An apparatus and method for shaping an end of a cylindrical metal tubular component into a shaped mouth piece. A heated die is provided whose inner surface corresponds to the outer surface of the mouth piece to be produced, with means to progressively force said end into said die. In front of the die is provided a block having a duct for maintaining the tubular component in position during the forcing operation, cooling means surrounding said block to avoid a rise in temperature of the part of the component not in the course of being shaped.

3 Claims, 9 Drawing Figures
APPARATUS AND METHOD FOR SHAPING A CYLINDRICAL METAL TUBULAR COMPONENT

FIELD OF THE INVENTION

The invention relates to the shaping of tubular metal components.

In aeronautical construction and associated techniques it is desirable to have available, both as structural elements or as transmission members, tubular components with ends whose diameter is less than that of the body, the connecting parts being usually frustoconical. The ends serve for the connecting of the component, particularly by screwing.

PRIOR ART

A method is known according to which the cylindrical component is treated by two jaws with a frustoconical chucking range gripping the component and shaping it by a succession of squeezing operations, the component being progressively introduced between the two jaws which are moved so as to alternately withdraw from one another and then approach one another.

With this method there is a limit to the extent to which the component's shape can be changed. Defects in the component are difficult to avoid. It is often necessary to carry out an additional treatment involving machining and/or annealing. The cost is rather high.

It has also been proposed, particularly for the manufacture of gas cylinders, to upset a tubular component in a die with a shaping cavity. In many cases difficulties arise in this connection, particularly because of parasitic deformations, such as bends which occur.

The use of a plunger piston involves a considerable complication without however giving completely satisfactory results.

SUMMARY OF THE INVENTION

The invention relates to an apparatus for shaping an end of a cylindrical tubular metal component into a reduced mouth piece, comprising a heated die whose inner surface corresponds to the outer surface of the mouth piece to be produced and means for progressively forcing the said end into the die, the die being preceded by a block providing a duct for maintaining the tubular component in position during the forcing operation, means for cooling surrounding the said block designed to avoid a rise in temperature of the part of the tubular component not in the course of being shaped, which would affect its mechanical strength.

The invention likewise relates to a method for shaping the end of a tubular component into a reduced mouth piece by forcing said end into a hot-wall shaping cavity, the tubular component being simultaneously cooled and held in position by its contact with the cold wall of a guide duct, upflow from said cavity.

The method in accordance with the invention subjects a metallic component to a continuous action, most advantageously produced by a hydraulic jack, the shaping being effected by a hot flow process.

The tubular component is pushed by an axial force into a smooth non interrupted wall cavity. It is the force of the push which shapes the component by cooperation with the frustoconical surface of the cavity.

The shaping advantageously takes place at a die-working temperature of the metallic material from which the component is formed.

By continuing the thrust after the face of the component has abutted against a boundary surface of the cavity, a thickening of the frustoconical wall is obtained. In one embodiment, in a final stage, the thrust on the component is continued and the progression of the end is effected through a cylindrical passage extending the frustoconical cavity, the end of which is unobturated. In this way a jointing appendix is obtained without interrupting the process.

The method according to the invention is applicable to components of a very wide range of metallic materials: light alloys, steel, and so on, particularly for the production of connecting rods.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic view in longitudinal section of part of an apparatus in accordance with the invention;

FIG. 2 is a view on a smaller scale, with the tube in different condition during treatment;

FIGS. 3 to 6 are views similar to FIG. 2, but for other conditions of the tube;

FIG. 7 relates to an apparatus according to the invention, but for a modification;

FIG. 8 is similar to FIG. 7, for another condition of the tube;

FIG. 9 shows a tube after treatment, in longitudinal section.

The apparatus or device in accordance with the invention comprises a guide device 10 consisting of a block 11 having a cylindrical duct 12. The guide device 10 is followed by a die 13 having a cylindrical duct 14, extending the duct 12; the cylindrical surface 14 extends by a frustoconical surface 15; the inner frustoconical surface 15 extends by a cylindrical surface 16 which opens on to the front discharge surface 17.

In the cylindrical duct 16 may be removably introduced the body 21 of a plug 22, whose front inner face 23, which is flat, lies in the plane of the circle 24 connecting the cylindrical surface 16 and the frustoconical surface 15.

The block 11 is surrounded by a cooling device 25, for instance a coiled pipe with water circulation. The block forming the die 13 is surrounded by a heating device 26, preferably with electrical resistances.

The cylindrical tube 30 — of light alloy for instance, such as that known as AU2GN, or that known as AU4G1 — whose end 31 is to be shaped, is first of all preferably submitted, if requisite, to a cold-hardening and truing treatment, making it possible to obtain, on the one hand the diametrical and thickness dimensions required and on the other hand a fine crystallization.

After lubricating its outer surface the tube is introduced by its end 31 into the guide device 10, the diameter of the inner surface 12 being substantially equal to that of the outer surface 32 of the tube, and it is introduced into the die 13 until its surface 33 comes into the plane 34 connecting the cylindrical surface 14 and the frustoconical surface 15. The progression movement of the tube is effected under the action of a hydraulic press (not shown). The tube, heated by the device 26, gradually penetrates the frustoconical cavity 35, its outer surface 32 abutting the inner surface 15, which is frustoconical (FIG. 2). As the tubular wall 36 penetrates the cavity 35, it increases in thickness in proportion as the diameter decreases. The cooling provided by the device 25 prevents any flame occurring. When
the face 33 of the tube 30 comes into contact with the front face or end 23 (FIG. 3), the thickness of the tube at the said face is greater than the thickness of the original cylindrical wall; the frustoconical part of the tube thus shaped is defined by an outer frustoconical surface 37, the taper of which is the same as that of the surface 15, and an inner surface 38 with a more accentuated taper.

The invention also provides for continuing the thrust action. During this stage the tube assembly no longer moves forward, but an increase in thickness is produced of the frustoconical wall 39 obtained during the preceding stage, at the expense of the part 41, remaining cylindrical, of the tube end adjacent to the part 39 (FIG. 4). The operation is continued until the desired inner profile 42 is obtained, which is chosen in particular according to the final thickness desired for the cylindrical appendix.

The plug 21 is then removed, either by hand or automatically. For instance, the removal could be effected when the pressure of the application of the surface 33 against the end 23 exceeds a predetermined value, or else after the lapse of a given period of time. The tubular component assembly resumes its forward movement and a cylindrical end 44 (FIG. 5) is formed, the outer surface of which has the same diameter as the inner cylindrical surface 16, the thickness being substantially that of the portion 43. The thrust is interrupted when a cylindrical appendix 44 of the desired length has been obtained, which length may be substantially that of the cylindrical duct 16 (FIG. 6).

The finished component thus comprises, starting with a cylindrical body 46 which has the same thickness as the original tube 30, a frustoconical part 47 whose thickness increases from the connecting part to the body 46, and a cylindrical part 48, or end, the thickness of which is equal to the greatest thickness of the frustoconical part 47 of the wall.

It is possible to obtain by means of this method a frustoconical tubular part whose internal diameter, having a straight section, is a small fraction of the diameter of the large section, to the point of even being closed, and without any defects appearing in the texture of the metal and/or the condition of the surface.

The inner surface 49 of the cylindrical end 48 may subsequently be tapped for connecting the component to another similar or different component.

The other extremity of the component 30 may be treated in the same manner to obtain the second finished end.

The invention provides a method of production in accordance with which the thread of the inner surface of the cylindrical end 48 is obtained in the last stage of the thrust. In this mode of production, the die has a central core 51 (FIG. 7). This core may, for instance, be introduced after the removal of the plug 21. The outer surface of the said core has a screw thread 52. During the thrust the frustoconical tubular part 53 travels in the space provided between the core 51 and the inner surface 16 (FIG. 8). The cylindrical end 54 is progressively formed and, during this movement, the core 51 is also entrained. When a sufficient length has been attained, the removal of the core 51, simply by unscrewing, leaves a finished end 55 provided with its tapped thread 56 (FIG. 9).

I claim:

1. A shaping device for shaping an end portion of a cylindrical tube made of sheet metal, said device comprising:

a generally tubular guide block and an elongate hollow die member disposed in abutting and aligned relationship, said guide block constituting the feed end and the end of the die member opposite to the guide block the finishing end of the device, said guide block and said die member defining therein contiguous from the feed end toward the finishing end of the device a first guide portion having an inner diameter fitting the outer diameter of a tube to be shaped, a cylindrical guide portion also having an inner diameter fitting the outer diameter of the tube, a frustoconical first shaping portion tapered toward said finishing end, said shaping portion having at its wide end an inner diameter equal to the inner diameter of the second guide portion, and a cylindrical second shaping portion having an inner diameter equal to the inner diameter of the first shaping portion at the narrow end thereof, cooling means jacketing said guide block for cooling a tube portion therein, and heating means jacketing the second guide portion, the first shaping portion and the second shaping portion for heating said second guide portion and the shaping portions to a temperature causing softening of a tube portion therein whereby upon forcing the tube to be shaped into the device from the feed end thereof toward the finishing end the tube end portion when successively entering the first shaping portion and then the second shaping portion is deformed to obtain a frustoconical configuration and a cylindrical configuration of reduced diameter respectively, and the wall thickness of the tube wall at the deformed end portion of the tube is increased so as to compensate for the decrease of the peripheral outline of the tube at the deformed end portion thereof.

2. The shaping device according to claim 1 and comprising a plug including a cylindrical portion having an outer diameter fitting the inner diameter of said second shaping portion, said cylindrical plug portion being formable into said second shaping portion of the die member from the finishing end thereof.

3. The shaping device according to claim 1 and comprising an externally threaded core member formable into said second shaping portion from the finishing end of the die member for internally threading a cylindrical tube portion of reduced diameter therein.

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