July 19, 1949. R. G. HARDY 2,476,296

METAL CASTING APPARATUS

Filed Aug. 8, 1945

FIG. 1

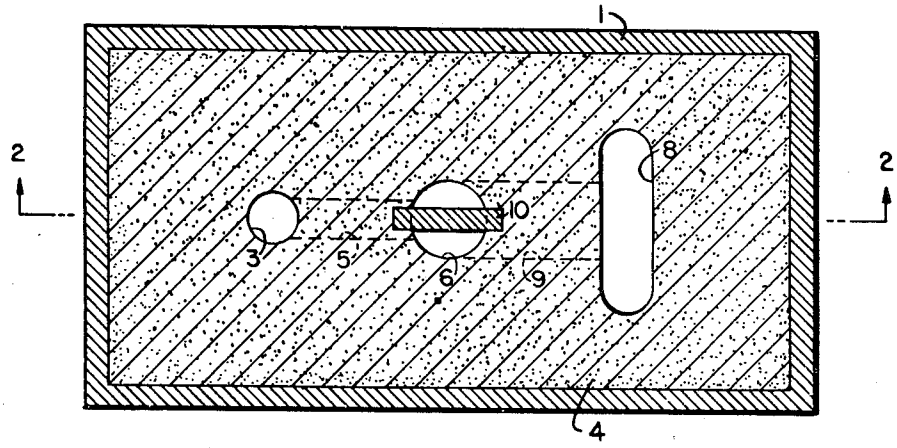
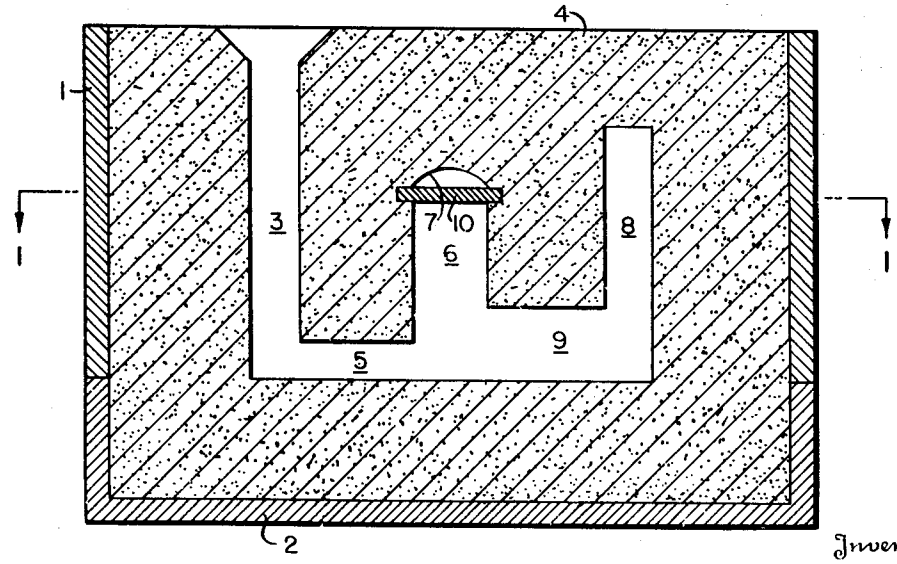


FIG. 2



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Patented July 19, 1949 2,476,296

UNITED STATES PATENT OFFICE

2,476,296

METAL CASTING APPARATUS

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Application August 8, 1945, Serial No. 609,706

5 Claims. (Cl. 22—134)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This invention relates to metal casting, and more particularly to an apparatus for force feeding casting material into the casting chamber.

In casting metals, in order to obtain a homogeneous casting, which will be free from defects resulting from incomplete feeding of the metal into the casting chamber, it is sometimes the practice to employ means whereby during the casting operation pressure will be applied to the casting material to force feed the casting material into the casting chamber. For example, a riser may be employed having suitable dimensions and location relative to the dimensions and location of the casting chamber, so that during the casting operation the hydro-static pressure of the casting material in the riser chamber will be sufficient to force feed the casting material into the casting chamber. Where, in order to obtain satisfactory feeding, it is necessary to employ feeding pressures in excess of one atmosphere, the required size of the riser chamber may become an important consideration, and it may well be impractical to make the riser chamber as large as is required.

An object of the present invention is to provide an efficient and effective apparatus for casting metals.

A further object of the present invention is to provide an apparatus for metal casting whereby during the casting operation a high pressure feeding action will be produced without employing a large riser chamber.

In accordance with one embodiment of this invention, a metal casting mold is employed having a blind riser located therein. A quantity of a volatilizable metal is located in the riser chamber so that during the casting operation the heat of the molten casting metal will cause the volatilizable metal to be volatilized and to produce a gas pressure in the riser chamber which will effect force feeding of the casting metal into the casting chamber.

Other objects and advantages of the present invention will be apparent from the following detailed description taken in conjunction with the drawings, wherein:

Fig. 1 is a horizontal sectional view taken along the line 1—1 of Fig. 2 showing a casting mold constructed in accordance with one embodiment of this invention and having a riser chamber formed therein and provided with a quantity of a volatizable metal; and,

Fig. 2 is a vertical sectional view taken substantially along the line 2—2 of Fig. 1.

Referring now to the drawings, it will be seen

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that a substantially conventional sand mold is there shown comprising an upper section or cope 1 and a lower section or drag 2. A vertically extending sprue passage 3 is formed in the sand 4, which fills the mold, and this passage connects at its lower end to a horizontally extending runner passage 5. The right end of the runner passage 5 connects to the base of a blind riser chamber 6. As may be seen in the drawings, the riser chamber 6 is of substantially cylindrical shape and the upper end wall 7 of the riser chamber is curved to form a dome. The lower right side of the riser chamber 6 is connected to a casting chamber 8, formed in the mold, by a horizontally extending runner passage 9, the casting chamber 8 being formed to have the desired internal configuration. The relative sizes of the several passages and chambers is of considerable importance and it is desirable that the runner passage 9 connecting the casting chamber 8 to the riser chamber 6 have a cross-sectional dimension substantially the same as or slightly greater than the cross-sectional dimension of the casting chamber 8. Similarly the cross-sectional dimension of the riser chamber 6 is selected to be as large as or slightly greater than the cross-sectional dimension of the casting chamber 8. The cross-sectional dimension of the runner passage 5, however, is made substantially smaller than the cross-sectional dimension of the runner passage 9, so that, during the casting operation, the metal in the runner passage 5 will tend to solidify substantially prior to the solidification of the metal in the casting chamber 8, the runner passage 9, and the riser chamber 6. At the same time, by making the riser chamber 6 and the runner passage 9 of similar cross-sectional size to the casting chamber 8, solidification of the casting material in the runner passage 9 and the riser chamber 6 will not occur prior to solidification of the metal in the casting chamber 8.

Normally, in using a mold such as that illustrated, a quantity of the casting material is poured into the sprue passage 3, runs down the sprue passage and along the runner passage 5 and enters the riser chamber 6. The casting material then flows down the runner passage 9 and into the casting chamber 8. The pouring operation is conducted at such a speed that the riser chamber 6 and casting chamber 8 are substantially filled prior to any freezing or solidification occurring in the metal. Then, as the metal begins to solidify, since the runner passage 5 is made, as hereinbefore stated, of substantially smaller cross-sectional dimension than the runner pas-

sage 9, the metal in the runner passage 5 will tend to solidify first, thus, in effect, sealing the riser chamber 6, runner passage 9 and the casting chamber 8 from the sprue passage 3 and the outside atmosphere. The weight of the molten casting material in the riser chamber thus serves to force feed the metal through the runner passage 9 and into the casting chamber 8, and to maintain a constant feeding pressure.

In some cases it has been found that because of the peculiar location of the casting chamber or because of the dimensions or configuration of the casting chamber, it is necessary to employ riser chambers of impractical or undesirable size in order to obtain the required gravity feeding. Also, where certain alloys or metals having relatively low skin strength are used as the casting material, such as brass or bronze, ordinary atmospheric pressure feeding techniques are wholly inadequate.

In accordance with the present invention, in order to provide a force feed at a pressure which may be far in excess of atmospheric pressure, a quantity of a metal which is volatilizable at the temperature of the molten casting material is located in the riser chamber during the preparation of the mold. In practice, a number of metals have been found to be satisfactory and the choice of a particular metal will, in general, be dictated by the casting material and the required feeding pressure. For example, in casting medium melting point alloys such as brass or bronze, a suitable volatilizable metal has been found to be zinc; the zinc may be used alone or in combination with other volatilizable metals such as phosphorus. By combining several metals various rates of volatilization may be obtained. As a practical matter, it is usually desirable to employ as a volatilizable metal one which will not contaminate the casting material. For example, zinc is particularly desirable where the casting material is an alloy including as an element thereof zinc.

As shown in the drawings, a rod 10 of the volatilizable metal is located in the upper portion of the riser chamber 6 being mounted transversely thereacross. As the purpose of the invention is to attain a superatmospheric pressure at the top of the riser 6, the element must be mounted so as to be nonventilating in the sense of not functioning to produce or preserve an air passage through any skin of solidified metal formed on the walls of the riser during casting. The method of mounting here shown is merely illustrative, however, and the volatilizable metal may be suspended by wires or otherwise suitably located in the riser chamber in a manner to permit the formation of a continuous lining of solidified metal around the walls of the riser chamber.

During the casting operation, which is conducted substantially as hereinbefore described, the casting metal in the runner passage 5 will tend to solidify prior to the casting metal in the riser chamber 6, the runner passage 9 and the casting chamber 8, because of the smaller cross-sectional size of the runner passage 9. This effectively seals the portion of the mold to the right of the runner passage 5, as viewed in these drawings, from the sprue passage. At the same time, as the casting material fills the riser chamber and comes into contact with the volatilizable metal, the heat of the casting material will cause the volatilizable metal to be volatilized and the metal vapors will tend to fill the riser chamber. In the case of zinc it has been found that the metal vapor or gas will, upon touching the walls of the riser chamber, condense and form a skin or layer of metal thereover, thus constituting means providing an airtight compartment and preventing the escape of pressure through the sand. Depending on the cross-sectional size of the body of volatilizable material, the composition of the body, and the amount of volatilizable metal used, a vapor pressure considerably in excess of atmospheric pressure may be developed in the riser chamber. This vapor pressure will force feed the casting material through the runner passage 9 and into the casting chamber 8, thereafter maintaining pressure on the casting material during the solidification thereof. The rate at which pressure is developed may be controlled by a proper selection of the cross-sectional size of the volatilizable metal body in the riser and of the composition of the body, a larger size producing a lower rate of volatilization.

It will be apparent that the volatilized metal striking the casting material will tend to mix with and to chill the casting material. However, by employing zinc as the volatilizable material when casting an alloy such as bronze or brass which includes zinc as an element thereof, the zinc while tending to chill the casting material will at the same time tend to lower the melting point of the casting material, thus in large part compensating for the chilling effect and aiding in maintaining the casting material in the runner passage 9 and riser chamber in a liquid state. With other alloys, other volatilizable metals may be used with similar results.

It will be understood that while, in general, it is preferred to locate the riser chamber intermediate the casting chamber and the sprue passage, this arrangement is not prerequisite and any location of the riser chamber which will permit the feeding of metal from the riser to the casting chamber after the metal in the sprue passage has solidified may be employed.

While but one embodiment of this invention has been shown and described, many changes and modifications may be made therein without departing from the spirit or the scope of the present invention.

The invention shown and described herein may be manufactured or used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. Apparatus for casting molten metals having a volatility less than that of zinc comprising, a mold provided with a casting chamber, a blind riser chamber communicating with said casting chamber and pouring passage means communicating with said riser chamber, and a quantity of solid zinc disposed in the said riser chamber of said mold.

2. Apparatus for casting molten metals comprising, a mold provided with a blind casting chamber, a non-vented blind riser chamber communicating with said casting chamber and pouring passage means communicating with said riser chamber, and a solid metallic substance volatile at the melting temperature of the metal to be cast disposed in said riser chamber.

3. Apparatus for casting molten metal comprising, a mold provided with a casting chamber, a non-vented blind riser chamber having surfaces substantially impermeable to metallic vapor, communicating passage means connecting said casting chamber and said riser chamber hav-

ing relatively low freeze-off capacity and pouring passage means communicating with said riser chamber having relatively high freeze-off capacity, and solid metallic material volatile at the melting temperature of the metal to be cast disposed in the riser chamber of said mold.

4. Apparatus for casting molten metal comprising, a mold provided with a casting chamber, a non-vented blind riser chamber having surfaces substantially impermeable to metallic vapor, passage means connecting said casting chamber and said riser chamber and adapted to prolong the molten condition of the metal after pouring and passage means connecting said riser chamber with the source of said molten metal adapted to promote solidification of the metal after pouring, and solid metallic material volatile at the melting temperature of the metal to be cast disposed in the riser chamber of said mold.

5. Apparatus for casting molten metal comprising, a mold provided with a casting chamber, a blind riser chamber communicating with said casting chamber by relatively large cross-section passage means and relatively small cross-section

pouring passage means communicating with said riser chamber, and a quantity of solid metal volatile at the melting temperature of the metal to be cast disposed in the riser chamber of said mold.

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