. 113—53)

The machine of the present invention is designed to operate in general conformity with the method set forth and described in the Dewey Patent No. 2,265,723, issued December 9, 1941; although the mechanism herein shown and described involves certain changes and additions which particularly adapt it for use under special conditions, as will be fully set forth in detail hereafter.

The Dewey method as described in the patent aforesaid provides for the use of a reinforcing bushing or collar which surrounds the undeformed portion of the tube at a point immediately adjacent to the region undergoing deformation for the purpose of confining the deforming operation to the tubing wall in immediate contact with the forming rollers. In the Dewey patent the said bushing or collar is carried directly by the carriage frame which mounts the forming tool so that it is in effect to be regarded as a permanent or unified constituent in the structure of the machine.

It has been found, however, from experience that the reinforcing collar or bushing is frequently subjected to the abrasive or scouring action of scale particles adhering to the tubing so that under operating conditions it tends to be rapidly worn down and may frequently require replacement in order to maintain the machine in serviceable condition. The present machine is designed to overcome these disadvantages and at the same time provide for adequate reinforcement by the employment of a disconnected ring or collar of proper size to surround the tube, adapted to be moved by the advancement of the carriage so that it will always maintain its proper position with relation to the tubing which it surrounds. By employing a ring of this character which may be in the form of a cut-off section of cylindrical tubing of the proper diameter, frequent replacements may be made from time to time as occasion requires without dismantling the machine as a whole or without stopping its operation during any considerable interval of time since the reinforcing ring may be merely slipped onto the tube in advance of its introduction into the machine and will thereafter perform its reinforcing operation and maintain its position at all times during the progress of the deforming operation.

Further objects and details will appear from a description of the invention in conjunction with the accompanying drawings wherein—

Figure 1 is a view taken transversely of the

bed of the machine showing the carriage in elevation;

Fig. 2 is a longitudinal sectional view taken on line 2—2 of Fig. 1; and

Fig. 3 is a section on line 3—3 of Fig. 2.

It is not deemed necessary to show or describe the entire machine since the working parts which constitute the features of the present invention are fully illustrated in the accompanying drawings. The machine in the form shown is one in which the length of tubing subject to deformation is rotated without longitudinal advancement save that due to the elongation which may be occasioned by its reduction in diameter. With the tubing so held and rotated the forming rolls will be longitudinally advanced and radially moved to impart the intended configuration, although it will be understood that the principles of the present invention may be equally applied to a machine in which the tubing itself is advanced against the forming rolls which are maintained in a fixed position.

The machine as shown provides for the use of a tool assembly which includes three forming rolls 10 and the mountings therefor. The rolls are of uniform configuration and are mounted at equally spaced intervals to concurrently engage the tube at three equally spaced points, which arrangement is highly desirable for the purpose of accurately centering the tube in view of the fact that the reinforcing ring or collar 11 is not connected to the frame of the machine and is thus incapable of assisting in the centering operation. It is desirable to mount the three forming rolls in slightly stepped longitudinal relation to the tube since the deforming action is directed against a tube shoulder which is advancing along the tube and which presents a slight pitch or spirality which is the result of the concurrent rotation of the tube and the advancement of the forming rolls.

However, it will be understood that the formation of the rolls and the mountings therefor are identical in each case so that a description of one will suffice. Each roll 10 as shown is of substantially elliptical formation in cross section with flat center faces 13 on each side which merge into beveled acting faces 14 and with a rounded periphery 15 which directly contacts the tube surface.

It will be noted that the outer margin of the forward beveled face contacts the evolving tube shoulder which causes the metal to flow down by minute increments beneath the rounded edge of the roll immediately beyond the region reinforced

by the ring or collar 11 so that the deforming action is confined to that portion of the tube which is in direct contact with the acting surface of the three forming rolls which thus prevents the tube from being crushed or collapsed beyond the region of deformation.

The ring or collar 11 is preferably held in sliding frictional engagements with the tube by the providing of a bowed flat spring 18, one end of which is riveted to the collar with the other end free to press against the tube. Thus as the rolls are advancing against the evolving shoulder on the rotating tube, the reinforcing collar will be shoved forwardly while at all times maintaining its intended position in immediate adjacency to the forming rolls.

Each forming roll is mounted upon or provided with a shaft 16a, the ends of which are carried by the ball-races 17 so that the rolls will rotate freely under frictional contact with the rotating tube. The inner ball-race 17 is mounted within a slide block 18 which is provided with a chamber 19 to afford clearance for the roll and which has screwed thereto a face plate 20, carrying the outer ball-race. The slide plate is mounted for radial movement within a channeled guide arm 21 which, in conjunction with the remaining guide arms affording the triplicate arrangement, constitutes a rigid guide frame 22 of three point configuration.

Each of the slide plates is held within its channeled guide arm 21 by the provision of overhanging guide bars 23, the inner ends of which contact one another and thus afford mutual reinforcement for the guide frame as a whole.

The guide frame is carried by a carriage block 24 and all of the parts heretofore described which are longitudinally movable relatively to the tube, are included in the term "tool assembly." The carriage block rides upon a flat track rail 25 and a beveled track rail 26 which extend upward from the base frame 27 of the machine, which may be of any desired length to afford the degree of travel required in the intended operation. It is not deemed necessary to describe any particular means for imparting longitudinal movement to the carriage which means may be of the character commonly employed in lathes or the like for the purpose of advancing a tool or similar element. It will be understood, however, that the rate of advancement of the carriage should be relatively slow in comparison with the peripheral speed of rotation of the tube surface so that the tube will be subjected to a multiplicity of rotations during the period of its contact with the forming rolls within the region of deformation.

If desired, the means for imparting longitudinal travel may be in the nature of a feeding screw of the character shown in the Dewey patent previously mentioned although other means are equally available for a like purpose. As shown in Fig. 2, the forming rolls co-act with an interior two-part mandrel consisting of sections 28 and 29, section 28 being provided with a tongue 30 fitted into a socket 31 in the section 29 to maintain the proper alignment. The mandrel section 28 is keyed within a power-driven chuck 32 provided with jaws 33 which also grip the forward end of the tube, while the rear end of the tube with the mandrel section 29 are held within a suitable tail-stock not shown, which, however, will ordinarily permit slippage of the tube to allow for its elongation unless it is desired to prevent such elongation in order to build

up the wall thickness in the area subjected to a reduction in diameter.

In order to control the radial in and out movements of the forming rolls, each of the slides 18 has mounted thereon template roller 34, the ends of which are journaled within ball bearings 35 carried by bearing blocks 36 and 37 outstanding from the outer end of the slide plate. Each template roller co-acts with a configured template 38 which is secured to an adjacent beam 39 by means of bolts 40. The side of the beam is inwardly shouldered to provide contact for the template 41; and shims may, if necessary, be employed to true the position for the configured edge of the template with respect to the roller with which it co-acts. The template as shown in Fig. 2 is provided with a relatively short hump or projection 42, having an edge configuration which is complementary to the surface configuration of the mandrel so that as the carriage is advanced against the rotating tube the forming rolls will be forced inward, that is, radially inward, to the degree required to reduce the diameter of the tube to the extent permitted by the interior mandrel.

It will, of course, be understood, however, that if a thinning of the wall thickness is required, the configuration of the template will be such as to reduce the gap between the rollers and the mandrel with a resultant squeezing and thinning of the metal wall of the tube. In like manner the wall within the region of reduction may be thickened by resisting the tendency of the tube to elongate and by increasing the gap between the mandrel and the forming rollers so that the wall thickness will build up as the diameter is reduced.

In order to normally retract the slide plates with the forming rolls, each journal block 36 is provided with an overhanging lug 43 which is contacted by a spring 44 which thus resists the inward thrust of the slide plate occasioned by inward protuberances on the template. As shown in Fig. 1 the template occupies an intermediate position between the bearing blocks 36, and the springs 44 are mounted upon upwardly extending bolt rods 45, the inner ends of which are screwed into the associated guide arms.

In order to adjust the carriage without maintaining a contact between the template rollers and the templates, each of the rollers is provided with an outwardly protruding stem 46 which permits it to be withdrawn from its bearings temporarily during the adjustment of the carriage. It should be understood that each of the slide plates is similarly equipped and provided with a roller which co-acts with its template in suitable position as shown in Fig. 1.

Operation

With the end of a length of tubing mounted upon the mandrel and engaged by the jaws of the clutch, and with the carriage retracted to such position with respect to the templates that the template rolls will clear the hump, power will be applied to the chuck and to the carriage with the result that the tube and the enclosed mandrel will be rapidly rotated while the carriage is slowly advanced longitudinally and until the template rollers engage the protuberant portions of the respective templates at which point the rollers will begin to move inwardly in conformity of the pattern afforded by the edges of the templates. These movements will serve to begin the reduction in diameter of the tube, conformably

to the template pattern and the configuration of the mandrel, and these operations will result in a formation of a tube shoulder against which the faces of the rolls will act as the carriage advances, causing the metal to flow down beneath the end of the collar 11 by minute increments as the evolved shoulder advances along the length of the tube. During such advancement, the collar 11, though disconnected with the carriage, will be moved forwardly by contact with the rollers or associated parts of the carriage while maintaining itself constantly at the proper point to perform the required reinforcing function, and this is particularly necessary in view of the fact that the tube immediately in advance of the region of deformation is spaced out from the configuring mandrel so that the latter affords no interior reinforcement for the tube at this stage.

The method of the present invention is intended primarily for use in a configuring of metal tubes which have been heated to a high degree at or near the area of deformation which occasions the formation of a scale having sharp abrasive properties, and which, as the reinforcing collar is advanced along the tube surface, will have a tendency to scour or cut or abrade the interior surface of the collar which must of necessity be somewhat snugly fitted upon the tube to subserve its reinforcing function.

Since collars of the character shown may be readily cut as unit sections from length of tubing of the required diameter, and since the scouring and abrasion will quickly tend to wear out such a collar, it is evident that an inexpensive, easily replaceable, and readily fitted collar of the character here described is highly desirable in that it enables the work to proceed without interruption since collars of this character may be readily fitted onto the lengths of tubing in advance of their introduction into the machine so that a constant supply of collars may be kept on hand and replaced from time to time as occasion may require.

The tri-point roller contact here employed possesses special advantages in an operation of this kind, since the three equally spaced rollers afford accurate centering for the tube which thus eliminates the necessity for fitting the collar itself into the frame of the machine in order to subserve a centering function.

After the carriage has advanced to the extent required to reduce the tube throughout the configured section of the mandrel and template, the machine may be stopped and the mandrel sections separately withdrawn from opposite ends of the tube which completes the operation.

Although I have referred throughout to the fact that the collar is not connected with the frame of the carriage or other portion of the machine, I wish it to be understood that such statements are not intended to apply to the use of a mere temporary engagement of the collar to the carriage as a convenient means of holding the parts in proper operating relation where substantially all the support for the collar is afforded by the tubing itself rather than by the machine.

I claim:

1. In a machine for configuring tubing the combination of a plurality of forming rolls positioned to contact a tube wall at spaced intervals and adapted to center and radially support the same at the region of deformation, mountings for the respective rolls adapted to permit radial movement thereof, means for moving the respective rolls radially in conformity with the require-

ments of the intended configuration; means for relatively rotating the tube with respect to the rolls, means for relatively advancing the rolls with respect to the tube, and a closely fitting reinforcing collar freely mounted upon and slidably adjustable endwise free from external connection with the machine and surrounding the tube in immediate adjacency to the region subject to the deforming action of the rolls and positioned to be contacted and held in operative relation close to the rolls and slidably adjusted relatively to the tube by the relative longitudinal movement between the rolls and the tube.

2. In a machine for configuring tubing the combination of a plurality of forming rolls positioned to contact a tube wall at spaced intervals and adapted to center and radially support the same at the region of deformation, mountings for the respective rolls adapted to permit radial movement thereof, means for moving the respective rolls radially in conformity with the requirements of the intended configuration; means for relatively rotating the tube with respect to the rolls, means for relatively advancing the rolls with respect to the tube, a closely fitting reinforcing collar freely mounted upon and slidably adjustable endwise free from external connection with the machine and surrounding the tube in immediate adjacency to the region subject to the deforming action of the rolls and positioned to be contacted and held in operative relation close to the rolls and slidably adjusted relatively to the tube by the relative longitudinal movement between the rolls and the tube, and a spring member secured to the collar and engaging the tube to maintain frictional spring tension between the collar and tube.

3. In a machine for configuring tubing the combination of three forming rolls equally spaced with relation to the axis of the tube to be configured and adapted to apply radially directed support and deforming pressure equally at three points upon the tube wall, a mounting for each of the rolls comprising a guide arm, a slide plate radially movable within the guide arm, the guide arms extending radially from a common center and in unison constituting a guide frame, means for imparting predetermined radial movements to the slide plates, means for imparting relative rotation between the tube and the guide frame, means for imparting relative longitudinal movement between the tube and the guide frame, and a closely fitting reinforcing collar freely mounted upon and slidably adjustable endwise free from external connection with the machine and surrounding the tube in immediate adjacency to the region subject to the deforming action of the rolls and positioned to be contacted and held in operative relation close to the rolls and slidably adjusted relatively to the tube by the relative longitudinal movement between the rolls and the tube.

4. In a machine for configuring tubing the combination of three forming rolls equally spaced with relation to the axis of the tube to be configured and adapted to apply radially directed support and deforming pressure equally at three points upon the tube wall, a mounting for each of the rolls comprising a guide arm, a slide plate radially movable within the guide arm, the guide arms extending radially from a common center and in unison constituting a guide frame, means for imparting predetermined radial movements to the slide plates, means for imparting relative rotation between the tube and the guide frame,

means for imparting relative longitudinal movement between the tube and the guide frame, a closely fitting reinforcing collar freely mounted upon and slidably adjustable endwise free from external connection with the machine and surrounding the tube in immediate adjacency to the region subject to the deforming action of the rolls and positioned to be contacted and held in operative relation close to the rolls and slidably adjusted relatively to the tube by the relative longitudinal movement between the rolls and the tube, and a spring member secured to the collar and engaging the tube to maintain frictional spring tension between the collar and tube.

5. In a machine for configuring tubing the combination of a plurality of forming rolls positioned to contact a tube wall at spaced intervals and adapted to center and radially support the same at the region of deformation, mountings for the respective rolls adapted to permit radial movement thereof, means for moving the respective rolls radially in conformity with the requirements of the intended configuration; means for relatively rotating the tube with respect to the rolls, means for relatively advancing the rolls with respect to the tube, a closely fitting reinforcing collar freely mounted upon and slidably adjustable endwise free from external connection with the machine and surrounding the tube in immediate adjacency to the region subject to the deforming action of the rolls and positioned to be contacted by at least one of the rolls and held in operative relation close to the rolls and slidably adjusted relatively to the tube by the relative longitudinal movement between the rolls and the tube, and a mandrel within the tube and having within the region of intended deformation a peripheral configuration complementary to the pattern of the radial movements imparted to the rolls and mounted to maintain a fixed location relative to the tube.

6. In a machine for configuring tubing the combination of a plurality of forming rolls positioned to contact a tube wall at spaced intervals and adapted to center and radially support the same at the region of deformation, mountings for the respective rolls adapted to permit radial movement thereof, means for moving the respective rolls radially in conformity with the requirements of the intended configuration; means for relatively rotating the tube with respect to the rolls, means for relatively advancing the rolls with respect to the tube, a closely fitting reinforcing collar freely mounted upon and slidably adjustable endwise free from external connection with the machine and surrounding the tube in immediate adjacency to the region subject to the deforming action of the rolls and positioned to be contacted by at least one of the rolls and held in operative relation close to the rolls and slidably adjusted relatively to the tube by the relative longitudinal movement between the rolls and the tube, a spring member secured to the collar and engaging the tube to maintain frictional spring tension between the collar and tube, and a mandrel within the tube and having within the region of intended deformation a peripheral configuration complementary to the pattern of the radial movements imparted to the rolls and mounted to maintain a fixed location relative to the tube.

7. In a machine for configuring tubing the combination of three forming rolls equally spaced with relation to the axis of the tube to be configured and adapted to apply radially directed

support and deforming pressure equally at three points upon the tube wall, a mounting for each of the rolls comprising a guide arm, a slide plate radially movable within the guide arm, the guide arms extending radially from a common center and in unison constituting a guide frame, means for imparting predetermined radial movements to the slide plates, means for imparting relative rotation between the tube and the guide frame, means for imparting relative longitudinal movement between the tube and the guide frame, a closely fitting reinforcing collar freely mounted upon and slidably adjustable endwise free from external connection with the machine and surrounding the tube in immediate adjacency to the region subject to the deforming action of the rolls and positioned to be contacted by at least one of the rolls and held in operative relation close to the rolls and slidably adjusted relatively to the tube by the relative longitudinal movement between the rolls and the tube, and a mandrel within the tube and having within the region of intended deformation a peripheral configuration complementary to the pattern of the radial movements imparted to the rolls and mounted to maintain a fixed location relative to the tube.

8. In a machine for configuring tubing the combination of three forming rolls equally spaced with relation to the axis of the tube to be configured and adapted to apply radially directed support and deforming pressure equally at three points upon the tube wall, a mounting for each of the rolls comprising a guide arm, a slide plate radially movable within the guide arm, the guide arms extending radially from a common center and in unison constituting a guide frame, means for imparting predetermined radial movements to the slide plates, means for imparting relative rotation between the tube and the guide frame, means for imparting relative longitudinal movement between the tube and the guide frame, a closely fitting reinforcing collar freely mounted upon and slidably adjustable endwise free from external connection with the machine and surrounding the tube in immediate adjacency to the region subject to the deforming action of the rolls and positioned to be contacted by at least one of the rolls and held in operative relation close to the rolls and slidably adjusted relatively to the tube by the relative longitudinal movement between the rolls and the tube, a spring member secured to the collar and engaging the tube to maintain frictional spring tension between the collar and tube, and a mandrel within the tube and having within the region of intended deformation a peripheral configuration complementary to the pattern of the radial movements imparted to the rolls and mounted to maintain a fixed location relative to the tube.

9. A machine for configuring tubing comprising a bed, a tool assembly mounted upon the bed, and including a plurality of tube centering and supporting forming rolls slidable within the tool assembly for relative radial movements with respect to the axis of the tubing being configured, means for radially moving the rolls to configure the tube supported thereby, means for relatively advancing the tool assembly with respect to the tube, a tube reinforcing collar mounted solely upon and slidably surrounding the tube adjacent the tool assembly in position to be contacted by a portion thereof to impart longitudinal movement along the tube by relative movement of the tool assembly and tube.

10. A machine for configuring tubing comprising a bed, a tool assembly mounted upon the bed and including a plurality of tube centering and supporting forming rolls slidable within the tool assembly for relative radial movements with respect to the axis of the tubing being configured, means for radially moving the rolls to configure the tube supported thereby, means for relatively

advancing the tool assembly with respect to the tube, a tube reenforcing collar mounted solely upon and slidably surrounding the tube adjacent the tool assembly in position to be contacted by the side of at least one of the forming rolls during the operation of the machine for relatively advancing the collar along the tube.

CLARENCE L. DEWEY.