Sept. 18, 1934. M. G. DUMAS 1,973,893

METHOD OF AND APPARATUS FOR CASTING INGOTS, BLOOMS, BARS, ETC

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FIG. 1.

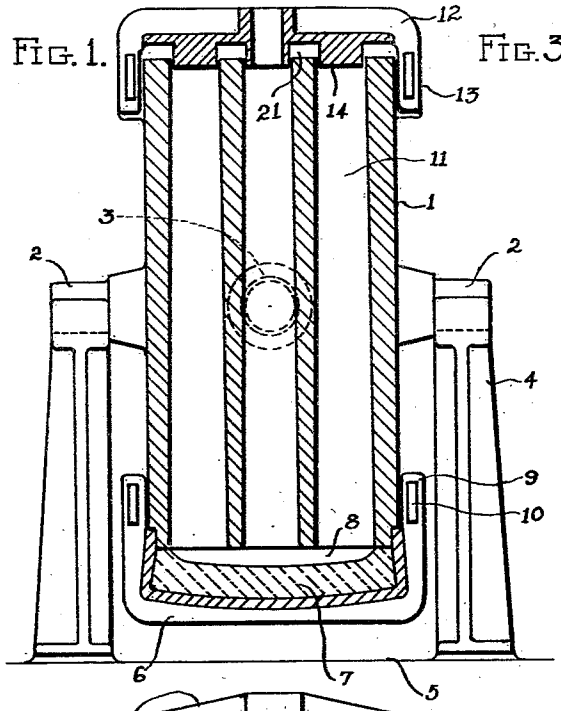


FIG. 3.

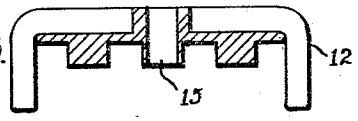


FIG. 4.

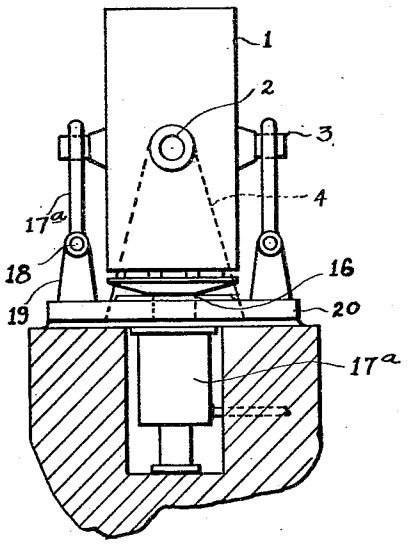


FIG. 2.

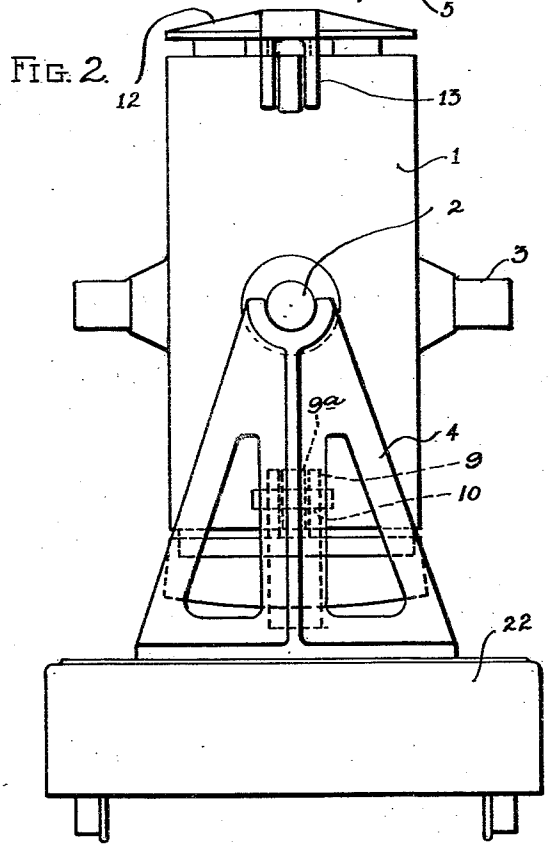


FIG. 5.

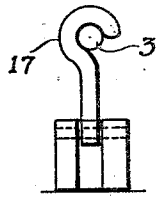
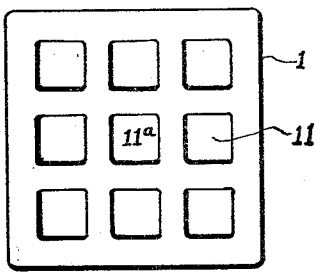


FIG. 6.



INVENTOR

Maxwell G. Dumas

by William B. Jaspert

Attorney.

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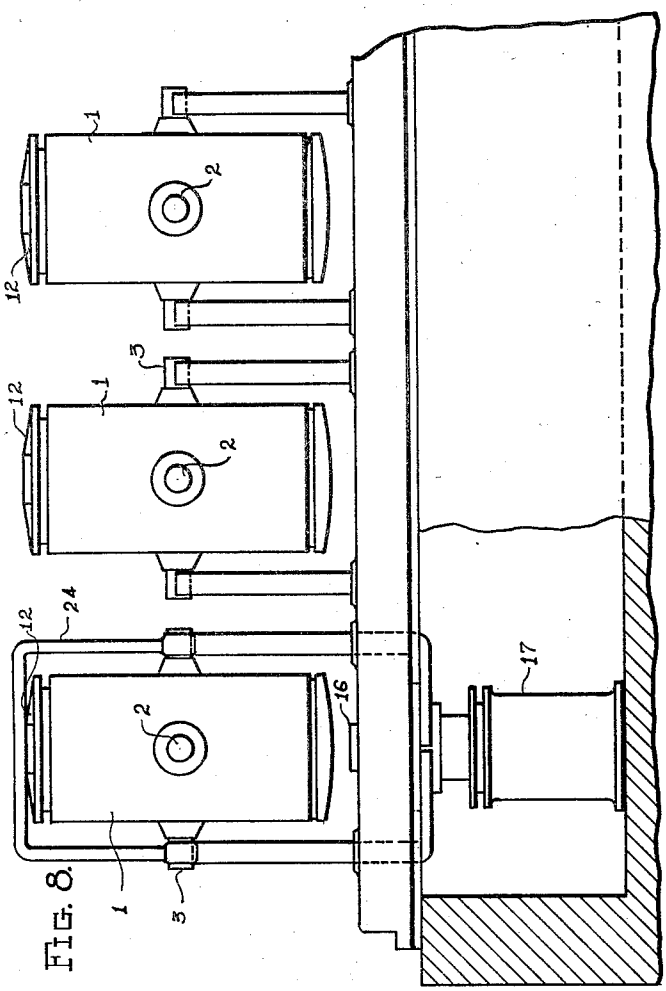


FIG. 8.

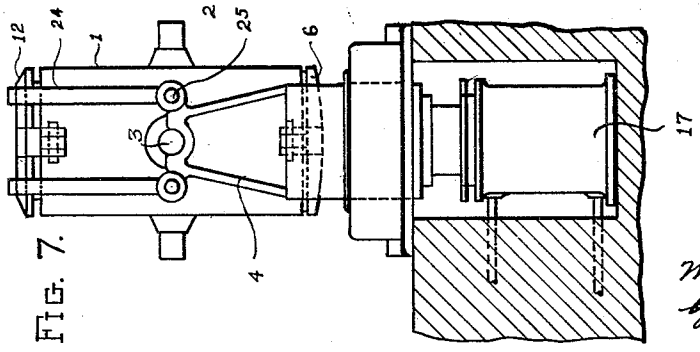


FIG. 7.

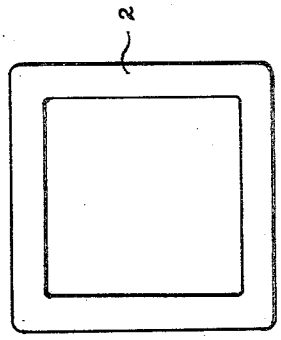


FIG. 10.

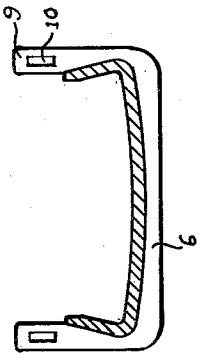


FIG. 9.

INVENTOR
Maxwell G. Dumas
by William B. Jaspert.
Attorney.

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FIG. 11.

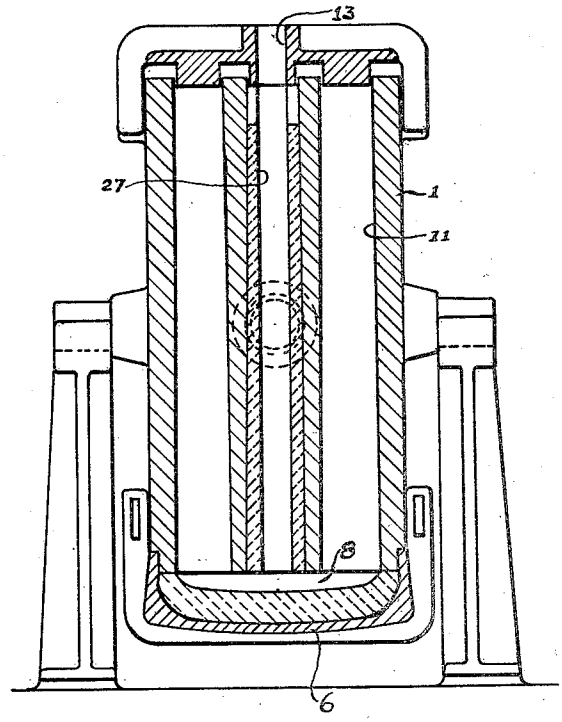


FIG. 12.

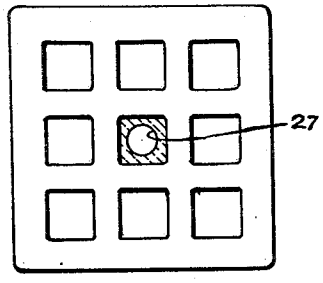
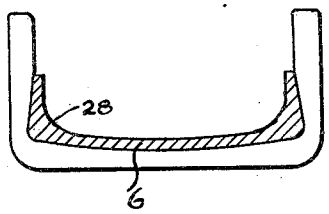


FIG. 13.



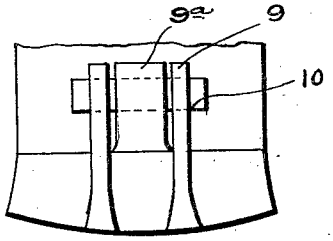


FIG. 14

INVENTOR
Maxwell G. Dumas
by William B. Jaspert
Attorney.

Patented Sept. 18, 1934

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UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR CASTING INGOTS, BLOOMS, BARS, ETC.

Maxwell G. Dumas, Pittsburgh, Pa.

Application January 29, 1932, Serial No. 589,635

5 Claims. (Cl. 22—142)

This invention relates to method of and apparatus for casting steel bars, blooms, ingots or the like, and it is among the objects thereof to provide a method of casting steel bars which shall reduce or modify the grain structure of the metal and produce bars of homogeneous structure and of great density, strength and toughness.

A further object of the invention is the provision of a method for casting steel bars and blooms of a smooth outer surface and which shall subject the metal to rapid chilling to produce a small grain structure with a corresponding reduction of segregation and shrinkage.

A further object of the invention is the provision of apparatus for casting a plurality of blooms or bars simultaneously and which shall be adapted for pouring the metal into the top of the mold in one of its cavities and subject the same to rise from the bottom of the mold in the remaining cavities whereby all the benefits of bottom pouring are obtained.

A further object of the invention is the provision of a casting process and apparatus whereby the metal after it has been poured in the molds may be subjected to compression to increase its density, and which shall be adapted to permit stripping the molds with facility and in an expedient manner thereby reducing its manufacturing cost.

These and other objects of the invention will become more apparent from a consideration of the accompanying drawings constituting a part hereof in which like reference characters designate like parts and in which:

Figure 1 is a vertical sectional view of a multiple mold for pouring bars and blooms in accordance with the principles of this invention and showing the supporting structure in elevation.

Figure 2 a side elevational view thereof taken at right angles to the view of Figure 1;

Figure 3 a cross-sectional view of a mold cover employed on the mold of Figure 1;

Figure 4 a sectional elevational view illustrating the method of securing the mold for the stripping operation;

Figure 5 a detail view of a hook member employed for engaging the mold in its position shown in Figure 4;

Figure 6 a top plan view of the multiple mold shown in Figure 1 with the cover removed;

Figure 7 a side elevational view of the mold mounted on an hydraulic ram showing clamping means for holding the same to subject the metal to a compression operation;

Figure 8 a side elevational view showing a multiple or battery of such molds;

Figure 9 a sectional elevational view of a modified form of the bottom element of the mold of Figure 1;

Figure 10 a top plan view of an ingot mold;

Figure 11 a vertical sectional elevational view of a modified form of the mold of Figure 1;

Figure 12 a top plan view of Figure 11, and

Figure 13 a sectional elevational view of a modified form of the bottom closure shown in Figure 9.

With reference to Figures 1 to 6 inclusive of the drawings, the structure therein illustrated comprises a mold 1 provided with trunnions 2 and 3, the trunnions being disposed at right angles to each other to facilitate the manipulation and mounting of the mold 1. In Figure 1 the mold is shown supported on a pair of uprights or block bearings 4 which are mounted on a concrete base 5.

The bottom of the mold 1 is provided with a closure 6 having a lining of refractory material 7 which is recessed at 8 to provide a cavity for a purpose to be hereinafter stated. Closure 6 is provided with clamping members 9 having slots 10 for receiving wedges or the like which cooperate with slots in lugs 9*a* formed on the sides of the mold 1 as shown in Figure 14.

The mold is provided with a plurality of cavities 11 as shown in Figure 6 of the drawings, the central one of which being designated by the reference character 11*a*.

A cover 12 is provided to close the top of the mold 1 the cover being provided with depending lugs 13 which are slotted for receiving wedges, as in the bottom closure 6, to secure the cover to the body of the mold 1. The cover is provided with a series of projecting members 14 which fit into the mold cavities to bear upon the metal after it is poured in the mold. The cavity or recess 8 provided in the refractory material 7 of the closure 6 at the bottom of the mold establishes communication between all of the cavities 11 of the mold.

In Figure 3 the cover 12 is shown with an opening 15 in the center thereof, this being provided to permit pouring of the metal into the mold after the cover is secured in place. When the opening 15 is utilized in the cover, a funnel or other hopper-like member is employed or may be employed to direct the flow of the metal as

it is poured through the central opening into the mold.

In Figure 4 of the drawings, the mold 1 is illustrated without the cover 12 and without the supporting bearing members 4 which however are present as shown in the dotted lines and upon which the molds rest. In Figure 4 the mold is shown directly above an hydraulic ram 16 which is operated in a cylinder 17 through the application of fluid pressures. When the molds 1 are placed above the ram and in the supports 4 a pair of hooks 17*a* are swung over the trunnions 3 the hooks 17*a* being pivoted at 18 to brackets 19 which are integral with the supporting structure 20.

The above described apparatus is utilized for pouring bars or blooms in the following manner.

The mold in Figure 1 is shown with the closure member 6 at the bottom, and the cover 12 is removed to open the top of the mold. The metal is poured from a ladle through the central mold cavity 11*a* and by virtue of the recess 8 in the bottom closure, the metal uniformly flows to and slowly rises in the adjacent cavities 11 until the mold is filled. The cover 12 is then placed on top of the mold with the projections 14 resting on the metal leaving a space 21 between the partition members of the mold and the cover 12. The mold is then swung on its trunnion 2 to render the bottom closure 6 the top of the mold and the metal in the recess 8 thereof will then feed to the various cavities in the same manner that the head metal of a sink head or hot top will feed metal to an ingot mold, thus producing a sound bar or bloom in the several mold cavities.

When the metal has solidified sufficiently, the mold is transferred to the hydraulic ram illustrated in Figure 4 and the hook members 17*a* are swung in place around the trunnions 3. The closure member 6 is then removed by removing the wedges from the slots 10 and pressure is applied to the hydraulic ram 16 which pushes the cover member 12 against the metal in the mold causing the projections 14 to push out the bars from the mold cavities. This manner of stripping the mold is readily accomplished and the projecting portions of the bars are clamped and removed from the mold for transference to a reheating furnace and subsequent rolling operations.

When the cover shown in Figure 3 is employed, the pouring opening 15 is plugged before the mold is inverted for the feeding and stripping operation.

In Figure 2 of the drawings, the mold is shown mounted on supports carried by a wheeled truck 22 to facilitate its transportation from the point where the metal is poured to the hydraulic presses where the molds are stripped.

In Figures 7 to 10 of the drawings, is shown apparatus for compressing the metal after it is poured in the mold which consists of the following equipment.

The three molds shown in Figure 8 or any number of such molds are placed over the hydraulic units as shown in Figure 4. The mold structures are the same as that of Figure 1 with the exception that the bottom closure 6 is not provided with the refractory material 7, such an unlined closure being shown in Figure 9. The metal is poured in the mold in the manner described in connection with Figure 1 with the closure 6 at the bottom and the cover member 12 is placed thereon as previously explained. In Figure 7 a pair of straps 24 are shown hinged at 25 to the trunnion support 4, and the straps 24 are placed over the cover member 12 in the manner shown. Pressure is then applied to the hydraulic ram and the lower closure 6 is engaged by the hydraulic ram 16 and the entire mold is pressed against the cover member 12 which is held by the straps 24 to cause the projections 14 of the cover to press into the metal thereby compressing the bars and rendering them very dense and of a fine grain structure.

After the metal has been thus compressed, the straps 24 are swung back and the mold is swung 180° and additional pressure is applied to the cover member 12 to strip the metal from the mold.

The space 21 between the partition members of the mold and the cover must be of sufficient proportions to allow for the compression of the metal in the mold and still provide clearance to strip the molds in the manner described in connection with Figure 1 after the metal has solidified.

In Figure 10 of the drawings is shown a mold 2 having a single cavity as in the conventional type of ingot mold, this type of mold being employed in the casting of ingots by the pressing method to either utilize the end member 7 as a sink head which is sealed and solid with the end of the mold when attached in the manner described in connection with Figure 1 or to get the benefit of the compression method of forming the ingot as disclosed in connection with Figures 7 and 8 of the drawings.

It might be mentioned that in the stripping operation, the mold becomes top heavy after the bars have been extruded a distance therefrom thus causing it to tilt automatically after the ram is removed and when so tilted the mold may be gripped and raised to strip the bars in the usual manner.

In the structure shown in Figures 11 and 12 of the drawings, the mold 1 is provided with the cavities 11 similar to those shown in Figure 1, but the central cavity which is in register with the opening 13 of the cover is provided with a lining of refractory material 27 forming a round orifice as shown in Figure 12 of the drawings.

The lining is of such thickness that the amount of metal in the center column is very small in proportion to the total amount of the metal cast into the mold so that there will be very litle waste. By utilizing the refractory lining 27, the metal poured through the center column of the mold will spread in the cavity 8 of the bottom closure 6 and rise uniformly in the cavity 11 to obtain what in effect is bottom pouring without the inconveniences incident to bottom pouring operation. When the mold is filled, the pouring opening 13 in the cover is sealed and the mold is inverted so that the bottom closure 6 will act as a sink head or feeder for the metal in the cavity 11.

In Figure 13 is shown a modified form of bottom closure with rounded corners which is adapted for use in the same manner as the unlined closure shown in Figure 9 of the drawings.

It is evident from the foregoing description of the invention that the method and apparatus for forming bars, blooms, ingots or the like, possess numerous advantages over the conventional method of forming bars and blooms from ingots which after pouring are placed in a soak-

ing pit and are subsequently rolled into blooms and bars with intermediate reheating operations that greatly enhance the cost of fabrication.

By the present method the bars and blooms are poured direct and are of smooth outer surface on account of the bottom pouring method with the exception of the single bloom or bar which is formed in the center column of the mold by the top pouring method and by employing a common sink head or feeder as is accomplished by means of applicant's refractory lined bottom closure member 6, a sound bar or bloom may be produced. Also, the use of the compression method as herein illustrated and described greatly compresses the metal and gives it a much finer grain structure whereas by the conventional method of pouring ingots, the ingot is composed of a very heterogeneous material which although somewhat modified in subsequent operations of heat treatment and rolling, is to a large degree retained in the final product.

Applicant is aware that attempts have been made to form bars and blooms by pouring, utilizing the centrifugal pouring method, which however, have not been satisfactory due to the porous quality and poor surface of the resultant product, and by means of the method herein disclosed all of the detrimental features of these methods are eliminated.

Although one embodiment of the invention has been herein illustrated and described, it will be obvious to those skilled in the art that various modifications may be made in the details of construction without departing from the principles herein set forth.

I claim as my invention:

1. Apparatus for pouring steel bars or the like comprising a mold having a plurality of cavities, a closure common to all of said cavities providing a space between the ends of said cavities and the closure member, a cover for said mold having projections extending into the cavities of the mold whereby the metal is stripped from the mold after partial solidification.

2. Apparatus for pouring steel bars or the like comprising an invertible mold having a plurality of cavities, a bottom closure therefor which is recessed to provide a communicating chamber for the respective cavities of said mold, a cover for said mold, and means for securing the cover to said mold in spaced relation with the top thereof, said cover having projections adapted to extend into the mold cavities whereby when the cover fastening means are removed the projecting portions will act to strip the bars from the mold cavities by applying pressure thereto.

3. Method of casting metal which comprises pouring metal in the central cavity to a communicating bottom chamber of a plural cavity mold to cause the metal to simultaneously and uniformly rise in all of the cavities, placing a cover on the metal in said mold out of contact with the top of said mold, inverting the mold to constitute the bottom chamber a sink head for feeding excess metal to prevent the formation of shrink cavities in the castings and applying pressure to the end cover to compress the metal in the mold cavities.

4. Apparatus for casting metal bars or the like comprising a mold pivotally mounted on a support and having partitions to constitute a plurality of cavities extending longitudinally of the mold, said cavities being open at both ends and being arranged in angularly spaced relation around a central cavity, a bottom closure spaced from the ends of the cavities forming a chamber common to all of said cavities, a cover for the mold having projections of substantially the cross-sectional area of the top of the mold cavities and having a pouring gate in alinement with the central cavity, means for inverting said mold on its support and means for securing the bottom closure to the mold support when the mold is inverted.

5. Apparatus for casting metal bars or the like comprising a mold having a plurality of cavities with their longitudinal axes in parallel alinement and disposed in angularly spaced relation around a central cavity, a bottom closure forming a chamber common to all of said cavities and a top closure having projecting areas corresponding in spacing and size to the areas of the respective mold cavities, a gate in said cover in alinement with the central cavity, said central cavity having a refractory lining, means for inverting said mold after the metal is poured therein, and means for securing the top closure against displacement when the mold is in its inverted position, said means being adapted to prevent displacement of the mold and top closure when the top closure is subjected to pressure.

MAXWELL G. DUMAS.