April 30, 1935. B. BENEDICT 1,999,229

PROCESS AND APPARATUS FOR MAKING TUBULAR SHELLS FROM SHEET METAL

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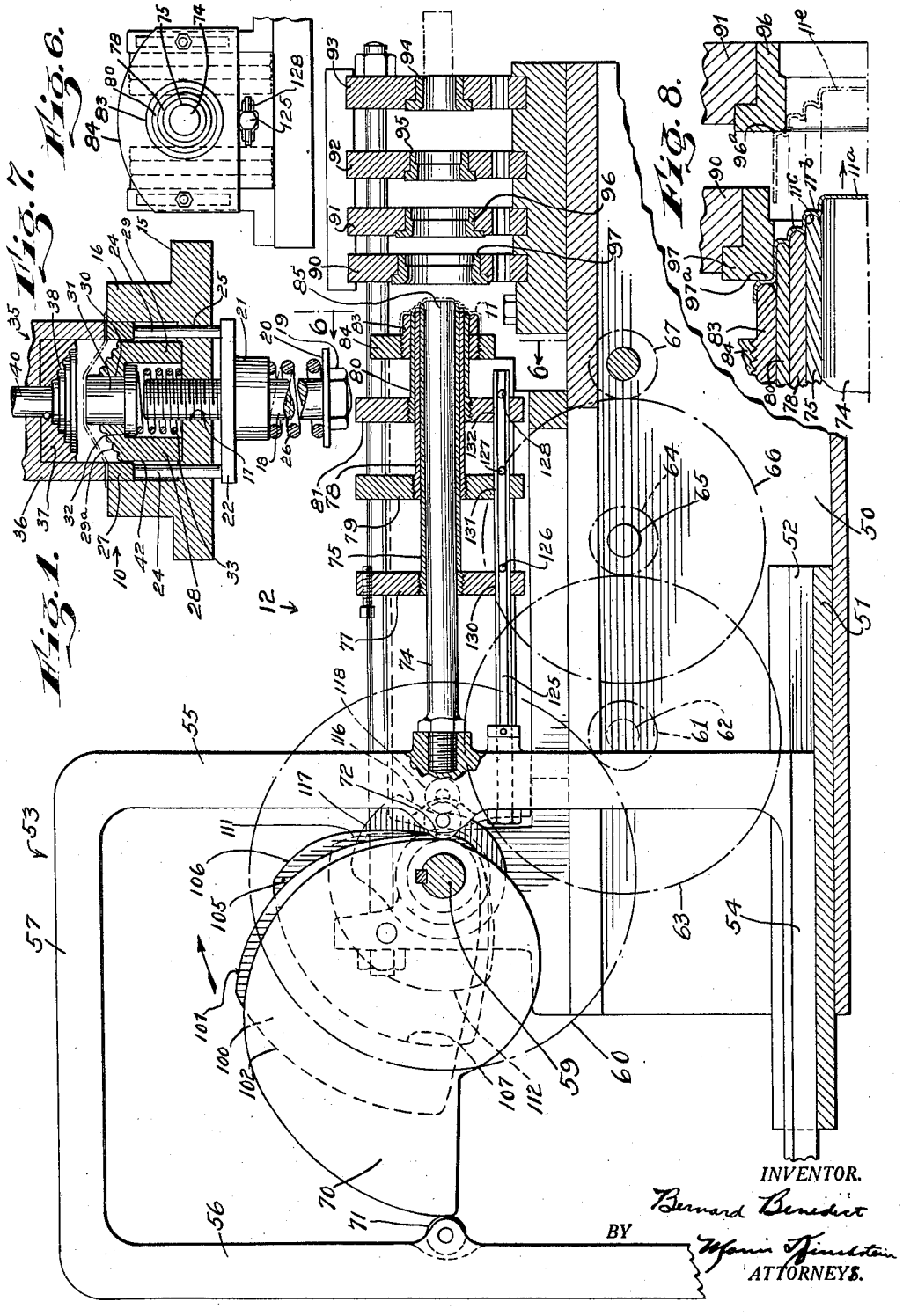


Fig. 1.

Fig. 6.

Fig. 8.

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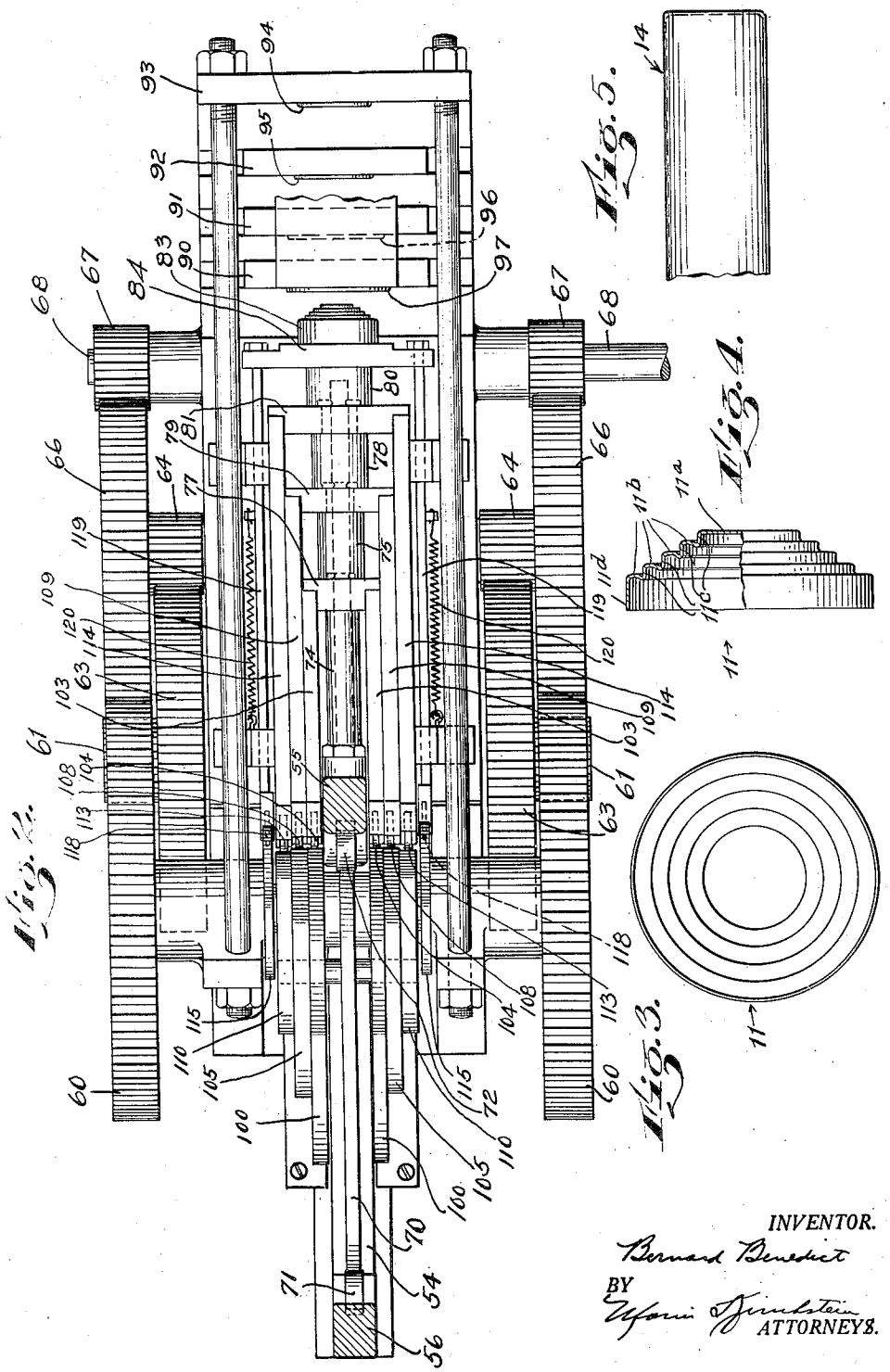


Fig. 1.

Fig. 5.

Fig. 4.

Fig. 3.

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1,999,229

PROCESS AND APPARATUS FOR MAKING TUBULAR SHELLS FROM SHEET METAL

Bernard Benedict, Jamaica, N. Y.

Application August 29, 1931, Serial No. 560,062

16 Claims. (Cl. 113—46)

This invention relates to processes and apparatus for making tubular shells, such as battery electrodes and the like articles, from flat sheet metal.

An object of this invention is to provide a process whereby sheet metal such as steel and the like metals may be formed into tubular shells without unduly stretching the metal or disturbing the grain thereof and in a continuous operation without necessitating annealing or the like intermediate softening operations, whereby such tubular shells may be made easily, efficiently and economically.

A further object of this invention is to provide a highly improved apparatus of the character described, for forming seamless cups or shells of hard metal, such as steel, copper, iron and brass, which shall be smooth and positive in action, comprise comparatively few and simple parts, which shall be relatively inexpensive to manufacture and yet practical and efficient to a high degree in use.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

The invention accordingly consists in the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the construction hereinafter described, and of which the scope of application will be indicated in the following claims.

In the accompanying drawings in which is shown one of the various possible illustrative embodiments of this invention,

Fig. 1 is an elevational, cross-sectional view of the apparatus embodying the invention;

Fig. 2 is a top plan view of the apparatus shown in Fig. 1 with parts of the yoke in cross-section;

Fig. 3 is an end view of the cup formed with the die mechanism embodying my invention and illustrating an intermediate step in the formation of the finished shell;

Fig. 4 is a side elevational view partially in cross-section of the cup shown in Fig. 3;

Fig. 5 is a side elevational view (partly broken away) of the finished shell formed with my improved apparatus and process;

Fig. 6 is a view taken on line 6—6 of Fig. 1;

Fig. 7 is an elevational, cross-sectional view of the die mechanism embodying my invention for forming the cup shown in Fig. 3; and

Fig. 8 is an elevational, cross-sectional view illustrating an intermediate position of a portion of the apparatus shown in Fig. 1, showing intermediate positions of the plungers.

Referring now in detail to the drawings, 10 designates a die embodying the invention for making the cup 11 shown in Figs. 3 and 4, from flat sheet metal; and 12 designates the drawing apparatus embodying the invention for making the tubular shell 14 of said cup 11. The die 10 comprises a base plate 15 formed with an upwardly extending, integral cylindrical flange 16 and an axial screw-threaded opening 17. Screwed in said opening 17 and extending downwardly from the plate 15 is a rod 18 provided with a nut 19 at the lower end thereof and a washer 20 resting on said nut. Slidably mounted on said rod 18 is an annular member 21 having a flange portion 22. Upstanding from and fixed to said flange 22 are a plurality of pins 24 slidably extending through parallel openings 25 formed in said plate 15. A strong coil compression spring 26 interposed between the member 21 and the washer 20 serves to normally urge the member 21 into contact with the underside of the plate 15. The pins 24, as clearly shown in Fig. 7, are disposed on the inside of the cylindrical wall 16, and are preferably of equal height. A ring member 27 may be supported on the top ends of said pins, and preferably has a sliding fit with the inner wall of said flange 16.

Mounted on the plate 15 and within the flange 16 is a male die member 28 having a cylindrical portion 29 provided with an upper stepped die portion 29a. The surface 29a is formed with radially or transversely curved annular steps, the steps decreasing in diameter toward the top. Preferably, each step is formed with a cylindrical side surface and with an annular top surface, of substantially semi-circular cross-section. The die portion 29a is preferably formed with an axial cylindrical opening 30 slidably receiving a plunger member 31 having an integral flange 32 contacting the inner horizontal surface of the die and forming the top step of the die member 28. The top edge of the plunger may likewise be curved similarly to the other steps of the die. A coil compression spring 33 interposed between the plate 15 and the underside of the member 31, serves to normally lift said member 31. Preferably, however, in the lifted position shown in Fig. 7, the plunger 31 forms a taller step than the remaining steps of the die.

A complementary punching and die member 35 is suitably mounted for vertical sliding movement for coaction with the die member 28. Said member 35 comprises an outer annular member 36 adapted to register with the ring member 27. Slidably mounted within the member 36 is the

female die portion 37 having steps 38 similarly shaped and adapted to cooperate with the steps of die portion 29a. A rod 40 may be fixed to said member 37 so that after the cup 11 is formed in the manner hereinafter described, the rod 40 may be pushed downwardly in any suitable manner to lower said die member 37 and release the cup.

The method of forming said cup 11 with the die mechanism or press 10 will now be described. A piece of flat sheet metal is placed on top of the plunger 31 (with the punch and die member 35 lifted away from the lower die member 28). Said member 35 is then lowered first to the position shown in Fig. 7. This operation causes the sheet plate to bend into the form shown in Fig. 7. The spring 33 retains the plunger 31 in lifted position so as to draw the metal inwardly and form a frusto conical surface shown in dotted lines in Fig. 7.

The formation of said conical surface provides extra metal to permit formation of the curved steps without causing undue strain on the metal. Continued downward movement of the member 35 will thereafter cause the sheet metal to be sheared or punched annularly at the outer edge of the cylindrical portion 36, and the formation of the steps when the die portions 29a and 38 are pressed together. During this action, the plunger 31 will be pushed downwardly against the spring 28; and the ring 27 will also be pushed down and the spring 26 compressed. The resulting cup 11 will be formed with a circular bottom wall 11a, with four annular transversely curved portions 11b and with four cylindrical annular portions 11c, and an outer cylindrical flange 11d. The portion 11a and the portion 11c adjacent thereto, and the interconnecting curved corner portions are formed by the plunger 31, and the annular portion 11d is formed by the die portion 36, which is somewhat spaced from the outer cylindrical surface 42 of the lower die member 28. The cup shaped member 11 may thereafter be removed from the die by lowering the rod 40. Said cup shaped member thus preformed from the flat metal sheet is then formed into the shell 14 on the apparatus 12 in the manner hereinafter described.

Said apparatus 12 comprises a supporting frame 50 provided at the bottom thereof with a fixed guide 51 having a horizontal longitudinal groove 52.

Slidably mounted on said guide 51 is a substantially rectangular yoke 53 having a bottom wall 54 received within the groove 52, a front upright wall portion 55, a rear upright wall portion 56 and a top portion 57. For reciprocating said yoke 53, there is provided a horizontal shaft 59 suitably journalled on the frame 50. Mounted on the outer ends of the shaft 59 are similar gears 60 meshing with small gears 61 mounted on shafts 62 suitably journalled on opposite sides of the frame 50. Fixed to said shafts 62 are large gears 63 meshing with small gears 64 mounted on shafts 65 likewise suitably journalled on opposite sides of the frame 50. Fixed to said shaft 65 are large gears 66 meshing with gears 67 mounted on a common shaft 68, connected to any suitable driving mechanism. Thus, the driving shaft 68 is connected through the balanced reducing gears 61, 63, 64, 66 and 67, to the shaft 59.

Mounted on said shaft 59 is a 180° rock-cam 70 interposed between rollers 71 and 72 suitably mounted on the rear and front walls 56 and 55 respectively of the yoke. Thus, upon rotating the shaft 59 in the direction shown by the arrow, in Fig. 1, the yoke will be reciprocated back and forth, since the cam will engage one roller during 180° rotation and another roller during the next 180° rotation. Attached to the wall 55 of the yoke is a horizontal central plunger 74 extending forwardly therefrom, for the purpose hereinafter described.

Slidably mounted on said plunger 74 is a tubular plunger 75 to the rear end of which is screwed a disc 77. Slidably mounted on the tubular plunger 75, is a tubular plunger 78 to the rear end of which there is screwed a disc 79 and slidably mounted on said plunger 78 is a plunger 80 to the rear end of which there is screwed a disc 81, and slidably mounted on the plunger 80 is a tubular plunger 83 to the rear end of which there is screwed a disc 84. The plungers 74, 75, 78, 80, and 83 are of successively increasing diameter as shown in Fig. 1, and the discs 77, 79, 81 and 84 are normally spaced from one another. The diameter of the plunger 74 is substantially equal to the diameter of the plunger 31 so that the front end 85 thereof may fit within the smallest step 11a, 11c of the cup 11. The forward ends of plungers 75, 78, 80 and 83 are of semi-circular transverse cross-section. In normal position, the forward ends of the plungers are such that the cup 11 may be fitted over the curved ends of said plungers for contacting the same. Thus, the five plungers will contact the entire inner surface of the cup so that the cup may be tightly fitted on said plungers as shown in Fig. 1 of the drawings.

The plungers are adapted to be advanced in the manner hereinafter described, for cooperation with spaced die members 90, 91, 92 and 93, fixedly secured to the frame 50 in any suitable manner. The member 93 is provided with a ring 94 having a somewhat greater inner diameter than the outer diameter of inner or central plunger 74, to allow for the thickness of the shell 14 to be formed. The member 92 is provided with a ring 95 having an inner diameter likewise somewhat greater than the outer diameter of the plunger 75. The member 91 is provided with a ring member 96 having an inner diameter somewhat greater than the outer diameter of the plunger 78, and the member 90 is provided with a ring member 97 having an inner diameter somewhat greater than the outer diameter of the plunger 80. The ring members 94, 95, 96 and 97 are preferably made of hard metal and are coaxial with one another and with the plungers.

Means is provided for advancing all of the plungers simultaneously until the forward end of the plunger 83 of largest diameter presses the outer annular ring portion 11b of the cup 11 against the adjacent surface 97a of the ring 97; for thereafter simultaneously advancing the plungers 74, 75, 78, and 80 until the forward end of the plunger 80 presses the next annular portion 11b of the cup 11 against the surface 96a of the ring 96; then simultaneously advancing the plungers 78, 75 and 74 forwardly until the forward end of the plunger 78 presses the next annular portion 11b of the cup 11, against the ring 95; then simultaneously advancing the plungers 74, 75 until the forward end of the plunger 75 presses the next portion 11b against the ring 94 and then finally advancing the plunger 74 alone until the completed tubular shell 14 is formed.

To this end there is fixedly mounted on the shaft 59 on opposite sides of the central cam 70, a pair of similar cams 100, each of said cams having a cammed surface 101 and a dwell or circular surface 102. Fixed to the disc 77 on opposite sides of the yoke 55 are parallel rearwardly extending plates 103 to the rear ends whereof are attached rollers 104 adapted to contact the cam 100, so that upon rotating the shaft 59, the cammed surface 101 will first engage the rollers 104 for pushing the plates 103 and consequently the disc 77 forwardly, until the dwell portion 102 of the cam engages the rollers. Obviously, during the period of contact between the dwell portion 102 and the rollers, the disc 77 will not be advanced. Fixedly mounted on said shaft 59 on opposite sides of the cams 100 are a pair of similar cams 105 each likewise provided with a cammed surface 106 and a dwell surface 107. Said cams 105 are adapted to coact with the rollers 108 mounted at the ends of parallel plates 109, disposed on opposite sides of plates 103 and fixed at the forward ends thereof to the disc 79. A pair of similar cams 110 mounted on said shaft 59 on opposite sides of the cams 105 are likewise provided with cammed surfaces 111 and dwell surfaces 112, and are adapted to cooperate with rollers 113 fixed at the ends of parallel plates 114. Plates 114 are disposed on opposite sides of plates 109 and are likewise fixed at the forward ends thereof to the next disc 81 so that said disc will be advanced upon rotating the shaft 59. A pair of cams 115 are likewise mounted on the shaft 59 and provided with cammed surfaces 116 and dwell surfaces 117. Said cams 115 are adapted to cooperate with rollers 118 mounted at the rear ends of parallel rods 119, the forward ends of said rods being fixed to the front disc 84.

The cams 70, 100, 105, 110 and 115 are so arranged that as the shaft 59 is rotated, the yoke 53 with its central plunger 74 will begin moving together with the discs 77, 79, 81 and 84. This simultaneous movement of all the plungers will continue until the dwell portions 117 of the smallest cams 115 engage rollers 118 of the rods 119. At this point, the plunger 83 will press the cup against the first ring 97, thereafter, the disc 84 and its plunger 83 will not be advanced, but the four inner plungers will continue movement together until the dwell portion 112 of the cam 110 engages its rollers 113, and the forward end of the plunger 80 presses the cup against the next ring 96. During this last named movement, the portion 11*d* of the cup and the outer transversely curved annular portion 11*b* of the cup have been shaped to form the cup 11*e* shown in dotted lines in Fig. 8, thus reducing the outer diameter of the cup by one step. The portion 11*d* and the outermost curved annular portion 11*b* of the cup are shaped or formed around the surface 97*a* of the ring 97 and the cup is reduced in diameter by one step.

Continued movement of the shaft 59 will cause the three inner plungers 78, 75 and 74 only to be simultaneously advanced until the dwell portions 107 of the cams 105 engages rollers 108 and the cup is pressed against the ring 95. The three outer plungers then remain stationary and the two inner plungers are advanced for eliminating another outer step of the cup until the dwell portions 102 of the cams 100 contact the rollers 104. The plunger 75 then in turn becomes stationary and the inner plunger 74 alone is advanced by the action of the cam 70 for drawing the final step of the cup and producing the tubular shell 14. In advanced position, the discs 77, 79, 81 and 84 are substantially in contact with one another. Thus, the operation of the apparatus 12 thus far described shapes out the steps successively beginning with the outer step to form the cup into a tubular shell by holding each step in a sliding grip between the several plungers and rings while gradually forcing said step out of said grip.

The entire action in forming the shell 14 from the cup 11 occurs during 180° rotation of the shaft 59. During the second half of the turn, or the next 180°, the yoke 53 is returned to its original position, drawing therewith the plunger 74. The outer disc 84 is returned to its original position by means of tension springs 120 attached at the forward ends thereof to the rods 119 and at the rear thereof to fixed portions of the frame 50. For returning the discs 77, 79, and 81 to their original positions, shown in Fig. 1, there is provided a rod 125 fixed at the rear end thereof to the wall 55 of the yoke 53. Attached to said rod are cross members 126, 127 and 128 normally disposed in front of said discs 77, 79 and 81 respectively. The disc 77 has a bore 130 to permit the rod 125 to slide therethrough, and the cross piece 126 is adapted to engage the front surface of said disc 77, for returning said disc to its original position upon drawing the yoke rearwardly. The disc 79 likewise has a bore 131 of sufficient width to permit the cross piece 126 to pass therethrough. The cross piece 127 however, is somewhat longer than the cross piece 126 so that upon moving the yoke rearwardly, the cross piece 126 will pass through said opening 131 and the outer ends of the cross piece 127 will engage the disc 79 for moving the same rearwardly. The disc 81 is provided with an opening 132 large enough to permit both the cross pieces 126 and 127 to pass therethrough, but the cross piece 128 is somewhat longer than the cross piece 127 so that the outer ends of the cross piece 128 will engage the disc 81 for moving the same rearwardly upon returning the yoke to its rearward position.

Thus after all of the plungers are advanced to the forward position for forming the tubular shell 14, the rearward movement of the yoke 53 will retract the central plunger 74 as well as the rod 125. Upon moving the yoke 53, the plunger 74 and the rod 125 rearwardly, the cross piece 126 will pass through the openings 132 and 131 in the discs 81 and 79 respectively. The cross piece 126 is adapted to contact the disc 77 for moving said disc, together with its plunger 75 rearwardly. This movement continues until the cross piece 127, which is adapted to pass through the opening 132 in the disc 81, contacts the disc 79 for moving the same together with its plunger 78, rearwardly. The yoke 53 and plungers 74, 75, and 78 then move rearwardly together until the cross piece 128 engages the disc 81 for also moving said disc together with its plunger 80 rearwardly. During this latter movement, the disc 84 with its plunger 83 will also be moved rearwardly by the springs 120. The disc 84, however, will stop in the normal rearward position thereof, as shown in Fig. 1, and the disc 81, together with the discs 79, 77 and plungers 78, 75 and 74 continue movement rearwardly until the yoke 53, the discs 77, 79 and 81, and the plungers reach their normal rearward positions.

It will thus be noted that the plunger 74 moves rearwardly until the plunger 75 is carried rearwardly therewith, and thereatfer the plungers 74, 75 move rearwardly together until the plunger 78 begins moving rearwardly. Thereafter the three

inner plungers 74, 75, 78 move rearwardly together until the plungers 80 and 83 begin to move rearwardly therewith. Thereafter all of the plungers move rearwardly together until the disc 84 reaches its rearward position. Thereafter, the four inner plungers move rearwardly together until they all reach their rearward normal positions. The frame 50 is provided with suitable stop means to retain the discs 77, 79, 81 and 84 in the rearward positions thereof.

Obviously after the shell 14 is formed, the same may be removed from the forward end of the plunger 74 in any suitable manner and the rear rough edge thereof may be suitably trimmed. The shell 14 obviously may be made for a large variety of uses, such as cartridge shells, cups and the like.

A dominant feature of the invention is the making of the cup 11 having transversely curved, annular steps, and thereafter forming the shell 14 by eliminating the steps, one step at a time, beginning with the outermost step. The curved portions 11b of the steps provide sufficient metal so that during the forming processes on the machine 12, excessive strain due to stretching of the metal is substantially eliminated, and the compression on the metal during the forming processes which usually hardenes the metal and renders the same brittle, is greatly reduced. The tube 14 may thus be formed without the metal hardening to such a degree as to become brittle or breaking or cracking, and the steps may hence be shaped out without the necessity for annealing. The steps of the cup 11 may thus be shaped out or eliminated successively without interrupting the processes for annealing purposes. The curvature of the portions 11b supplies the extra metal necessary, so that the steps may be shaped out by the action of the plungers and rings of the machine 12 without actually causing a high degree of stretching of the said metal, which often causes defects and breakage during the forming processes. Obviously, the curved, radial portions 11b of the cup may be angular or corrugated, or otherwise suitably shaped, and the dies 29a and 37 and the ends of the plungers correspondingly shaped to provide the cup with extra metal. In other words, the portions 11b should be of transverse non-rectilinear cross-section. Furthermore the provision of the curved or transversely non-straight surfaces 11b provides sufficient metal so as to prevent the thinning of the metal during the forming processes, usually resulting from stretching.

Another dominant feature of the invention is that the movable plunger 31 in the die 10 forming a frusto-conical surface prior to the dieing operation provides a sufficiency of metal to relieve the strain caused during the dieing operation.

My improved process and apparatus is particularly adapted for hard metal such as sheet steel which with methods or apparatus heretofore known cannot be drawn into cups of considerable length as compared with their diameter without intermediate annealing and other practical difficulties and disadvantages. With my improved process and apparatus, I have found it possible to form sheet steel, for example, into a shell of length equal to approximately three times its diameter with a continuous operation without annealing or interruption and without rupture of the metal.

It will thus be seen that there is provided a device in which the several objects of this invention are achieved, and which is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiment above set forth, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. The art of making tubular metal forms from sheet metal consisting in preforming from the sheet a cup having a plurality of annular steps, and then shaping out the steps successively beginning with the outer step by holding each step in a sliding grip while gradually forcing said step out of said grip to form said cup into a tubular shell.

2. The art of making tubular metal forms from sheet metal consisting in preforming from the sheet a cup having a plurality of annular steps having radial portions of non-rectilinear cross-section, and then shaping out the steps successively beginning with the outer step by holding each step in a sliding grip while gradually forcing said step out of said grip to form said cup into a tubular shell.

3. The art of making tubular shells from flat sheet metal consisting in preforming from the sheet a cup having a plurality of radially non-rectilinear annular portions and interconnected by annular cylindrical portions and constituting annular steps, then shaping out the steps beginning with the outer step by holding each step in a sliding grip while gradually forcing said step out of said grip to reduce the diameter and increase the depth of the cup.

4. The art of making tubular shells from flat sheet metal consisting in preforming from the sheet a cup having a plurality of radially non-rectilinear annular portions and interconnected by annular cylindrical portions and constituting annular steps, then pressing against opposite sides of one step and against one side of the contiguous annular step of lesser diameter for shaping out the first mentioned step, and repeating this operation for the next step.

5. The art of making tubular shells from flat sheet metal consisting in preforming from the sheet a cup having a plurality of radially non-rectilinear annular portions and interconnected by annular cylindrical portions and constituting annular steps, then pressing against opposite sides of one step and against one side of the contiguous annular step of lesser diameter for shaping out the first mentioned step, and repeating said operation successively on each annular portion until all of the steps have been shaped out.

6. The art of making tubular metal forms consisting in die stamping a disc to preform a cup having a plurality of annular steps and thereafter shaping out the steps successively beginning with the outer step by holding each step in a sliding grip while gradually forcing said step out of said grip to form said cup into a tubular shell.

7. The art of making tubular metallic forms consisting in die stamping a disc to preform a cup having a plurality of annular steps having radial portions of non-rectilinear cross-section, and thereafter shaping out the steps successively beginning with the outer step by holding each step in a sliding grip while gradually forcing said step out of said grip to form said cup into a tubular shell.

8. The art of making tubular shells from flat sheet metal consisting in forming a disc of metal into a frusto-conical cup, then die stamping said cup to preform a plurality of annular transversely curved steps thereon, and then shaping out the steps successively beginning with the outer step by holding each step in a sliding grip while gradually forcing said step out of said grip to form the tubular shell.

9. The art of making tubular shells from flat sheet metal consisting in die punching a sheet to preform a cup having a plurality of radially non-rectilinear annular portions interconnected by annular cylindrical portions and constituting annular steps, and then shaping out the steps, beginning with the outer step, by holding each step in a sliding grip while gradually forcing said step out of said grip to reduce the diameter and increase the depth of the shell.

10. The art of making tubular shells from flat sheet metal consisting in die punching a sheet to preform a cup having a plurality of radially non-rectilinear annular portions interconnected by annular cylindrical portions and constituting annular steps of successively decreasing diameter, then clamping one of said non-rectilinear portions between two annular members disposed on both sides of said portion, and then pressing a plunger against the inner surface of the next non-rectilinear portion of lesser diameter for shaping out the first mentioned non-rectilinear portion.

11. The art of making tubular shells from flat sheet metal consisting in preforming a cup having a plurality of steps of successively decreasing diameter, each step comprising a non-rectilinear portion and an annular cylindrical portion, and then pressing a non-rectilinear portion of one of said steps against an annular ring and forcing a member against the non-rectilinear portion of the next step of lesser diameter for shaping out the first named step.

12. In apparatus of the character described, a central plunger, a plurality of tubular telescoping plungers slidably mounted thereon, said tubular plungers being of successively decreasing length, discs at the rear ends of said tubular plungers, a member attached to the rear of said central plunger, cammed means for moving said member, a rod attached to said member, parallel to said central plunger and having a plurality of spaced, cross pieces thereon, each cross piece being adapted to engage one of said discs, each disc being formed with an opening adapted to permit the crosspiece for each of said discs rearwardly thereof, to pass therethrough.

13. In apparatus of the character described, a central plunger, a plurality of tubular telescoping plungers slidably mounted thereon, a yoke attached to the rear of said central plunger, cammed means for advancing said yoke, and a plurality of cams associated with said cammed means for advancing said tubular plungers in predetermined relation to said first plunger, and a member associated with said yoke and having a lost motion connection with said tubular plunger for moving said tubular plungers rearwardly to the normal rearward positions thereof.

14. In apparatus of the character described, a plurality of slidably mounted telescoping plungers the ends of said plungers forming a stepped annular surface adapted to receive a cup formed with a series of annular steps, fitted thereon, a plurality of fixed, spaced annular rings of gradually decreasing diameter, coaxial with said plungers and disposed forwardly thereof, means for advancing said plungers until the outer plunger presses the outer step of said cup against the first ring of greatest diameter, means for thereafter retaining the first plunger stationary, and advancing the remaining plungers simultaneously for shaping out the outer step of said cup, until the next inner plunger presses the next step of the cup against the next ring of lesser diameter, then holding the two outer plungers stationary and advancing the remaining inner plungers for shaping out the next step of the cup, until the next inner plunger presses the next step of the cup against the next ring of said still lesser diameter.

15. In apparatus of the character described, a plurality of slidably mounted telescoping plungers, the ends of said plungers forming a stepped annular surface adapted to receive a cup formed with a series of annular steps, a plurality of spaced, fixed annular ring portions of successively decreasing diameters coaxial with said plunger and disposed forwardly thereof, means for advancing said plungers simultaneously until the outer plunger presses the outer step of said cup against the first ring of greatest diameter, means for thereafter retaining the first plunger stationary, and advancing the remaining plungers simultaneously for shaping out the outer step of said cup until the inner plunger presses the next step of the cup against the next ring of lesser diameter, means for then holding the two outer flanges stationary and advancing the remaining inner plungers for shaping out the next step of the cup until the next inner plunger presses the next step of the cup against the next ring of still lesser diameter, and means for thereafter moving the plungers rearwardly to return the same to the normal rearward positions thereof.

16. In apparatus of the character described, a plurality of slidably mounted telescoping plungers having transversely, non-rectilinear end portions adapted to receive a cup formed with a series of transversely, non-rectilinear annular steps, and a plurality of fixed, spaced, annular rings of successively decreasing diameters coaxial with said plungers and disposed forwardly thereof, the ring of greatest diameter being disposed adjacent said plungers, means for advancing the plungers until the outer plunger presses the outer step of the cup against the first ring, means for thereafter retaining the first plunger stationary and advancing the remaining plungers for drawing out the outer step of the cup until the next inner plunger presses the next step of the cup against the next ring.

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