

Sept. 12, 1944.

C. L. CLARK

2,357,793

MACHINE FOR WORKING SHEET METAL ARTICLES

Filed March 2, 1942

4 Sheets-Sheet 1

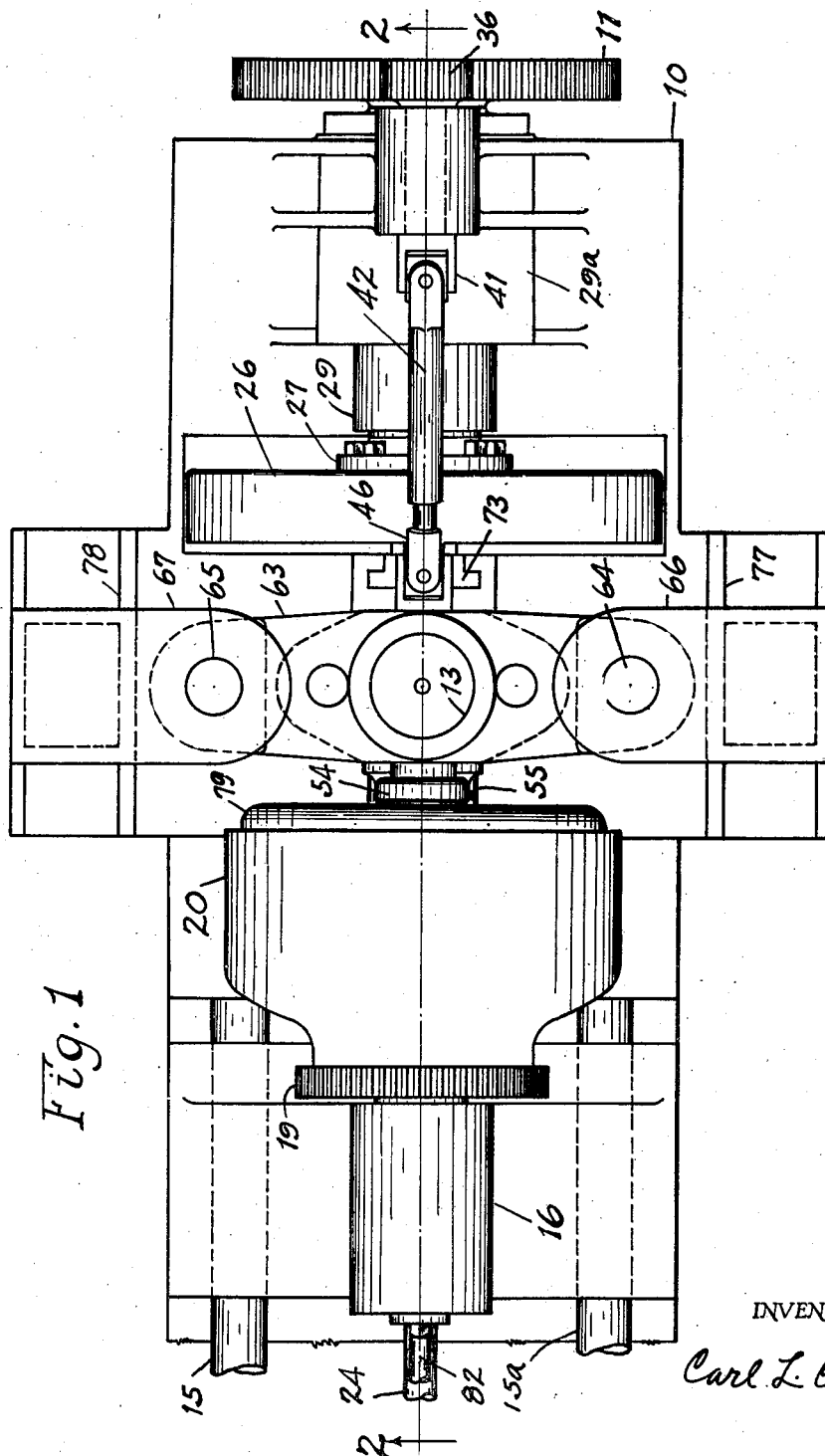


Fig. 1

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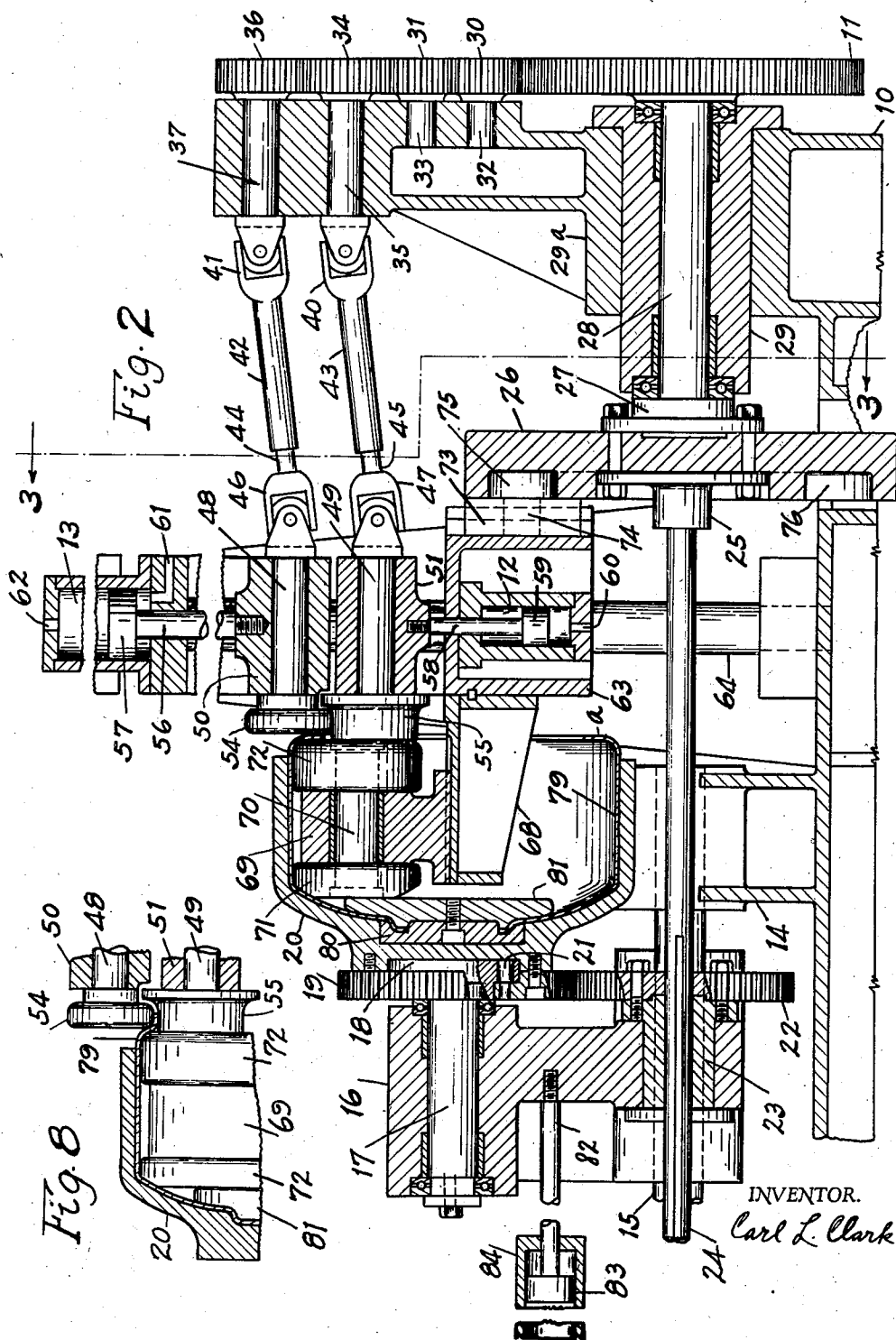
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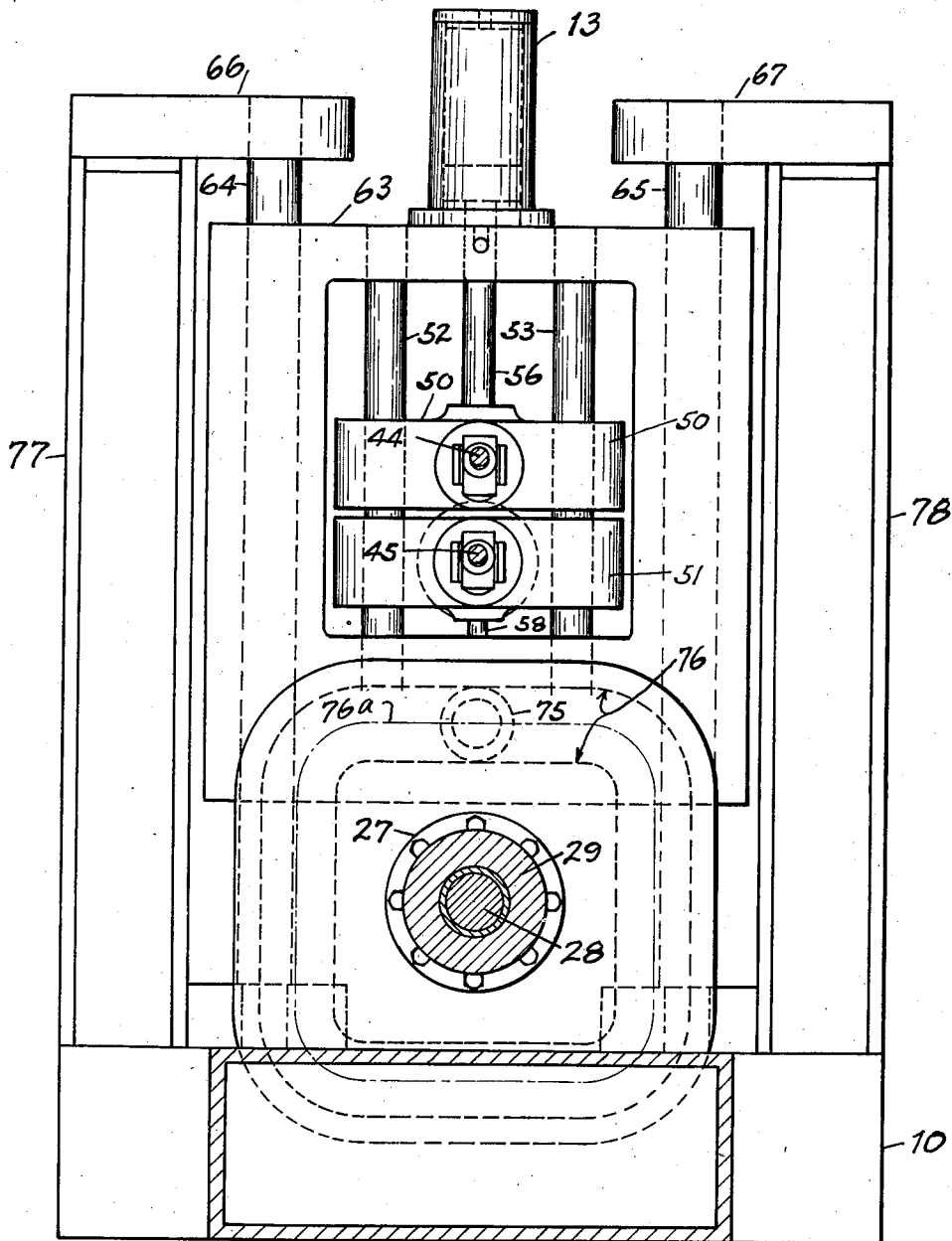


Fig. 3

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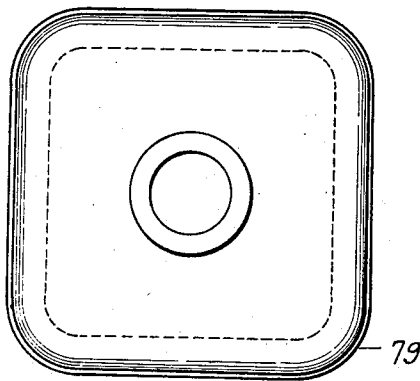


Fig. 6

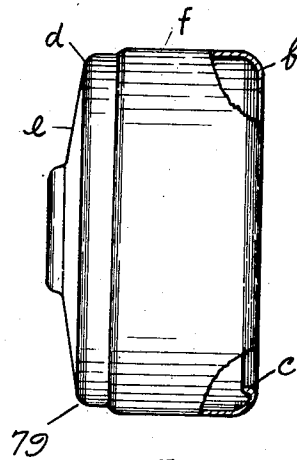


Fig. 7

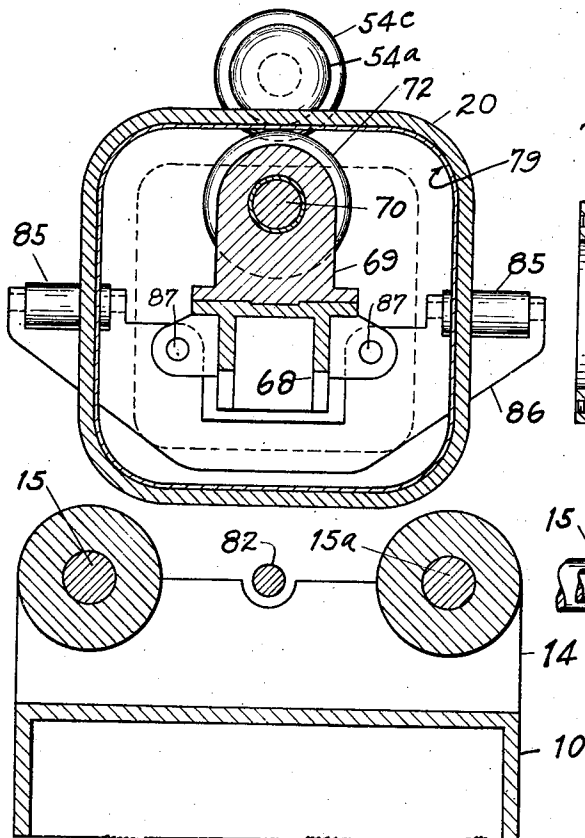


Fig. 5

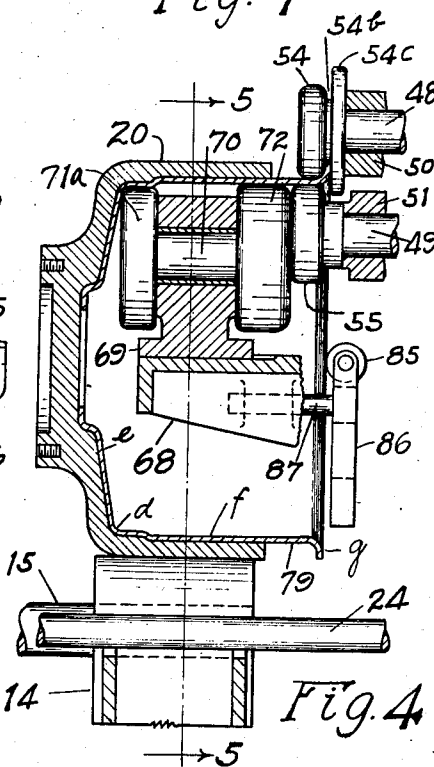


Fig. 4

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2,357,793

MACHINE FOR WORKING SHEET METAL ARTICLES

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Application March 2, 1942, Serial No. 432,969

5 Claims. (Cl. 153—29)

This invention relates to rolling apparatus for the working of sheet metal articles such as sheet metal receptacles; and particularly the invention has special application to rolling machines especially adapted to the art of making so-called turtle-necked and bullet-nosed tubs or containers made from sheet metal which are closed at one end and which are contracted at their opposite or open end. More specifically, this invention has special application to apparatus for forming a bullet-nose or partially forming a so-called turtle-neck shape at the upper or open end of the side wall of a relatively deep non-cylindrical receptacle or container of such cross section, for instance, as a square with rounded corners, or of an elliptical cross section, and having integral bottom and side wall all formed or drawn from a single piece or blank of sheet metal.

Such non-cylindrical receptacles are adaptable to many uses, for example, as tubs for power-driven washing machines; as turtle-necked and bullet-nosed tubs for washing machines, or for wringerless dryers. Such tubs are usually drawn from a ductile material such as deep drawing vitreous enameling iron and are usually covered with a vitreous enamel coating.

Non-cylindrical tubs, such as, for instance, rounded corner square tubs with turtle-neck or bullet-nose shaped open end portions are difficult and expensive to make by present known methods, which require multiple press operations, localized annealing and welding and excessive metal finishing as well as wastage of metal trimmed off and discarded. But the advantage of such a tub lies not only in its eye appeal but also in the fact that the square tub has substantially more washing capacity in comparison with the usual cylindrical tub of a diameter equal to the width of the square tub.

It is therefore a principal object of the present invention to provide a new improved and inexpensive rolling device for forming a bullet-nosed shape at the open end portion of a closed bottom non-cylindrical receptacle formed of a single sheet or blank of sheet metal.

It is a further object of the present invention to provide improved apparatus for forming a bullet-nose shape in the open end portion of a non-cylindrical closed bottom sheet metal receptacle by a new, improved and simplified cold working operation which may be quickly, readily and easily performed without waste of material, excessive metal finishing, and without repeated working, annealing and pickling operations.

With the foregoing and other desirable objects

in view, the invention is described in conjunction with the accompanying four sheets of drawings hereby made a part of the specification, and wherein:

Fig. 1 is a plan view of a rolling machine embodying the present invention;

Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view taken upon the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary sectional view showing the rollers of the machine as they appear during one period of the rolling operation and also shows a modified means of locating the receptacle axially;

Fig. 5 is a fragmentary vertical sectional view taken on the line 5—5 of Fig. 4;

Fig. 6 is an end view showing the contour of a square round cornered, deep drawn receptacle after being worked by the apparatus in Fig. 1;

Fig. 7 is a side elevation with parts broken away and in section, showing the receptacle in Fig. 6 after being worked by the apparatus in Fig. 1 and also showing the turtle-neck shape to be formed by other apparatus following the working by the apparatus in Fig. 1; and

Fig. 8 is a fragmentary view similar to portions of Fig. 2 showing partial forming of the open end portion of the receptacle.

Similar numerals refer to similar parts throughout the following description and the various figures of the drawings.

The invention will be described particularly as it may be applied to a machine for forming a bullet-nose or for partially forming a so-called turtle-neck shape in tubs of sheet metal, particularly those of a square, round cornered, section, or an elliptical section or of other rounded sections not cylindrical in shape. And further, its adaptability for forming the above mentioned shapes in cylindrical tubs of sheet metal will be indicated. It will be understood that the machine here shown is illustrative only of a particular application of the invention, which is in no wise limited thereto.

Attention is directed to Figs. 1, 2 and 3, wherein parts constructed in accordance with the invention are shown supported upon a base 10. In this base may be housed a prime mover to drive the mechanism through gear 11, and a hydraulic pump for operating the hydraulic cylinders 12 and 13. Disposed upon base 10 is bracket 14 supporting shafts 15 and 15-a. Brackets similar to 14, not shown, are attached to an extension of the base 10 and support extensions of shafts 15

and 15—*a*, not shown. Shafts 15 and 15—*a* support bracket 16 in which shaft 17 is rotatively journaled, and to which is attached flange 18. To flange 18 are mounted gear 19 and chuck 20 to rotate therewith. Pins 21 are mounted in flange 18 and engage gear 19. Gear 19 is driven by gear 22 which is mounted on quill 23 which is keyed to shaft 24, and is rotatively journaled in bracket 16.

Flange 25 is attached to shaft 24 which is attached to and rotates with cam 26 which is also attached to flange 27. Flange 27 is attached to shaft 28 which is rotatively journaled in sleeve 29. Shaft 28 is driven by gear 11, and sleeve 29 is mounted in bracket 29—*a*.

Gear 34 is driven through idlers 30 and 31 which are rotatably mounted respectively on shafts 32 and 33. Gear 34 is attached to shaft 35 which is rotatably journaled in bracket 29—*a*. Gear 34 drives gear 36 which is attached to shaft 37 which is rotatably journaled in bracket 29—*a*. Universal joints 40 and 41 are attached respectively to shafts 35 and 37.

Shaft 48 is driven through quill 42, shaft 44 and universal joint 46 and shaft 49 through 43, 45 and 47. Shaft 48 is rotatably mounted in bearing block 50 and shaft 49 is rotatably mounted in bearing block 51. Bearing blocks 50 and 51 are slidably mounted on guide rods 52 and 53 which, as indicated in Fig. 3, are fixedly mounted in housing 63.

Roll 54 is mounted on shaft 48 and rotates therewith, and likewise roll 55 is mounted on shaft 49 and rotates therewith. Piston rod 56 is attached to upper bearing block 50, and piston 57 is attached to rod 56 and operates in cylinder 13. Piston rod 58 is attached to lower bearing block 51, and piston 59 is attached to rod 58 and operates in cylinder 12.

Cylinder 12 is connected through opening 60 to a hydraulic pump, not shown. Cylinder 13 is also connected to this hydraulic pump through openings 61 and 62 and through piping and control valve not shown.

Housing 63 which is slidably mounted on guide rods 64 and 65, which are attached at their upper ends to brackets 66 and 67 respectively and at their lower ends to base 10, carries bracket 68. Bracket 68 carries bearing block 69, and shaft 70 is rotatably journaled in said bearing block 69. Rolls 71 and 72 are mounted on shaft 70 and rotate therewith. Attached to housing 63 is bracket 73 which carries stud 74, shown by dotted lines in Fig. 2, on which is rotatably mounted cam roller 75. Cam roller 75 operates in cam groove 76 in cam 26. The dot and dash line 76—*a* in Fig. 3 indicates the path of travel of the roller 75. The contour of this path is made identical with the contour of the inside surface of receptacle 79 at the area contacted by roller 72.

Brackets 66 and 67 are mounted respectively on brackets 77 and 78 which are mounted on base 10.

Receptacle 79 is mounted in chuck 20 and is held in position by means of plates 80 and 81 and roll 71 against which plate 81 abuts. Bracket 16, which carries chuck 20, is moved longitudinally along supporting shafts 15 and 15—*a* by means of piston rod 82 and piston 83 and air cylinder 84. Cylinder 84 is attached to base 10 by a suitable bracket, not shown.

Referring to Figs. 4 and 5 there is shown a deep drawn receptacle blank 79 as drawn, pierced and trimmed preparatory to the operation of rolling in the open end portion as shown in Fig. 2 at *a*. This receptacle, as drawn and trimmed, in-

cludes side wall *f*, bottom wall *e* joined by the curved corner *d* to side wall *f* and having an out-turned flange *g* at the open end portion. The contour of the tub is as shown in Fig. 5, namely square with rounded corners, but the contour can be elliptical or otherwise rounded in which no radius of the contour is less than the radius of roll 72 in Figs. 2, 4 or 5. Chuck 20 in Figs. 4, and 5 is identical with chuck 20 shown in Figs. 1 and 2 but there is omitted the plates 80 and 81 in Fig. 2 and in their stead rolls 85 are used to position the receptacle longitudinally. These rolls engage outturned flange *g*. A variation of rolls 54 and 55 in Fig. 2 is shown in Figs. 4 and 5. The top roll 54, Fig. 4, mounted for common rotation with shaft 48 is provided with a grooved portion, 54—*b*, to engage the outturned flange *g* and an abutting portion, 54—*c*, against which the outturned flange abuts during a portion of the rolling operation. Rolls 85 are carried by bracket 86 which is adjustable longitudinally of the receptacle 79 by means of rods 87. Attention is directed to the adjustable feature of bearing block 69 with reference to bracket 68. This adjustment is axially of receptacle 79 to compensate for various depths of receptacle. This same feature is indicated in Fig. 2.

Figures 6 and 7 show a receptacle with inturned flange *b* in Fig. 7 as worked in the apparatus of Figs. 1, 2, 3, 4 and 5 and flange *c* subsequently curled inward to complete a turtle-neck shape. The receptacle as shown is rectangular in contour with rounded corners.

The receptacle includes a side wall *f*, and a bottom wall *e* joined by the curved corner *d*. This receptacle as drawn and before the open end portion is rolled in as shown at *b* Fig. 7, is provided with an outturned flange *g* as shown in Fig. 4. This receptacle as drawn could be trimmed to eliminate the outturned flange but it will be readily apparent that considerable economy is effected by not discarding this outturned portion as is necessary in present methods of closing-in this type of receptacle in which a series of press operations are made use of.

Fig. 4 shows the receptacle in position for roll-in in the open end portion thereof, and Fig. 2 shows the rolling-in completed. Roll 55 is yieldingly mounted to engage the inside surface of the receptacle in line with roll 72 and is urged against this surface by the pressure exerted in cylinder 12. The extreme upward travel of this roll is limited to the position shown in Fig. 4 and it is caused to move downward in unison with roll 54, as the operation of rolling-in progresses, by the pressure exerted on roll 54 by the downward pressure exerted in cylinder 13. These two rolls, namely 54 and 55, grip the side wall of the receptacle and prevent buckling or wrinkling during rolling in the same manner as the pressure ring of a draw die in a single acting drawing press equipped with a pressure pad or cushion prevents wrinkles forming in a sheet metal blank during a drawing operation.

Attention is directed to the drive mechanism for rolls 54 and 55. Roll 54 is moved toward and away from the receptacle by the action of pressure in cylinder 13 and roll 55 moves in unison with roll 54 during the rolling operation. For this reason universal joints are utilized in driving these rolls.

Attention is also directed to gears 19 and 22 arranged to rotate chuck 20 during the rolling operation. These gears are of the same pitch

diameter and are preferably provided with accurately shaped teeth to eliminate backlash. It is essential that cam 26 rotates at the same speed as the chuck and synchronously with each other since rolls 71 and 72, which engage the inside surface of the receptacle, are maintained in contact with this surface while the receptacle is in rolling position. This contact of the rolls is maintained through the action of cam roller 75 operating in cam groove 76 (see Fig. 3) since both the rolls 71 and 72 and cam roller 75 move in unison with housing 63 to which they are attached.

The progress of the working operation is illustrated in Figs. 2, 4 and 8. Initially the receptacle 79 drawn, trimmed and pierced, as shown in Fig. 4 with outturned flange *g*, is placed inside chuck 20 which has previously been moved to the extreme left, which is the loading and unloading position. Preceding the placing of the receptacle in the chuck, plates 80 and 81 are attached to the bottom of the receptacle as shown in Fig. 2 or they may be omitted when rolls 85 are used to align the outturned flange with groove 54—*b* in roll 54 Fig. 4. Rolls 85 are also operable with the plain roll 54 shown in Fig. 2. Chuck 20 with the receptacle therein is then moved longitudinally to the extreme right or rolling position. Upper bearing block 50 carrying roll 54 which has previously been raised is then moved downward and roll 54 engages the open end portion of the receptacle.

During the interval that the chuck with the receptacle therein moves to the right to rolling position, the prime mover, not shown, operating through gear 11 causes the gears, cam, chuck and rolls 54 and 55 to rotate and, at the instant of engagement with the inside surface of the receptacle, rolls 71 and 72 also rotate.

As roll 54 is fed downward by the pressure exerted in cylinder 13 by the hydraulic pumps (not shown) the open end portion of the receptacle extending beyond roll 72 is gripped between rolls 54 and 55 as they move in unison and is drawn and shaped about the contour and face of roll 72. During the rolling in, rolls 71 and 72 are maintained in contact with the inside surface of the receptacle wall by the action of the cam and cam roller.

Upon completion of the operation the pressure against the upper face of piston 57 in cylinder 13 is released by the control valves (not shown) and another control valve (not shown) causes the pressure medium to flow from the hydraulic pump through opening 61 causing roll 54 to move away from the receptacle.

As roll 54 moves away the prime mover (not shown), which is provided with automatic brake that prevents coasting and permits the operator to unload and load the receptacle in the chuck without loss of time, is stopped rotating. This permits the operator to remove the rolled-in receptacle immediately upon completion of the movement of the chuck to the extreme left and insert a new receptacle with outturned and trimmed flange ready for rolling.

It will be noted that receptacles of various contours can be rolled-in by changing to a suitable chuck and cam groove that conform in contour to that of the receptacle. It will also be noted that a cylindrical receptacle can be rolled by using a cylindrical chuck and a cylindrical cam groove. It is further to be noted that the machine is operable on receptacles not having a flange at the open end portion but, as previously

stated, there is a distinct economy in the utilization of such a flange in the case of drawn receptacles.

I claim:

1. In a machine adapted for roller working a non-cylindrical closed bottom receptacle, the combination comprising: means for holding the receptacle in alignment, three rolls adapted to engage the side wall of the receptacle, means for moving one of said rolls radially toward a second to grip the receptacle therebetween, yielding means mounting the second roll for radial movement in unison with the first roll after the receptacle has been gripped therebetween, means mounting the three rolls for joint radial movement relative to the receptacle to maintain said rolls in contact with the receptacle during the roller working, said means including a housing on which said rolls are rotatably mounted, a cam roller rotatably mounted on said housing, a cam rotatably mounted, a groove in said cam engaged by said cam roller, the contour of said cam groove being identical with the contour of the portion of the receptacle engaged by said third roll, and means for synchronously rotating said receptacle and said cam about their respective axes as said first and second rolls in their joint movement roller work the receptacle adjacent the third roll.

2. In a machine adapted for roller working a non-cylindrical sheet metal receptacle having a closed bottom a side wall and a flange at one end thereof including three rolls, a groove in one of said rolls to engage the flange in the receptacle, means for radially moving said grooved roll radially toward a second to grip the receptacle therebetween, yielding means mounting said second roll for radial movement in unison with the grooved roll after the receptacle has been gripped therebetween, means for rotating said grooved and second rolls, means mounting the third roll and maintaining same in contact with the inside face of the side wall of the receptacle said means moving the three rolls jointly radially with respect to the receptacle as said receptacle rotates, said grooved and second rolls in their radial movement roller working the receptacle adjacent the third roll, means for rotating the receptacle about its axis, means for maintaining the axis of said receptacle in fixed position during said roller working, and means engaging the flange of the receptacle to align the same for engagement with the grooved roll.

3. In a machine adapted for roller working a non-cylindrical side walled closed bottom sheet metal receptacle, the combination comprising: a chuck adapted to hold the receptacle; a plurality of rolls adapted to engage the side wall of the receptacle, one of said rolls being adapted to engage the inside face of the side wall of said receptacle on a line spaced from the open end thereof, a second roll adapted to engage the open end portion of said surface adjacent said first roll, and a third roll adapted to engage the opposite surface of said receptacle at said open end portion; means for rotating the second and third rolls; means mounting the third roll for radial movement; a rotatable member; a cam groove in one face thereof, the contour of the center of which being identical with the contour of the receptacle at the portion engaged by the first roll; a cam roller engaging said cam groove; means for synchronously rotating the chuck and said member having therein said cam groove about their respective axes; means for moving the third roll radially with respect to the receptacle, and

radially toward the second roll to grip the side wall of the receptacle therebetween and thereafter for moving radially said third and second rolls in unison; said rolls in their joint radial movement working the receptacle adjacent the first roll; yielding means mounting the second roll for radial movement with the third roll and for urging said second roll against the receptacle; a housing adapted to support the cam roller and the first roll; means mounted in said housing to guide the radial movements of the second and third rolls; means mounting the housing for radial movement with respect to the receptacle for maintaining the first roll in engagement with said receptacle, and means for positioning the receptacle axially during the rolling operation.

4. Apparatus for roller working a non-cylindrical side walled sheet metal article including three rolls, means for radially moving one of said rolls radially toward a second to grip an article therebetween, yielding means mounting said second roll for radial movement in unison with the first roll after the article has been gripped therebetween, means mounting the third roll to maintain the same in contact with the article said means moving the three rolls jointly radially with respect to the article as said article rotates, means for maintaining the axis of the article in fixed position during the roller working, said means including a chuck to receive said article, means for rotating said chuck and said article about their common axis, said first and second rolls in their joint radial movement roller work-

ing the article adjacent the third roll, and means for moving the chuck axially to permit placing the article therein and to permit removal of said article from the apparatus.

5. In a machine for roller working the side wall portion of a non-cylindrical sheet metal article, the combination of means for maintaining the axis of the article in fixed position, a revolving face cam the axis of which is non-axial with reference to the article, a cam roller engaging said face cam, a housing to which said roller is attached, a contoured roller rotatably mounted on said housing and adapted to engage the inside face of the side wall of the article, means for rotating the article and the cam synchronously about their respective axes, the contour of the face cam being such that the contoured roller is caused to move rhythmically with the rotation of the article and to maintain engagement with the inside face of the side wall as said article and cam rotate, two brackets mounted in said housing, guiding means mounted in said housing on which said brackets are mounted for radial movement with reference to the axis of the article independently of said rhythmic movement of the contoured roll, a roller rotatably mounted on each of said brackets, one of said rollers being adapted to engage the inside face and the other the outside face of the article adjacent the contoured roll, and means for moving said two rolls jointly to roller work the side wall adjacent the contoured roll.

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