Feb. 25, 1930. W. F. EPPENSTEINER ET AL 1,748,333

APPARATUS FOR CASTING METALS

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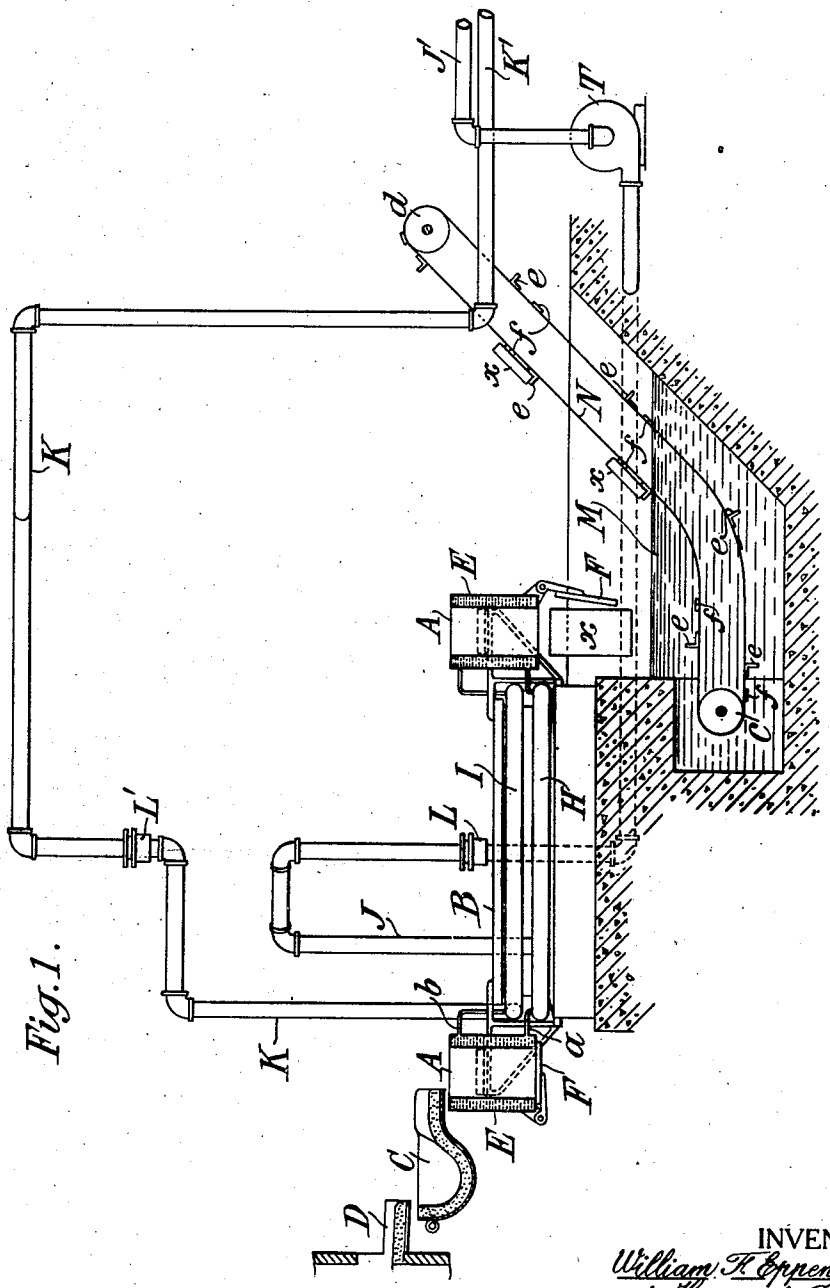


Fig. 1.

INVENTORS:
William F. Eppensteiner
and Henry M. Green,
By Attorneys,
Fraser, Bryan & Manley

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Fig. 2.

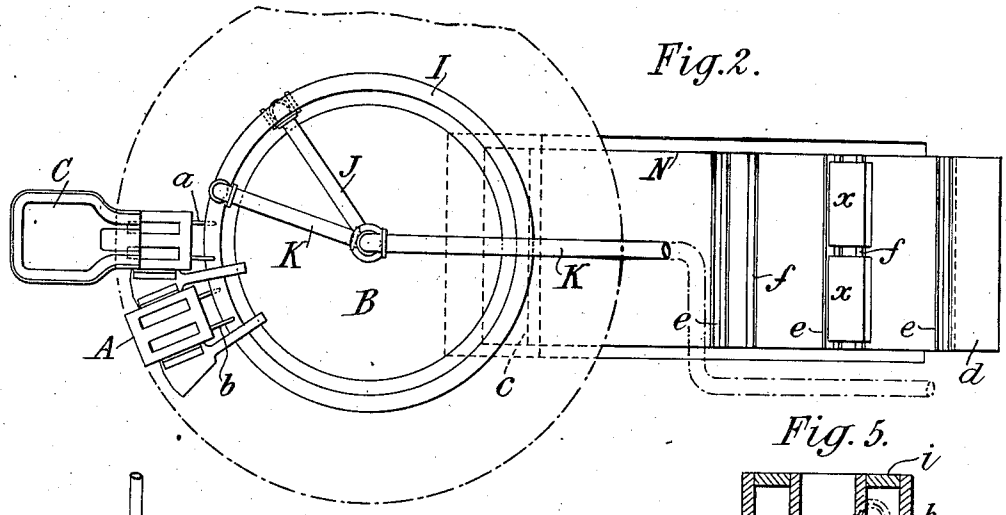


Fig. 3.

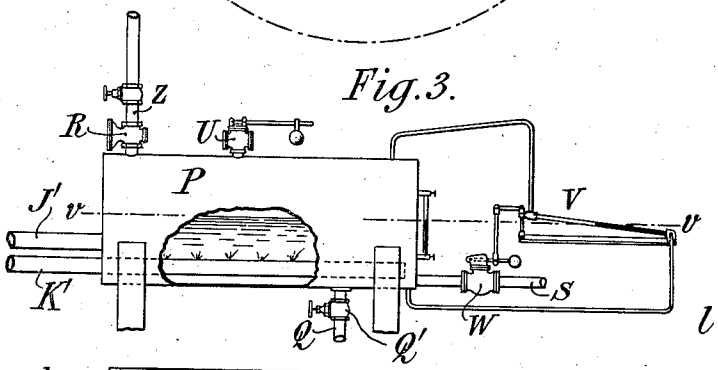


Fig. 4.

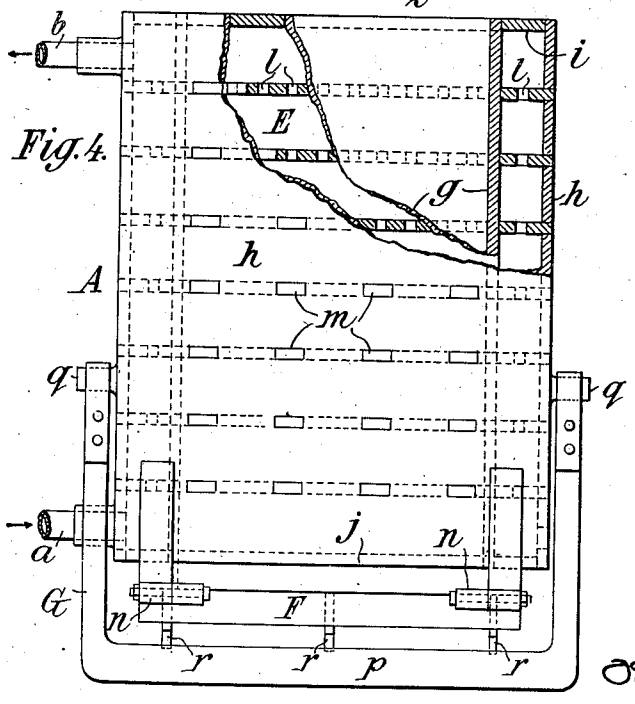
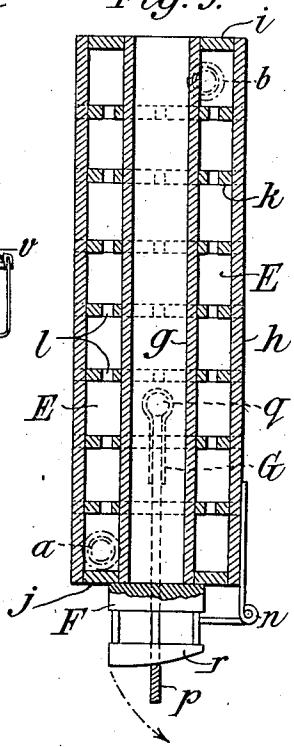


Fig. 5.



INVENTORS:
William F. Eppensteiner
and Henry M. Green
By Attorneys,
Fraser, Myers & Manley

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Fig. 6.

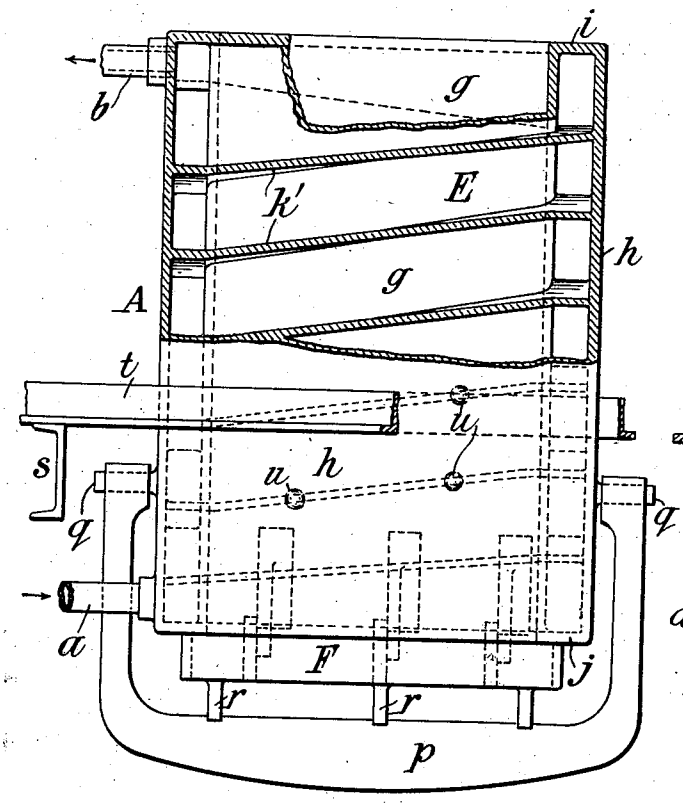


Fig. 7.

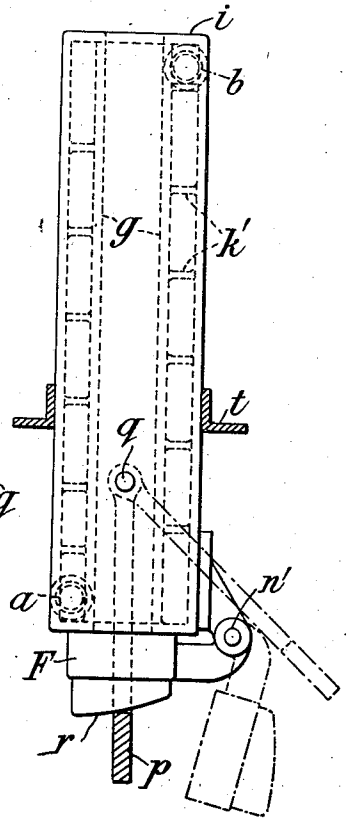
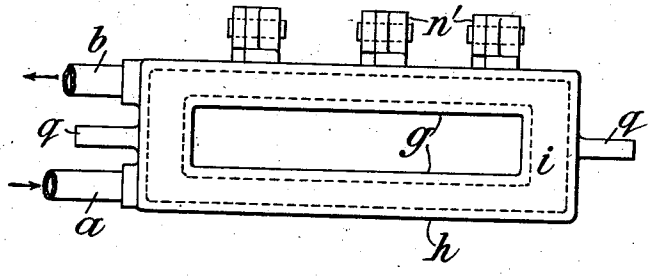


Fig. 8.



INVENTORS:
William F. Eppensteiner
and Henry M. Green
By Attorneys,
Fraser, Myers & Manley

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UNITED STATES PATENT OFFICE

WILLIAM F. EPPENSTEINER, OF RAHWAY, AND HENRY M. GREEN, OF CARTERET, NEW JERSEY, ASSIGNORS TO UNITED STATES METALS REFINING COMPANY, OF CARTERET, NEW JERSEY, A CORPORATION OF NEW JERSEY

APPARATUS FOR CASTING METALS

Application filed March 26, 1928. Serial No. 264,590.

This invention provides improved apparatus for casting metals, being peculiarly adapted for the casting of copper or like metals according to the process set forth in another application executed by us, Serial No. 253,825, filed February 13, 1928.

According to that method the copper is cast into an upright mold having parallel or very nearly parallel inner walls to form a flat cake suitable for subsequent rolling. The mold is water-jacketed and water (or other cooling medium) is circulated through such jacket in such manner as to so effectively cool the inner walls of the mold as to rapidly chill the copper and cause it to contract and thereby free itself from the walls of the mold. The mold has a bottom opening closed by a removable bottom or door through which the cast cake is discharged so that it falls out downwardly and may be received into a water bath for further cooling. This method produces an elongated flat cake which is parallel or very nearly so from side to side and from end to end, so that the difficulty usually encountered in rolling wedge cakes or the ordinary end-poured cakes, is avoided. The main advantage of this method is that the oxidation is confined to the upper end of the cake, which alone is exposed to the atmosphere and which, being of the smallest area, diminishes the oxidized surface portion to the minimum; and being at an end of the cake, which is rolled down endwise, appears only in one end of the rolled sheet which is readily removable by shearing off in the usual manner. The method referred to thus facilitates the production of sheet copper and economizes its cost.

The present invention provides apparatus peculiarly adapted to the casting of copper by the method referred to. A plurality of such upright molds is employed, the molds being mounted upon any suitable carrier, such as a revolving wheel or turntable, and moved either continuously or intermittently. In the casting position on one side of the wheel the molds receive the molten metal; while passing around toward the opposite side the cast metal is solidified and chilled; on reaching the opposite side (or any position suitably removed so as to continue the cooling for the required time) the mold is opened and its contained cast cake is dropped out. The empty molds are then returned to the casting position, and during the interval of time while the molds are thus returning they are cooled and put in readiness for the next casting. Means are provided for the proper circulation of cooling water (or other convenient liquid) through the jackets of the molds and for regulating the temperature of the water so as to introduce it into the water jackets at that temperature which gives the best result.

The accompanying drawings show the preferred form of the apparatus.

Figure 1 is a side elevation of the casting machine, partly in section.

Fig. 2 is a plan thereof.

Fig. 3 is a side elevation forming a continuation of Fig. 1 and showing a suitable means for feeding the cooling water at a prescribed regulated temperature.

Fig. 4 is a side elevation of the mold on a larger scale, partly in section.

Fig. 5 is a vertical transverse section thereof.

Fig. 6 is a vertical section of a different construction of mold.

Fig. 7 is an elevation of the mold shown in Fig. 6.

Fig. 8 is a plan thereof.

Referring to the drawings, A A designate a series of molds carried by any suitable carrier B which is conveniently constructed as a revolving wheel or turntable, as shown. The molds are equidistantly arranged, so that after after each casting operation the wheel turns an angular distance from one mold to the next; this may be done by hand or by any suitable automatic mechanism. For casting, any usual ladle C may be provided, which when filled with molten copper may be tilted to run the copper into the mold which is in the casting position. It is preferable to locate the ladle close to a pouring spout or tap D leading from a furnace in which the copper is fused. The molds may have only one cavity for casting a single

cake, or (especially for thinner cakes) the molds may have a plurality of cavities, in which case the ladle should have a corresponding number of spouts. In Fig. 2 the molds are shown as double molds, that is, with two cavities for casting two cakes together; and for this purpose the ladle is formed with a double spout to simultaneously pour into both cavities. For this, the mold may be stationary during pouring, or if the carrier moves continuously, the ladle may travel with it while pouring and then return under the tap D to receive its next charge. Each mold is formed with a water jacket E and with an opening at the bottom closed by a trap door or other removable bottom closure F which also may be water-jacketed. This door may be conveniently held closed by a hinged loop or bail G engaging a wedging under surface formed beneath the door. Water is introduced into each jacket through a lower inlet pipe *a*, and is discharged therefrom through an upper pipe *b*. As these pipes revolve with the turntable, they are all connected to annular pipes H, I. The pipe H receives water from a pipe J, and the pipe I discharges water into a pipe K, by which it is carried away. To provide for the rotation of the table the pipes J and K are each arranged with a portion coinciding with the central axis of rotation, this portion including a swivel connection L for the pipe J, and L′ for the pipe K, these swivel connections being formed as stuffing boxes to make leak-tight connections. It is apparent that on introducing water through pipe J into the annular pipe H, it will flow therefrom through the branch pipes *a* into the mold jackets and will flow out from the latter through the branch pipes *b* into the annular pipe I, and from this will be discharged through the return pipe K. Thus water is circulated simultaneously through the jackets of all the molds.

As shown, the molds receive the molten copper on one side of the wheel and discharge the solidified and chilled cakes on the diametrically opposite side. This is a suitable arrangement, but it is not essential that these receiving and discharging positions be located 180 degrees apart, as some other spacing may in some cases be preferable. At the right of Fig. 2 the cast cake is shown dropping out of the mold upon the opening of its trap door F. It is desirable to locate at this point a water bath M, so that the cast cakes which are still hot may be further cooled by the water. Some means should be provided for removing these cakes from the water bath, and for this purpose a belt or chain conveyor N may conveniently be applied. It may readily be constructed of endless chains carried over pulleys *c d* and having cross-bars *e* and *f* for carrying the cakes up the inclined plane which the emerging portion of the conveyor assumes. The cakes can be dropped from the pulley *d* onto any suitable means (not shown) for carrying away the cakes. The cakes will thus be carried off immediately, or at any convenient time, for subsequent treatment.

It is important for the best carrying out of the method that the molds be kept at a uniform temperature, which is best accomplished by regulating the temperature of the entering water. This is the function of the apparatus shown in Fig. 3. This apparatus comprises a closed tank P resembling an ordinary boiler, with certain accessories. The tank P is filled with water up to a desired level. On starting the apparatus, steam is admitted through a pipe Q whereby initially to raise the water in the tank to the desired temperature. The pipe Q is controlled by a valve Q′ which may be a gravity check valve. A pipe J′ leads from the body of water in the tank and connects with the inlet pipe J of Fig. 2, a pump T being preferably interposed to insure circulation. Thus the water is carried to the pipe J, which establishes a continuous flow through the intervention of the stuffing box with the portion of this pipe mounted on the carrier and connected with the distributing pipe H. From the pipe I of the carrier the return flow takes place through the pipe K, and by the intervention of its stuffing box L′ to the stationary portion of this pipe, which in Fig. 3 is continued by the pipe K′. This pipe K′ enters the lower part of the body of water in tank P and is preferably perforated in order to distribute the heated returning water into such body of water in the tank. The water in the mold jackets is highly heated by the molten metal therein. Thus the returning water is commonly heated to a much higher temperature than the outflowing water, so that once the operation has been started, the steam inlet valve Q′ is closed. The temperature, which may exceed the normal boiling point of water, may be regulated by controlling the pressure in the tank P. For this purpose the outlet pipe Z by which excess steam is discharged, is provided with an adjustable relief valve R which may be set to pass off the steam at any desired pressure, and thereby to determine the temperature which is maintained within the tank. The steam may be conducted to any desired place for its utilization. By making the valve Q′ a check-valve, it will close itself as soon as a suitable pressure develops within the tank; the valve shown may be manually closed by its handle, when the apparatus is to be shut down. To protect the tank P against accidentally excessive pressure, a safety valve U is desirably provided.

Some suitable means must be provided for maintaining the water in the tank P at the desired level. For this purpose any suitable

construction of automatic feed water regulator V may be provided, as, for example, the one shown in Fig. 3, and which is so well understood as to require no description. It controls an inlet valve W in the water feed pipe S, through which water under a pressure exceeding that in the tank P is introduced in sufficient quantities to maintain the normal water level *v—v* in the tank.

It results from the operation of this heating apparatus that the water is circulated at a substantially uniform temperature by the pump T through the annular inlet pipe or manifold H and branch pipes *a* to the various mold jackets; in these jackets the water is heated to a higher temperature by the heat given out from the metal being cast; the water thus re-heated is discharged from the jackets through pipes *b* and re-collected in the annular pipe I and returned to the hot-water tank, the excess steam being blown off through relief valve R.

It has been found by experience that the best results are attained by heating the water to such temperature that when it enters the molds it will be between 212 and 270 degrees F.

The water-jacketed molds A may be variously constructed. Two suitable constructions are shown. The one shown in Figs. 4 and 5 will be first described.

The mold has an inner shell *g* forming a mold cavity, and an outer shell *h* united by top and bottom members *i* and *j*. The water jacket E is subdivided by partitions *k k*, which in this construction extend transversely and are formed with perforations *l* for permitting the water to circulate upward from one compartment of the water jacket to the next. These several elements are best constructed of wrought iron or steel and welded together, preferably by electric welding. To make a strong union, so that the outer shell *h* will resist the internal pressure due to the circulating water being under pressure, it is preferable to form the partitions *k* with lugs *m* (Fig. 4) which pass through coinciding holes in the outer shell and are united by a welded joint. This construction makes a very strong mold capable of withstanding heavy internal pressure, and one in which the circulation of cooling water through the jacket is so diffused by means of the perforations *l* that a very uniform circulation is maintained. The trap door or bottom F is shown solid or without a water jacket, because of the difficulty of conveying the water into and from such a jacket through packed joints conincident with the hinge axis; instead it is made as a solid casting hinged along one side by any suitable construction of hinges *n*, strap hinges being shown in this instance. To hold the bottom closed for casting, a swinging bail or heavy strap *p* is provided, being hung upon pivot pins or studs *q* attached to opposite sides of the mold; the lower part of the bail *p* engages ribs *r r* formed on the under side of the bottom door F, and having an arc-shaped surface eccentric to the arc of travel of the upper edge of the lower member of the bail, so that as the bail swings under the door a wedging action occurs, whereby the door is forced upward to a tight seat; in practice, engagement is made tight by a blow with a hammer. For dumping, a blow on the bail to drive it to the right in Fig. 5 throws it back and releases the trap door, which falls open and dumps the cast cake.

Another construction of mold is shown in Figs. 6, 7 and 8. Here, also the mold has an inner wall *g* and an outer wall *h*, with top *i* and bottom *j*, as before, and also has intervening partitions which in this instance are lettered *k'*, since they are specifically different from those in Figs. 4 and 5. The partitions *k'* are preferably imperforate, and instead of dividing the water jacket E into compartments, they are arranged with a gradual upward incline forming a spiral, whereby the water jacket constitutes a continuous spiral channel leading from the inlet *a* at the bottom to the outlet *b* at the top. It results that the cooler water entering at the bottom circulates in a spiral or flattened helical path around the inner wall of the mold, being gradually heated as its flows, and being discharged at its highest temperatures from the outlet *b*. Preferably the inlet *a* is applied at one side, as shown in Fig. 7, so as to discharge the water unobstructedly into one flat side of the water jacket, and the outlet *b* is applied at the opposite side, as shown. Preferably in both mold constructions the inlet and outlet pipes *a*, *b*, point in the same direction for convenience in connecting with the annular pipes H, I, shown in Fig. 1. In the construction shown in Figs. 6, 7 and 8, the parts *g*, *h*, *i*, *j*, and *k'*, may be built up and united by welding, as described with reference to Figs. 4 and 5, or they may be cast, or partly cast and partly welded. A suitable mode of construction is to form the inner shell *g* in one piece, and the outer shell *h* in another, the top *i* being formed on either, and the bottom *j* on the other; the partitions *k'* in such case will be formed as ribs projecting from the inner shell *g*. Then the outer shell may be slipped over the inner shell and a tight joint made by welding at top and bottom, but without necessarily forming a water-tight weld or joint between the outer edges of the partitions or ribs *k'* and the inner face of the outer shell, since a slight leakage from one convolution of the spiral channel to the next is unimportant. It is, however, desirable to strengthen the outer shell *h* on its flat sides to enable it better to resist the internal pressure, by form-

ing occasional welds uniting it to the outer edges of the ribs k', these being indicated at $u\ u$ in Fig. 6. These serve the same purpose as the elements m in Fig. 4. The trap door F is here shown as a solid casting as before (although it might be water-jacketed), and the hinges m' are shown with one member cast integrally on the door, and the other member applied by casting or welding to the outer side of the mold. Here again the same fastening for the bottom door is shown, consisting of a bail p hung on pins q and engaging ribs r having curved wedging lower faces. Either construction of mold may be supported by means of rolled members s, t, forming part of the revolving carrier or turntable B in Fig. 1.

The described apparatus may be used for casting not only copper, but various other metals and alloys having properties more or less analogous to those of copper.

The mold may be further modified according to the construction shown in Fig. 5 of our application No. 253,825, filed February 13, 1928, and as described in the specification of that application.

We claim as our invention:

1. An apparatus for casting metal comprising an endless carrier and succession of jacketed molds carried thereby, the carrier formed as a turntable, annular inlet and return pipes carried thereby having branches leading to the jackets of the respective molds, and supply and return pipes connected respectively to said annular pipes and located at the axial center around which the turntable turns, and there provided with swivel connections between the stationary and rotative portions of said pipes.

2. The combination with apparatus comprising jacketed molds, of a water tank and means for maintaining the water therein at a predetermined temperature, and means for conducting such water to the respective mold jackets.

3. The combination with apparatus comprising jacketed molds, of a hot water tank and means for maintaining the water therein at a predetermined pressure, and means for conducting such water to the respective mold jackets.

4. The combination with apparatus according to claim 3, of means for maintaining the water in such tank at a predetermined pressure, and means for feeding water thereto to maintain a uniform level therein.

5. The combination with apparatus according to claim 2, the means for maintaining a predetermined temperature comprising a steam-inlet pipe to said tank, and a check-valve therein for shutting off inflow of steam when a sufficient temperature is generated within the tank.

6. The combination with apparatus according to claim 3, the means for maintaining the water in the tank at a predetermined pressure comprising a blow-off valve adjustable to discharge fluid at varying pressures.

7. A water-jacketed mold arranged vertically and having a bottom closure consisting of a hinged trap door and a swinging bail for holding it closed, having a wedging engagement with the under side of the door.

In witness whereof, we have hereunto signed our names.

WILLIAM F. EPPENSTEINER.
HENRY M. GREEN.