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(54) **Ladle equipped with gas-blowing device having accumulator cylinder**

(57) A ladle (1) equipped with a gas blowing device having an accumulator cylinder (7) is provided, which has the capability of suppressing molten metal from penetrating into an injection plug (3) embedded in the ladle (1) and having a high resistance leading to a longer service life of the injection plug (3). The gas-blowing device (5) comprises a main pipe (8) for blowing gas into the ladle (1) via a gas-blowing plug (3) from a positionally independent gas supply source (4); an accumulator cylinder (7) for accumulating the gas supplied through the main pipe (8); and a controller (6). The controller (6) is used for accumulating the gas into the accumulator cylinder (7) when the gas blowing through the main pipe (8) begins or when the gas blowing is carried out, and for starting to blow the gas accumulated in the accumulator cylinder (7) simultaneously with a termination of the gas blowing through the main pipe (8).

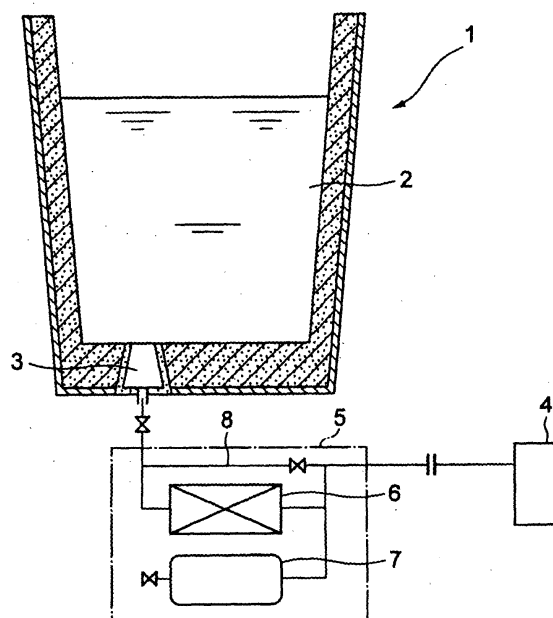


FIG. 1

Description

Field of the Invention

[0001] The present invention relates to a ladle equipped with a gas-blowing device that has an accumulator cylinder.

Related Art

[0002] In general, molten metal after refining in a melting furnace, such as an electric furnace or a converter, is transferred to a ladle for ladle-refining. The ladle, which is used to contain molten metal, is made of a metal container whose inner surface is coated with a refractory material. It is usually provided with an embedded injection plug in the bottom of the ladle, the injection plug being connected to an injection passage through which gas is blown into the molten metal contained in the ladle.

[0003] A gas source apparatus is disposed separately and fixedly in a factory and supplies gas to the injection passage of the injection plug. Thus, the gas is blown into the molten metal by way of the injection plug. Blowing the gas causes the molten metal to be stirred for ladle refining thereof.

[0004] However, during the transfer of the ladle to the next place for the next process, the gas blowing by the above fixed gas source is interrupted as the ladle containing molten metal is separated from the gas source fixedly disposed in the factory. Hence, the gas cannot be provided from the gas source to the molten metal during the transfer. When the blowing gas is interrupted, the molten metal in the ladle penetrates into the gas passage in the plug. If the penetrated molten metal is frozen in the injection passage, the injection passage and injection plug are partly or entirely choked up with the hardened metal, resulting in undesirable situations.

[0005] To overcome such drawbacks, a ladle has recently been provided with a cylinder which is accumulated with a compressed gas secured on the bottom or side thereof. Use of the ladle provided with the accumulator cylinder with a gas allows the gas to be injected into the ladle while the ladle separated from a fixedly disposed gas source apparatus is being transferred to the next process.

[0006] Thus, even during the transfer of the ladle, the gas in the accumulator cylinder can be fed to the injection passage of the injection plug connected to the ladle and hence a predetermined level of the gas back pressure is established in the injection passage. This back pressure prevents the molten metal from penetrating into the injection passage, thereby eliminating any inconveniences due to the choke of the injection passage.

[0007] By the way, the recent economic situations strongly demand that injection plugs used for stirring molten steel or others by blowing gas into ladles should be improved in productivity and lowered in production cost, in addition to higher durability and higher quality

for the stirring.

[0008] The characteristics that should be imposed on the injection plug can be summarized as follows:

- (1) an injection plug should be longer in its service life,
- (2) an injection plug should have a high gas-blowing success rate, and
- (3) an injection plug should have a gas-blowing characteristic to meet a metallurgical reaction and a stirring force.

[0009] Injection plugs are generally classified into a slit type of plug (in which a through hole is formed) that enhances the service life and a porous type of plug that attaches importance to reliability in bubbling. Each type of plug has its own characteristics, so that which type of plug should be used dependent on operating conditions.

[0010] For instance, differing from the porous type of plug, the slit type of plug can be manufactured using a dense castable refractory. Compared to the porous type of plug, the slit type of plug has both a lower porosity and a higher strength, thus is remarkably excellent in erosion resistance. Moreover, the slit type of plug has many advantages including higher flexibility to design of an amount of flow of blowing gas and supply of a large amount of flow of the gas.

[0011] However, regardless of such advantages, the porous type of plug has currently been used more often than the slit type. The reason is that the slit type of plug is easier to choke due to penetration of metal, which may bring about malfunctions in blowing the gas.

[0012] The ladle that has reached its life time is moved to a maintenance yard where the ladle is maintained. Usually, as part of the maintenance operation, the ladle is washed with oxygen gas to remove the penetrated metal remaining inside the plug. Though the porous type of plug is able to blow gas from its entire surface, the slit type plug has to blow gas from its thin slits. The slit type of plug becomes more difficult than the porous type of plug concerning the removal of the metal. As a result, comparison about the oxygen washing time shows that the slit type of plug needs a longer washing time than the porous type.

[0013] In the case of the above-mentioned conventional accumulator cylinder, a volume of gas accumulated in the cylinder has a certain limitation, which is largely different from the gas source apparatus. Each of the gas source apparatus are fixedly placed in a factory such that a sufficient amount and highly compressed gas is supplied for a stable flow of gas. Meanwhile, when the accumulator cylinder is used to blow the gas into the injection plug, the gas flow is obliged to suppress its gas pressure to lower values and the gas flow to smaller values.

[0014] Such a lowered gas pressure and a less gas flow make it impossible to hold a high gas back-pressure in the injection passage of the injection plug. Such an

insufficient back-pressure is difficult to completely avoid molten metal from penetrating into the injection passage.

[0015] When considering the above situation, the present inventors made an analysis with respect to not only improving how to accumulate the gas and how to blow the gas in cases where the accumulator cylinder is used but also how to raise the reliability in blowing gas into the injection plug. The analyzed results showed that an accumulator cylinder type of gas-blowing device and a ladle equipped with the device could be provided, which have the capability of avoiding molten metal more securely from penetrating into the injection plug, having high resistance which is highly effective for a longer service life of the injection plug.

Summary of the Invention

[0016] A first embodiment of the present invention provides a ladle equipped with a gas-blowing device provided with an accumulator cylinder, the gas-blowing device comprising:

- a main pipe for blowing gas into the ladle via a gas-blowing plug from a positionally independent gas supply source;
- an accumulator cylinder for accumulating the gas supplied through the main pipe; and
- a controller for accumulating the gas into the accumulator cylinder when the gas blowing through the main pipe begins or when the gas blowing is carried out, and for starting to blow the gas accumulated in the accumulator cylinder simultaneously with a termination of the gas blowing through the main pipe.

[0017] A second embodiment of the present invention provides a ladle configured such that the gas-blowing device having the accumulator cylinder is detachable from the ladle.

[0018] A third embodiment of the present invention provides a ladle configured such that the gas-blowing device having the accumulator cylinder is secured on either a bottom or a side of the ladle.

[0019] A fourth embodiment of the present invention provides a ladle configured such the main pipe is equipped with a check valve allowing the gas to be blown in a direction to the injection plug and a switching valve allowing the gas to be blown into the ladle.

[0020] A fifth embodiment of the present invention provides a ladle configured such that the controller has a loop pipe connected with both the main pipe and the accumulator cylinder, wherein the loop pipe comprises

- (a) a first check valve arranged to allow the gas to flow at least in the direction to the injection plug, and
- (b) a pressure-reducing valve arranged next to the first check valve.

[0021] A sixth embodiment of the present invention provides a ladle configured such that a pressure gauge and a flow meter are arranged in turn next to the pressure-reducing valve in the direction to the gas-blowing plug.

[0022] A seventh embodiment of the present invention provides a ladle configured such that both of a flow-regulating valve and a second check valve are arranged in turn next to both the pressure gauge and the flow meter.

[0023] An eighth embodiment of the present invention provides a ladle configured such that the ladle is configured to be used dedicatedly to molten metal including molten steel, molten iron, molten copper, and molten aluminum.

Brief Description of the Drawings

[0024] In the accompanying drawings:

- Fig. 1 is a sectional view showing a ladle equipped with a gas-blowing device provided with an accumulator cylinder according to an embodiment of the present invention;
- Fig. 2 is a block diagram of the accumulator cylinder type of gas-blowing device;
- Fig. 3 shows change of pressure versus time required for accumulating gas into the accumulator cylinder type of gas-blowing device, according to an embodiment;
- Fig. 4 shows changes of pressure and amounts of flow of gas versus time elapsing in discharging the gas from the accumulator cylinder type of gas-blowing device, according to an embodiment;
- Fig. 5A is a vertically sectioned view, taken along a line I - I in Fig. 5B, of a slit type of plug employed as an injection plug employed by the gas-blowing device, according to an embodiment; and
- Fig. 5B is a plan view of the slit type of plug.

Detailed Description of Preferred Embodiments

[0025] Referring to the accompanying drawings, various preferred embodiments of the present invention will now be described.

[0026] Penetration of molten metal into an injection plug and others of an injection plug will be caused due to static pressure applied by the molten metal itself, in cases where no ordinary gas blowing is carried out when the ladle is in transition, waiting, or operation for casting the molten metal. When a gas is continuously blown into the molten metal from the injection plug at a pressure larger than the static pressure applied by the molten metal, the penetration of the molten metal into the injection plug is avoided or at least reduced.

[0027] With reference to conceptually depicted in Fig.

1, a ladle 1 according to the present embodiment will now be described. In the present embodiment, the ladle 1 is equipped with gas-blowing device provided with an accumulator cylinder. The ladle 1 is able to accommodate therein high-temperature molten metal 2 (generally molten steel or molten iron) and at a bottom of the ladle is attached an injection plug 3 to blow gas into the molten metal 2 contained in the ladle 1.

[0028] Types of gas to be blown into the molten metal 2 include inert gas, such as argon gas or nitrogen gas. A factory is provided with gas supply sources 4 fixedly placed at several predetermined separate spots. The gas-blowing device can be connected to a gas supply source 4 for gas supply to the gas plug. Beneath the bottom of the ladle 1 is provided a gas-blowing device 5 having an accumulator cylinder. The gas-blowing device 5 is detachably secured, for example, on the bottom of the ladle bottom with a fitting, such as screws.

[0029] As shown in Fig. 1, the gas-blowing device 5 according to the present embodiment comprises a controller 6 and an accumulator cylinder 7, both of which are connected in parallel to a main pipe 8 used as a gas passage to perform the ordinary gas blowing. The gas-blowing device is also provided with a loop pipe connecting the main pipe 8 to the accumulator cylinder 7 so that the cylinder 7 is forcibly accumulated simultaneously with the start of a gas supply.

[0030] The gas accumulated into the accumulator cylinder 7 is subjected to control of pressure and flow amount thereof when the gas passes the controller 6. Hence the pressure and flow amount of the gas can easily be regulated depending on various operating conditions. The gas-flowing device 5 is configured in such a way that it automatically switches over from the ordinary gas blowing to gas blowing that uses the accumulator cylinder 5 as an alternative gas supply source, simultaneously with the end of the ordinary gas blowing. Instead of the configuration in which the gas-flowing device 5 is mounted on the bottom of the ladle 1, the device 5 may be mounted on a side of the ladle 1.

[0031] Referring to Fig. 2 also showing the concept of the present invention, the accumulator cylinder type of the gas-flowing device will now be explained. The main pipe 8 connected to the gas supply source 4 is provided with a main check valve 31, resulting in that the gas is allowed to flow in a direction to the injection plug 3 but prohibited from flowing in the opposite direction to the gas supply source 4. Thus, the gas is fed to the injection plug 3 through a switching valve 38, which is also inserted in the main pipe 8 near to the injection plug 3 than the main check valve 31.

[0032] With the gas being fed ordinarily, as long as the gas-blowing device 5 provided with an accumulator cylinder 7 is connected with the gas supply source 4, the gas is continuously supplied to the accumulator cylinder 7 via a first check valve 32 installed in the controller 6.

[0033] Specifically, in cases where the gas is accumu-

lated in the accumulator cylinder 7, a subsidiary pipe is used which branches at a certain position in the course of the main pipe 8. The first check valve 32 belonging to the controller 6, which is inserted in the subsidiary pipe, permits the gas to flow therethrough to the accumulator cylinder 7 where the gas is accumulated.

[0034] The first check valve 32 is subject to pressure-controlled so that the pressure of the gas contained in the accumulator cylinder 7 will remain below a predetermined pressure. It is preferred that the accumulator cylinder 7 is provided with a safety valve 39. In contrast, when the gas-blowing device 5 is disconnected from the gas supply source 4, the first check valve 32 prohibits the gas discharged from the accumulator cylinder 7 from routing to the main pipe 8.

[0035] To be specific, the gas that has been discharged from the accumulator cylinder 7 is supplied to a pressure-reducing valve 33, where the pressure of the gas is reduced to a certain level, the valve 33 serving as one member of the controller 6. In this embodiment, the gas whose pressure has been reduced is fed to a pressure gauge 34 where its pressure value is displayed, then to a flow meter 35 where its flow amount is displayed.

[0036] The gas is then fed to the main pipe 8 through both of a flow-regulating valve 36 and a second check valve 37, which are inserted for preventing an inverse flow of the gas. The pressure gauge 34, flow meter 35, flow-regulating valve 36, and second check valve 37 may be removed from the loop, if they are unnecessary according to design.

[0037] In regulating flow of the gas, it is advantageous that the flow-regulating valve 36 is disposed, which consists of, for example, a needle valve. When considering the inflow of the gas from the main pipe 8, it is required to use the second check valve 37. The gas is further supplied to the injection plug 3 by way of a switching valve 38.

[0038] With reference to Fig. 3, changes in the gas pressure to be accumulated in the accumulator cylinder of gas-blowing device 5 will now be explained. The gas-blowing device 5 according to the present invention is configured so that pressure can be accumulated in the cylinder during a period of time for the ordinary gas blowing operation in which a great deal of gas supplied from the gas supply source is blown from the injection plug. Because there is a difference between the pressure in the gas supply source and the pressure necessary for permitting the gas to flow through the injection plug, the difference in the pressures cause accumulation of the gas in the cylinder.

[0039] Fig. 3 shows the changes in a gas pressure accumulated in the cylinder during the ordinary gas blowing. As shown, when the gas supply source is approximately 10×10^5 Pa in pressure, the gas, whose pressure is about 2×10^5 Pa, is blown into the injection plug at a rate of 450 l/min. The lateral axis in Fig. 3 shows time (seconds), while the vertical axis therein shows the

gas pressure (Pa). The graph reveals that the pressure will be accumulated up to the pressure in the gas supply source for about 20 seconds.

[0040] An accumulating speed of the gas in the accumulator cylinder depends on gas permeability of the injection plug. More concretely, if the injection plug has a high gas permeability, its accumulating speed will be lowered. By contrast, when the injection plug is low in its gas permeability, its accumulating speed will be raised. In either way, the accumulation almost up to the source pressure can be achieved.

[0041] As a result, the gas of a predetermined pressure is accumulated in the cylinder 7. The pressure of the gas accumulated in the cylinder 7 may be chosen properly within the range of pressures lower than a pressure of the gas supply source 4. By way of example, a pressure can be chosen from the range of 4×10^5 to 10×10^5 Pa, but it is not limited to the amount selected from such a range.

[0042] With reference to Fig. 4, the gas blowing from the accumulator cylinder will now be explained. Fig. 4 represents changes in a gas pressure in cases where the accumulated gas in the cylinder is discharged through the injection plug, with the gas supply source having a pressure of about 10×10^5 Pa. In Fig. 4, the lateral axis shows time (min.), the left vertical axis shows a pressure (Pa), and the right vertical axis shows an amount of blown gas (liters/min.). Changes in the amount of blown gas are shown by rectangular marks, while the primary pressure, that is, the source pressure in the cylinder is represented by round marks. In addition, the secondary pressure, that is, a pressure before the injection plug is expressed by triangular marks.

[0043] As is clear from the curves shown in Fig. 4, both the amount of blown gas and the secondary pressure kept to their specified values last for about 23 minutes, and then begins to decrease in compliance with a decrease in the primary pressure in the cylinder. The gas blowing lasts for approximately 40 minutes, and then ceases.

[0044] The amount of gas blown from the accumulator cylinder 7 can be selected in an appropriate way depending on conditions including the quantity of molten metal to be contained in the ladle 1. For instance, such amount can be assigned to 1 to 20 liters per minute. The blowing time can for example be set to 5 to 60 minutes. As will easily be understood, the amount of blown gas per unit time and the blowing time are not limited to the above listed figures.

[0045] Furthermore, in the case that the gas contained in the accumulator cylinder 7 is short of both pressure and amount of flow, it is preferable to perform an accumulating operation by connecting the cylinder 7 to the gas supply source 4. This operation allows high-pressurized gas from the gas supply source 4 to be accumulated again into the cylinder 7.

[0046] Figs. 5A and 5B are schematic views showing a slit type of plug, which is one example of the injection

plug 3 according to the present embodiment. In Fig. 5A, a longitudinally sectioned view of the slit type of plug is illustrated, while in Fig. 5B, a top plan view thereof is illustrated. As shown in Fig. 5A, the slit type of plug, which is made of refractory material, is formed into a trapezoid in section.

[0047] The slit type of plug 51 has a plurality of slits 52, which are formed therethrough so as to function as injection gas passages. Hence the gas that has entered the injection passages is guided therealong. The slits 52 are formed so that they pass through in parallel with the longitudinal center axis of the slit type of plug 51.

[0048] For example, the slits 52 are formed so as to connect an upper end surface 53 of the plug 51 to a lower end surface 55 thereof. Thus, as shown in Fig. 5A, the slits 52 have upper-end openings 54 to come into contact with the molten metal in the cylinder and lower-end openings 56 to introduce gas.

[0049] Furthermore, an alternative configuration concerning the slits 52 is such that another type of injection plug, for example, a porous type of plug is mounted on the upper end surface 53 of the slit type of plug 51. In this configuration, the slits 52 are also formed to link their upper-end openings 54 to blow gas into the porous type of plug to their lower-end openings 56.

[0050] As described, the slits 52 are formed in such a manner that they penetrate the slit type of plug 51, with the result that the gas is easier to flow, resistance against flow of gas is reduced, and pressure loss becomes smaller.

[0051] As shown in Fig. 5B, by way of example, each of the slits 52 is formed to have two long sides 52x facing to each other and have two short sides 52y facing to each other. The slits 52 are composed of a large number of slits formed in a radial direction when viewed in section perpendicular to the longitudinal axis of the plug. Each of the upper-end openings 54 and each of the lower-end openings 56 are identical in the opening shapes to each other, and formed to have both the two long sides 52x and the short sides 52y, respectively.

[0052] Accordingly, because each slit 52 is shaped into an elongated strip in the horizontal section, which is advantageous in suppressing the molten metal from penetrating into the slit passages, which constitute a sectional area of all the slit passages formed in the injection plug 3 still secured as large as possible.

[0053] The ladle according to the present embodiment is applicable to molten metals such as molten steel, molten iron, molten copper, and molten aluminum. By way of example, in the case that molten steel is employed as the molten metal, applicable processes include an receiving process of the molten steel in the ladle, a ladle refining process for the second refining, a degassing process after the ladle refining, a continuous casting process in which the molten steel in the ladle is discharged to a tundish of a continuous casting machine to continuously cast it, a slag-removal process conducted after the continuous casting, and a washing process

of a gas-blowing plug with oxygen gas.

[0054] For the ordinary gas-blowing operation, the gas-blowing device is connected with the gas supply source 4 disposed at each of the stations of a factory, in which the above receiving process, ladle refining process, degassing process, and continuous casting process are carried out. This connection enables the gas supply source 4 to automatically accumulate gas into the accumulator cylinder 7.

[0055] The above processes still involve a transfer process to transfer the ladle 1 from the acceptance process to the ladle refining process, a further transfer process to transfer the ladle 1 from the ladle refining process to the degassing process, and a still further transfer process to transfer the ladle 1 from the degassing process to the continuous casting process, in addition to both of the foregoing slag-removal process in which slag remains in the ladle 1 are exhausted by tilting the ladle 1 from which the molten steel has been discharged into the tundish and the washing process in which deposits such as residuals of molten steel are removed by spraying oxygen gas into the ladle 1 and the injection plug 3 after the exhaust of the slag.

[0056] The gas blowing from the accumulator cylinder 7 is carried out at one or more processes selected from the foregoing processes, transfer processes, slag removal process, and washing process. For removing the choke in the injection plug, it is preferable to carry out a blowing operation with a small quantity of gas for all the process for the acceptance, transfers, slag removal, and washing.

[0057] In the case that the gas supply source 4 is not disposed at the site for the acceptance process, it is easier that the molten steel to become metal penetrates into the slits of the injection plug 3. In that case, it is preferable to set up the ladle 1 such that it accepts the molten steel in the state where the accumulator cylinder 7 is operated to supply gas to the injection plug 3 for gas blowing.

[0058] Further, in cases where the gas supply source 4 is not disposed at the site for the continuous casting process, it is preferred that, with the accumulator cylinder 7 driven so as to provide the injection plug 3 with gas, the molten metal in the ladle 1 is transferred to the tundish. An amount of the molten steel in the ladle 1, that is, a surface level of the molten steel, will decrease in an end period of time in the continuous casting process.

[0059] Therefore static pressure due to the molten metal, which is exerted on the injection plug 3, becomes small in the end period compared to a beginning period in the continuous casting process. Hence supplying the gas to the injection plug 3 from the accumulator cylinder 7 in the end period in the continuous casting process allows residuals in the slots to be exhausted.

[0060] In addition, the gas can be supplied from the accumulator cylinder 7 to the injection plug 3 in the dregs-exhausting and/or washing processes. This sup-

ply is also effective for exhausting residuals in the slits of the plug.

[0061] In each of the foregoing processes, a surface level of the molten metal in the ladle 1 determines molten-metal-originated static pressure (per unit area) exerted on the injection plug 3. The molten metal tries to penetrate into the slits of the injection plug 3 depending on its current molten metal surface level. Hence, providing the slits with gas back pressure (per unit area) equal or more to or than a molten-metal static pressure acting on the slits makes it possible to effectively suppress the penetration of the molten metal into the slits.

[0062] In each of the foregoing transfer processes, the accumulator cylinder 7 is driven to supply its accumulated gas to the injection plug 3. The gas blowing from the injection plug 3 will suppress the molten metal from penetrating into the slits of the injection plug 3. Thus, though the ladle 1 will be transferred after being separated from the gas supply source 4 (that is, no gas is supplied from the gas supply source 4 during the transfer), the alternative gas supply from the accumulator cylinder 7 can be obtained. As a result, the slits of the injection plug 3 are released from their chokes due to penetration of the molten metal.

[0063] In the above configuration, if there is no necessity for changing the conditions for a gas-blowing operation, it is enough that the pressure-reducing valve and the flow meter in the controller are once subjected to their settings. Such modification permits the accumulator cylinder to operate for gas blowing under a certain condition at any time. Alternatively, it is also self-evident that an ordinal transmission/reception apparatus can be used to adjust the pressure-reducing valve and/or the flow meter based on a wireless or wired remote operation manner. The remote operation is able to secure safety for handling the ladle that contains molten metal.

Example

[0064] A slit type of plug, serving as an injection plug, mounted on the bottom of the ladle was subjected to an examination. Molten steel was employed as molten metal. Two plugs are mounted on the ladle bottom for comparative test, in which the gas-blowing device with the accumulator cylinder was attached to one plug and no washing with oxygen gas was conducted (such washing will normally be conducted).

[0065] On the other hand, the other plug was not connected to the accumulator cylinder type of gas-blowing device, but the slit type of plug underwent the ordinal operation including washing with oxygen gas. The capacity of the accumulator cylinder was 38 liters. A supply pressure of gas was 10×10^5 Pa and the pressure-reducing valve was set to 3×10^5 Pa. An amount of flow from the gas-blowing device with the accumulator cylinder was determined to be 10 liters/min.

[0066] The examination results showed that the slit type of plugs of which original lengths were both 455

mm changed differently between the ordinary operation and the operation according to the present invention. That is, the slit type of plug that performed the ordinary operation without the gas-blowing device according to the present invention changed into a plug of which remaining length is 190 mm. In contrast, the slit type of plug that used the gas-blowing device according to the present invention changed into a plug of which remaining length was 315 mm.

[0067] Accordingly, the erosion of the slit type of plug according to the present invention was reduced to almost half of that for the plug to which the ordinary operation is applied. Thus, it has been found that a remarkable advantage is provided by the present invention. Additionally, wetting of the molten steel to the slit type of plug was also examined. The results were such that the gas-blowing device according to the present invention showed almost no wetting, while the wetting based on the ordinary operation showed about 50 mm.

[0068] The ladle equipped with the gas-blowing device with the accumulator cylinder according to the present invention suppresses molten metal from penetrating into the injection plug, thereby contributing to reduction in poor gas blowing. In addition, to suppress the penetration of the molten metal lessens the number of times of washing with oxygen gas. Hence, it is remarkably advantageous in obtaining a longer service life of the plug.

Claims

1. A ladle equipped with a gas-blowing device provided with an accumulator cylinder type, the gas-blowing device comprising:

- a main pipe (8) for blowing gas into the ladle (1) via a gas-blowing plug (3) from a positionally independent gas supply source (5);
- an accumulator cylinder (7) for accumulating the gas supplied through the main pipe (8); and
- a controller (6) for accumulating the gas into the accumulator cylinder (7) when the gas blowing through the main pipe (8) begins or when the gas blowing is carried out, and for starting to blow the gas accumulated in the accumulator cylinder (7) simultaneously with a termination of the gas blowing through the main pipe (8).

2. The ladle according to claim 1, wherein the gas-blowing device (5) having the accumulator cylinder (7) is detachable from the ladle (1).

3. The ladle according to claim 1 or 2, wherein the gas-blowing device (5) having the accumulator cylinder (7) is secured either on a bottom or a side of the ladle (1).

4. The ladle according to any of claims 1 to 3, wherein the main pipe (8) is equipped with a check valve (31) allowing the gas to be blown in a direction to the injection plug (3) and a switching valve (38) allowing the gas to be blown into the ladle (1).

5. The ladle according to any of claims 1 to 4, wherein the controller (6) has a loop pipe connected with both the main pipe (8) and the accumulator cylinder (7), wherein the loop pipe comprises

- (a) a first check valve (32) arranged to allow the gas to flow at least in the direction to the injection plug (3), and
- (b) a pressure-reducing valve (33) arranged next to the first check valve (32).

6. The ladle according to claim 5, further comprising a pressure gauge (34) and a flow meter (35) arranged in turn next to the pressure-reducing valve (33) in the direction to the gas-blowing plug (3).

7. The ladle according to claim 6, further comprising a flow-regulating valve (36) and a second check valve (37) arranged in turn next to both the pressure gauge (34) and the flow meter (35).

8. The ladle according to any of claims 1 to 7, wherein the ladle (1) is configured to be used dedicatedly to a ladle for molten steel, molten iron, molten copper, and molten aluminum.

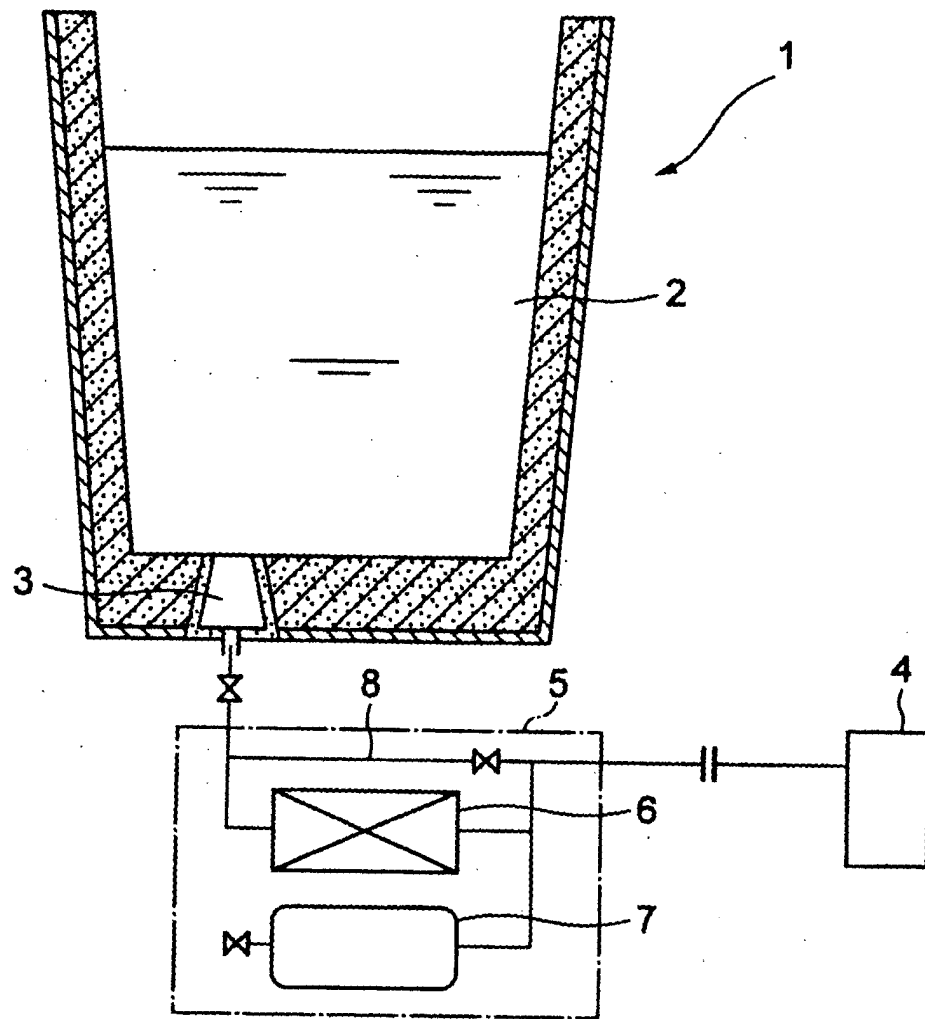


FIG. 1

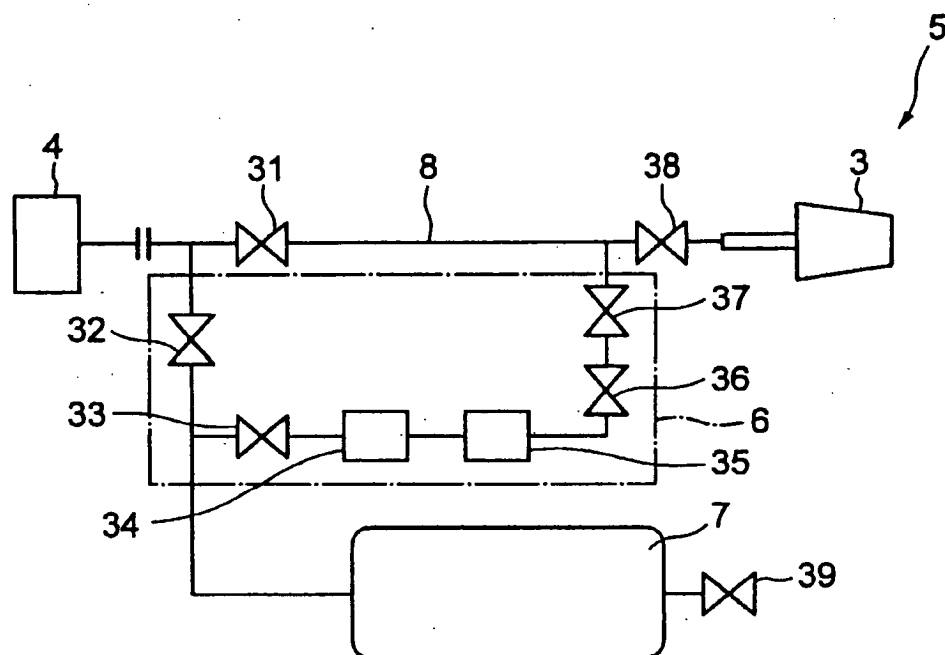


FIG. 2

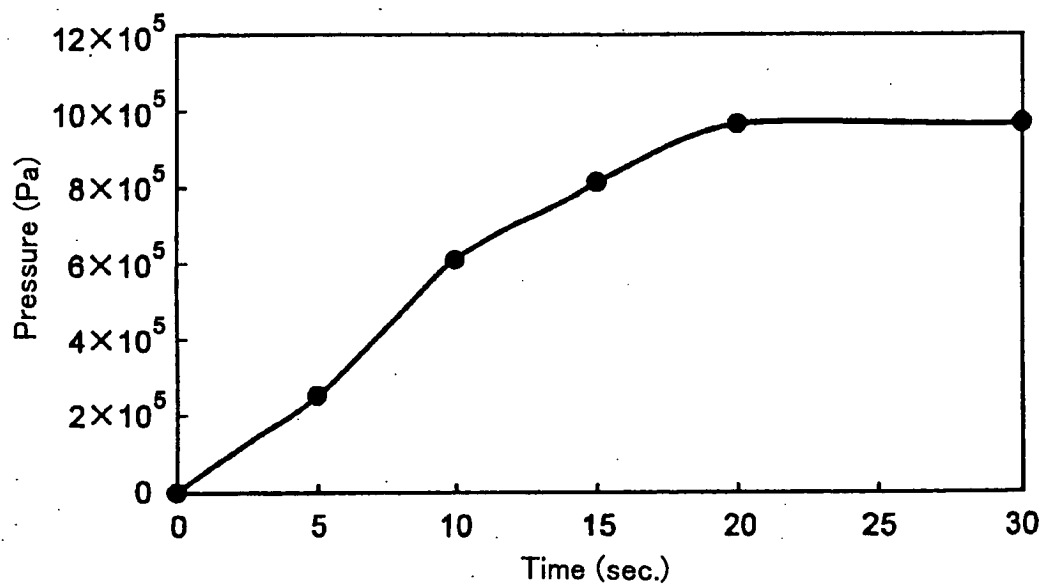


FIG. 3

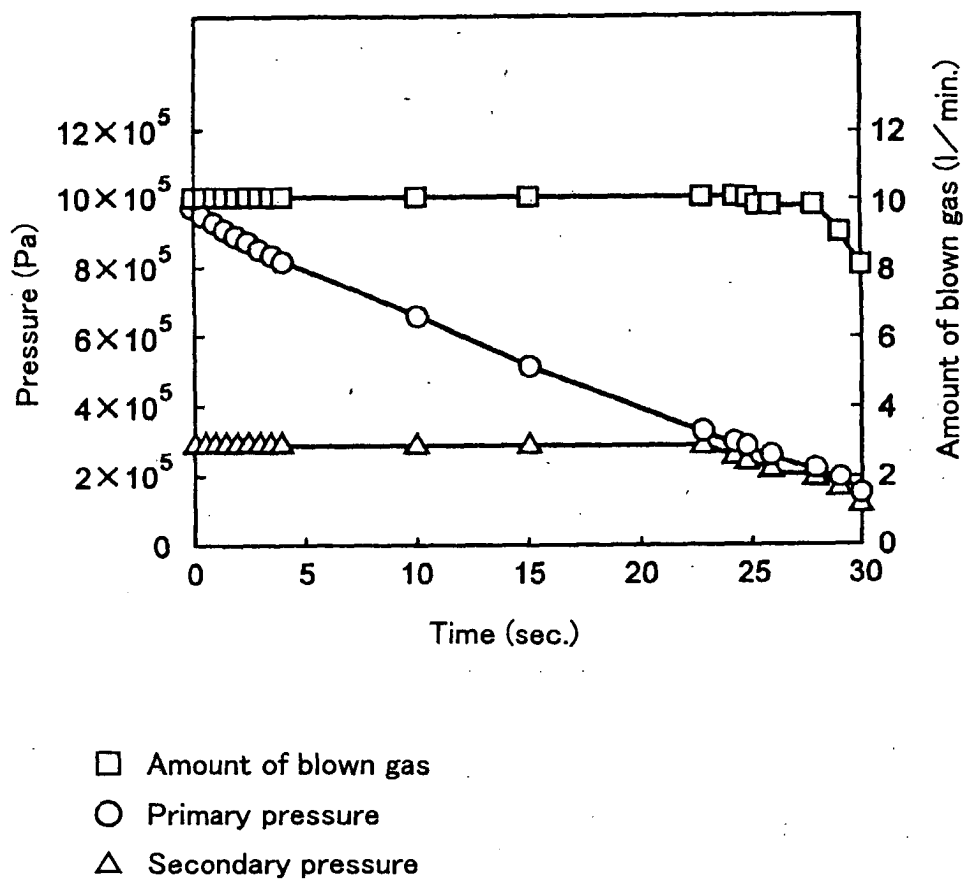


FIG. 4

FIG. 5A

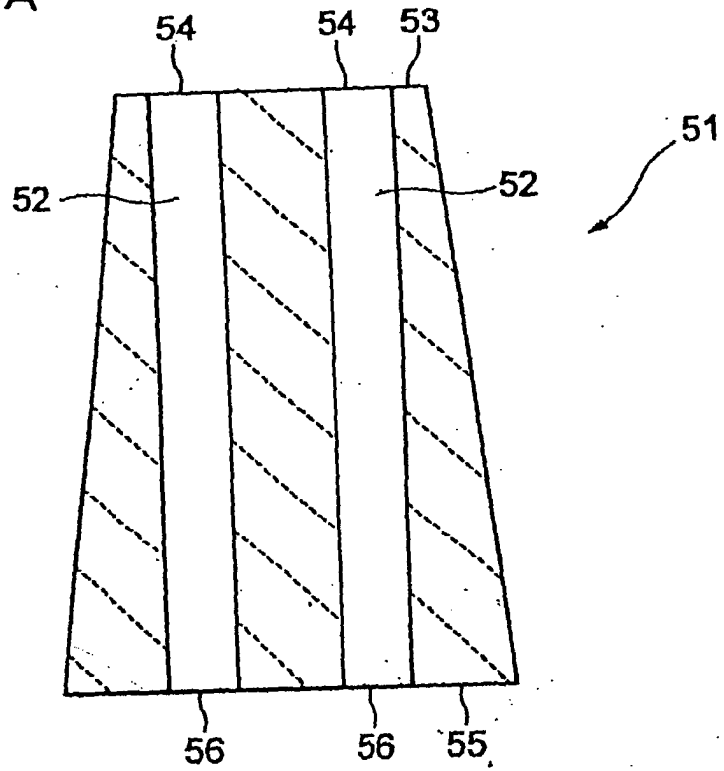


FIG. 5B

