

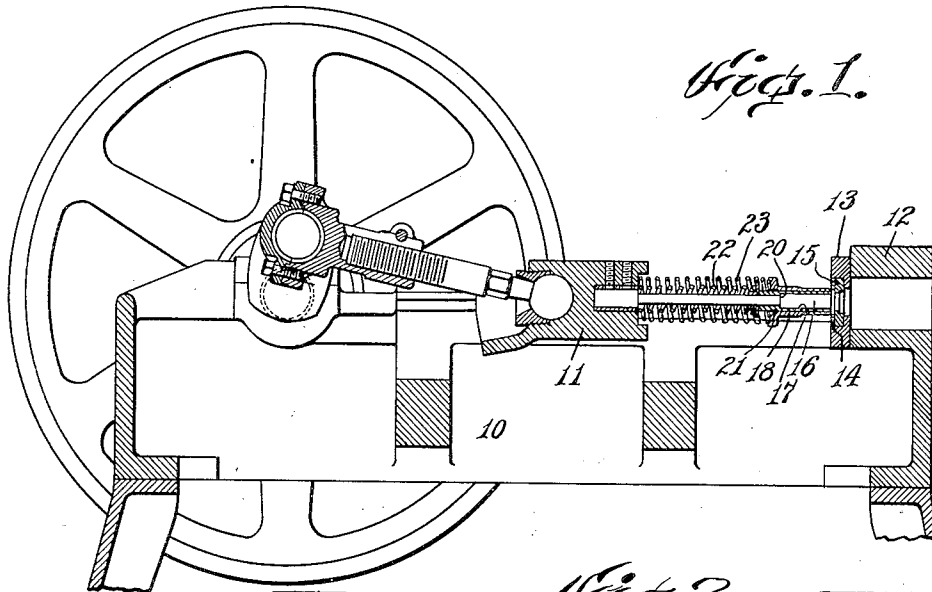
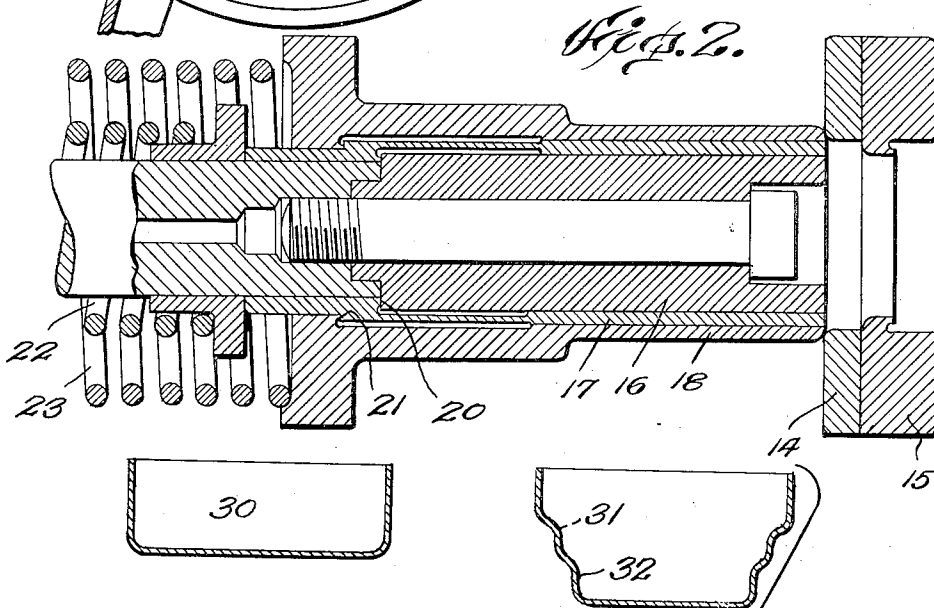
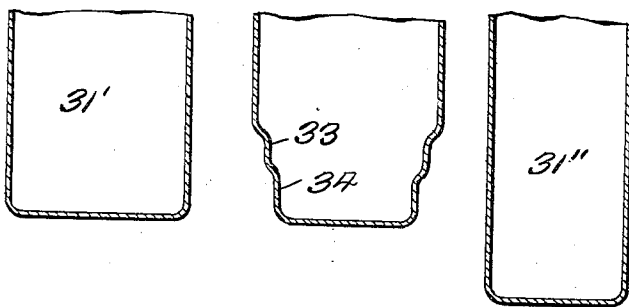
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APPARATUS FOR PRODUCING DEEP CUPS FROM SHEET METAL

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APPARATUS FOR PRODUCING DEEP CUPS
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The object of my invention is to produce deep drawn cups of sheet metal more rapidly and at less cost than has heretofore been possible and to that end my invention consists in an improved means for punch-die drawing.

Heretofore deep drawn cups of sheet metal, such for instance as battery cups of sheet zinc, have been punch-die produced in the following manner:

A flat circular sheet blank of appropriate thickness and diameter has been subjected to a punch-die comprising a one-step die, a cooperating punch capable of projecting through the orifice of the die, and a spring backed pressure sleeve associated with the punch and yieldingly held upon the periphery of the sheet during the time the punch is projected through the die to drive the sheet through the orifice of the die between the die and the pressure sleeve, the result being a cup of comparatively large diameter and comparatively shallow depth. This operation is followed by successive operations of similar one-step punch dies, each acting to produce a single diameter reduction of the cup accompanied by a corresponding increase of depth.

The heat developed in the cup by the drawing operation is a substantial element in the production of the article and therefore, in order to conserve the heat developed in one operation for its effect during the next succeeding operation it has been common practice to provide a battery of one-step punch dies through which the material is carried in rapid succession and, in the production of battery cups for the ordinary dry batteries commonly on the market, the initial cup forming operation and four successive one-step diameter reducing operations have been considered necessary so that a battery of five one-step die punches have been required to complete the operation.

Of course, by a proper substitution of punch dies in a single press, the entire cupping operation may be performed with a single press but in that case the heat developed in the cups during one drawing operation is dissipated before the cups can be subjected to a second drawing operation.

In accordance with my present invention I first reduce a sheet metal blank to a large diameter shallow cup as heretofore. This cup is then subjected to a multi-step punch-die operation, the product of this operation being subjected to successive further multi-step punch-die operations until a product of the desired reduced diameter and extended depth is attained. The

multi-step punch-die which I use is of such form that, for a major portion of the operation, diameter reduction and depth increase is being produced simultaneously at the several steps of the die so that the heat developed in the material during passage through one step of the die is immediately available at the next succeeding diameter-reduction step so that the material flows through the die with great ease and uniformity.

My present practice, in the production of common battery cups, is to provide a battery of three punch presses, the first of which produces an initial shallow cup from the blank sheet while each of the two succeeding punches effects a double-diameter reduction. Each of these double-diameter reduction presses operates a little more rapidly than single-diameter reduction presses have heretofore successfully operated, thereby materially reducing the cost of production because of the elimination of two presses and their attendants, the freeing of floor space for other equipment, and the increased rate of production.

The simultaneous multi-step diameter reduction is possible by reason of my improved multi-step punch die which consists of a multi-step die, the steps of which are axially spaced a distance less than the depth of the pre-formed cup which is presented to it, and a punch carrying a plurality of spring-backed sleeves, the outer one of which serves as a pressure sleeve for the article in its initial condition and the inner ones of which serve successively as punches for one or more steps of the die and ultimately as a spring backing for the article as it passes through one of the die steps.

The accompanying drawing illustrates my invention:

Fig. 1 is a vertical section of a punch press of common form equipped with one of my improved multi-step punch dies;

Fig. 2 is a diametrical section, on a larger scale, of one of my improved punch dies; and

Fig. 3 is a diagram showing successive steps through which a blank is carried to the ultimate product.

In the drawing 10 indicates an ordinary punch press having a reciprocating punch head 11 and a die receiver 12.

My improved die comprises a holder plate 13 and two comparatively thin drawing dies 14 and 15 of successively smaller diameters (more may be coordinated in some cases if desired).

Associated with the multi-step die is a punch comprising a central punch element 16 sized to

be projectible through the eye of the die 15, a punch and pressure sleeve 17 sleeved upon punch 16 and sized to be projectible through the eye of die element 14 and to act as a pressure element in conjunction with the eye of die 15, and a pressure sleeve 18, sleeved upon sleeve 17, and sized to act as a pressure element in conjunction with the eye of die element 14. Punch 16 is externally shouldered, and sleeve 17 is internally shouldered, as indicated at 20 so that when these shoulders are in engagement the ends of elements 16 and 17 are in the same plane. Sleeve 17 is externally shouldered and sleeve 18 internally shouldered as indicated at 21 so that when these shoulders are in engagement the ends of sleeves 17 and 18 are in the same plane.

A backing spring 22, interposed between punch head 11 and sleeve 17 serves to normally urge sleeve 17 into shouldered engagement with punch 16, and a backing spring 23, interposed between punch head 11 and sleeve 18 yieldingly urges sleeve 18 into shouldered engagement with sleeve 17.

The operation is as follows:

A pre-formed cup 30 whose internal diameter is slightly greater than the external diameter of sleeve 18, and the depth of which is generally somewhat greater than the axial thickness of either of the die elements 14 and 15, being interposed between the die and punch, the punch is driven against the cup. Sleeve 18 engages the bottom of the cup at its greatest diameter and presses it against die element 14 with a pressure determined by the strength of spring 23; sleeve 17 and punch 16 proceed through die element 14 whereupon sleeve 17 is arrested at the mouth of die element 15 and is thereafter pressed against the material at the mouth of die element 15 by spring 22, and punch 16 proceeds through the mouth of die element 15, the strengths of springs 22 and 23 are so adjusted that each of the sleeves 17 and 18 may, independently of the other, afford to the metal which is being drawn through the adjacent die element an appropriate pressure which will result in a proper flowing of the material through the structure and within the strength of that portion of the material which is contacted by the punch 16.

I think it quite probable that with some materials more than two diameter reductions may be attained at a single operation, care being exercised to provide proper clearances between the several die elements and their associated punch elements.

As the material of the cup 30 is carried through the first multi-step die the diameter of the cup is first reduced, as indicated at 31 (Fig. 3), as the material is drawn between die 14 and sleeve 18 and again reduced as indicated at 32, as the material is drawn between die 15 and sleeve 17, these operations occurring simultaneously for the major portion of the period of the complete operation and resulting in the cup 31' which is then subjected, if a cup of less diameter and greater depth is desired, by a similar multi-step reduction as indicated at 33, 34, resulting in the ultimate product 31''.

The relative strengths of the two springs 22 and 23 must, of course, be necessarily proportioned, as will be well understood by those skilled in the art, in order that just the right resistance may be offered to the passage of the metal between the elements of the punch and the die.

In practice I have found that the necessary amount of resistance to metal flow at one step of the die is not the same as that necessary at another step and the possibility of individualizing these pressures, by the use of the relatively movable pressure sleeves and individual backing springs is quite important. The use of backing springs to develop the necessary properly proportioned pressures, as distinguished from controllable fluid pressures, is also distinctly advantageous in commercial operations because the spring pressures will be uniform for successive operations and may be developed at substantial speeds wherever fluid pressures are difficult to accurately control and involve such reductions of speed of operation as to involve very substantially greater costs of production.

I claim as my invention:

1. Cup-drawing mechanism comprising a multi-shouldered die formed for a plurality of simultaneous diameter-reducing drawing operations, and a cooperating punch comprising a central punch projectible through the smallest eye of the die, and a plurality of individually spring-backed sleeves sleeved upon the central punch, the outer one of said sleeves sized to be obstructed by the largest orifice of the die and to cooperate therewith to clamp the metal to be operated upon between itself and such largest orifice, and each subjacent sleeve being sized to be projectible into the die and to cooperate with the next smallest orifice of the die to clamp the metal to be operated upon between itself and a shoulder of the die, the shoulders of the die being so axially spaced that, when the center punch enters the smallest orifice of the die the several sleeves will be simultaneously in clamping engagement with the material being operated upon.

2. Cup-drawing mechanism comprising a die having two annular drawing shoulders, one of smaller diameter than the other, and a cooperating punch comprising a central core projectible through the smaller die orifice, a sleeve sleeved upon said core and projectible into the larger diameter of the die to a position to clamp the material to be operated upon between itself and the smaller diameter shoulder of the die, a spring backing said sleeve, a second sleeve sleeved upon the first sleeve and sized to clamp the material to be operated upon between itself and the larger diameter shoulder of the die, and a spring backing, independent of the first spring backing, for said second sleeve, the two shoulders of the die being so axially positioned that, when the central punch enters the small-diameter orifice of the die, the material operated upon will be clamped between the die and both sleeves.

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