

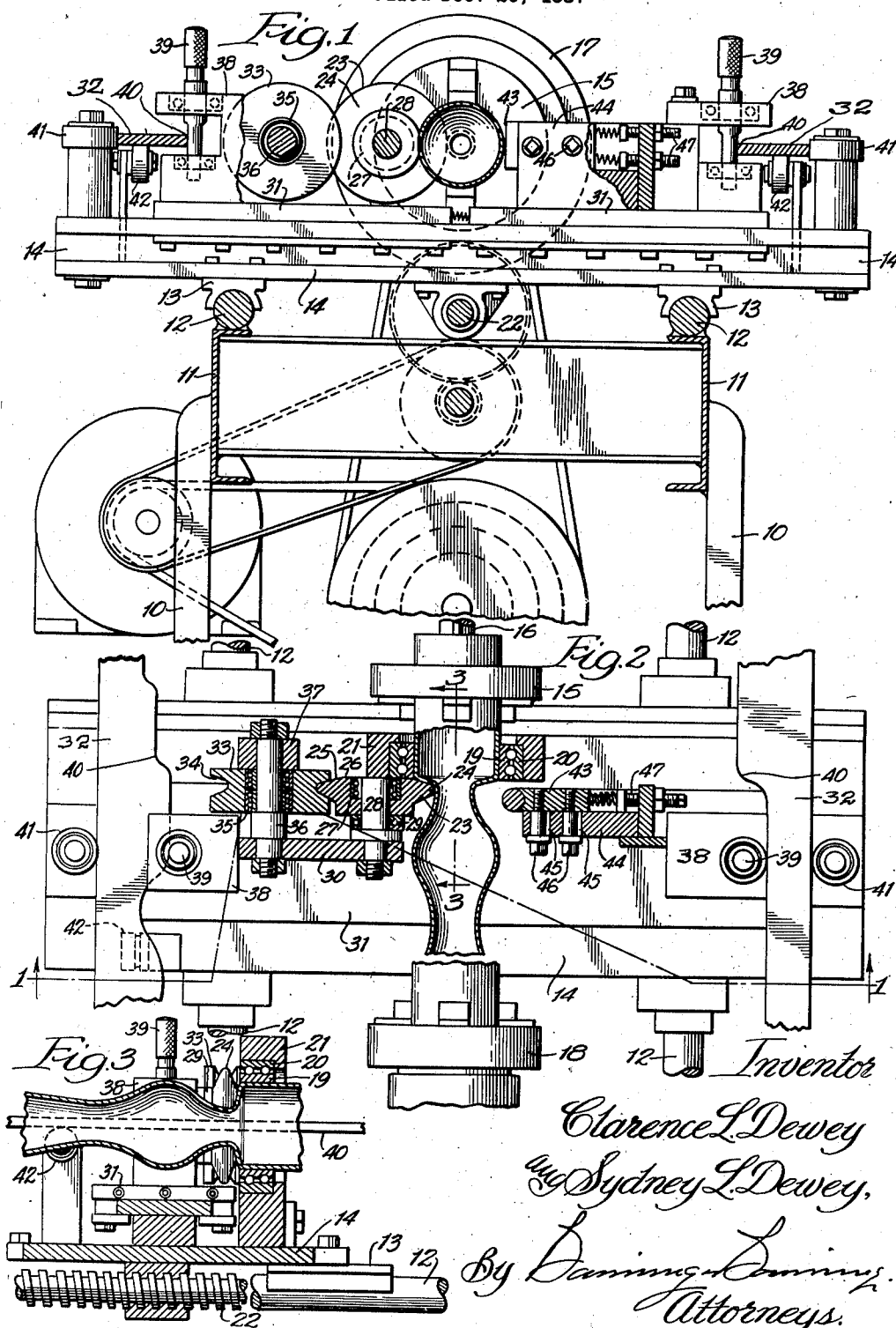
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FORMING TOOL FOR TUBE FORMING MACHINES

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FORMING TOOL FOR TUBE FORMING
MACHINES

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8 Claims. (Cl. 113—53)

The tube forming machine of the present invention is similar to that set forth and described in our copending application, Serial No. 91,468, filed July 20, 1936, which relates to a machine which makes provision for the rotation of the tube concurrently with the longitudinal advance of the forming tool which is subjected meanwhile to in and out or radial movements in order to impart the desired configuration to the tube wall.

The deformation of the tube is occasioned by the pressure of the edge and forward face of the advancing forming tool against the shoulder formed in the wall of the tube by the flowing down of the metal at a point immediately adjacent to a surrounding bushing which confines the deformative action to the region immediately adjacent to the tube.

The present invention is directed in particular to the use of a forming tool in the shape of a roller having the proper edge and face configuration to act upon the tube wall, and to the mounting for the roller, which serves to hold it rigidly in position and enable it to exert the necessary pressure against the tube wall to produce the desired exterior contour. It is necessary that the roller shall move radially in immediate proximity to the terminus of the bushing which supports the tube, so that the mounting for the roller must be so designed as to permit such movements against the resistance of the tube wall without deflection, and to attain this result the forming roller is reinforced by a backing roller which prevents any tilting or canting of the forming roller and compels it to maintain the sinuous or variable line of forward advance in conformity with the pattern which it is intended to impart to the tube wall.

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

Figure 1 is a sectional elevation, taken on line 1—1 of Fig. 2;

Fig. 2 is a plan view partly in section of the forming tool and associated parts; and

Fig. 3 is a fragmental sectional elevation, taken on line 3—3 of Fig. 2.

The machine as a whole being of the general structure illustrated in our co-pending application aforesaid, it is not deemed necessary to describe the machine as a whole, but it suffices to state that it is mounted upon legs or standards 10 which support a frame 11 carrying tracks 12, which furnish mountings for guide blocks 13 which slide upon the tracks and support a carriage 14 upon which the principal elements of the present invention are mounted.

The tube undergoing deformation is gripped at its forward or undeformed end by a chuck head 15 which is carried by a grooved shaft 16 slidably engaged by a set of pulleys 17 so that a selected

pulley may be power-driven to impart rotation to the grooved shaft 16 and the chuck head carried thereby, and at the same time permit the necessary longitudinal movement of the chuck head to accommodate variations in the length of the tube occasioned by its reduction in diameter. If desired, provision can be made to resist the natural elongation of the tube while being deformed, in accordance with the principles set forth in our co-pending application, Serial No. 180,802 filed December 20, 1937, abandoned in favor of our copending application, Serial No. 204,900 filed April 28, 1938. These special features, however, form no part of the present invention and need not be described in detail.

The deformed end of the tube is carried by a chuck head 18, which if desired may be power driven, although ordinarily it suffices to rotate the tube from one end only. The undeformed forward end of the tube, at a point immediately adjacent to the area of deformation, is encircled and reinforced by a ring-shaped bushing 19, which closely embraces the exterior of the tube, and in conjunction with the forming tool serves to define the shoulder which continually evolves as the metal flows down from beneath the bushing and along the face of the forming tool. The bushing is mounted for rotation within ball bearings 20 suitably housed within a standard or support 21 upstanding from the carriage.

The carriage is fed forwardly at reduced speed and restored at increased speed through the action of a feed screw 22, which is power driven at a rate commensurate with the speed of rotation of the tube through power connections which need not be described in detail.

The forming tool which more particularly forms the subject matter of the present invention is in the form of a roller 23 having a rounded edge 24, and a beveled forward acting face 25 which merges into a flat or plane center face 26.

The roller 23 is mounted upon ball bearings 27 carried by a fixed stub shaft 28, and the rear face of the roller bears against a thrust bearing 29. The forward center face of the roller bears directly against the flat aligned rear faces of the mounting 21, and the ball bearings 20 and the bushing 19, so that the roller may move radially behind the bushing and associated parts to bring the beveled acting face 25 to bear against the shoulder formed in the tubing, without any material gap or interruption in the contact of the roller with the surface of the tube at the point or angle where the metal flows down around the shoulder.

The stub shaft 28 is carried by a supporting plate 30 which is mounted upon a slide plate 31 supported upon the carriage and adapted to have in and out radial movements imparted thereto through the action of a patterned template 32,

which determines the configuration of the exterior of the tube.

In view of the fact that it is necessary to support the forming roller with its forward face in direct contact with the bushing, and at the same time to make provision for the in and out radial movements of the roller, it is not feasible to directly support the forward end of the shaft 28, and in order to prevent any yielding or canting of the roller and its mountings, the roller is supported and reinforced by a backing roller 33 having a groove 34 in its periphery, which registers with the beveled edge of the forming roller. The backing roller is mounted upon ball bearings 35 carried by a fixed shaft 36 supported at its rear end within the plate 30 and at its forward end within a standard 37, so that the backing roller, which is abundantly reinforced against tipping or canting, will serve to maintain the forming roller in position and enable it to withstand the thrust occasioned by its action upon the metal of the tube.

The slide plate is provided with a block 38 which mounts a roller 39 bearing against the configured inner edge 40 of the template, and in order to maintain the template in fixed relation with respect to the axis of the tube undergoing fabrication, the outer straight edge of the template bears against a roller 41 mounted upon the carriage 14 and movable therewith. The under side of the template is supported upon a roller 42 carried by the carriage, and this arrangement enables the template to be lightly supported upon the fixed frame of the machine in view of the fact that it will be held against displacement at the point of application of the deforming pressure by the contact of the rollers above described.

In Fig. 2 we have shown a roller forming tool at the left side of the machine, but it may be desirable in certain cases to employ a fixed tool in lieu of a roller, and we have therefore illustrated such an arrangement at the right of Fig. 2. In this case the fixed forming tool 43 is carried by a plate 44 having slots 45 which receive bolts 46 adapted to clamp the forming tool in position after suitable adjustment by an adjusting screw 47. As shown, the fixed tool is actuated by a template like the one previously described, although if desired the necessary in and out movements may be imparted manually through suitable adjusting mechanism which need not be described in detail.

In operation, the forward or undeformed end of the tube will be entered through the bushing and clamped within the chuck head 15, after which power will be imparted to the chuck head to rotate the tube at the desired speed. Concurrently with the rotation of the tube, the carriage will begin to advance and the forming roller will move inwardly in varying degree and in conformity with the pattern applied to the inner edge of the template. The thrust of the forming roller will be resisted by the backing roller, and the mountings for the two rollers are sufficiently rigid and rugged to prevent any tilting, canting or deflection of the forming roller when subjected to the heavy pressures incidental both to its radial movements and to its advance against the evolving shoulder in the tube. The forward face of the roller will thus be held in close contact with the bushing and mountings therefor, so that no gap will be provided for the outward bulge or displacement of the wall of the tube, which will be compelled to flow down over the beveled face of the forming roller and under the rounded edge thereof.

It has been found that when the tube wall has been relieved from the pressure of the forming tool there is a slight tendency to expand, and for this reason it is ordinarily necessary to slightly accentuate the pattern imparted to the template in order to secure the resultant desired configuration in the tube, so that the outline of the tube, when completed, will vary slightly from the pattern on the edge of the template. This indicates the necessity for providing extremely rigid mountings for the forming roller, and this is especially true where provision is made for resisting the natural tendency of the tube to elongate when reduced in diameter, which resistance may, if desired, be applied in order to regulate the thickness of the tube walls in the manner defined in our co-pending application, Serial No. 180,802, abandoned in favor of our copending application, Serial No. 204,900 filed April 28, 1938.

The use of a roller in place of a fixed forming tool may be desirable in cases where the stress is great in the deformation of the metal and the friction occasioned by the use of a fixed forming tool would prove excessive, or in other cases where the use of a roller more nearly conforms to the requirements for a desired wall thickness in the completed tube.

Although the invention has been described with particularity as to detail, it is not the intention, unless otherwise indicated in the claims, to limit the invention to the precise form shown, since modifications may be made therein without departing from the spirit of the invention. Thus, although in the machine as shown, provision is made for supporting the tube and rotating the same concurrently with the radial and advancing movements of the forming tool, it will be understood that the same result can be attained by revolving the forming tool around a non-rotating tube and by imparting longitudinal movements to the tube rather than to the forming tool and associated parts, so that, where reference is made to such movements, it will be understood that relative rather than absolute movements are referred to.

We claim:

1. In a machine of the class described, the combination of means for supporting a tube, a forming roller and a mounting for journalling the same in position to bring the edge of the roller into coaxing relation with the wall of the tube, means for imparting radial movements to the forming roller with respect to the axis of the tube, a backing roller engaging the edge of the forming roller and radially movable therewith for holding the forming roller in its intended position with respect to the tube, means for imparting relative rotation to the tube with respect to the forming roller, and means for exteriorly reinforcing the tube and located forwardly of and in close proximity to the forward face of the forming roller and means for imparting longitudinal movement relatively to the tube, to the forming roller, the mounting and backing rollers, and reinforcing means.

2. In a machine of the class described, the combination of means for supporting a tube, a forming roller and a mounting for journalling the same in position to bring the edge and forward face of the roller into coaxing relation with the wall of the tube, means for imparting radial movements to the forming roller with respect to the axis of the tube, a backing roller engaging the edge of the forming roller and radially movable therewith for holding the forming roller in its in-

tended position with respect to the tube, and means for imparting relative rotation to the tube with respect to the forming roller and for imparting longitudinal movement to the forming roller, the mounting and backing roller relatively to the tube, and a bushing positioned to surround the tube and movable longitudinally with the forming roller and presenting its rear face in substantial contact with the forward face of the forming roller.

3. In a machine of the class described, the combination of means for engaging and supporting a tube and imparting rotation thereto, a carriage movable longitudinally with respect to the axis of the tube, a slide plate mounted upon the carriage and movable radially with respect to the axis of the tube, means for imparting radial movements to the slide plate concurrently with the advance of the carriage, a forming roller adapted to act against the surface of the tube, a stub shaft for rotatably mounting the forming roller, means carried by the slide plate and located at the rear of the forming tool for supporting the stub shaft at the rear end only, a backing roller engaging the edge of the forming roller for preventing yielding thereof, a shaft for journaling the backing roller, means at each end of the last mentioned shaft for rigidly supporting the same upon the slide plate, and means for exteriorly reinforcing the tube and located forwardly of and in close proximity to the forward face of the forming roller said means being mounted upon the carriage.

4. In a machine of the class described, the combination of means for engaging and supporting a tube and imparting rotation thereto, a carriage movable longitudinally with respect to the axis of the tube, a slide plate mounted upon the carriage and movable radially with respect to the axis of the tube, means for imparting radial movements to the slide plate concurrently with the advance of the carriage, a forming roller having a beveled forward face and a rounded edge and adapted to act against the surface of the tube, a stub shaft for rotatably mounting the forming roller, means carried by the slide plate and located at the rear of the forming tool for supporting the stub shaft at the rear end only, a backing roller engaging the edge of the forming roller for preventing yielding thereof, a shaft for journaling the backing roller, and means at each end of the last mentioned shaft for rigidly supporting the same upon the slide plate, and a bushing mounted upon the carriage and adapted to closely embrace the tube at a point immediately in advance of the forward face of the forming roller.

5. In a machine of the class described, the combination of means for engaging and supporting a tube and imparting rotation thereto, a carriage movable longitudinally with respect to the axis of the tube, a slide plate mounted upon the carriage and movable radially with respect to the axis of the tube, means for imparting radial movements to the slide plate concurrently with the advance of the carriage, a forming roller adapted to act against the surface of the tube, a stub shaft for rotatably mounting the forming roller, means carried by the slide plate and located at the rear of the forming roller for supporting the stub shaft at the rear end only, a backing roller having a groove in its periphery

engaging the edge of the forming roller, a fixed shaft upon which the backing roller is journaled, means at each end of the fixed shaft for rigidly supporting the same upon the slide plate, and means for exteriorly reinforcing the tube and located forwardly of and in close proximity to the forward face of the forming roller said means being mounted upon the carriage.

6. In a machine of the class described, the combination of means for engaging and supporting a tube and imparting rotation thereto, a carriage movable longitudinally with respect to the axis of the tube, a slide plate mounted upon the carriage and movable radially with respect to the axis of the tube, means for imparting radial movements to the slide plate concurrently with the advance of the carriage, a forming roller having a beveled forward face and a rounded edge and adapted to act against the surface of the tube, a stub shaft for rotatably mounting the forming roller, means carried by the slide plate and located at the rear of the forming roller for supporting the stub shaft at the rear end only, a backing roller having a groove in its periphery engaging the edge of the forming roller, a fixed shaft upon which the backing roller is journaled, means at each end of the fixed shaft for rigidly supporting the same upon the slide plate, and a bushing mounted upon the carriage and adapted to closely embrace the tube at a point immediately in advance of the forward face of the forming roller.

7. In a machine of the class described, the combination of means for engaging and supporting a tube and imparting rotation thereto, a carriage mounted to move longitudinally with respect to the axis of the tube, a bushing mounted upon the carriage and closely embracing the tube and terminating at the point of deformation of the tube, a forming roller having a flat forward center face and a beveled forward marginal face and a rounded edge, the flat forward face of the roller being in substantial contact with the bushing, a mounting for the forming roller supported by the carriage, means for imparting radial movements to said mounting concurrently with the advance of the carriage to cause the flat forward face of the forming roller to move across the surface of the bushing, and a backing roller carried by the mounting for the forming roller and having its periphery in engagement with the outer edge of the forming roller for supporting the same against yielding.

8. In a machine of the class described, the combination of means for supporting and relatively rotating a tube, a forming roller positioned to engage the tube wall and a mounting for said roller having relative forward movement with respect to the axis of the tube, said forming roller having a flat forward center face and a beveled forward margin and a rounded edge, a member closely engaging the tube and in substantial contact with the flat forward center face of the forming roller and movable forwardly with the forming roller, means for imparting radial movements to the forming roller concurrently with the relative advance thereof, and a backing roller engaging the outer edge of the forming roller and adapted to prevent yielding thereof and forwardly movable therewith.

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