March 10, 1953 E. BLAIR 2,630,916

EXTRUSION OF METALS

Original Filed Aug. 19, 1947 2 SHEETS—SHEET 1

Fig:1.

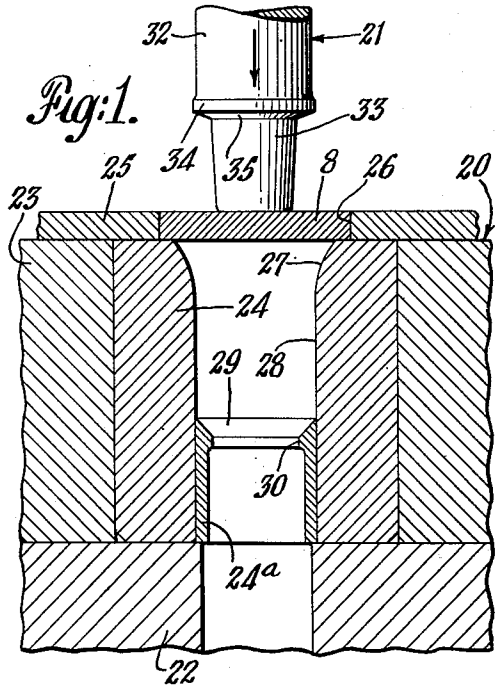


Fig:2.

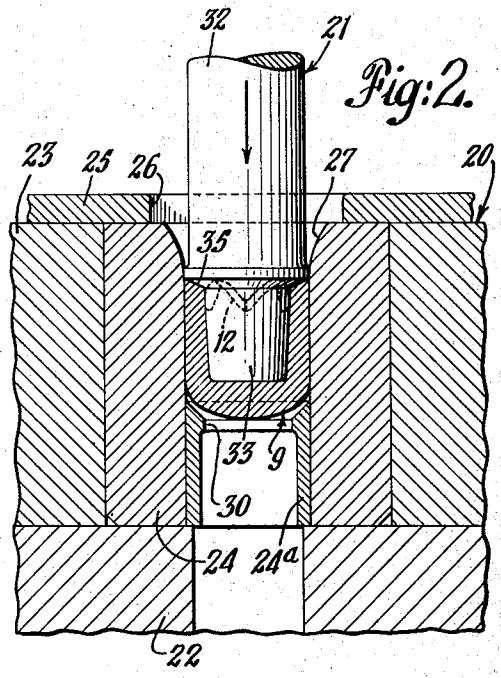


Fig:3.

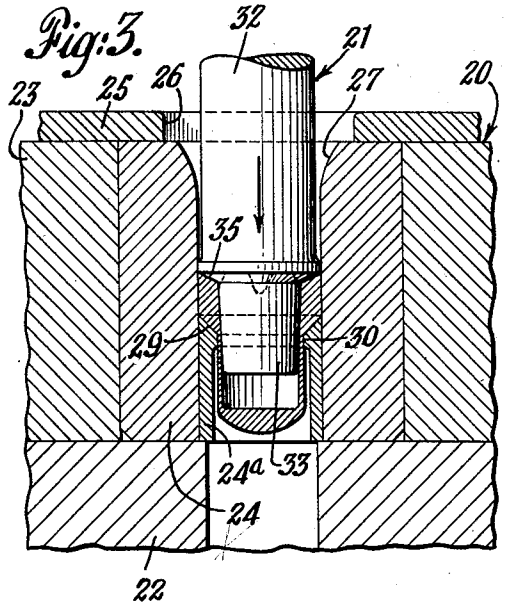
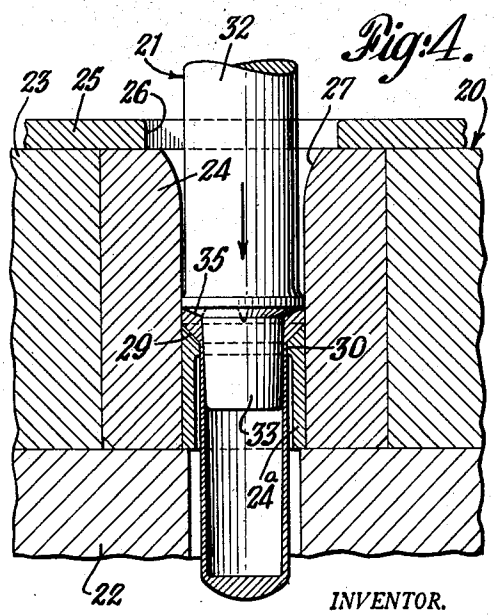


Fig:4.



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EXTRUSION OF METALS

Original Filed Aug. 19, 1947 2 SHEETS—SHEET 2

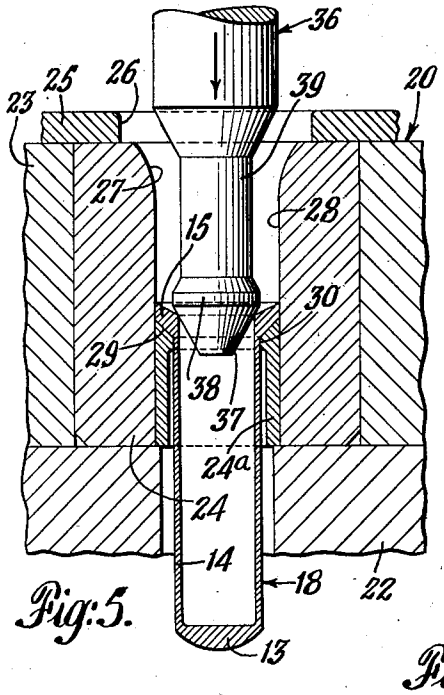


Fig:5.

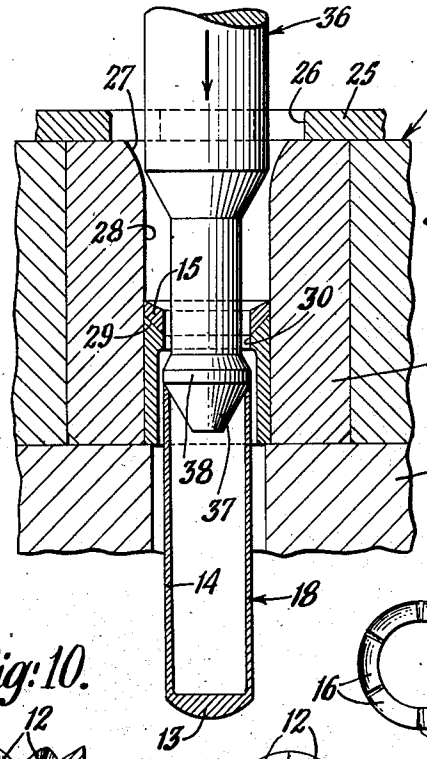


Fig:6.



Fig:9.

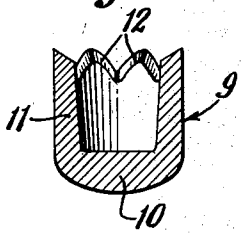


Fig:10.

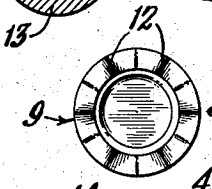


Fig:11.

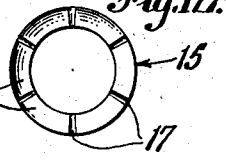


Fig:12.

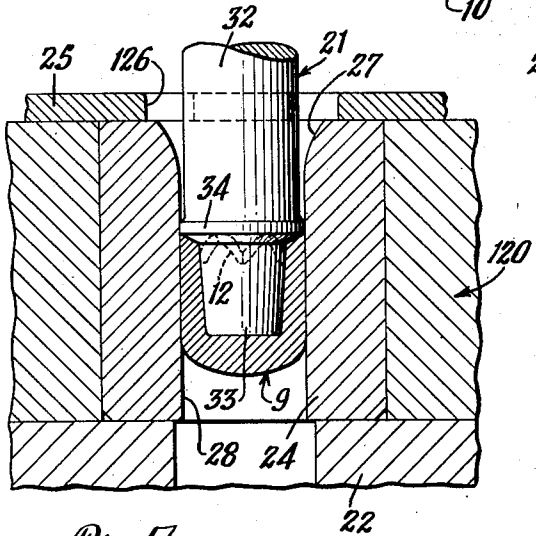


Fig:7.

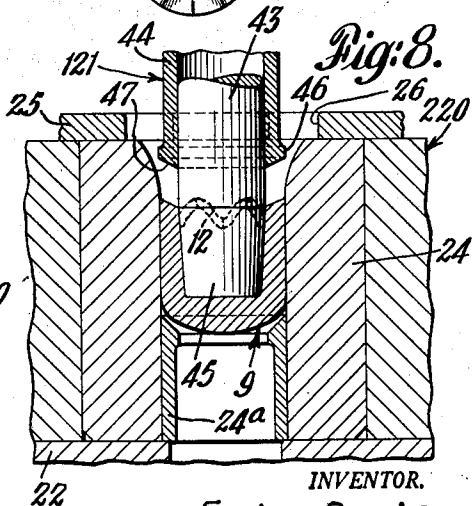


Fig:8.

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Patented Mar. 10, 1953

2,630,916

UNITED STATES PATENT OFFICE

2,630,916

EXTRUSION OF METALS

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Continuation of abandoned application Serial No. 769,511, August 19, 1947. This application September 19, 1947, Serial No. 774,913

2 Claims. (Cl. 207—10)

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The invention relates to the extrusion of tubular articles, such as used in the manufacture of cartridge shells, although not limited to such use.

This application is a continuation of application filed August 19, 1947, Serial No. 769,511, entitled Extrusion of Metals, now abandoned.

Objects of the present invention are to produce an improved tubular product; to provide an improved method of extrusion; and to produce an improved extrusion press.

The preferred method of practising the invention uses a stationary die having a substantially cylindrical bore with a flaring mouth and a seat above the mouth. Down in the bore is an extrusion bushing having an annular projecting abutment with an upper beveled squeeze surface. Cooperating with the die is a plunger comprising a shank having an annular guide flange providing a lower beveled squeeze surface. Under the guide flange is a tapered former.

To use the press, a polygonal disc blank, from which the tubular product is to be made, is placed in the above-mentioned seat. Downward movement of the plunger first cups the blank disc, forming an intermediate cupped blank having a saw-toothed or serrate upper edge. Further downward movement of the plunger presses the side wall of the cupped blank between the plunger and die squeeze surfaces, to extrude the metal downwardly between the die abutment and the former, thus forming the tubular product, in a single pressing operation.

In some cases it may be desirable to use a composite plunger in which the squeeze surface is located on the lower end of a sleeve which is slidably mounted upon a mandrel, the lower end of which constitutes the former. If desired also, the cupping operation may be carried out by one stroke of the press and the extrusion operation by a subsequent and independent stroke of the press.

In any case, according to the preferred method of practicing the invention, the extruded product comprises a closed end tube having an outwardly projecting segmental flange or scrap ring. This scrap ring may be removed by providing a trimming punch which enters the extrusion die and which shears the scrap ring off from the tubular product.

The invention also consists in certain new and original features and combinations hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part hereof, in which:

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Fig. 1 illustrates one form of impact extrusion press, by which the invention may be practiced, showing the blank in position ready for the pressing operation;

Fig. 2 illustrates an intermediate position of the press, at the end of the cupping operation, just prior to the extruding operation;

Figs. 3 and 4 illustrate intermediate positions of the press, showing different stages of the extruding operation;

Fig. 5 illustrates the final extruded product with the trimming punch at the beginning of the trimming operation;

Fig. 6 illustrates the tubular product being severed from the scrap ring by the trimming punch;

Fig. 7 illustrates a modified form of press for performing the cupping operation separately from the extruding operation;

Fig. 8 illustrates a modified form of press, using a composite punch for cupping and extruding in the same pressing operation;

Fig. 9 illustrates one form of disc blank from which the tubular product is formed;

Fig. 10 is a longitudinal section through the cupped blank, formed as an intermediate product;

Fig. 11 is a plan view of Fig. 10; and

Fig. 12 is a plan view of the severed scrap ring.

In the following description and in the claims, various details will be identified by specific names for convenience, but they are intended to be as generic in their application as the art will permit.

Like reference characters denote like parts in the several figures of the drawings.

In the drawings accompanying and forming part of this specification, certain specific disclosure of the invention is made for purposes of explanation, but it will be understood that the details may be modified in various respects without departure from the broad aspect of the invention.

Referring to the drawings, the preferred manner of practising the present invention consists, briefly, as follows: The flat hexagonal blank shown in Fig. 9 is placed in the press of Fig. 1 and the punch 21 is lowered, first, to cup the blank, as shown in Fig. 2, and then to extrude

the metal of the cup as shown in the successive steps of Figs. 3 and 4. The punch 21 is then raised and the trimming punch 36 is lowered into the same die, as indicated in Fig. 5; this severs the scrap ring and forms the final tubular product as shown in Fig. 6. It will thus be seen that the cupping and extrusion steps take place consecutively in a single stroke or pass of the press. Details of the invention will be described hereinafter.

The initial, intermediate and final products will now be described.

As shown in Fig. 9, the initial product is in the form of a hexagonal disc 8 cut from sheet or plate material. This disc may be of other polygonal outline, such as square, octagonal, etc. It is characterized by having angular corners which aid in the extrusion process as explained more in detail below; the polygonal shape saves scrap when the several polygonal discs are cut from the original metal sheet or plate. The starting polygonal disc may also be prepared otherwise, for example, by transversely cutting or shearing a metal rod.

Referring now to Figs. 10 and 11, the intermediate cupped product 9 has rounded bottom wall 10, cylindrical side wall 11 with a saw-toothed or serrate upper edge 12; the teeth or summits of edge 12 correspond to the corners of the hexagonal blank 8. The edge may be slightly thinned or scarfed toward the outside by the drawing action of the press, as will be more apparent from the description of the pressing operation.

Referring now to Fig. 5, the intermediate product shown therein is formed by the completion of the cupping and extruding operation. This product comprises a cylindrical tube 18 having a relatively thick bottom 13 and a relatively thin side wall 14 which is slightly thicker at the bottom than at the top. The intermediate product 18 has an outwardly projecting integral segmental scrap ring 15.

The final products are shown in Fig. 6. These products comprise the cylindrical tube 18 and the severed scrap ring 15. The cylindrical tube 18 constitutes the final product of the present invention. This may be subject to further fabrication depending upon the use for which the product is formed. In the case of cartridge cases, further working will be in accordance with the particular type of ammunition desired.

The scrap ring 15 includes a series of segments 16 partially connected by cut or weakened portions 17. The segments 16 correspond to the teeth of the cup of Fig. 10 and the slots or weakened portions 17 correspond to the spaces between the teeth. The scrap ring, as the name implies, goes back to the melting furnace for refabrication into sheet.

The structure of the preferred form of press will now be described.

Referring to Fig. 1, the press comprises a stationary die 20 and a vertically movable plunger 21. The die comprises a support 22 on which rests a base 23. The base holds an extruding ring 24, upon which rests a centering plate 25. The centering plate is fixedly mounted with its circular recess 26 concentric with the axis of the press. The extruding ring 24 has a flaring mouth 27 merging into cylindrical bore 28. Within bore 28 is the extrusion die 24a having a beveled, annular squeeze surface 29 and an extrusion flange 30. The parts of the die are

fixedly secured together in any conventional manner.

The plunger 21 comprises a shank 32 which is suitably secured to power mechanism (not shown) for driving the punch downwardly, as will be understood by those skilled in the art. The shank 32 has a projecting flange or collar 34 having a guide fit in the circular bore 28. The bottom of flange 34 has a beveled annular squeeze surface 35, below which is tapered former or plug 33.

It will be noted that both the die squeeze surface 29 and the plunger squeeze surface 35 are beveled, but that the bevel of the plunger squeeze surface is flatter than the bevel of the die squeeze surface. This facilitates extrusion of the metal as will be more apparent as the description proceeds.

Referring now to Fig. 5, the trimming punch 36 has a conical nose 37 terminating in a shear flange 38 above which is a reduced shank 39. It will be understood that the trimming punch 36 will be driven downwardly by suitable overhead operating mechanism. This punch cooperates with the die 20 to trim off the scrap ring 15, as will be explained more in detail below.

The operation of the cupping and extrusion plunger and of the trimming punch will now be described. The hexagonal blank 9 is placed in the centering recess 26, as shown in Fig. 1; the plunger 21 is then in its uppermost position which will be somewhat above that shown in Fig. 1. After proper oiling of the cupping and die surfaces, the press will be operated, causing the plunger 21 to move downwardly under high speed and with great force. This operation cups the blank, as shown in Fig. 2, and then extrudes the cupped blank as illustrated in Figs. 3 and 4. The plunger 21 finally comes to rest in a position slightly below that shown in Fig. 4, corresponding to the fully extruded product shown in Fig. 5.

The plunger 21 is then raised and the punch 36 is brought into register with the die opening. The trimming punch 36 is then lowered to position shown in Fig. 5. The shear flange 38 cooperates with the flange 30 of the die to shear off the final tubular product 18 from the scrap ring 15, as illustrated in Fig. 6. The tubular product 18 then drops by gravity into a suitable receptacle (not shown). When the trimming punch 36 rises, it carries the scrap ring 15 with it, this ring resting upon the upper beveled surface of the shear flange 38. The scrap ring is removed from the stripping punch during the next stroke of the press by means of a conventional stripping device.

It will be noted, particularly from Figs. 1 to 4, that the cupping and extrusion takes place consecutively in a single pass of the press. The nose of the former 33 pressing against the hexagonal blank 9 cups the blank, the flaring mouth 27 and the bore 28 assisting in the cupping operation. Immediately after the intermediate cup is formed, the squeeze surface 35 on the plunger presses down against the saw-toothed edge 12; this presses the bottom of the cup against the die squeeze surface 29, causing the metal to extrude or flow between the conical surface of the former 33 and the die flange 30. Due to the conical shape of the former 33, the thickness of the metal extruded when the plunger is in the position of Fig. 3 will be slightly thicker than the thickness of the metal extruded when the plunger is in the position shown in Fig. 4. Thus the tubular product has a somewhat thicker wall at its closed end. Former 33 is cylindrical in shape when the

desired product is intended to have the same wall thickness from top to bottom.

It will be noted that the relative diameter of the bore **28** and the height of the side walls **11** of the intermediate cup blank are such that the metal flows generally in a direction lengthwise of the tube being formed and of the axis of the press. The slope of the squeeze surfaces **29** and **35** facilitates this action.

Practice of the present invention greatly facilitates impact extrusion of metal tubes. In fact, the use of hexagonal disc blanks has permitted the successful extrusion of tubes of some metals which could not be successfully extruded by conventional methods using ordinary circular disc blanks.

The heat formed by the initial cupping operation plus the heat formed by the subsequent compressing of the saw teeth on the cup blank flows into the metal of the blank and assists materially in softening or plasticizing the metal, greatly facilitating extrusion. The saw teeth furthermore provide a cushioning effect to soften the blow of the plunger, which relieves shock on the press. In addition, the polygonal shape of the disc blank from which the saw teeth are formed results in great saving of scrap during the initial cutting of the hexagonal blanks from the original metal sheets or plates.

The following is a specific example of a successful extruding operation. The original disc blank was a hexagonal brass blank weighing 217 grains having a thickness of 0.139 to 0.142 inch and having a distance across flats of 0.918 inch. The combined cupping and extruding operation produced a scrap ring weighing 30 grains and a tubular product weighing 187 grains. The tubular product had an outside diameter of 0.5 inch and a length of 2.0 inches.

Some idea of the saving in scrap will be gathered from the fact that the use of ordinary circular disc blanks results in a scrap of at least 33%, while with hexagonal blanks the scrap is cut down to about 4%. The saving in metal in producing 30–06 cartridge cases from metal sheet is shown by the fact that in the conventional blanking and drawing process, the manufacture of one thousand shells requires 55 pounds of metal, of which 26.8 pounds are scrap. In contrast, by applying the hexagonal blanking and extrusion process of this invention to the same sheet, the manufacture of one thousand shells requires but 41.5 pounds of metal of which only 13.3 pounds are scrap.

The resulting extruded tubular product formed by practising the present invention is ideally suited for further fabrication into cartridge cases. Similar products, heretofore produced commercially for fabrication into cartridge cases, are made only by a complex series of separate drawing, annealing, washing and trimming operations. The present method is less expensive and quicker, saves scrap, relieves the press and produces a superior product. This invention also accomplishes a substantial reduction in the amount of machinery required for a given output and thus decreases the amount of factory floor space that is needed. Since the number of operations is also reduced, less storage space is needed for work in process.

The use of the intermediate cup blank with saw toothed edge is also useful in cases where the cupping and extruding are done in different passes of the press. Fig. 7 shows a press for cupping only. The plunger **21** may be substantially the same shape as the plunger in Fig. 1, while

the die **120** may be very similar to the die **20** of Fig. 1 except that the extruding bushing **24a** is not used. Here, the hexagonal blank **9** is placed in a centering recess **126** and the dropping of the plunger **21** to the position shown in Fig. 7 causes the cupping operation, the product being substantially the same as that formed at the first stage of the pressing operation of Figs. 1 to 4 and illustrated in Figs. 10 and 11.

This cup may constitute the initial blank for a separate extruding operation. Such separate extruding operation may be carried out in an extruding press, such as shown in Figs. 1 to 4, or in any other similar extruding press such as illustrated in Hooker Patent No. 918,154, patented April 13, 1909, or in Hooker Patent No. 1,368,725, patented February 15, 1921.

In some cases, the combined cupping and extruding operation in a single pass of the press may require a modified form of plunger. Such a composite plunger is illustrated in Fig. 8. Here the die **220** may be substantially the same as the die **20** in Fig. 1. The plunger **121**, however, is formed with a central arbor **43** and a concentric sleeve **44**. The arbor **43** has the tapered former **45**, while the sleeve **44** has the centering flange **46** and squeezing surface **47**.

Suitable mechanism, either cam operated or hydraulically operated (not shown), moves the composite plunger parts separately. For example, the arbor **43** may be moved downwardly to cup the original disc blank, bringing it to the position shown in Fig. 8. The sleeve **44** may descend and, at the proper time, the squeeze surface **47** may engage the saw toothed edge **12** starting the extruding operation, the arbor **43** ceasing its movement sufficiently to prevent the nose of the former **45** pushing through and perforating the bottom of the cup blank. Such construction and operation may be desirable when the starting disc blank is relatively large in diameter or distance across flats, to avoid the possibility of the former breaking through the bottom of the cup before the extrusion could start.

While certain novel features of the invention have been disclosed herein, and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. The method of making an extruded metal tube which comprises providing a polygonal flat blank, cupping said blank to form a cupped product having a bottom and substantially cylindrical walls terminating in a serrate edge, said serrate edge being formed in the cupping operation by the polygonal nature of the blank in which the corners of the blank form hills separated by valleys and the number of the sides of the blank being limited to produce pronounced hills and valleys, then applying pressure to said serrate edge in a direction lengthwise of said walls, to subject the margin of said bottom and the walls of said blank to an extrusion operation, during which operation the initial pressure is applied to said hills which flow, during the extrusion operation, into said walls to practically eliminate the valleys and extrude the metal of said walls and hills to form the extruded metal tube.

2. The method of making an extruded metal tube which comprises providing a cupped product having a bottom and substantially cylindrical walls terminating in a serrate edge, said serrate

edge being formed by cupping a polygonal flat blank in which the corners of the blank form hills separated by valleys and the number of the sides of the blank being limited to produce pronounced hills and valleys, then applying pressure to said serrate edge in a direction lengthwise of said walls, to subject the margin of said bottom and the walls of said blank to an extrusion operation, during which operation the initial pressure is applied to said hills which flow, during the extrusion operation, into said walls to practically eliminate the valleys and extrude the metal of said walls and hills to form the extruded metal tube.

EMILE BLAIR.

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