Feb. 16, 1937. E. GIACCHINO 2,070,589

PROCESS OF FORGING HOLLOW METAL BLANKS

Filed Aug. 31, 1933

Fig.1.

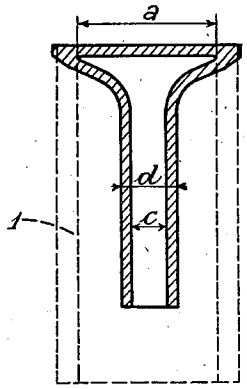



Fig.2.

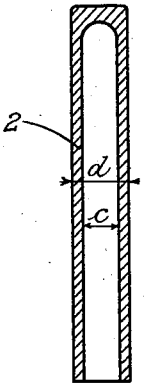



Fig.3.

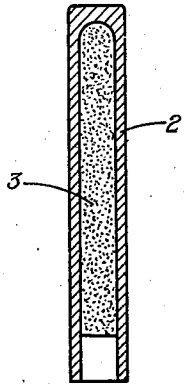



Fig.4.

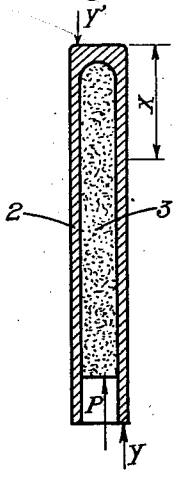



Fig.5.

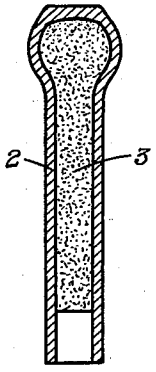



Fig.6.

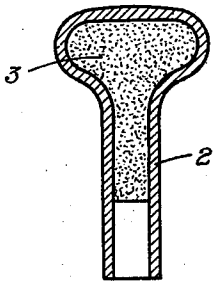
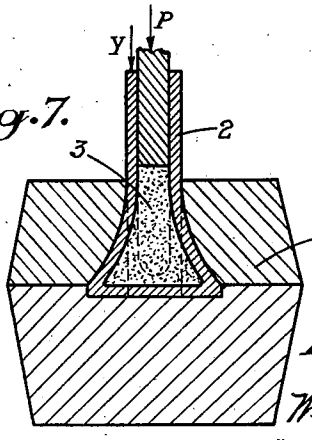



Fig.7.




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# UNITED STATES PATENT OFFICE

2,070,589

## PROCESS OF FORGING HOLLOW METAL BLANKS

Ezio Giacchino, Brussels, Belgium; Francesca Teresa Rebaldo Giacchino, Aldo Giacchino, and Ezio Giacchino, Jr., sole heirs of Ezio Giacchino, Sr., deceased, assignors, by direct and mesne assignments, to Société Anonyme Forgeage Electrique Giacchino, Brussels, Belgium, a Belgian company

Application August 31, 1933, Serial No. 687,693
In Belgium July 4, 1933

3 Claims. (Cl. 29—156.7)

My invention relates to a process for shaping and forging metal stock and it has for its object to shape or forge hollow metal bodies of varying inner cross-section, with the use of a fuel or of electrical energy as heating agent.

A particular object of my invention is to make hollow metal bodies of flaring cross-section, such bodies being very difficult to shape by the usual processes, as is the case with some valves for the engines of flying machines.

In accordance with my invention I obtain this result in a very simple and reliable manner by heating a hollow or a tubular blank over a suitable length and expanding by internal pressure the portion thereof which has been softened by heat. To apply such internal pressure, various means may be resorted to.

In one embodiment of my invention, I exert the required internal pressure by means of a deformable core forced into the tubular blank, which core may suitably be formed of a loose material of low electric conductivity infusible at forging temperature, preferably graphite powder.

Preferably the tubular blank is closed at the end which is to be expanded, the closure then consisting of a bottom wall integral with the blank and inwardly rounded at the corners to prevent the formation of cracks.

The mere expansion of the blank by the means above referred to makes it possible to obtain a part which can be subsequently finished in a press. It is however also possible to shape directly the part to the requisite form and size, by expanding it in a suitable die.

The effect of expansion on the heated blank may create a tendency for a wall thereof to stretch and become locally thinner. If it is desired to obtain uniform wall thickness, I may apply during the forging operation, an axial pressure on the blank in order to feed metal to the expanded portion and thus give said portion the desired wall thickness.

By combining an internal pressure exerted by means of a deformable core and an axial pressure applied to the blank itself, and by suitably adjusting these pressures relatively to each other, I am also enabled to shape the blank during forging.

The two pressures then may be applied by two coaxial plungers adapted for independent actuation, and acting on the blank and on the deformable core respectively. A convenient machine adapted to carry out my improved process is described and claimed in my co-pending patent application Ser. No. 687,694 of even date herewith.

In order that the various features of my improved process and its advantages may be more fully understood, reference will be had to the accompanying drawing in which the steps of forging a hollow valve body are diagrammatically illustrated by way of example.

In the drawing:

Fig. 1 is a sectional elevation of the hollow valve body.

Fig. 2 is a similar view of the blank from which it is forged.

Figs. 3 to 6 are similar sectional views illustrating the blank in successive stages of the forging operation.

Fig. 7 is a sectional elevation showing the method of forging the same valve in a die.

In order to forge a valve body such as shown in Fig. 1, the usual process starts from a solid blank *l* of substantially the same diameter as the enlarged portion of the valve. In this blank a hole is bored, with a diameter corresponding to the inner diameter *a* of the enlarged portion, whereupon said portion is forged and the stem is contracted to its final diameter *d*. This method has several inconveniences; the size of the hollow and the wall thickness vary considerably from one piece to the other; the operation furthermore is slow, difficult and expensive.

With my improved process these inconveniences are completely avoided. I start from a tubular blank 2 having an outer diameter *d* and an inner diameter *c* equal to the outer diameter and inner diameter, respectively, of the valve stem, said blank being closed at one end (Fig. 2). In the hole in the blank, the end of which is preferably rounded to avoid the formation of cracks, I insert a suitable loose or plastic material 3, as powdered graphite for example (Fig. 3). This graphite is well packed in order that its volume shall remain substantially uniform in the course of forging.

In order to enlarge the hollow within the blank, I heat the blank electrically over a given length *x* from its closed end. At the same time, or immediately thereafter, I exert a pressure *p* on the core 3 (Fig. 4) thereby creating within the blank an internal pressure adapted to swell the portion *x* which has been softened by heat (Fig. 5).

If, while the expanding pressure *p* is exerted on the core, I apply on one of the ends of the blank an axial pressure in the direction of ar-

row $y$, or $y'$ (Fig. 4) this pressure assists in causing the wall to bend outwardly at $x$, and furthermore it causes metal to be fed to that portion of the wall, whereby the thickness of this bent or expanded portion will be caused to remain substantially uniform.

A form of blank such as shown in Fig. 6 is thus obtained. This can easily be stamped or pressed between suitable dies to the final shape illustrated in Fig. 1.

By suitably controlling the application of heat, as the heating temperature, the place and the size of the heated portion, and by adjusting the pressures $p$ and $y$ or $y'$ I am enabled to vary according to requirements, in the course of the operation, the form or size of the swelling and the thickness of its walls.

In the example shown in Fig. 7, the end of the hollow blank 2 which is to be enlarged is provided with a core 3 and heated, whereupon it is promptly placed into a die 4 and a pressure $p$ is exerted on the core. On expanding, the blank 2 then is caused to take up the shape of the die. In this case also an axial pressure as $y$ may be exerted on the blank in order to force metal to feed the expanded portion.

It will be understood that my improved process can be used for forging hollow bodies of various forms either from blanks having a closed end, as shown, or from tubular blanks open at both ends. In the latter case a suitable stop or abutment may be provided for holding the core used for expanding the blank.

I claim:

1. In a process of forging hollow metal bodies, inserting a deformable core of powdered graphite in a tubular blank, applying an electric heating current to a portion of said blank to soften the metal forming such portion, applying pressure to said core to expand said softened portion, simultaneously applying axial pressure to said blank, and controlling the shape of the expanding blank by varying the application of heat and the relative pressures on said core and on said blank.

2. Those steps in the process of forging hollow metal bodies which consist in inserting a deformable core in a tubular blank, applying heat to a portion of the blank to soften the metal forming said portion, applying pressure to the core to expand the softened portion, simultaneously applying axial pressure to the blank, and controlling the shape of the expanding blank by varying the application of heat and by independently varying the pressures exerted on the core and on the blank.

3. Those steps in the method of forging hollow metal bodies which consist in inserting a deformable core of a substantially no-conducting pulverulent material in a tubular blank, electrically heating a portion of the blank to soften the metal forming said portion, applying pressure to the core to expand the softened portion, simultaneously applying axial pressure to the blank, and controlling the shape of the expanding blank by controlling the application of heat and also by independently controlling the pressure exerted on the core and on the blank.

EZIO GIACCHINO.