

March 27, 1945.

C. E. LOGAN ET AL

2,372,628

METAL POURING DEVICE

Filed Feb. 16, 1944

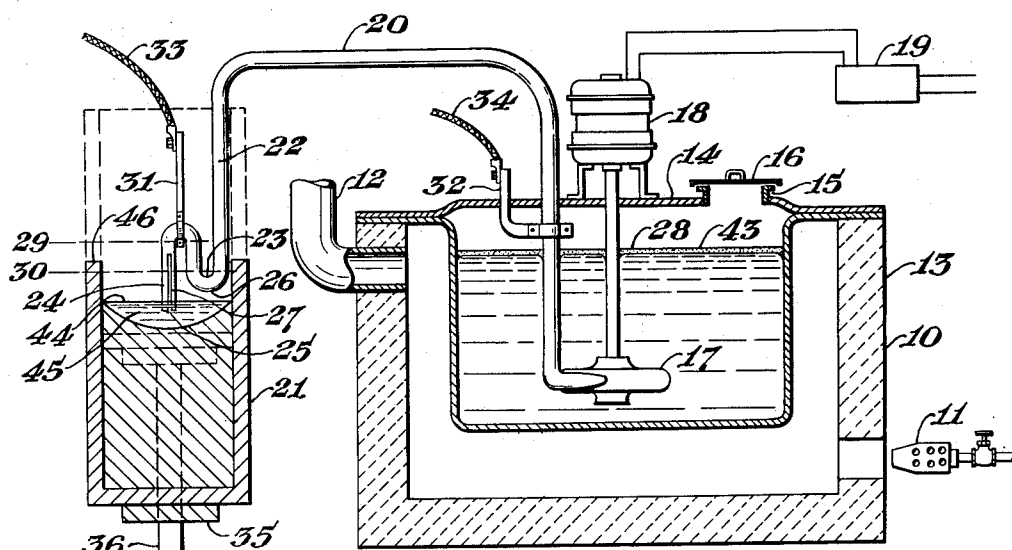


Fig. 1

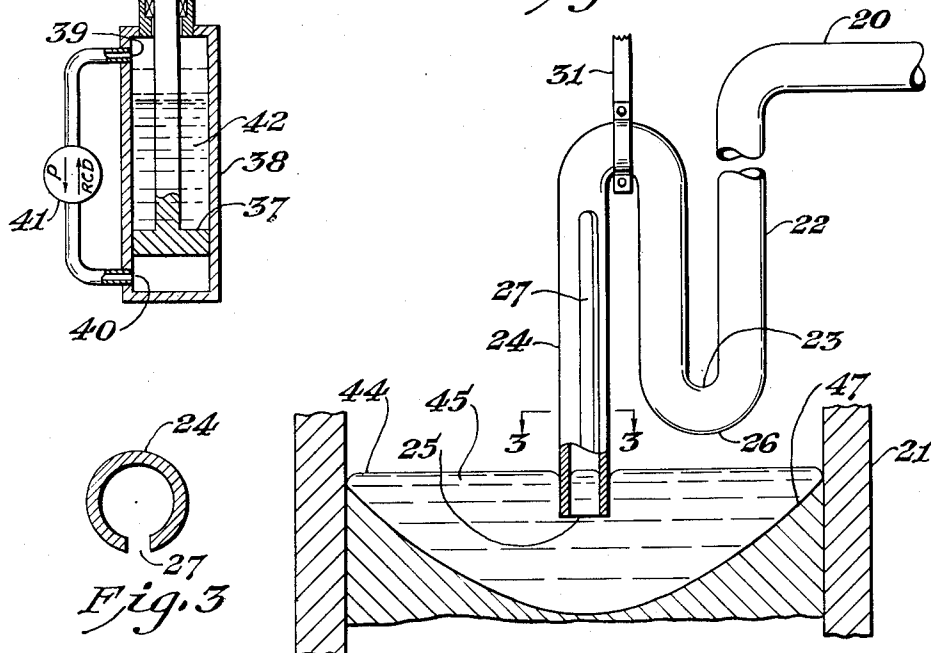


Fig. 2



Fig. 3

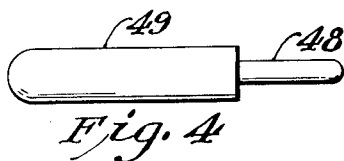


Fig. 4

INVENTORS
 Clarence E. Logan
 Martin C. Dowling
 BY Philip E. Hartung
 Griewold & Burdick
 ATTORNEYS

UNITED STATES PATENT OFFICE

2,372,628

METAL POURING DEVICE

Clarence E. Logan, Martin C. Dowling, and Phillip E. Hartung, Midland, Mich., assignors to The Dow Chemical Company, Midland, Mich., a corporation of Michigan

Application February 16, 1944, Serial No. 522,540

3 Claims. (Cl. 22—79)

The invention relates to means for handling molten oxidizable metal. It more particularly concerns an improved device for pouring molten magnesium and alloys thereof into a succession of molds as in casting ingots.

In an application Serial No. 522,532, filed February 16, 1944, by Charles E. Nelson and Adolph T. Peters, there is described an apparatus and method for casting ingots of magnesium and its alloys in which a body of the metal is maintained at pouring temperature in a melting pot and transferred therefrom into an ingot mold. The transfer is accomplished by pumping the molten metal through a pipe provided with a trap for forming a liquid seal at the discharge end of the pipe, thereby to keep it filled with molten metal between pourings. With this apparatus, the molten metal passes from the pipe through the trap and thence through a depending spout extending into the receiving mold which is arranged to be lowered at such a rate that the tip of the spout remains submerged in the molten metal in the ingot mold until it is filled. The flow of metal is then arrested and the downward movement of the mold continued so as to uncover and drain the spout, permit removal of the filled ingot mold from beneath the spout, and replacement by another mold so that the process may be repeated to form a succession of ingots.

A disadvantage of this apparatus is that oxidation of molten metal occurs in the discharge spout as the air rushes in to displace the metal which runs out when the spout drains under the influence of gravity as the tip of the spout is uncovered. The oxidation product forms a skin or shell which tends to adhere to the inside of the spout and must be removed from time to time so as to keep the spout open to the flow of metal. In order to accomplish this, it is generally necessary to discontinue the operation of the apparatus so as to gain access to the spout and then to insert a clean-out tool lengthwise of the spout. This is a hazardous operation when the trap and pipe contain molten metal as in ordinary operation of the apparatus. On the other hand, if the pipe and trap are first emptied of metal, so as to permit cleaning the spout without hazard, then additional difficulties arise due to oxidation products forming inside the pipe as the molten metal is replaced by air. In any case, it is difficult to properly clean the discharge spout while maintaining a liquid metal seal in the trap.

We have now devised an improved metal-pouring device, operable in combination with the aforesaid apparatus, for pouring a succession of

molds without the aforesaid disadvantages, hereinafter fully described and particularly pointed out in the claims, the annexed drawing and following description setting forth an embodiment of the invention.

In the said drawing—

Fig. 1 is an elevation partly in cross-section showing an apparatus including the device of the invention with which the device may be used.

Fig. 2 is an enlarged view of a portion of Fig. 1 showing an embodiment of the invention.

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

Fig. 4 is a side elevation of a tool used for cleaning the device of the invention.

Referring to the drawing, a furnace setting 10 is shown provided with a burner 11 and flue 12. A melting pot 13 is placed in the setting and is provided with a cover 14 and filling opening 15 having a removable cover 16. A pump 17 in the pot is driven by motor 18 controlled by rheostat 19. The outlet of the pump is connected to one end of a pipe 20 extending beyond the pot to the ingot mold 21, while the other end is formed into a depending leg 22. Formed coextensively with the leg 22 is a U bend trap 23 for liquid metal, the trap being provided with a depending discharge spout 24, the end 25 of which extends below the bottom 26 of the trap. The spout is provided with a slot 27 which extends from the end 25 to within the sealing levels 29 and 30 of the trap. The pipe, depending leg, trap, and spout thus form a continuous passage for the metal. The trap is so positioned, with respect to the elevation of the surface of the liquid metal 28 in the pot, that its level lies between the sealing levels 29 and 30 of the trap.

Current-carrying terminals 31 and 32 are shown attached to near the extreme ends of the pipe 20 and these in turn are connected by lugs to current-carrying cables 33 and 34, respectively.

The ingot mold 21, in position to receive metal from the spout 24, is shown nearly filled and supported by a platform 35 carried on the end of piston rod 36 attached to piston 37 operating in the vertically disposed hydraulic cylinder 38. The opposite ends of the cylinder are provided with ports 39 and 40 which are piped to the reversible, preferably constant delivery, fluid pump 41. The cylinder, its appended piping, and the pump are filled with an operating fluid, such as oil, indicated by 42.

In operation, the melting pot 13 is filled with magnesium or alloy thereof to be cast to a level, between the operative levels 29 and 30 of the

trap 23, indicated at 26. Such filling may be accomplished either by introducing solid metal through the filling opening 15 and melting the metal in the pot or by transferring molten metal to the pot from a separate pot (not shown but which may be of similar construction to 13 and provided with a similar furnace setting), such filling or transfer of melted metal being made from time to time as needed to maintain the level in the pot 13 within the aforesaid levels. Typical examples of magnesium alloys which may be handled with the apparatus are the Dowmetal alloys set forth in the accompanying table, together with the appropriate pouring temperature for ingot casting.

Alloy	Nominal composition, per cent				Pouring temp. °F.
	Aluminum	Manganese	Zinc	Magnesium	
FS.....	3.0	0.3	1.0	Remainder..	1,260
J.....	6.5	0.2	1.0	do.....	1,200
M.....		1.5		do.....	1,300
O.....	8.5	2.0	0.5	do.....	1,200
Magnesium (unalloyed).....					1,300

It is advantageous to maintain a thin layer of a protective flux 43 over the molten metal in the pot to prevent undue oxidation, especially when the cover 16 is removed, as during introduction of additional metal. Suitable fluxes are composed of the chloride of alkali and alkali-earth metals and a small proportion of a thickening agent such as magnesium oxide so that the flux is somewhat viscous. As an example, the following flux composition may be used: potassium chloride, 37.5 percent; magnesium chloride, 42 per cent; barium chloride, 4.5 per cent; calcium fluoride, 3.5 per cent; and magnesium oxide, 7.5 per cent.

Having provided a body of molten metal in the melting pot at the proper pouring temperature, e. g., usually at about 1200° to 1300° F., an ingot mold 21 is placed upon the platform 35 and raised so that the inside bottom of the mold is just below the end 25 of the spout 24. This is accomplished by operating the reversible fluid pump 41 so as to transfer fluid 42 in the cylinder 38 from the space above piston 37 to the space below the piston until it is raised to the desired level, as determined by the position of the discharge end of the pouring spout in relation to the inside bottom of the mold. Thus, the ingot mold is placed in the initial position for filling.

An electric current is passed through pipe 20 from the cables 33 and 34 in sufficient strength to maintain the pipe at the pouring temperature of the metal during its flow therethrough. With pipe 20 up to temperature, the pump 17 is put into operation by regulating the rheostat 19 so as to pump molten metal from the pot 13 through pipe 20 into the ingot mold 21 at a relatively small but substantially constant rate, e. g., about 1.5 to 2.5 gallons per minute for a 12-inch diameter cylindrical ingot. As the metal enters the ingot mold, it is lowered in vertical alignment with the discharge spout at a rate such as to maintain the end 25 of the discharge spout just below the surface 44 of the liquid metal 45. This is accomplished by operating the pump 41 so as to transfer fluid 42 from below the piston 37 to the space above it. The proper rate of pouring requires that the mold be lowered at a rate between about 3 and 5.5 inches per minute. In this way, the metal fills the mold in a quiescent condition and

consequential oxidation of the surface of the liquid in the mold and occlusion of oxide in the ingot is avoided.

Lowering of the ingot mold is continued without uncovering the spout and a pool of liquid metal maintained on the top of the solidified ingot metal until the filling has progressed to near the brim 46 of the mold. Transfer of metal to the ingot mold is thus arrested by either stopping or so reducing the speed of the pump 17 that it no longer will cause metal to flow to the mold. The spout then drains to the level of the metal in the mold. While the flow of liquid metal through the pipe 20 is arrested, the ingot mold is further lowered by manipulating the fluid pump 41 until the brim 46 of the mold is below the spout 24. The pool 45 is then allowed to solidify. After filling and allowing all the metal therein to solidify, the ingot mold is removed from the platform 35 and the solidified ingot removed from the mold. Meanwhile, any oxide skin or shell formed on the inside of the spout is removed by grasping the handle 48 of the tool (shown in Fig. 4), inserting the point 48 into the slot 27, and raking it from top to bottom. After vacating the platform either another empty mold or the same mold after emptying is placed upon the platform 35 and the process repeated.

Since, by means of the tool shown in Fig. 4, the pouring spout 24 may be easily cleaned, no difficulty is encountered in restarting the flow of metal between the pouring of successive ingots. In addition, the slotted pouring spout has the advantage that successive pourings are not delayed due to oxide formations, if any, in the spout.

We claim:

1. In a device for discharging molten oxidizable metal into molds in succession from a pot holding a body of metal at pouring temperature by pumping the molten metal therefrom through a pipe to each mold and maintaining the pipe filled with molten metal between pourings, the combination with the pipe at the delivery end of a trap depending from the pipe adapted to form a liquid metal seal therein, a discharge spout depending from the trap to below the bottom thereof, and having a slot extending lengthwise thereof, said pipe, trap, and spout forming a continuous passage for liquid metal.

2. In a device for discharging molten oxidizable metal into molds in succession from a pot holding a body of metal at pouring temperature by pumping the molten metal therefrom through a pipe to each mold and maintaining the pipe filled with molten metal between pourings, the combination with the pipe at the delivery end of a depending leg formed therein, a trap comprising a U bend formed in the lower end of the leg so that the leg forms one arm of the U, and a depending spout extending below the U formed of the other arm of the U, the spout having a slot lengthwise thereof, said pipe, leg, trap, and spout forming a continuous passage for liquid metal.

3. In a device for discharging molten oxidizable metal into molds in succession from a pot holding a body of metal at pouring temperature by pumping the molten metal therefrom through a conveying pipe to each mold and maintaining the pipe filled with molten metal between pourings, the combination with the conveying pipe at the delivery end of a trap for liquid metal comprising a U bend formed of a length of pipe and

having a short arm and a long arm, the long arm being attached to the conveying pipe perpendicularly thereto, a discharge spout comprising a straight length of pipe attached to the said short arm and extending beyond the bottom of the U, ⁵ the discharge spout being slotted lengthwise thereof from the discharge end to near the short

arm of the U, and a current-carrying terminal attached to the upper end of the discharge spout.

CLARENCE E. LOGAN.
MARTIN C. DOWLING.
PHILIP E. HARTUNG.