United States Patent [19]

Simon

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[54] **PROCESS FOR COLD FORMING A METAL TUBE WITH AN INWARDLY THICKENED END**

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Related U.S. Application Data

[62] Division of Ser. No. 384,441, Aug. 1, 1973, Pat. No. 3,837,205.

[52] **U.S. Cl.** 228/112; 228/173

[51] **Int. Cl.** **B23k 27/00**

[58] **Field of Search** 29/470.3, 484, 486; 72/260, 370

[56] **References Cited**

UNITED STATES PATENTS

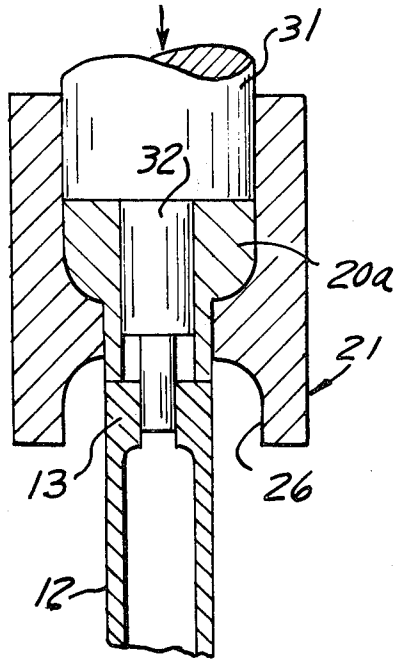
3,820,230 6/1974 Katunich 29/470.3

Primary Examiner—C. W. Lanham
Assistant Examiner—Robert M. Rogers
Attorney, Agent, or Firm—Cullen, Settle, Sloman & Cantor

[57] **ABSTRACT**

Placing a short tubular metal blank into an open die, having an inner, annular extrusion shoulder, and partially pressing the blank through the shoulder to extrude an elongated, uniform wall thickness tube portion. Then placing a second blank into the die in end to end contact with the remaining portion of the first blank, and pressing the second blank similarly part way through the die extrusion shoulder to simultaneously extrude the remaining portion of the first blank through the shoulder to form it with the same OD as its first extruded portion, but with a smaller ID, to form an inwardly thickened end portion on the extruded part, while also extruding the uniform wall thickness portion on the second blank, and then repeating the cycle.

2 Claims, 8 Drawing Figures



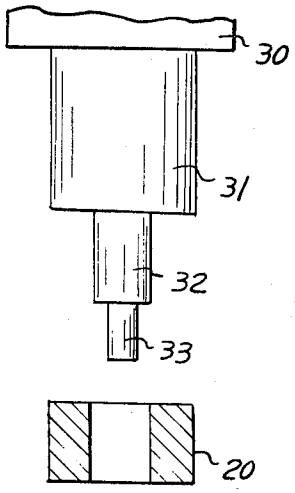


FIG. 3

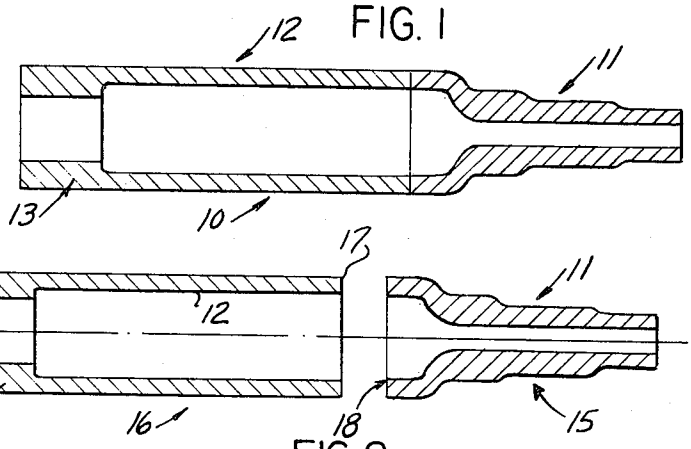


FIG. 2

FIG. 1

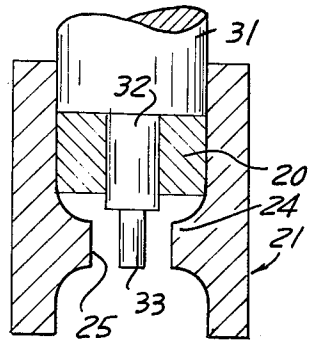


FIG. 4

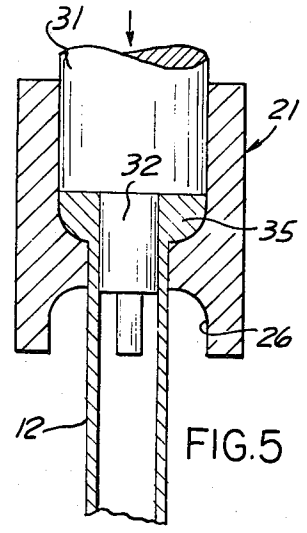


FIG. 5

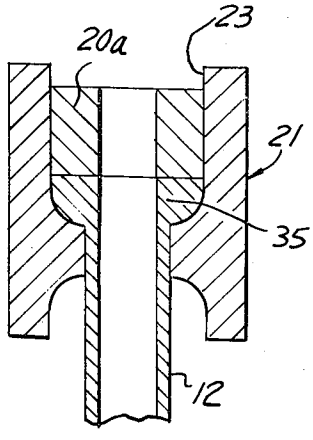


FIG. 6

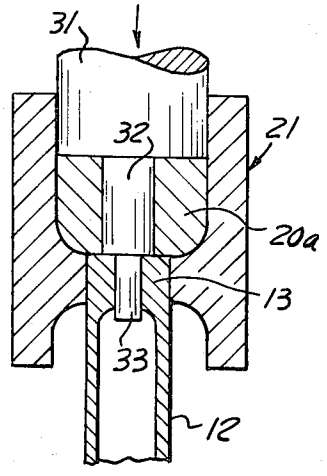


FIG. 7

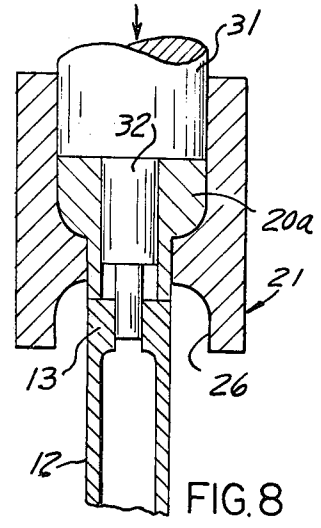


FIG. 8

PROCESS FOR COLD FORMING A METAL TUBE WITH AN INWARDLY THICKENED END

BACKGROUND OF THE INVENTION

The invention herein relates to a process for cold forming or extruding a metal tube having a thickened or inwardly flanged end. While the process herein may be used to form tubes for a variety of purposes, it is particularly adaptable in the manufacture of rear axles for trucks, such as is commonly called a "Salesbury axle". In such type axles, it is common to forge or machine or both, an elongated tube having an end portion of reduced outer and inner diameters and formed with steps or shoulders for connection to wheel bearings and the like. The main portion of the axle is formed as a relatively thin wall uniform diameter tube and the opposite end is formed with an inwardly directed flange or thickened portion. Such end is normally inserted into a socket formed on a housing, such as a truck differential housing.

The forming of such a type axle requires a number of forging steps and then a number of machining steps to provide the accurate sizes required and also proper surface finishings. Since the axle is made of one piece of metal, a number of compromises as to the type of metal selected and the proper heat treating, must be made to maximize the different strength and other characteristics required from the opposite ends of the axle.

Hence, the process herein is concerned with the manufacturing of part of such a type axle, namely, the body or barrel portion with the thickened end, wherein such an axle may be made in two parts rather than in one as is conventional, to thereby reduce manufacturing steps and costs and provide for a better product. Such process may also be used to produce metal parts which generally are uniformly tubular in shape with an inwardly extending flange or thickened portion at one end.

SUMMARY OF THE INVENTION

The invention herein contemplates forming a uniform crosssection tube with an inwardly directed flange or thickened portion at one end, starting with a short, tubular blank which is cold formed or extruded through a die in a press. The die, mounted upon a press bed, is formed with an open blank receiving portion, beneath which is an annular shoulder or extrusion throat with a smaller opening through which the blank may be extruded. The press ram is provided with a ram punch member for pressing the blank through the shoulder and its opening.

The process herein includes first pressing the blank partially through the extrusion shoulder so that a substantial portion of the blank is extruded into a uniform, relatively thin wall, tubular section, leaving an outwardly flanged remaining blank portion in the die blank receiving part. Then a new blank is placed into the die and it too is pressed downwardly through the shoulder or die opening. In so doing, the previous, partially pressed blank is pushed through the extrusion shoulder. As it goes through, its thickened outwardly directed flange portion cold flows inwardly to form an inwardly thickened or flanged portion.

Meanwhile, the new blank is partially extruded and takes the place of the preceding blank. Then the cycle is repeated by again adding a new blank, etc. Thus, each new blank acts as if it is part of the ram punch,

making the contact with the preceding blank and consequently permitting much faster production as compared to a single blank by blank operation, but also reducing wear and breakage of the ram punch itself.

The ram punch may be provided with properly sized, smaller extension members which fit into the blank for sizing the inner diameters of the blank during the extrusion thereof. Hence, the finished product can be held to a very accurate tolerance with respect to its OD and ID, thereby eliminating machining and surface finishing steps which have been required in the past, in connection with forming such devices by forging or machining processes.

Where the finished product is to be used as a portion of the above mentioned Salesbury type axle, the axle portion containing the various stepped configurations and the like, may be separately made, as for example, by the process described in my prior U.S. Pat. No. 3,739,620, issued June 19, 1973 for a Process for Forming a Flared End Tubular Metal Part.

The two separate pieces, namely, the piece made by the invention of this application and the second piece may then be welded together such as by means of inserting the end of one into the other and spinning one piece relative to the other to generate sufficient friction and heat for a good spin formed weld. In this way, a finished axle or similar device may be made, with the advantage that the two pieces may be separately made of separate types of metal and/or separately heat treated to thereby improve the desired strength and characteristics of each end portion of the finished part.

These and other objects and advantages of this invention will become apparent upon reading the following description, of which the attached drawings form a part.

DESCRIPTION OF DRAWINGS

FIG. 1 is a cross-sectional view of a truck axle made in accordance with the invention herein.

FIG. 2 is a view similar to FIG. 1 but shows the two parts of the axle separated.

FIG. 3 illustrates in cross-section, the press apparatus for carrying out the process herein, with the ram opened and a blank ready for insertion into the die.

FIG. 4 schematically illustrates the position of the blank in the die with the ram moved downwardly.

FIGS. 5–8 show successive steps in the process.

DETAILED DESCRIPTION

FIGS. 1 and 2 illustrate a hollow, tubular axle **10**, commonly referred to as a "Salesbury axle" and typically used as the rear axle of a light truck. Such axles typically are formed with a reduced or configured end portion **11** having various diametrical portions for receiving and engaging with wheel or bearing parts, and an elongated tubular central or barrel portion **12** having an inwardly flared or inwardly thickened end portion **13.** Such axles have in the past been manufactured in one piece through a variety of forging and/or machining operations.

The process herein contemplates forming the axle in two separate pieces, namely, a first piece **15** which encompasses the reduced end portion **11,** and a second piece **16** which includes the barrel portion **12** and the thickened portion **13.** Thus, the two pieces are separately made with the piece **16** made in accordance with the process of this application and the piece **15** made

by some other process. To assemble the two pieces to make a complete axle, their respective ends **17** and **18** may be abutted and welded together by a suitable conventional welding processes.

The process herein contemplates maing the piece **16,** or similarly shaped pieces, from a metal blank **20** which is in the form of a short, tubular piece of metal, such as steel. As shown in FIG. **3,** the manufacturing equipment includes a die **21** mounted upon a press bed **22** of a convention press. The die has an upwardly opening blank reciving chamber or portion **23,** beneath which is an annular extrusion should **24** to provide a central extrusion opening o throat **25,** beneath which is a relieved exit end opening **26.** An opening **17** in the bed or in blocks built up upon the bed provides space for downward movement of the extrusion.

The die is aligned with a conventional press ram **30,** which is schematically shown as the press itself forms no part of the invention herein. The ram includes a downwardly extending press ram punch **31** sized to fit into the die opening **23.** The punch also includes a smaller diameter, downwardly extending sizing punch **32** and a second, even smaller diameter lower sizing punch **33.**

With reference to FIGS. **3** through **8,** the process herein includes the following steps: First, as shown in FIG. **3,** a blank **20** is dropped into the die opening **23.** The press ram **30** is then lowered, as shown in FIG. **4,** so that the lower end of the ram punch **31** engages the upper end of the blank and the sizing punch **32** extends through the opening in the center of the blank. Next, as shown in FIG. **5,** the ram is moved downwardly against the press bed, to extrude the blank partially through the extrusion shoulder and its opening **25,** thereby extruding a relatively thin wall, uniform diameter wall thickness tube or barrel portion **12.**

The downward movement of the ram is stopped before the blank is completely extruded through the shoulder so as to leave an enlargement or outwardly extending flange portion **35** within the die opening **23,** this portion being the unextruded portion of the blank.

Next, the ram is retracted, i.e., lifted upwardly, and a new blank **20***a*, identical to the original blank **20** is dropped into the die opening **23,** as seen in FIG. **6.** The new blank is now in end to end contact with the upper end of the original blank **20,** that is the remaining enlarged portion **35** thereof.

Thereafter, as shown in FIG. **7,** the ram is again lowered to press the blank **20***a* downwardly into the die, which thereby presses the original blank through the die opening completely. In this step, the material which formed the remaining portion of the original blank, that is the enlargement **35,** is forced inwardly, now being positioned in an inwardly directed enlargement, namely, the thickened portion **13** whose ID is sized by the sizing punch **33.**

Meanwhile, the ram continues moving downwardly, as shown in FIG. **8,** so that the second blank **20***a* is extruded, in the same way as was the first blank, and simultaneously pushes the completely extruded original piece downwardly and out of the die completely. The press continues downwardly until the second blank assumes the shape and position of the first blank as is illustrated in FIG. **5** and thereafter a new blank is inserted as shown in FIG. **6** and the cycle repeats.

Hence, as can be seen, each blank functions as a portion of the ram to push the preceding blank during the time it itself is being extruded. This permits rapid operation, as well as preserving the press equipment and die against much of the normal wear which would be encountered in a one-by-one blank pressing operation.

Essentially, the process herein is carried out with the metal being cold. Actually, it is preferable to heat the metal so as to warm it to a point below its metallurgical transition points to thus permit easier flow of the metal under pressure and thereby reduce the required ram pressure. Thus, by cold forming, it is meant that the blanks are either at room temperature or at relatively low temperatures, i.e., below transition points.

Although the figures illustrate the extrusion of a tube of circular outer and inner diameters, the shape in cross-section of the tube may be varied. In addition, it is possible in this process to form inner or outer surface configurations on the tube, such as longitudinally extending gear teeth, by suitably profiling either the shoulder throat or opening **25** or the surfaces of the sizing punches **32** and **33.**

Having fully described an operative embodiment of this invention, I now claim:

1. A method for forming an elongated tubular metal axle-like part having one end formed with reduced outer diameter portions and the opposite end formed with an inwardly thickened portion and a central barrel portion of uniform diameter and thickness, comprising:

separately forming the part in two separate pieces, namely, one piece having the formed reduced outer diameter portions with that piece terminating at the barrel portion, and a second piece consisting of the barrel portion and the inwardly thickened portion, comprising extruding said second piece by:

positioning a relatively short tubular blank within a die mounted upon the base of a press having an aligned ram, with the die having an open inlet end with a blank receiving portion and an outlet end having an inwardly extending annular extrusion shoulder whose inner cross-sectional diameter is smaller than that of the blank receiving portion for extruding the blank therethrough;

ram pushing the blank partway through the die shoulder for thereby extruding the barrel portion on the blank, leaving the remaining portion of the blank still within the die blank receiving portion;

next, inserting a second, identical blank into the die blank receiving portion in end to end contact with the first mentioned blank;

then ram pushing the second blank through the die shoulder to form a barrel portion thereon, thereby simultaneously forcing the first blank completely through the die shoulder to cause the portion previously remaining within the die blank receiving portion to flow inwardly to form the inwardly thickened portion of the piece, and then repeating the cycle of inserting a new blank, etc.;

and thereafter welding said extruded second piece to a preformed first piece end to end, to form the completed axle-like part.

2. A method as defined in claim **1** and said welding comprising the steps of inserting the edge of the unthickened end of the second piece into the edge of the corresponding diameter end of the first piece and then spinning one piece relative to the other to spin weld them together.

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