

[54] **PISTON-TYPE VALVE FOR MELTING FURNACES**

[76] Inventors: **John McCarthy**, 1522 Black Hawk Trl., Benton Harbor, Mich. 49022; **Keith Paul**, 1328 S. Manor Dr., St. Joseph, Mich. 49085

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[58] **Field of Search** 222/559; 137/324; 266/38

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Primary Examiner—Robert B. Reeves

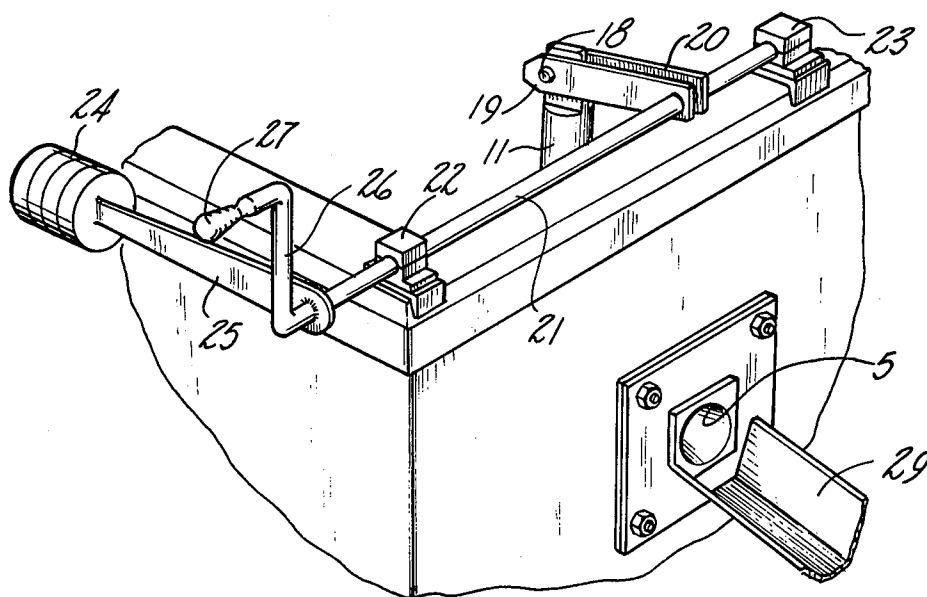
Assistant Examiner—David A. Scherbel

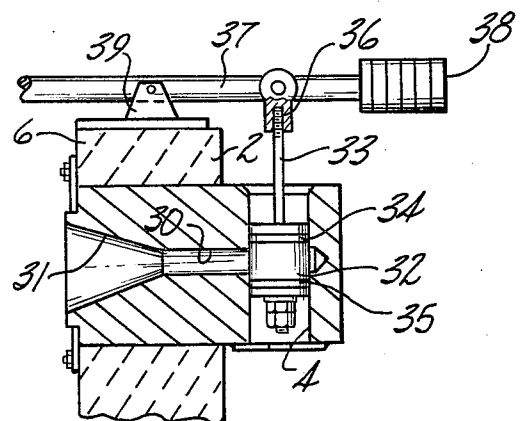
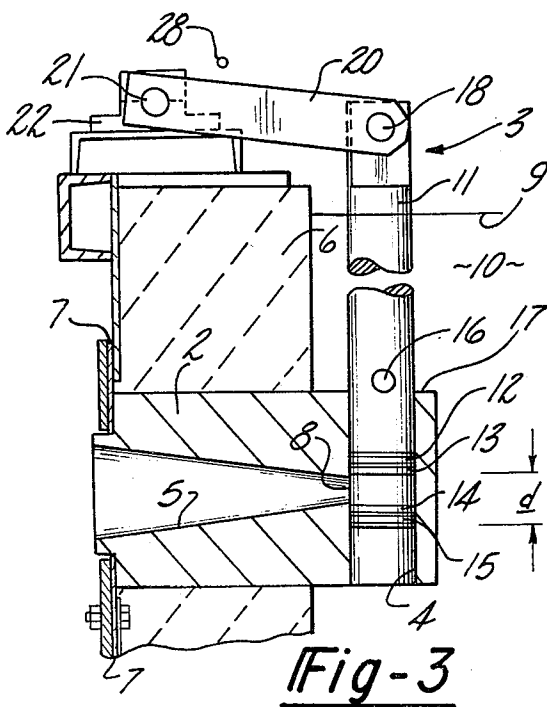
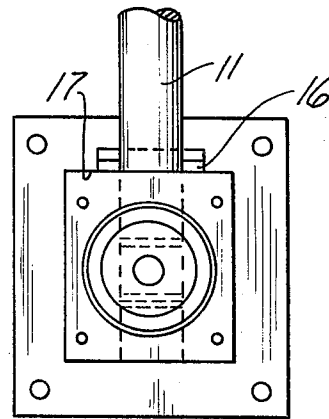
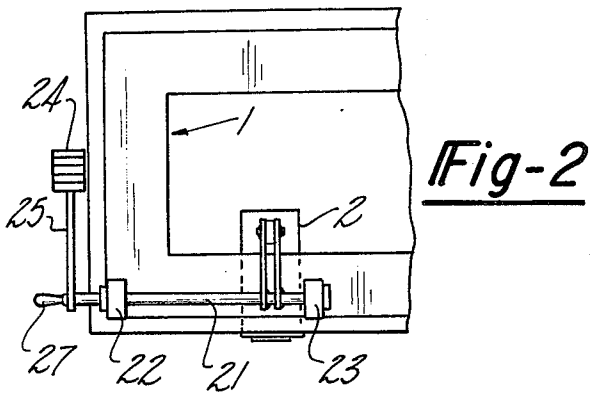
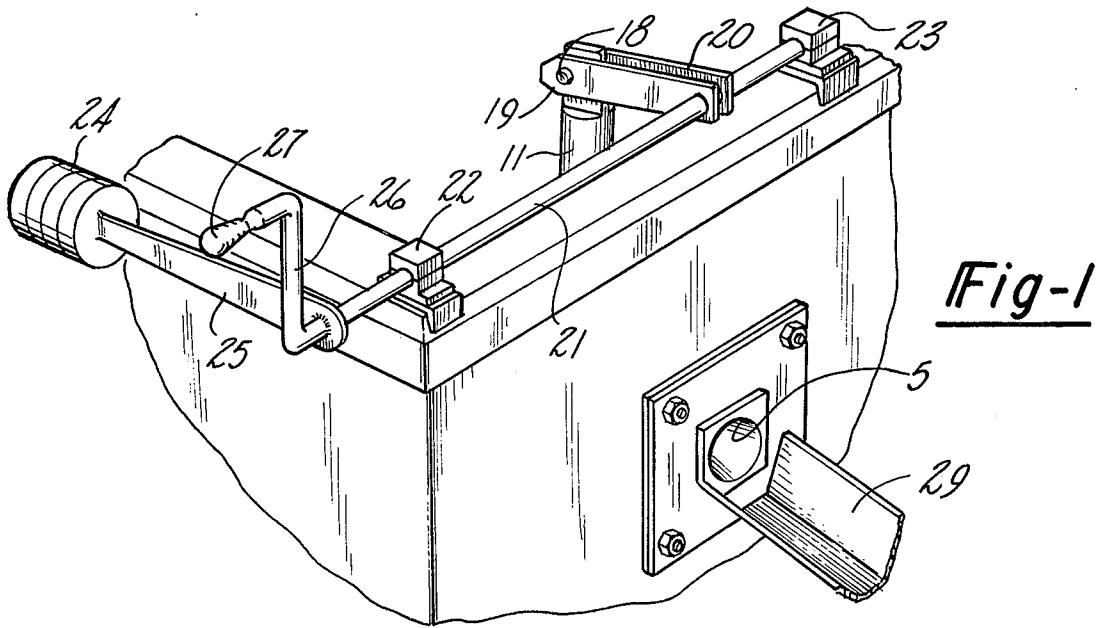
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[57] ABSTRACT

A method and mechanism for controlling the transfer and retention of flowable material, such as molten metal, from a melting furnace. A block having two passages is affixed in the furnace wall. The first vertically-oriented passage accommodates a movable piston mechanism. A second tapered passage communicates with its smaller end to the first passage, with its larger end to the exterior of the furnace. When the piston mechanism is raised, a flow path is opened for the molten metal to pass up through the first passage and then through the second passage for use at the exterior of the furnace, such as in a pouring spout. In the closed position, piston rings seal from above and below the common line of intersection between the first and second passages.

1 Claim, 5 Drawing Figures





PISTON-TYPE VALVE FOR MELTING FURNACES

The present invention relates to an apparatus and method for selectively controlling the transfer and retention of flowable material. In particular, the present invention relates to an apparatus and a method for tapping molten metal from a melting and/or holding furnace.

BACKGROUND OF THE INVENTION

Heretofore, many problems have been encountered in the retention and transfer of flowable materials from one place to another place. In particular, if the flowable material is a molten metal, many problems have been encountered in the feeding of the molten metal to a dip well or to a casting or an extruding machine. Once the molten metal is brought to its proper conditions in the furnace, a primary condition of which may be the temperature, it is essential to avoid delay in transferring the molten metal to a new location where desired. Inefficient methods and delays in transferring the molten metal may result in poor quality of production, and in the formation of excessive oxides. Furthermore, it is desirable to avoid delays in order to avoid the unwanted hardening or loss of the molten metal.

The present invention provides a relatively simple, efficient, and inexpensive apparatus and method for curing the prior art disadvantages set forth hereinabove.

SUMMARY OF THE INVENTION

The present invention provides an apparatus for selectively controlling the transfer and retention of flowable material, including first means for containing the flowable material, and second means connected to the first means for providing a flow path between the interior and the exterior of the first means for the flowable material. The apparatus also includes third means at least a portion of which is contiguous with the second means for selectively opening and blocking the flow path for the flowable material.

The present invention also provides a method of using the aforementioned apparatus for selectively controlling the transfer and retention of flowable material. The method comprising the step of placing a predetermined quantity of the flowable material within the first means. The method also includes the step of maintaining the third means in a predetermined position so that the flow path for the flowable material is blocked until predetermined conditions occur. The method also includes the step of operating the third means to selectively open the flow path for the flowable material within the second means so that the flowable material may pass unobstructed through the flow path within the second means from the interior of the first means to the exterior of the first means.

In a preferred embodiment of the present invention, the first means for containing the flowable material comprises a melting and/or holding furnace, and the flowable material comprises molten metal. The second means comprises a heat-treated steel block having the general shape of a rectangular parallelepiped, and being provided therein with first and second passages in communication with each other which form the flow path between the interior and the exterior of the furnace. The second means is disposed within a wall of the furnace at a position which is normally below the up-

permost level of the molten metal in the furnace so that when the third means has selectively opened the flow path, the molten metal may flow into the first passage and then pass into the second passage for transfer to the exterior of the furnace. The first passage is provided with a central longitudinal axis which is disposed substantially perpendicular to the central longitudinal axis of the second passage. The third means may include a piston mechanism which moves in response to an operator's lever in conjunction with a counterweight device. The piston mechanism is disposed, dimensioned and arranged to move within the first passage, and is provided with at least two piston rings which are spaced apart by a distance which is greater than the largest diameter of the common line of intersection between the first and second passages.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a perspective view of a furnace together with the apparatus for selectively controlling the transfer and retention of molten metal in accordance with a first embodiment of the present invention.

FIG. 2 depicts a top plan view of the embodiment illustrated in FIG. 1.

FIG. 3 illustrates an enlarged side elevational view, partly in section, of the inventive apparatus according to the embodiment shown in FIGS. 1 and 2.

FIG. 4 illustrates a front elevational view taken from the exit side of the second means of the embodiment shown in FIGS. 1-3.

FIG. 5 illustrates a view of a second embodiment according to the principles of the present invention.

DETAILED DESCRIPTION OF SOME EMBODIMENTS OF THE PRESENT INVENTION

The term "flowable material" as used herein is intended to connote any material which is capable of flowing, including solids, gases, liquids, and any combinations of the foregoing.

The term "first means" as used herein is intended to connote any means for containing or initially holding the flowable material. In the particular embodiments of the present invention which are described in detail hereinafter, the first means refers to a furnace, and the flowable material refers to a molten metal contained in the furnace.

The term "second means" as used herein is intended to connote any means which is connected to the first means for providing a flow path between the interior and the exterior of the first means for the flowable material. In the particular embodiments of the present invention which are described hereinbelow, the second means refers to a path block which is disposed within a wall of the furnace which holds the molten metal.

The term "third means" as used herein is intended to connote any means which has at least a portion thereof that is contiguous with the second means for selectively opening and/or blocking the flow path for the flowable material. In particular, the term third means as used in the particular embodiments of the invention described in detail hereinbelow refers to a combined piston mechanism, lever arrangement, and counterweight mechanism for selectively obstructing and opening the flowable path for the molten metal.

With reference to a first embodiment of the present invention as illustrated in FIGS. 1 through 4, there is shown a first means or furnace 1, a second means or tap

block 2, and a third means generally designated as 3. The tap block 2 may take the form of a special die steel block provided with a first passage 4 and a second passage 5. The tap block 2 is affixed within a furnace wall 6 and is provided with seals 7 to ensure intimate connection, to minimize heat loss, and to avoid any leakage. In practice, it has been found desirable to use H-13 heat-treated special die steel for the tap block 2.

The first passage 4 is in communication with the second passage 5 through a common line of intersection 8.

As shown best in FIG. 3, the first passage 4 may have a substantially constant diameter and a central longitudinal axis which is oriented substantially in a vertical direction.

The second passage 5 may be in the form of a tapered channel having its smallest cross-sectional diameter in the area of the common line of intersection 8, and having its largest diameter cross section at the exit end of the second passage 5 communicating with the exterior of the furnace 1.

It has been found desirable in connection with applications where the flowable material constitutes molten metal to maintain a ratio of the smaller diameter of the second passage 5 to the substantially constant diameter of the first passage 4 of approximately 1 to 2.

The tap block 2 may be positioned anywhere desired along the furnace wall 6, but it is preferred to position the tap block 2 substantially below the uppermost typical lever 9 (as shown in FIG. 3) of the molten metal 10 contained in the furnace 1.

As shown best in FIG. 3, the third means 3 includes a piston 11 which may, for example, be provided with a plurality of piston rings 12, 13, 14 and 15, respectively.

The piston 11 is shown in its lowermost position in FIGS. 3 and 4, in which position the flow path between passage 4 and passage 5 is blocked. A stop 16 is provided for the closed or lowermost position of the piston 11. The stop 16 may take the form of a press fit pin inserted through the piston 11 which may abut against the upper edge 17 of the tap block 2 when the piston is in its lowermost position.

A pin 18 pivotally connects the upper end of the piston 11 to a pair of crank arms 19 and 20, respectively. The other end of the pair of crank arms 19 and 20 is rigidly affixed to a shaft 21. The shaft 21 is rotatably mounted within a pair of blocks 22 and 23 which are rigidly affixed on top of the furnace wall 6.

A counterweight 24 is rigidly affixed to a counterweight arm 25, which in turn is rigidly affixed near one end of the shaft 21. The shaft 21 terminates in an operator's lever 26 which has an elongated longitudinal axis disposed substantially perpendicular to the elongated longitudinal axis of counterweight arm 25. The lever arm 26 terminates in a perpendicularly arranged operator's handle 27.

With reference to FIG. 3, it should be noted that the molten metal 10 enters the bottom portion of first passage 4 and exerts an upwardly directed force on the bottom surface of piston 11, tending to urge the piston 11 to rise. The force exerted by the molten metal 10 on the bottom surface of piston 11 is transmitted through the pin 18 and crank arms 19 and 20 to urge the shaft 21 to rotate counterclockwise as viewed in FIG. 3. With reference to FIGS. 1 and 2, it can be seen that the aforementioned force exerted on shaft 21 is counter-

acted or counterbalanced by way of the oppositely directed force exerted on shaft 21 by means of counterweight 24 and counterweight arm 25. FIG. 1 shows the counterweight arm 25 in a position wherein the counterweight 24 exerts its maximum downwardly directed force to counteract the upwardly directed force exerted on piston 11 by molten metal 10. In this position, the flow path between passage 4 and passage 5 is blocked and the piston 11 is in its lowermost condition.

In order to open the flow path completely between passages 4 and 5, the piston 11 must be raised by a distance d which is shown in FIG. 3 and which represents the maximum travel of the piston 11. To ensure that no excessive or unnecessary travel of the piston 11 occurs, a stop 28 is provided above the crank arms 19 and 20.

FIGS. 1 through 4 illustrate a first embodiment of the present invention shown in the position where the flow path between passages 4 and 5 is blocked or obstructed by the piston mechanism 3. To open this flow path completely, the operator would grasp the operator's handle 27 and rotate the shaft 21 clockwise as viewed in FIG. 1 until the crank arms 19 and 20 engage the stop 28 which is illustrated in FIG. 3. In this position, the piston 11 has travelled to its maximum upper position and has traversed the distance d which is indicated in FIG. 3. In this condition the flow path between passages 4 and 5 is completely unobstructed by the piston 11. This would permit the molten metal 10 to flow up through the opening in the bottom of passage 4, and then out through the common line of intersection 8 and then through the tapered passage 5 to the exterior of the furnace 1. FIG. 1 illustrates a trough 29, which may be welded to the exterior surface of the furnace 1, for directing the flow of the molten metal to, for example, a dip well or a ladle mechanism (not shown).

To again close the flow path between the passages 4 and 5, the operator would merely rotate the operator's handle 27 counterclockwise as viewed in FIG. 1 until the stop pin 16 abuts against the upper edge 17 of the tap block 2. In this position, the piston 11 is in its lowermost position and the flow path is completely blocked and properly sealed to prevent any leakage by the piston rings 12, 13, 14 and 15.

In a preferred operating embodiment which is illustrated in FIGS. 1-4, it has been found preferable to keep the ratio of the smaller diameter of the passage 5 to the substantially constant diameter of the passage 4 to be approximately 1 to 2. Some typical dimensions of the preferred operating embodiment would be: maximum piston travel (d) of $2\frac{1}{2}$ inches; the diameter of the passage 4 would be 3 inches; tapered passage 5 would have a 15° included angle; the smaller diameter of passage 5 would be $1\frac{3}{8}$ inches and the larger exit diameter would be $4\frac{3}{8}$ inches; stop 16 would comprise a 1-inch diameter press fit pin; the longitudinal axis of shaft 21 would be $3\frac{3}{8}$ inches above the top of the furnace 1; the top of the furnace would be approximately five feet above the floor; the steel tap block 2 would be 16 inches by 8 inches by 9 inches and may be heat treated H-13 special die steel.

FIG. 5 illustrates another embodiment of the present invention wherein similar parts are referenced by similar reference numerals to the above-described embodiment. In the FIG. 5 embodiment, the first passage 4 communicates with a constant diameter passage 30, which in turn communicates with a tapered passage 31 leading to the exterior of the furnace 1.

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The third means or piston mechanism 3 includes a piston 32 which is loosely fit for misalignment to a piston shaft 33. The piston 33 is provided with two piston rings 34 and 35.

The piston shaft 33 is connected to a loose link 36 for misalignment, and the loose link 36 is pivotally connected to a shaft 37 having a counterweight 38 affixed to one end thereof. A pivot block 39 which is rigidly affixed to the top of the furnace pivotally holds the shaft 37. In a preferred operating embodiment of the FIG. 5 arrangement, the passage 4 has a constant diameter of approximately 2 inches, and the passage 30 has a constant diameter of approximately 1 inch.

In all embodiments of the present invention, the shaft 21 or 37 is made long enough to protect all personnel from being burned or splashed with molten metal without the necessity of wearing shields or guards.

In the embodiment illustrated in FIG. 3, the piston 11 has a 3/1000 inch clearance.

The tap block may, of course, be placed anywhere along the vertical height of the furnace wall 6. For example, in the embodiment illustrated in FIGS. 1 through 4, the bottom surface of the steel block 2 has been placed approximately three feet above the floor.

While certain forms and arrangements of the elements employed in the present invention are disclosed herein, it will be understood that these are illustrative only and that various changes may be made therein without departing from the invention as defined by the appended claims.

We claim:

1. An apparatus for selectively controlling the transfer and retention of flowable material, comprising, in combination:

first means for containing said flowable material;
second means connected to said first means for pro-

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viding a flow path between the interior and the exterior of said first means for said flowable material; third means, at least a portion of which is contiguous with said second means for selectively opening and blocking said flow path for said flowable material; and wherein:

said first means for containing said flowable material comprises a furnace;

said flowable material comprises molten metal;

said second means comprises a heat treated steel block having the general shape of a rectangular parallelepiped, and being provided therein with first and second passages in communication with each other which form said flow path between the interior and the exterior of said furnace;

said second means being disposed within a wall of said furnace at a position which is normally below the uppermost level of the molten metal in said furnace so that when said third means have selectively opened said flow path, said molten metal may flow into said first passage and then pass into said second passage for transfer to the exterior of said furnace;

said first passage having a central longitudinal axis which is disposed substantially perpendicular to the central longitudinal axis of said second passage;

said third means includes a piston mechanism which moves in response to an operator's lever in conjunction with a counter-weight device;

said piston mechanism being disposed, dimensioned and arranged to move within said first passage, and being provided with at least two piston rings which are spaced apart by a distance which is greater than the largest diameter of the common line of intersection between said first and second passages.

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