April 29, 1941. D. BOHM 2,239,696

METHOD AND APPARATUS FOR FORMING THE RIMS OF CYLINDRICAL SHELLS

Filed May 29, 1936 5 Sheets-Sheet 1

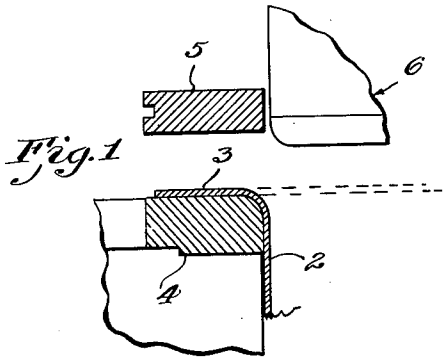


Fig. 1

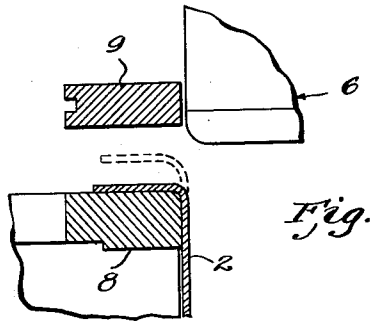


Fig. 2

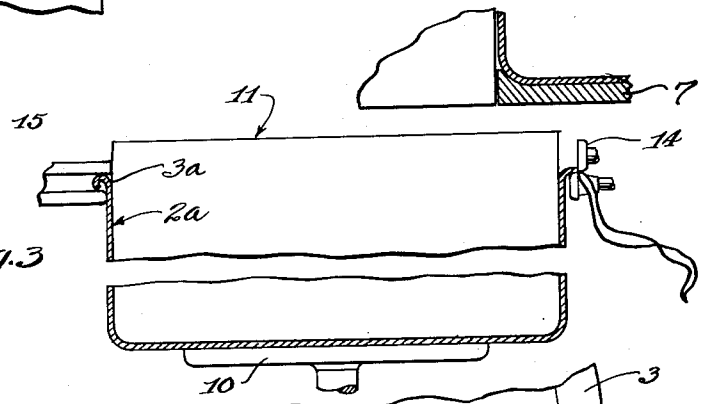


Fig. 3

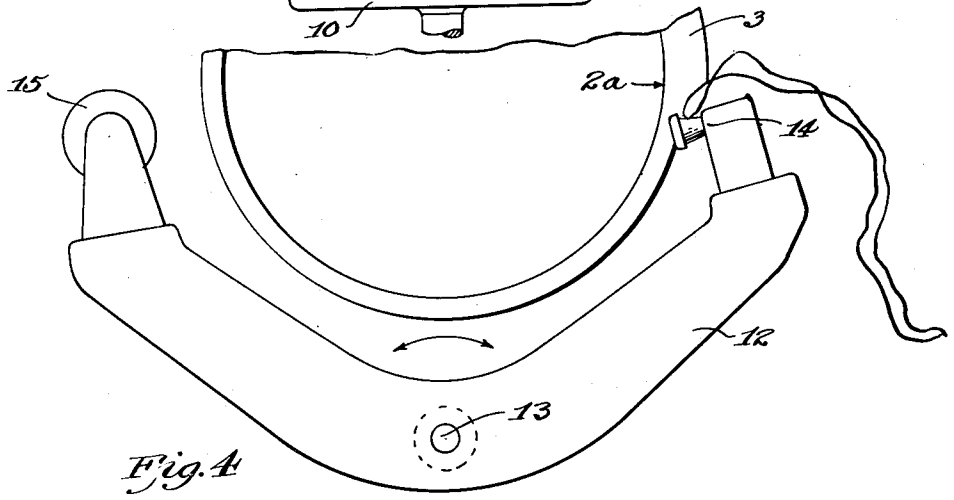


Fig. 4

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Fig. 5

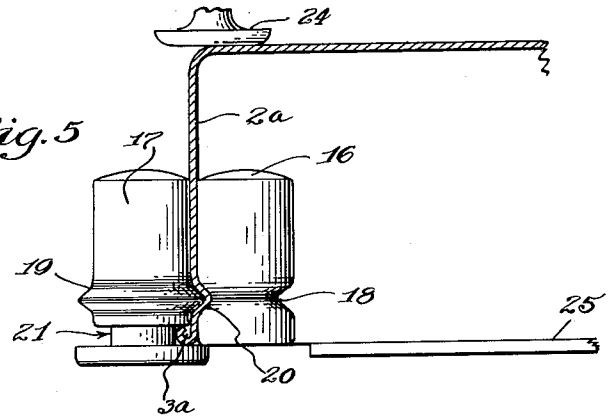


Fig. 6

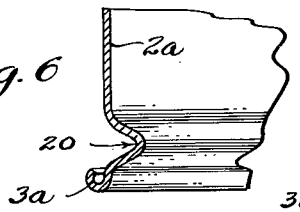


Fig. 7

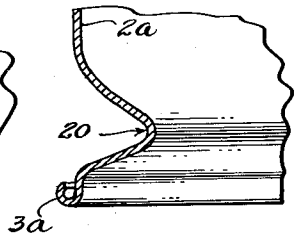


Fig. 8

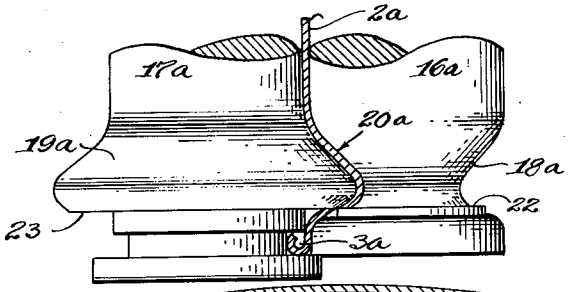
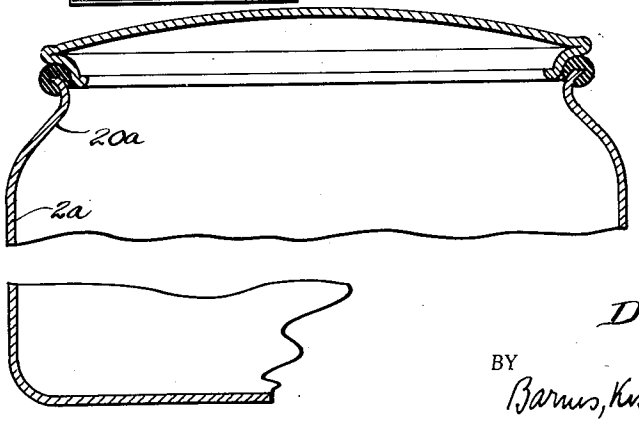


Fig. 9



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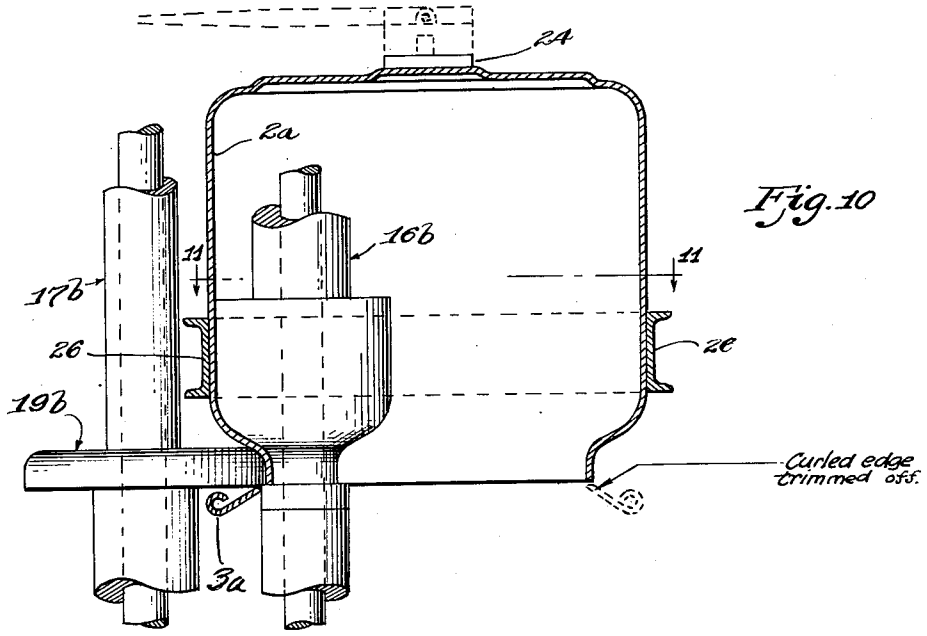


Fig. 10

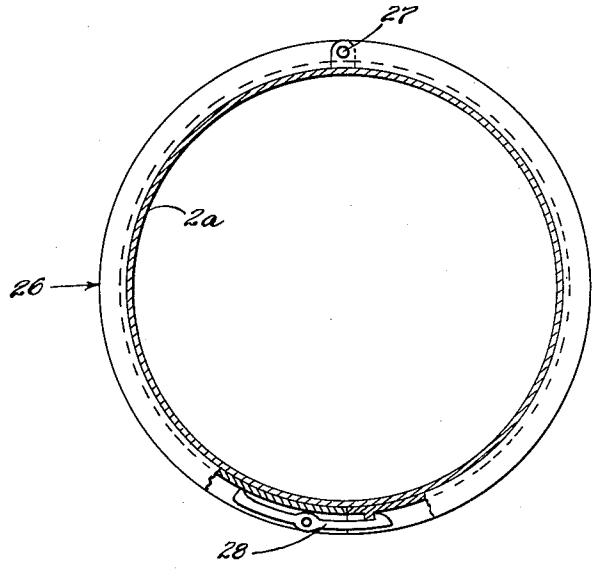


Fig. 11

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Filed May 29, 1936 5 Sheets-Sheet 4

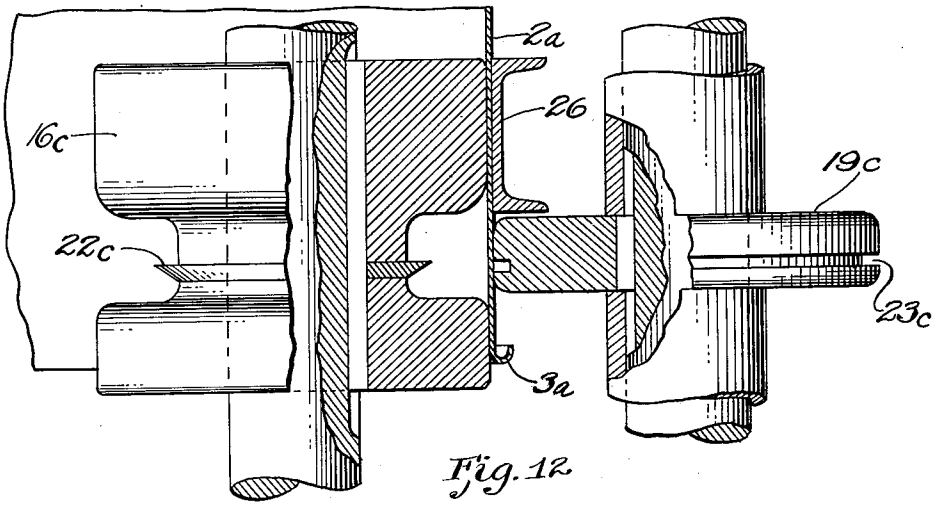


Fig. 12.

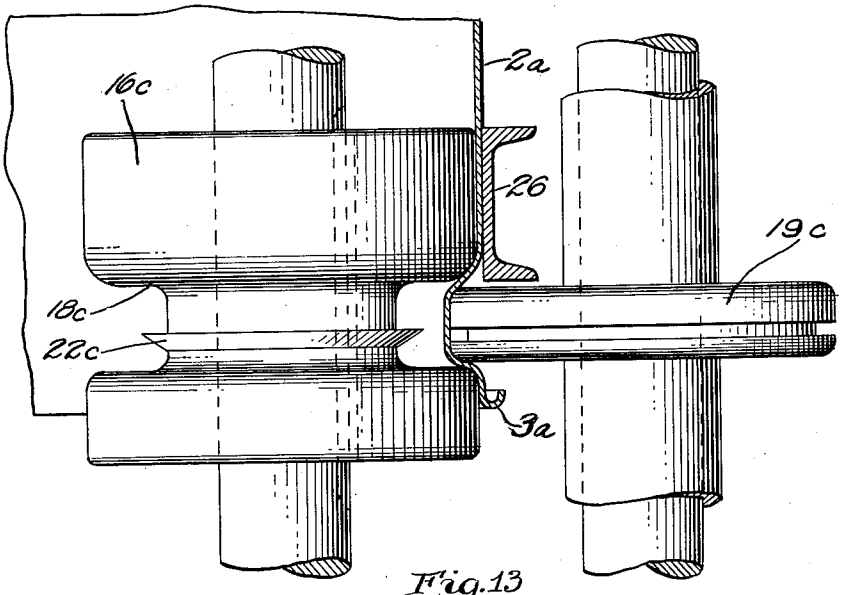


Fig. 13

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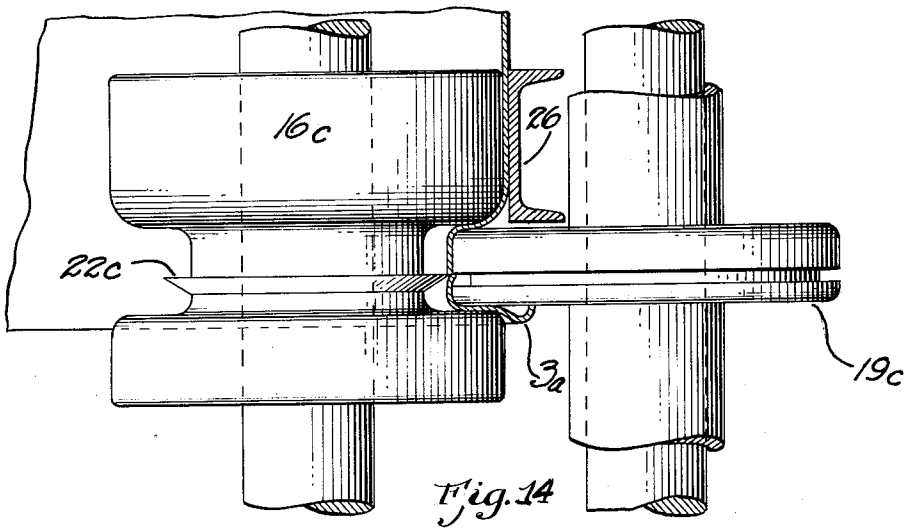


Fig. 14

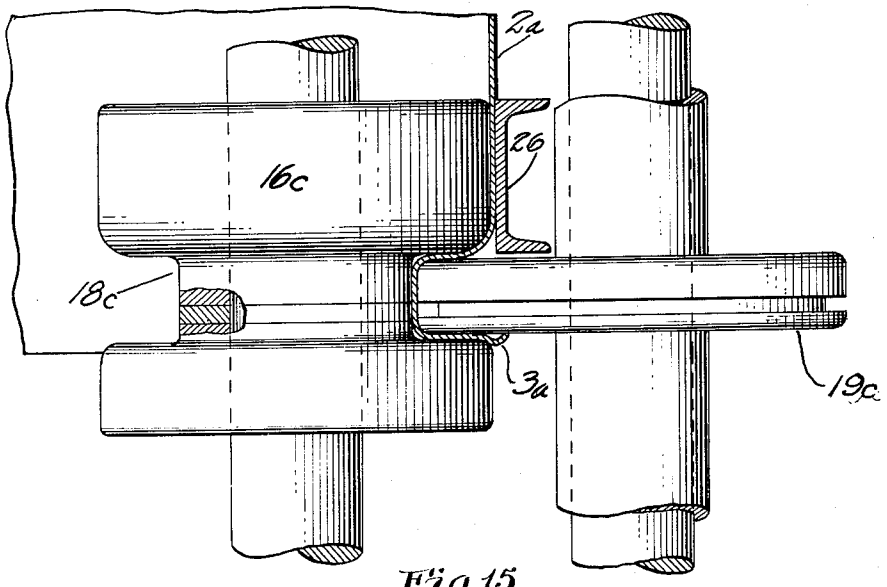


Fig. 15

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2,239,696

UNITED STATES PATENT OFFICE

2,239,696

METHOD AND APPARATUS FOR FORMING THE RIMS OF CYLINDRICAL SHELLS

Daniel Bohm, Salem, Ohio, assignor to Mullins Manufacturing Corporation, Salem, Ohio, a corporation of New York

Application May 29, 1936, Serial No. 82,617

21 Claims. (Cl. 153—2)

This invention relates to the method and apparatus for forming rims of drawn cylindrical shells and has to do particularly with the forming of the "necked-in" top or rim portion of washing machine tubs, buckets and the like.

During recent years it has been the practice to form washing machine tubs and the like with a distinct "necked-in" formation as contrasted with prior art practice of merely forming a relatively small bead at the top periphery of the cylindrical tub. The forming of this distinct "necked-in" portion, with or without the bead has been the source of much difficulty and requiring extensive fabricating steps.

It is the object of the present invention to form a distinct "necked-in" portion of relatively great depth adjacent the top portion of a cylindrical tub or the like by a simple, cold working operation which embodies substantially holding one point of two spaced portions of a wall of a rotating member in a fixed plane and drawing out the intermediate portion of the wall by a rotating forming die.

An important step in my method of fabrication has to do with the curling over of the edge of the tub and the utilization of the curled over portion as a fixed or fulcrum point with relation to which a portion of a cylindrical wall is drawn or "necked-in"; the direct result of this step is that the curled over portion or bead is rotated and maintained in a substantially fixed plane while the portion of the tub adjacent the curled over portion is subjected to successive drawing operations.

Still another feature has to do with a combined "necking-in" and trimming step wherein simultaneously with the completion of the "necking-in" of the tub, another portion of the tub is trimmed off; this trimmed off portion being the fulcrum point with relation to which the metal was stretched or drawn during the main forming step.

A still further feature has to do with the step of and means for maintaining the tub or other article in a straight sided cylindrical shape during the "necking-in" operations. Further features have to do with details of the progressive fabricating steps and fabricating means for carrying out the steps as will be more clearly set forth in the specification and claims.

In the drawings:

Fig. 1 is a view, partly in cross section and largely diagrammatic, illustrating the step of drawing a cylindrical unit such as a washing machine tub.

Fig. 2 is a view similar to Fig. 1 but showing the second, or sizing, operation.

Fig. 3 is a view largely diagrammatic illustrating the trimming and curling steps.

Fig. 4 is a view taken at right angles to Fig. 3 and showing diagrammatically the means for successively trimming and curling the edge of the tub.

Fig. 5 illustrates the step of subjecting the tub to forming rolls of a peculiar shape, the bead of the tub being held in a fixed plane by a groove in one of the forming rolls.

Figs. 6 and 7 illustrate successive operations in getting the final depth required for the "necked-in" portion of the tub.

Fig. 8 illustrates the final step of forming and shearing.

Fig. 9 is a cross sectional view illustrating diagrammatically the contour of a "necked-in" tub formed in accordance with the present invention.

Fig. 10 is a view similar to Fig. 8 but illustrating a slightly modified fabricating step in that the side walls of the tub are progressively maintained straight and cylindrical during the "necking-in" and shearing steps.

Fig. 11 is a sectional view taken on line 11—11 of Fig. 10 and illustrating in particular the clamping or latching means for holding the retaining ring in place.

Figs. 12 to 14 illustrate the three steps of "necking-in" and trimming a tub, utilizing feeding rolls of slightly different construction than shown in Fig. 10.

Fig. 15 illustrates the step of forming a relatively deep "necked-in" portion in one operation.

The successive figures of the drawings, particularly Figs. 1 to 8, disclose the important steps in carrying out my invention in connection with the formation of the rim portion of washing machine tubs, and similar cylindrical containers. In Fig. 1, I have illustrated, more or less diagrammatically, the step of initially drawing a rough tub form from a flat sheet, the cylindrical wall of the tub or shell being indicated as at 2 and the rim flange as at 3, the usual forming members comprising a draw ring 4, a hold-down ring 5 and a punch 6.

In the second step as illustrated in Figure 2, a pad member 7 is shown as forming and defining the bottom contour of the tub or shell, a sizing ring 8 and a flattening ring 9, providing a finished size and contour for the upper portion of the tub.

Next the formed tub which is indicated as at

2a is mounted in a lathe or similar machine tool so that the axis of the tub is in alignment with the axis of the lathe; Figure 3 shows diagrammatically the tub being held in place between a tail stock clamp 10 and a mandrel 11. As best shown in Fig. 4 a rocker arm 12 may be oscillatably mounted about a pivot 13 carried by the lathe or other machine tool, such rocker arm carrying a trimming tool 14 and a curling tool 15. Although Figure 3 shows the upper edge of the tub being trimmed and curled simultaneously, this is for illustration only, as in actual operation, the rocker arm 12 will first be moved to trimming position to trim the flange 3 of the tub, as illustrated in Figure 4, after which trimming operation, the rocker arm will be moved about the pivot 13 to subject the rotating trimming edge to a curling action by the tool 15, whereby to curl the top edge of the tub as at 3a.

The initial step of actually forming the bead in the rim of the tub is illustrated in Figure 5 wherein a radially stationary forming roll is shown at 16 and a radially reciprocable forming roll at 17. The mechanism for carrying and actuating the tooling rollers 16 and 17 is not shown, but it will be understood that such rollers may be carried and actuated by a machine such as shown in the patent to Horvath, 1,850,958 of March 22, 1932. It will be understood that several operations may be necessary in order to get the final depth of bead required, with the result that the rim of the tub may be subjected to successive sets of forming rolls in order to produce the final tub rim shape.

The rolls 16 and 17 shown in Figure 5, are an example of the initial forming rolls that may be used, the radially stationary roll 16 having an annular depressed forming surface 18 and the reciprocable roll 17 having a complemental raised forming surface 19. An important feature of the initial forming rolls 16 and 17, as well as the rolls used in forming the bead 20a, is the annular groove 21 formed at one end of the reciprocating roll 17. This groove is of such size as to receive the rolled edge 3a of the tub, the purpose of this groove 21 being to retain the rolled edge 3a in a fixed plane during the complete forming operations. It will be understood that, while I prefer to use the outer roll 17 as a reciprocating roll, regardless of which roll is reciprocated or whether they are both partially reciprocated, the essential point is that the bead 3a is retained in a fixed plane so that when the tub ware 2a is drawn or formed in the rim of the tub the metal is drawn from a point intermediate the edge and the bottom of the tub and does not pull away from the edge; in other words, the important point here is to provide a hold-down for the rotating edge of the tub during the drawing, bending, spinning and forming of the bead.

After the initial forming of the "necked-in" portion or bead 20, the tub may be subjected to a second and third set of forming rollers so as to produce the rim shapes as shown at Figures 6 and 7, it being understood that the shapes shown are illustrative and may vary widely in accordance with the final design and shape required. In Figure 8, I have shown the rim of the tub as being subjected to the final forming and shaping operation and the effective forming surface 19a on the roller 17a cooperating with the effective forming surface 18a on the rollers 16a to produce the final desired shape 20a on the rim section. An important feature of the final forming roll shown in Figure 8 is the positioning and formation of surfaces 22 and 23, formed as a part of the rolls 16a and 17a, respectively; as the movable roll nears the end of its travel in finally shaping the bead 20a the two surfaces 22 and 23 cooperate to trim away the curl 3a and other excess material from the rim of the tub.

It will be distinctly understood that in some cases the initial forming rolls may take the shape and perform the operation of the final rolls as shown in Figure 8, but in the practical carrying out of my method wherein the shape desired for the bead approaches that disclosed in Figure 9, I have found it best to use two or more sets of rolls. In also carrying out the steps, I prefer to use a pressure shoe 24 for contacting the bottom of the tub or other article and a supporting surface 25 upon which the shell rim rides during rotation.

It will thus be seen that by forming a curled edge at the rim of the tub and utilizing this curled edge as a hold-down for the revolving periphery of the tub, I am able to draw the bead to substantially any shape desired by a simple, cold rolling operation. No heating or annealing of the tub is necessary and the flow of metal during the rolling operation is even and uniform. It will also be understood that some tubs or similar articles may require the top curl 3a as a part of the finished shape, in which case the curl would not be trimmed off in the final operation. In other cases it may be required to have a curl formed at the apex of the formed bead, in which case it may be necessary to trim off the hold-down bead and form an additional bead at the trimmed rim of the tub. Figure 9 illustrates the general contour of a tub finished in accordance with the steps illustrated in Figures 5 to 8, but it will be understood that the rim of the tub or other similar article may be given any one of many widely varying forms and still come within the method steps covered by the present invention.

In Figures 10 and 11, I have shown a slightly modified arrangement having forming rolls 16b and 17b wherein the actual forming portion 19b is held in position by suitable spacers, the upper spacer of which is of such small diameter as to permit the use of a retaining ring 26, the purpose of which is to maintain a straight sided tub wall 2a during the "necking-in" operations. It will be obvious that this retaining ring will prevent bulging out of the side walls of the tub at the start of the "necking-in" operation. As best shown in Figure 11, the retaining ring 26 is formed in two parts hinged together at 27, and adapted to be held in closed position by means of a spring latch 28. The split ring is slipped over the tub as shown in Figures 10 and 11, before the rolling operations are performed and maintains the diameter of the tub, at a point adjacent the part to be "necked-in," during the rolling operations.

The forming rolls as shown in Fig. 10 will generally be used for forming relatively deep necked-in portions in a single operation. Here the retaining groove is dispensed with and a hold-down or reinforcing effect on the edge is obtained because the rolled over bead 3a is relatively stiff and offers resistance to any change in diameter of the tub. During the final shearing step, as shown in Fig. 10, the bead 3a will contact with the bottom of the member 19b; Fig. 10 showing the trimmed off curled edge as fall-

ing after being cut off. Thus while the curled edge may be spaced from the forming roll at the start of the forming operation, it may be said to be maintained below the effective surfaces of the forming rolls and between planes defined by relatively narrow limits during the entire forming operation and during the last part of the forming operation when the bead contacts with the bottom of the roll, it will be maintained in a positive fixed plane.

In Fig. 12 I have illustrated a further modification wherein inner forming roll **16c** takes the general configuration of the roll **16** shown in Fig. 5 and outer forming roll **19c** takes the general configuration of the forming roll **19b** shown in Fig. 10. In this modification a trimming member **22c** is carried as a part of the inner forming roll **16c**, the edge of the trimming member cooperating with a groove **23c** formed in the roll **19c**. Similar to the showing in Fig. 10, a retainer ring **26** is utilized in this modification and the forming rolls **16c** and **19c** are so positioned relative to the edge of the tub that the curled edge **3a** is spaced a short distance below the cutting plane formed by the member **22c** and the groove **23c**.

In Fig. 13 the rotating forming rolls are shown as being moved relative to each other to initiate the necking-in of the top part of the tub. As illustrated in this figure, it will be seen that the curled edge **3a** still operates as a hold-down or reinforcing means to permit necking-in of the top part of the tub during the rotating and forming step. While some of the metal flows from the curled edge during the necking-in step, as is best illustrated in Fig. 14 this curled edge still operates as a sort of floating hold-down reinforcement until it contacts with the bottom surface of the forming roll **19c** where the contact continues until trimming off of the open end of the tub. Thus while the distance between the curled edge **3a** and the bottom surface of the forming roll **19c** changes slightly as the necked-in portion is gradually formed in a single operation, nevertheless, as far as the actual effect is concerned, this curled edge or hold-down operates as though it were maintained exactly in the same plane and even though some metal flows from the curled edge, it operates as a hold-down reinforcement until the final trimming step.

In the event of a relatively deep necked-in portion the trimming member **22c** may be removed, as best shown in Fig. 15, which permits forming of the relatively deep necked-in portion in a single operation. In this case it will be seen that even more metal is taken from the curled edge **3a** but that such edge still maintains its hold-down and reinforcing properties, and, of course, will contact with the bottom surface of the roll **19c** during the greater part of the final forming operation.

What I claim is:

1. The method of forming rims of washing machine tubs and similar articles which comprises curling over the edge of the tub, setting up relative movement between the tub and forming units, subjecting the rim portion of the tub to the forming units, whereby to give said rim portion a predetermined shape, maintaining said curled edge in a substantially fixed plane during said forming action and shearing off said curled edge at the completion of said forming step and during the relative movement between the tub and the forming units.

2. The method of forming a bead in the surface of a substantially cylindrical sheet metal member which comprises curling over one edge of said cylindrical surface, subjecting only a localized portion of said surface adjacent said edge to a drawing action whereby to form a relatively deep annular bead, causing relative movement between the cylindrical member and the forming means, said curled over edge acting as a reinforcing means in controlling the flow of metal during the forming process.

3. The method of forming rims of washing machine tubs and similar articles which comprises giving the edge of the tub a predetermined shape, subjecting the rim portion of the tub to relatively movable rotating forming rolls, said forming rolls cooperating with said preformed edge whereby to maintain said edge in a substantially fixed plane during the forming action of the rolls upon the rim, subjecting said rim portion to a plurality of sets of forming rolls and maintaining said preformed edge in the same plane during the successive forming actions on the rim and shearing off said preformed edge as a step in the final forming of the rim.

4. A mechanism of the character described, comprising rotating forming rolls, one being reciprocably movable relative to the other, one of said forming rolls having a shouldered portion adapted to receive a preformed edge formed as a part of the article being subjected to forming action by the rolls whereby said shouldered portion and preformed edge cooperate as a hold-down to maintain said edge in a substantially fixed plane during the movement of one of the forming rolls towards the other and complemental surfaces formed on said forming rolls and cooperating upon the final forming action to shear off said edge.

5. A mechanism of the character described, comprising rotating forming rolls, one being reciprocably movable relative to the other, one of said forming rolls having a shouldered portion adapted during at least part of said reciprocal movement to receive a preformed edge formed as a part of the article being subjected to forming action by the rolls whereby said shouldered portion and a portion of said other roll cooperate to maintain said edge beyond said cooperating portions during the movement of one of the forming rolls towards the other, said forming rolls being so shaped and spaced relative to each other that a retainer ring may be positioned between the shafts of the respective forming rolls and clamped around the article being formed and complemental surfaces formed on said forming rolls and cooperating upon the final forming action to shear off said edge.

6. The method of forming a bead adjacent the periphery of a substantially cylindrical sheet metal member which comprises curling over one edge of said cylindrical surface, subjecting a portion of said surface adjacent said edge to a necking-in action whereby a portion of the metal flows from said edge and a portion from the cylindrical periphery of said sheet metal member, and utilizing said curled over edge as a reinforcing means during the flowing of the metal and forming of said necked-in portion.

7. The method of forming a relatively deep bead adjacent the edge of a moving wall of sheet metal, in a single operation, which comprises shaping an edge of said moving wall to reinforce and stiffen the same, subjecting a localized portion of said moving wall at a point spaced from but adjacent said edge to forming tools of predetermined shape whereby to draw metal from said

wall and distort the same laterally into a shape corresponding to the shape of said forming tools, and utilizing the shaped edge of the moving wall as a reinforcement means during substantially the entire forming action whereby metal may flow from said edge during the forming action.

8. The method of forming a relatively deep draw adjacent the edge of a moving wall of sheet metal, which comprises shaping an edge of said moving wall to reinforce and stiffen the same, subjecting a localized portion of said moving wall at a point spaced from but adjacent said edge to forming tools of predetermined shape, portions of said forming tools cooperating to confine said shaped edge beyond a plane defined by said cooperating portions of the forming tools, causing relative movement between said forming tools to distort said moving wall laterally, a portion of the metal flowing from said shaped edge during the drawing action, and utilizing the shaped edge of the moving wall as a reinforcing means during the entire forming action.

9. The method of necking-in the peripheral wall of a substantially cylindrical unit such as a washing machine tub and the like, which comprises causing relative movement between the peripheral portion to be formed and forming units having complemental effective forming surfaces, maintaining the extreme peripheral edge portion of the unit beyond a plane defined by one edge of the effective forming surfaces of the forming units, and subjecting the rim portion adjacent said extreme edge portion to a forming action whereby a portion of the metal in said rim portion is drawn away from said edge portion while said edge portion is maintained beyond said plane.

10. The method of necking-in the peripheral wall of a substantially cylindrical unit such as a washing machine tub and the like, which comprises causing relative movement between the peripheral portion to be formed and forming units having complemental effective forming surfaces, maintaining the extreme peripheral edge portion of the unit beyond a plane defined by one edge of the effective forming surfaces of the forming units, and subjecting the rim portion adjacent said extreme edge portion to a plurality of successive forming actions whereby a portion of the metal in said rim portion is drawn away from said edge portion while said edge portion is beyond said plane.

11. The method of forming rims of washing machine tubs and similar articles which comprises curling over the edge of the tub, setting up relative movement between the tub and forming units having complemental effective forming surfaces, subjecting the rim portion of the tub to the forming units, whereby to give said rim portion a predetermined shape, said forming units cooperating to maintain said curled edge beyond a plane defined by one edge of the effective forming surfaces of the forming units, said curled edge thereby acting as reinforcing means in controlling the flow of metal during the forming operation.

12. The method of forming rims of washing machine tubs and similar articles which comprises curling over the edge of the tub to form a reinforcing rim, setting up relative movement between the tub and forming units of predetermined shape, subjecting the rim portion of the tub to the forming units, whereby to give said rim portion the shape of the forming units, and maintaining said curled edge beyond a plane defined by cooperating portions of said forming units during said forming action whereby said reinforced rim causes at least a portion of the metal in said formed part of the rim to be drawn from the side walls of the tub between the said curled portion and the bottom of the tub.

13. A mechanism of the character described, comprising rotating forming rolls, one being reciprocably movable relative to the other, one of said forming rolls having a shouldered portion adapted during at least part of said reciprocal movement to receive a preformed edge formed as a part of the article being subjected to forming action by the rolls, said other roll having a portion cooperating with said shouldered portion to maintain said edge beyond a plane defined by said cooperating portions during the movement of one of the forming rolls towards the other, said forming rolls being so shaped and spaced relative to each other that a free retainer ring may be positioned between the shafts of the respective forming rolls and clamped around the article being formed whereby said ring will move with said article.

14. The method of cold forming a relatively deep draw adjacent the edge of a moving wall of sheet metal, which comprises preshaping an edge of said moving wall to reinforce and stiffen the same, subjecting a localized portion of said moving wall at a point spaced from but adjacent said preshaped edge to forming tools of predetermined shape whereby to form and bend said moving wall into a shape corresponding to the shape of said forming tools, said preshaped edge acting as a reinforcing means during the greater part of the forming and bending step to maintain the shape of the edge of the moving wall and control the flow of metal into the drawn portion.

15. A mechanism for forming rims of washing machine tubs and similar articles comprising rotating forming rolls, one being reciprocally movable relative to the other, said forming rolls having a diameter substantially smaller than said tubs and having cooperating portions adapted to positively confine a localized portion of a tub as a reinforcing edge between opposed rolling surfaces whereby said edge functions as a hold-down during the greater part of the movement of one forming roll towards the other while the portions of the tub adjacent said reinforcing edge are being formed.

16. A mechanism for forming a relatively deep draw adjacent the edge of a moving wall of sheet metal, comprising rollers radially movable relative to each other, one roller located on one side of said wall and the second on the other side, said rollers having opposed radial surfaces spaced axially to positively confine and exert pressure on a localized portion of the edge of said wall whereby said edge functions as a hold-down during the forming of said deep draw when both rollers are rotating in opposite directions and moving radially toward each other, said hold-down action causing a portion of the metal to flow in the drawing action.

17. The method of forming a reduced neck at an end of a cylindrical sheet metal article which includes the steps of shaping an edge at an end of such article, supporting the article between roller dies, holding the shaped edge in a fixed plane, and cold working the metal adjacent to said shaped edge by rotating the dies and moving the axes thereof relatively toward one another; which working simultaneously rolls the

metal, increases the cross sectional length thereof, reduces the diameter of the article, and flows metal from said article to the reduced portion to form the desired reduced neck shape.

18. The method of forming a reduced neck at an end of a cylindrical closed bottom sheet metal article which includes the steps of shaping an edge at the open end thereof, supporting the article between roller dies, engaging and holding the shaped edge in a fixed plane, pressing against the closed bottom of the article, and working the metal intermediate the extremities of the article and adjacent to said shaped edge by rotating the dies and moving the axes thereof relatively toward one another; which working simultaneously rolls the metal, increases the cross sectional length thereof, reduces the diameter of the article to form a curved wall between the reduced neck and the side walls of the article, and draws a portion of the metal from the article to the reduced neck.

19. A mechanism of the character described, comprising rotating forming rolls, one being reciprocably movable relative to the other, said forming rolls having cooperating portions adapted to confine a reinforcing edge portion of the article being subjected to forming action by the rolls whereby said edge portion functions as a hold-down during the greater part of the movement of one forming roll towards the other, one of said forming rolls having a shoulder relative to which said edge portion is spaced when the forming rolls move relative to each other but which shoulder at least a part of which the edge portion is adapted to contact during the latter part of the forming action.

20. The method of necking-in the peripheral wall of a substantially cylindrical unit such as a washing machine tub and the like, which comprises causing relative movement between the peripheral portion to be formed and forming units having complemental effective forming surfaces, maintaining the extreme peripheral edge portion of the unit beyond a plane defined by one edge of the effective forming surfaces of the forming units, subjecting the rim portion adjacent said extreme edge portion to a forming action whereby a portion of the metal in said rim portion is drawn away from said edge portion while said edge portion is maintained beyond said plane, and shearing off the edge portion and a part of the rim portion at the completion of the forming action.

21. A mechanism for forming rims of washing machine tubs and similar articles comprising rotating forming rolls, one being reciprocably movable relative to the other, said forming rolls having a diameter substantially smaller than a tub and having cooperating forming portions adapted to confine a localized edge portion of a tub beyond the effective surfaces of said forming portions whereby said localized portion functions as a reinforcing hold-down during the movement of one forming roll towards the other while the portions of the tub adjacent said localized edge are being formed and shearing means positioned adjacent the cooperating forming portions of said rolls for cutting off an edge portion of the tub at the completion of the forming step.

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