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FORMING ROLLS HAVING A CURVED FORMING SHOE TANGENTIAL TO ONE ROLL ON A LINE CONNECTING THE AXES OF THE ROLLS

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Fig. 1

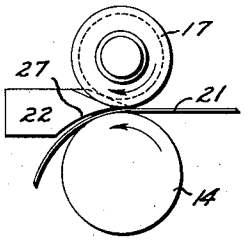


Fig. 6

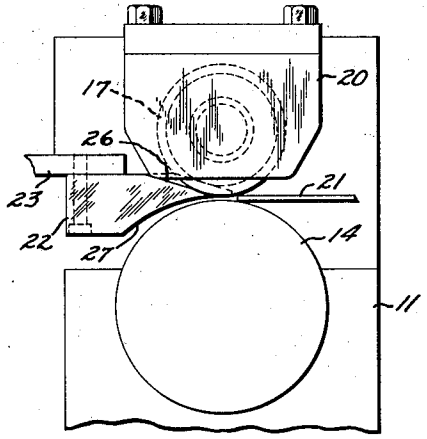


Fig. 3

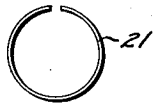


Fig. 7

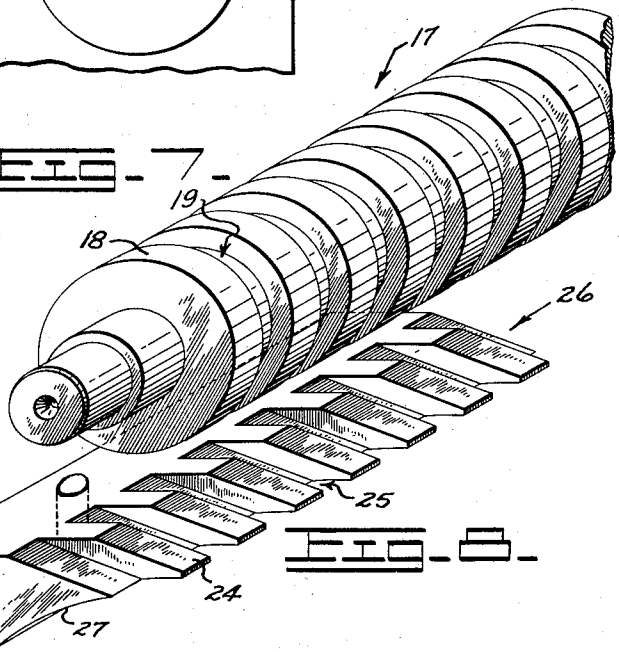


Fig. 2

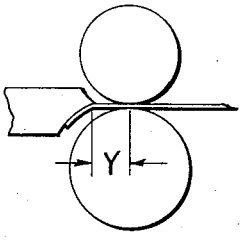


Fig. 4

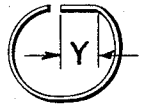
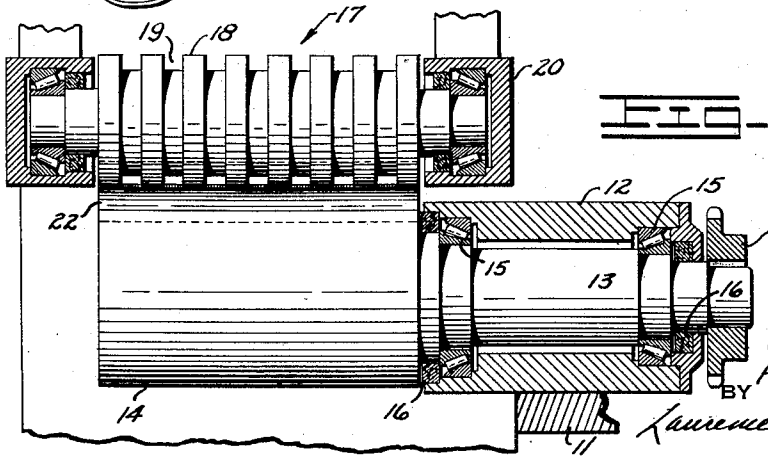


Fig. 8

Fig. 5



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FORMING ROLLS HAVING A CURVED FORMING SHOE TANGENTIAL TO ONE ROLL ON A LINE CONNECTING THE AXES OF THE ROLLS

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5 Claims. (Cl. 153—54)

The present invention relates to the forming and rolling of strip and sheet stock and more particularly to an improved structure for producing formed true cylindrical articles from metal stock.

In the forming of cylindrical metal articles from sheet or strip stock, as for example cans, drums, rings, electric motor housings and the like, several known means of forming have been universally employed. In some instances, as in the forming of tubing, sheet stock is fed through progressive capstan or hour glass rolls until a final tubular form is achieved. Ordinarily the seams are butted or lapped for fastening as by welding or riveting. In other instances, material is fed between parallel forming rolls and strikes against a breaker shoe which deflects the moving strip of material and starts the material in a closing path until the stock returns to the initial starting point. Seam fastening is then accomplished if desired. In this latter method of manufacturing cylinders from sheet or strip stock, great difficulty has been encountered in producing a "true" cylindrical form by reason of the fact that the breaker shoe is necessarily spaced apart from the roll contact and, to the extent of that spacing, an actual "break," better expressed as an out-of-round bending, occurs. While the former method, utilizing capstan rolls, produces an accurate cylinder, the production is relatively continuous and desired sized segments must be severed from the tube produced.

It is accordingly one of the objects of the present invention to provide an improved structure employing rolls and a forming shoe capable of producing accurate cylinders from sheet and strip stock.

It is another object of the present invention to provide a roll type forming device employing a shoe which does not distort the cylinder from the round at any stage of forming.

It is still another object to provide a roll and shoe structure for forming cylindrical articles which incorporates positive drive of the feed material while eliminating gap between forming shoe and rolls.

Another object is to reduce friction at the initial forming as material to be formed enters the rolls.

Other objects including structural simplicity, service ruggedness, and economy will become apparent as the description proceeds.

In the drawings:

Figure 1 is a schematic view illustrating the combination of rolls and shoe comprising the present invention and demonstrating the movement of stock through the rolls into immediate contact with the forming shoe.

Figure 2 schematically illustrates the movement of stock through a conventional forming arrangement employing a breaker shoe.

Figure 3 is a plan view of a cylinder formed by the structure of the present invention.

Figure 4 is a plan view of a cylinder illustrating the distortion from a true cylinder resulting from the necessary spacing of the contacting breaker shoe from the roll contact with the stock.

Figure 5 is a cut-away side elevation of a cylinder forming machine with the forming shoe in position and coordinated with the idling forming roll in accord with the present invention.

Figure 6 is a front elevation view of the structure comprising the present invention and illustrating stock moving into the rolls and showing the forming shoe in meshed tangential position at the forming roll contact point.

Figure 7 is a perspective view of an idling roll in accord with the present invention having spaced alternate concentric raised and depressed annular lands and grooves.

Figure 8 is a perspective view of the forming shoe of the present invention having lands and grooves capable of being placed in meshing relation with the idler roll illustrated in Figure 7.

General description

In general, as is true in conventional forming art, a drive roll is provided which is operably attached to a suitable machine base. An idler roll is also provided above the drive roll. The idler roller is provided across its face with alternate raises and depressions as annular alternate lands and grooves. A forming shoe is also provided having similar but meshing lands and grooves along its fore face and extending partially into the curved working face. The idler roll and the drive roll engage the stock as it is fed to the forming device. At engagement, the mesh relationship possible between the idling roll and the forming shoe, by reason of the lands and grooves in each, allows sufficient clearance to permit tangential positioning of forming shoe contact and idling roll contact establishing simultaneous forming and rolling contact and eliminating any break or distortion in the forming operation. In this particular a graphic illustration of the structural change accomplishing the improved result is noted by contrasting the conventional forming apparatus in Figure 2 with the schematic structure of the present invention shown in Figure 1. Figures 4 and 3, respectively, illustrate the difference in product result. The distortion "out-of-round" in the conventional apparatus is expressed in terms of the value "Y" which is the measured distance between contact at the rolls and contact at the forming surface. Thus, smooth operational forming is accomplished and the cylinder produced, where the relationship between shoe and rolls is as described, is highly accurate.

Specific description

Referring more specifically to the structure, as set forth in the drawing, a machine base **11** is provided. The machine base **11** is cut away for clarity to reveal the operative and cooperating elements of the instant invention. A housing **12** journals the stub shaft **13** of the smooth drive roll **14**. Suitable frictionless bearings **15** are provided in the housing **12** and against shaft **13**. Seals **16** are also provided to render the housing **12** and bearings **15** dust free and to retain any suitable lubricating provisions. The housing **12** is attached to the machine base **11** and may be rendered axially reciprocating as where the forming apparatus is a stage prior to welding or riveting or where other transfer is required. The drive roll **14** and housing **12** are best illustrated in Figure 5 and as therein illustrated a drive spur **13***a* is keyed to the end of the shaft **13**. Drive (not illustrated) may be direct (electric, hydraulic, pneumatic etc.) or indirect as by gearing, chain, belting or the like. The drive of the shaft **13** rotates the drive roll **14** as schematically indicated in Figure 1. In spaced parallel relationship from said drive roll **14** is an idler roll **17**. The relationship of spacing between the rolls **14** and **17** is adjustable to accommodate various thicknesses of stock **21** while main-

taining desired forming pressures. The idler roll 17 is provided with annular spaced lands 18 and grooves 19. The idler roll 17 is journalled in roll housing 20, preferably equipped with substantially frictionless bearings of the radial-thrust variety. A forming shoe 22 is provided which is detachably fixed (as by bolts or other fasteners) to the mounting pedestal 23 of the machine base 11. The forming shoe 22 is provided with lands 24 and grooves 25 in one bevelled face 26. The lands 24 and grooves 25 of the shoe 22 mesh with the alternate lands 18 and grooves 19 to form, when meshed, a continuous surface comprising roll 17 and stationary shoe 22 at the point of contact as between stock 21 and roll 17. A curvilinear forming face 27 is provided in the leading under-edge of the shoe 22. The forming face curves in the direction of curvature of roll 14 away from roll 17, as seen in Fig. 6. The curvilinear surface 27 thus engages the stock 21 substantially at roll contact and thus immediately transposes the form of the moving stock 21 as illustrated best in Figures 1, 3, and 6. It will be appreciated that the meshing of lands and grooves as between the idler roll 17 (Figure 7) and the shoe 22 provides sufficient clearance relief to accomplish substantially tangential coincidence between the forming surface 27 and the contact of roll 17 with stock 21.

Operation

In operation, stock 21 is fed into the forming machine between drive roll 14 and idler roll 17. At contact, controlled forming commences in a smooth surface transition with the forming face 27 of the shoe 22. The surface 27 determines the size of the cylinder formed by the device as seen in Figures 1 and 3. The intermesh as between shoe 22 and roll 17 makes possible the desired constant control of curvature. Reduced friction is encountered as between roll 17 and stock 21 and thrust loading is immediately transmitted through shoe 22 to the machine base 11. Operational results in cylinder forming devices built in accord with this description have proved excellent where the following tolerances were held as between roll 17 and forming shoe 22:

Roll	$\left\{\begin{matrix}.499\\.501\end{matrix}\right.$ inches Male (land).
	$\left\{\begin{matrix}.501\\.499\end{matrix}\right.$ inches Female (groove).
Shoe	$\left\{\begin{matrix}.466\\.469\end{matrix}\right.$ inches Male (land).
	$\left\{\begin{matrix}.534\\.531\end{matrix}\right.$ inches Female (groove).

No undesirable striations were observed in the product after exhaustive use. No unusual wear was observed in rolls, shoe, or bearings. Precision welding of seams in cylindrical products of the forming operation was continuously accomplished with minimum down-time for out-of-round forming. Product accuracy permitted shells thus formed to be fitted immediately to machined end closures.

While the description has proceeded relating the particular forming structure to metal it will be appreciated that the structure has application to analogous plastic arts. Further, while the grooved roll has been described as the idling roll it will be appreciated that in some instances it will be desirable to drive with the grooved roll and such a structure is intended to be included as a modification of the present invention. As in the roll 17 it will be understood that either or both rolls can be located between fore and aft journals. The precise control of sizes of cylindrical articles formed will necessitate variations in the curvilinear surface 27 of the forming shoe 22 and such changes are likewise intended to be included as a modification in structure covered by the scope of the present invention. While the major portion of this description has related to the forming of cylindrical articles it will be appreciated that other curvilinear results in product may be similarly produced by changes in curvature set on the meshed forming shoe 22 and by obvious plural combinations of rolls and shoes. Other improvements and modifications obvious to those skilled in the art are intended to be encompassed by the present invention as limited by the scope of the hereinafter appended claims.

We claim:

1. In a device for forming a strip into a curvilinear article, a pair of parallel rolls closely spaced so as to contact opposite sides of a strip passing between them, one of said rolls having alternating circumferential lands and grooves, a forming shoe having complementary lands and grooves meshed with the lands and grooves of said one roll and a curvilinear forming face on the side thereof opposite the grooved face, said forming shoe having its forming face in cooperating tangential relationship with said one roll at the point thereof nearest the other roll, said forming face of said forming shoe curving in the direction of curvature of said other roll and away from said one roll, so that said one roll and said shoe present a continuous forming surface to a strip passing between them and the other roll.

2. In a device for forming a strip into a curvilinear article, a pair of parallel rolls closely spaced so as to contact opposite sides of a strip passing between them, one of said rolls having alternating circumferential lands and grooves, a forming shoe having a curvilinear forming face and a plurality of lands and grooves on a face opposite said forming face but inclined toward it, said forming shoe being positioned between said rolls with the lands and grooves on the shoe meshed with the lands and grooves on said one roll, said inclined face being next adjacent said one roll and inclined inwardly toward the point thereon nearest said other roll, said forming shoe having its forming face in cooperating tangential relationship with said one roll at said point, said forming face of said forming shoe curving in the direction of curvature of said other roll and away from said one roll, so that said one roll and said shoe present a continuous forming surface to a strip passing between them and the other roll.

3. In a device for forming a strip into a curvilinear article, a pair of parallel rolls closely spaced so as to contact opposite sides of a strip passing between them, one of said rolls having parallel alternating circumferential lands and grooves, a forming shoe having a curvilinear forming face for bending the strip, said shoe having another face formed by a plurality of alternating parallel lands and grooves complementary with the lands and grooves of said one roll and meshed therewith and said other face being inclined with respect to the direction of travel of the strip between the rolls and with respect to the forming face to form teeth projecting outward of the grooves opposite to the direction of travel of the strip, said shoe having its forming face in cooperating tangential relationship with said one roll at the point thereof on a line connecting the axes of said one roll and said other roll, said forming face of said forming shoe curving in the direction of curvature of said other roll and away from said one roll, so that said one roll and said shoe present a continuous forming surface to a strip passing between them and the other roll.

4. In a device for forming a cylindrical article from sheet or strip stock, a pair of parallel adjustable spaced rolls operable to contact the opposite sides of sheet or strip passing between them, one of said rolls having a plurality of circumferential parallel alternating lands and grooves, a forming shoe having a plurality of parallel alternating lands and grooves along one face thereof complementary with the lands and grooves on said one roll and meshed therewith, said lands and grooves on the shoe forming ramp-like teeth extending outward of the grooves and of increasing dimension in a plane perpendicular to the axis of the rolls progressing away from

the rolls, said shoe having a curvilinear forming face for bending the strip or sheet extending tangentially to said one roll and forming an extension of the surface thereof from the point thereon nearest the other roll, said forming face being inclined with respect to said lands and grooves, said forming face of said forming shoe curving in the direction of curvature of said other roll and away from said one roll, so that said one roll and the shoe present a continuous forming surface to a sheet or strip passing between them and the other roll.

5. The apparatus of claim 4 including drive means for turning at least one of said rolls.

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