May 5, 1970 H. L. HARVILL ET AL 3,510,116

METAL DISPENSING FURNACE

Filed Aug. 30, 1967 2 Sheets-Sheet 1

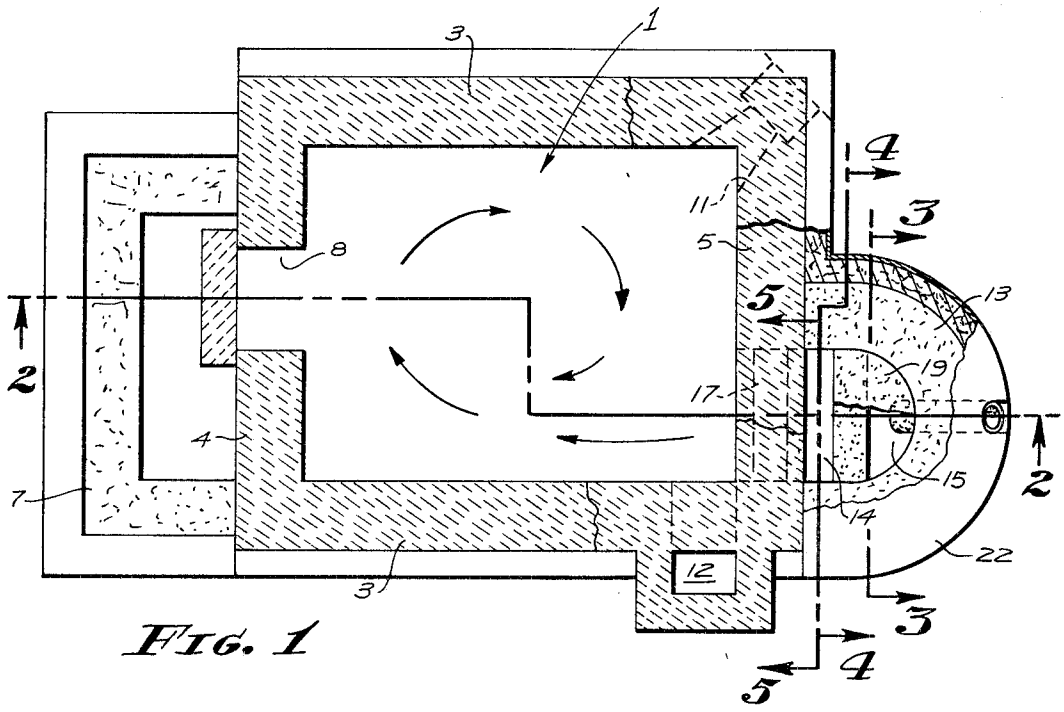


FIG. 1

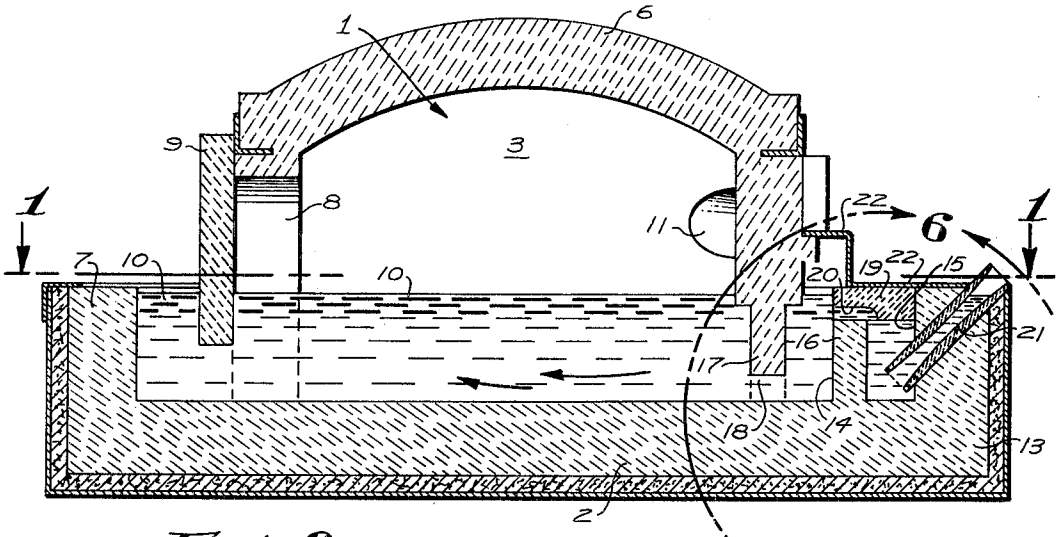


FIG. 2

HENRY L. HARVILL
JOHN I. HARVILL
INVENTORS

BY Lyon & Lyon
ATTORNEYS

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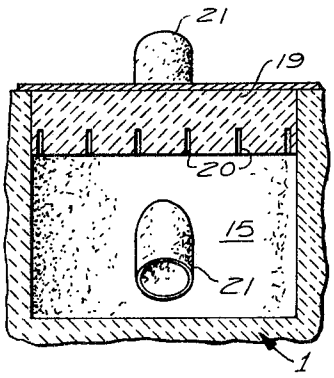


FIG. 3

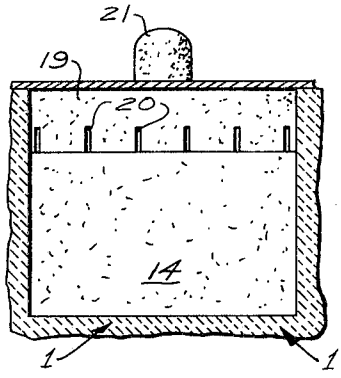


FIG. 4

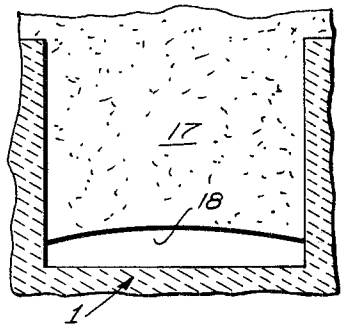


FIG. 5

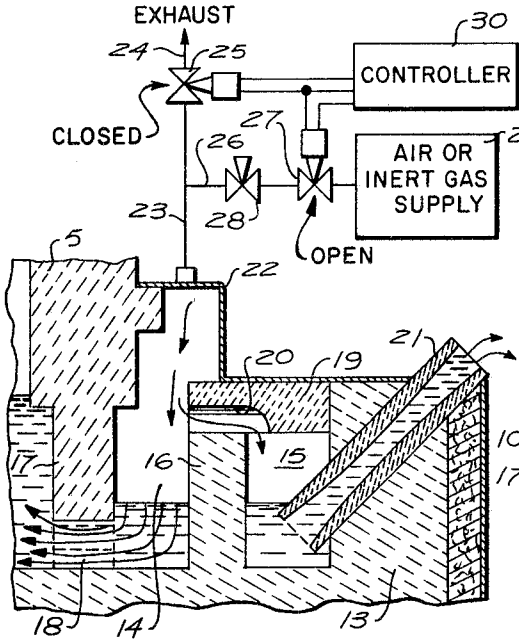


FIG. 6

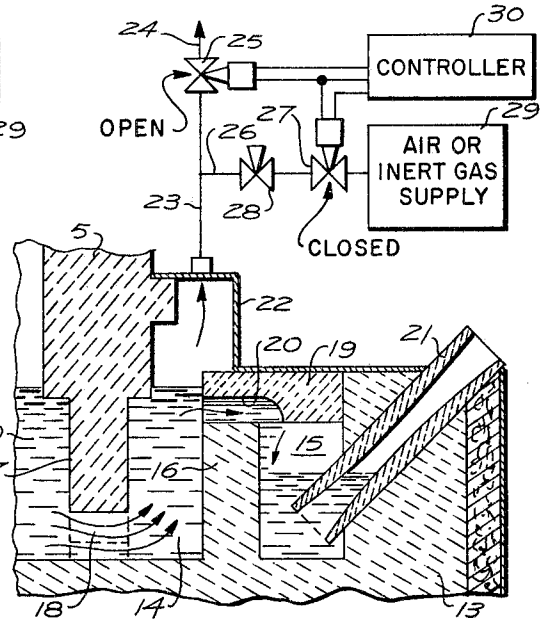


FIG. 7

HENRY L. HARVILL
JOHN I. HARVILL
INVENTORS

BY Lyon & Lyon
ATTORNEYS

United States Patent Office

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METAL DISPENSING FURNACE

Henry L. Harvill, Riverside, and John I. Harvill, Corona, Calif. (both of P.O. Box 777, Corona, Calif. 91720)

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Int. Cl. F27d 3/14

U.S. Cl. 266—38 6 Claims

ABSTRACT OF THE DISCLOSURE

A metal dispensing furnace having a molten metal reservoir, a surge chamber joined to the reservoir by a submerged opening, and a dispensing chamber having a discharge spout and intermittently connected with the surge chamber over a baffle wall separating the surge and dispensing chambers.

The surge and dispensing chambers being intermittently exposed to a common source of air or inert gas under pressure, and to a common exhaust so that the molten metal in the dispensing chamber is periodically discharged, while simultaneously molten metal in the surge chamber is caused to backflow into the reservoir, agitating the metal therein, particularly at the bottom of the reservoir; then, alternately, is permitted to refill the surge and dispensing chambers causing further agitation of the molten metal in the reservoir.

BACKGROUND OF THE INVENTION

It is essential in the intermittent dispensing of molten metal alloys into molds of various types including those contained in die casting machines that the formulation remain constant; that is, for example, heavier components remain uniformly suspended and not settle out. It is also essential that impurities be prevented from discharging with the molten metal, without requiring frequent cleaning of the furnace. Also, it is desirable that the metal in the furnace reservoir have a higher temperature than the metal temperature at the pouring spout.

A primary object of the present invention is to provide an effective means and method of agitating the molten metal alloy in the reservoir primarily below the surface slag so that the heavier components are maintained in suspension without causing the slag or other surface contaminants from being mixed into the molten metal. This is accomplished by providing a surge chamber between the reservoir and dispensing chamber, the surge chamber preferably being larger than the dispensing chamber, and pressurized simultaneously with pressurization of the dispensing chamber so as to drive rearwardly into the reservoir a quantity of molten metal calculated to cause an optimum stirring and mixing of of the metal.

A search of the prior art did not reveal this concept; however, in some instances, backflow did occur but in an amount totally inadequate to effect stirring of the molten metal. Of the references revealed in the search, the following patents are selected as representative: Howard, 1,138,110, May 1915; Peterson, 2,464,714, March 1949; Edstrand, 2,846,740, August 1958; Holz, 3,050,794, August 1962.

The Howard patent discloses a glass furnace in which some backflow into the "refining" chamber occurs. It is clear that the backflow is greatly restricted and not at high velocity. It is clear that this flow was not intended to and, in fact, does not accomplish the purposes of the present invention.

The Peterson patent uses a displacement member and the "storage" compartment and the "melting" compartment are in communication above as well as below the liquid level. There is no disclosure regarding the size of the submerged connecting passage, and no comment regarding whether or not any backflow occurs. The overflow lip to the discharge spout is only slightly above liquid level, so that if any inadvertent backflow does occur, it would be ineffectual.

The Edstrand and Holz patents show a dispensing chamber with a constructed vertical tube communicating with the reservoir. As a consequence, the volume of backflow is, at best, only a small fraction of the displacement in the dispensing chamber, so that, at best, no effective agitation of the metal in the reservoir can occur.

A further object of this invention is to provide a novelly related surge chamber and dispensing chamber in which the surge chamber is not only larger than the dispensing chamber, but communicates therewith through restricted passages so that backflow into the reservoir is both rapid and of sufficient volume to effect optimum agitation.

A still further object is to provide, by means of a baffle wall between the surge chamber and the dispensing chamber, an optimum temperature gradient whereby the temperature of the metal is predictably lower than its temperature in the reservoir.

DESCRIPTION OF FIGURES

FIG. 1 is a sectional view of the molten metal furnace, taken principally along the line 1—1 of FIG. 2.

FIG. 2 is a longitudinal, sectional view thereof, taken through 2—2 of FIG. 1, the level of the molten metal being shown in its quiescent state prior to dispensing a charge of molten metal.

FIG. 3 is an enlarged, fragmentary, sectional view, taken through 3—3 of FIG. 1, showing the restricted entrance slits communicating with the dispensing chamber, and showing the dispensing spout.

FIG. 4 is a similar enlarged, fragmentary, sectional view, taken through 4—4 of FIG. 1, showing the baffle between the surge and dispensing chambers, and showing the entrance ends of the flow restricting slits between the surge and dispensing chambers.

FIG. 5 is a similar, fragmentary, sectional view, showing the opening communicating between the surge chamber and the reservoir.

FIG. 6 is an enlarged, fragmentary, sectional view, taken within 6—6 of FIG. 2, showing the molten liquid level in the surge chamber and dispensing chamber on completion of the dispensing cycle, and indicating diagrammatically, the means for pressurizing the surge and dispensing chamber.

FIG. 7 is a similar, fragmentary, sectional view, showing the surge chamber in its refilled condition, and showing the dispensing chamber in the process of being refilled with molten metal.

SPECIFICATION

The metal dispensing furnace is constructed in the usual manner of brick, capable of withstanding the temperatures of molten metal. It is customary to encase the brick in suitable insulating material, which in turn is encased in a metal jacket or, for mechanical protection, suitable metal framework is provided for the brick, the framework being protected by the brick from exposure to the temperatures of the molten metal.

The furnace may be gas or oil fired, or may be an induction or resistance type electric furnace. For purposes of illustration, a gas fired type of furnace is shown. The furnace includes a reservoir 1 for molten metal, the reservoir having a bottom wall 2, side walls 3, end walls 4 and 5, and a top wall 6 which is arched to provide mechanical support. At one end 4, there is provided a charging extension 7, open at its upper side, and com-

municating with the reservoir through an opening **8**, closed by a vertically adjustable door **9**, the lower end of which dips into the molten metal **10**, so as to isolate the charging extension **7** from the reservoir **1**. If the furnace is of the gas fired type, a substantial chamber is provided above the surface of the metal intersected by a burner opening **11**, which receives a gas burner unit, not shown. A vent **12** leads from the reservoir. The construction thus far described may be considered as conventional.

At the end of the reservoir, opposite from the charging extension **7**, is a dispensing extension **13**. In exercise of the present invention, the dispensing extension includes an upwardly open surge chamber **14** adjacent the end wall **5**, and an upwardly open dispensing chamber **15** separated from the surge chamber **14** by a baffle wall **16**, the upper surface of which is below the intended minimum level of molten metal.

The submerged portion of the end wall **5** is reduced in width, as indicated by **17**, and the reservoir communicates with the surge chamber through a submerged opening **18**.

Resting on the baffle **16** and closing the dispensing chamber **15**, is a metering block **19**, having a set of relatively narrow slots **20** which form with the upper side of the baffle wall **16**, a series of restricted passageways communicating between the surge chamber **14** and the dispensing chamber **15**. A dispensing spout **21** extends upwardly at an angle from the dispensing chamber **15** to a height slightly above the maximum intended level of metal in the reservoir **1**.

The dispensing extension **13** is covered with a suitable deck **22** which may be metal or metal-lined with suitable heat resisting material. The deck forms a sealed closure for the dispensing chamber **15** and surge chamber **14** so that these chambers may be pressurized.

Connected directly to the surge chamber **14** and indirectly to the dispensing chamber **15** through the slots **20** is a surge line **23** for the flow of air, or, preferably, an inert gas, to or from the chambers. The surge line connects to an exhaust line **24**, having an exhaust valve **25**, and to a supply line **26** having a supply valve **27** and a throttle valve **28**. The supply line **26** connects to a source of air or inert gas under pressure, indicated by **29**. The exhaust valve **25** and supply valve **27** are preferably solenoid operated and connected to a controller **30**, arranged to open these valves alternately and to time the cycle that each valve is open.

Operation of the metal dispensing furnace is as follows:

When the reservoir and chambers are exposed to atmospheric pressure, the operating level of the molten metal may vary between a maximum level just below the discharge level of the spout **21**, and a minimum level just above the upper surface of the baffle wall **16**. Due to the communication provided between the reservoir and the two chambers, the molten metal fills the reservoir and the two chambers to a common level, as shown in FIG. 2. This is the condition when the exhaust valve **25** is opened. When the exhaust valve is closed and air or inert gas is applied under pressure, the rate of flow of the air or gas is determined by the adjustment of the throttle valve **28**. While the slots **20** offer some resistance to the flow of molten metal therethrough, they do not offer appreciable resistance to the flow of a gas. Therefore, once the slots **20** are cleared of metal, the pressure in the dispensing chamber and the surge chamber is equal so that as additional gas is supplied, the levels of these two chambers recede essentially equally. The molten metal in the dispensing chamber discharges through the spout **21**, whereas the molten metal in the surge chamber flows backwardly into the reservoir. The backward flowing metal flows across the bottom of the reservoir agitating the metal therein and in particular, causing a remixing of the heavier constituents of the molten metal alloy. This is accomplished without appreciably disturbing the surface and any slag which may be floating thereon, so that the agitation of the metal does not introduce contamination. It will be noted, as shown in FIG. 1, that the passageway or opening **18** may be disposed at one lateral side of the wall **5**, so that the incoming surge of molten metal from the surge chamber **14** may tend to move in a rotary path, as indicated by arrows in FIG. 1. The amount of agitation may be optimized by providing a larger or smaller surge chamber. It is found desirable that the surge chamber be at least as large as the dispensing chamber.

The amount of metal discharged from the spout **21** varies with the capacity of the die or mold cavity intended to receive the metal. For maximum efficiency, however, it is desirable to pour a quantity of metal representing a substantial portion of the capacity of the dispensing chamber. This also increases the volume of metal which surges backwardly into the reservoir.

The volume of molten metal discharged with each pressure cycle is determined by the pressure and the time that the dispensing chamber is exposed to the pressure. After the dispensing cycle is completed, the supply valve **27** is closed and the exhaust **25** is opened to atmosphere. Initially this causes a surge of molten liquid from the reservoir into the surge chamber **14**, filling the chamber to a level above the baffle wall **16**. The molten metal then flows through the slots **20** into the dispensing chamber. The slots offer some resistance to the flow of the metal so that the dispensing chamber fills at a slower rate than the surge chamber **14**. The time required to refill the dispensing chamber is, however, well under the time required to present empty dies or molds to the dispensing spout. By changing the width or the number of slots **20**, the flow into the dispensing chamber may be optimized.

The method of dispensing and agitating molten metal consists essentially in producing a backward surge of molten metal into the reservoir simultaneously with the dispensing of the molten metal into dies or molds, and then producing a forward surge of molten metal during the initial portion of the cycle in which a new charge of molten metal is brought into readiness for a subsequent dispensing cycle, the volume of metal moved by each surge being such as to produce optimum stirring or agitation of the molten metal, especially the lower portion of the metal in the reservoir.

It is highly desirable to maintain a temperature gradient between the reservoir and the dispensing chamber; that is, the molten metal in the reservoir should be higher than the metal in the dispensing chamber. This temperature difference can be preselected by the thickness of the wall **17** and the baffle **16** and the selection of the material comprising these walls so as to have a faster or slower rate of heat transfer.

While particular embodiments of this invention have been shown and described, it is not intended to limit the same to the details of the constructions set forth, but instead, the invention embraces such changes, modifications and equivalents of the various parts and their relationships as come within the purview of the appended claims.

We claim:

1. A metal dispensing furnace, comprising:

(a) a reservoir for molten metal;

(b) a closed surge chamber at one end of said reservoir and communicating therewith through a submerged passageway for flow of molten metal in either direction between said reservoir and chamber, said passageway permitting equalization of the molten liquid level in said reservoir and surge chamber;

(c) a dispensing chamber;

(d) a baffle separating said surge chamber and dispensing chamber, said baffle having an upper level below the equalized level of molten metal in said reservoir and surge chamber;

(e) a discharge spout for said dispensing chamber having an outlet above the equalized level of molten

metal in said reservoir, surge chamber and dispensing chamber;

(f) and means for gas pressurizing said surge and dispensing chambers thereby to drive molten liquid from said surge chamber into said reservoir at an agitation creating rate, and simultaneously, to drive molten metal from said discharge spout.

2. A metal dispensing furnace, as defined in claim **1**, wherein:

(a) means defines a constricted communication between said surge chamber and said dispensing chamber over said baffle, of lesser area than the submerged passageway between said reservoir and said surge chamber.

3. A metal dispensing furnace, as defined in claim **1**, wherein:

(a) the effective volume of said surge chamber is at least equal to the effective volume of said dispensing chamber.

4. A metal dispensing furnace, comprising:

(a) a reservoir for molten metal;

(b) a closed surge chamber at one end of said reservoir;

(c) a dispensing chamber adjacent said surge chamber and having a discharge spout;

(d) means forming a submerged passageway between the bottom of said reservoir and the bottom of said surge chamber tending to equalize the molten liquid level therein;

(e) a baffle separating said surge and dispensing chambers, said baffle having an upper surface adjacent to but below the minimum operating height of molten metal in said reservoir, said spout being above the maximum operating height of molten metal in said reservoir;

(f) and means for simultaneously applying pressure to said surge chamber and dispensing chamber to drive the contents of said surge chamber backward into said reservoir to cause a submerged current of molten metal across the bottom of said reservoir thereby to agitate the molten metal therein; and simultaneously, to cause discharge of molten metal from said spout.

5. A metal dispensing furnace, as defined in claim **4**, wherein:

(a) a cover is provided for said dispensing chamber, one margin of the cover being disposed on said baffle, and having a set of slits the vertical depth of which corresponds to the difference between the minimum and maximum operating level of molten metal in said reservoir, said slits forming restricted communication between said surge chamber and dispensing chamber.

6. A metal dispensing furnace, as defined in claim **1**, wherein:

(a) the metal in said reservoir is exposed to a heat source to maintain the metal therein in a molten state, said surge chamber being heated from the molten metal flowing therein from said reservoir thereby to establish a temperature gradient between said reservoir and said surge chamber;

(b) and said dispensing chamber being heated by the molten metal received therein from said surge chamber and by heat transfer through said baffle thereby to maintain a further temperature gradient between said surge chamber and said dispensing chamber.

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J. SPENCER OVERHOLSER, Primary Examiner

J. S. BROWN, Assistant Examiner

U.S. Cl. X.R.

75—46; 222—373