The present invention relates to an apparatus for forming sheet metal caps and has particular reference to devices for controlling the reforming of a projecting edge of such caps.

In the forming of sheet metal caps, it is sometimes advantageous to curl the projecting edge so that it will be smooth and uniform. However, it has been found that variable factors such as the thickness of the metal plate from which the cap is made, ductility and other characteristics of the plate greatly affect the curl and result in variations in certain over-all dimensions of the cap. The more easily the plate can be bent the more curl is usually formed. Hence where it is desirable or necessary to maintain a definite dimension of the cap, for example its over-all height, it is also necessary to control the amount of curl, regardless of the thickness of the plate or its ductility or other variable characteristics.

The instant invention contemplates overcoming these difficulties by providing in a die mechanism for forming a cap or other dish shaped article, devices for controlling the amount of projecting flange or curl formed on the cap or article.

An object of the invention is the provision in a sheet metal cap forming apparatus, of devices wherein the reforming of a projecting edge of a cap may be controlled in such a manner as to control a predetermined over-all dimension of the cap.

Another object is the provision of such a cap forming apparatus wherein the controlled reforming of the projecting edge of a cap may be effected as an incident to the forming of the cap.

Another object is the provision in a sheet metal cap forming die mechanism of devices wherein the pressure on the draw ring of the die mechanism during its return stroke is controlled in such a manner as to control the amount of curling of the projecting edge of a drawn cap so that control over the over-all height of the cap may be effected regardless of the thickness or ductility or other quality of the plate from which the cap is made.

Numerous other objects and advantages of the invention will be apparent as it is better understood from the following description, which, taken in connection with the accompanying drawings, discloses a preferred embodiment thereof.

Referring to the drawings:

Figure 1 is a vertical sectional view taken through a cap forming apparatus embodying the present invention, the view illustrating the relation of the parts prior to operation on a strip of sheet material, with parts broken away.

Figs. 2 and 3 are fragmentary sectional views of the apparatus illustrated in Fig. 1, showing different positions of parts of the forming apparatus during different stages of formation of the cap and the reforming of its projecting edge; and

Figs. 4 and 5 are enlarged fragmentary transverse sections of a cap produced in the forming apparatus shown in Fig. 1, the two views showing different stages in the forming of the cap.

As a preferred embodiment of the instant invention the drawings illustrate a die mechanism for first cutting a disc from a strip A of sheet metal (Fig. 1) and then drawing the disc into a cap shell B (Fig. 2) having a surrounding wall or skirt section C terminating in a projecting edge D. Following the drawing action the projecting edge D is formed with an edge curl E (Fig. 5).

The cap is then ejected from the mechanism. It will be obvious that the step of cutting may be eliminated and a previously formed disc blank or a preformed cap having a projecting edge to be reform may be used in the first instance.

The apparatus disclosed for the purpose of illustrating the invention is embodied in a standard form of press and comprises a die shoe or plate 21 (Figs. 1, 2 and 3) which is mounted on a press bed or bolster plate in the usual or preferred manner. The die shoe 21 supports an annular die cutedge 22. The cutedge is secured to the shoe by bolts 23 (Fig. 1).

Cutting and forming of the cap B from the strip A of sheet material is effected by a pair of opposed, substantially concentric, annular instrumentality having a forward and return movement and which comprise a conventional reforming or curling ring 25 disposed within the cutedge 22 and a vertically reciprocable conventional punch 26 disposed above and in alignment with the curling ring. The punch is carried in the usual manner as by a slide member which moves up and down above the die parts. This slide member forms no part of the novelty of the instant invention and illustration and further description is therefore omitted.

The lower end of the punch 26 is hollow and carries therein an annular knockout 28. The knockout is formed on a stem 29 which extends up through the punch and at its upper end carries a hardened cam shoe 31 located in a bore 32 formed in the punch. The cam shoe 31 extends above the punch and engages against a rotatable edge cam 33 which operates the knockout. A compression spring 34 coiled around the stem 29 and interposed between the cam shoe 31 and the punch 26 at the bottom of the bore 32 keeps the cam shoe in engagement with the cam 33.

The curling ring 25, disposed within the cut-
edge 22, surrounds an annular die center or anvil 35 which is supported on the die shoe 21 and securely held in place by bolts 37. The upper face of this anvil is located slightly below the upper edge of the cutedge 22.

In the normal position of the curling ring 25 as shown in Fig. 1, its upper face is flush with the upper edge of the cutedge 22. The ring is located in this position by a stop flange 38 which is formed on the ring and which engages against a shoulder 39 formed in the cutedge. In this position the curling ring is supported on the upper ends of a plurality of vertically disposed support or die pins 42 which extend down through the die shoe 21 and which at their lower ends are secured in a pin plate 43 located below the die shoe.

The pin plate 43 surrounds a threaded bolt 44 which is secured in and which depends from the die shoe 21. The plate is maintained under a predetermined pressure of an ejector spring 45 of the compression type, which surrounds the bolt and which is interspersed between the plate and a pair of lock nuts 45 carried on the bolt. The pressure of the spring against the plate may be adjusted by adjustment of the lock nuts 45 to effect a predetermined pressure on the curling ring 25.

In the operation of the mechanism, to cut and form a cap B from the strip A of sheet metal, the punch 26 moves down through a forward stroke against the strip and clamps it in a slip grip against the curling ring 25. As the punch continues to move down through this forward stroke, it depresses the curling ring against the force of the spring 45 and cooperates with the cutedge 22 to cut through the strip and thus sever a circular disc or blank therefrom. The outer marginal edge of this blank is held in the slip grip between the punch and the curling ring. The knockout 28 moves down with the punch and clamps the inner portion of the blank against the upper face of the anvil 36.

With continued forward movement of the punch, it further depresses the curling ring 25 and thereby draws or forms the blank over the anvil 36 to form the side wall or skirt C of the cap, the punch moving down over the anvil as shown in Fig. 2. Thus the cap is now disposed within the punch. This drawing action is continued until the cap is fully formed and the lower edge of the punch has passed or is adjacent to the terminal edge D of the cap. If desired this drawing action may be terminated just prior to the lower edge of the punch reaching the terminal projecting edge of the cap so as to leave a slight flange or flare on this projecting edge.

During this forward stroke of the punch, the descending reforming or curling ring 25 engages against and depresses a plurality of reforming or curling pins 51. These curling pins extend through the die shoe 21 and at their lower ends are secured in a pin plate 52. The pin plate 52 rests on a conventional rubber or other resilient hollow block 53 which surrounds the ejector spring 45. The block is held in place by washers 54, 55 and lock nuts 56 carried on the lower end of the spring bolt 41. An initial compression of the rubber block 53 is made by adjusting the lock nuts 56.

Thus as the curling ring 25 is forced down in the cutedge 22, it further compresses the rubber block 53 beyond its initial compression and thereby sets up in the rubber considerable pressure which greatly exceeds the strength of the ejector spring 45. At this point in the cycle of operation of the die mechanism, i.e. when the lower edge of the punch 26 is adjacent to the terminal projecting edge D of the drawn cap B as shown in Fig. 2, the punch ceases its downward or forward movement and begins its upward or return stroke. The knockout 28 during the forward stroke moves down into a position on top of the cap during the drawing operation and remains in this position to hold and form the anvil 36 against the return stroke of the punch.

During the return stroke of the punch 26 the projecting edge D of the cap B is reformed to produce the edge curl E (Fig. 5) hereinafter mentioned while the knockout 28 holds the cap in place on the anvil 36. For this purpose the inner, upper edge of the curling ring 25 is formed with a conventional curling recess or die 61 (Figs. 1, 2 and 3) which is in vertical alignment with the projecting edge D of the cap B when the latter is on the anvil 36.

On the up or return stroke of the punch 26, the built up pressure in the rubber block 53 forces the curling ring 25 upwardly with the punch, keeping the ring in engagement with the punch and forcing the curling die 61 against the projecting edge D of the drawn cap B. Thus as the curling ring moves up, its curling die 61 reforms the projecting edge D into the edge curl E (Figs. 3 and 5).

 Provision is made for limiting the curling action so that this action will be stopped a predetermined distance from the top face of the anvil 36 by a manner control may be had over the height dimension of the cap regardless of the thickness of the material from which the cap is made or the ductility of this material. Thus this height dimension may be constantly maintained and all caps made in this mechanism will be the same height.

This control of the amount of curling of the projecting edge D of the drawn cap is brought about by a stop element 53 which preferably is interspersed between the bottom of the die shoe 21 and the top face of the pin plate 52 of the rubber 53. In the instant mechanism as disclosed in the drawings, the stop element 53 is in the form of a sleeve or bushing which surrounds the curling ring pins 51. There is one bushing for each pin. The lower ends of the bushings are threaded and engage in a threaded bore 54 formed in the pin plate 52 so that the bushings may be adjusted vertically. A lock nut 55 is provided on each bushing for locking the bushings in an adjusted position.

Thus the stop element bushings 53 may be adjusted to limit within a predetermined range, the upward travel of the pin plate 52 against the pressure of the rubber block 53 and hence through the pins 51 control the curling action of the curling ring die 61. As shown in Fig. 3 this limiting action is brought about by the upper end of the stop sleeve 63 coming into engagement with the bottom of the fixed die shoe 21. This engagement stops further upward movement of the pin plate 52 and the pins 51 and thus the pressure of the rubber block 53 becomes ineffective against the curling ring 25.

Since the ejector spring 45 purposely is made weaker than the available pressure of the rubber block 53 so that this spring can not continue the curling action, the forming of curl thus ceases when the stop elements 53 engage the fixed die shoe 21 and the height of the cap is thus maintained. However the ejector spring 45 continues.
to press the pins 42 against the bottom of the curling ring 28 and as soon as the knockout 29 releases its hold on the cap B and starts to move up with the punch, the ejector spring 45 further lifts the curling ring and thus ejects the finished cap from the anvil. The cap usually clings to the punch and when the punch is high enough in its up travel, the knockout operates to eject the cap from the punch to any suitable place of deposit.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

I claim:

1. In a cap forming apparatus, the combination of a die shoe, a support mounted on said die shoe for a cap having a projecting edge, a reforming and ejecting ring surrounding said support and movable relative thereto for engagement with the projecting edge of said cap, a plurality of said pins engaging and supporting said ring, a reforming pin plate located below said die shoe, support pins carried by said ejector pin plate and having sliding movement in said die shoe, said support pins engaging and supporting said ring, a reforming pin plate located below said die shoe, reforming pins carried by said reforming pin plate and having sliding movement in said die shoe, for pressure engagement with said ring, means operating against said reforming pin plate and acting through said reforming pins for forcing said ring upward against said support pins for further forcing said ring upward against said projecting cap edge to eject said cap from the apparatus after the reforming of its projecting edge.

2. In a cap forming apparatus, the combination of a die shoe, a support mounted on said die shoe for a cap having a projecting edge, a reforming and ejecting ring surrounding said support and movable relative thereto for engagement with the projecting edge of said cap, a plurality of adjustable stop elements disposed between said die shoe and said reforming pin plate and limiting the travel of said ring toward the projecting edge of said cap under the action of said resilient member for limiting the reforming action on said projecting edge for maintaining a predetermined dimension of said cap, and resilient means of a strength less than that required to effect a reforming action on the projecting edge of said cap and operating against said ejector pin plate for forcing said ring against said projecting edge for ejecting said cap from the apparatus after the reforming of said projecting edge.

3. In a cap forming apparatus, the combination of a pair of opposed, substantially concentric punch and ring members having a forward and a return movement and clamping a disc positioned therebetween in a slip grip, an anvil coactive with said members during their forward movement for drawing said disc from between the slip grip of said members and into one of them thereby shaping the disc into a cap having its edge left projecting, pressure means acting against said ring member during the return movement of said members and forcing said ring member against said projecting edge of said cap for reforming said edge, stop means controlling the action of said pressure means for controlling the reforming of said cap edge to maintain a predetermined height dimension of said cap, and auxiliary pressure means having a strength less than that required to reform the projecting edge of said cap and operating against said ring member during its return movement and forcing said ring member against said projecting edge for ejecting said cap from said anvil after the reforming operation.

4. In a cap forming apparatus, the combination of a die shoe, a support mounted on said die shoe for a cap having a projecting edge, a reforming and ejecting ring surrounding said support and movable relative thereto for engagement with the projecting edge of said cap, a plurality of pins slideable in said die shoe for supporting said ring, a reforming pin plate and having sliding movement in said die shoe, said support pins engaging and supporting said ring, a reforming pin plate located below said die shoe, reforming pins carried by said reforming pin plate and having sliding movement in said die shoe, for pressure engagement with said ring, means operating against said reforming pin plate and acting through said reforming pins for forcing said ring upward against said projecting cap edge to reform the same, and resilient means of a strength less than that required to effect a reforming action on the projecting edge of said cap and operating against said ejector pin plate through said support pins for further forcing said ring upward against said projecting cap edge to eject said cap from the apparatus after the reforming of its projecting edge.

5. In a cap forming apparatus, the combination of a die shoe, a support mounted on said die shoe for a cap having a projecting edge, a reforming and ejecting ring surrounding said support and movable relative thereto for engagement with the projecting edge of said cap, a plurality of pins slideable in said die shoe for supporting said ring, a reforming pin plate and having sliding movement in said die shoe, said support pins engaging and supporting said ring, a reforming pin plate located below said die shoe, reforming pins carried by said reforming pin plate and having sliding movement in said die shoe, for pressure engagement with said ring, means operating against said reforming pin plate and acting through said reforming pins for forcing said ring upward against said projecting cap edge to reform the same, and resilient means of a strength less than that required to effect a reforming action on the projecting edge of said cap and operating against said ejector pin plate through said support pins for further forcing said ring upward against said projecting cap edge to eject said cap from the apparatus after the reforming of its projecting edge.
gaged thereby to further lift said ring to eject the reformed cap from said cap support.

6. In a cap forming apparatus, the combination of a pair of opposed, substantially concentric punch and ring members having a forward and a return movement and clamping a disc positioned therebetween in a slip grip, a die shoe, an anvil mounted on said die shoe and coactive with said members during their forward movement for drawing said disc from between the slip grip of said members and into one of them thereby shaping the disc into a cap having its edge left projecting, a plurality of pins slideably mounted in said die shoe and engaging said ring member, reforming pressure means acting against said pins during the return movement of said paired members and forcing said ring member against said projecting edge of said cap for reforming said edge, and adjustable stop means on said pins and engageable with said die shoe for limiting the travel of said ring member under reforming pressure for controlling the reforming of said cap edge to maintain a predetermined height dimension of said cap, and ejecting pressure means acting against said ring member for forcing said ring member against said reformed edge for ejecting said cap from the anvil.

FRANK SCIBELLI.

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