

June 29, 1937.

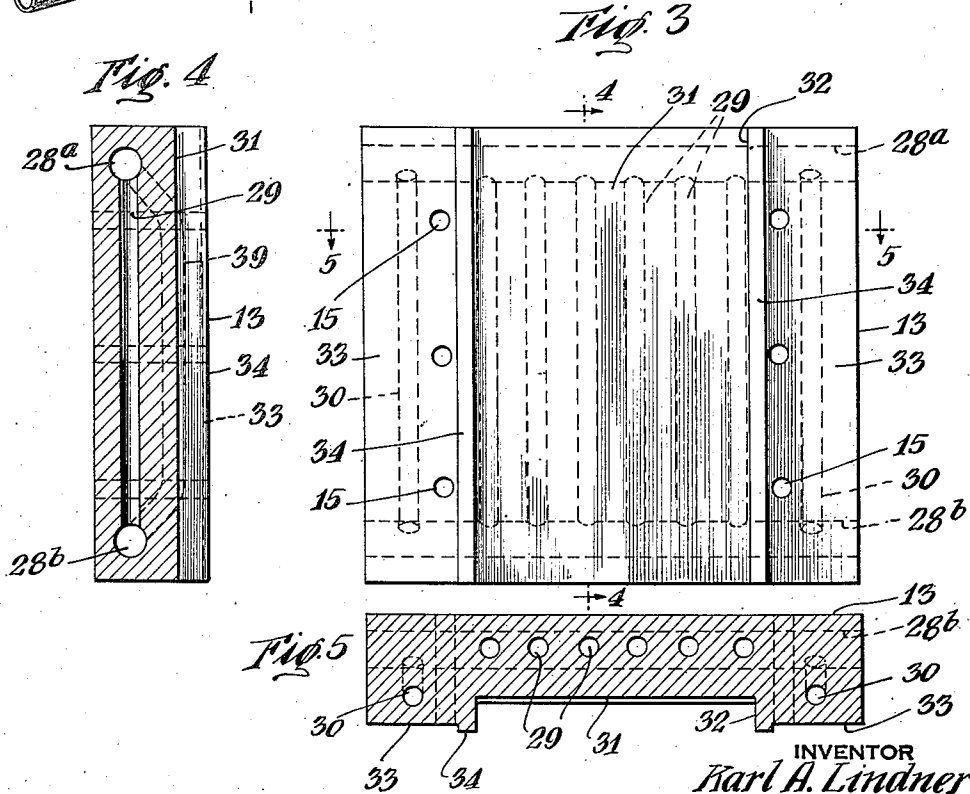
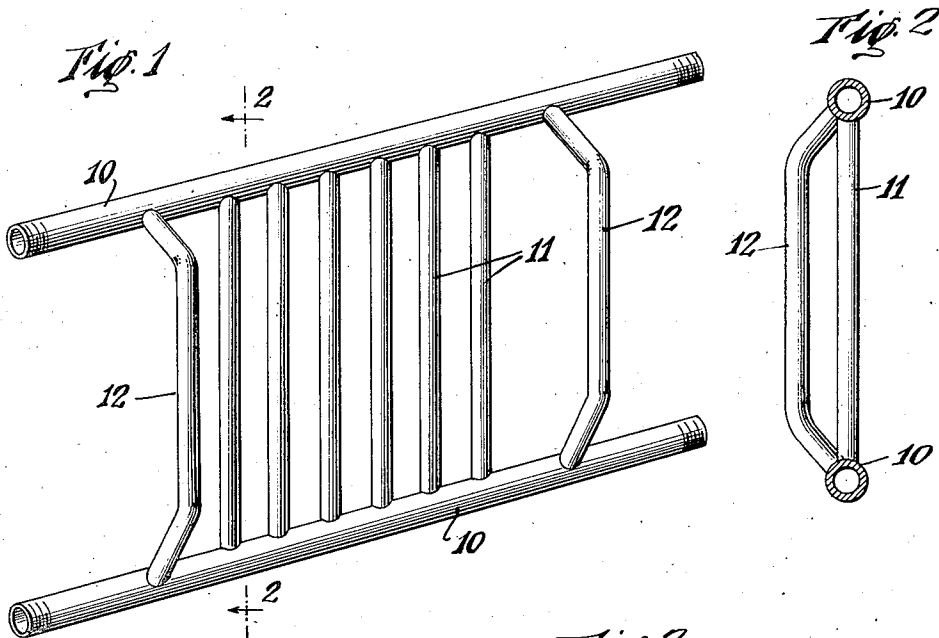
K. A. LINDNER

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METAL MOLD

Filed Sept. 5, 1934

5 Sheets-Sheet 1



INVENTOR
Karl A. Lindner
BY *James K. Kuntz*
ATTORNEY

June 29, 1937.

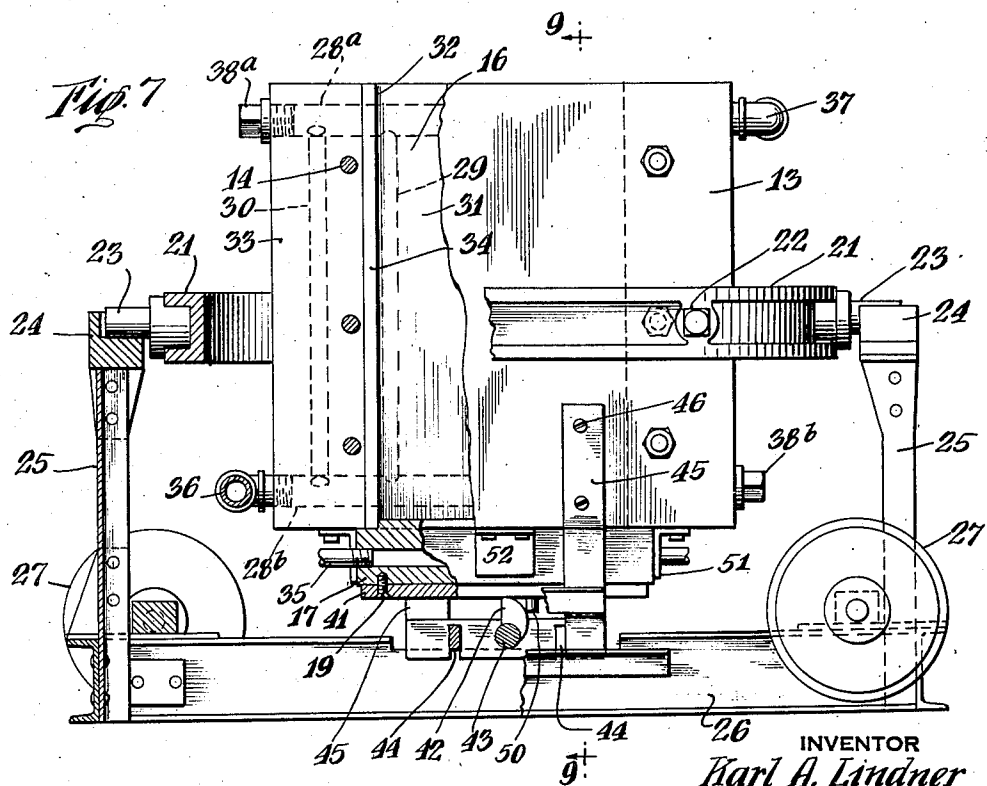
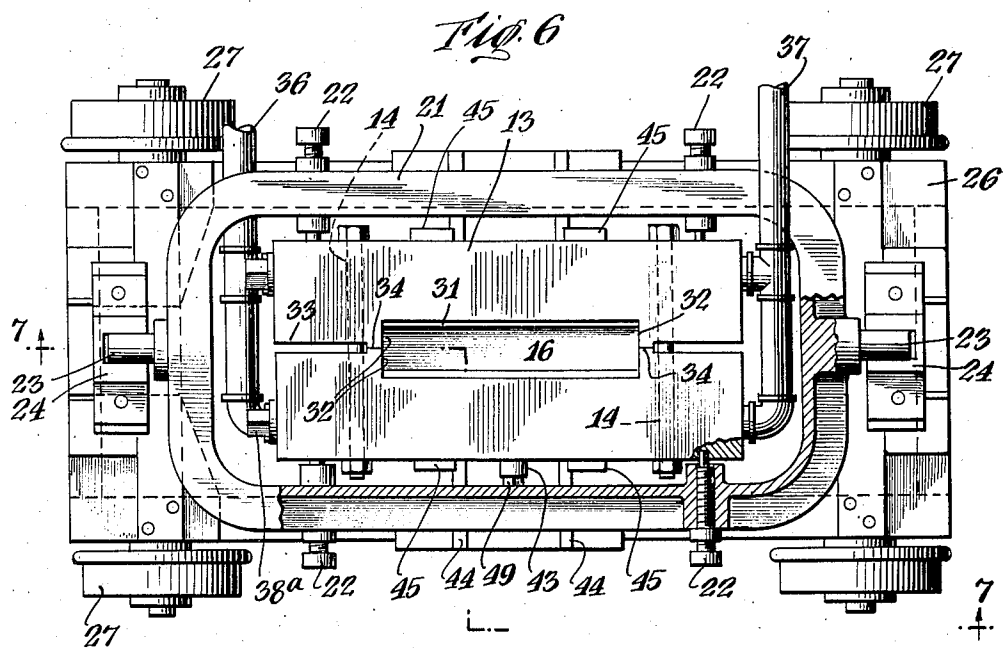
K. A. LINDNER

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METAL MOLD

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INVENTOR
Karl A. Lindner
 BY
James K. Kuntz
 ATTORNEY

June 29, 1937.

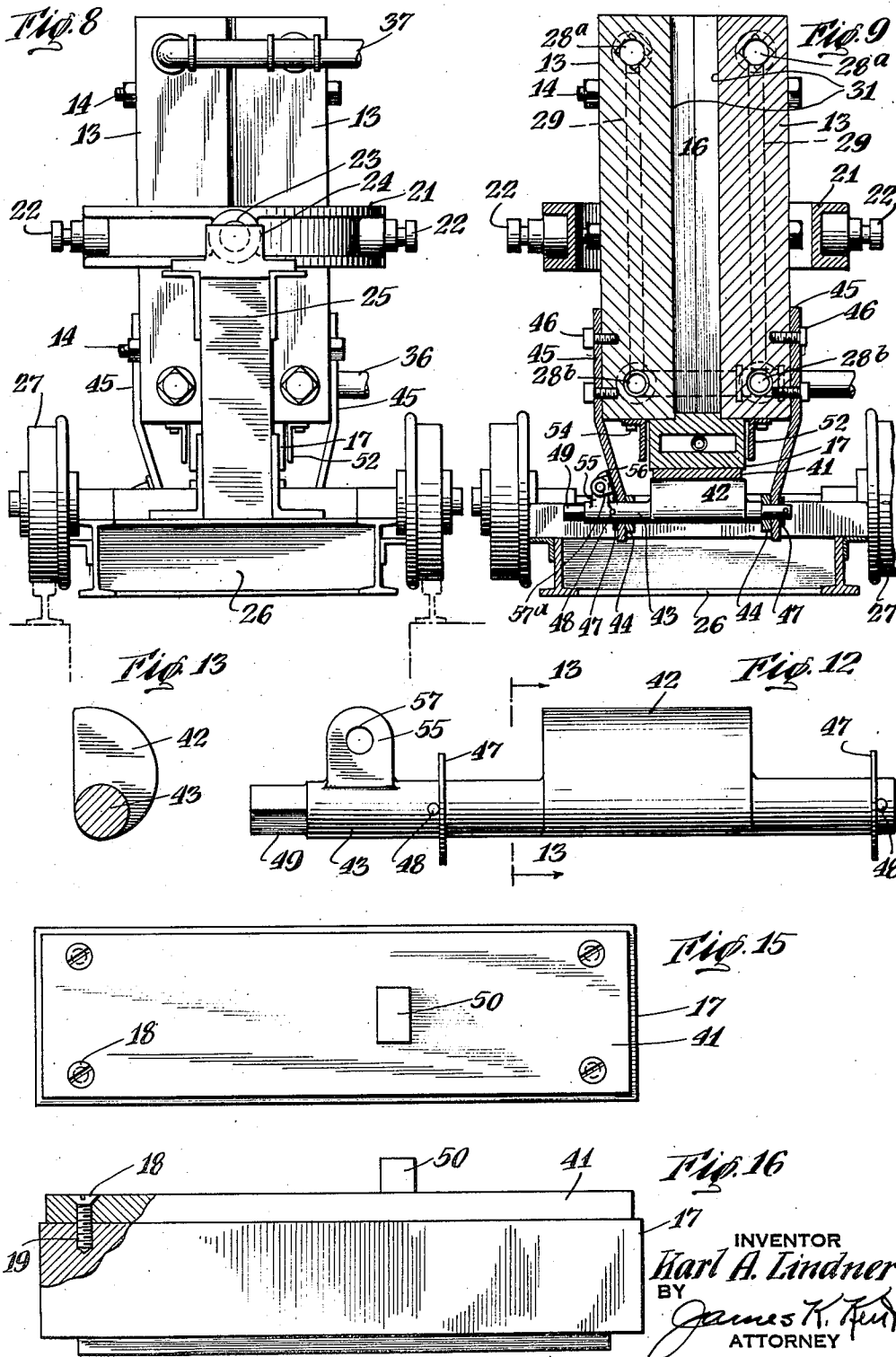
K. A. LINDNER

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METAL MOLD

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5 Sheets-Sheet 3



INVENTOR
Karl A. Lindner
BY *James K. Felt*
ATTORNEY

June 29, 1937.

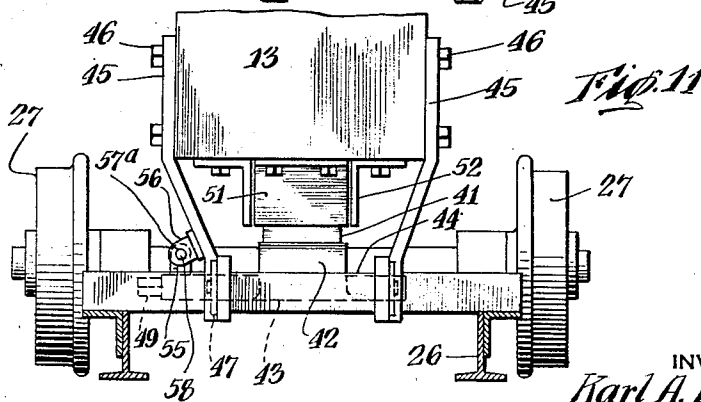
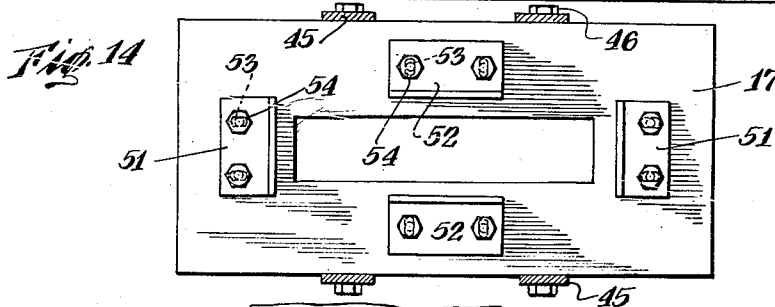
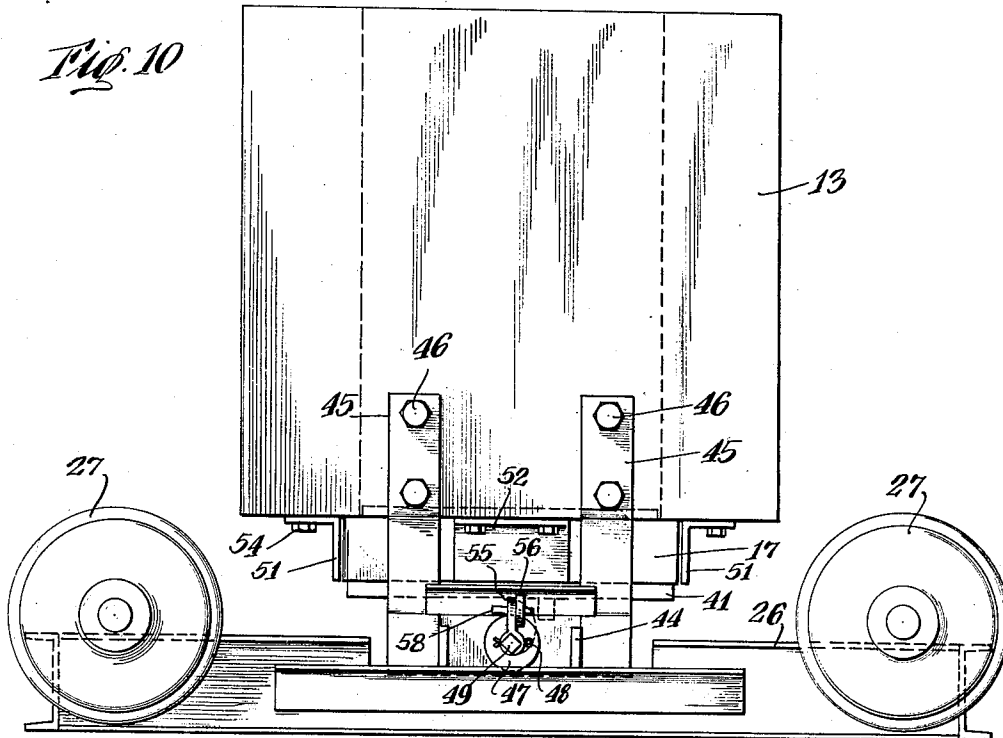
K. A. LINDNER

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METAL MOLD

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5 Sheets-Sheet 4



INVENTOR
Karl A. Lindner
BY
James H. Kent
ATTORNEY

June 29, 1937.

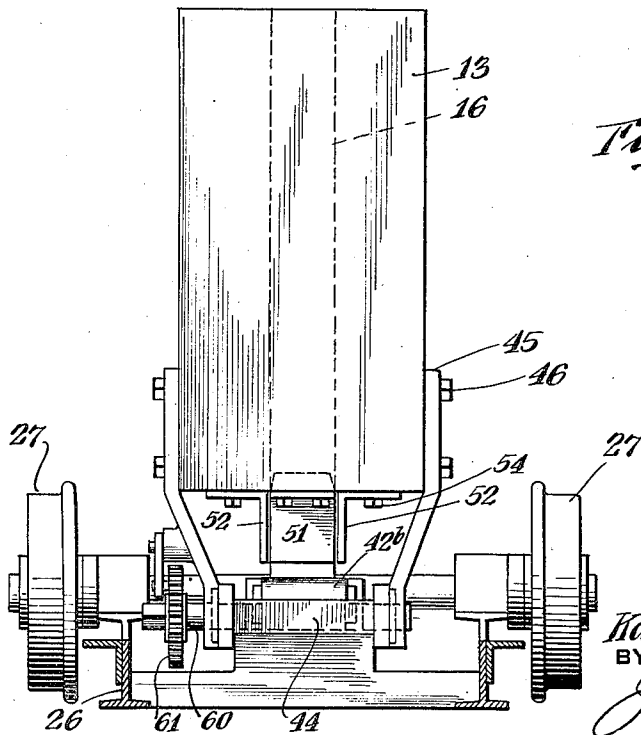
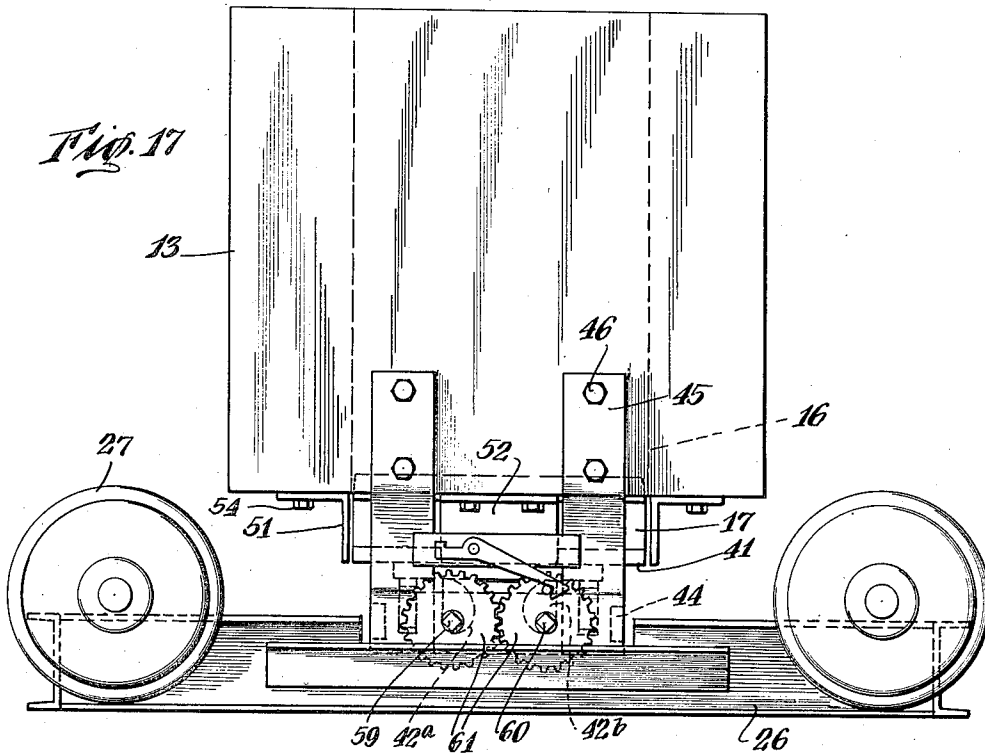
K. A. LINDNER

2,085,324

METAL MOLD

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5 Sheets-Sheet 5



INVENTOR
Karl A. Lindner
BY *James H. Feix*
ATTORNEY

UNITED STATES PATENT OFFICE

2,085,324

METAL MOLD

Karl A. Lindner, Rahway, N. J., assignor to
American Smelting and Refining Company,
New York, N. Y., a corporation of New Jersey

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13 Claims. (Cl. 22—139)

The improved form of mold to which the present invention pertains is designed to produce improved metal castings, such as castings of copper or other metals or alloys having substantially like properties, the invention dealing especially with an improved form of mold construction for the casting of electrolytic copper, in the form of cakes possessing definite predetermined dimensions, and other desired characteristics.

In the production of high grade castings from electrolytically refined copper or copper of similar purity, the best results have been attained by pouring into upright water-cooled molds having a vertical casting cavity with parallel sides or sides closely approaching to parallelism, under such conditions that the cast metal is rapidly solidified and caused to shrink free from the walls of the casting cavity, so that it may be discharged therefrom by gravity.

In order to produce high-grade castings of the above-indicated character, it has been thought necessary to employ the cooling water, or other cooling medium, entering the mold for cooling the same to solidify the metal, at relatively elevated temperatures, certain operators specifying temperatures lying between approximate extremes of 160° F. to 212° F., such operators laying emphasis upon the inoperativeness of using jacketed molds through the jackets of which water is circulated to cool the mold by connecting the mold to an ordinary service pipe supplying water at temperatures approximating 50° to 60° F., alleging that the cooling of the mold by water entering at such a low temperature cannot produce castings of the high-grade, uniform character throughout the cake and perfect surface required for the production of flat cakes for rolling.

However, it has been found that it is entirely feasible to produce castings of the requisite high-grade, uniform character throughout the cake, and with the perfect surface required for the production of flat cakes for rolling, by cooling the mold by connecting it to an ordinary service pipe supplying water at temperatures approximately 50° to 60° F., or what is commonly known and referred to as "tap" water, when certain precautions are taken in applying the mold dressing or mold wash to the interior of the mold.

It will be recalled that it is customary to employ, in casting operations, a mold dressing which coats the interior of the mold and forms a separating medium between the surface of the mold and the molten metal being cast therein. Bone

ash is a customary material for this purpose, it being applied to the mold by suspending it in a liquid such as water, and spraying or flushing the suspension into the mold until the inner surfaces thereof are coated with the dressing. The mold is heated during the application of the dressing sufficiently to cause a rapid evaporation of the liquid in which the bone ash is distributed, the solid material adhering to the surfaces of the mold and forming a coating thereover.

It has been found that where the mold dressing is uniformly distributed in a comparatively thick coating over the interior of the mold, it is entirely feasible to cool the mold by connecting it to an ordinary service pipe supplying "tap" water at temperatures approximating 50° to 60° F.

One of the objects of the present invention, therefore, is to provide an improved mold structure which facilitates the application of an even, comparatively thick, coating of a mold dressing to the interior of the mold.

A further object of the invention is to provide a mold of the above-indicated character having a movable bottom permitting ready access to the interior of the mold, enabling a ready application of a heavy, even coating of the mold dressing to the interior of the mold, while preventing excessive accumulation of mold dressing on the bottom of the mold, thereby very materially enhancing the production of satisfactory castings with the low temperature of cooling water such as mentioned above.

A further object of the present invention is to provide an improved mechanism for opening and closing the bottom of the mold, and an improved construction of the mold bottom itself.

Other objects of the invention will become apparent as the description proceeds, the invention being exemplified in the discussion and illustrations hereinafter set forth in detail, and in the combination and arrangement of parts shown in the accompanying drawings, and described in the following specification, the features of novelty of the invention being more particularly pointed out in the appended claims.

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, in which

Fig. 1 is a perspective view of an iron core assembly for forming cooling ducts in the sides of the mold;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is an elevation of the interior of one side of the mold;

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3, looking in the direction of the arrows;

Fig. 5 is a sectional view taken along the line 5—5 of Fig. 3, looking in the direction of the arrows;

Fig. 6 is a top plan view of the mold assembly;

Fig. 7 is a sectional view taken along the line 7—7 of Fig. 6, looking in the direction of the arrows;

Fig. 8 is an end view of the mold assembly illustrated in Figs. 6 and 7;

Fig. 9 is a sectional view taken along the line 9—9 of Fig. 7, looking in the direction of the arrows;

Fig. 10 is a fragmentary side elevation of the mold showing details of the improved bottom construction and mechanism for operating the same;

Fig. 11 is an end elevation of the mold of Fig. 10, the view being taken at right angles to Fig. 10;

Fig. 12 is a detail view of the bottom operating mechanism illustrated in Figs. 10 and 11;

Fig. 13 is a sectional view taken on line 13—13 of Fig. 12, looking in the direction of the arrows;

Fig. 14 is a plan view of the mold bottom showing guide means for the closure gate to assure proper centering thereof;

Fig. 15 is a bottom view of the closure gate employed for closing the mold bottom;

Fig. 16 is a side elevation of the closure gate illustrated in Fig. 15;

Fig. 17 is a side elevation of a modified form of the construction, illustrating the use of a double cam for effecting positive movement of the mold bottom both towards and away from the mold;

Fig. 18 is an end view of the construction shown in Fig. 17.

Referring more particularly to the drawings, Figs. 1 and 2 show an iron core assembly comprising headers 10, cross pipes 11 and end cross pipes 12, the latter being positioned out of line with the cross pipes 11. Figs. 3 to 5 show a mold side piece 13 used in constructing the mold. Two such pieces or sections are joined by bolts 14 extending through drilled holes 15 to form the mold cavity 16. Removable gate 17 closes the bottom of the mold cavity and is held in place by means which will be hereinafter described. The mold is mounted within yoke 21 and held in fixed position therein by set screws 22. Trunnions 23 seated in bearings 24 support the mold yoke assembly upon uprights 25 carried by frame 26 which is mounted on wheels 27.

In constructing the mold, an iron core assembly such as illustrated in Figs. 1 and 2 is constructed comprising headers 10 with cross pipes 11 and end cross pipes 12. Molten copper is then cast around the iron pipe assembly to yield a copper block in which the pipes 10, 11 and 12 are embedded. The pipes are then removed as by leaching with sulphuric or hydrochloric acid preferably agitated with air to assist in dissolving the iron, after which the block is suitably machined to form a mold side piece or section hav-

ing longitudinal cooling ducts 28a and 28b, and transverse cooling ducts 29 and 30.

As shown in Fig. 5, one side of the mold section is machined to provide a recess which upon assembly with a similar mold section forms the mold cavity. For reasons hereinafter pointed out, great care is exercised in machining this recess or cavity in order to insure a very definite and predetermined taper of not less than 0.025 nor more than 0.075 inch per foot of mold depth. Again, while such definite taper is provided along the sides 31 of the mold which define the thickness of the copper cake or slab cast therein, the sides 32 of the mold which define the width of the cake or slab are machined parallel without taper. By this relatively slight but definite tapering of the sides 31 of the mold sections, a mold cavity having a slightly greater cross-sectional area at the top than at the bottom is provided in the assembled mold. Also, as shown in Figs. 3, 5 and 6, the outer portions of the sides of the mold sections lying on either side of the mold cavity are machined or recessed at 33 to provide flanges 34 on opposite sides of and adjacent to the mold cavity.

In assembling the mold, holes 15 are drilled through the mold sections and two such sections are joined by bolts 14. Gate 17 is provided with a cooling duct 35 and closes the bottom of the mold. The mold is mounted in yoke 21.

For cooling the mold inlet header 36 connected with longitudinal cooling ducts 28b and outlet header 37 connected to longitudinal cooling ducts 28a are provided. The other ends of the longitudinal ducts 28a and 28b are closed with suitable plugs 38a and 38b, respectively. The header 36 is connected to a source of cooling medium, such as tap water, in any conventional manner, and preferably in such a way that the connection may be readily broken to allow the mold to be freely moved about the plant on wheels 27. Header 37 which exits the water is likewise connected to a suitable outlet conduit. As has been mentioned above, it has been found entirely feasible to use ordinary tap water as the cooling medium where a relatively thick, uniform coating of a mold dressing is applied to the mold cavity. This mold dressing may be bone ash, the coating thereof being obtained by flushing a suspension of bone ash in water through the mold cavity. Or the dressing may be a mixture of an inert substance selected from the class consisting of bone ash, bone-black, or graphite, or combinations thereof, and a suitable adhesive constituent, such as rosin, gum copal, gum arabic, gum tragacanth, rosin pitch, glue, gelatin, or the like, dissolved in a suitable low boiling solvent such as, for example, denatured alcohol. Thereafter, the molten copper is poured into the cavity and the mold cooled by means of water introduced through inlet header 36 into the longitudinal ducts 28b, whence it passes upwardly through the sides of the mold by way of transverse ducts 29 and 30 into longitudinal ducts 28a from which it exits through header 37. By thus keeping the mold relatively cool but above the dew point of the adjacent atmosphere, warping and checking of the mold walls is materially reduced. Upon solidification of the copper, the headers 36 and 37 may be disconnected and the cast copper cake which has the definite taper corresponding to the dimensions of the cavity is released from the cavity by inverting the mold and yoke.

It has been said above that care must be taken

to apply the coating of the mold dressing uniformly to the surfaces of the mold cavity. Therefore, in order to provide ready access to the mold cavity at both ends thereof, and to prevent excessive accumulation of the mold dressing at the bottom of the mold, the bottom of the mold cavity may be opened as desired by the provision of the gate 17 and the improved mechanism for operating the gate, so that the mold cavity may be entirely open for flushing in the mold dressing, thereby facilitating the production of a uniform coating thereof on the surfaces of the cavity while securely and tightly closing the cavity during actual molding operations.

Gate 17 is provided for the purpose of opening and closing the mold cavity 16. The underside of gate 17 is provided with a wear plate 41 of suitable hard material, such as steel, for forming a wearing surface for an operating cam 42, welded or otherwise suitably secured to an operating shaft 43, the cam 42 being eccentrically positioned relatively to the shaft 43, as clearly shown in Figs. 10 and 13, which also show clearly the preferred shape of the cam.

The shaft 43 is turnably mounted in suitable bearings formed in bars 44, 44 interconnecting straps 45, 45 secured by bolts 46, 46, or equivalent members to the side pieces 13 of the mold, the shaft 43 being held in position by collars 47, 47 abutting against the bars 44, 44 and secured by cotters 48, 48. The shaft 43 may be provided with a squared end 49, Figs. 10, 11 and 12, for the reception of an operating crank, not shown, by means of which the shaft 43 and cam 42 may be turned.

It will be seen that the wear plate 41 moves along the curved surface of the cam as the cam is rotated. In order to properly guide the movement of the gate 17, the wear plate 41 is provided with a lug 50 which continuously engages the curved surface of the cam and serves to help control the movement of the gate responsive to actuation of the cam. The gate 17 engages guide angles 51, 51, and 52, 52 during its movement, these guide angles being provided with slotted holes 53 for the reception of tap bolts 54 securing the angles in position.

Wear plate 41 is secured to gate 17 by bolts or the like 18 received in holes 19 adjacent each corner of the wear plate.

The shaft 43 is also provided with a lug 55 welded to the shaft 43 and having a hole 57 therethrough, this lug being adapted to register with a similar lug 56 welded to strap 45 and having a similar hole 57a therethrough, so that when the shaft 43 is turned to close the gate 17 during casting, the lugs and holes will be brought into registry for receiving a safety locking bolt 58, which prevents the shaft 43 from turning during pouring of the metal into the mold, thus assuring the bottom of the mold being securely closed during casting operations.

It will be seen that since the gate 17 is supported by the cam 42, when the shaft is turned the gate will follow the curved surface of the cam, its movement being guided by lug 50 and by the guide angles 51, 51, and 52, 52; and the configuration of the cam is such that the bottom of the mold will be freely opened when the gate has reached its maximum open position, thereby enabling a ready application of a uniform coating of a mold dressing to the surfaces of the mold cavity 16. During the casting operations, the cam 42 tightly clamps the gate 17 against the bottom of the mold, the gate being held properly

centered by the guide angles 51, 51 and 52, 52. Loss of metal through the bottom of the mold is thereby prevented, and the insertion of the safety bolt 58 through the lugs 55 and 56 positively prevents accidental opening of the gate 17 during casting operations, as the shaft 43 is securely held against turning. The application of an even coating of mold dressing enables ordinary tap water to be employed as the cooling medium with entire satisfaction and with no detrimental effects on the properties of the castings.

As will be seen from Figs. 17 and 18, a plurality of cams may be used where the mold is of large size, so that a straight movement of the mold bottom is assured, as well as positive movement both towards and away from the body of the mold.

For accomplishing this purpose, a pair of cams is shown, the individual cams being indicated at 42a and 42b, and being similar in shape to the cam 42, cams 42a and 42b being mounted on shafts 59 and 60, respectively, and being provided with meshing gears 61, 61, whereby the cams will be simultaneously rotated upon actuation of either cam, as described in connection with cam 42, above. The position of the cams beneath the mold bottom or gate 17 is such that the gate 17 is always squarely presented to the mold body so that a proper closure of the mold cavity by the gate is assured at all times together with positive movement of the gate both towards and away from the mold body.

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; and obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention; and it is wished therefore not to be restricted to the precise construction herein disclosed, it being intended and desired to embrace within the scope of the invention such modifications and changes as may be necessary to adapt it to varying conditions and uses.

Having thus described and shown an embodiment of this invention, what is desired to secure by Letters Patent of the United States is:

1. A mold comprising the combination with a mold body defining a mold cavity therein, of a movable closure for the cavity, supporting mechanism for the closure including a cam, means for actuating the cam to cause movement of the closure member towards and away from the mold body and cavity, and means for guiding the movement of the closure rectilinearly relatively to the mold body.

2. A mold comprising the combination with a mold body defining a mold cavity therein, of a movable closure for the cavity, supporting mechanism for the closure including a cam and a turnable shaft carrying the cam, and means for guiding the closure in rectilinear movements relative to the mold cavity responsive to turning movements of the shaft and cam.

3. A mold comprising the combination with a mold body defining a mold cavity therein, of a movable closure for the cavity, supporting mechanism for the closure including a cam and a shaft carrying the cam, means on the mold body for guiding the closure in rectilinear movements relative to the mold cavity responsive to turning movements of the shaft and cam, and a guide lug

on the closure engaging the cam to control the movements of the closure.

4. A mold comprising the combination with a mold body defining a mold cavity therein, of a movable closure for the cavity, supporting mechanism for the closure including a cam engaging the closure and a shaft carrying the cam, and guides depending from the mold body for guiding the closure in rectilinear movements relative to the mold cavity responsive to turning movements of the shaft, the closure being maintained by the guides in centered relation relative to the mold cavity.

5. A mold comprising the combination with a mold body defining a mold cavity therein, of a movable closure for the cavity, and mechanism for supporting the closure and for imparting movement thereto relatively to the mold body and cavity, the said mechanism comprising a shaft and a cam eccentrically mounted on the shaft and engaging the closure for maintaining the closure in clamped relation against the mold cavity when in closed position while controlling the movement of the closure to open position responsively to corresponding movement of the shaft and cam.

6. A mold comprising the combination with a mold body defining a mold cavity therein, of a movable closure for the cavity, and mechanism for enabling the closure to move substantially rectilinearly relatively to the mold body, the said mechanism including guides extending from the mold body between which guides the closure moves, a cam for actuating the closure, and a shaft for operating the cam, the closure being maintained by the guides in centered relation relative to the mold cavity.

7. A mold comprising the combination with a mold body defining a mold cavity therein, of a movable closure for the cavity, mechanism for enabling the closure to move substantially rectilinearly relatively to the mold body, the said mechanism including guides extending from the mold body between which guides the closure moves, a cam for actuating the closure and a shaft for actuating the cam, the cam being eccentrically mounted on the shaft, the closure being maintained by the guides in centered relation relative to the mold cavity, and locking means for preventing turning of the shaft during casting operations thereby preventing displacement of the closure relative to the mold cavity during casting operations.

8. A mold comprising the combination with a mold body defining a mold cavity therein, of a movable closure for the cavity, and supporting mechanism engaging the closure and enabling movement of the closure towards and away from the mold body and cavity, the said mechanism including a cam engaging the closure and means for operating the cam, the said closure including a wear plate intermediate the closure and cam and forming a contact surface for the cam.

9. A mold comprising the combination with a mold body defining a mold cavity therein, of supporting means for the mold body, a movable closure for the cavity, mechanism for moving the closure substantially rectilinearly relatively to the mold body, the said mechanism including a cam and a shaft for actuating the cam, and coop-

erating lugs on the shaft and mold supporting means adapted to receive a locking pin therethrough when the closure is in closing position for preventing turning of the shaft during casting operations.

10. A mold comprising the combination with a mold body defining a mold cavity therein, of supporting means for the mold body, a movable closure for the cavity, mechanism for enabling the closure to move substantially rectilinearly relatively to the mold body, the said mechanism including guides extending from the mold body between which guides the closure moves, a cam for actuating the closure and a shaft for actuating the cam, the cam being eccentrically mounted on the shaft, the said closure being maintained by the guides in centered relation relative to the mold cavity, and cooperating lugs on the shaft and mold supporting means adapted to receive a locking pin therethrough when the closure is in closing position for preventing turning of the shaft during casting operations.

11. A mold comprising the combination with a mold body defining a mold cavity therein, of supporting means for the mold body, a movable closure for the cavity, mechanism for enabling the closure to move substantially rectilinearly relatively to the mold body, the said mechanism including guides extending from the mold body between which guides the closure moves, a cam for actuating the closure and a shaft for actuating the cam, the cam being eccentrically mounted on the shaft, the said closure being provided with a wear plate engaging the cam and being maintained by the guides in centered relation relative to the mold cavity, and cooperating lugs on the shaft and mold supporting means adapted to receive a locking pin therethrough when the closure is in closing position for preventing turning of the shaft during casting operations.

12. A mold comprising the combination with a mold body defining a mold cavity therein, of supporting means for the mold body, a movable closure for the cavity, mechanism for enabling the closure to move substantially rectilinearly relatively to the mold body, the said mechanism including guides extending from the mold body, between which guides the closure moves, a cam for actuating the closure and a shaft for actuating the cam, the cam being eccentrically mounted on the shaft, the said closure being provided with a wear plate engaging the cam and a guide lug adapted to ride on the surface of the cam for guiding the movements of the closure responsively to movements of the cam, the closure being maintained by the guides in centered relation relative to the mold cavity, and cooperating lugs on the shaft and mold supporting means adapted to receive a locking pin therethrough when the closure is in closing position for preventing turning of the shaft during casting operations.

13. A mold comprising the combination with a mold body defining a mold cavity therein, of a movable closure for the cavity, a plurality of cams for operating the closure and intermeshing gearing on the cams for effecting simultaneous operation of the cams to produce positive movement of the closure both towards and away from the mold body.