Dec. 28, 1954 G. A. LYON 2,698,268

METHOD OF MAKING SHELL CASINGS

Filed Aug. 17, 1950 2 Sheets-Sheet 1

Fig. 1

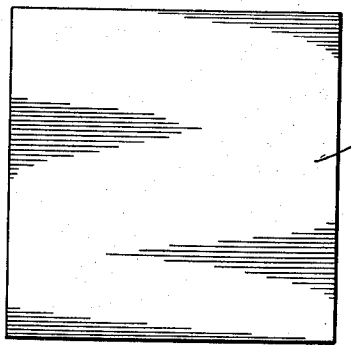


Fig. 2

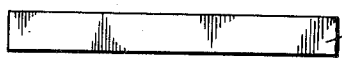


Fig. 3

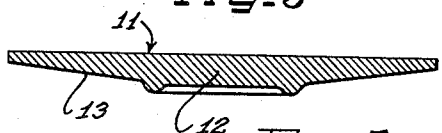


Fig. 4

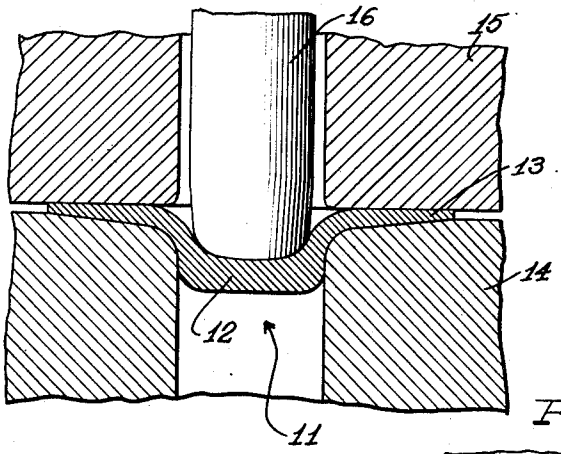


Fig. 5

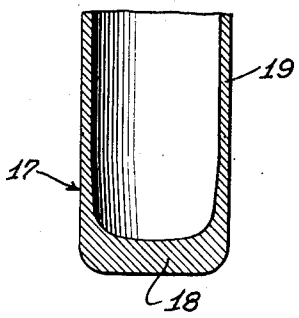


Fig. 6

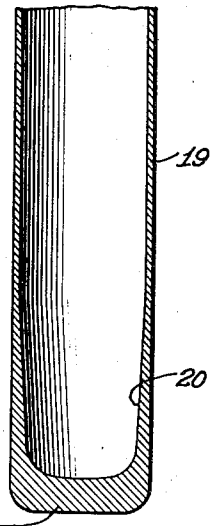
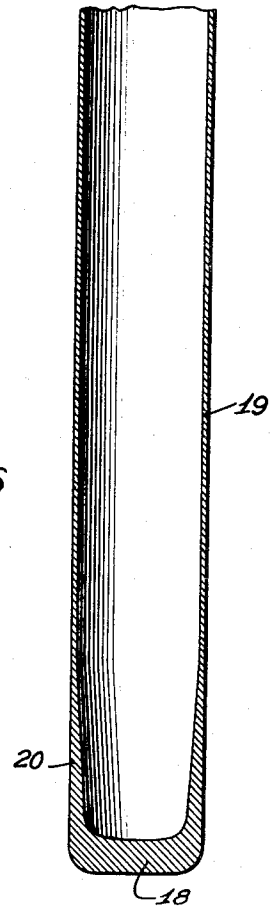


Fig. 7



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Dec. 28, 1954 G. A. LYON 2,698,268

METHOD OF MAKING SHELL CASINGS

Filed Aug. 17, 1950 2 Sheets-Sheet 2

Fig. 8

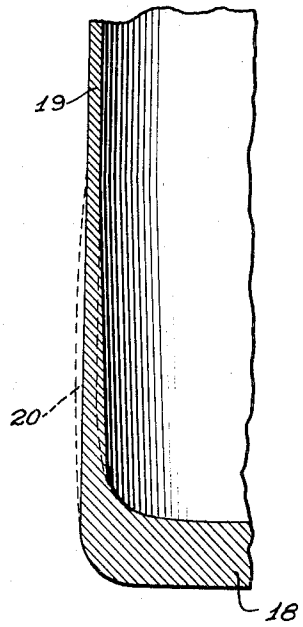


Fig. 9

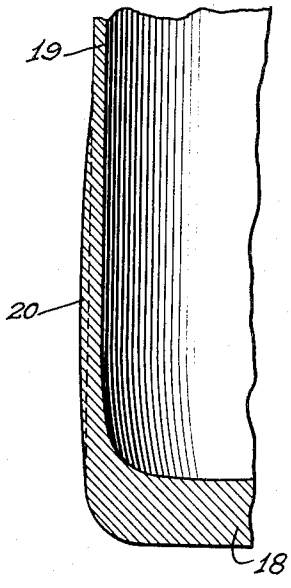


Fig. 10

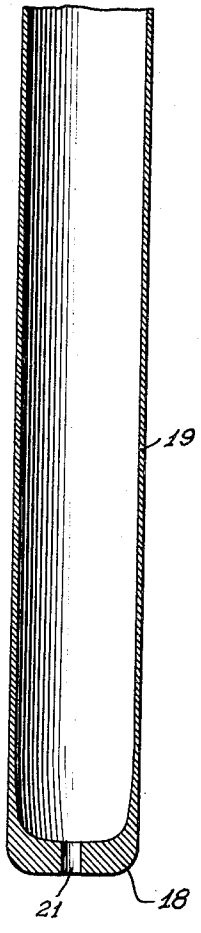
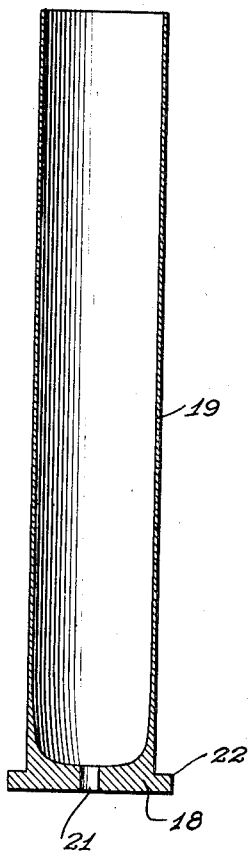


Fig. 11.



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METHOD OF MAKING SHELL CASINGS

George Albert Lyon, Detroit, Mich.

Application August 17, 1950, Serial No. 179,971

9 Claims. (Cl. 148—12.4)

This invention relates to a method of making shell casings and more particularly to a method of coining and drawing a metallic casing from a blank of metal cut from a slab.

In the manufacture of cartridge shell casings such, for example, as are used in modern anti-aircraft and anti-tank shells, it is particularly desirable to have the metal in the cylindrical wall of the casing hardened immediately adjacent the base without hardening of the base.

It is my understanding that in some of the present methods now used, and particularly where electric annealing is employed between the progressive drawing operations, soft spots tend to develop adjacent the junction of the casing wall and the base. Needless to say, any weakening of the wall at this area constitutes a source of danger in the firing of the shell made from such a casing as it would have a tendency to explode at such weakened or breach area.

The problem is somewhat further complicated by the fact that while the cylindrical wall must be properly hardened, the cylindrical base, on the other hand, if hardened to the same extent, becomes difficult to machine in the ultimate shaping of the base.

Now I propose, in accordance with the features of this invention, to provide a method of making a shell casing wherein the metal is properly distributed between the base and the cylindrical wall and wherein proper hardening of the wall can be obtained without requiring that the base portion be hardened to the same extent at the same time.

It is also an object of this invention to provide an improved, simplified and less expensive method of making such metal cylindrical casings.

In accordance with the general features of this invention there is provided in a process of drawing a metallic cartridge casing from a blank, the steps of coining the blank into substantially a circular disc having a thickened center portion or button with an annular marginal portion tapered away from the center toward the periphery of the disc, drawing and cupping the disc to form a cup with the thickened center substantially at the base, and the tapering portion in the cylindrical wall of the cup, progressively drawing the wall of the cup to elongate the same with a thickened wall portion adjacent and merging into the base of the cup, bulging said thickened wall portion radially outwardly and progressively drawing said bulged portion away from the base lengthwise into the wall to cold work the same.

Another feature of the invention relates to the contemporaneous cupping and drawing of the coined blank so as to eliminate the necessity of a separate drawing step.

Yet another feature of the invention relates to subjecting the lower part of the casing, after the bulging and cold working of the lower portion of the wall to a salt bath heating treatment for preserving the desirable cold working characteristics obtained in the bulging and working of such lower portion of the casing wall.

Other objects and features of this invention will more fully appear from the following detailed description taken in connection with the accompanying drawings which illustrate the steps of my process and wherein:

Figure 1 is a plan view of a polygonal or square shaped blank;

Figure 2 is an end or edge view of a blank shown in Figure 1;

Figure 3 is a cross-sectional view through a disc coined from the blank in accordance with my process;

Figure 4 is a fragmentary cross-sectional view showing diagrammatic die numbers and a punch in the process of cupping and drawing the coined disc;

Figure 5 is a fragmentary vertical cross-sectional view through a cylindrical cup formed from the initial cupping or drawing steps;

Figures 6 and 7 are vertical cross-sectional views through the cylindrical casing progressively drawn from the cup shown in Figure 5 and showing how the bottom wall of the casing is thickened and tapered into the base of the casing;

Figure 8 is an enlarged fragmentary cross-sectional view of a lower portion of the casing shown in Figure 7 and illustrating by dotted lines the lower tapered thickened portion which is to be bulged radially outwardly;

Figure 9 is a fragmentary cross-sectional view similar to Figure 8 showing how the tapered thickened portion is bulged outwardly after being subjected to a punch or press operation and illustrating in dotted lines the position of the thickened portion prior to the bulging operation;

Figure 10 is a fragmentary vertical cross-sectional view through the casing showing how it looks after the bulged portion has been uniformly drawn into the cylindrical wall of the casing as well as showing the base perforated; and

Figure 11 is a vertical sectional view through the casing after the base has been shaped to form a flange thereon.

As shown on the drawings:

It is believed that my novel process will be fully understood from a description of the foregoing drawings showing diagrammatically the condition of the blank, cup and casing at different stages of the process of fabrication.

While it is contemplated that my invention may be employed in the fabrication of cartridge casings, such as 40 mm. casings shown in my issued Patent No. 2,360,354, my invention is not limited in its application to that particular size of casing, as it may be used equally well with other sizes and particularly in the fabrication of larger gauge cartridge casings.

Also, while my invention is particularly adapted for use in the fabrication of casings from low carbon steel, it is not to be thus limited as it is contemplated that it could be used to advantage in the making of casings from brass blanks. However, if the casing is made from a brass blank, it may require more annealing operations between draws than it would where the casing is made from low carbon steel.

The reference character 10 designates generally a square of polygonal shape of metal cut or sheared from a suitable slab. Subsequent to this shearing operation, the sides of the blank are suitably ground to eliminate bumps and irregularities. Also, the blank can be subjected to suitable annealing such, for example, as a so-called spheroidizing anneal.

Thereafter, the blank is placed onto a suitable coining die which may be generally similar to that shown in my aforesaid patent and coined into a circular disc of predetermined diameter consistent with the particular size of casing being made. During this coining operation, the coined disc 11 (Figure 3) is provided with a central thickened portion or button 12 and an annular marginal inclined portion 13 which tapers from the center 12 to the periphery of the disc. A suitable trimming operation is employed for trimming off the excess metal or flash beyond the edge of the coined disc 11.

Subsequent to this coining operation the coined disc may be suitably annealed by subjecting it to a bonderizing anneal or the like. It is to be understood in the description of the subsequent operations that, if required, the article may be subjected to annealing and pickling throughout the different steps or stages of the process. It is, of course, well known in the metallurgy art that an article, as it is progressively worked or drawn, may require annealing between operations in order to condition the metal.

In Figure 4 I have illustrated diagrammatically the next step of the process which combines cupping and drawing in a single operation. In this operation the

coined disc **11** is placed between suitable cooperating die members **14** and **15** and upon being subjected to the action of the punch **16** is caused to be cupped. In this cupping operation the central thickened portion **12** is pushed downwardly in the die members. At the same time the tapered portion **13** is pulled downwardly through the dies causing it to be elongated. In this action of drawing the portion **13** is first pulled between the die members which results in the wiping and working of the metal. Continued movement of the punch **16** downwardly results in the pulling of the entire tapered portion about the punch, thereby resulting in the forming of a cupped case **17** (Figure 5) having a thickened base **18** and a cylindrical wall **19** which is of a lesser thickness than that of the initial tapered portion **13**.

Following this initial cupping and drawing operation, the casing is subjected progressively to additional drawing operations to progressively reduce its wall **19**, as shown in Figures 6 and 7, and to provide at the junction of this wall at the base **18** a tapered thickened section or portion **20** which is best shown in Figure 8.

I propose, in accordance with the features of my process, to use this tapered thickened portion **20** for the purpose of augmenting the hardness of the metal in the casing wall immediately above the base **18** without substantially affecting the hardness of the base itself.

It will be appreciated that in forming this tapered thickened portion **20** a punch with a tapered end is employed.

Now I propose to push or bulge this thickened portion **20** radially outwardly from the full line position shown in Figure 8 to the dotted line position. I effect this by using a punch with a straight cylindrical wall at its end which, upon entering the casing, progressively bulges the portion **20** from the dotted line position shown in Figure 9 to the full line position. This results in a cold working of the wall at this thickened portion **20** without affecting the other portions of the casing. In other words, the portion **20** is subjected to more cold working than the upper part of wall **19** and base **18**.

Subsequent to this bulging operation, the drawn cylindrical casing, as shown in Figure 10, is subjected to additional drawing operation which progressively moves the metal of the bulge **20** uniformly upward distributing it in the cylindrical wall **19** so that the wall, with the exception of its base **18**, is then of substantial uniform thickness.

At some time in the various drawing operations, a hole **21** is punched in the base **18**. Then, as shown in Figure 11, the base **18** is shaped to provide it with a flange **22**.

In order to preserve the cold working characteristics of the metal immediately above the base **18**, derived during the working of the bulge **20**, I propose to subject the lower part of the casing to a heat annealing process such as that shown in my issued Patent No. 2,059,468. In this heat treatment the lower end of the casing is inserted in a bath of fused salts at a temperature of from about 1450° F. to 1650° F. for a very short period of time, less than five minutes, and thereafter such heat treated end is quenched in a bath containing a salt of one of the alkali metals and lime. In other words, I heat the casing at the area immediately above the base rapidly to a temperature in the vicinity of the Ac_3 point in a non-oxidizing heat medium for a sufficiently short period of time so as not to change the characteristics of the steel obtained during the cold working operation. Quickly thereafter I quench the steel to harden it at portion **20**.

It will be appreciated that by reason of the base **18** being substantially thicker than the adjoining wall portion, the adjoining wall portion will heat up rapidly so that by proper timing very little heat need be imparted to the base portion **18**. That is to say, I am desirous of avoiding undue hardness of the base **18** since it is easier to machine when it is not unduly hardened. Moreover, it does not require the hardness that is necessary at its junction portion with the cylindrical wall.

During this heat treatment operation, the salt solution can readily enter the lower part of the casing through the hole **21** which likewise is employed for draining the casing when it is removed from the heat treatment bath.

In the event the casing is made from brass instead of low carbon steel, I contemplate using the cold working obtained by the portion **20**, although in that event the casing would not be subjected to the salt bath heat treatment noted above. From the standpoint of the actual cold working of the metal, it may be found that other processes of heat treating could be used equally as well as my own referred to above and described more in detail in my aforesaid Patent No. 2,059,468.

From the foregoing description it is evident that the augmented thickness of metal above the portion **20** may be completely distributed in the wall of the casing without any overlap of the metal and all without disturbing the base proper. In addition, the work hardening of the wall immediately above the base will eliminate dead spots at this area, such as heretofore existed in casings where electronic heating has been employed in the annealing of the metal.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. In a process of drawing a metallic cartridge casing from a blank, the steps of coining the blank into a substantially circular disc having a thickened center with an annular marginal portion tapering away from the center toward the periphery of the disc, drawing and cupping the disc to form a cup with the thickened center substantially at the base and the tapered portion in the cylindrical wall of the cup, progressively drawing the wall of the cup to elongate the same with a thickened wall portion adjacent and merging into the base of the cup, bulging said thickened wall portion radially outwardly, and progressively drawing the material of the outer surface of said bulged portion away from the base into the wall to cold work the wall immediately above the cup base.

2. In a process of drawing a steel cartridge casing from a blank, the steps of coining the blank into a substantially circular disc having a thickened center with an annular marginal portion tapering away from the center toward the periphery of the disc, drawing and cupping the disc to form a cup with the thickened center substantially at the base and the tapered portion in the cylindrical wall of the cup, progressively drawing the wall of the cup to elongate the same with a thickened wall portion adjacent and merging into the base of the cup, bulging said thickened wall portion radially outwardly, progressively drawing said bulged portion away from the base into the wall to cold work the wall immediately above the base, heating the steel in the lower portion of the wall to a temperature of about 1450° F. to 1650° F. for a short interval of time in a non-oxidizing heating medium whereby the wall immediately above the base will be heated to said temperature but the base will be heated to a lesser temperature only, and then plunging the lower part of the casing in an aqueous quenching bath whereby the hardness imparted to said casing adjacent said base portion by cold working will be preserved and said thickened base portion will remain in a semi-hard state only.

3. In a process of drawing a steel cartridge casing from a blank, the steps of shaping the blank into a substantially circular disc having a thickened center with an annular marginal portion tapering away from the center toward the periphery of the disc, drawing and cupping the disc to form a cup with the thickened center substantially at the base and the tapered portion in the cylindrical wall of the cup, progressively drawing the wall of the cup to elongate the same with a thickened wall portion adjacent and merging into the base of the cup, bulging said thickened wall portion radially outwardly, progressively drawing said bulged portion away from the base into the wall to cold work the wall portion immediately above the base, perforating the base, plunging the lower part of the casing including said cold worked wall portion into a heat treating bath at a temperature in the vicinity of the Ac_3 point for a sufficiently short period of time so as to preserve the characteristics of the steel in the cold worked portion of the wall, thereafter removing the casing from the bath and draining the bath out of the lower part of the casing through the perforation, and quenching the casing to harden the cold worked portion of the wall.

4. In a process of drawing a cylindrical casing from a blank, the steps of forming the blank into a substantially circular disc having a thickened center, drawing and cupping the disc with the thickened portion located principally at the base of the cup, progressively drawing

the wall of the cup to elongate the same with a thickened inwardly tapering portion adjacent and merging into the base of the cup, bulging said thickened wall portion radially outwardly to increase the internal and external diameters of the thickened wall portion and progressively drawing the bulged portion away from the base into the wall while maintaining the inner diameter of said wall portion at substantially said increased internal diameter but substantially reducing said external diameter of said wall portion to cold work same.

5. In a process of drawing a metallic casing from a slab, the steps of forming a circular disc from the slab, drawing and cupping the disc to form a cup with a thickened center substantially at the base, progressively drawing the wall of the cup to elongate same with an inwardly tapering thickened portion adjacent and merging into the base of the cup, bulging said thickened wall portion radially outwardly to increase the internal and external diameters of the thickened wall portion, and progressively drawing said bulged portion away from the base and into the wall while maintaining the inner diameter of said wall portion at substantially said increased internal diameter but substantially reducing said external diameter of said wall portion.

6. In a process of drawing a metallic cartridge casing from a blank, the steps of coining the blank into a substantially circular disc having a thickened center portion with an annular marginal portion tapering away from the center toward the periphery of the disc, placing said disc between and subjecting the same to the action of cupping die members and thereby drawing and cupping the disc to form a cup with the thickened center portion substantially at the base and the tapered portion in the cylindrical wall of the cup, progressively drawing the wall of the cup to elongate the same with a thickened wall portion adjacent and merging into the base of the cup, bulging said thickened wall portion radially outwardly, and progressively drawing said bulged portion away from the base into the wall to cold work the wall immediately above the base.

7. In a process of drawing a metallic cartridge casing from a blank, the steps of coining the blank into a substantially circular disc having a thickened center portion with an annular marginal portion tapering away from the center toward the periphery of the disc, placing said disc between and subjecting the same to the action of cupping die members and thereby drawing the disc to form a cup with the thickened center portion substantially at the base and the tapered portion in the cylindrical wall of the cup, progressively drawing the wall of the cup to elongate the same with a thickened wall

portion adjacent and merging into the base of the cup, bulging said thickened wall portion radially outwardly, progressively drawing said bulged portion away from the base into the wall to cold work the wall immediately above the base, and heat treating the cold worked portion of the casing in a fused salt bath to condition same without materially hardening said base portion.

8. In a process of drawing a metallic cartridge casing from a blank, the steps of coining the blank into a substantially circular disc having a thickened center portion with an annular marginal portion tapering away from the center toward the periphery of the disc, placing said disc between and subjecting the same to the action of cupping die members and thereby drawing the disc to form a cup with the thickened center portion substantially at the base and the tapered portion in the cylindrical wall of the cup, progressively drawing the wall of the cup to elongate the same with a thickened wall portion adjacent and merging into the base of the cup, bulging said thickened portion outwardly and working said bulge upwardly into the wall to cold work the wall adjacent the base and heat treating the work hardened portion of the casing in a fused salt bath to condition such portion above the casing base.

9. In a process of drawing a cylindrical casing from a metal blank, the steps of coining and cupping the blank to form a cup having a cylindrical side wall and a comparatively thicker base, progressively drawing the wall of the cup to elongate the same with its thickest wall portion adjacent and merging into said base, bulging said thickest wall portion radially outwardly and progressively drawing said bulged portion away from the base into the cup wall to cold work the wall immediately above the base.

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