April 10, 1945. R. E. SLATER 2,373,606

METAL DRAWING

Filed May 20, 1944

Fig. 1.

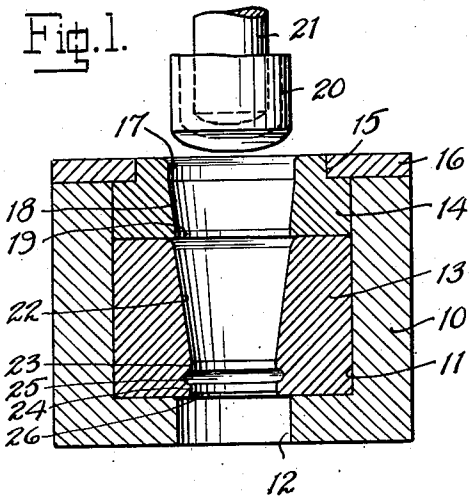


Fig. 2.

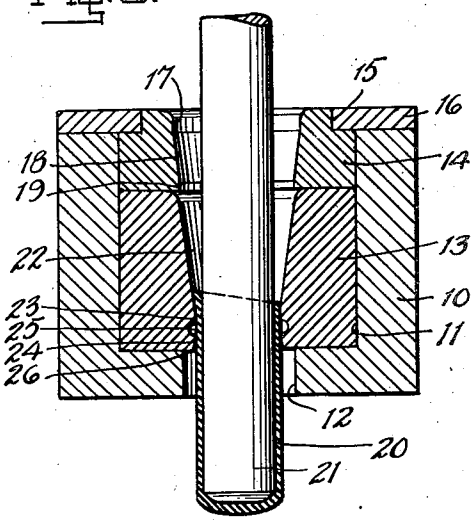


Fig. 3.

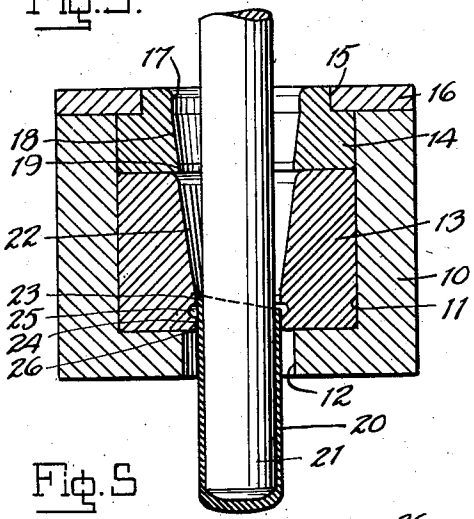


Fig. 4.

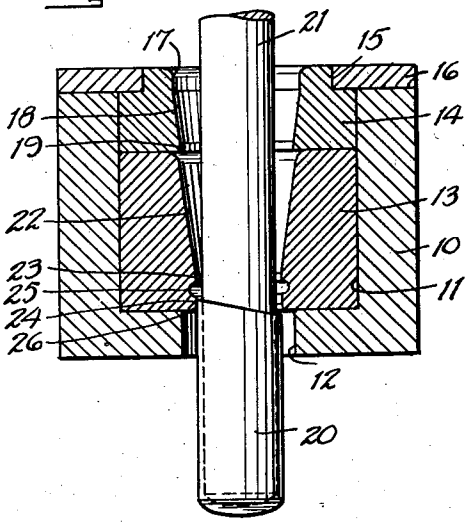
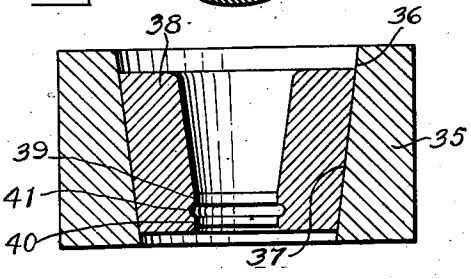


Fig. 5



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METAL DRAWING

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Application May 20, 1944, Serial No. 536,478

9 Claims. (Cl. 205—8)

The present invention relates to a drawing die, particularly for the drawing of tubular or shell shaped articles, such for instance as bullet jacket components produced by one or more drawing operations from a cup shaped blank or a previously drawn shell.

In the drawing of a tubular article the tubular wall is usually drawn to a greater height at one side than the other, this unevenness in the tube sides being due in part to the fact that the wall of the cup from which the shell is drawn is usually slightly uneven in height, and this unevenness increases with each successive drawing operation. The usual type of drawing die is provided with a relatively short land, this being necessitated in practice in order to prevent excessive frictional drag such as might occur in the case of a relatively high land. Where the height of the land is less than the maximum disparity between the high and low sides of an unevenly drawn tube the short side of the tube is drawn clear of the die land before the long side is drawn into the position of minimum clearance between the punch and the land, and a differential in pressure is therefore developed which forces the punch out of concentricity with the land diameter. In such case the punch is forced nearer the side of the land from which the short side of the drawn tube has been disengaged, so that the portion of the long side of the tube which is still to be drawn is worked to a greater thickness than the other portions of the tube. This thicker portion or lip will be deformed by bending and this bending is usually great enough to induce further bending in subsequent drawing operations. Also, as the last portions of the metal on the short side of the tube are being pulled out of the die land the pressure differential builds up from zero to its maximum amount, and this variation in pressure on the last few particles on the short side works the metal so that the wall is bent inwardly toward the axis of the tube in a curvilinear manner. Consequently the metal which forms the inward radius is decreased in thickness by the squeezing action of the die and the deflected punch. Thus, a drawn tube having uneven sides may be considerably bent at its end, the high side may be substantially thicker than the normal wall thickness of the tube, and the short side may be substantially thinner. The current practice, to obviate difficulty in succeeding drawing operations, is to cut off the end of the drawn tube below the thickened and bent end.

Obviously, if the height of the die land is equal to or greater than the maximum disparity in height between the long and short sides of the drawn article, the short side will be supported by the die land while the long side is being sized between the punch and the die land. This is impractical, however, because of the increased frictional drag due to the increased land height and because the total compressive force developed increases with an increase in land height, with the result that the forces exerted on the die are of such magnitude that the bottom part of the die may be broken away from its body, or the base of the tube broken away from the tube body because the forces exerted on the tube exceed the ultimate strength of the tube metal.

It is an object of the present invention to provide a drawing die wherein excessive frictional drag and total compressive force are eliminated, and wherein the end portion of the short side of the drawn article is supported by the die land while the end portion of the long side is being sized between the punch and a die land, to the end that the tube wall remains straight and is of uniform thickness throughout. It is particularly proposed to provide a multiple land die, wherein adjacent die lands are of identical diameter and are separated by a clearance groove, the height of each die land being insufficient to create excessive frictional drag, and the height of the groove between the die lands being such that the short side of the tube will be in contact with and supported by a lower die land while the long side of the tube is being formed between an upper die land and the punch. In practice, it is proposed to provide a set of die lands separated by one or more grooves, each die land having a height less than the maximum height disparity between the tube sides, the total axial length of said lands and grooves having a combined or total height at least equal to the maximum disparity. Hence, the article is completely formed to uniform wall thickness by the upper die land before any portion of its end edge leaves the lower die land.

With the above and other objects in view, an embodiment of the invention is shown in the accompanying drawing, and this embodiment will be hereinafter more fully described with reference thereto, and the invention will be finally pointed out in the claims.

In the drawing:

Fig. 1 is a vertical sectional view of the die and its cooperating punch, according to the illustrated exemplary embodiment of the invention, a cup to be drawn being shown in relation thereto.

Fig. 2 is a similar view, showing the tube partially drawn.

Fig. 3 is a similar view, showing the tube completely drawn and with its upper end portion entirely within the die.

Fig. 4 is a similar view, showing the tube completely drawn and with its upper end portion partially disengaged from the die.

Fig. 5 is a vertical sectional view of an alternative type of die holder.

Similar reference characters indicate corresponding parts throughout the several figures of the drawing.

Referring to the drawing, the tube drawing apparatus, of the punch and die type illustrated by way of example in the present disclosure, comprises a die holder 10 provided with a downwardly extending cylindrical pocket 11 having a central opening 12 in its bottom. In the lower portion of the pocket there is engaged a die block 13, superimposed by a top die and bushing member 14 having an annular shouldered recess 15 at its upper side engaged by a retaining ring 16 secured upon the upper side of the holder 10.

The top die and bushing member 14 is of conventional form and is provided with a passage therethrough including an upper cylindrical entrance portion 17, a downwardly converging tapered portion 18 and a lower cylindrical land portion 19. This member is for the purpose of positioning and guiding the cup 20 to the die block 13 which incorporates the improved structure of the invention, the cup being engaged within the passage of the upper die member and pressed downwardly therethrough through the downstroke of the punch 21. As illustrated, this upper die member in addition to positioning and centering the cup is adapted to impart a slight preliminary draw to it.

The die block 13 is provided with a vertical passage in axial alignment with the passage of the upper die member 14, and comprising a downwardly converging tapered portion 22 extending to the upper cylindrical die land 23. In spaced relation below the die land 23 there is provided a second die land 24 of identical diameter therewith, an annular clearance groove 25, semi-circular in cross section, being provided between the upper and lower die lands 23 and 24. Below the die land 24 there is provided a short downwardly divergent outlet portion 26.

It is pointed out that the upper die land, which is adapted to cooperate with the punch to draw and form the tube, is relatively narrow in order to eliminate excessive frictional drag and excessive total compressive force, and in practice its axial width dimension is less than the maximum or average disparity in height between the high and low sides of an unevenly drawn tube. While the height of the lower die land 24 is preferably the same as that of the upper die land it may in fact be of different height, inasmuch as its main function is to provide a support for the drawn tube in spaced relation below the upper die land. As the wall of the tube when it engages the lower die land has already been drawn the problem of excessive drag and compressive force is not present in the lower die land to the same extent as in the upper die land. Essentially, the total height of the die lands and grooves is at least equal to or greater than the maximum or average disparity between the high and low sides of an unevenly drawn tube, so that as the tube is drawn no part of its upper end portion will leave the lower die land before the entire tube is drawn and formed between the upper die land and the punch.

The operation is as follows:

As shown in Fig. 1 the cup 20 is slightly uneven at its upper edge, this being an average condition. As this cup is drawn by the cooperating punch and die this unevenness increases, so that the drawn tube is of substantially greater height at one side than at the other. As seen in Fig. 2, the tube is partially drawn, the lower side of its upper edge just starting to be formed between the upper die land 23 and the punch. As seen in Fig. 3, the high side of the tube has been drawn into the position of minimum clearance between the upper die land and the punch and at the same time the low side of the tube has left the upper die land and is being supported by the lower die land 24. As seen in Fig. 4, the drawn tube is disengaged at its low side from the lower die land 24, and from this position the punch carries it below the die where it is stripped from the punch as the latter is moved upwardly. It will be seen that at all times during the forming of the tube the punch is supported in concentric relation within the die through the support of the drawn tube interposed between the punch and the lower die land 24, so that there is no possibility of the punch being forced out of concentricity. Consequently, the tubular wall of the drawn article is of straight form and uniform thickness therethrough, and the drawing operation is carried out without creating an undue stress in the die or in the drawn article. The proper positioning of the punch with the die eliminates any possibility of inward bending of the end portion of the short side of the tube or of the thickening of the end portion of its long side. The drawn tube may therefore be subjected to further drawing operations without the necessity for cutting off the end, and straightness and uniformity of thickness will be maintained through the successive drawing operations.

In Fig. 5 is shown an alternative type of die holder such as disclosed in detail in copending application Serial No. 535,011, filed May 11, 1944. The die holder 35 has a tapered aperture 36 which engages the tapered exterior surface 37 of the die 38. The die 38 has lands 39 and 40 and clearance groove 41 similar to that just described for die block 13 of Figs. 1 to 4, inclusive. As set forth in said copending application, the die is preferably hard and the holder relatively elastic, such as a spring steel. The taper and elasticity of the holder, hardness of the die, downwardly converging mouth portion, area of lands, etc., are chosen so that increase of drawing pressure and impact as the work piece first hits the die will not affect the size of the piece being drawn, the die being movable downwardly in the holder with increase of drawing pressure and thus expanding the holder, and returnable to its free position upon completion of the drawing, thereby removing the stress on the die due to the holder. By the use of the tapered die and holder, the lands are kept at a constant diameter regardless of drawing pressure so as to produce work of a constant diameter.

The form of the invention illustrated in the drawing and described herein is typical and illustrative only, and it is evident that the invention is capable of embodiments in other forms, all falling within the scope of the appended claims, which are to be broadly construed.

What is claimed is:

1. The method of drawing tubular articles

wherein the tube wall is drawn to a greater height at one side than the other, comprising passing the tube through a drawing die having a drawing passage including a plurality of axially spaced annular die lands, the total height of said lands and spacing being at least equal to a predetermined disparity in height between the sides of said drawn tube.

2. The method of drawing tubular articles wherein the tube wall is drawn to a greater height at one side than the other, comprising passing the tube through a drawing die having a drawing passage including a plurality of axially spaced annular die lands, the first of said die lands being of less axial height than a predetermined disparity in height between the sides of said drawn article, and said plurality of die lands and spacing having a total axial height at least equal to said predetermined disparity.

3. The method of drawing tubular articles wherein the tube wall is drawn to a greater height at one side than the other, comprising passing the tube through a drawing die having a converging drawing passage terminating in a plurality of axially spaced annular die lands, the first of said die lands being of less axial height than a predetermined disparity in height between the sides of said drawn article, said plurality of die lands and spacing having a total axial height at least equal to said predetermined disparity.

4. The method of drawing cup-shaped tubular articles wherein the tube wall is drawn to a greater height at one side than the other, comprising passing the article through a drawing die having a drawing passage including annular die lands having a height at least equal to a predetermined disparity in height between the two sides of said drawn article and divided into two parts by an annular groove.

5. The method of drawing cup-shaped tubular articles wherein the tube wall is drawn to a greater height at one side than the other, comprising passing the article through a drawing die having a passage including a plurality of axially spaced annular die lands of identical diameter, the first of said die lands being of less axial height than a predetermined disparity in height between the sides of said drawn article, and said plurality of die lands and spaces therebetween having a total axial height at least equal to said predetermined disparity.

6. The method of drawing cup-shaped tubular ammunition components wherein the tube wall is drawn to a greater height at one side than the other, comprising passing the component through a drawing die having a drawing passage including a plurality of axially spaced annular die lands and spaces having a total height at least equal to a predetermined disparity in height between the sides of said drawn component.

7. The method of drawing cup-shaped tubular articles wherein the tube wall is drawn to a greater height at one side than the other, comprising passing the article through a relatively non-elastic drawing die having a tapered exterior surface, said die having a plurality of axially spaced annular die lands, said die lands and spaces having a total height at least equal to a predetermined disparity in height between the sides of said drawn article, and an elastic die holder having a tapered aperture freely supporting the exterior tapered surface of said die, said holder being adapted to expand to enable said die to move relative thereto during the processing of a workpiece to substantially prevent expansion of said die.

8. A drawing die for drawing cup-shaped tubular articles wherein the tube wall is drawn to a greater height at one side than the other, having a drawing passage including a plurality of axially spaced die lands, said lands being of the same diameter, the total axial height of said lands and spaces being at least equal to a predetermined disparity in height between the two sides of said drawn article.

9. A drawing die for drawing cup-shaped tubular ammunition components wherein the tube wall is drawn to a greater height at one side than the other, having a converging drawing passage terminating in a plurality of axially spaced annular die lands, said lands being of the same diameter, the first of said die lands being of less axial height than a predetermined disparity in height between the sides of said drawn article, and said plurality of die lands and spacings having a total axial height at least equal to said predetermined disparity.

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