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VACUUM TREATMENT OF METALS

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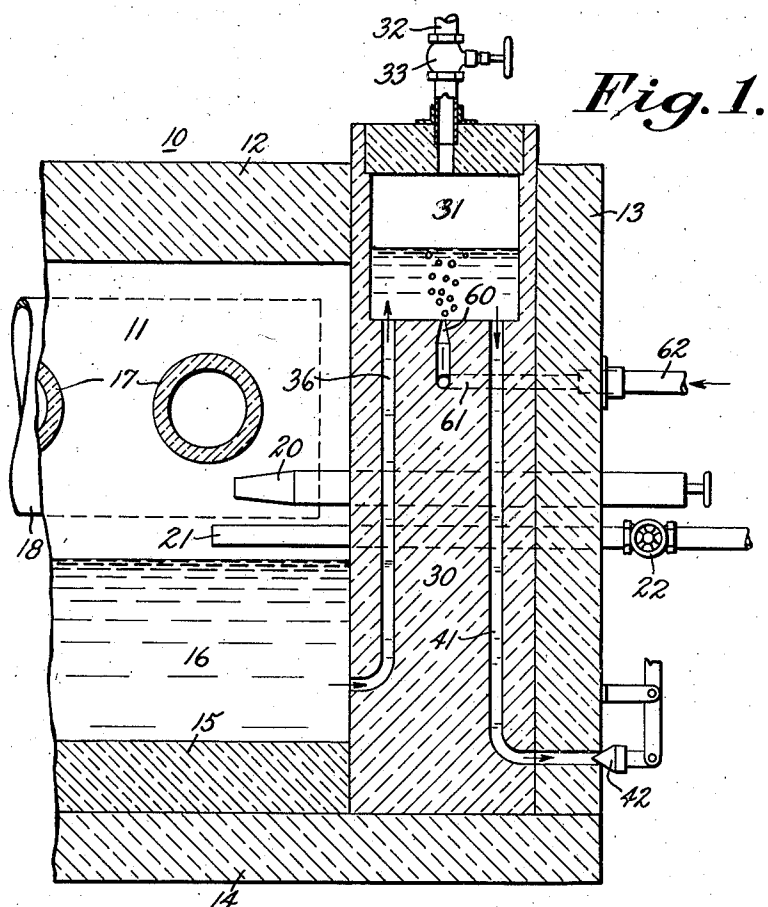


Fig. 1.

Fig. 2.

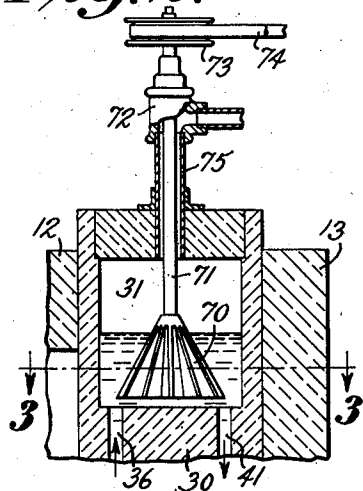
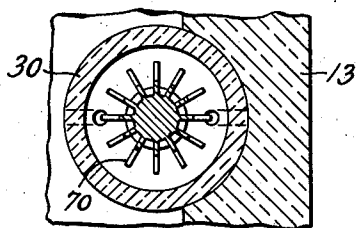


Fig. 3.



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VACUUM TREATMENT OF METALS

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Application October 12, 1933, Serial No. 693,239

6 Claims. (Cl. 266—34)

This invention relates to the preparation of metals for casting and more particularly to the vacuum treatment of molten metals.

In certain instances, it has been found that by subjecting molten metals to a vacuum the characteristics of the casting are improved. For example, the casting may be made particularly free from gases and voids. The present invention accordingly provides an improved method and means for effecting this treatment which is simple, effective and economical and is an improvement on the invention described in the co-pending application of Jesse O. Betterton, Serial Number 675,149. The invention is particularly adapted to the treatment of non-ferrous metals, such as copper and aluminum, but it may also be applied to the treatment of other metals, as will be apparent to a person skilled in the art.

In accordance with this invention, the metal is melted, preferably in a non-absorbable atmosphere, and on its way to a casting box is passed through a vacuum chamber in which it is agitated to bring all parts of the bath to the surface where it is directly subjected to the action of the vacuum. In certain embodiments of the invention, the metal is agitated by a mechanical stirrer or agitator or by passing a gas, such as air, through the metal.

The invention also consists of certain novel features hereinafter more fully set forth. Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be carried out, may be better understood by referring to the following description, taken in connection with the accompanying drawing forming a part thereof, in which

Fig. 1 is a partial vertical section through a furnace illustrating one embodiment of the present invention;

Fig. 2 is a partial vertical section through a modified form of a vacuum chamber; and

Fig. 3 is a section taken on the line 3—3 of Fig. 2.

Like reference characters denote like parts in the several figures of the drawing. In the following description and in the claims various details will be identified by specific names for convenience but they are intended to be as generic in their application as the art will permit.

Referring to the drawing more in detail and particularly to Fig. 1, the invention is shown as applied to a furnace 10 comprising side walls 11,

roof 12 and an end wall 13. The furnace is also provided with a bottom 14 having a lining 15 of suitable refractory material upon which a bath 16 of molten metal is supported.

The furnace may be provided with a plurality of fire flue tubes 17 which may be supported by the side wall 11 in any suitable manner and may join a suitable header 18. Each flue 17 may be provided with a suitable burner (not shown) by which heat is supplied to the furnace. An auxiliary burner 20 may be mounted in the end wall 13 to assist in raising the temperature of the furnace, for example, in starting the melting operation. A pipe 21 may also be provided for supplying a chemically inert, non-absorbable gas to the furnace, which may be controlled by suitable means, such as a valve 22.

It is to be understood that the various parts of the furnace outlined above are of standard construction and that only so much thereof has been described as is essential to a proper understanding of the present invention.

The vacuum treating device is shown as comprising a cylinder 30 which may be made of any suitable refractory material having sufficient heat conductivity to permit a uniform heat distribution to be maintained, for example, graphite, silicon carbide, or other molded material. The cylinder 30 is mounted within the end walls of the furnace in a position to receive heat therefrom, whereby the metal is prevented from freezing as it passes through the cylinder in the manner to be described.

The cylinder 30 is provided, preferably at its upper end, with a vacuum chamber 31 which communicates by pipe 32, controlled by valve 33, with a suitable source of vacuum (not shown). The vacuum chamber communicates with the bath 16 by a channel 36 and is provided with a discharge channel 41 controlled by a valve 42 adapted to discharge metal to a suitable casting apparatus (not shown). A nozzle 60 is mounted in the lower part of the vacuum chamber 31 in a position to supply gases under pressure thereto. Said nozzle may be connected by a passage 61 to a pipe 62 through which the gases are passed.

In the operation of the above described apparatus, the metal to be melted is supplied to the furnace 10 in any convenient manner and is suitably heated by said furnace while a chemically inert, non-absorbable atmosphere is maintained therein. The pressure is then reduced within the vacuum chamber 31 by applying suction to pipe 32 and a vacuum is produced in the chamber sufficient to raise the molten metal from the

bath 16 through the channel 36 into the chamber 31, partially filling the chamber. The metal is then discharged through the channel 41 into the casting apparatus (not shown).

- 5 The vacuum chamber 31 is maintained partially filled with metal, as for example, half full, and inactive, insoluble gases are admitted through the nozzle 60. The gas bubbles, breaking through the liquid metal, serve to increase the amount of surface of metal exposed to the vacuum and to agitate the metal so as to facilitate the escape of dissolved gases. The source of the vacuum may be sufficiently large so that the gases admitted through the nozzle 60 do not materially increase the gas pressure within the chamber 31. The sweeping action of the insoluble gas further improves the rate of elimination of the dissolved gas by more effectively removing the same from the vacuum chamber.
- 20 Referring to Figs. 2 and 3, the vacuum chamber and associated mechanism are similar to that above described. In this form of the invention, however, an agitating device comprising a plurality of radially extending blades 70, mounted upon a rotating shaft 71, is supported in a suitable manner, such as by housing 72, above the top of the vacuum chamber. Suitable means, such as a sheave 73, adapted to cooperate with a belt 74, may be provided for rotating the blades 70. A suction pipe 75 may be formed concentric with the shaft 71 and may operate as a support for said housing 72. It is obvious, however, that the mechanical construction may be varied as desired.
- 35 In this form of the invention, the blades 70 are rotated and are adapted to continuously agitate the metal within the chamber 31 so as to continuously change the surface of the metal and to expose various parts of the metal directly to the action of the vacuum within said chamber. The impeller is preferably formed of some non-metallic material having a low heat conductivity, such as graphite, lava, fire brick or the like. The shaft 71 may be cooled by suitable means, such as by circulating water or other cooling medium (not shown). It is obvious that the type of impeller may be varied. A preferred form has been shown for purposes of illustration only.

While certain specific terms have been used for convenience in describing the present invention, it is to be understood that the invention is not to be limited thereby. For example, the term "vacuum" has been employed in describing the chamber 31 and the operation of the apparatus.

55 It is to be understood, however, that the degree of vacuum may be varied as required in each particular instance without departing from the spirit of the invention. It is also to be understood that the furnace 16 and the associated apparatus may be operated at substantially atmospheric pressure and preferably in the presence of a non-oxidizing non-absorbable gas in a manner more fully described in the co-pending application above referred to.

65 Although certain preferred embodiments of the

invention have been shown for purposes of illustration, it is to be understood that the invention is not to be limited thereto but is only to be limited in accordance with the following claims when interpreted in view of the prior art.

What is claimed is:

1. The process of treating molten metals which comprises passing the molten metal through a vacuum chamber and bubbling a gas through the body of the metal in said chamber whereby the surface exposed to the action of the vacuum is increased and constantly changed through thorough agitation of the metal.
2. An apparatus for vacuum treating molten metals comprising a body forming a vacuum chamber, means for passing molten metals there-through, and means to agitate the metal therein comprising an impeller immersed in said metal.
3. An apparatus for vacuum treating molten metals comprising a body forming a vacuum chamber, means for passing molten metals there-through, and means to agitate the metal therein comprising an impeller formed of non-heat conducting material immersed in said metal.
4. In combination with a metal melting furnace, vacuum treating means comprising a body member interposed in said furnace and having a vacuum chamber, said chamber being mounted above the level of the metal in said furnace and connected thereto by means of a channel, the elevation of the chamber bearing a relation to the barometric height of the metal such that the metal from said bath is raised into said chamber by the vacuum within said chamber, and means associated with said chamber to agitate the metal for changing the surface exposed to the vacuum.
5. In combination with a metal melting furnace, vacuum treating means comprising a body member interposed in said furnace and having a vacuum chamber, said chamber being mounted above the level of the metal in said furnace and connected thereto by means of a channel, the elevation of the chamber bearing a relation to the barometric height of the metal such that the metal from said bath is raised into said chamber by the vacuum within said chamber, and an impeller mounted to engage the metal in said chamber to agitate the same and change the surface exposed to the vacuum.
6. In combination with a metal melting furnace, vacuum treating means comprising a body member interposed in said furnace and having a vacuum chamber, said chamber being mounted above the level of the metal in said furnace and connected thereto by means of a channel, the elevation of the chamber bearing a relation to the barometric height of the metal such that the metal from said bath is raised into said chamber by the vacuum within said chamber, and means to introduce gases below the surface of the metal to agitate the metal and assist in the removal of occluded gases therefrom.

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