No. 618,353. Patented Jan. 24, 1899.

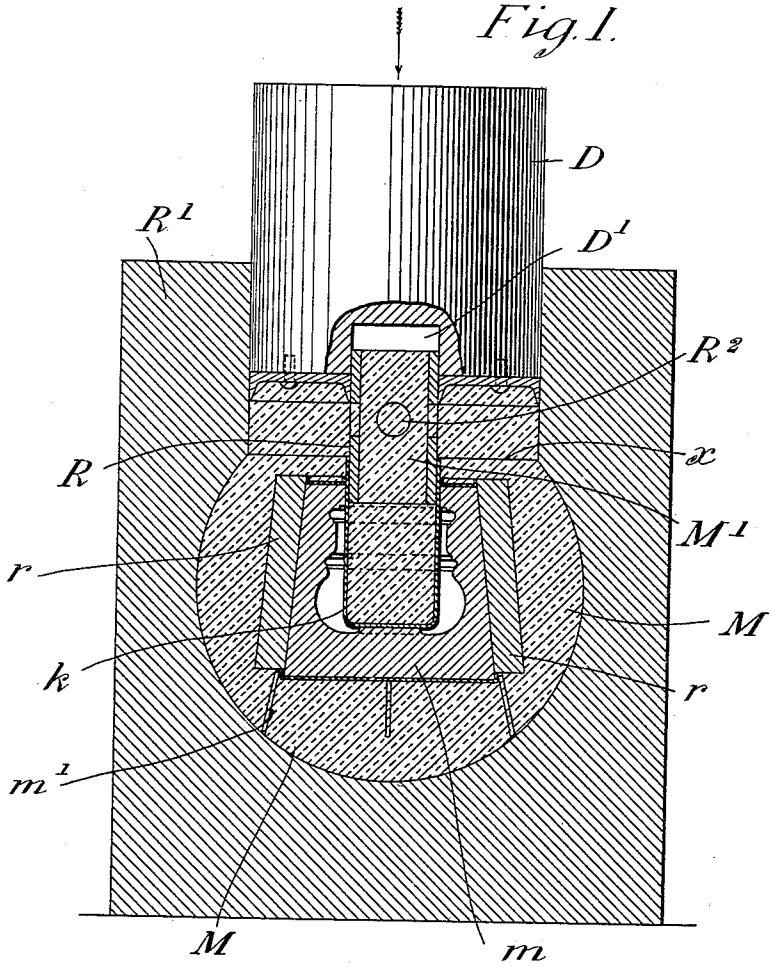
C. HUBER.

PROCESS OF AND APPARATUS FOR SHAPING, EMBOSSING, OR ORNAMENTING HOLLOW METAL BODIES.

(No Model.) (Application filed Dec. 29, 1897.)

2 Sheets—Sheet 1.

Fig. 1.



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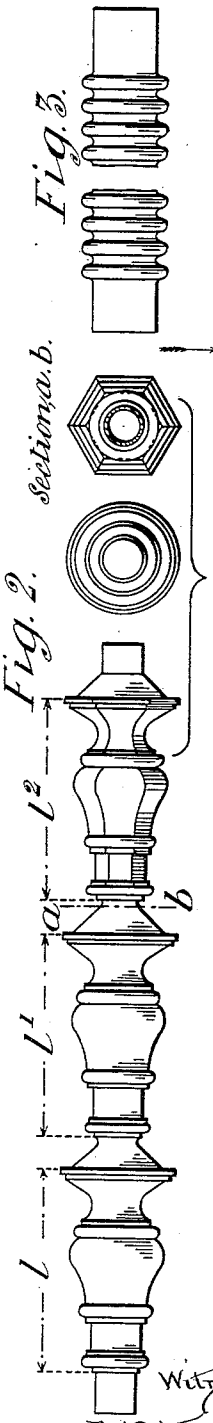

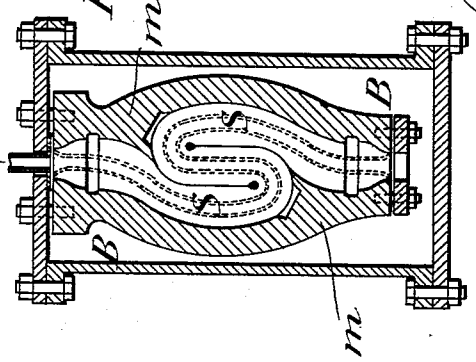

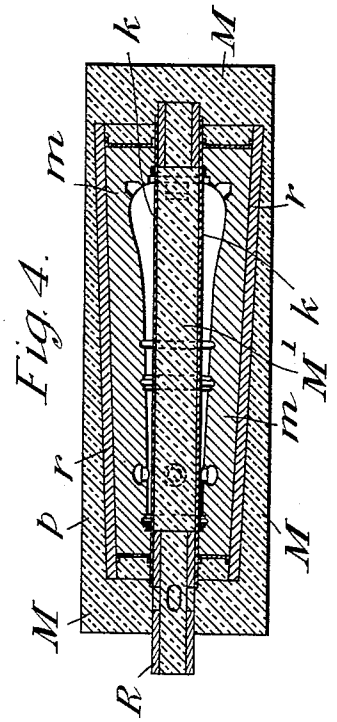

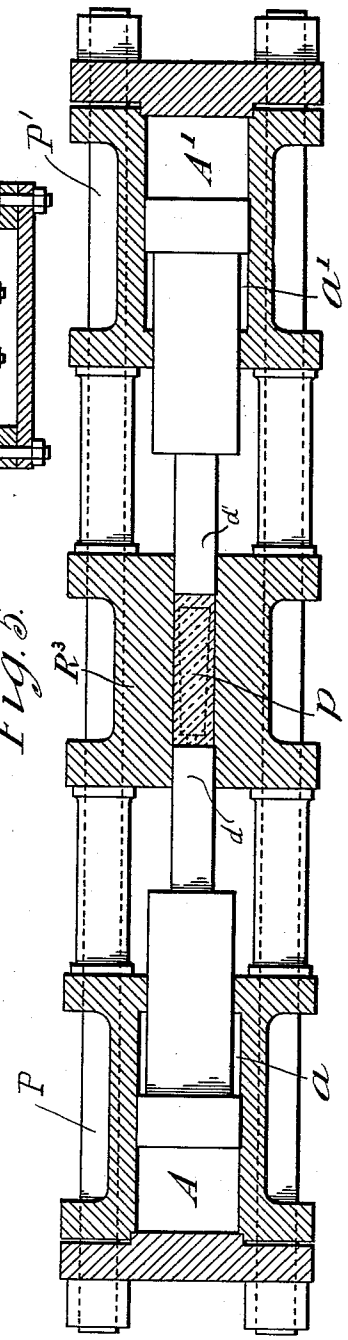

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PROCESS OF AND APPARATUS FOR SHAPING, EMBOSSING, OR ORNAMENTING HOLLOW METAL BODIES.

SPECIFICATION forming part of Letters Patent No. 618,353, dated January 24, 1899.

Application filed December 29, 1897. Serial No. 664,248. (No model.)

To all whom it may concern:

Be it known that I, CARL HUBER, a citizen of Austria-Hungary, residing at 1 Graben 28, Vienna, in the Empire of Austria-Hungary, have invented a certain new and useful Process of and Apparatus for Shaping, Embossing, or Ornamenting Hollow Metal Bodies, (for which I have obtained Letters Patent in Great Britain, No. 3,135, dated February 11, 1896; in Germany, No. 93,318, dated February 6, 1896; in France, No. 253,851, dated February 11, 1896; in Belgium, No. 119,945, dated February 10, 1896; in Hungary, No. 5,502, dated February 12, 1896, and in Austria, No. 46/984, dated March 14, 1896,) of which the following is a specification.

The object of the invention, hereinafter described in detail, is, in the first place, to provide a process for the manufacture of hollow metal bodies either with or without figure ornamentations, as well as plain ornamented objects, by means of either simple or compound engraved steel molds or forms without risk of the latter becoming destroyed although subjected to a very high pressure, frequently amounting to several thousand atmospheres, the reason of this being that said molds are surrounded on all sides by a pressure substance and are therefore acted upon by a more or less equalized pressure.

In the drawings, Figure 1 is a sectional elevation of an apparatus for carrying out my invention; Fig. 2 and the detached end and sectional views thereof and Fig. 3 represent hollow articles such as made by my process. Fig. 4 is a sectional view showing the parts and substances arranged to form a cartridge adapted to be inserted in a press. Fig. 5 is a longitudinal sectional view of a press used in connection with the cartridge shown in Fig. 4, and Fig. 6 is a sectional view of an apparatus illustrating the application of my invention to forming bent pipes.

The main principle of the invention is illustrated at Fig. 1 of the accompanying drawings. In a receiver R′ there are a removable piston D and a matrix-die *m*, consisting of several parts containing the design or ornament and held together by means of a ring *r*. A tubular blank *k*, to which it is desired to impart the configuration of the matrix-die *m*, has fitted into its open end a tube R, having lateral apertures R^2, and these parts are then introduced through the opening of the matrix-die, as shown, the opening being such that the blank *k* is clamped with a close fit between the die *m* and the tube R. The tube R is received into a cylindrical recess D′ in the face of the piston D.

In order to give to the hollow metal body or shell *k* the exact shape and to reproduce thereon all the decorative designs and ornaments that are engraved upon the matrix-die *m*, the latter, containing the hollow body or shell *k*, is placed in the hollow of the receiver or pressure chamber R′, care being taken that the matrix-die *m* touches neither the walls nor the bottom of the receiver R′, but is centrally arranged therein, and it is for that purpose placed upon a kind of improvised wire stand *m′*. The entire space is now filled in either with molten metal or with some other substance M, whose melting-point must, however, be lower than that of the hollow metal body or shell *k*. All the spaces, both outside the matrix-die *m* and inside the hollow metal body or shell *k*, with the exception of the space between the latter and the matrix-die *m*, will thus be filled up.

The substance or metal M, employed for filling up the spaces outside the matrix-die *m*, might be of a cheaper description and less easily fusible than that M′, hereinafter more fully referred to, used for filling up the inside space of the metal body or shell *k* and required for the actual pressing; but the latter—that is, the easily-fusible metal—must occupy the pressure-chamber above the line *x*, or instead of employing two metals of different degrees of fusibility two metals or alloys which will not combine, such as lead and zinc, may be substituted therefor. The core bar or mandrel D is now placed in the bore of the receiver R′, as represented in the drawings, and the whole subjected to hydraulic pressure, the amount of which is regulated according to the nature of the metal that is being shaped or embossed, the less easily fusible metal displaced by the descent of the piston D, passing into the tube R through the apertures R^2 and forcing a portion of the substance M′ into the recess D′. The continued

descent of the mandrel D will thus cause the requisite molding pressure to be exercised on the shell *k*.

Instead of employing hydraulic presses the pressure on the metal or filling-up substance may also be produced by blows under a steam-hammer, by mechanical presses, stamping apparatus, or other suitable means. The spaces outside the matrix-die *m* may thus, as already stated, be filled up with a harder but nevertheless compressible material M, which should, however, be less easily fusible than the actual filling-up material M′, which has to bear the brunt of the main pressure. The object of this arrangement is to free the matrix-die *m* from pressure, notwithstanding the fact of the outer surface being larger than the inner one, to a greater extent than would be possible if the materials used were of the same description. Moreover, the difference in the materials used for filling up the outer and inner spaces serves also to prevent the outer material M from penetrating into the joints of the compound matrix-die *m* and to render the action of the inner material M′ more effective, it being analogous to the action of water-pressure, the use of which, although not altogether excluded, has not for the moment been taken into consideration.

Having described the main principle of the invention, some examples of its practical application by means of appropriate machinery will now be given.

The whole contrivance shown in the foregoing figures and hereinbefore described in detail and which may be described as a cartridge can be subjected to any machinery capable of producing the requisite pressure either by hydraulic power, by impact, or by other means.

Figs. 2, 3, and 4 and the end and sectional views of Fig. 2 show a series of hollow bodies or objects which can be made by this process either singly (bottom included) or else in a series of the same pattern and cut to lengths $l\ l'\ l^2$ from one and the same tube or hollow body or shell *k* and not only of cylindrical shape, but also with polygonal, oval, or other section. The hollow objects thus obtained can be ornamented with figures or any other decorative designs, or the outer surface can be embossed in a variety of ways, either for decorative or technical purposes—as, for instance, in the case of tubes, such as heating-tubes with undulatory or star-shaped sections.

The duplex hydraulic press shown in Fig. 5 is suitable for the manufacture of articles of the above description on a large scale. For this purpose I first prepare a cartridge (shown in longitudinal section at Fig. 4) consisting of the divided matrix-die *m*, held together by the outer shell *r* and containing the tubular blank *k*, with its mouthpieces R projecting at each end from the die. The blank and mouthpieces are filled with the soft pressure material M′, and the matrix-die and shell are also surrounded by the pressure material M by placing the die in a suitable cylindrical mold and casting the material round it. In this case the pressure material employed is a solid plastic substance. The "cartridge" *p* thus prepared is then introduced into the cylindrical pressure-chamber of the receiver R^3, forming part of the double press. (Shown in longitudinal section at Fig. 5.) This press operates in such a way that while it subjects the interior of the blank and the exterior of the matrix-die to pressure, as described with reference to Fig. 1, it at the same time causes the cartridge to travel gradually along the chamber of receiver R^3 from the end at which it was introduced to the other end at which it is discharged, so that by having a number of such cartridges prepared the operations of molding can be carried out with the rapidity requisite for a large output. For this purpose the press is arranged and operates as follows: The hydraulic press consists of two opposite cylinders P P′, in each of which the hydraulic pressure can act both on the full area of the back end of the piston at A and A′ and on a small annular area *a a′* at the front end. The cylinders are firmly fixed by a suitable pillar-framing to the strong receiver R^3, and the pistons have extensions *d d′*, of a reduced diameter, adapted to fit accurately into the pressure-chamber of R^3. The hydraulic cylinders are provided with valve-gear of any suitable known arrangement, whereby pressure fluid can be admitted either only into the spaces A and A′, or only into the spaces *a* and *a′*, or simultaneously into A and *a′*, or simultaneously into A′ and *a*. Such valve apparatus forming no part of my present invention, I have not shown it on the drawings.

The action is as follows: Assuming that piston *d* has been withdrawn from the receiver R^3 by the admission of fluid only to space *a* and that piston *d′* has been advanced by the admission of fluid-pressure at A′, so as to assure a forward position somewhat in advance of that shown in the drawings, then a cartridge *p*, Fig. 4, is introduced into the receiver R^3 from the open left-hand end, and pressure fluid is admitted first into A, so as to bring plunger *d* into the pressure-chamber, and then also into *a′* and A′. The cartridge will now be subjected to a considerable pressure between *d* and *d′*, which will effect the molding of the blank *k* in the manner described with reference to Fig. 1, and at the same time, the combined pressure in A and *a′* being greater than the opposing pressure in A′, piston *d* will gradually advance in the pressure-chamber, forcing the cartridge *p* to the right hand therein and also forcing the piston *d′* backward, which in its turn will force the liquid behind it back into the accumulator or pressure-reservoir. When by this action the piston *d′* has been forced out of R^3 and the cartridge *p* has been sufficiently protruded at the right-

hand end of R^3, it is drawn out, the piston *d* is forced back by the admission of fluid-pressure at *a* and connecting space A with a discharge-opening by means of the valve-gear. A fresh cartridge *p* is then introduced, and the above-described action is repeated.

It may be here mentioned that the holding together of the compound matrix-dies *m* can be effected not only by surrounding them with molten metal, but also by filling up the spaces around them with any other suitable material, or with plates made of some suitable material and of appropriate shapes, or by inclosing them in a mantle or envelop, which would render it unnecessary to renew the same for each fresh charge.

In some cases the matrix-die may be formed of plaster and, if desired, in one piece, which would require to be destroyed in order to release the finished article.

There is a further application of the above process in connection with the manufacture of bent tubes or pipes—such, for instance, as the so-called "lead" siphons or traps. Fig. 6 shows such a pipe bent in several places. Hitherto all such curved pipes had either to be cast, pressed, or soldered, and in either case the process was both expensive and unreliable. By the present process a pipe S, with a smaller diameter than the one required, is placed in the matrix-die *m*, consisting of two parts and left open at both ends. The tube S, as well as the receiver B, together with the properly-tightened matrix-die *m* placed therein, are thereupon subjected to pressure by means of a pump, with the aid of suitable pressure material, such as water, so that, as in the case of the hollow metal bodies above referred to, an expansion of the pipe is effected until it completely fills the matrix-die *m*. Simultaneously with the shaping of the pipe or tube any marks, designs, ornaments, or the like can be embossed thereon. In the manufacture on a large scale the same pattern can either be repeated several times in one and the same matrix-die or by the aid of several matrix-dies placed in the same receiver.

I am aware that it has been proposed to electrically heat a tubular metal blank within a mold or matrix-die while the interior and exterior of the blank and the exterior of the mold are all subjected to fluid-pressure for the purpose of causing the blank to assume the shape of the mold by such combined fluid-pressure, and I do not claim such a method of operating as forming part of my present invention, according to which pressure is only admitted to the interior of the tubular blank and to the exterior of the mold or matrix-die.

Having thus described the nature of this invention and the best means I know of carrying the same into practical effect, I claim—

1. A process for the manufacture of shaped, plain, or ornamental hollow bodies from pipes, tubes, or shells of metal consisting in placing the latter in a suitable matrix-die properly supported, and forcing into the interior thereof and around the same molten pressure substances of a lower melting-point than the hollow body that upon the interior of the latter being of a lower melting-point than that upon the exterior of the matrix-die substantially as herein shown and described.

2. An apparatus for carrying into effect the process hereinbefore described consisting of a hollow receiver or pressure chamber, a divided or other matrix-die mounted centrally in the receiver or pressure chamber, and adapted to receive a metal tube or shell and a piston actuated by any suitable motive power for forcing a substance capable of flowing under pressure around the exterior of the matrix-die and into the interior of the metal tube or shell substantially as herein shown and described.

3. An apparatus for carrying into effect the process hereinbefore described consisting of a hollow receiver, a divided or other matrix-die mounted centrally in a receiver or pressure chamber, and adapted to receive a metal tube or shell, a tube or holder for the metal shell laterally apertured beyond the latter, a piston fitting into the receiver and recessed to receive the end of the holder of the shell and means for actuating the piston and forcing a substance capable of flowing under pressure around the exterior of the matrix-die and into the interior of the metal tube or shell substantially as herein shown and described.

4. A process for the manufacture of shaped, plain or ornamental hollow bodies from tubular metal blanks, which consists in placing the latter in a matrix-die contained within a hollow receiver of a size to leave a space between it and the matrix-die, charging the interior of the tubular blank and the space surrounding the matrix-die with a substance capable of flowing under pressure and subjecting such substance both within the blank, and outside the matrix-die, to direct pressure, substantially as described.

5. Apparatus for carrying out the process herein described consisting of the combination of a hollow receiver or pressure chamber, a divided or other matrix-die mounted in the receiver so as to have a space between the two and adapted to receive a tubular blank, and a hydraulic press adapted to exert direct pressure simultaneously upon bodies of a substance capable of flowing under pressure contained respectively within the tubular blank and the space surrounding the matrix-die, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 14th day of December, A. D. 1897.

CARL HUBER.

Witnesses:
HENRY C. CARPENTER,
CHAS. E. CARPENTER.