921,972.

E. GATHMANN.

INGOT MOLD.

APPLICATION FILED NOV. 27, 1908.

Patented May 18, 1909.

2 SHEETS—SHEET 1.

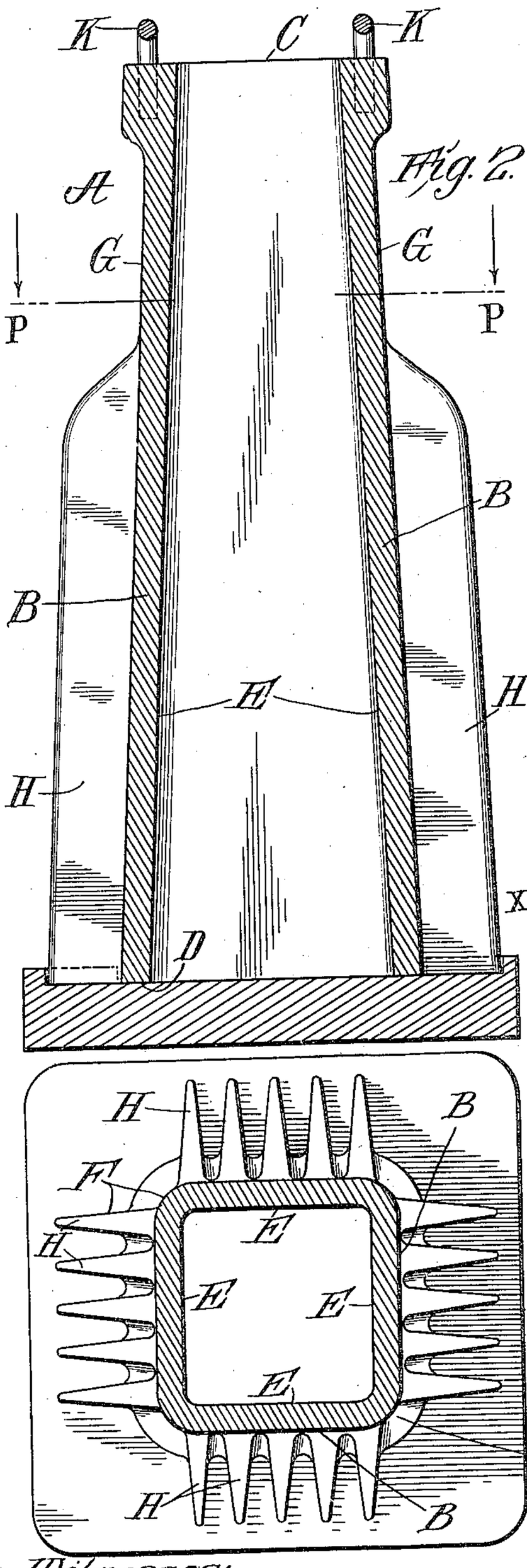

Fig. 2.

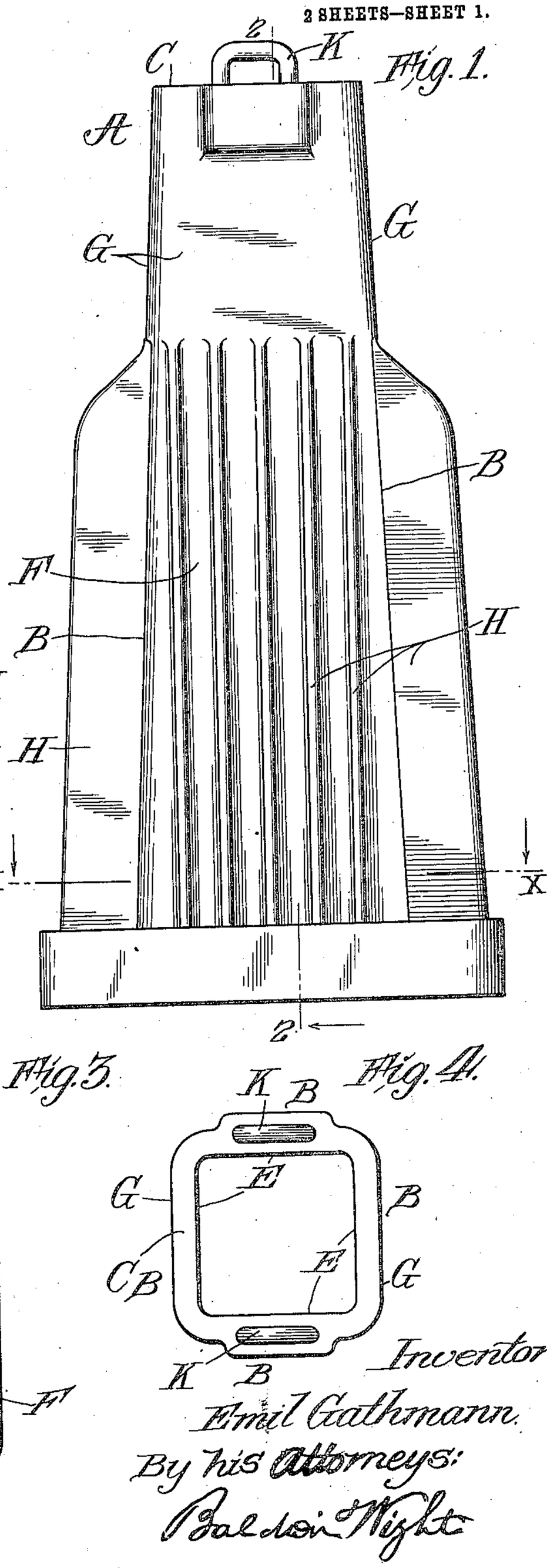

Fig. 1.

Fig. 3.

Fig. 4.

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2 SHEETS—SHEET 2.

Fig. 5.

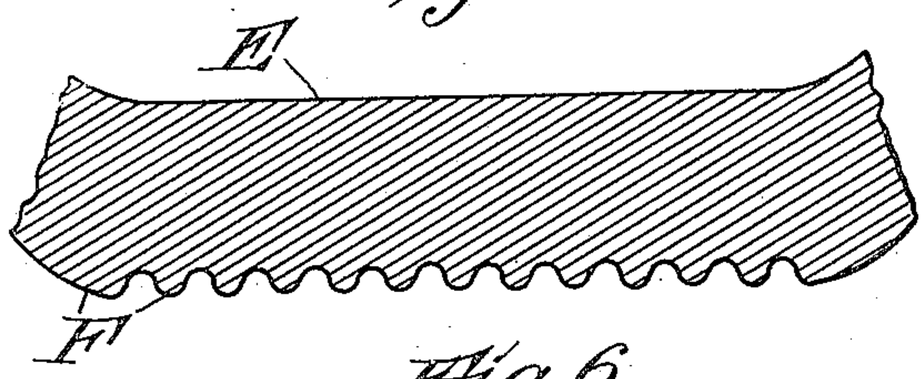


Fig. 6.

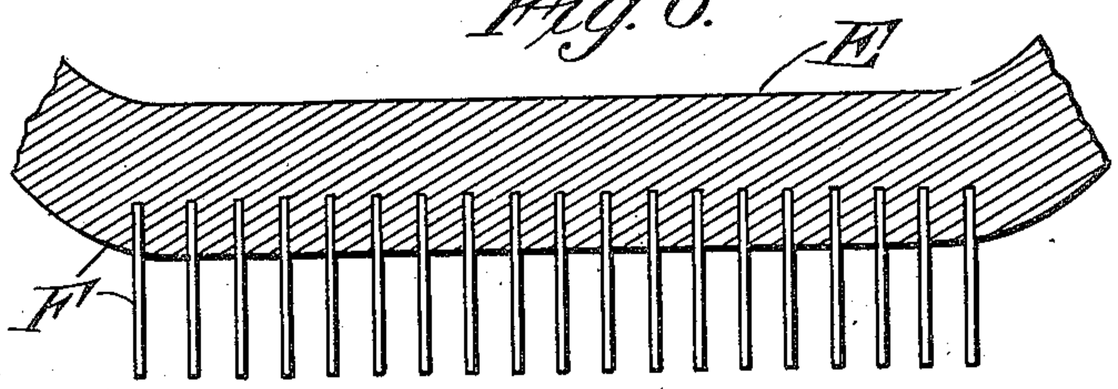


Fig. 7.

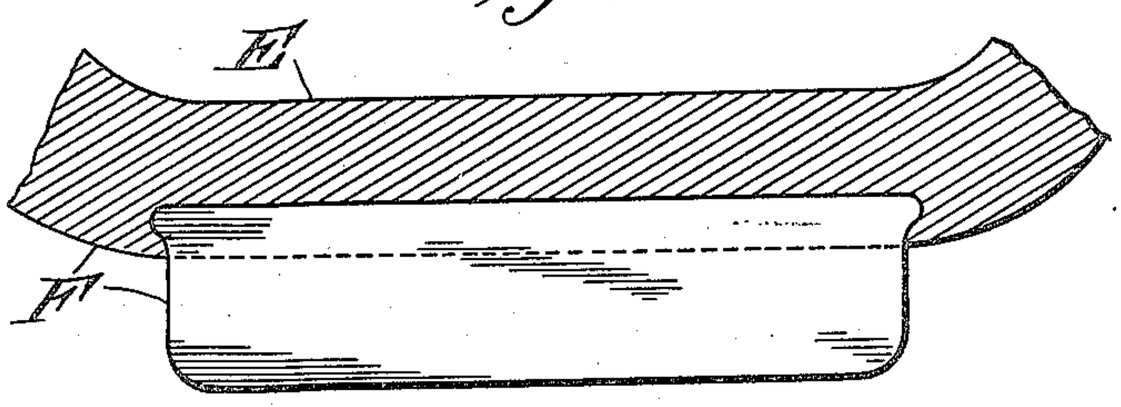
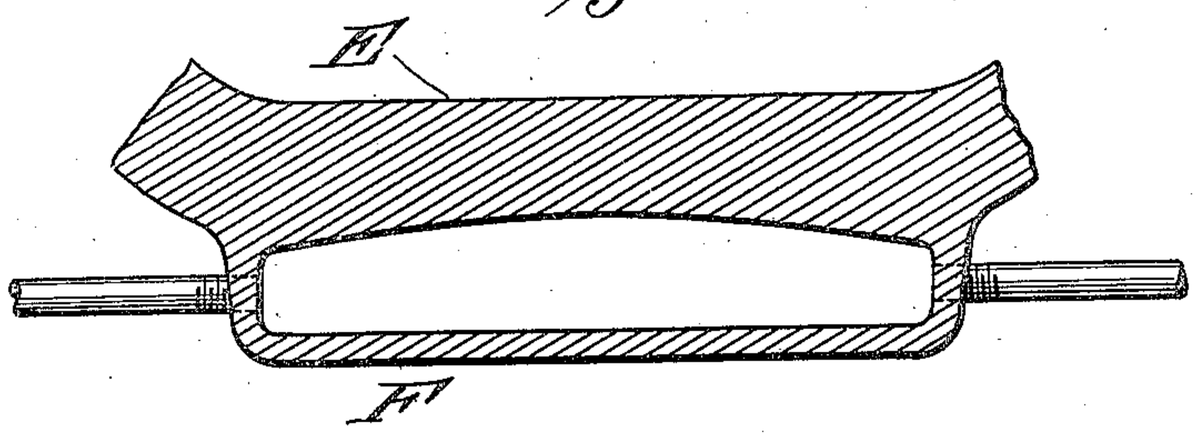


Fig. 8.



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UNITED STATES PATENT OFFICE.

EMIL GATHMANN, OF BETHLEHEM, PENNSYLVANIA.

INGOT-MOLD.

No. 921,972. Specification of Letters Patent. Patented May 18, 1909.

Application filed November 27, 1908. Serial No. 464,546.

To all whom it may concern:

Be it known that I, EMIL GATHMANN, a citizen of the United States, residing in Bethlehem, in the county of Northampton and State of Pennsylvania, have invented certain new and useful Improvements in Ingot-Molds, of which the following is a specification.

My invention relates primarily to that type of molds wherein are cast steel or alloy ingots which contract in their freezing or solidification from the hot liquid casting and which are subsequently pressed, rolled or hammered into various commercial structural shapes and forgings.

The primary object of my invention is to provide a metallic mold whereby steel ingot castings can be so manufactured that the so-called pipe or cavity, which forms in the upper middle portion of the ingot manufactured by the usual methods, is greatly reduced or practically eliminated.

Another object of my invention is to provide a mold wherein the liquid steel is rapidly cooled whereby ingotism or the formation of large crystals in the structure of the ingot is greatly reduced.

A further object of the invention is to so cool the mold by favoring radiation of heat from certain portions of the ingot that a cleaner and more homogeneous steel casting is produced.

By my improvements I effect a saving and make fit for structural or forging purposes a large percentage of the ingots usually cropped or scrapped on account of piping and other imperfections incident to the present manufacturing practices.

The accompanying drawings illustrate some of my designs for a mold adapted to operate in the manner above stated. They illustrate merely a few of the various ways of embodying my invention.

Figure 1 shows a side elevation of a form of mold which may be employed. Fig. 2 shows a vertical section thereof. Fig. 3 shows a transverse section on the line P—P of Fig. 2 looking in the direction of the arrows. Fig. 4 is a view of the top of the mold. Figs. 5 to 8 inclusive show several modifications of radiating surfaces. Fig. 5 shows such a surface formed with a number of relatively small pockets or depressions. Fig. 6 shows the surface formed with longitudinally or vertically inserted ribs. Fig. 7 shows such ribs arranged horizontally. Fig. 8 shows a jacket cooling device.

The mold A, shown in Figs. 1 to 4 inclusive, is substantially bottle-shaped, the portion below the line P—P being the body portion and the portion above this line, the neck. The mold here shown has side walls B, a top portion C, and a bottom portion D. The side portions B have interior surfaces E and outer surfaces F and G. The lower or body portion of the mold is constructed to favor the cooling of the molten metal in such portion much more rapidly than the metal in the upper portion or neck of the mold. This is done by giving it a greater heat absorption, conduction or radiating quality. In Figs. 1, 2 and 3 the outer surface F of the lower portion of the mold located below the line P—P is given a roughened contour and the surface G above the line P—P has a smoother contour. This roughened surface is preferably provided by forming on the surface F vertically arranged outwardly extending spaced ribs H. In this way an increased radiating surface is presented per superficial area of the side walls of the mold in the lower part thereof. As hereinafter described, such increased radiating surface may be provided in other ways, and other ways may be adopted for causing the lower part of the molten metal contained in the mold to cool more rapidly than the upper part thereof. Handles K may be fitted to the mold for convenience of manipulation and transportation in the stripping of the cooled ingot. The mold should be seated on a stool or platform, in the usual way, for closing its lower portion during the casting or cooling of the ingot. The radiating ribs H, shown in Figs. 1, 2 and 3, are preferably disposed in an upright or vertical direction in order that induced currents of air may be created which insures a better cooling of the ribs by convection, but forced air currents may be directed against such portions of the mold as require rapid cooling, if desired.

Instead of employing vertically arranged ribs, as shown in Figs. 1, 2, 3 and 6, I may arrange the ribs horizontally, as shown in Fig. 7, or I may merely form pockets or recesses in the walls of the mold with corresponding projections, as shown in Fig. 5. I may, if desired, provide for the rapid cooling

of the lower portion of the mold by a cooling jacket, as indicated in Fig. 8, through which water or other cooling fluid may be circulated. In all cases the lower portion of the mold is so formed, or is so equipped, that an increased radiating surface is provided per superficial area of the side walls of the lower part of the mold, or such lower portion of the mold is given, in other suitable ways, a greater quality of radiation, conduction or convection than the upper part thereof.

In the use of my invention the mold is preferably pre-heated to the desired degree in order to avoid sudden strains, the liquid steel is then teemed or poured into the mold from a ladle, or the like, in any suitable way until the mold is filled, preferably up to, or near its upper end. The heat from the liquid steel is then rapidly conveyed from the inner surface E of the side walls B by conduction outward to the surfaces F and G upward to the top C of the mold and downward to the surface D. The heat from the liquid steel having thus passed by conduction to the outer surface of the mold is further transmitted by radiation and convection into the surrounding atmosphere. As the speed of heat radiation from any similar body is directly proportional to the exposed surface and is also governed by the character of the surface, the heat will radiate far more rapidly from the rough surface F or the ribs H than from the smoother surface G. It thus follows that the upper portion of the ingot will retain its heat for a much longer period of time than the lower portion thereof, or, rather, the lower or body portion of the mold will be cooled far more rapidly than the upper portion thereof. The upper portion of the molten metal thus being the last to cool will feed liquid steel to the lower portion of the molten metal as the latter freezes and contracts. This contraction takes place as is well understood from a neutral longitudinal axis and usually forms the so called pipe, but by my improvements this pipe or cavity is automatically filled by the liquid metal fed to it from above and so the pipe or cavity in the cast ingot is by my improvements prevented.

The entire time of freezing for a given size of ingot is considerably reduced by my improvements as the radiation of heat is greatly enhanced from the major portion of the outer side surfaces of the mold.

The exact location of the line P—P at which the radiation favoring and non-favoring surfaces of the mold meet cannot be definitely determined except by experiment for specific sizes and depths of molds. I have, however, found by experiment that the part G should not extend beyond one and a half times the largest horizontal cross section of the ingot being cast in order to avoid piping action.

The quicker freezing of the steel cast in my mold largely prevents ingotism or the formation of large crystals as well as segregation of the various elements in the steel.

The difficulty of preventing piping of steel ingots is well known to those familiar with the art to which my invention relates. Many attempts have been made to obviate this piping action, but my improvements accomplish the desired result by simple and inexpensive means.

No claim is made herein to the method herein described as such method is claimed in my application No. 481,888, filed March 8, 1909.

I claim as my invention:

1. A mold, the upper part or neck of which has a relatively smooth contour while the lower part of the mold is provided with a series of radial outwardly extending ribs.

2. A mold having its major outer portion of a roughened contour and the upper neck portion of a relatively smooth contour whereby heat radiation from the lower portion of the mold is more rapid than from the upper portion.

3. A metallic mold provided with means for favoring heat radiation, conduction and convection from its lower portion, while its upper portion is relatively smooth and has less of these qualities.

4. A metallic mold formed with substantially vertical retaining walls provided with heat radiating means in the major portion of its outer surface and having a contracted upper vertical portion, the side walls of which are disposed in a plane other than that forming the contour of the major portion of the mold.

5. A bottle-shaped metallic mold, the lower portion of which below the neck is formed to favor heat absorption to a greater extent than the neck whereby the molten metal in the neck of the mold is caused to descend and fill the pipe or cavity formed in the lower portion of the metal.

6. A metallic mold, the lower portion of which is constructed or equipped to favor the cooling of the molten mass to a greater extent at the bottom and lower part of the mold than at the upper part thereof.

In testimony whereof, I have hereunto subscribed my name.

EMIL GATHMANN.

Witnesses:
R. W. LEIBERT,
PAUL J. GATHMANN.