E. GATHMANN.
TEEMING INGOT MOLDS.
APPLICATION FILED JAN. 8, 1919.

1,298,036. Patented Mar. 25, 1919.

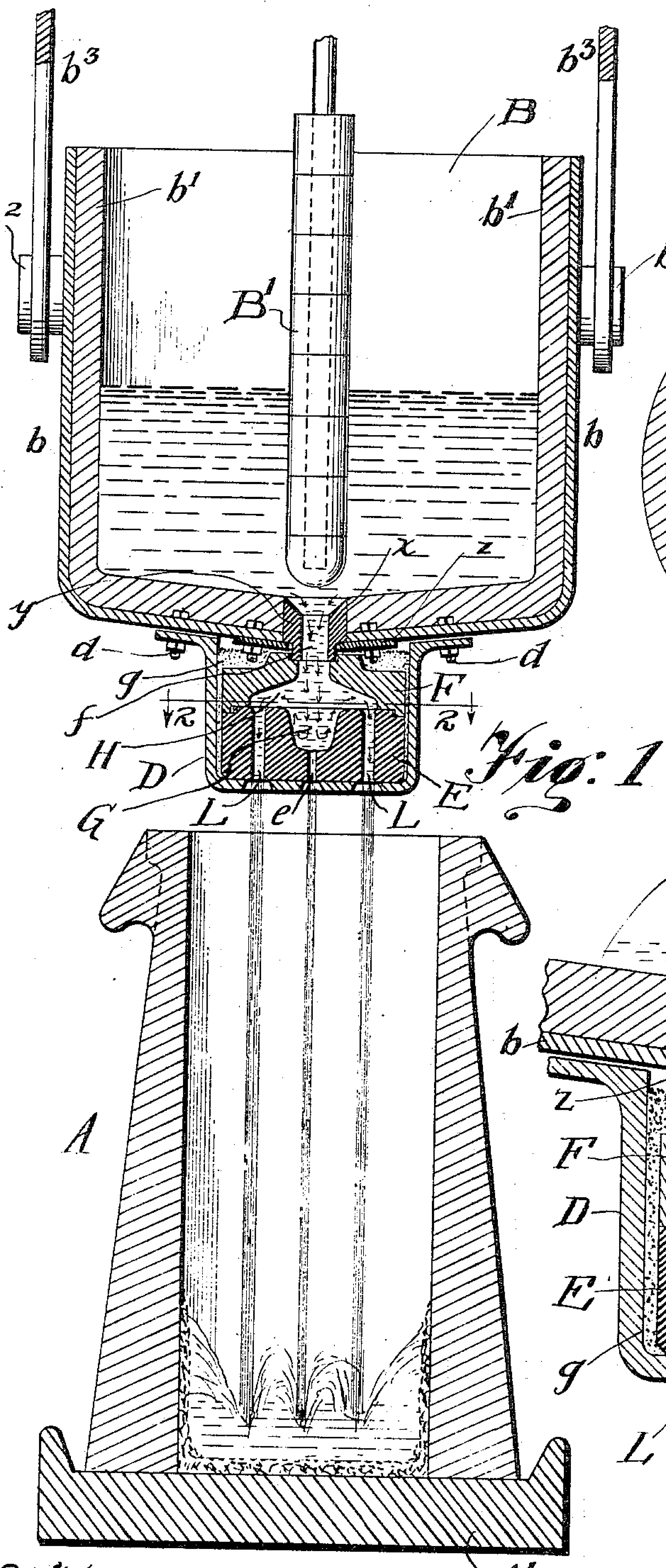


Fig: 1

Fig: 2

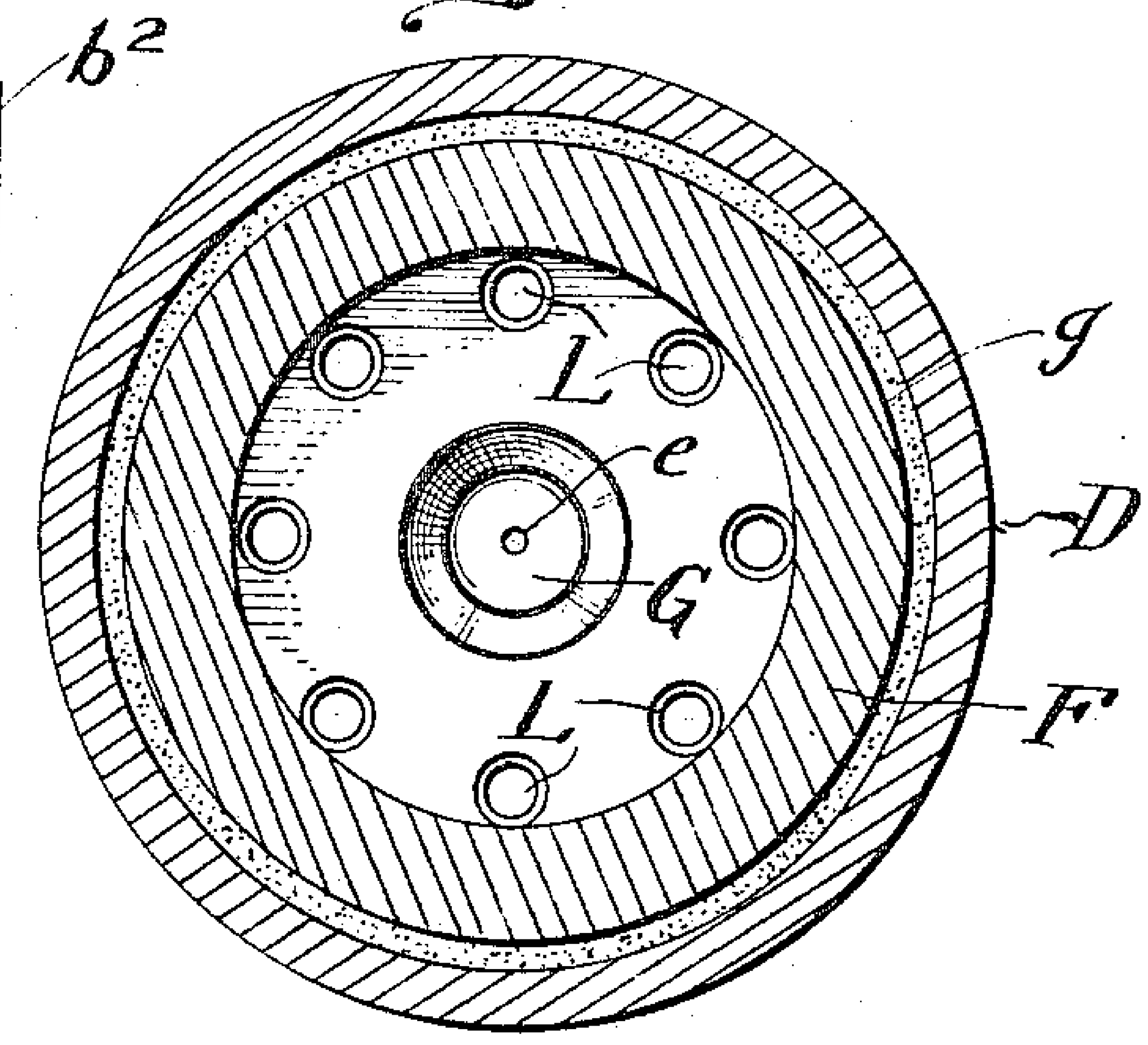
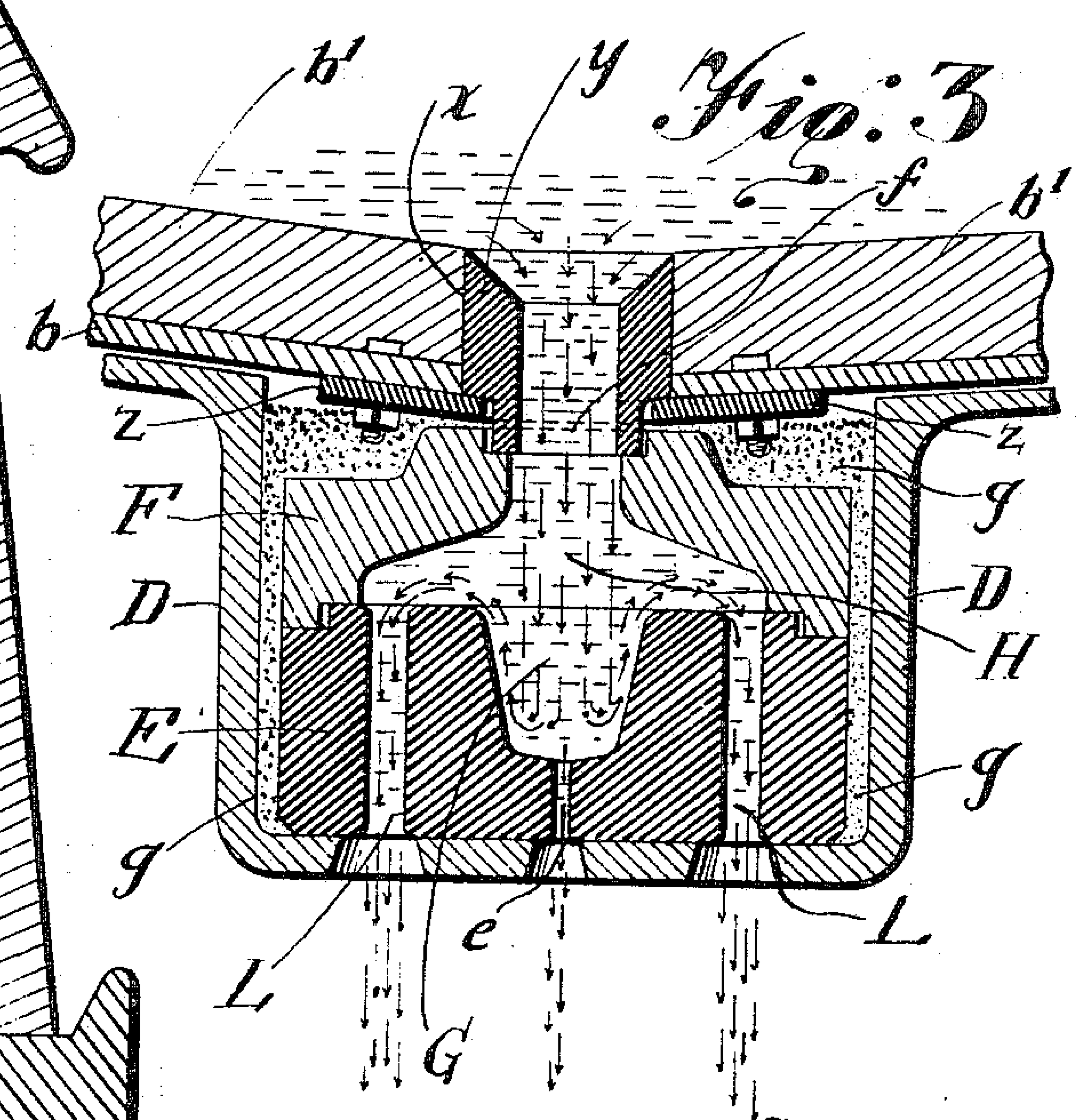


Fig: 3



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TEEMING INGOT-MOLDS.

1,298,036. Specification of Letters Patent. Patented Mar. 25, 1919.

Application filed January 8, 1919. Serial No. 270,178.

To all whom it may concern:

Be it known that I, Emil Gathmann, a citizen of the United States, residing in Baltimore city, Maryland, have invented certain new and useful Improvements in Teeming Ingot-molds, of which the following is a specification.

This invention relates to the casting of metal ingots or the like, and particularly to the pouring or teeming of metallic ingot molds.

Ordinarily metallic ingot molds are teemed from a ladle provided with a valve-controlled nozzle. The metal passes in a large stream or column with high velocity and under great hydraulic pressure through the nozzle and into the mold chamber. This stream of metal at first strikes the bottom of the mold chamber and often injures it, and furthermore during the entire period of teeming the metal splashes violently, causing it to mingle with air and to strike with great force against the side walls of the mold chamber in such manner as to cut the mold walls and to cause the molten metal to weld to said walls, and thus not only impede the proper shrinking of the ingot away from said walls and also the easy stripping of the ingot from the mold, but it often results in producing what are called "cold shuts" or "scabs" on the ingot, which are a serious defect that cannot be remedied by subsequent processes, and often result in imperfect products from the ingot.

In my application for Patent No. 265,582, filed Dec. 6, 1918, I have shown, described, and claimed an apparatus for teeming ingot molds, in which provision is made for preventing these objections heretofore encountered in mold pouring, and in my application for Patent No. 265,583, filed Dec. 6, 1918, I have described and claimed a novel method for performing the teeming operation in such manner as to prevent injury to the mold wall and to produce a better ingot.

Briefly stated, the method described in said application consists in teeming an ingot mold from a ladle or container of molten metal, consisting in passing molten metal from the ladle with a definite volume and velocity and in delivering the metal to the mold with the same volume but with a reduced velocity and in an approximately vertical direction into the mold chamber. The apparatus shown in said application comprises a ladle or container of molten metal and a valve-controlled nozzle therefor, provided with means for discharging molten metal at reduced velocity and with an increased area in an approximately vertical direction into a mold chamber without materially reducing the volume of the metal delivered thereto. More specifically the apparatus comprises a nozzle for the ladle provided with a passage of relatively large cross sectional area through which the molten metal passes from the ladle into the nozzle, and with a plurality of outlet passages through which molten metal is delivered to the mold, there being an expansion or distribution chamber for the ladle located between the inlet passage and the discharge passages. Such apparatus has in practice proved most efficient, but I have found that similar and improved results may be obtained by certain modifications in the construction of the nozzle and in the method of passing the molten metal therethrough.

Broadly stated, my present invention consists in passing the metal downward from the ladle into the nozzle, causing the metal to then rise within the nozzle, and then discharging the metal from the nozzle downwardly into the mold chamber. In this way the passage of the metal through the nozzle is baffled or impeded by having its direction changed, and therefore the velocity of the metal is reduced. The apparatus for performing this operation comprises a nozzle provided with an inlet passage which discharges into a baffle chamber in which the direction of movement of the metal is changed, and said baffle chamber discharges into another chamber above it, which is of larger cross sectional area and to which the discharge openings of the nozzle are connected. Other features of the invention will be hereinafter described.

In the accompanying drawing:—

Figure 1 is a sectional view of a metallic ingot mold and a ladle for teeming the mold constructed in accordance with my present invention.

Fig. 2 shows a section on the line 2—2 of Fig. 1.

Fig. 3 is an enlarged sectional view showing more clearly the details of construction of the nozzle and the manner in which the molten metal flows therethrough.

In Fig. 1 I have shown a well known form of mold A resting on a stool or base A′. The ladle B is in general of well known construction except that the devices applied to the outlet of the ladle are made in accordance with my invention. As usual, the ladle comprises an outer casing or shell b of metal and a lining b' of refractory material, such as fire-brick, and the ladle is provided with ears b^2 which may be engaged by suitable devices b^3 for supporting the ladle and these devices may be connected with cranes or other mechanism for moving the ladle from place to place as desired. An opening x is formed at the bottom of the ladle and is preferably centrally located as indicated, and this opening is controlled by a valve or stopper B′ of well known construction which may be provided with any suitable devices for operating it.

The devices applied to the outlet opening x constitute generally what may be termed a nozzle. The nozzle shown is similar, broadly considered, to that shown in my applications for patent above mentioned. It comprises a metallic casing D which may be detachably connected with the bottom of the ladle by bolts or other suitable devices d. This casing incloses and supports blocks E, F of refractory material which are chambered and provided with passages for molten metal. In the outlet opening x of the ladle is located a block or bushing y of refractory material of usual construction, and this is held in place by an annular plate z bolted to the bottom of the ladle. This bushing y is provided with a valve seat for the stopper B′ arranged immediately above it. Below the valve seat there is a passage f of relatively large cross sectional area through which the molten metal passes from the ladle and this may be termed the inlet passage to the nozzle.

In the block E is formed a chamber G which I call the baffle chamber. It is located directly below the passage f and is of larger cross sectional area than said passage. Between said baffle chamber and the passage f is an intermediate chamber H, which is of larger cross sectional area than the baffle chamber G, and for convenience I call this a distribution chamber, inasmuch as it delivers to outlet passages L. Preferably the outlet passages are of the form indicated more clearly in Fig. 2. The cross sectional area of each of said passages is materially less than the cross sectional area of the passage f, but the combined cross sectional area of said discharge passages is much greater than the cross sectional area of said inlet passage. These passages L are arranged approximately vertically so that molten metal discharged through them passes into the mold chamber in the manner indicated in the drawing without coming in contact with the side walls of the mold.

The blocks E and F may be surrounded by loam g as indicated and the block E is formed with a passage e of small diameter, which is merely for the purpose of draining the chamber G, although of course some metal will pass through this narrow passage while teeming. This is not objectionable even though the metal passing through said passage has a high velocity, as the amount of metal passing through it is relatively small and is centrally located.

In the operation of the apparatus molten metal passes through the inlet passage f in a solid column of relatively large cross sectional area and of relatively high velocity. It passes downward through the distribution chamber H and into the baffle chamber G. In view of this high velocity and of the weight of metal, the column extends nearly to the bottom of the chamber, but then the column is broken and the molten metal rises in the chamber, in the manner indicated by the arrows, and flows into the intermediate or distribution chamber where it spreads and then passes downward through the discharge passages L.

During this operation the volume of metal delivered from the ladle is practically uniform, but the velocity of the metal is materially changed after leaving the ladle and before its discharge from the nozzle. Inasmuch as the direction of flow of the metal is changed in the manner indicated in Fig. 3, it is obvious that the flow of the metal is impeded or baffled and the speed of flow is therefore reduced. This method of reducing the velocity of the metal without decreasing the volume by changing the downward flow to an upward flow before delivery is sufficient alone to improve ingot pouring, it being understood of course that the discharge of metal is free after such change in direction either through a plurality of discharge passages or otherwise.

It will be observed that the metal is forced through the nozzle under great hydraulic pressure exerted by the mass of metal in the ladle, this pressure being exerted not only on the metal as it enters the nozzle but being effective in forcing the metal under reduced velocity from the nozzle, and the metal is delivered in a substantially vertical direction to the mold chamber in such manner as to not come in contact with the walls thereof.

By reference to my two pending applications before referred to, a further explanation may be obtained concerning the operation of the apparatus and the advantages resulting from the inventions therein described and shown, and which are also embodied in my present improvements.

As the column of molten metal passes into the nozzle it flows directly into the baffle chamber G and then is directed upward as before described, but in doing this some of the metal remains relatively quiet on the bottom of the chamber and acts as a cushion to receive the inflowing metal and thus prevents, to a large extent, injury to the bottom wall of the chamber. This is a matter of considerable importance as it prolongs the life of the nozzle appreciably.

The refractory portions of the nozzle are preferably made in two parts. The part *y* before referred to is of usual construction. The lower part E may be cast in one piece and it contains the baffle chamber G and the outlet passages L and also the drain passage *e*. The upper section F is formed to provide the distribution chamber H which connects with the passage *f* in the bushing *y*, and it also connects with the discharge passages L.

It will be understood that the ladle is filled with sufficient metal to supply a plurality of molds in succession, and sometimes there is a short pause when passing from one mold to another. Therefore if metal were allowed to remain in the baffle chamber it would solidify and close the chamber and for this reason I provide the drain passage *e*, which prevents the accumulation of metal in the baffle chamber. Of course when the ladle is being transferred from one mold to another the stopper is lowered and no metal enters the nozzle, and there is therefore no discharge of metal while the ladle is being shifted, but as soon as the stopper is raised metal passes into the nozzle and is discharged in the manner before described. After the stopper is again lowered and before the ladle is shifted the chambers of the nozzle are completely drained.

The baffle chamber is preferably of sufficient cross sectional area to accommodate at least twice as much metal as that represented by the cross sectional area of the incoming stream, so that the stream of metal may readily rebound after impact in the chamber and pass freely upward and laterally toward the discharge passages.

At all times, when the stopper is raised, there is hydraulic pressure in the various chambers and passages of the nozzle, but this pressure is reduced after the metal enters the nozzle and before it is discharged therefrom. In this way the volume of metal passing out of the ladle is not reduced while passing through the nozzle, but the velocity of the metal entering the mold is materially reduced and accomplishes the results heretofore explained.

I claim as my invention:

1. A ladle or container of molten metal provided with a nozzle having a vertical inlet passage, a baffle chamber into which the metal flows vertically, and in which it then rises, and an outlet for the metal, the entrance of which is above the bottom of said baffle chamber.

2. A ladle or container of molten metal provided with a nozzle having a vertical inlet passage, a baffle chamber of relatively large cross sectional area into which the metal flows vertically and in which it then rises, and an outlet for the metal of larger cross sectional area than the inlet to the nozzle, the entrance to which is above the bottom of said chamber.

3. A ladle or container of molten metal provided with a nozzle having a vertical inlet passage of relatively large cross sectional area, a baffle chamber of larger cross sectional area than the inlet passage into which the metal flows vertically and in which it then rises, and a plurality of outlets leading from said baffle chamber, each of which is of smaller cross sectional area than the inlet passage, but which collectively are of considerably larger cross sectional area than said passage.

4. A ladle or container of molten metal provided with a nozzle having a vertical inlet passage, a baffle chamber into which the metal flows vertically and in which it then rises, a chamber intermediate the inlet passage and the baffle chamber of larger cross sectional area than either the inlet passage or the baffle chamber, and an outlet from said intermediate chamber through which molten metal passes to a mold.

5. A ladle or container of molten metal provided with a nozzle having a baffle chamber into which metal flows from the ladle, a distribution chamber located above the baffle chamber, and means for conducting metal from the distribution chamber in a substantially vertical direction to a mold.

6. A nozzle for teeming ladles provided with an inlet passage, a baffle chamber located below said passage, a distribution chamber located above said baffle chamber, and discharge passages for the molten metal connected with said distribution chamber.

7. A nozzle for teeming ladles comprising a plurality of sections of refractory material fitted together and provided with a baffle chamber, a distribution chamber, and a plurality of discharge passages communicating with said distribution chamber.

8. A method of teeming ingot molds from a ladle or container of molten metal provided with a nozzle, which consists in passing the metal downward into the nozzle, causing it to then change its course and to then pass in a substantially vertical direction from the nozzle into the mold.

9. A method of teeming ingot molds from a ladle or container of molten metal provided with a nozzle, which consists in passing the metal downward into the nozzle, causing it to then rise in the nozzle and to then pass downward in a substantially vertical direction into the mold.

10. A method of teeming an ingot mold from a ladle or container of molten metal provided with a nozzle, which consists in

passing the metal downward into the nozzle, causing it to then rise within the nozzle, and then discharging it from the nozzle in a substantially vertical direction and in a plurality of streams into the mold chamber.

11. A method of teeming an ingot mold from a ladle or container of molten metal provided with a nozzle, which consists in passing a column of molten metal downward into the nozzle, causing the metal to rise in the nozzle and to spread laterally therein, and then causing the metal to be discharged from the nozzle into a mold chamber.

12. A method of teeming an ingot mold from a container of molten metal provided with a nozzle, which consists in passing the metal downward in a solid column into the nozzle, causing the metal to rise in the nozzle, spreading it laterally, and then discharging the metal in a plurality of streams in a substantially vertical direction into a mold chamber.

13. A ladle or container of molten metal provided with a nozzle having a vertical inlet passage, a baffle chamber into which the metal flows vertically and in which it then rises, an outlet for the metal, the entrance of which is above the bottom of said baffle chamber, and a relatively small outlet or drainage passage connected with the bottom of the baffle chamber.

14. A ladle or container of molten metal provided with a nozzle having a vertical inlet passage, a baffle chamber into which the metal flows vertically and in which it then rises, a chamber intermediate the inlet passage and the baffle chamber, an outlet from said intermediate chamber through which molten metal passes to a mold, and a drain passage connected with the bottom of the baffle chamber.

15. A nozzle for teeming ladles comprising a plurality of sections of refractory material provided with an inlet passage, a baffle chamber, and a plurality of discharge passages communicating with said baffle chamber, each of said discharge passages being of smaller cross-sectional area than that of the inlet passage, but the cross-sectional area of said discharge passages collectively being greater than that of said inlet passage.

In testimony whereof, I have hereunto subscribed my name.

EMIL GATHMANN.