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METHOD OF FORMING SHOULDERED ARTICLES

Filed April 5, 1962

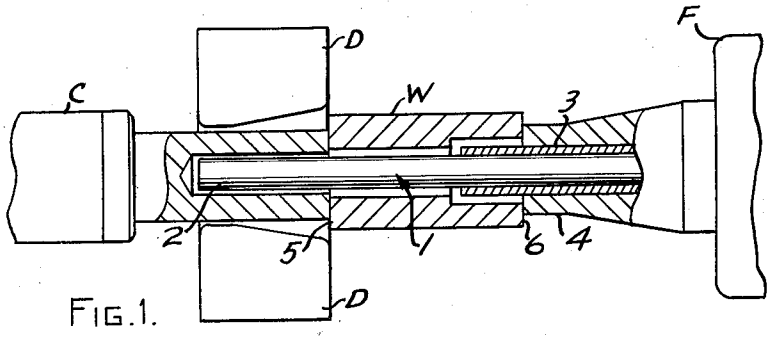


FIG. 1.

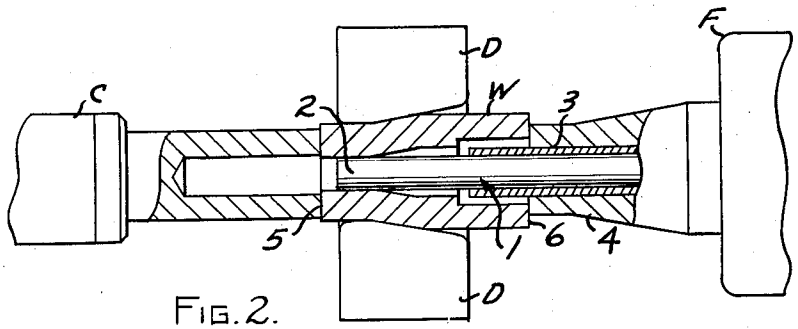


FIG. 2.

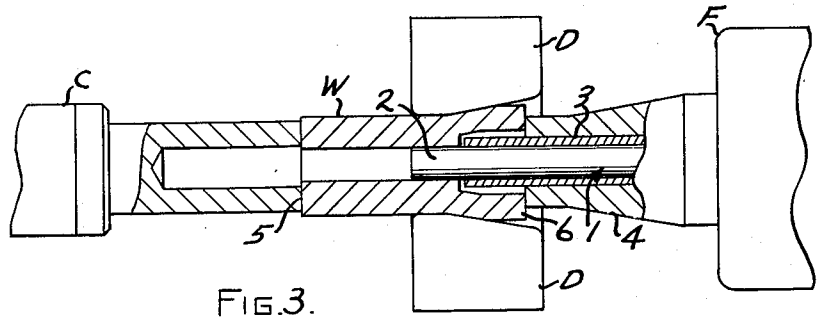


FIG. 3.

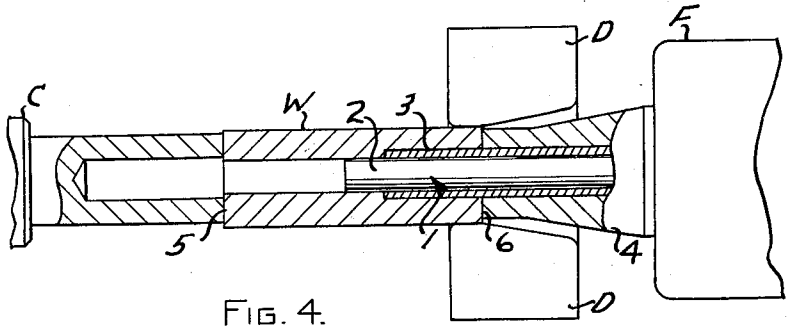


FIG. 4.

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METHOD OF FORMING SHOULDERED ARTICLES

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This invention relates to the formation of gun barrels or the like in which an internal stepped configuration is given to an article by means of cold forming or swaging.

In such a process an article is fed through a plurality of oppositely located rapidly pulsating dies which exert sufficient force on the article so as to reduce its outside dimensions which simultaneously make its internal configuration conform to the shape of a mandrel located within a bore formed in the article.

Hitherto it has not been possible to form the stepped configuration desired without resorting to the use of a plurality of mandrels successively operating in the article or if a single mandrel is used the desired spacing of the shouldered configurations cannot be obtained with sufficient accuracy to meet present day demands.

The primary object of the present invention is to obtain an accurately formed shoulder or the like in the internal bore of a work piece during a cold forming operation as defined above.

A second object is to obtain a precise, sharply defined shoulder or similar configuration in a work piece by means of a cold forming operation.

Still another object is to obtain an accurately located and precise and sharply defined shoulder or similar shape in a work piece while subjecting it to the action of a plurality of rapidly pulsating dies in the manner well known to the art.

Other objects will be apparent from the following specification and the accompanying drawing in which:

FIGURE 1 shows the work piece in place and ready to be fed through the dies to be subjected to the action thereof.

FIGURE 2 shows the work piece being subjected to the action of the dies to have the smaller internal configuration formed thereon.

FIGURE 3 shows the work piece upon completion of the formation of the smaller internal configuration and at the start of the formation of the shouldered portion therein.

FIGURE 4 shows the work piece at the completion of its passage through the dies and the completion of the formation of the desired internal shape of the bore of said work piece.

Like numerals and symbols denote the same elements wherever they appear on the drawing.

In the drawing F designates a feeding unit which is designed to obtain the desired feeding movement of the work piece W through a plurality of dies D which may be two or more in number and which are actuated by any means well known in the art.

The feeding unit F may be hydraulic, electrical or mechanical or a combination of one or more such constructions as long as the necessary forces are obtained to produce the required results.

At the emergence side of the dies is a cushioning device C which receives the work piece W as it emerges from the dies D and has been subjected to their forming action. The force exerted by cushioning device C also may be hydraulically, electrically or mechanically controlled or a combination of one or more of these as long as the desired forces are exerted on the work piece W in order to obtain the requisite results.

The total feeding force exerted by the feeding unit F is composed of a plurality of components or increments

so that at least one of the components of the feeding force exerted by the feeding unit F may be reduced so as to be of less magnitude than the force exerted by the cushioning device C for a purpose to be later described.

As shown in FIGURE 1 the work piece W is mounted on a mandrel indicated generally as 1 which is composed of two elements 2 and 3. The element 3 is slideable over the element 2. Both of these elements are mounted in the leading nose portion 4 of the feeding unit F. Element 1 is shaped to give the desired shape to the leading portion of work piece W as it is fed through the dies D whereas element 3 is shaped to give the desired shape to the trailing portion of work piece W as it is in turn fed through the dies D.

During the forming of the first portion of the work piece element 2 is held in a fixed position relative to the dies D and the work piece is fed over element 2 and element 3 also slides over element 2. When the enlarged portion of the bore is formed element 2 and element 3 are held in a fixed position relative to each other and they are fed through the dies along with the work piece W.

As shown in FIGURE 1 the work piece W is about to be fed into the dies D under force exerted by the feeding unit F. The cushioning device C abuts the leading face 5 of work piece W opposite the trailing face 6 of the work piece W which is engaged by portion 4 of the feeding unit F. The force exerted on the work piece W by cushioning device C is of less magnitude than that exerted on the work piece W by the feeding unit F thus enabling the work piece to be fed forwardly over element 2 of mandrel 1 and through the dies D to reduce the outside diameter of the leading portion of the work piece and to make said portion conform to the shape of the mandrel as it is fed over the mandrel and is subjected to forces exerted by the rapidly pulsating dies.

It will be obvious that as work piece W is fed through the dies D the leading face 5 will advance an amount equal to the amount of feed given by feed unit F plus an amount equal to the elongation of the work piece due to its reduction in size.

In FIGURE 2 the work piece W is shown as it has started through the forming operation and has begun to emerge from the dies D. Here the leading face 5 has advanced a distance in excess of the amount of feed by an amount due to the lengthening of the work piece due to its reduction under the working of the dies D.

As shown in FIGURE 3 the smaller internal diameter of the work piece W has been formed by its movement over the element 2 of mandrel 1. Up until this moment the feed movement of the work piece has been imparted to it by nose portion 4 of feeding unit F. The cushion device C has gradually withdrawn as the force exerted by it has been less than the force exerted on the work piece by the feeding unit and the elongation of the work piece. The element 3 of mandrel 1 and nose portion 4 of the feeding unit have moved as a unit and element 3 has moved over element 2 of the mandrel 1 from the position shown in FIGURE 1 to that shown in FIGURE 3.

The pressure exerted on nose portion 4 is now reduced until it is of less magnitude than the pressure exerted by the cushioning device C. However the pressure on mandrel 1 and on its elements 2 and 3 is maintained in order to continue to feed the work piece at the desired feed rate through the dies D. The feed is now obtained by the pressure exerted on the work piece by the element 3 of the mandrel 1 which has its end shaped to conform to the shape of the shoulder to be formed on the work piece. As shown in the present drawing the shoulder formed will be at right angles to the axis of the work but obviously it may be tapered or may be given any other shape desired.

Since the pressure exerted by nose portion 4 is less than

that exerted by the cushioning device C the elongation of the work piece due to its reduction in size occurs from left to right as seen in FIGURE 4 instead of from right to left as was the case when the smaller internal diameter was being formed as shown in FIGURES 2 and 3.

The flow of metal from left to right by reason of the elongation maintains the shoulder formed by mandrel element 3 firmly against the mandrel and does not allow the shoulder to be displaced any distance from the mandrel while the enlarged portion of the bore of the work piece is being formed.

During this second step of forming the elements 2 and 3 of the mandrel 1 are held in a fixed position relative to each other and move with the work piece through the dies as a unit while the nose portion 4 of the feeding unit F has been allowed to recede under pressure to accommodate the elongation.

By controlling the direction of elongation in the manner described above it is possible to form a multi-chambered article with all shoulders precisely located and accurately formed with a simple mandrel construction and in a single operation which has not hitherto been possible.

What I claim and desire to secure by Letters Patent is:

1. A method for the forming of a plurality of axially spaced contours in the bore of a hollow work piece in one continuous operation comprising the steps of feeding said work piece through a plurality of oppositely located pulsating dies exerting forces onto the work piece adequately large to reduce its outside dimensions and make its interior conform to a stepped mandrel located within the bore of the blank, holding the leading section of said mandrel stationary underneath the dies and feeding the work piece over the mandrel and through the dies at a given feed rate by force exerted on its trailing end, in such manner as to make the formed part emerge behind the dies at a rate equal to the feed rate plus the elongation occuring during the reducing of the work piece cross-section; continuing this operation to a predetermined point along the axis of the work piece and from there on forcing the mandrel to move at the feed rate through the dies to feed and reduce the work piece in such manner as to make the formed part emerge behind the dies at a rate no greater than the feed rate and to force the elongation of the work piece resulting from its cross-section reduction to take place in a direction opposite to the feed direction, resulting in a forward elongation for one portion of the forming operation and in a backward elongation for another portion of the forming operation.

2. A method as set forth in claim 1 where the feeding force exerted on the trailing end of the work piece is resisted by a cushioning force exerted on the leading end of the work piece, the cushioning force being less than this feeding force during the first portion of the forming operation and exceeding this feeding force during the succeeding portion of the forming operation although never exceeding the total feeding force.

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