

Sept. 15, 1936.

W. H. PEIRCE

2,054,635

METHOD OF MAKING COPPER MOLDS

Filed May 10, 1934

2 Sheets-Sheet 1

Fig. 1

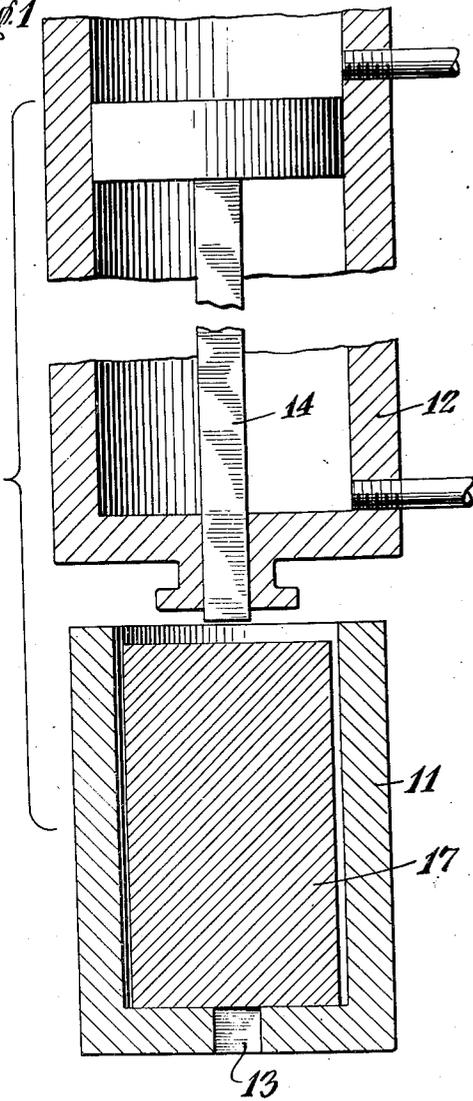


Fig. 2

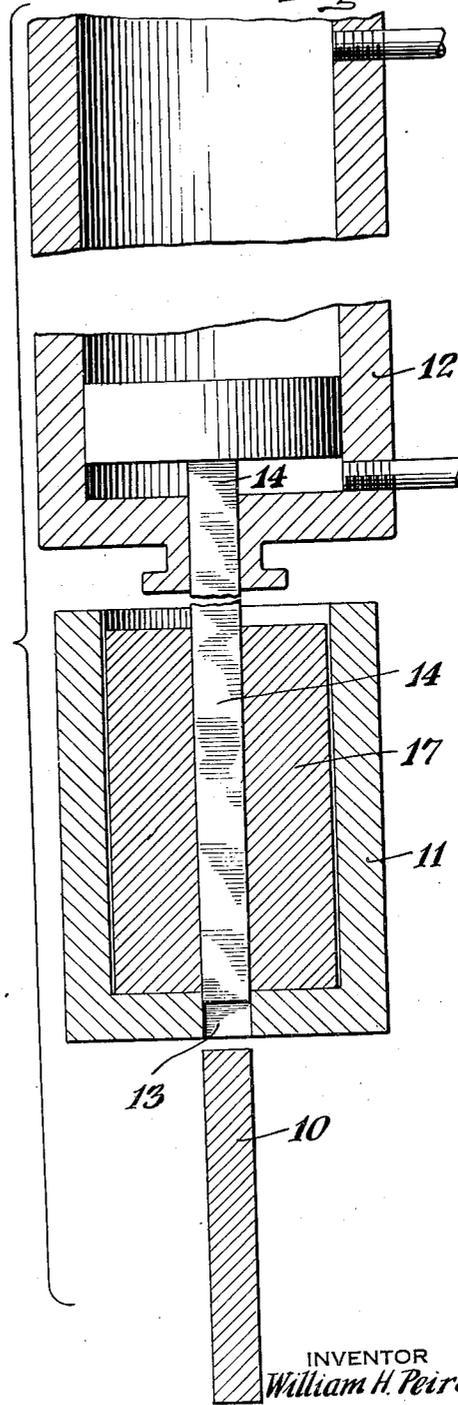
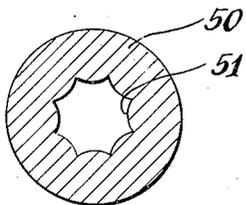


Fig. 10



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Fig. 3

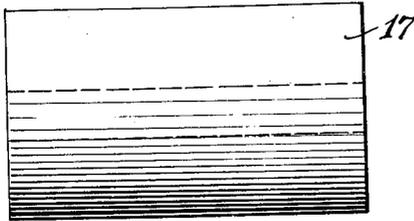


Fig. 4

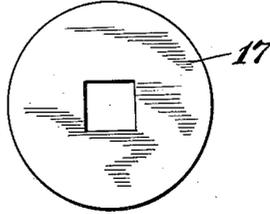


Fig. 5

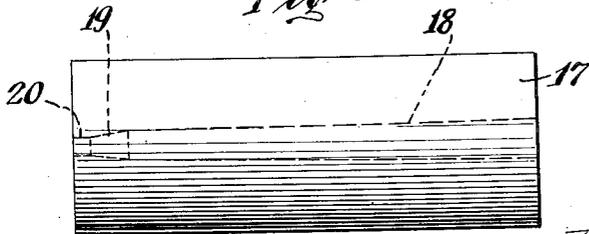


Fig. 6

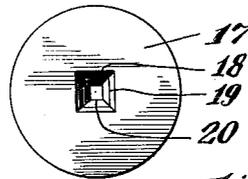


Fig. 8

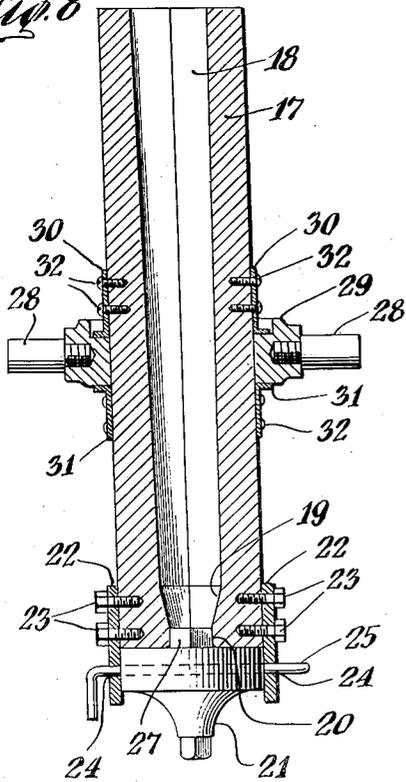


Fig. 9

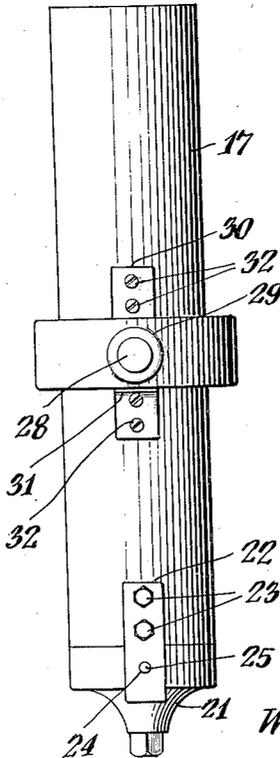
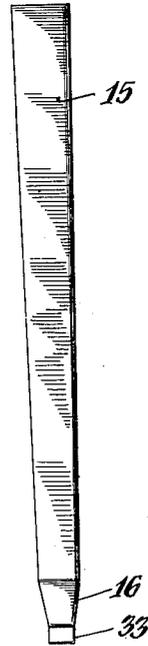


Fig. 7



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2,054,635

METHOD OF MAKING COPPER MOLDS

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Application May 10, 1934, Serial No. 724,836

7 Claims. (Cl. 29—148.2)

This invention relates to vertical casting molds and to an improved method of making such molds from copper and copper alloys.

The invention provides copper molds admirably suited for copper and other non-ferrous metal alloys such as, for example, brass, bronze, nickel silver, monel metal and the like as well as ferrous metals and alloys such as ordinary carbon steels, stainless steels, rustless iron and the like which have relatively high melting points.

In accordance with the invention, molds may be made which will produce castings of any desirable cross sectional shapes whether square, rectangular, circular or irregular and likewise of any desirable depth.

The invention is particularly suited to the production of castings which are not of uniform cross sectional area and especially vertical cast bars of electrolytic copper, oxygen-free copper, deoxidized copper and copper alloys.

Generally stated, the invention contemplates a two step process of making molds mechanically direct from metal in suitable form, such as a cast block, cake or billet of the desired conformation without secondary machining or finishing processes.

More particularly, the invention comprises the piercing of a block, cake or billet of copper, while in a heated condition and while held in a receptacle of appropriate size, with a tool or plunger adapted to make a cavity or recess in the block, cake or billet of predetermined conformation and dimensions, and then subjecting the product to a cold drawing operation over a tool or mandrel whereby the dimensions of the interior cavity or recess are brought to the precise and exact dimensions desired.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which

Fig. 1 is a diagrammatical representation of a piercing press;

Fig. 2 is a diagrammatic representation of the press with the plunger at the end of a piercing stroke;

Fig. 3 is a side view of a pierced billet;

Fig. 4 is an end view of the same billet;

Fig. 5 is a side view of a mold, partially completed;

Fig. 6 is an end view of the same mold;

Fig. 7 is a side view of a mandrel for use in forming the mold;

Fig. 8 is a section of the finished mold;

Fig. 9 is an elevation of the finished mold; and

Fig. 10 represents a cross section of a modified form of mold.

In the following description and in the claims, various details will be identified by specific names for convenience, but they are intended to be as generic in their application as the art will permit.

Like reference characters denote like parts in the several figures of the drawings.

In the drawings accompanying and forming part of this specification, certain specific disclosure of the invention is made for purposes of explanation, but it will be understood that the details may be modified in various respects without departure from the broad aspect of the invention.

Referring now more particularly to the drawings, a piercing press is diagrammatically represented in Figs. 1 and 2 in which a receptacle 11 is adapted to hold a hot copper billet 17 suitable for piercing. A double-acting ram 12 is adapted to apply pressure to the piercing tool or plunger 14 which may be square or round or of any other suitable cross section. The plunger 14 will thereby operate to pierce a core from the hot billet, forcing the core through a die 13 in the end of receptacle 11. This die may be of a similar cross section to that of plunger 14.

In the piercing operation, the hot billet 17 is placed in the receptacle 11 and the ram is operated to force the plunger 14 through the hot billet. A core 10 is thus pierced from the center of the billet (Fig. 2). The billet is originally slightly smaller than the interior of the receptacle whereby it may expand slightly during the piercing operation to yield the dimensions desired in the pierced billet. The ram is then reversed to withdraw the plunger from the billet. Usual suitable means are provided to withdraw the billet from the receptacle.

The pierced billet or mold stock thus formed is shown in Figs. 3 and 4. In this example, the billet may be of circular cross section with a uniform square hole extending axially throughout its length. It may be of any length or shape desired within the limits of the piercing press.

Any oxide formed on the mold stock by the hot piercing may be removed preferably by pickling

in a suitable reagent such as, for example, sulphuric acid solution, with subsequent water washing to remove traces of the pickling reagent. The square hole may still be somewhat roughened about its edges due to the action of the piercing press, however, and the stock may contain other flaws and cavities formed during the casting of the billet.

The next step not only eliminates this roughness, forming a smooth surface within the hole and eliminating the cavities but also shapes the stock into the configuration desired in the finished mold. This is accomplished by subjecting the stock to one or more cold draws over one or more smooth steel mandrels, the last mandrel having the desired shape and dimensions of the mold required.

Such a mandrel is shown in Fig. 7 which is square in cross section with the sides tapering slightly throughout the greater portion of its length as indicated at 15. Near one end, the mandrel is slightly more tapered, as indicated at 16 and has a small portion adjacent the tapered portion 16 having sides substantially parallel as indicated at 33.

The final cold drawing step produces a shell or main body portion 17 of the mold as is shown in Figs. 5 and 6 in which 18 corresponds to the tapered sides 15 of the mandrel shown in Fig. 2 and 19 corresponds to the slightly tapered portion 16 of the mandrel and 20 corresponds to the portion 33 of the mandrel.

In the finished mold, the main body portion 17 is provided with a suitable base 21 to form a bottom for the mold cavity and which comprises a single copper piece shaped to conform with the cross sectional area of the body portion 17 of the mold. A projecting square portion 27 of the base is designed to fit snugly in the portion 20 of the body of the mold. The base is mounted on the body of the mold by means of straps 22 fixed to the body portion by bolts 23. A hole is provided in the base and holes 24 are provided in the straps to register with said hole in the base. A pin 25 is inserted through these holes to hold the base rigidly in the proper position.

Suitable trunnions 28 are mounted upon the body portion of the mold by means of shoulder 29 which is fixed to the body portion by means of angles 30 and 31 which are held to the body portion by bolts 32. The completed mold may then be mounted in a cradle in a manner suitable for receiving the molten metal to be cast. Modifications in the shape of the mold may be readily made in accordance with the invention. One modification is shown in Fig. 10 in which 50 represents the shell and 51 the cross sectional shape of the mold cavity. This indicates the wide application of the method herein described.

It is seen from the foregoing description that the shortcomings of the method of forming a copper mold by allowing molten copper to freeze around a core and then extracting the core are avoided. While that method is commonly practiced, it is disadvantageous in that the rough surfaces formed by the core must be machined smooth to finished dimensions. The improved method of the invention avoids this machining operation. Further, the old core method produces appreciable percentages of defective molds due to cracks and blow holes and often these defects are not visible until after a considerable amount of machine work has been done.

Another method, heretofore commonly employed for forming copper molds, was to bore a

solid block of copper to produce the mold cavity. But this method is relatively expensive and unless the metal is forged before boring a large portion will be found unsound from gas pockets and must be discarded after a great deal of time and money has been spent.

Another serious limitation upon the methods heretofore commonly practised is that molds having a considerable depth and cross section other than circular can be produced only with difficulty, if at all.

The present invention avoids all these shortcomings and provides a method whereby a mold of any desirable depth and of any shape of cross section may be produced economically and which will stand up after long, hard usage. Expensive and difficult machinery operations are entirely eliminated while a smooth, accurately dimensioned flawless casting cavity is produced. Hidden flaws and cavities present in the original mold stock are likewise eliminated. There may be thus made, according to the invention, a more perfect mold of longer life and more convenient form.

While certain novel features of the invention have been disclosed and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. The method of forming a mold which comprises inserting a hot metal billet into a receptacle, piercing said billet with a plunger, removing and cold drawing said pierced billet over a smooth mandrel having a configuration similar to that desired for the casting cavity in the mold and attaching a bottom to the piece thus formed.

2. The method of forming a mold which comprises piercing a suitable hot copper billet thereby yielding a mold stock of desired length having a cavity therein of uniform cross-section, thereafter drawing said mold stock over a smooth mandrel, the exterior dimensions of which correspond to the desired dimensions of the cavity in the finished mold and closing one end of said mold by securing a copper bottom-piece thereto.

3. In forming a mold having a depth substantially greater than its width, the improvement which comprises piercing a hot copper block in a press adapted to yield a mold stock having a cavity of uniform cross-section and thereafter subjecting the stock to successive cold draws over a series of mandrels, the last draw being performed on a mandrel possessing the same shape as the cavity desired in the finished mold.

4. In forming a mold, the improvement which comprises piercing a hot copper billet and then cold drawing said pierced billet over a smooth mandrel so shaped as to determine the configuration of the casting cavity of the finished mold.

5. The method of forming a mold for vertical casting of metals and alloys which comprises piercing a block of hot copper to form a body portion having a uniform cavity therethrough, drawing the pierced body portion over mandrels to impart the desired dimensions to the mold cavity and sealing that end of the mold which is on the bottom when said mold is in position for casting.

6. The method of forming a mold which comprises piercing a hot copper block in a suitable press thereby yielding a mold stock of desired length having a cavity therein of uniform cross-section, suitably pickling said mold stock to re-

move oxide coating from the cavity, thereafter drawing said mold stock over a smooth mandrel, the exterior dimensions of which correspond to the desired dimensions of the cavity in the finished mold and affixing a copper bottom-piece to one end of said mold.

7. The process of making a mold for casting metals which comprises piercing a hot solid piece

of copper or copper alloy in a press to form a hollow shell, removing the oxide formed on the surfaces of the shell, drawing said shell over a steel mandrel of the size and shape of the casting to be made in said mold and suitably sealing one end of the mold body.

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