

(19)



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(11)

EP 0 901 854 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
25.01.2006 Bulletin 2006/04

(51) Int Cl.:
B22D 39/06 (2006.01) **B22D 35/04** (2006.01)
B22D 17/30 (2006.01)

(21) Application number: **98901083.0**

(86) International application number:
PCT/JP1998/000416

(22) Date of filing: **30.01.1998**

(87) International publication number:
WO 1998/033612 (06.08.1998 Gazette 1998/31)

(54) **APPARATUS FOR SUPPLYING MOLTEN METAL AT PREDETERMINED RATE**

VORRICHTUNG ZUM ZUFÜHREN VON METALLSCHMELZE IN VORGEGEBENEN MENGEN

DISPOSITIF D'ALIMENTATION DE METAL EN FUSION A UNE VITESSE DETERMINEE

(84) Designated Contracting States:
DE FR GB IT

(30) Priority: **04.02.1997 JP 2115997**

(43) Date of publication of application:
17.03.1999 Bulletin 1999/11

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JP-A- 63 252 667

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Description

Technical Field

[0001] The present invention relates to a molten metal feeding system for each time feeding a constant quantity of molten metal, such as aluminum alloy or others, from a molten metal holding furnace to a die casting machine in which the molten metal is replenished and stored in the holding furnace after being melted in a metal melting furnace.

Background Art

[0002] A conventional molten metal feeding system is so constructed that molten metal kept in a holding furnace is forced onwards through a molten metal delivery tube into a die casting machine by the aid of an electromagnetic pump set in the delivery tube which extends from the holding furnace to the die casting machine.

[0003] Where the molten metal is of nonferrous metal such as aluminum alloy and the like and undesiredly gets mixed with magnetic material such as iron and the like, the electromagnetic pump of a conventional feeding system can become clogged with the portion of magnetic material which is attracted to the inside of the electromagnetic pump, resulting in a breakdown. Further problems are raised in maintaining the quantity and constant feed of the delivered molten metal, and hence in the cost of production, since the molten metal flowing in the delivery tube cannot be immediately halted when the pump stops. Also, the electromagnetic pump is expensive.

[0004] A system according to the preamble of claim 1 is known from JP-A-8-10937.

[0005] In view of the above-described problems, it is an objective of the present invention to provide a molten metal feeding system capable of each time steadily feeding a constant quantity the molten metal to the die casting machine without said problems, and at a reduced production cost.

[0006] According to the present invention, there is provided a system for feeding a constant quantity of molten metal to a die casting machine comprising: a sealed pot having an ingress port provided on a bottom side of the sealed pot so as to open upwardly and an egress port, said sealed pot being arranged at a predetermined level within a molten metal holding furnace; a molten metal delivery tube having one end communicating with the egress port and the other end communicating with a pouring gate of a die casting machine; a pair of valves for opening and closing the ingress port and the egress port; interconnected with each of the valves; a level detecting mechanism for detecting an upper limit level L1 and a lower limit level L2 of the molten metal within the pot; and an internal pressure controller system adapted for increasing the internal pressure in the pot by charging an inactive gas and adapted for decreasing the internal pressure in the pot by discharging the once compression-charged inactive gas from the pot; characterized in that: the one end of said delivery tube extends into the inside of the pot from a side wall at the lower end of the pot; said egress port is provided in said one end of the delivery tube so as to open upwardly in parallel to said ingress port; and the valves are each shaped like a bar and are arranged in parallel within the pot for opening and closing the ingress port and the egress port of the pot by vertical motion produced by the valve actuating means.

[0007] According to the system for feeding a constant quantity of molten metal to a die casting machine, the molten metal let in through the ingress port into the inside of the pot is depressed from the upper limit level L1 to the lower limit level L2 by the pressure of the charged gas and is thereby delivered from the inside of the pot through the egress port along the delivery tube. Therefore, a constant quantity of the molten metal within the molten metal holding furnace can each time be automatically delivered steadily to the die casting machine. Where the molten metal is of nonferrous metal such as aluminium alloy and the like and undesiredly gets mixed with magnetic material, there is no likelihood that the inside of the delivery tube will become clogged with the ingredient of magnetic material and the system fall into a breakdown, as in the case of using the electromagnetic pump, since the inside pressure system is incorporated to let the molten metal in and out with the aid of the inactive gas. This enables the production to be achieved at a reduced relative cost.

[0008] Further, according to this system for feeding a constant quantity of molten metal, a pair of the valves for each opening and closing the ingress port and the egress port of the pot are provided in juxtaposition, and the inside pressure controller system is provided for decreasing the inside pressure in the pot by discharging the once compression-charged inactive gas from the pot so that, when the pressure controller system performs the discharge of the inactive gas from the pot by switching the switch valve, the molten metal in the holding furnace is forced to flow through the ingress port into the pot in a state where the valve for the egress port is closed due to downward motion of valve. Therefore, the quantity of the molten metal flowing from the holding furnace into the pot can be regulated quantitatively to be a constant amount, and thus the quantity delivered from the pot each time can be kept to a constant quantity. In primary embodiments of the invention, the once compression-charged inactive gas is discharged to the open air.

[0009] Further, according to the present system for feeding a constant quantity of molten metal to a die casting machine, a pair of valves are arranged inside the pot in parallel to one another and allowed to move vertically in the pot which is shut perfectly to the open air, i.e. the inside of the pot is sealed in perfect separation from the molten metal inside the molten metal holding furnace communicating with the open air, and the ingress port and the egress port provided on the bottom side of the

pot are opened/closed by the valves on the inside of the sealed pot. This enables the molten metal to be fed through the egress port without the entry of oxides.

[0010] According to a modification of the present invention, the internal pressure controller system discharges the once compression-charged gas from the pot to reduce the internal pressure in the pot by sucking the once compression-charged inactive gas forcibly from the pot, to thereby allow the molten metal into the pot through the ingress port.

[0011] According to the modified system for feeding a constant quantity of molten metal constant quantity of, a pair of valves, each for opening and closing one of the ingress port and the egress port of the pot, are provided in juxtaposition and an inside pressure controller system is provided for decreasing the inside pressure in the pot by sucking the once compression-charged inactive gas forcibly from the pot. Therefore, in addition to the effects of the modification, where the surface of a body of the molten metal stored in the holding furnace is lessened and thus lowered by the delivery of the molten metal from the pot, the upper limit level L1 on the inside of the pot can always be kept to a fixed position, so that there becomes no need for frequent replenishment of the molten metal holding furnace with supplemental molten metal, resulting in practical use of the supplement work of the molten metal and delivery in a more consistent quantity.

[0012] In a system for feeding molten metal in constant quantity to a die casting machine according to the above aspects, the valve actuating means comprises a fluid pressure actuator erected on an upper side of the pot, with a piston rod, thereof joined to the valve, which valve is shaped like a bar.

[0013] Further, according to the modified system for feeding molten metal in constant quality to a die casting machine, a pair of the valves are arranged inside the pot in parallel to one another and allowed to move vertically in the pot which is shut perfectly to the open air, i.e. the inside of the pot is sealed in perfect separation from the molten metal inside the molten metal holding furnace communicating with the open air, and the ingress port and the egress port provided on the bottom side of the pot are opened and closed by the valves on the inside of the sealed pot. This enables the molten metal to be fed through the egress port without the entry of oxides.

[0014] According to the above systems for feeding a constant quantity of molten metal the fluid pressure actuator may be mounted on the upper side of the pot as a driving means of the valve and be joined to the bar-shaped valve, so that the driving means of the valve can be simplified and made compact.

[0015] Further, in the systems above, according to the first aspect and modification thereof, the pot, the valve and the molten metal delivery tube are each made out of ceramics.

[0016] According to this system, for feeding molten metal in constant quantity, since the pot, the valve and the molten metal delivery tube are each made out of ce-

ramics, they are superior in heat resistance and can be produced at a reduced cost.

[0017] Yet further, in the systems above according to the first and second aspects, the ingress port of the pot may be provided on the outside thereof with a filter, made from ceramic, for removing impure materials.

[0018] According to this system, the mounting of the filter on ingress port on the outer side of the pot enables the removing of oxides, dust and the other particles contained in the molten metal in the holding furnace, and hence delivery of molten metal only of a good quality to the die casting machine.

Brief Description of the Drawings

[0019] To enable a better understanding of the present invention, and to show how the same may be carried into effect, reference will now be made by way of example only, to the drawings, in which:

Fig. 1 is an elevational side view, in longitudinal section, of the molten metal feeding system of the first specific form of the invention;

Fig. 2 is an enlarged section of a part of the molten metal feeding system shown in Fig. 1;

Fig. 3 is an elevational side view, in longitudinal section, of the molten metal feeding system of the second specific form of the invention; and

Fig. 4 is an enlarged section of one embodiment of a level detecting mechanism.

Detailed Description

[0020] The first specific form of the molten metal feeding system of the invention shown in Fig. 1 is a particular application to a case in which molten metal, especially of aluminum alloy, is fed to a die casting machine. Fig. 2 shows the enlarged section of a part of the first specific form. In these figures, the numeral 1 indicates a pot of hollow cylinder closed at the bottom, which has a molten metal ingress port 2 and a molten metal egress port 3 at the position related to the bottom. The pot 1 is made out of ceramics and is arranged perpendicularly at a predetermined level inside an open type molten metal holding furnace 5 while the upper end 1a of the pot 1 is supported in a sealed condition by a support block 4 of heat-resistant material meeting the necessary requirements for such an application and the remainder of the pot 1 is suspended from the support block 4. The holding furnace 5 contains a body of molten metal 6 of aluminum alloy stored substantially fully within the furnace, which molten metal is supplied from a metal melting furnace. In this manner, the pot 1 is immersed, as shown in Fig. 1, in the body of molten metal 6.

[0021] The numeral 7 indicates a molten metal delivery tube made of ceramics, of which one end is communicated with the egress 3 of the pot 1 and the other end is adapted to be communicated with a pouring gate (not

shown) of a die casting machine M. The delivery tube 7 has three sections, i.e. a vertical section 7a extending vertically from the egress 3 along the outside of the pot 1, a bend section 7b passing through the support block 4 and supported therein, and a horizontal section 7c running horizontally from the bend section to the die casting machine M. A free end 7d of the horizontal section 7c is adapted to be pressed on the pouring gate of the casting machine M. Incidentally, a heater (omitted in the drawing) is attached to the delivery tube 7 so that the molten metal from the pot 1 can be fed while being kept at the appropriate temperature.

[0022] The numeral 8 indicates a valve for opening and closing the ingress port 2 of the pot 1 due to the motion in a direction perpendicular thereto of a stroke exerted by a fluid pressure actuator 9 serving as a means for actuating the valve 1. The valve 8 is made of ceramics and comprises, as shown in Fig. 2, a valve proper 8a, rounded at the lower end and a valve bar 8b, hollow on the inside. The fluid pressure actuator 9 is erected on the support block 4 and its piston rod 9a is inserted into the support block 4 to be capable of sliding in a sealed manner, and is joined to the valve bar 8b on the inside of the support block 4. In this manner, the elongating action (extension) of the actuator 9 causes downward motion of the valve bar 8b, to bring about the tight engagement of the valve proper 8a with the ingress port 2, resulting in the closure of the ingress port 2. On the other hand, the shortening action (retraction) of the actuator 9 causes upward motion of the valve bar 8b, to bring about release of the valve proper 8a from the ingress port 2, resulting in the opening of the ingress port 2.

[0023] In the embodiments illustrated in the drawings, the ingress port 2 on the bottom side of the pot 1 is configured downwardly open manner, while the valve 8 for opening and closing the ingress port 2 is arranged to move vertically within the pot 1. However, in a modification (not forming part of the present invention), it is possible for the ingress port 2 to be configured in such a manner as to open upwardly at a hollow projection expanded laterally from a part of the bottom of the pot 1, while the valve 8 for opening and closing the ingress port 2 is arranged to move vertically on the outside of the pot 1.

[0024] The numeral 10 indicates a level detecting mechanism for detecting the upper limit level L1 and the lower limit level L2 of molten metal inside the pot 1. The upper limit level L1 refers to a surface of molten metal within the pot 1 at the time of starting to feed the molten metal to the die casting machine, and is inclined (under gravity), to become identical to the surface level Lo of the body of molten metal inside the holding furnace 5 and outside the pot 1. On the other hand, the lower limit level L2 refers to the surface of the molten metal within the pot 1 at the time of ending the feeding of molten metal to the die casting machine. In the level detecting mechanism 10 particularly shown as an example in Fig. 4. A flange member 12 is fixed on the support block 4 by way of a plate piece 11 located just above the pot 1, a guide sleeve

13 being arranged vertically and fixed in the support block 4, the plate piece 11 and the flange member 12 in a piercing manner, and an elongated floating shaft 14 being so arranged as to extend through the guide sleeve 13 while the lower and upper ends of the floating shaft 14 are provided with a float 15 and a detection member 16, respectively. Further, a transparent cylindrical cover 17, with an upper end thereof closed, is arranged vertically and fixed on the flange member 12 so as to accommodate the upwardly extending portion of the floating shaft 14 as well as the detection member 16. In the outer side of the cylindrical cover 17, there are provided photoelectric switches 18, 19 as a detecting means of the detection member 16 at the upper and lower levels, so as to be adjustable in their own level positions, which switches each comprise a pair consisting of a light projector 18a, 19a and a light receiver 18b, 19b.

[0025] In this manner, the upper side photoelectric switch 18 can detect the upper limit level L1 of the molten metal within the pot by way of the detection member 16, and the lower side photoelectric switch 19 can detect the lower limit level L2 by way of the detection member 16.

[0026] The above-described plate piece 11, flange member 12, guide sleeve 13, float shaft 14, float 15, detection member 16 and cylindrical cover 17 are each made out of ceramics. The detecting means of the detection member 16 is not limited to the photoelectric switch, but can use the other switches such as a proximity switch. Incidentally, the above-described level detecting mechanism 10 is of a float type, but can also be of an optical type to directly measure the surface of the molten metal 6 in the pot 1 by way of laser beams, or be of a capacitance type level gauge.

[0027] The numeral 20 in Fig. 1 indicates an inside pressure controller system adapted for increasing the inside pressure in the pot 1 by charging an inactive gas (a nitrogen gas or a dry air difficult to react with the molten metal), and for decreasing the inside pressure in the pot 1 by discharging the once compression-charged inactive gas to the open air. The inside pressure controller system 20 comprises a gas charging source 22 which includes a tank for accommodating an inactive gas and a gas charging pump and is connected by way of a guide line 23 to a gas passing pipe 21 (see Fig. 1) which is arranged in the plate piece 11 and the support block 4 so as to communicate with the inside of the pot 1. In the guide line 23, there are interposed a pressure adjusting valve 24 and an electromagnetic switch valve 25. The electromagnetic switch valve 25 is electrically connected with a control unit (not shown in the drawing) of the fluid pressure actuators 9, 39 and the photoelectric switches 18, 19 of the level detecting mechanism 10. As for the pressure adjusting valve 24, an electric control type pressure control valve can be used for altering the inside pressure in the pot 1 as desired.

[0028] In this manner, for increasing the inside pressure in the pot 1 by charging the inactive gas, the switch valve 25 is operated so as to let the gas flow from the

gas charging source 22 to the gas passing pipe 21. On the other hand, for decreasing the inside pressure in the pot 1, the switch valve 25 is operated so as to stop the gas flowing from the gas charging source 22 and make the gas passing pipe 21 communicate with the open air through a gas discharging route. Adjustment of the inside pressure in the pot is performed by the pressure adjusting valve 24. Incidentally, for the gas charging source 22, a high pressure cylinder filled with inactive gas can also be used.

[0029] In the ingress port 2 of the pot 1, there is mounted on the outside thereof a filter 26, made of ceramics, for removing impure materials such as oxides, dust and others contained in the molten metal 6 in the holding furnace 5. The filter 26 is formed into a shape like a box as shown in Fig. 2, a semisphere or other desired shape, and is porous with about 10 to 60 meshes. The mounting of the filter 26 is performed by engaging an upper collar portion 26a of the filter 26 with a bent projection 27 provided on the outside of the bottom of the pot 1. The filter 26 is not essential, but is used if need be.

[0030] The above-described delivery tube 7 is communicated with a horizontal displacement mechanism 28 of a fluid pressure actuator type so as to move in a horizontal direction together with the pot 1. Particularly, the horizontal displacement mechanism 28 is so constructed, as shown in Figs. 1 and 2, that pairs of right and left wheels 32, installed by way of brackets 31 on the support block 4, can roll on right and left horizontal guide rails 30a which are formed on support frames 30 at the right and left sides extended horizontally from both the lateral sides of the upper end of a base frame 29 standing upright close to the holding furnace 5, and that a fluid pressure actuator 33 installed on the base frame 29 is connected by a piston rod 33a and a connecting rod 33b to the support block 4. The telescopic action of the fluid pressure actuator 33 enables the pot 1 and the delivery tube 7 integral with the support block 4 to move longitudinally in a horizontal direction and thereby can ensure the engagement of the free end 7d of the delivery tube 7 with the pouring gate (not shown) of the die casting machine M in a pressing manner.

[0031] The numeral 38 indicates a valve for opening and closing the egress port 3 of the pot 1 due to the perpendicular motion with a fluid actuator 39.

[0032] Particularly, the valve 38 for the egress port 3 is similar to the valve 8 for the ingress port 2, and is made of ceramic and comprises, as shown in Fig. 5, a valve proper 38a rounded at the lower end and a valve bar 38b. The fluid pressure actuator 39 is erected on the support block 4 side by side with the fluid pressure actuator 9 for the ingress valve 8 and its piston rod 39a is inserted into the support block 4 to be capable of sliding in a sealed manner, and is joined to the valve bar 38b in the inside of the support block 4. In this manner, the elongating action (section) of the actuator 39 causes downward motion of the valve bar 38b, to bring about tight engagement of the valve proper 38a with the egress port 3, resulting

in the closure of the egress port 3. On the other hand, the shortening action of the actuator 39 causes upward motion of the valve bar 38b, to bring about the release of the valve proper 38a from the egress port 13, resulting in the opening of the egress port 3.

[0033] In operation, the molten metal feeding system constructed above, in a situation where the ingress port 2 of the pot 1 is put in an open position due to the upward motion of the ingress valve 8 while the egress port 3 of the pot 1 is put in a closed position due to the downward motion of the egress valve 38, the inside of the pot 1 is caused to communicate with the open air by the inside pressure controller system 20, so that the molten metal 6 in the holding furnace 5 flows through the ingress port 2 into the inside of the pot 1 and rises up to the upper limit level L1, which is detected by the level detecting mechanism 10. Particularly, with the rise of the molten metal within pot 1, the float 15 on the surface of the molten metal rises and the detection member 16, by way of the floating shaft 14, also rises. When the detection member 16 rises to a position related to the upper limit level L1, the detection member 16 is sensed by the photoelectric switch 18.

[0034] At this time, the sensing signal from the photoelectric switch 18 activates the fluid pressure actuator 39 into an elongating motion to move the valve 38 downwardly to close the ingress port 2, and also activates the fluid pressure actuator 39 into an elongating motion to move the valve 38 upwardly to open the egress port 3. At the same time, the inside pressure controller system 20 activates so as to charge the inactive gas through the gas passing pipe 21 into the inside of the pot 1. Thereby, the molten metal within the pot 1 is put under pressure and is caused to flow through the egress port 3 into the delivery tube 7. Then, the molten metal surface inside the pot 1 drops down to the lower limit level L2, and the detection member 16 also drops to a position related to the lower limit level L2, which is sensed by the photoelectric switch 19. At this time, the sensing signal from the photoelectric switch 19 activates the fluid pressure actuator 9 into a shortening motion to move the valve 8 upwardly and open the ingress port 2, and also activates the fluid pressure actuator 39 into an elongating motion to move the valve 38 downwardly to close the egress port 3. At the same time, the inside pressure controller system 20 activates so as to discharge the once compression-charged inactive gas within the pot 1 from the pot 1, through the gas passing pipe 21 and the gas discharging route formed by the switch valve 25 to the open air. Thereby, the molten metal in the holding furnace 5 flows into the pot 1. Sequentially, those processes are repeated.

[0035] According to the above-described molten metal feeding system, the molten metal within the pot 1, which, as described above, is put under pressure by the inactive gas charged into the pot 1 and drops from the upper limit level L1 to the lower limit level L2, is fed through the delivery tube 7 by a specified quantity equivalent to the

product of the interval between both the limit levels L1, L2 and the sectional area of the inside of the pot 1. As a result, the repetition of the above processes enables feeding of the molten metal in a quantity proportional to the repetition. The fed quantity of the molten metal is adjustable as desired by altering vertically the positions of the upper and lower side photoelectric switches 18 and 19 of the level detecting mechanism. In this case, either or both of the upper and lower side photoelectric switches 18 and 19 may be changed in position.

[0036] In the present molten metal feeding system, when the molten metal in the pot 1 lowers down to the lower limit level L2 and the detection signal activates the pressure controller system 20 so as to discharge the once compression-charged gas, from the pot 1 with the switching of the switch valve 25, the molten metal in the holding furnace 5 is forced to flow through the ingress port 2 into the pot 1 in a state where the valve 38 for the egress port 3 is closed due to the downward motion of the valve 38. Accordingly, the flowing quantity of the molten metal from the holding furnace 5 into the pot 1 can be regulated quantitatively. For example, there is no likelihood that a part of the molten metal flown into the pot 1 escapes through the egress port 3 of the pot 1.

[0037] The second specific form of the molten metal feeding system of the invention shown in Fig. 3 is different from the above-described first form in that there is provided an inside pressure controller system 40 adapted to reduce also the inside pressure in the pot 1 by sucking the once compression-charged inactive gas forcibly from the pot 1. Except for this respect, the third specific form has the same construction as the second specific form. Thus, the same constituent elements are indicated by the same reference numerals and description of the same elements is omitted.

[0038] Particularly, the inside pressure controller system 40 comprises, as shown in Fig. 3, a gas tank 34 for accommodating an inactive gas and a gas charging pump 35 for feeding the inactive gas within the tank 34 to the gas passing, pipe 21 to which tank 34 and pump 35 are both connected by a way of a guide line 36. In the guide line 36, there are interposed a pressure adjusting valve 37 and an electromagnetic switch valve 41. Further, the electromagnetic switch valve 41 and the gas tank 34 are connected by a bypass line 42, in which there are interposed a sucking pump 43 and a pressure adjusting valve 44. The electromagnetic switch valve 41 is electrically connected with a control unit (not shown in the drawing) of each of the fluid pressure actuators 9, 39 and the photoelectric switches 18, 19 of the level detecting mechanism 10.

[0039] In this manner, to increase the inside pressure in the pot 1 by charging the inactive gas, the switch valve 41 is so operated as to cut off the bypass line 42 and let the gas to flow from the gas charging pump 35 to the gas passing pipe 21. On the other hand, to decrease the inside pressure in the pot 1, the switch valve 41 is operated so as to stop the gas flowing from the gas charging pump

35 to the gas passing pipe 21 and release the bypass line 42. The adjustment of the inside pressure in the pot 1 is performed by the pressure adjusting valves 37, 44.

[0040] In operation the molten metal feeding system constructed as above, in a situation where the ingress port 2 of the pot 1 is put in an open position due to the upward motion of the ingress valve 8 while the egress port 3 of the pot 1 is put in a closed position due to the downward motion of the egress valve 38, the inside of the pot 1 is sucked to the outside by the inside pressure controller system 40, so that the molten metal 6 in the holding furnace 5 flows through the ingress port 2 into the inside of pot 1 and rises up to the upper limit level L1, which is detected by the level detecting mechanism 10. Particularly, with the rise of the molten metal within pot 1, the float 15 on the surface of the molten metal rises and the detection member 16, by way of the floating shaft 14, also rises. When the detection member 16 raises to a position related to the upper limit level L1, the detection member 16 is sensed by the photoelectric switch 18.

[0041] At this time, the sensing signal from the photoelectric switch 18 activates the fluid pressure actuator 9 into an elongating motion (extension) to move the valve 8 downwardly to close the ingress port 2, and also activates the fluid pressure actuator 39 into a shortening motion (retraction) to move the valve 38 upwardly to open the egress port 3. At the same time, the inside pressure controller system 40 activates to charge the inactive gas through the gas passing pipe 21 into the inside of the pot 1. Thereby, the molten metal within the pot 1 is put under pressure and is caused to flow through the egress port 3 into the delivery tube 7. Then, the molten metal surface within the pot 1 drops down to the lower limit level L2, and the detection member 16 also drops a position related to the lower limit level, which is sensed by the photoelectric switch 19. At this time, the sensing signal from the photoelectric switch 19 activates the fluid pressure actuator 9 into a shortening motion (retraction) to move the valve 8 upwardly to open the ingress port 2, and also activates the fluid pressure actuator 39 into an elongating motion (extension) to move the valve 38 downwardly to close the egress port 3. At the same time, the inside pressure controller system 40 activates to discharge or return the once compression-charged inactive gas in the inside of the pot 1 to the gas tank 34 through the gas passing pipe 21 and the bypass line 42 opened by the switch valve 41. Thereby, the molten metal in the holding furnace 5 flows into pot 1. Sequentially, those processes are repeated.

[0042] According to the above-described molten metal feeding system the inside molten metal in the pot 1, which, as described above, is put under pressure by the inactive gas charged into the pot 1 and drops from the upper limit level L1 to the lower limit level L2, is fed through the delivery tube 7 by a specified quantity equivalent to the product of the interval between both the limit levels L1, and L2 and the sectional area of the inside of the pot 1. As a result, the repetition of the above proc-

esses enables the delivery of the molten metal of a quantity proportional to the repetition. Similarly to the operations in the first and second specific forms, the delivered quantity of the molten metal is adjustable as desired by altering vertically the position of the upper and lower side photoelectric switches 18, 19 of the level detecting mechanism. In this case, either or both of the upper and lower side photoelectric switches 18, 19 may be changed in position.

[0043] Especially, in the present molten metal feeding system, there is provided the valve 8 for the ingress port 2 and the valve 38 for the egress port 38 as well as the inside pressure controller system 40 adapted to reduce the inside pressure in the pot 1 by sucking the once compression-charged inactive gas forcibly from the pot 1. Accordingly, where the surface Lo of a body of the molten metal 6 stored in the holding furnace 5 is lowered by the delivery of the molten metal from the pot 1, the upper limit level L1 within the pot 1 can always be kept at a fixed position, so that there is no need for frequent replenishment of the molten metal holding furnace 5 with supplemental molten metal, resulting in practical use of the supplement work of the molten metal to feed the metal in a more consistent quantity.

[0044] Incidentally, the above-described specific forms are the application are directed mainly to the case of feeding the molten metal of aluminum, but are not limited thereto. For example, it is possible to apply these systems to the cases of using magnesium or others as the molten metal. In the case of using magnesium as the molten metal, the pot, valves and delivery tube may be made out of iron.

Industrial Applicability

[0045] As evident from the above description, according to the present invention, a constant quantity of the molten metal within the molten metal holding furnace can be automatically fed steadily to the die casting machine. Where the molten metal is of nonferrous metal such as aluminium alloy and the like and gets mixed with magnetic material, there is no likelihood that the inside of the feeding system will become clogged by the portion of magnetic material and the system fall into a breakdown, as in the case of using the electromagnetic pump, since the inside pressure controller system is incorporated for letting the molten metal in and out with the aid of inactive gas. This enables the production at a relatively reduced cost. Further, the use of the inactive gas prevents oxides from being formed on the molten metal surface in the pot. In addition, since the molten metal can be fed without suffering a decrease in temperature, it is not necessary to supply heat for maintaining the temperature of the metal melting furnace and the molten metal furnace. This serves to save energy, and enables the casting to achieve a high quality.

Claims

1. A system for feeding a constant quantity of molten metal to a die casting machine comprising:

a sealed pot (1), having an ingress port (2) provided on a bottom side of the sealed pot (1) so as to open upwardly and an egress port (3), said sealed pot (1) being arranged at a predetermined level within a molten metal holding furnace (5) ;
a molten metal delivery tube (7) having one end (7a) communicating with the egress port and the other end (7d) communicating with a pouring gate of a die casting machine (M);
a pair of valves (8, 38) for opening and closing the ingress port (2) and the egress port (3);
valve actuating means (9, 39) interconnected with each of the valves (8, 38);
a level detecting mechanism (10) for detecting an upper limit level L1 and a lower limit level L2 of the molten metal (6) within the pot; and
an internal pressure controller system (20, 40) adapted for increasing the internal pressure in the pot by charging an inactive gas and adapted for decreasing the internal pressure in the pot by discharging the once compression-charged inactive gas from the pot,

characterized in that:

the one end (7a) of said delivery tube (7) extends into the inside of the pot from a side wall at the lower end of the pot;
said egress port (3) is provided in said one end of the delivery tube (7) so as to open upwardly in parallel to said ingress port (2); and
the valves (8, 38) are each shaped like a bar and are arranged in parallel within the pot (1) for opening and closing the ingress port (2) and the egress port (3) of the pot by vertical motion produced by the valve actuating means (9, 39).

2. A system for feeding a constant quantity of molten metal to a die casting machine according to Claim 1, wherein the internal pressure controller system (40) discharges the once compression-charged inactive gas from the pot to reduce the internal pressure in the pot by sucking the once compression-charged inactive gas forcibly from the pot, to thereby allow the molten metal (6) into the pot through the ingress port (2).
3. A system for feeding a constant quantity of molten metal to a die casting machine according to Claim 1, wherein the internal pressure controller system (20) discharges the once compression-charged in-

active gas from the pot to reduce the internal pressure in the pot by discharging the once compression-charged inactive gas to the open air.

4. A system for feeding a constant quantity of molten metal to a die casting machine according to claim 1, 2 or 3, wherein the valve actuating means comprise fluid pressure actuators (9, 39) mounted on an upper side of the pot with respective piston rods (9a, 39a) thereof joined to the respective valves (8, 38). 5 10
5. A system for feeding a constant quantity of molten metal to a die casting machine according to any preceding claim, wherein the pot (1), the valves (8, 38) and the molten metal delivery tube (7) are each made of ceramic material. 15
6. A system for feeding a constant quantity of molten metal to a die casting machine according to any preceding claim, wherein the ingress port (2) of the pot (1) is provided with an external filter (26) made of ceramic material for removing impure materials. 20

Patentansprüche 25

1. System zur Zufuhr einer konstanten Menge geschmolzenen Metalls zu einer Spritzguss-Maschine, umfassend: 30

einen abgedichteten Tiegel (1), der an einer Bodenseite des abgedichteten Tiegels (1) eine so vorgesehene Eintritts-Öffnung (2) aufweist, dass sie nach oben zu öffnen ist, sowie eine Austritts-Öffnung (3), wobei der abgedichtete Tiegel (1) an einem vorab bestimmten Niveau innerhalb des Halteofens (5) für das geschmolzene Metall angeordnet ist; 35
ein Förderrohr (7) für geschmolzenes Metall, welches ein Ende (7a) aufweist, welches mit der Austritts-Öffnung kommuniziert, und dessen anderes Ende (7d) mit einem Gießtor der Spritzguss-Maschine (M) kommuniziert; 40
ein Paar von Ventilen (8, 38) zum Öffnen und Verschließen der Eintritts-Öffnung (2) und der Austritts-Öffnung (3); 45
Ventil-Betätigungselemente (9, 39), die mit jedem der Ventile (8, 38) verbunden sind;
einen Niveau-Detektionsmechanismus (10) zum Detektieren eines oberen Grenzniveaus L1 und eines unteren Grenzniveaus L2 des geschmolzenen Metalls (6) innerhalb des Tiegels; und 50
ein Kontrollsystem (20, 40) für den internen Druck, welches zum Anheben des internen Drucks in dem Tiegel durch Zufuhr eines inaktiven Gases sowie zum Absenken des internen Drucks in dem Tiegel durch Ablassen des ein- 55

mal zur Kompression zugeführten inaktiven Gases aus dem Tiegel angepasst ist, **dadurch gekennzeichnet, dass:**

- das eine Ende (7a) des Förderrohrs (7) sich in das Innere des Tiegels von einer Seitenwand an dem niedrigeren Ende des Tiegels erstreckt; 5
die Austritts-Öffnung (3) in dem einen Ende des Förderrohrs (7) so vorgesehen ist, dass sie parallel zu der Eintritts-Öffnung (2) nach oben zu öffnen ist; und
die Ventile (8, 38) jeweils wie ein Stab geformt sind und parallel innerhalb des Tiegels (1) zum Öffnen und Verschließen der Eintritts-Öffnung (2) und der Austritts-Öffnung (3) des Tiegels durch die von den Ventil-Betätigungselementen (9, 39) produzierte vertikale Bewegung angeordnet sind.
2. System zur Zufuhr einer konstanten Menge geschmolzenen Metalls zu einer Spritzguss-Maschine gemäß Anspruch 1, wobei das Kontrollsystem (40) für den internen Druck das einmal zur Kompression zugeführte inaktive Gas von dem Tiegel abgibt, um den internen Druck in dem Tiegel durch Zwangssaugen des einmal zur Kompression zugeführten inaktiven Gases aus dem Tiegel zu reduzieren, um hierdurch den Zutritt des geschmolzenen Metalls (6) in den Tiegel durch die Eintritts-Öffnung (2) zu ermöglichen. 25
3. System zur Zufuhr einer konstanten Menge geschmolzenen Metalls zu einer Spritzguss-Maschine gemäß Anspruch 1, wobei das Kontrollsystem (20) für den internen Druck das einmal zur Kompression zugeführte inaktive Gas vom Tiegel ausgibt, um den internen Druck im Tiegel durch Ausgeben des einmal zur Kompression zugeführten inaktiven Gases zur Umgebungsluft zu reduzieren. 35
4. System zur Zufuhr einer konstanten Menge geschmolzenen Metalls zu einer Spritzguss-Maschine gemäß Anspruch 1, 2 oder 3, wobei die Ventil-Betätigungselemente Fluiddruck-Stellglieder (9, 39) umfassen, die an der oberen Seite des Tiegels mit an den jeweiligen Ventilen (8, 38) verbundenen jeweiligen Kolbenstangen (9a, 39a) befestigt sind. 40
5. System zur Zufuhr einer konstanten Menge geschmolzenen Metalls zu einer Spritzguss-Maschine gemäß einem der voranstehenden Ansprüche, wobei der Tiegel (1), die Ventile (8, 38) sowie das Förderrohr (7) für geschmolzenes Metall jeweils aus einem keramischen Material gefertigt sind. 45
6. System zur Zufuhr einer konstanten Menge geschmolzenen Metalls zu einer Spritzguss-Maschine 50

gemäß einem der voranstehenden Ansprüche, wobei die Eintritts-Öffnung (2) des Tiegels (1) mit einem externen Filter (26) versehen ist, der zur Entfernung von Verunreinigungsmaterialien aus keramischem Material erzeugt ist.

Revendications

1. Système destiné à fournir une quantité constante de métal fondu à une machine à coulée sous pression comprenant:

un creuset rendu étanche (1) comportant un orifice d'entrée (2) disposé sur un côté inférieur du creuset rendu étanche (1) de manière à ouvrir vers le haut et un orifice de sortie (3), ledit creuset rendu étanche (1) étant disposé à un niveau prédéterminé à l'intérieur d'un four de conservation de métal fondu (5),

un tube de délivrance de métal fondu (7) ayant une première extrémité (7a) communiquant avec l'orifice de sortie et l'autre extrémité (7d) communiquant avec un port d'une machine à coulée sous pression (M),

une paire de vannes (8, 38) destinées à ouvrir et fermer l'orifice d'entrée (2) et l'orifice de sortie (3),

des moyens d'actionnement de vannes (9, 39) reliés mutuellement avec chacune des vannes (8, 38),

un mécanisme de détection de niveau (10) destiné à détecter un niveau limite supérieur L1 et un niveau limite inférieur L2 du métal fondu (6) à l'intérieur du creuset, et

un système de contrôleur de pression interne (20, 40) conçu pour augmenter la pression interne dans le creuset en chargeant un gaz inactif, et conçu pour diminuer la pression interne dans le creuset en évacuant le gaz inactif chargé auparavant par compression du creuset,

caractérisé en ce que :

la première extrémité (7a) dudit tube de délivrance (7) s'étend à l'intérieur du creuset depuis une paroi latérale au niveau de l'extrémité inférieure du creuset,

ledit orifice de sortie (3) est disposé dans ladite première extrémité du tube de délivrance (7) de manière à s'ouvrir vers le haut parallèlement audit orifice d'entrée (2), et

les vannes (8, 38) sont chacune formées comme une barre et sont agencées en parallèle à l'intérieur du creuset (1) afin d'ouvrir et fermer l'orifice d'entrée (2) et l'orifice de sortie (3) du creuset par un mouvement vertical produit par le moyen d'actionnement de vannes (9, 39).

2. Système destiné à fournir une quantité constante de métal fondu à une machine à coulée sous pression selon la revendication 1, dans lequel le système de contrôleur de pression interne (40) évacue le gaz inactif auparavant chargé par compression du creuset pour réduire la pression interne dans le creuset en aspirant le gaz inactif chargé auparavant par compression de manière forcée depuis le creuset, afin d'admettre ainsi le métal fondu (6) dans le creuset au travers de l'orifice d'entrée (2).

3. Système destiné à fournir une quantité constante de métal fondu à une machine à coulée sous pression selon la revendication 1, dans lequel le système de contrôleur de pression interne (20) évacue le gaz inactif chargé auparavant par compression du creuset afin de réduire la pression interne dans le creuset en évacuant le gaz inactif chargé auparavant par compression à l'air extérieur.

4. Système destiné à fournir une quantité constante de métal fondu à une machine à coulée sous pression selon la revendication 1, 2 ou 3, dans lequel les moyens d'actionnement de vannes comprennent des actionneurs à pression de fluide (9, 39) montés sur un côté supérieur du creuset, leurs tiges de pistons respectives (9a, 39a) étant réunies à leurs vannes respectives (8, 38).

5. Système destiné à fournir une quantité constante de métal fondu à une machine à coulée sous pression selon l'une quelconque des revendications précédentes, dans lequel le creuset (1), les vannes (8, 38) et le tube de délivrance de métal fondu (7) sont chacun constitués de matériau de céramique.

6. Système destiné à fournir une quantité constante de métal fondu à une machine à coulée sous pression selon l'une quelconque des revendications précédentes, dans lequel l'orifice d'entrée (2) du creuset (1) est muni d'un filtre externe (26) réalisé en matériau de céramique afin d'éliminer les matériaux impurs.

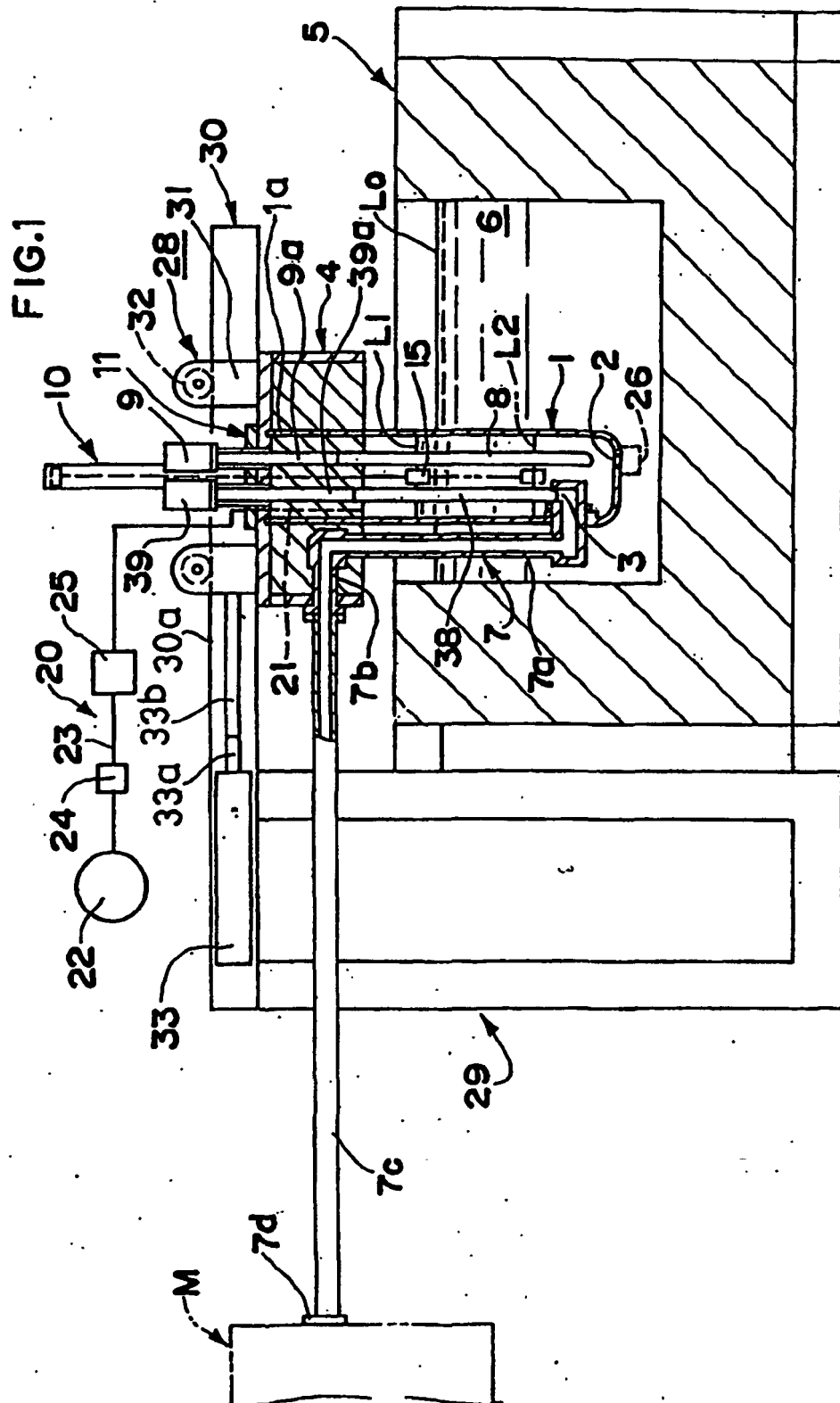


FIG.2

