

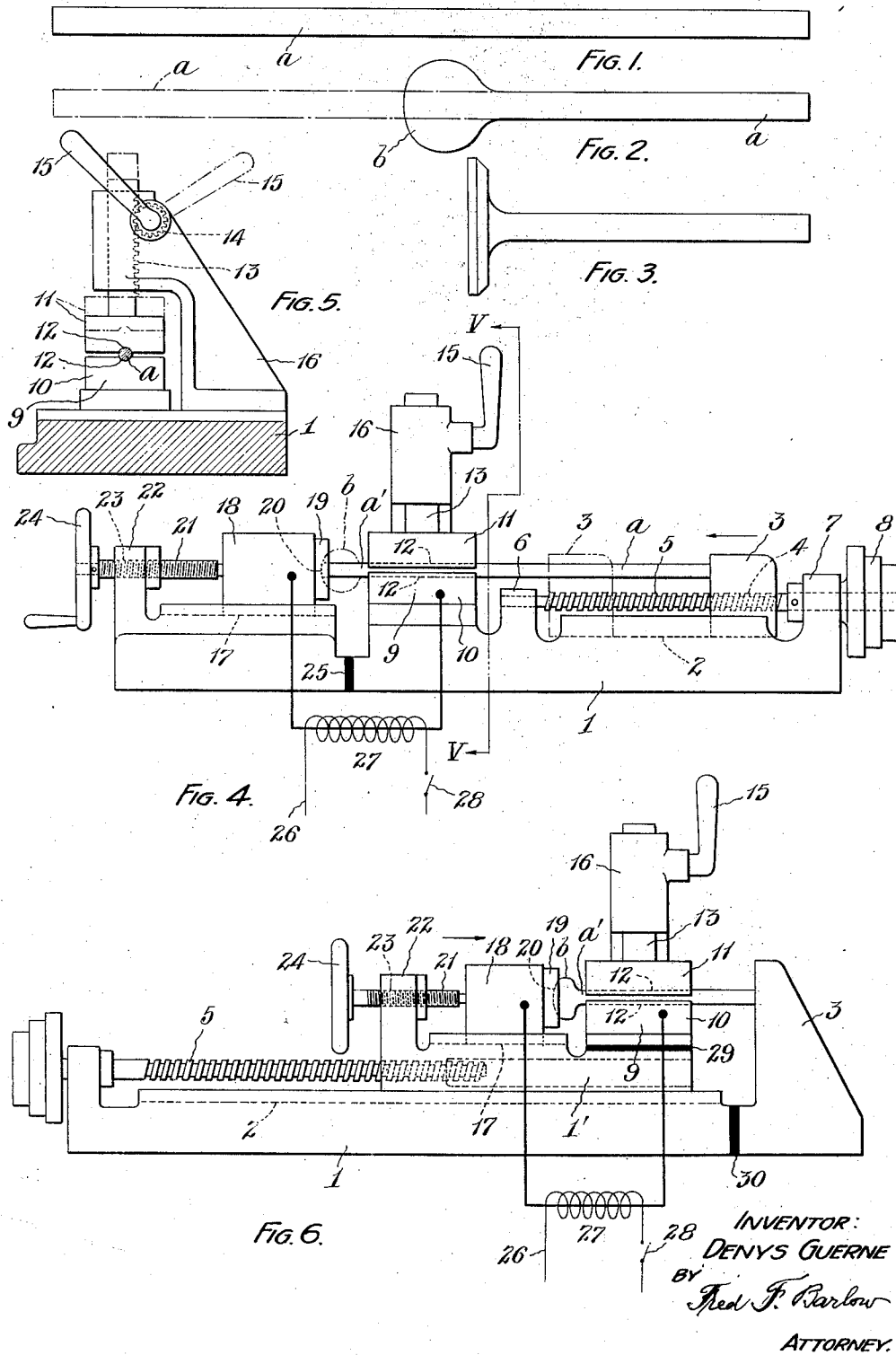
July 13, 1926.

1,592,275

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PROCESS AND APPARATUS FOR THE PRODUCTION OF MACHINE PARTS

Filed Dec. 11, 1923



UNITED STATES PATENT OFFICE.

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PROCESS AND APPARATUS FOR THE PRODUCTION OF MACHINE PARTS.

Application filed December 11, 1923, Serial No. 680,050, and in France March 15, 1923.

My invention relates to a process and an apparatus for producing metal parts of varying cross-sectional area such as, for example, poppet valves for internal combustion engines, lubrication bolts, or similar metal elements.

The object of the invention is to produce such varying cross-section in the particular article to be made, in an economical and efficient manner, and at the same time have imparted thereto, to the greatest possible degree, such advantageous physical characteristics as its duty may require.

The said invention consists of a method and apparatus hereinafter fully described and particularly pointed out in the claims.

The various ways of producing these articles having varying cross-section and which have heretofore been practiced, are well known to those skilled in the art, as by casting, forging, gathering, welding, machining, etc.

Some of these methods and the apparatus have involved the use of an electric current for heating the blank, as for example is shown and described in the Thomson Patent No. 396,010 issued January 8, 1889; Lemp Patent No. 432,630 issued July 22, 1890; Lauder & Simpson Patent No. 437,654 issued September 30, 1890, and Murray Patent No. 1,259,275 issued March 12, 1918.

In so far as I am aware, the practice prior to my invention was such that the size of an enlargement made in a single operation from a heated bar of uniform cross-section when secured in a holder and then upset by forcing it against an abutment, without buckling the bar, was limited to a portion of the stock whose volume is approximately not greater than the area of the section of a cylindrical bar, multiplied by three times the diameter of such bar, or in the case of a section other than circular, multiplied by three times the diameter of the circumscribing circle of said section.

By my invention, however, I am enabled to greatly decrease this limitation as to the volume of the enlargement and with corresponding economical results.

Specifically, my invention has for its object the formation of such enlargements of any desired size, by a continuity of operation and independently of the diameter of the stock to be worked.

This I accomplish by supporting the stock or blank in one electrode so as to be slidable therein, then causing an extrusion of the blank from such electrode and at the same time subjecting it to compression by applying force in the direction of its axis counteracted by the physical resistance of the other electrode acting either as a fixed or a movable abutment or clamp, as will hereinafter appear.

In this manner a portion of the blank is continually fed out of the electrode so that the volume of metal being worked is constantly increased until the requirements of the finished product are satisfied.

The metal newly introduced into the sphere of operation is of constant diameter but is not heated to upsetting temperature until a short time after it emerges from the electrode. The unworked portions of the blank are advanced with comparative rapidity toward the heated part so that the metal of the blank near the upset portion does not reach a temperature substantially greater than the A_{c3} point of the particular steel used in the process.

The temperature referred to, as is well known to those skilled in the art, is a critical point in the working of the steel, and such as marks a period in its physical character, beyond which it is deteriorative as to the strength of the metal.

The elongated form of the electrode maintains the proper alinement of the bar while it is being extruded, whereby the force exerted by the block 3 may be applied by contact only, avoiding the necessity of clamping the end of the bar, as previously practiced.

The annexed drawings and the following description set forth in detail certain means embodying my invention, the disclosed means, however, constituting but one of the various mechanical forms in which the principle of the invention may be employed.

In said annexed drawings:

Figure 1 represents a front elevation of a blank rod which may be used to form a poppet valve by means of my improved apparatus and according to the method forming my present invention.

Fig. 2 represents a front elevation of said rod after having had the enlargement formed thereon.

Fig. 3 represents a front elevation of a completed valve made from the structure shown in Fig. 2.

Fig. 4 represents a front elevation of one form of apparatus for carrying out my invention, the electrical relationship of the parts being illustrated diagrammatically.

Fig. 5 represents a vertical cross-section of the apparatus taken on the plane indicated by line V—V in Fig. 4.

Fig. 6 represents a front elevation of a modified form of said apparatus.

For the purpose of illustrating the method and apparatus constituting my invention, I have elected to show in the drawings an apparatus designed for and hereinafter to describe the process carried out thereby as particularly applicable to, the manufacture of poppet valves. The illustrated embodiment of that part of said invention which relates to the apparatus, includes a suitable base 1, Fig. 4. At the right-hand end of said base, in the device illustrated, is formed a horizontal slide-way 2 in which is mounted a block 3. This block is formed with a horizontal interiorly threaded bore 4 which is engaged by a horizontal, rotatable but longitudinally fixed screw 5. The inner end of this screw is mounted in a suitable fixed bearing support 6 and the outer end portion thereof is mounted in a suitable fixed bearing support 7, the extreme outer end of the screw having fixed thereto a cone pulley 8 by means of which it may be driven through the medium of a suitable belt (not shown).

Also mounted upon the base is a two-part or divided electrode 9, the lower portion 10 of which is fixed with reference to the base and the upper portion 11 of which is vertically movable. The adjacent inner faces of the two parts of the electrode are formed with horizontal grooves 12 conforming in cross-section to the cross-section of the blank to be worked, which together form a seat through which the cylindrical rod or bar *a* in this particular illustrated instance to be operated upon, may be slid as will be hereinafter explained.

The upper portion 11 of the electrode is provided with a vertical rack 13, Fig. 5, which is engaged by a pinion 14 connected with a handle 15 all suitably mounted in and supported by a fixed frame portion 16. It will therefore be seen that by turning the handle, the upper electrode portion may be raised or lowered. The weight of the electrode portion 11 and its attached parts is sufficient to cause same to bear down upon the upper surface of the rod or blank when in position to effect the necessary electrical contact between the electrode parts and said blank. At the other end of the base is formed a horizontal slide-way 17 upon which is mounted a second electrode 18, the latter having its inner end provided with a die

19 having a concave or hemi-spherical face 20. The outer end of the electrode 18 is engaged by or connected with a horizontal and longitudinally movable adjusting screw 21 mounted in a suitable fixed support 22 having an interior horizontal threaded bore 23 engaging the threads of the screw 21. The outer end of this screw is provided with a hand-wheel 24 by means of which it may be rotated.

The two electrodes are suitably insulated from each other, as for example by means of insulation 25, and they form terminals of an electric circuit 26 including a suitable transformer 27. The electrical connections with the electrodes are made properly flexible so that they may accommodate themselves to the motion of said electrodes, as will be readily understood.

A suitable switch 28 is provided in the primary circuit by means of which the current may be turned on and off as required.

In operating the above described device, the electrode part 11 is first raised as shown in dotted lines in Fig. 5 so as to permit the insertion therebetween of a blank cylindrical rod *a* upon whose end it is desired to form the enlargement necessary for making the required valve head, the block 3 having been first backed away so as not to interfere with such insertion.

The electrode 18 is then adjusted with reference to the electrode 9 so as to cause the die 19 to be properly spaced from the electrode 9, the distance between said die and electrode being made sufficiently great to permit of the formation of the enlargement of the desired size without interference. The requirements as to this distance are determined empirically and controlled by the experience of the operator.

After the electrode 18 has been properly set, the rod is placed in position and the upper electrode 11 is lowered down upon the rod or blank so as to make the necessary electrical contact as shown in full lines in Fig. 5, but as before described, such contact is just sufficient to permit the proper passage of the current through the blank and not prevent the latter's sliding through the electrode 9 and in the seat provided therein. The screw 5 is then turned by a hand operation of the belt until the block 3 engages the right-hand end of the blank and moves the latter until its left-hand end abuts the face of the die 19, as shown in full lines in Fig. 4. The apparatus and blank are now in position for the beginning of the enlarging operation.

The switch 28 now being closed, current passes through the electrode 9 into the blank, through the latter to the electrode 18, thus establishing a closed circuit. That part of the blank which projects from the electrode 9 and intermediately of the two elec-

trodes offers the most electrical resistance of any part of the circuit, and hence becomes heated, the current being of sufficient strength to raise the temperature of the projecting part sufficiently to render same plastic to the required degree. As soon as the metal reaches the proper state of plasticity, the belt power is thrown on so as to rotate screw 5 and move the block 3 slowly but continuously in the direction indicated by the arrow in Fig. 4. This causes the blank to move in a similar direction, effecting a compression thereof and in the direction of its axis by reason of the counteracting resistance and force produced by the stationary die-face 20 which acts as an abutment, thus causing the plastic metal to flow radially outward from the axis of the rod, the concave form of the die-face lending itself to the initiation of such action. A continuation of this rotation causes the blank to be continuously extruded from the electrode 9 toward the electrode 18, until the parts reach a position shown by the dotted lines in Fig. 4, and the plastic metal to gather and finally form the required enlargement *b* such as is shown in Fig. 2. Such extrusion is effected with comparative rapidity and so as not to produce a temperature substantially exceeding the Ac3 point, as previously described.

It will be noted that as a result of this extrusion there is continually presented on the exterior of the electrode 9 a portion *a'* of the rod of the original diameter thereof and hence of a maximum and constant resistance.

After the required enlargement is produced, the blank may then be removed and such enlargement, which is still plastically hot, subjected to further operations, such as forging, pressing, upsetting, hammering, or the like, which may be desired or required in the further steps of fabrication and producing the required and finished valve head shown in Fig. 3.

In the modified form of the device shown in Fig. 6, in which the same reference characters are used as in the previously described drawing, to indicate like parts in the two types of machine, I have provided a base 1 formed with a longitudinal slide-way 2 on which is mounted a carriage 1'. This carriage is formed with a slide-way 17 upon which is mounted the adjustable electrode 18 movable by means of the screw 21 and hand-wheel 24, all in a manner similar to that of the first described apparatus. The two-part electrode 9 is also mounted upon this carriage and is provided with the upper movable part 11 and the means for moving same vertically previously described. The block 3 in this case is made a fixed part of the frame and suitable in-

sulation such as 29 and 30 is introduced so as to prevent a short circuit.

As before, the two electrodes 9 and 18 are connected with the circuit 26 including the transformer 27 and switch 28, and a longitudinally fixed and rotatable screw 5 is provided and engages and is adapted to move the carriage 1' upon its slide-way.

In this last described apparatus, after the two electrodes have been adjusted in the manner previously described, the blank introduced and the required frictional contact between the blank and its slide-way effected, the screw 5 is turned by hand until the right-hand end of the blank abuts the block 3 and the left-hand end abuts the face of the die 19. A further movement of the screw therefore will cause the longitudinal compression and the gathering of the end of the blank in the same manner as in the case of the previously described apparatus.

In this latter case, however, the blank is stationary and the electrodes are both movable relatively thereto but still stationary relatively to each other. The principle of operation, however, is exactly the same as before, there being produced in both cases a relative movement between the two-part electrode and the blank and a relative movement between the other electrode and the block 3.

Also as before, there is a continuous extrusion throughout the operation of the blank relatively to the electrode 9.

It will be noted from the above that any desired amount or length of the rod or blank may be gathered in one continuous operation, while at the same time but a short portion of same projects from the electrode 9 and hence requires no support intermediately of the electrodes. My improved process may therefore be readily applied to the production of enlargements of any required size upon rods or blanks of comparatively small diameter.

What I claim is:

1. The steps in a process of producing metal parts, which consist in supporting a blank in an electrode; effecting contact between one end of said blank and a second and permanent electrode; passing an electric current through said blank and effecting extrusion of said blank from said first-named electrode toward said second-named electrode, while engaged by the latter.
2. The steps in a process of producing metal parts, which consist in supporting a blank in an electrode and in a manner which will permit of relative movement between said electrode and blank; effecting contact between a second and permanent electrode and one end of said blank; effecting such relative movement between said first-named electrode and blank and effecting a

relative movement of the second-named electrode toward the unworked portion of said blank, at the same time passing an electrical current through the circuit so established.

3. The steps in a process of producing metal parts, which consist in extruding from an electrode in a right line a blank against a permanent electrode forming an abutment therefor while passing a current through the electrode and the part of the blank being worked.

4. A process of forming an enlargement on a metal blank comprising electrically heating the blank between two electrodes, advancing the unworked portions thereof toward the heated part to effect upsetting thereof so rapidly that the metal of the blank near the upset portion does not reach a temperature substantially greater than the Ac3 point of the particular metal employed.

5. The process of forming in one continuous operation an enlargement upon a metal bar which comprises electrically heating and continuously feeding and upsetting a portion of the bar whose stock is in volume greater than the area of a cross-section of the bar multiplied by three times the diameter of a circumscribing circle of said cross-section, and while that portion of the bar which is being upset is laterally unsupported.

6. The process of forming in one continuous operation an enlargement upon a metal bar which comprises heating between two electrodes and continuously feeding and upsetting a portion of the bar whose stock is in volume greater than the area of a cross-section of the bar multiplied by three times the diameter of a circumscribing circle of said cross-section, and while that portion of the bar which is being upset is laterally unsupported.

7. A process for making an article having an enlargement comprising the heating electrically to upsetting temperature the end of a blank of substantially the diameter of the resultant stem of the article and so rapidly advancing the blank toward the heated end and against an upsetting abutment, while continuing the heating, as to prevent the blank adjacent the upset portion from reaching upsetting temperature.

8. In apparatus for forming an enlargement upon a blank; the combination of an electrode provided with an elongated seat adapted to make sliding contact with said

blank; a second electrode adapted to engage one end of said blank; and a member relatively movable toward and from said second-named electrode and adapted to hold the other end of said blank against relative movement.

9. In apparatus for forming an enlargement upon a blank, the combination of an electrode provided with a seat adapted to make sliding contact with said blank; a second electrode adjustable toward and from said first named electrode and adapted to engage one end of said blank; and additional means relatively movable toward and from said second-named electrode and adapted to hold the other end of said blank against relative movement.

10. In apparatus for forming an enlargement upon a blank, the combination of an electrode provided with a seat adapted to make sliding contact with said blank; a second electrode adapted to engage one end of said blank; and a member relatively movable toward and from said second-named electrode and adapted to engage the other end of said blank, said first-named electrode being located intermediately of said second-named electrode and said member.

11. In apparatus for forming an enlargement upon a blank, the combination of a frame, an electrode fixed thereon provided with an elongated seat adapted to make sliding contact with said blank, a second electrode mounted on said frame adapted to engage one end of said blank, and means operating on the other end of the blank to force it through the first electrode and against the second electrode.

12. The combination specified in claim 11, in which the first-named electrode is adjustably mounted.

13. In apparatus for forming an enlargement upon a blank, the combination of a frame, an electrode fixed thereon provided with an elongated seat adapted to make sliding contact with said blank, a second electrode mounted on said frame adapted to engage one end of said blank, movable means for engaging the other end of said blank, and means for advancing said movable means to cause the blank to pass through the first electrode and against the second electrode to upset the end of the blank.

In witness whereof I affix my signature.

DENYS GUERNE.