

(No Model.)

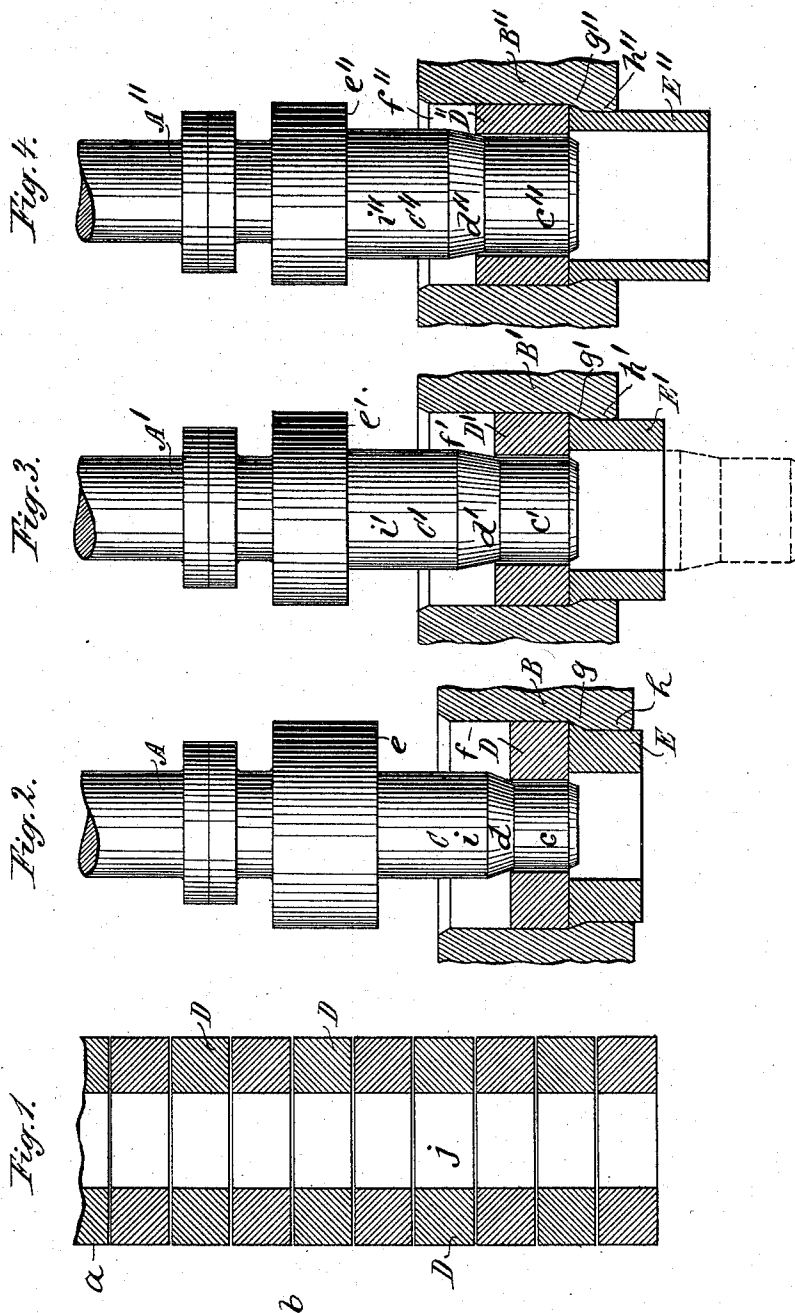
3 Sheets—Sheet 1.

T. BICHEROUX.

PROCESS OF AND APPARATUS FOR COMPRESSING, &c., AND NEW
SHAPENING HOLLOW INGOTS IN MATRICES.

No. 571,332.

Patented Nov. 17, 1896.



WITNESSES:

Fred White
Thomas F Wallace

INVENTOR:

Toussaint Bicheroux,
By his Attorneys:

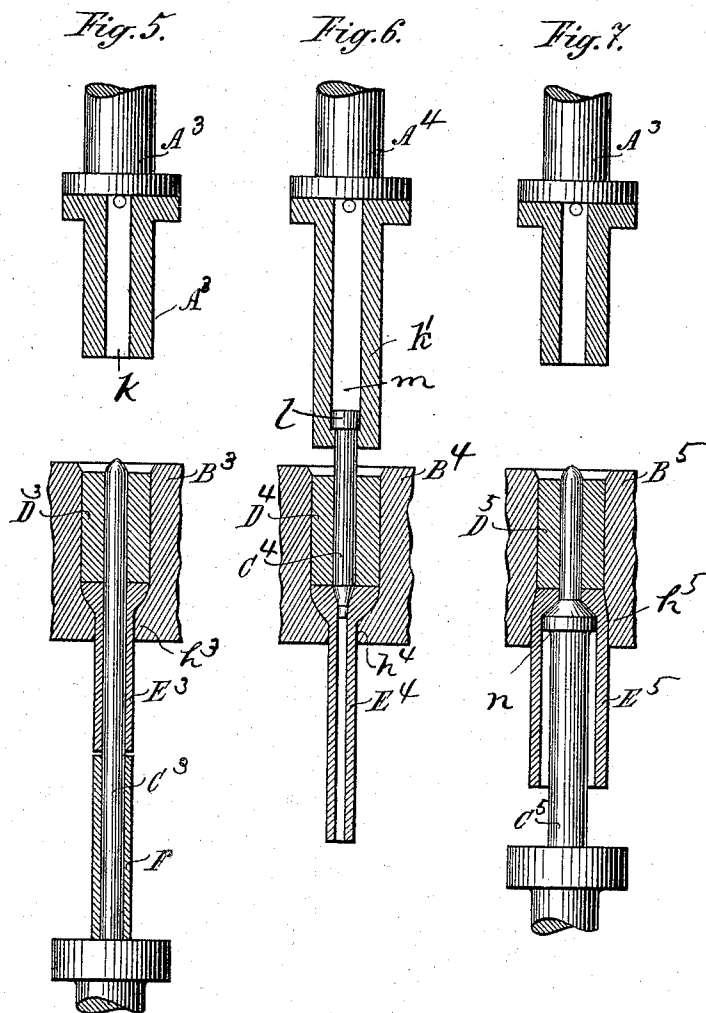
Arthur C. Orser & Co.

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3 Sheets—Sheet 3.

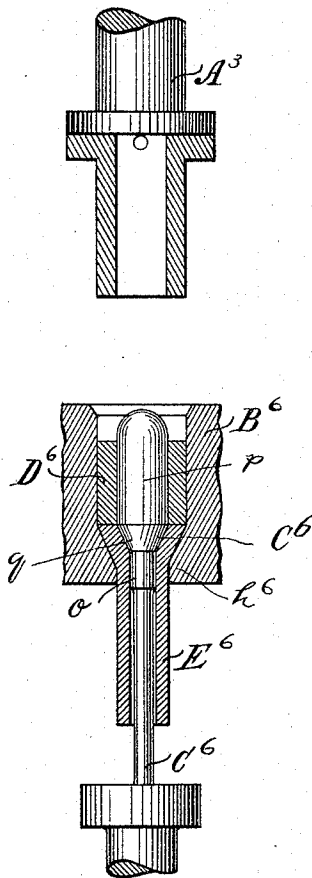
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Fig. 8.



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UNITED STATES PATENT OFFICE.

TOUSSAINT BICHEROUX, OF DUSSELDORF, GERMANY, ASSIGNOR TO DUISBURGER EISEN UND STAHLWERKE, OF DUISBURG, GERMANY.

PROCESS OF AND APPARATUS FOR COMPRESSING, &c., AND NEW-SHAPENING HOLLOW INGOTS IN MATRICES.

SPECIFICATION forming part of Letters Patent No. 571,332, dated November 17, 1896.

Application filed June 12, 1895. Serial No. 552,503. (No model.)

To all whom it may concern:

Be it known that I, TOUSSAINT BICHEROUX, a subject of the King of Prussia, Emperor of Germany, residing at Dusseldorf, in the Kingdom of Prussia and Empire of Germany, have invented certain new and useful Improvements in Processes of and Apparatus for Compressing and Simultaneously New-Shapening Hollow Ingots in Matrices, of which the following is a specification.

This invention relates to improvements in the method of and apparatus for producing hollow bodies from ingots or pigs.

Ingots, pigs, and the like are generally made singly, and it is well known that hollow tubular bodies, cylinders, rings, hoops, or the like which are made therefrom by perforating and forging or rolling do not possess the required regularity, solidity, and equal density, although every attention may be given to the operation.

The object of the present invention is to obtain from hollow ingots or the like while in a heated state, by a peculiar method of compressing and transforming the same, cylinders, tubes, hoops, or rings either complete and ready for use or in a condition for rolling or drawing into other shape, and which are more accurate in form and more dense in texture than those made by the old method of simply perforating, forging, and rough-rolling.

A further object of the invention is to prevent waste of the material under treatment, and to this end means are provided for protecting the highly-heated metal against the admission of air into contact therewith, thus preventing the undue cooling of the metal under treatment and the formation of scale, iron slack, and the like.

In order that the said invention may be clearly understood and readily carried into effect, I will proceed, aided by the accompanying drawings, fully to describe the preferred and certain other adaptations of the same.

In the accompanying drawings, Figure 1 is a vertical axial section of a hollow ingot divided into several annular or ring-like parts. Fig. 2 is a fragmentary elevation of the apparatus, partly in axial section, employed to

produce the hollow bodies from the part ingots and showing the first operation. Fig. 3 is a similar view of a succeeding apparatus and showing the next operation. Fig. 4 is a similar view of a succeeding apparatus and showing the next operation. Fig. 5 is a similar view representing a modified apparatus, and Figs. 6, 7, and 8 are similar views representing further slight modifications.

Referring to Figs. 1 to 4, inclusive, I will first describe the preferred form of my invention.

In carrying the invention into effect the head or riser *a* of the molded ingot *b* is first removed and the ingot is then cut or divided into a number of parts or rings *D*, as represented at Fig. 1. These part ingots or rings are next heated in a suitable manner and introduced one upon the other and in a particular order into a series of matrices *B B' B''*, which may be suitably formed in one piece or of several parts held together by hydraulic pressure or by means of keys, wedges, or the like, as will be readily understood. In these matrices *B B' B''* the part ingots or rings *D* are submitted to a compressing, solidifying, and shaping process in such manner that the part ingots or rings *D* are acted upon equally and uniformly on all sides, while the admission of air thereto is prevented. The first part or ingot *D* having been introduced into the matrix *B* and pressed into the shape represented by *E* in Fig. 2, each succeeding part ingot or ring *D* is supported on the preceding one, which has been submitted to one compressing operation and has become more or less compressed and transformed into a tubular body *E*, as represented at Fig. 2, and each succeeding part ingot or ring *D* passed into the same matrix *B* is similarly pressed into such shape. The presser or plunger *A*, which is caused to advance by hydraulic or other suitable power, terminates in a mandrel *C*, which at its reduced end *c* first enters the aperture of the part ingot or ring *D*, and in its further advance by its conical part *d* it enlarges the opening in the ring *D* and at the same time presses and solidifies the metal against the inner wall *f* of the matrix *B*, squeezing it and causing it to upwardly or axially and diametrically spread. In the fur-

ther forward movement of the presser or plunger A, Fig. 2, the enlargement *e*, which is provided above the mandrel C and which is constructed to closely fit the bore *f* of the matrix B, completely closes the same, and the part ingot or ring D under treatment is completely inclosed on all sides and is thus transformed, condensed, and solidified, while protected from atmospheric influence. The shoulder *e* then forces the ingot D into the contracting part *g* of the matrix and past this part into the smaller cylindrical or reduced part *h* thereof. In entering the confined annular space between the cylindrical part *i* of the presser and the walls *g* and *h* of the matrix the ingot D is reduced in thickness, compacted and increased in length. The presser stops at or before reaching the part *g* of the matrix, and the ingot acted on is left in the matrix in the form shown at E in Fig. 2, partly shaped and partly unshaped. The presser is lifted, a second ingot is placed in the first, and by the fall of the presser is first expanded above that first treated and then used to drive the latter completely through the part *h* and give it its cylindrical elongated shape, that shown at D' in Fig. 3.

After the operation lastly above described the preceding piece E is ejected from the lower end of the matrix B by the advancing part ingot or ring D as a ring D', Fig. 3. This ejected piece D', which is still highly heated, is placed in another matrix B', Fig. 3, having parts *f'* *g'* *h'* similar to the parts *f*, *g*, and *h* of matrix B, where it is acted upon by a presser A', having a thicker mandrel C', having parts *c'*, *d'*, *i'*, and *e'* similar to the parts *c*, *d*, *i*, and *e* of presser C, and is thus transformed and condensed into a hollow body E' in the manner described with respect to the first matrix, Fig. 2, when in the first matrix another part ingot or ring was introduced and acted upon, as hereinbefore described. Then a second ring D' is placed on the first and the latter is pressed clear through the matrix into the form shown at D'' in Fig. 4. Analogous matrix B'', having parts *f''*, *g''*, and *h''* and presser A'', having a mandrel C'', having parts *c''* *d''* *i''* *e''*, acts on the ring D'', giving it the initial shape E'', and subsequently a cylindrical shape like the lower end of E'', when it can be used for any subsequent operations incident to its purpose. It will be seen that this method of working the presser or plunger A and the mandrel C is not liable to irregular strains, inasmuch as they are accurately guided in the first instance by the entrance of the mandrel into the hole or aperture *j* of the part ingot or ring D and afterward by the advance of the enlarged part *e* and entrance thereof into the matrix B, while, if necessary, these parts may be cooled during their upward or return motion by the circulation of water through any suitable arrangement of conduits, as is well known in connection with various classes of machinery. Furthermore, the surface of the working parts do

not become wasted or injured, but can be used for a considerable time without requiring any attention, such as dressing or other repairs. This is a very essential feature of the present invention and is of great importance to the iron and steel manufacturer.

The various operations to which the part ingot is submitted, as hereinbefore described, are practically continuous and exceedingly rapid, while the work is correspondingly simple and inexpensive.

In practice I find that there is no bur formed within the lower partly-formed ingot during the expanding of the upper ingot; but should such a bur occur it will not materially interfere with the working of the ingots, as it will either be welded into the lower one during the finishing thereof or will be pushed through it, depending on the relative heat of the two ingots or on the degree of taper of the mandrel.

In the example given at Figs. 5 to 8 some modified apparatus for further pressing are shown in which the mandrel and presser are formed separately from each other, while the mandrel is guided in a hollow extension of the presser.

In the example given at Fig. 5 the mandrel C³ rises from below through the neck *h*³ of the matrix B³, and passes through the hollow pieces D³ E³ and F to be operated upon, projecting slightly beyond the same, so that it will enter and guide the advancing hollow presser A³. The mandrel C³ in this case is truly cylindrical, while the matrix is formed with a narrow neck *h*³, which by the downward pressure of the extension *k* of the plunger A³ compresses the metal under treatment into the form of a tube, as represented by the finished part F. In this case the mandrel C³ is arranged to form a mere guide or anvil for the extension of the presser A³, and inasmuch as its surface is truly cylindrical it does not increase or alter the diameter of the holes in the pieces D³ E³ under treatment.

In the example given at Fig. 6, on the contrary, the mandrel C⁴ is formed with an enlarged head *l*, which works and is thus guided in the bore *m* of the extension *k'* of the presser A⁴, while the mandrel C⁴ enters the hollow pieces D⁴ E⁴ under treatment in the same direction of travel as that of the extension *k'* of the presser A⁴, and the lower end of the mandrel C⁴ is gradually reduced, and the neck *h*⁴ of the matrix B⁴ is correspondingly contracted, so as to produce by the downward pressure of the plunger A⁴ a tube of smaller bore than that shown at Fig. 5.

In the example given at Fig. 7 the presser A⁵ is like that in Fig. 5, and the lower neck *h*⁵ of the matrix B⁵ is slightly enlarged, and the mandrel C⁵ is arranged in a similar manner to that represented at Fig. 5, that is to say, it enters the matrix B⁵ from below, while it is formed with a shoulder or enlargement *n* for the purpose of enlarging the bore of the pieces D⁵ under treatment, changing them to

the pieces E^5 as they pass the neck h^5 of the matrix.

In the example given at Fig. 8 the mandrel C^6 is formed in two parts, the lower part o being truly cylindrical, while the upper part p is formed of larger diameter, joining the lower part o by a conical neck q , and the matrix E^6 is at its neck h^6 contracted to compress the metal, being pressed therethrough around the part o of the mandrel C^6 .

It will be understood that the details of the apparatus may be more or less modified without departing from the spirit of the present invention.

15 What I claim is—

1. The herein-described method of producing hollow bodies from ingots and the like, consisting in compressing and shaping a hollow ingot or the like while in a heated state in a matrix by means of a presser, which method consists in pressing one hollow hot ingot of one shape against another hollow hot ingot, until the shape of the latter is changed as desired by such pressing, and then pressing said first-mentioned hollow hot ingot with another hollow hot ingot and thereby changing the shape of said first-mentioned hollow hot ingot.

2. The improved method of producing hollow bodies from ingots and the like, by pressing them through a compressing and shaping matrix, which method consists in superposing two hot hollow ingots, applying force to one and pressing it against the other, and thereby forcing the latter into the desired shape, then placing another hot hollow ingot against that to which force was applied, applying force to the ingot thus placed, pressing it against the ingot against which it is placed, and thereby pressing the latter into the desired shape.

3. The improved process of producing hollow bodies from hot hollow ingots between compressing and shaping matrices and mandrels, which consists in partially shaping the interior and exterior of one hot hollow ingot, then placing against the unfinished end thereof an unshaped hot hollow ingot and pressing the latter against said end of said first-mentioned ingot until the shaping of the latter is completed and the shaping of the adjacent end of the following ingot is partially effected.

4. In apparatus for producing hollow bodies, a matrix, in combination with a mandrel of less size than the interior of said matrix and extending through the latter, and a presser fitting said matrix between the walls of the latter and the walls of said mandrel, and movable into said matrix to force a hot hollow ingot through the space between said walls.

5. In apparatus for producing hollow bodies from hot ingots, a matrix for holding two ingots, a mandrel in said matrix for extending through two ingots when held therein, and a presser in the space between said mandrel and matrix, movable into the latter for pressing through it one of the ingots held therein and partially through it the other of such ingots.

6. In apparatus for producing hollow bodies, a matrix having receiving and discharge ends of different shape, in combination with a mandrel in said matrix extending from its portion of one shape to its portion of another shape, and a presser movable into and fitting the receiving end of said matrix between the walls of the latter and the adjacent walls of said mandrel at the receiving end of said matrix, substantially as and for the purpose set forth.

7. In apparatus for producing hollow bodies from hollow ingots, a matrix open at both ends and receiving the ingots at one end and discharging them at the other, in combination with a mandrel movable into the receiving end of said matrix and through the latter to the discharge end thereof for shaping the interior of ingots passing therethrough, and a presser between the walls of said mandrel and the receiving ends of said matrix and movable into said receiving end and partially through the latter for pressing ingots partially therethrough during its inward movement.

8. In apparatus for producing hollow bodies from hollow ingots, a matrix having differently-shaped receiving and discharge ends, in combination with a mandrel movable into said matrix and having a portion for entering the hollow of an unshaped ingot in the receiving end and a portion entering the interior of the partly-shaped ingot in the discharge end, and a presser between said mandrel and matrix, movable into the latter for pressing an unshaped ingot through the space between the matrix and mandrel.

9. In apparatus for making hollow bodies, the matrix B , in combination with a mandrel C movable therein and having a portion c , a tapering portion d and a shaping portion i , and a presser e movable into said matrix between the walls of the shaping portion i of the mandrel and the walls of the matrix, substantially as and for the purpose set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

TOUSSAINT BICHEROUX.

Witnesses:

ERNEST ANDRÉ,
WM. ESSENWEIN.