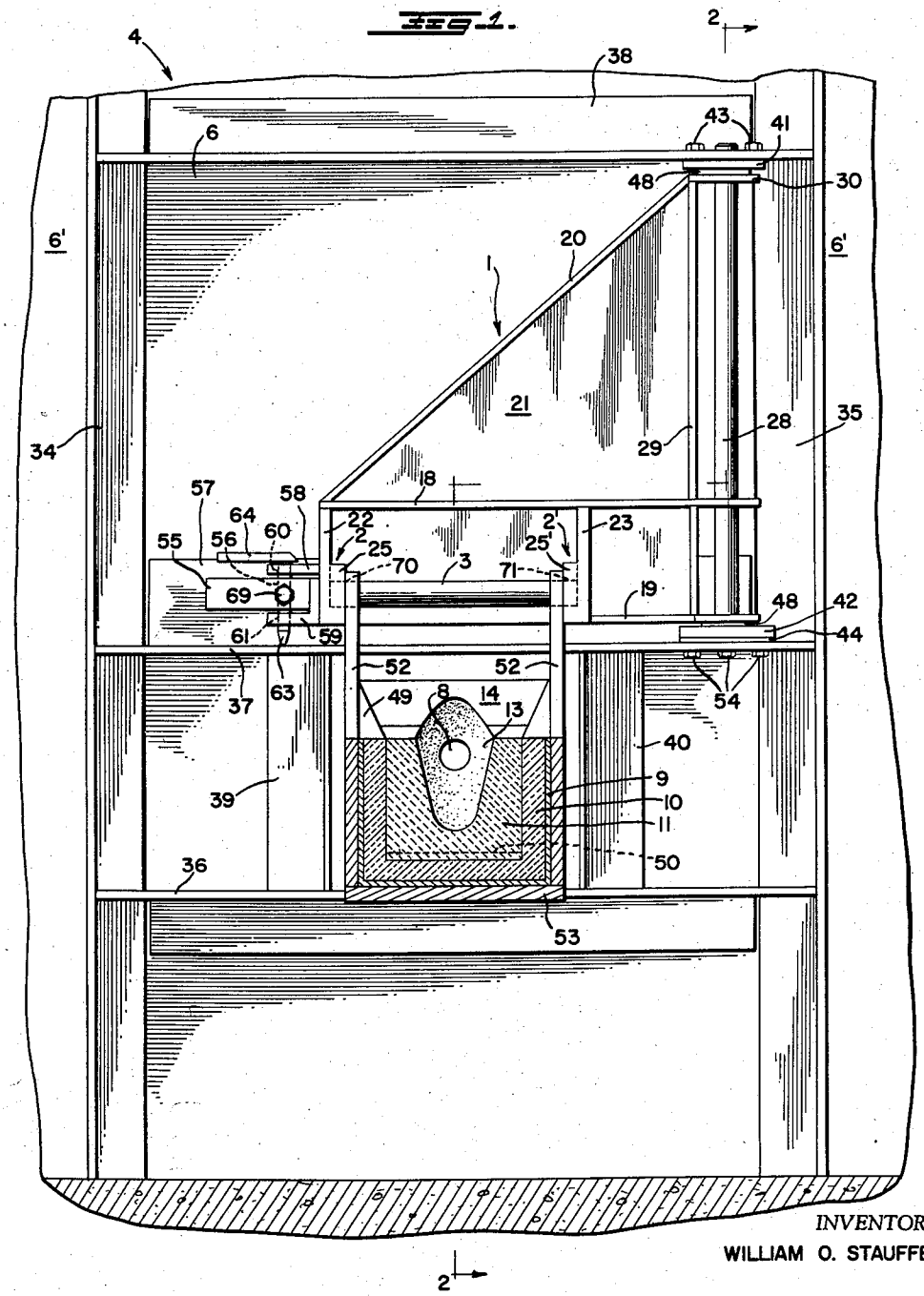
April 7, 1959 W. O. STAUFFER 2,880,989

APPARATUS FOR DISCHARGING MOLTEN METAL

Filed Nov. 13, 1956 2 Sheets-Sheet 1

FIG. 1.



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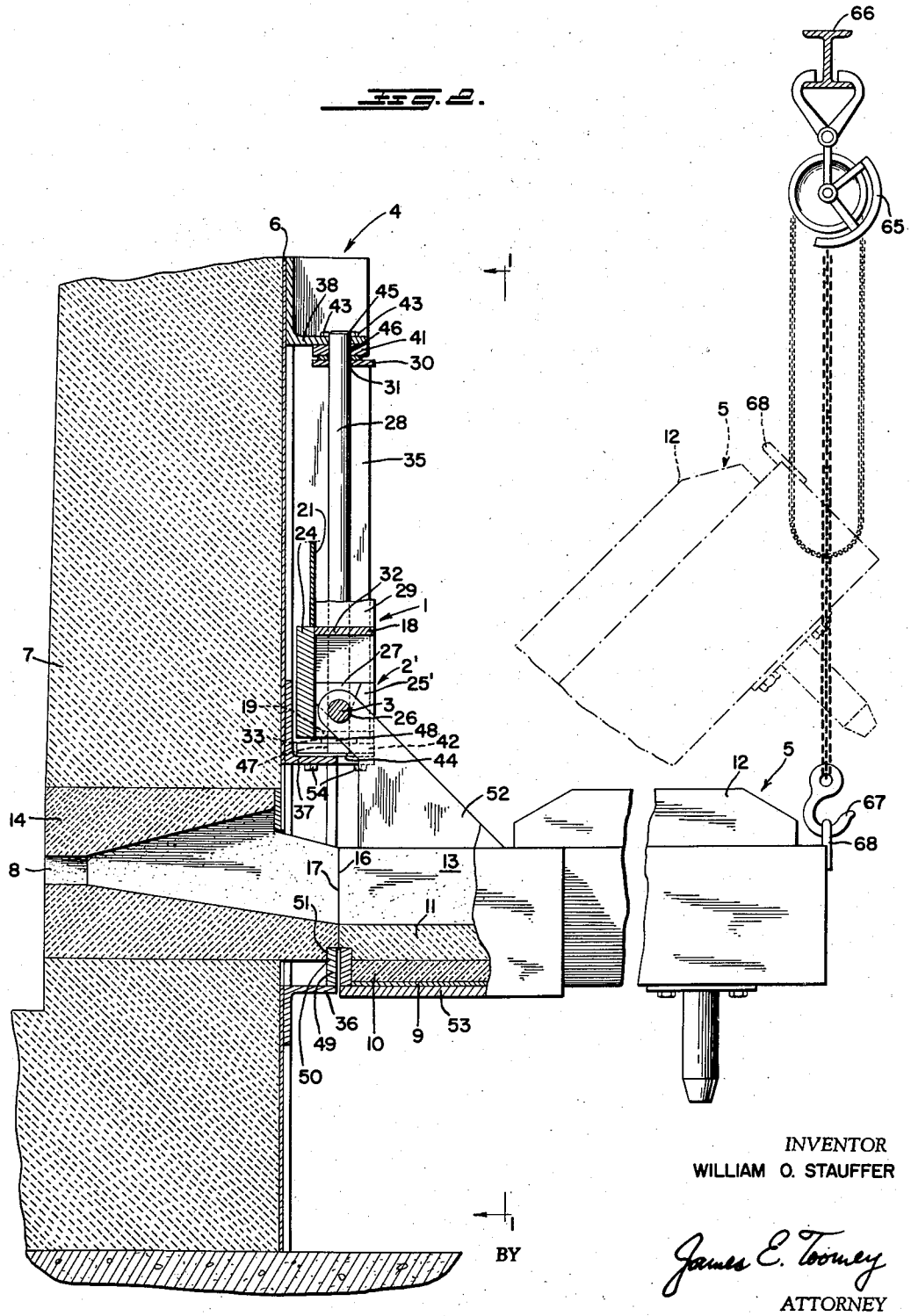
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APPARATUS FOR DISCHARGING MOLTEN METAL

Filed Nov. 13, 1956 2 Sheets-Sheet 2

FIG. 2.



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2,880,989

APPARATUS FOR DISCHARGING MOLTEN METAL

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3 Claims. (Cl. 266—38)

This invention relates to the handling of molten metal prior to the casting thereof. More particularly this invention relates to an apparatus for connecting a molten metal transfer trough directly to a source of molten metal, e.g. furnace or other molten metal receptacle which apparatus is effective to facilitate both vertical and horizontal movement of the transfer trough.

In the casting of metals, e.g. aluminum and aluminum alloys, it is common practice to provide a body of molten metal in a suitable holding receptacle, e.g. oil, gas, coal or coke, fired open hearth or reverberatory furnace, electrical resistance heated furnace or induction heated furnace. The molten metal is generally fluxed in the holding receptacle and then transferred from the holding receptacle to the casting station. In general, casting operations of the type dealt with in this invention necessitate the transfer of the molten metal from the furnace to the casting station by means of a transfer trough. The reason for this lies not only in the obvious operational difficulties encountered in attempting to place the casting station closely adjacent the furnace tap hole but also in the desirability of placing the casting station such that it can be supplied with molten metal from a plurality of furnaces. Accordingly, a long transfer trough is generally employed to transfer the molten metal from the furnace to the casting station.

According to prior art practice molten metal is poured from the furnace or receptacle into the trough. This generally necessitates the flow of the molten metal through the air which results in absorption of gas into the molten metal. The fall of the metal from the furnace or receptacle to the trough results in a splashing of the metal which causes a breaking of the protective oxide film on the metal and absorption of hydrogen into the melt from the moisture in the air. This fall of the metal and splashing also tends to increase the amount of dross and non-metallic films which may find their way into the ultimate casting. It has been discovered that a large part of the reabsorption of gas and the inclusion of non-metallic impurities during transfer of the molten metal from the furnace or receptacle to the casting station could be eliminated by preventing the metal from falling freely through the air into the transfer trough.

One prior art means for minimizing such free fall called for underpouring the metal into the transfer trough. According to this practice the metal passes from the furnace or receptacle through a suitable means such as a short transfer trough and an underpour outlet into a long transfer trough which transfers the metal to the casting station. While this method prevents some absorption of gas and formation of oxides due to fall of the metal through air and splashing, it does not completely eliminate such absorption or oxide formation. As the metal begins to pour into the transfer trough through the underpour outlet the metal of necessity must fall through the air until the liquid in the transfer trough is raised to a level sufficiently high to cover the lower end of the underpour outlet. During this period, there is a tendency for entrapment of gas and moisture in the molten metal resulting in porosity in the ultimate casting. In addition the falling and splashing of the molten metal results in the formation of oxide particles which become inclusions in the castings. Further, even after the level of the molten metal in the transfer trough rises sufficiently high to cover the lower end of the underpour outlet, there is considerable stirring action in the vicinity of the outlet which tends to stir in the dross and impurities which normally float on the surface of the molten metal, and the heavy impurities which normally lie on the bottom of the trough or container.

In order to overcome these disadvantages and to promote quiet flow of molten metal from the furnace into the trough, level pouring the molten metal from the holding receptacle to the transfer trough may be employed. According to prior art practice level pour troughs are directly connected to a furnace outlet by the use of bolts and nuts, cam and lever systems etc. For example, swing away bolts and nuts may be fastened to the furnace and engage the trough through slots in a suitable mating flange on the trough.

Such practice possesses certain inherent disadvantages with regard to movement of the trough. Raising and lowering of the outlet end of the trough places undue strain on the furnace wall and generally causes binding of the bolts when it is necessary to remove the trough after a cast or casting mishap. In addition movement of the trough necessitates loosening bolts on both sides of the trough, consequently requiring two men in order to break the joint in a reasonable time. When employing the short trough, long trough underpour system casting personnel may raise the outlet end of the pouring trough in the event of spill out or other emergencies. This cannot be done with the trough bolted to the furnace. In addition the bolted trough cannot be rapidly moved to one side out of the way, but on the contrary must be unbolted before movement requiring considerable time.

These inherent disadvantages have generally favored the use of the combination of a short transfer and a long transfer trough employing underpouring from the short trough to the long trough in preference to level pouring. The use of the short trough long trough technique has given rise to production losses, particularly in the production of high quality ingot for aircraft purposes wherein porosity and inclusions must be kept to a minimum.

Accordingly, the primary purpose and object of this invention is to provide an improved means for transferring molten metal from a source of molten metal such as a furnace or other receptacle to a transfer trough which eliminates or substantially reduces many of the disadvantages of the prior art techniques.

Another object of this invention is to provide a novel means for eliminating or substantially reducing defects such as porosity or inclusions in cast bodies.

Another object of this invention is to provide a novel apparatus for connecting a pouring trough with a source of molten metal such as a furnace or other receptacle whereby free fall of metal through the air into the transfer trough is prevented.

Another object of this invention is to provide a novel apparatus for connecting a pouring trough with a source of molten metal such as a furnace or other receptacle whereby quiet flow of metal into the transfer trough is promoted and movement of the trough in a vertical and horizontal direction facilitated.

It is a still further object of this invention to provide in a system for handling molten aluminum and aluminum alloys including a source of molten metal such as a fur-

nace or other receptacle and a transfer trough an apparatus for connecting the trough to the furnace, whereby defects such as porosity and inclusions are eliminated or substantially reduced from cast bodies of such metal and movement of the trough in the vertical and horizontal direction facilitated.

A further object of this invention is to provide an apparatus for fastening a molten metal transfer trough directly to a furnace outlet whereby movement of the trough in both a vertical and horizontal direction is facilitated.

Other objects and advantages of this invention will be apparent from the following description thereof in conjunction with the accompanying drawings.

In accordance with this invention a molten metal transfer trough is fastened to a molten metal holding receptacle such as a furnace by means of a swinging door or gate pivotally mounted on the furnace. The door or gate is provided with an adjustable vertical hinge and an adjustable latch means to obtain alignment. The door is also provided with a suitable horizontal pivot means comprising a pair of half bearings above the furnace outlet when the gate is in pouring position. These half bearings are used to support the inlet end of the level pouring trough, which is provided with a horizontal hinge pin positioned above the trough which rides in the door bearing halves. When the door is in the latched position the trough outlet end can be lowered through rotation about the horizontal hinge pin. The weight of the trough acting about the horizontal hinge pin provides sealing pressure on the door latch and vertical hinge and provides a horizontal thrust component for seating the trough against the furnace outlet. At the end of the cast or in the event of spill out, the normal reaction of the personnel conducting the casting operation is to lift the outlet end of the trough. By means of this invention, the trough can be so raised pivoting about the horizontal hinge pin. Raising the end of the trough also releases the latch tension whereby the latch can be easily removed by one man. In the alternative a suitable automatic latch may be employed whereby a man is not required to remove the latch. By removing the latch, the trough can also be swung horizontally pivoting about the vertical hinge. Besides releasing the latch tension, raising the end of the trough causes the connection between the trough and outlet to be opened to allow both trough and tapping block drainage into a pan below the joint. With drainage complete and the latch pin removed, the trough is free to swing (supported by the door or gate) about the vertical gate hinge away from the casting station. The trough can easily be removed from the door or gate when desired by lifting the trough up and out of the half bearings mounted on the gate which are open at the top for this purpose. In order to begin use of the trough the raised trough is swung into position, the door or gate latched and the trough lowered to pouring level closing the joint between the tapping block and the trough inlet.

For purposes of more satisfactory illustration, this invention will be specifically described with reference to the following drawings wherein identical parts are identified by identical numerals in the various views. In the drawings:

Figure 1 is a fragmentary elevational view with parts removed for purposes of clarity of the pouring trough, furnace and the connecting means of this invention taken along the line 1—1 of Figure 2 showing the pouring trough in cross section.

Figure 2 is a fragmentary side view partly in cross section with parts removed for purposes of clarity, of the pouring trough, furnace, and the connecting means of this invention taken along the line 2—2 of Figure 1.

Referring now more particularly to the drawing in which the same reference numerals have been applied to corresponding parts, the present invention involves the use of a swinging gate 1, half bearings 2 and 2' mounted on said swinging gate 1 and detachable horizontal pivot means.

In general, casting operations of the type dealt with in this invention necessitate the transfer of molten metal from a source thereof, such as a furnace 4 to a casting station (not shown) by use of an elongated transfer trough 5 for conveying the molten metal from the furnace 4 to the casting station. The furnace 4 generally comprises a shell fabricated from a suitable material such as steel, and made up of a series of panels 6 and 6' suitably joined together, panel 6 being contiguous to the furnace outlet. The furnace walls 7 are generally formed from a suitable refractory material which contacts the furnace shell panels 6 and 6'. In order to provide an outlet for furnace 4 a suitable tapping block 14 having an opening 8 defined therein may be provided in one wall 7 of furnace 4. Opening 8 is suitably designed to permit stopping flow of molten metal by suitable means such as dough-balling. The transfer trough 5 generally comprises an outer shell 9 fabricated from a suitable material such as steel which shell may be lined with a suitable insulating material 10 and a refractory material 11 defining a cavity 13 therein. For best operation of a transfer system, a suitable cover 12 may be provided over transfer trough 5. In order to permit level pour of molten metal from furnace 4 into trough 5 without leakage or spillage, the cavity 13 must register with the outlet or opening 8 in the tapping block 14. In order to seal the joint between the tapping block 14 and the refractory material 11 of the trough 5 it may be desirable to employ a suitable gasketing material between the abutting end surfaces 16 and 17 of the transfer trough 5 and the tapping block 14.

The trough mounting means embodying the principles of this invention comprises a swinging gate 1 mounted on panel 6 to one side of tapping block 14 by vertical pivotal mounting means which may comprise a pair of parallel horizontal members 18 and 19, a diagonal member 20, a vertical member 29 and a web of sheet or plate 21. These members are assembled by suitable means such as welding. At one extremity of the horizontal members 18 and 19 a suitable heavy vertical member 22 is affixed by suitable means such as welding. A second heavy vertical member 23 is similarly affixed between the horizontal members 18 and 19 and is spaced a distance from vertical member 22 greater than the width of trough 5. A third heavy member 24 may be suitably affixed between members 18 and 19 as shown in Figure 2. On the inside faces of heavy vertical members 22 and 23 suitable half bearings 2 and 2' are affixed by suitable means such as welding. Half bearings 2 and 2' generally comprise a block of metal 25 and 25' characterized by an open segment 27 in the upper corner portion of each block having a semi-circular portion 26 at the bottom thereof. Swinging gate 1 is pivotally fastened to the furnace panel 6 by suitable pivot means including a hinge pin 28.

In order to describe the connection of swinging gate 1 to furnace panel 6 a brief description of furnace panel 6 is required. Furnace panel 6 generally comprises a pair of vertical structural members 34 and 35 spaced each from the other and joined together by three horizontal structural members 36, 37 and 38. On either side of tapping block 14 are provided a pair of short vertical members 39 and 40. At the right hand end portions of horizontal members 37 and 38 are provided a pair of plates 41 and 42. Plate 41 is mounted on the underside of horizontal member 38 by means of bolts 43 passing through oversize openings in member 38, while plate 42 is suitably mounted on a bearing plate 44, plate 42 and bearing plate 44 being mounted on the upper surface of horizontal member 37 by means of bolts 54 passing through oversize openings in member 37. Since the openings in members 37 and 38 through which bolts 54 and 43 pass are oversize, e.g. larger than the diameter of bolts 54 and 43, adjustment of the position of swinging

gate 1 relative to furnace 4 is made possible. In order to mount swinging gate 1, pin 28 is passed through a suitable round opening 45 in horizontal member 38 and aligned round opening 46 in plate 41. Swinging gate 1 has a short horizontal member 30 joined to gate 1 at the point of intersection of diagonal member 20 and vertical member 29 extending to the right of vertical member 29 in Figure 1. Horizontal members 18 and 19 also extend to the right of vertical member 29 a distance equal to the length of short horizontal member 30. Round openings 31, 32 and 33 are provided in horizontal members 30, 18 and 19 respectively in alignment with each other to permit passage of hinge pin 28 therethrough. After passing through holes 31, 32 and 33 in horizontal members 30, 18 and 19, pin 28 passes into a round opening 47 in plate 42 and rests on bearing plate 44. In order to permit easy movement of swinging gate 1, washers 48 are employed between horizontal member 19 and the top surface of plate 42 and between the plate 41 and the top surface of member 30.

In order to make possible good contact between the end surfaces 16 and 17 of the trough 5 and tapping block 14, the tapping block is extended a short distance through panel 6 as shown in Figure 2. This extension of tapping block 14 is supported by a U-shape plate 49 which is suitably joined to horizontal member 36 and vertical members 39 and 40 by suitable means such as welding. The lower portion 50 of plate 49 matches a recess 51 in the end of tapping block 14.

In order to pivotally support the inlet end of transfer trough 5 at a point above the trough, heavy side plates 52 are fastened to the sides of trough 5 at the inlet end by suitable means such as welding. Side plates 52 have a configuration as shown in Figure 2 which is suitable for the purpose of pivotally supporting the trough at a point above the trough. To provide extra support and strength at the inlet end of the trough 5, a heavy horizontal plate 53 is affixed to the bottom thereof. Pivotal mounting of trough 5 in half bearings 2 and 2′ is accomplished by horizontal pin 3 which is passed through suitable round openings 70 and 71 in the upper extremities of side plates 52 and extends a short distance on either side of plates 52 to permit support within half bearings 2 and 2′. Horizontal pin 3 has a diameter to permit insertion in half bearings 2 and 2′, e.g. substantially the same or slightly smaller than the diameter of semi-circular portion 26 in half bearings 2 and 2′. In order to install the trough at the outlet, it is merely necessary to place the ends of horizontal pin 3 into semi-circular portions 26 of half bearings 2 and 2′ which may easily be done by downward passage at the end of horizontal pin 3 through the open segments 27 thereof. With the trough pivotally mounted in half bearings 2 and 2′ the action of gravity on trough 5 forces the end surfaces 16 and 17 of the trough and tapping block together to make a tight joint for level pouring of molten metal. In order to avoid excessive pressure between the end surfaces 16 and 17, a suitable adjustable leg (not shown) is mounted on the outlet end of trough 5.

In order to maintain the swinging gate 1 in position when the force of gravity is forcing the end surfaces 16 and 17 together a suitable latch means is provided at the end of swinging gate 1 furthest removed from the hinge pin 28. This latch may comprise a suitable short horizontal member 55 having a vertical round opening 56 passing therethrough. Member 55 may comprise a small piece of heavy plate affixed to a heavy plate 57 by suitable means such as welding, plate 57 in turn being affixed to horizontal member 37 by suitable means such as welding. To complete the latch two horizontal members 58 and 59 are affixed to the extremity of swinging gate 1 furthest removed from the hinge pin 28 in such a position that they extend over each face of member 55 when the gate is in position for pouring. Suitable openings 60 and 61 respectively are provided in members 58 and 59

which openings may be smaller than, but aligned with the opening 56 in member 55 when gate 1 is in pouring position. To latch the gate in suitable position, a suitable pin 63 having a diameter slightly less than openings 60 and 61 and appreciably less than opening 56 may be passed through said openings. To facilitate removal and placing of said pin in said openings, a suitable handle 64 is provided thereon.

When the door is in the latched position with pin 63 inserted through openings 60, 56 and 61, the trough outlet end can be lowered by pivoting about horizontal pin 3 and half bearings 2 and 2′, the weight of the trough acting about the horizontal hinge pin 3 providing sealing pressure through the latch means and the vertical hinge pin 28.

In order to adjust the closeness of swinging gate 1 with respect to tapping block 14, a suitable bolt member 69 may be passed through in engagement with a threaded opening in the side of member 55. This threaded opening is in open communication with opening 56 in member 55 whereby bolt member 69 may be threaded into contact with pin 63. The pressure between end surfaces 16 and 17 resulting from the force of gravity on trough 5 maintains pin 63 in contact with the end of bolt member 69 when the end of bolt member 69 is threaded into opening 56. Since opening 56 is larger than the diameter of pin 63, pin 63 and consequently the latch end of gate 1, may be moved toward or away from tapping block 14 by adjustment of the position of bolt member 69.

Upon completion of a cast or in the event of spill out, the normal operation is to raise the end of the trough to a position such as that shown in phantom in Figure 2. This is generally accomplished by use of suitable means such as a chain hoist 65 suspended from a suitable overhead structural member 66. The lower extremity of chain hoist 65 will generally be provided with a suitable hook means 67 which may engage a handle 68 affixed to the outlet end of trough 5 by suitable means such as welding. Once the end of the trough is raised, the pressure between surfaces 16 and 17 is released relieving the pressure on pin 63 permitting easy removal thereof. Upon removal of pin 63, the entire swinging gate 1 and transfer trough 5 may be moved out of the way of the casting station by pivoting about pin 28.

To begin a new casting operation, it is merely necessary to pivot gate 1 and trough 5 about pin 28 into casting position. Pin 63 may then be inserted through openings 60, 56 and 61 to maintain swinging gate 1 in position for pouring. The outlet of trough 5 may then be lowered to permit contact between end surfaces 16 and 17 which may be sealed by gravity when the trough is ready for pouring.

While this invention has been shown and described in connection with one specific embodiment thereof, it will be apparent to one skilled in the art that the invention is by no means limited thereto, but that many modifications may be made without departing from the scope thereof. By way of example, the swinging gate 1 rather than being mounted above the trough 5 and tapping block 14 could be mounted principally below the transfer trough with structural members extending above the trough to support the half bearings 2 and 2′ for pivotally mounting the trough at a point above the trough 5 and tapping block 14. The hinge 28 would then be in a lower position than as shown in the drawings.

What is claimed is:

1. An apparatus for fastening a molten metal transfer trough to the outlet of a molten metal holding receptacle characterized by ease of movement of the trough in both a vertical and horizontal direction comprising a swinging gate having vertical pivotal mounting means comprising a hinge pin, a pair of small plates and a bearing plate mounted on the framework of said receptacle, said small plates having round openings therein of a slightly larger diameter than said pin to permit passage of said pin, said

bearing plate being placed in contact with the undersurface of the lower of said small plates to provide a bearing surface for the lower end of said pin, said small plates and bearing plate being adjustably mounted on said holding receptacle framework by bolt means and oversize openings, said swinging gate having extensions along one side thereof with round openings of a diameter slightly larger than the diameter of said hinge pin, said openings being aligned with each other, said pin passing through the opening in the upper small plate, the openings in said extensions and the lower small plate, the lower end of said pin resting on said bearing plate thereby forming a vertical hinge for mounting said swinging gate on said holding receptacle, a suitable latch means comprising a short horizontal member fastened to the framework of said receptacle having a vertical round opening passing therethrough, a pair of horizontal members affixed to the side of said swinging gate opposite the vertical hinge side of said gate which overlap the upper and lower sides of said short horizontal member when said swinging gate is in pouring position against said receptacle wall, and pin means passing through openings in said pair of horizontal members and said short horizontal member thereby maintaining said swinging gate means in position, said pin means having a diameter less than the diameter of said holes in said short horizontal member and said pair of horizontal members, a bolt member threadedly engaged in the side of said short horizontal member passing into the opening in said member whereby the closeness of said gate member with respect to said outlet of said receptacle may be adjusted, and horizontal pivot means mounted in said gate means to pivotally support one end portion of said transfer trough.

2. The apparatus of claim 1 wherein said horizontal pivot means comprises a pair of half bearings mounted on said gate means in a position above and on either side of said outlet, a pair of side plates mounted on either side of the inlet end of said transfer trough extending to a position above said trough, each plate having a round opening in the upper end thereof said openings being aligned with each other and a pin of sufficient length to extend a short distance to either side of said plates passing through said openings, said pin having a diameter to permit insertion in said half bearings.

3. In a system for handling molten metal comprising a holding receptacle for molten metal including refractory walls, a metal shell, a tapping block defining an outlet for passage of molten metal therethrough mounted in said walls and extending a short distance through said shell, and a transfer trough having a refractory lining defining a cavity through which said molten metal passes, the improvement for fastening said trough directly to said outlet to permit level flow of molten metal from said receptacle into said transfer trough whereby movement of the trough in both a vertical and horizontal direction is facilitated comprising a swinging gate having vertical pivotal mounting means comprising a hinge pin, a pair of small plates and a bearing plate mounted on the framework of said receptacle, said small plates having round openings therein of a slightly larger diameter than said pin to permit passage of said pin, said bearing plate being

placed in contact with the under surface of the lower of said small plates to provide a bearing surface for the lower end of said pin, said small plates and bearing plate being adjustably mounted on said holding receptacle framework by bolt means and oversize openings, said swinging gate having extensions along one side thereof with round openings of a diameter slightly larger than the diameter of said hinge pin, said openings being aligned with each other, said pin passing through the opening in the upper small plate, the openings in said extensions and the lower small plate, the lower end of said pin resting on said bearing plate thereby forming a vertical hinge for mounting said swinging gate on said holding receptacle, a suitable latch means comprising a short horizontal member fastened to the framework of said receptacle having a vertical round opening passing therethrough, a pair of horizontal members affixed to the side of said swinging gate opposite the vertical hinge side of said gate which overlap the upper and lower sides of said short horizontal member when said swinging gate is in pouring position against said receptacle wall, and pin means passing through openings in said pair of horizontal members and said short horizontal member thereby maintaining said swinging gate means in position, said pin means having a diameter less than the diameter of said holes in said horizontal member and said pair of horizontal members, a bolt member threadedly engaged in the side of said short horizontal member passing into the opening in said member whereby the closeness of said gate member with respect to said outlet of said receptacle may be adjusted, and horizontal pivot means mounted on said gate means to pivotally support one end portion of said transfer trough, comprising a pair of half bearings mounted on said gate means in a position above and on either side of said tapping block, the upper portion thereof being open, a pair of side plates mounted on either side of the inlet end of said transfer trough extending to a position above said trough and each plate having a round opening defined in the upper end thereof, said opening being aligned with each other, a pin of sufficient length to extend a short distance to either side of said plates passing through said openings said pin having a diameter to permit insertion in said half bearings thereby pivotally supporting the inlet end of said trough in said half bearings.

References Cited in the file of this patent

UNITED STATES PATENTS

603,330	Hartman	May 3, 1898
1,154,281	Bates	Sept. 21, 1915
1,209,326	Nye	Dec. 19, 1916
1,265,602	Brosius	May 7, 1918
1,332,298	Kennedy	Mar. 2, 1920
2,252,760	Duclos	Aug. 19, 1941
2,676,011	Loftus et al.	Apr. 20, 1954

FOREIGN PATENTS

19,616	Great Britain	Sept. 3, 1906
91,619	Austria	Mar. 10, 1923
864,325	Germany	Jan. 22, 1953