Feb. 13, 1940. G. W. HAZEY 2,190,209

APPARATUS FOR ELIMINATING PIPE, ETC., IN METALS

Original Filed Dec. 7, 1934

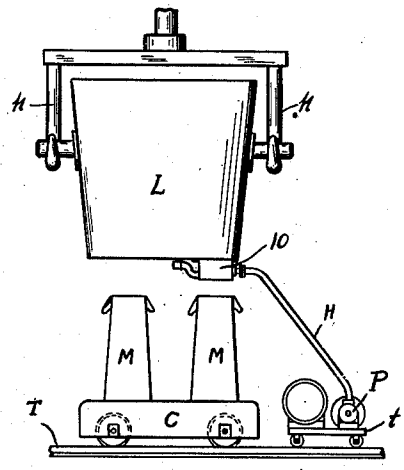

Fig. 1

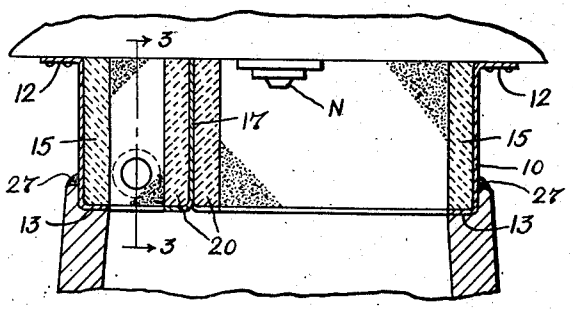

Fig. 2

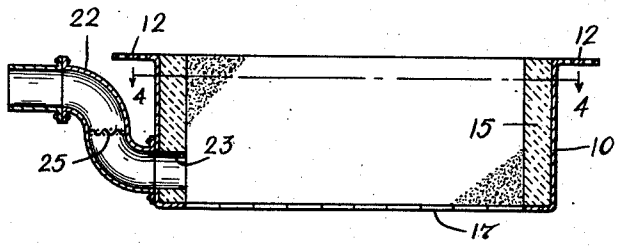

Fig. 3

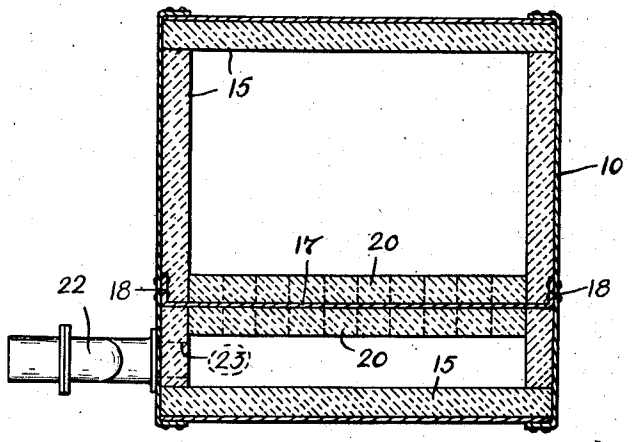

Fig. 4

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Patented Feb. 13, 1940 2,190,209

UNITED STATES PATENT OFFICE

2,190,209

APPARATUS FOR ELIMINATING PIPE, ETC., IN METALS

George W. Hazey, Cleveland, Ohio, assignor, by direct and mesne assignments, of twenty-five per cent to Richard C. Tuma, Los Angeles, Calif., six and two-thirds per cent to H. H. Handelman, Cleveland, Ohio, ten per cent to Edward Gadd, Leavittsburg, Ohio, and twenty-five per cent to Elias C. Tuma, Cleveland, Ohio

Original application December 7, 1934, Serial No. 756,496. Divided and this application April 1, 1938, Serial No. 199,388

1 Claim. (Cl. 22—73)

This invention is a division of my copending application Serial No. 756,496, filed December 7, 1934, and relates to the art of casting metal, and particularly to that phase of the art concerned with eliminating and avoiding imperfection in the articles cast. More particularly, my invention concerns the elimination of blow holes, fissures, pipe and other objectionable flaws frequently found in the cast metal when it has solidified. Although my invention may be used in casting ingots of various metals, a convenient example of its efficiency is illustrated by the example of steel poured into ingot molds in the casting of ingots which later are to be shaped in rolling mills.

It has been customary, when casting steel ingots, to transfer the molten metal from the furnace or converter to a large teeming ladle. This ladle was then transported to the pouring floor and the ingot molds successively filled. When the metal had cooled and the mold had been removed from thereabout, an examination of the ingots thus formed usually revealed several defects.

A pipe would have formed adjacent the vertical axis of the ingot, extending from the top downwardly, sometimes for about half the depth of the entire ingot. Oxidation of the exposed pipe surface prevented the metal from knitting properly into an integral piece when passed through the rolls of a mill. Hence, that portion of the ingot affected by the pipe had to be cut off and discarded,—a very wasteful loss of time and material, even though the discarded portion could be remelted.

The inclusion of gas and air bubbles in the ingot was also harmful because the gas so confined would react with the hot metal to form a thin film, for instance an oxide, about the surface of the metal exposed to the bubbles. This film of combined metal would also prevent the opposite portions of the ingot from knitting under the rolling action, and thus leave defects on the finished product.

It has, in general, been an object of my invention to eliminate the defects above mentioned from metal ingots. More specifically stated, it is an object of my invention to prevent the inclusion of objectionable gases and other foreign substances within the casting; it is also an object of my invention to eliminate shrinkage defects, known in ingot casting as "pipe."

It will be apparent from these objects that I contemplate employing apparatus comprising my invention in conjunction with metals other than steel, although it is with that metal that my invention is particularly concerned. My invention will become more apparent from the accompanying description and the drawing included therewith, the various salient features of the invention being set out in the claim.

In general, my invention comprises an apparatus to be used for removing as much of the gas confined within the empty ingot molds as possible. It is by the achievement of a partial vacuum within the molds, while the metal is being poured, and both before and after pouring, if desired, that I accomplish the objects above enumerated. The higher the degree of vacuum obtainable, the better will be the results, and the more perfect the final castings.

When my invention is incorporated in the process of casting steel ingots, I provide an apparatus carried by the teeming ladle, by means of which the desired vacuum within the mold is obtained. This apparatus comprises a box-shaped enclosure, carried on the bottom of the ladle and surrounding the pouring nozzle. At its lower end, the box, which I call a "vacuum box", is shaped to fit tightly around the edges of the upper end of an ingot mold. When the box is seated properly on top of the ingot mold, there will thus be provided a relatively air-tight chamber, comprising the interior of the vacuum box and the interior of the ingot mold. It is the chamber so formed from which I evacuate gas contained therein, and thus accomplish the objects of my invention.

Referring now to the drawing, Fig. 1 is an elevation, showing a teeming ladle with my vacuum box attached thereto, ready to be lowered against the top of my empty ingot; Fig. 2 is a transverse section through my vacuum box, showing the same secured to the ladle and resting on the top of an ingot mold; Fig. 3 is a transverse section through the construction of Fig. 2, as indicated by the line 3—3 on Fig. 2; Fig. 4 is a horizontal section through the modification of Fig. 3, as indicated by the line 4—4 on that figure.

The so-called "vacuum box" employed in the practice of my invention is preferably carried on the underside of the teeming ladle and surrounds the lower end of the nozzle used to pour the metal into the molds. This vacuum box as shown in Fig. 1 is fastened to the underside of a teeming ladle L, which in turn is suspended by a pair of hooks *h* from an overhead traveling crane. Lying beneath the travel of the

overhead crane is a track 1 adapted to carry a series of cars C forming a train of molds, two of which molds M may be carried by each car. When the pouring operation takes place, either the ladle L may be moved by the crane along the train of mold cars or the train itself may be moved underneath the ladle, permitting successive ingot molds to be poured.

The desired degree of vacuum may be obtained by means of a direct suction pump mechanism, by means of which the air is directly withdrawn from within the space to be evacuated. Such a pumping apparatus may be mounted on a suitable truck *t* adapted to be moved along the pouring floor with the ladle. On the truck *t* is carried a pump P preferably of the reciprocating type and which is driven by an electric motor. The hose H is used to transmit gas to the pump P by means of which direct evacuation of the ingot mold is produced.

A vacuum chamber is interposed between the teeming ladle and the ingot mold to permit the withdrawal of the air within the mold. This comprises a box 10 having outturned flanges 12 at the top and inturned flanges 13 at the bottom shaped to form a rectangular box open at each end. The outturned flanges 12 are riveted or otherwise securely fastened to the underside of a ladle L in a position to enable the box to surround the discharge nozzle N of the ladle.

A suitable firebrick lining 15 is provided for the box 10 and is supported on the inturned flanges 13 of the bottom of the box. As shown in Fig. 2, a partition 17 is formed, dividing the box into two sections, the ends of the partition terminating at flanges 18, which are riveted or otherwise securely fastened to adjacent faces of the sides of the box. The lower ends of the partition 17 are cut into segments of flange; alternate segments of which are bent horizontally on respective sides of the partition to support fire brick lining 20 on each side thereof.

It will be noted that the partition 17 is so disposed within the vacuum box that one chamber is considerably smaller than the other. The smaller of these chambers is provided with an exhaust pipe 22, securely fastened to the sides of the box and communicating with the interior through its opening 23 in the box and the firebrick. This pipe 22 extends outwardly horizontally and is provided with a screen 25 to bar the egress of solid particles from within the chamber to be evacuated.

The screen 25 is made removable to readily permit the cleaning of the pipe 22. At its free end, this pipe 22 is provided with a coupling of any well-known form to allow a suction hose H to be fastened thereto and yet be readily removable when desired. This hose H is fastened to the bayonet coupling of the pipe 22, which leads to a vacuum pump P used to produce the degree of vacuum desired within the ingot mold chamber. If desired, a baffle plate or similar construction may be interposed between the pipe 22 and the vacuum to prevent any solid matter from entering the pump chamber.

As heretofore mentioned, the effectual operation of my invention depends upon obtaining as nearly as practicable an air-tight seal between the various devices combining to form an enclosed chamber. Where the vacuum box is secured to the ladle in a permanent manner, this seal may readily be made airtight. If the siding forming the ingot mold is removable from the bottom, a seal here is readily effected as soon as the hot metal starts to accumulate in the bottom of the mold. In practice it has been found that by employing a rabbeted upper end in the ingot mold M as shown in Fig. 2, into which the vacuum box may closely fit, it has been possible to provide an effectual seal at this point. If, for any reason, it should be desired to form a complete seal for the entire chamber, this may be accomplished by packing the junction of the various parts, as, for instance, the junction of the vacuum box and the top of the ingot mold, with soft fire clay 27.

It is not necessary to make the vacuum box removable from the underside of the ladle, since the latter is never deposited directly on the ground, but rather is supported on a pair of trunnions, except during such period when various repairs are being made to it, at which time the vacuum box can be removed if desired.

In operation, my invention may be used to effect the evacuation of ingot molds at various times. Preferably I choose to begin the evacuation before any metal is poured into the mold and continue the evacuation for some time after the mold has been completely filled. This, however, is a matter of expediency and under certain conditions it might be found preferable to vary the evacuating action for a longer or shorter period of time, as best determined by the requirements of a particular case, and depending upon what sort of metal was cast with the aid of the apparatus and the method embodied in my invention.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the structure herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

In combination with a pouring ladle and a mold, a metal enclosure interposed therebetween to form with the mold a relatively air-tight chamber, a metal partition dividing said enclosure into two chambers, inturned flanges at the bottom of said enclosure and partition, a heat-resistant lining covering the interior of said enclosure and said partition and resting on said flanges, a fitting secured to said enclosure and leading to the interior of said smaller chamber and adapted to receive a hose connection by which gas is removed from the said chamber.

GEORGE W. HAZEY.