Nov. 22, 1927.

1,649,841

O. MAY

ART OF DRAWING SHEET METAL

Filed April 21, 1926

Fig. 1.

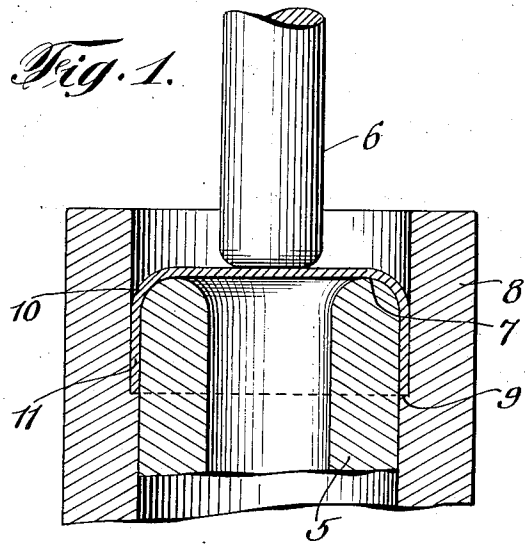


Fig. 2.

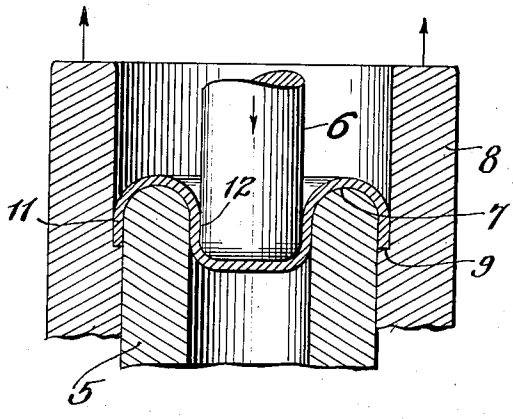
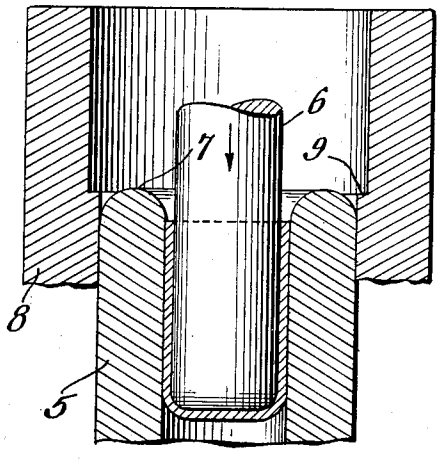


Fig. 3.



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UNITED STATES PATENT OFFICE.

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ART OF DRAWING SHEET METAL.

Application filed April 21, 1926. Serial No. 103,433.

This invention relates to the art of drawing sheet metal and similar materials, and has for its primary object to provide an improved method for drawing a sheet metal blank in the form of a relatively shallow cup of large diameter into a relatively deep shell of greatly reduced diameter in a single operation.

It is well known that in the drawing of sheet metal there is a definite limit to the possibility of reducing a blank of one diameter to a smaller diameter, or where the shell has already been drawn in reducing the same to a smaller diameter in one operation. Such limitation in the diameter reduction which is possible in a single drawing operation is due first to the fact that under the resulting stresses the material undergoes a molecular re-arrangement of its structure incident to internal compression and friction, and secondly, by reason of the fact that the surfaces of the metal sheet engaged by the pressure plate, the drawing and punching dies, are subjected to very high friction so that upon reaching the permissible limit or surpassing the same, the metal is subjected to a tearing strain by the transmission thereto of the pressure forces of the punch. Therefore, in order to obtain the greatest efficiency, it becomes necessary to first effect the reorganization of the crystalline structure of the metal by subjecting it to a proper heat treatment so that the metal structure will be capable of withstanding the high strains or stresses, and secondly, to reduce the surface friction created in the drawing operation as much as possible.

It is the purpose of my present improvements to provide a method whereby the sheet metal blank may be drawn in a single operation to a comparatively small diameter without first necessitating such a heat treatment thereof, and with practically the entire elimination of the frictional tearing strains incident to the prior art methods, to the end that a perfectly drawn shell of comparatively small diameter may be produced without the slightest indication of shrinking.

Essentially, my improved method comprehends subjecting the sheet metal blank to pressure between male and female drawing dies without the use of a pressure plate and wherein the metal sheet is drawn over the rounded edge of the hollow annular female die, and during the drawing operation relieving the metal sheet from frictional bearing contact upon the edge of the female drawing die.

With the above and other objects in view, the invention consists in the improved method of drawing sheet metal as well be hereinafter more fully explained, illustrated in the accompanying drawing, and subsequently incorporated in the subjoined claims.

In the drawing, wherein I have illustrated one simple and practical embodiment of the invention, and in which similar reference characters designate corresponding parts throughout the several views,—

Figure 1 is a more or less diagrammatic sectional view through a part of the apparatus showing the blank sheet metal form arranged in position upon the female drawing die at the start of the drawing operation;

Fig. 2 is a similar view showing an intermediate stage of the drawing operation, and

Fig. 3 is a like view showing the relative positions of the parts after the drawing operation has been completed and the blank converted into a relatively deep cylindrical shell of small diameter.

In the drawing of tubular or cylindrical sheet metal forms, it is possible to almost entirely eliminate surface friction by employing the old prior art method, commonly referred to as the "inside out" method. In other words, starting with a large diameter shallow cup-shaped blank, said blank is repeatedly drawn in reverse directions until it is finally reduced to the desired depth and diameter. Such a method is disclosed for instance, in the U. S. patent to Hodge No. 460,550, of October 6, 1891. In the use of this method however, in each drawing operation, there is a very small reduction of diameter, in order that wrinkling of the metal may be avoided. The method however, has the advantage that the stresses to which the metal is subjected are comparable to those which occur in the ordinary metal rolling process, and the material is not subjected to the severe strains or stresses which occur in the usual drawing operation by bending the metal over or upon relatively sharp corners. If it is attempted to draw the metal to final shape in one operation by rounding such sharp corners or increasing their radius, it becomes necessary to subject the metal to a very severe pressure by the pressure plate or ring, thus resulting in a corresponding increase in the frictional tearing forces to which the metal is subjected.

By means of my invention, I propose to draw the sheet metal cup shaped member to its final shape in one operation, thereby expediting the quantity production of such drawn articles over that possible in the use of the prior art process above referred to and at the same time obtain a perfectly drawn product.

To the above end, I have illustrated in the accompanying drawing a typical example of apparatus, for the purpose of elucidating the description of my new method, wherein there is provided a female drawing die 5 and a male drawing die or center punch 6. The upper edge of the annular cylindrical wall of the female die is a continuous convex surface 7 extending in an unbroken arc between and merging into the inner and outer surfaces of said die.

The female drawing die 5 is surrounded by a relatively movable metal sleeve or ring 8 having an internal annular shoulder 9. It will be understood that any desired means may be employed for axially moving the center punch 6 and the ring or sleeve 8 with respect to each other and with relation to the female drawing die 5.

In the operation of my improved method, the sheet metal blank indicated at 10 which has previously been stamped between suitable dies into shallow cup-shaped form of relatively large diameter is placed in an inverted position upon the upper rounded edge 7 of the female die 5, the annular wall of the blank extending downwardly upon the outer face of said drawing die. The center punch 6 is now moved downwardly under pressure to force the center of the blank into the bore of the female die member 5 and simultaneously the sleeve 8 is moved upwardly so that the shoulder 9 thereof engaging the lower edge of the flange 11 of the blank will exert an upward lifting force thereon, thus relieving the metal sheet as it is drawn over the convex end surface 7 of the female die of frictional pressure upon said surface. In this operation therefore, practically the only frictional pressure on the sheet metal which occurs, takes place between the opposite surfaces of the sheet metal and the side face of the male die member 6 adjacent its lower end and the inner surface of the female die 5 adjacent the juncture thereof with the rounded edge 7 of said die, or substantially at the point indicated at 12 in the drawing. This compressing pressure upon the sheet metal as it is forced into the hollow tubular female die is advantageous as it produces an ironing action which effectually eliminates any semblance of wrinkles in the metal sheet which might occur as it is drawn downwardly into the female die member. This downward movement of the center punch 6 and the upward movement of the sleeve or ring 8 continues until the drawing operation is completed so that at no time during said operation will there be any severe frictional contact of the metal sheet upon the upper rounded edge of the female die member 5. Therefore, in this single drawing operation, the large diameter metal cup is converted into the comparatively small diameter deep metal shell entirely free from wrinkles or other imperfections, as shown in Fig. 3 of the drawings.

From the foregoing description considered in connection with the accompanying drawing, my new method of drawing sheet metal in its several essential particulars, will be clearly understood. It will be seen that in so far as the perfection of the final product is concerned, I secure as good or better results as the old "inside out" method of the prior art, but with the elimination of the intermediate drawing operations. Therefore, by means of my improvement, it will be evident that quantity production of such articles can be greatly expedited and with a material decrease in expense incident to the elimination of much of the apparatus heretofore required. It will, of course be understood that the apparatus illustrated in the accompanying drawing is merely suggestive, and that the essential step of relieving the metal sheet of frictional strains in the drawing operation might be carried out in various other ways. Accordingly, it is to be understood that I reserve the privilege of resorting to all such legitimate modifications and adopting other alternative forms of apparatus for carrying out the method as may be fairly considered within the spirit and scope of the invention as claimed.

I claim:

1. The method of drawing a blank of sheet material into a cylindrical shape which consists in drawing the sheet under pressure over one end edge of a female drawing die and simultaneously applying a pressure to the sheet in a direction opposite the drawing pressure exteriorly of that portion of the sheet subjected to the drawing pressure to relieve the sheet from positive frictional contact with the end of the die.

2. The method of drawing a blank of sheet material into a cylindrical shape which consists in drawing the sheet under pressure into a female drawing die over a convex end edge thereof, and simultaneously applying a positive lifting force to the outer edge of the sheet to relieve the same of positive frictional contact with said convex end of the female drawing die.

3. The method of drawing metal sheets into cylindrical shapes which consists in first arranging a shallow cup-shaped sheet metal blank upon the rounded end edge of a female drawing die, and then subjecting the blank to the action of a center punch to

force the same under pressure into the female die and simultaneously with the movement of the center punch and continuously during the drawing operation, applying a force to relieve the metal sheet from positive frictional contact upon said rounded edge of the female die.

4. The method of drawing metal sheets into cylindrical shapes which consists in first arranging a shallow cup-shaped sheet metal blank upon the rounded end edge of a female drawing die, and then subjecting the blank to the action of a center punch to force the same under pressure into the female die, and applying an upward lifting force to the edge of the sheet metal plate continuously during the drawing operation to thereby sustain said sheet metal plate out of positive bearing frictional contact upon the end edge of the female drawing die.

5. In a sheet metal drawing apparatus, relatively movable male and female die members, said female die member having a convex edge over which the metal sheet is drawn, and means to exert continuous unbroken pressure on the metal sheet exteriorly and in a direction opposite the movement of the male die member for relieving frictional bearing pressure of the metal sheet upon said edge of the female die member during the drawing operation.

6. In a sheet metal drawing apparatus, male and female die members, one movable relative to the other, said female die member having a convex edge over which the metal sheet is drawn, and continuous unbroken pressure means, adapted to engage the metal sheet, simultaneously movable with in a direction opposite the movable die member to relieve frictional bearing pressure of the metal sheet upon said edge of the female die member during the drawing operation.

7. A method of drawing a sheet metal cup shaped member into a member of similar shape of less diameter and greater length, consisting in drawing the same under pressure into a female die over the edge thereof and simultaneously applying a positive lifting force to the edge of the cup shaped member to relieve the same of positive frictional contact with the edge of the female die.

8. The method of drawing the sheet metal cup shaped member into a member of similar shape of a less diameter and greater length consisting in drawing a member under pressure in a reversed position into a drawing die over the edge thereof and simultaneously applying a positive lifting force to the outer edge of the cup shaped member to relieve the same of positive frictional contact with the end of the female die.

In testimony that I claim the foregoing as my invention, I have signed my name hereto.

OTTO MAY.