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(71) Applicant: **Ramon Science and Technology Co., Ltd**
Hengyang, Hunan 421001 (CN)

(72) Inventors:
- **TIAN, Zhiheng**
  Hengyang
  Hunan 421001 (CN)
- **TIAN, Lu**
  Hengyang
  Hunan 421001 (CN)
- **TIAN, Li**
  Hengyang
  Hunan 421001 (CN)

(74) Representative: **Gunzelmann, Rainer**
Wuesthoff & Wuesthoff
Patent- und Rechtsanwälte
Schweigerstraße 2
81541 München (DE)

(54) **DEVICE AND METHOD FOR ADDING FLUX SLAG TO MOLD OF CONTINUOUS CASTING MACHINE**

(57) A device for adding flux slag to a mold of a continuous casting machine includes a slag hopper (101) for containing flux slag (112); a flux slag distributor having a spiral conveyor for conveying the flux slag and a plurality of ration chambers (106j) arranged in the pipe shell length direction of the spiral conveyor with slag spraying ports (106k); a flux slag pipeline assembly for connecting the slag hopper (101) with the spiral conveyor; a compressed gas supply device for supplying compressed gas to all ration chambers and a controller (103) for at least adjusting the spiral conveyor and the compressed gas supply device. A method for adding flux slag to a mold of a continuous casting machine is also provided. The slag-adding speed can be adjusted, and the slag distributes more uniform over the molten steel by using the device or the method of the invention.

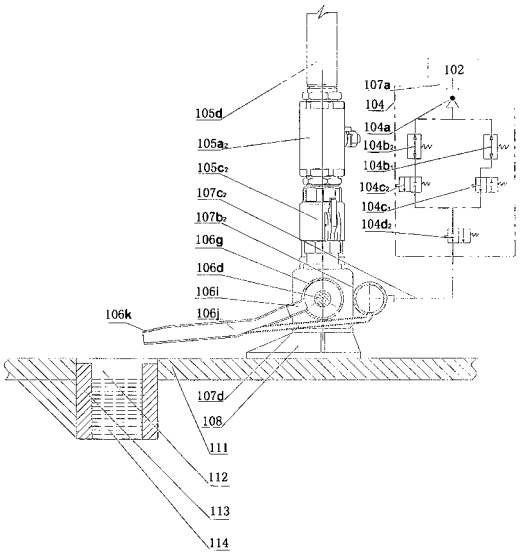


Fig. 5

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Description

Field of the invention

[0001] The invention relates to continuous casting machines, and more particularly, to a device and method for adding flux slag to a mold of a continuous casting machine.

Background art

[0002] Automatically adding slag to a mold is very important for ensuring the quality of the billet. One approach for adding slag is to use a compressed gas spraying slag method to add flux slag to the mold.

[0003] However, in the process of implementing the invention, the inventors found that there is a problem of non-uniform distribution of the slag when the compressed gas spraying slag method is used to add flux slag.

Summary

[0004] It is an object of the invention to provide a device for adding flux slag to a mold of a continuous casting machine, which can uniformly add slag. It is a further object of the invention to provide a method for adding flux slag to a mold of a continuous casting machine, which can uniformly add slag.

[0005] Therefore, on the one hand, the invention provides a device for adding flux slag to a mold of a continuous casting machine, which includes a slag hopper for containing flux slag; a flux slag distributor having a spiral conveyor for conveying the flux slag and a plurality of ration chambers arranged in a pipe shell length direction of the spiral conveyor with slag spraying ports; a flux slag pipeline assembly for connecting the slag hopper with the spiral conveyor; a compressed gas supply device for supplying compressed gas to each of the ration chambers for blowing the flux slag; and a controller for controlling the spiral conveyor and the compressed gas supply device.

[0006] In one embodiment, the slag hopper is disposed on a tundish operating platform of the continuous casting machine, the flux slag distributor is located on a cover of the mold.

[0007] In one embodiment, the flux slag pipeline assembly includes a down slag tube, an electric control adding slag valve and a manual adding slag valve connected to each other.

[0008] In one embodiment, the flux slag pipeline assembly further includes a first quick connector and a second quick connector installed at top and bottom sides of the down slag tube; a roller being disposed at another end of the flux slag distributor far away from the flux slag pipeline assembly; and the spiral conveyor has fixtures for supporting the weight of the spiral conveyor and the ration chambers.

[0009] In one embodiment, the spiral conveyor includes a transporting slag tube, a transporting slag screw rod located in the transporting slag tube, a receiving slag box located at a front end of the transporting slag tube, a slag collecting and discharging box located at a terminal end of the transporting slag tube, and a power unit for driving the transporting slag screw rod to rotate.

[0010] In one embodiment, the plurality of ration chambers includes at least two ration chambers with different volumes.

[0011] In one embodiment, the compressed gas supply device includes a gas tank, a first pressure branch and a second pressure branch at least connected to the gas tank, and a gas distribution tube connected to the first pressure branch and the second pressure branch.

[0012] In one embodiment, the gas distribution tube includes a plurality of pressure distribution tubes, a plurality of compressed air branch tubes connected to each of the pressure distribution tubes, a plurality of compressed air branch ducts connected to each of the compressed air branch tubes; wherein each of the pressure distribution tubes has the control valves set therein, and each compressed air branch ducts is communicated with corresponding ration chambers.

[0013] In one embodiment, open frequency of the control valves and/or speed of the spiral conveyor for conveying the flux slag are controlled by the controller.

[0014] On the other hand, the invention provides a method for adding flux slag to a mold of a continuous casting machine, which includes following steps: 1) arranging a group of slag spraying ports along a long side of a copper mouth of the mold; and 2) causing the flux slag being uniformly distributed in the range of a section of a molten steel of the mold where the flux slag falls by adjusting the pressure of a compressed gas which blows the flux slag during each of the slag spraying ports spraying slag.

[0015] In one embodiment, a pressure value of the compressed gas is adjustable between a first predetermined pressure value and a second predetermined pressure value; wherein the compressed gas of the first predetermined pressure value causes the flux slag to fall on one surface which is close to an inner arc and is of the molten steel of the mold; the compressed gas of the second predetermined pressure value causes the flux slag to fall on one surface which is close to an outside arc and is of the molten steel of the mold.

[0016] Further, the compressed gas has a first predetermined pressure vale, a second predetermined pressure, and a third predetermined pressure vale between the first and second predetermined pressure vales.

[0017] Preferably, the different predetermined pressure vales of the compressed gas are implemented through corresponding pressure adjusting branches, and opening or closing of each pressure controlling branch is controlled by control valves of the each pressure controlling branch.

[0018] Preferably, each pressure adjusting branch is connected to the same gas supplying source, and size

of the pressure in each pressure adjusting branch is realized by a pressure reducing valve reducing pressure.

[0019] Preferably, dividing each group of spraying slag ports into a plurality of small groups and distributing the compressed gas to each small group of spraying slag ports through distributing conduits, wherein a valve is respectively set in each of the distributing conduits to control opening or closing of the each of the distributing conduits, and the compressed gas is alternately supplied to each small group of spraying slag ports by controlling the open frequency of the valves.

[0020] Preferably, a supplying time of compressed gas of each small group of spraying slag ports is determined by a time interval between opening and closing the valves of the distributing conduits.

[0021] The device and method for adding flux slag to mold of continuous casting machine of the invention, by means of arranging a group of slag spraying ports along a long side of a copper mouth of the mold and controlling slag spraying ports speeds, the flux slag is uniformly distributed over one surface close to the inner arc of the molten steel in the mold and over one surface close to the outside arc of the molten steel in the mold, thereby uniformly adding the slag.

[0022] In addition to the above described purposes, characteristics, advantages, the invention further has other purposes, characteristics, advantages. The other purposes, characteristics, effects of the invention are hereinafter further explained in details with reference to drawings.

Brief description of the drawings

[0023] The accompanying drawings which constitute a part of the specification and are used for further understanding of the invention illustrate a preferred embodiment of the invention and, together with the specification, serve to explain the principles of the invention, in which:

Fig. 1 shows a device for adding flux slag to mold of continuous casting machine according to the invention;

Fig. 2 shows a schematic partially enlarged view of a flux slag distributor of the device for adding flux slag to mold of continuous casting machine of Fig. 1;

Fig. 3 shows a section view of the device for adding flux slag to mold of continuous casting machine of Fig. 1 taken along line A-A;

Fig. 4 shows a schematic partially enlarged view of the flux slag distributor of the device for adding flux slag to mold of continuous casting machine of Fig. 3;

Fig. 5 shows a section view of the device for adding flux slag to mold of continuous casting machine of Fig. 1 taken along line B-B;

Fig. 6 shows a system control diagram of the device for adding flux slag to mold of continuous casting machine of Fig. 1.

Detailed description of examples

[0024] In order to make objects, technical solutions and advantages of the invention clear, the invention is hereinafter further explained in details with reference to embodiments and drawings.

[0025] Figs. 1-5 are schematic structure views of a device for adding flux slag to mold of continuous casting machine according to the invention. Referring to Figs. 1-5, the device for adding flux slag to mold of continuous casting machine of the invention includes a slag hopper 101, a flux slag pipeline assembly, a flux slag distributor, a compressed gas supply device and a controller 103.

[0026] Each of the components will be described in the following in details, respectively. When referring to exterior characteristics of the device of the invention, please refer to Figs. 1-2; when referring to interior characteristics of the device of the invention, please refers to Figs. 3-5.

[0027] The slag hopper 101 is used to contain flux slag 112, and is disposed on a tundish operating platform 110. The slag hopper 101 has a slag outlet at its bottom.

[0028] The flux slag pipeline assembly, also called flux slag transfer pipeline, is used to connect the slag hopper 101 which is located above with the flux slag distributor which is located below, for the flux slag passing there through under control.

[0029] The flux slag pipeline assembly includes an electric control adding slag ball valve $105a_1$, a pneumatic clamping valve 105b, a quick connector $105c_1$, a down slag tube 105d, a manual adding slag ball valve $105a_2$, and a quick connector $105c_2$.

[0030] The quick connector $105c_1$ and the quick connector $105c_2$ are connected to opposite ends of the down slag tube 105d, respectively, for facilitating quickly disassemble the down slag tube 105d to remove the flux slag distributor.

[0031] Not all of the valves of the above flux slag pipeline assembly are necessary, and can be selected according to the needs, for example, the pneumatic clamping valve 105b can be omitted. The flux slag pipeline assembly can also have other device or equipment, for example, sensors for weight measurement, vibration devices for vibrating to assist down slag and so on.

[0032] The flux slag distributor, also called flux slag distributing assembly, is used to provide a plurality of slag spraying ports having controlled slag spraying speeds. These slag spraying ports are arranged a long side of the copper mouth of the mold to uniformly add slag to the molten steel in the mold.

[0033] The flux slag distributor specifically includes a spiral conveyor and a group of ration chambers 106j installed in the spiral conveyor.

[0034] The above mentioned spiral conveyor includes a motor 106a, a speed-down box 106b, a coupling as-

sembly 106c, a receiving slag box 106f, a transporting slag tube 106g, a transporting slag screw rod 106d located in the transporting slag tube 106g, a bearing seal assembly $106e_1$ located in a front end of the transporting slag screw rod 106d, a bearing seal assembly $106e_2$ located in a rear end of the transporting slag screw rod 106d, and a slag collecting and discharging box 106h located at a terminal end of the transporting slag tube 106g.

[0035] The above mentioned receiving slag box 106f is connected to the quick connector $105c_2$ to receive the flux slag from the slag hopper 101. The flux slag entering into the receiving slag box 106f is transported forward through the transporting slag screw rod 106d. The transporting slag screw rod 106d is driven to rotate by the motor 106a through the speed-down box 106b and the coupling assembly 106c.

[0036] The motor 106a is best to be an adjustable-speed motor such as stepper motor, so that the rotation speed of the transporting slag screw rod 106d can be adjusted. Of course, the driving motor 106a can also be a general motor or other power units for driving screw rotation, such as hydraulic motor and the like.

[0037] Each ration chamber 106j is communicated with the transporting slag tube 106g through a discharging slag tube 106i, to receive the flux slag from the transporting slag tube 106g. Each ration chamber 106j has a pipe segment with an expanded cross-sectional area to accumulate the flux slag. A terminal end of the pipe segment forms slag spraying ports 106k. Each ration chamber 106j is supplied with compressed gas through compressed air branch ducts 107d to blow the flux slag in the ration chamber out through the slag spraying ports 106k.

[0038] In the embodiment shown in the figures, the spiral conveyor has 15 ration chambers; in other embodiments the number of the ration chambers 106j can be increased or decreased according to needs such as the length of the long side of the copper mouth of the mold, for example, 10, 12, 14, 16, 18, 20, 21, 22, 25, 30 and so on.

[0039] The volume of the above mentioned each ration chamber for accumulating the flux slag can vary from each other, so that different amounts of slag are blown to the mold at the same time for adding slag. At this time, it is very useful for the ration chambers to be detachably installed on the transporting slag tube 106g. Moreover, the ration chambers can be made in the form with an adjustable volume.

[0040] The spiral conveyor can further have two or more fixtures 108 for supporting, to support the weight of the whole spiral conveyor when adding the slag. A roller 109 is disposed at an end of the spiral conveyor. A bottom of the roller 109 is higher than bottoms of the fixtures 8. During the process of adding slag, the roller is not in contact with a cover of the mold. When the spiral conveyor is removed, an end of the spiral conveyor where the slag enters into is lifted up, the roller then contacts with the cover 111; one operator can remove the flux slag distributing assembly from the mold cover.

[0041] The compressed gas supply device is used to supply compressed gas to each ration chamber 106j to blow the flux slag in the ration chamber out through the slag spraying ports 106k. The compressed gas is not limited to air, and can also be gas such as nitrogen which can avoid oxidation of molten steel.

[0042] The compressed gas supply device includes a gas tank 102, a gas control cabinet 104 having different pressure branches, and a gas distribution tube for providing compressed gas to each ration chamber.

[0043] The above mentioned gas control cabinet 104 includes an electronic control high pressure ball valve 104a, a pressure reducing valve $104b_1$ and high pressure electromagnetic valve $104c_1$ branch (first pressure branch), a pressure reducing valve $104b_2$ and a low pressure electromagnetic valve $104c_2$ (second pressure branch), an electromagnetic valve $104d_1$ for controlling the high pressure gas branch tube $107c_1$, an electromagnetic valve $104d_2$ for controlling the high pressure gas branch tube $107c_2$, and an electromagnetic valve $104d_3$ for controlling the high pressure gas branch tube $107c_3$. The high pressure electromagnetic valve $104c_1$ and the low pressure electromagnetic valve $104c_2$ are interlocked, that is, one opens the other closes. The electromagnetic valve $104d_1$, electromagnetic valve $104d_2$ and electromagnetic valve $104d_3$ can be interlocked, that is, one opens another two close.

[0044] The above mentioned gas distribution tube includes the high pressure gas branch tubes $107c_1$, $107c_2$ and $107c_3$, high pressure gas distribution tubes $107b_1$, $107b_2$ and $107b_3$, and a plurality of high pressure gas branch ducts 107d. The high pressure gas branch tubes $107c_1$, $107c_2$ and $107c_3$ are controlled to open or close by the electromagnetic valve $104d_1$, electromagnetic valve $104d_2$ and electromagnetic valve $104d_3$, respectively.

[0045] The above mentioned gas tank 102 can further have a pneumatic valve gas supplying tube 107e, to provide actuation gas for the pneumatic clamping valve 105b so as to control opening or closing of the pneumatic clamping valve 105b.

[0046] The above mentioned compressed gas supply device can provide two different kinds of compressed gas with high pressure or low pressure; in other embodiments, the gas control cabinet can also have a third pressure branch, thereby providing a compressed gas of third type of pressure. Of course, in other embodiments, a pressure continuously adjustable device such as high pressure pump can also be provided. Further, in the compressed gas supply device, open frequency of each control valve, switching between the valves and the like are controlled by the controller 103. However, the above described compressed gas supply device are only preferable embodiment, can also be other structures. The controller 103 will be described in the following in details.

[0047] The controller 103 is placed in a tundish car rail column 115, and provides control signals to components

that are needed to be controlled. With reference to Fig. 1 and Fig. 6, the controller 103 controls the motor 106a of the spiral conveyor and the gas control cabinet 104 to control the rotation speed of the motor 106a and open frequency of each control valve and switching between the valves of the gas control cabinet 104. Optionally, the controller 103 can automatically control according to predetermined states, and can also work according to input conditions from input devices such as sensors, keyboards and the like.

[0048] The running state of the device for adding flux slag to mold of continuous casting machine of the invention will be described in the following. Referring to Figs. 1-6, the flux slag 112 located in the slag hopper 101 which is on the tundish operating platform, enters into the receiving slag box 106f of the flux slag distributing assembly 106 which is located at an inner arc side of the mold cover 111, through the electric control adding slag ball valve $105a_1$, the pneumatic clamping valve 105b, the quick change coupler $105c_1$, the gravity down slag tube $105a_1$, the manual adding slag ball valve $105a_2$, and the quick change coupler $105c_2$.

[0049] Through the speed-down box 106b and the transporting slag screw rod 106d, the motor 106a supplies the flux slag in the receiving slag box 106f to the ration chambers 106j distributed along the length side of the mold via the transporting slag tube 106g and the discharging slag tube 106i.

[0050] After high pressure gas through the gas tank 102, a high pressure gas supplying tube 107a and the electronic control high pressure ball valve 104a of the gas control cabinet 104, the high pressure gas is divided into two branches: one branch through the pressure reducing valve $104b_1$ and the high pressure electromagnetic valve $104c_1$ provides high pressure gas, other branch through the pressure reducing valve $104b_2$ and the low pressure electromagnetic valve $104c_2$ provides low pressure gas; the two branches converge into one and then is divided into three branches, which are respectively through the electromagnetic valve $104d_1$ and the high pressure gas branch tube $107c_1$, the electromagnetic valve $104d_2$ and the high pressure gas branch tube $107c_2$, the electromagnetic valve $104d_3$ and the high pressure gas branch tube $107c_3$, and then supplied to the high pressure gas distribution tubes $107b_1$, $107b_2$ and $107b_3$, of which each is respectively divided into 5 branches of high pressure gas branch ducts 107d connected to the ration chambers 106j.

[0051] When the electronic control high pressure ball valve 104a and the high pressure electromagnetic valve 104c open, high pressure gas blows the flux slag in the ration chambers 106j out to one surface which is close to the outside arc and is of the molten steel 114 of the mold 113. When the electronic control high pressure ball valve 104a and the low pressure electromagnetic valve $104c_2$ open, low pressure gas blows the flux slag in the ration chambers 106j out to one surface which is close to the inner arc and is of the molten steel 114 of the mold 113. Therefore, a uniform slag covering layer 112 is formed on the surface of the molten steel. The pipeline assembly has the pneumatic clamping valve 105b. When the clamping electromagnetic valve 104e of the gas control cabinet 104 opens, the clamping valve 105b closes, the flux slag pipeline assembly 105 stops conveying slag. Electric signals for controlling all the above mentioned components are provided by the controller 103 which is placed in the tundish car rail column 115.

[0052] Through the above description, it can be seen the device for adding flux slag to mold of continuous casting machine of the invention obtains the following effects:

[0053] The controller controls rotating speeds of the screw in the spiral transporting slag tube driven by the motor and the open frequency of the control valves of the transporting flux slag tube and the high pressure gas supplying tube, the speed of adding slag can be adjusted according to the optimal consumption amount of the slag by the mold.

[0054] The volume of each of the ration chambers distributed along the length side of copper mouth of the mold can be adjusted according to consumption rate of the slag by the surface of the molten steel where it locates.

[0055] The slag hopper, the controller and the control valves of the slag tube of the device for adding slag are installed on a suitable position far away from the mold cover, other components go by the general name of flux slag distributing assembly which has a compact structure and a light weight and are installed on the cover.

[0056] The existing automatically adding slag device uses a pendular tube for adding slag. The disadvantage of the pendular tube for adding slag is that the tube for adding slag is too long and a screw rod thereof is long to ten meters which takes up large area of the cast-steel platform of the mold and greatly affects the normal operation of the cast-steel platform. Another automatically adding slag device is slag hopper moving type. The disadvantage of the slag hopper moving type is that the slag hopper of the moving device is higher and can only be installed outside of inner arc cover of the continuous casting machine. When the tundish car railway is in the inner arc and close to the cover, the device for adding slag can only be installed outside of the railway. This causes the tube for adding slag longer and taking up large area thereby obstructing manufacturing operation, and not suitable for a continuous casting machine with a turntable tundish.

[0057] The device for adding flux slag of the invention can be miniaturized, for example, having a height smaller than 150 millimetres (mm), a width smaller than 350mm and a length designed according to the cross section of the mold, the flux slag distributing assembly is installed on the mold cover close to the copper mouth, while other bulky components are installed at positions which are far away from the cover and do not affect processing operation. The device for adding flux slag of the invention can be widely used and be adapted to be used in the continuous casting machine with the turntable tundish.

[0058] The ration chambers of the invention are dis-

tributed along the length side of the copper mouth of the mold, the volume of each of the ration chambers can be adjusted according to consumption rate of the slag by the surface of the molten steel where it locates, that is, the slag is supplied according to need.

[0059] The rotating speeds of the motor which drives the screw in the spiral transporting slag tube to spirally transport the slag, and the open frequency of the control valves of the transporting slag tube and the gas tube are controlled by the controller according to the consumption rate of the slag by the mold.

[0060] The gas supplying tube of the invention has the pressure reducing valves, which can adjust the inlet gas pressure into the ration chambers to enable the flux slag blown to the surface of the molten steel to be uniformly distributed in the range of the section of the mold.

[0061] The flux slag distributing assembly of the invention has light weight, in one embodiment, about 60 kilogrammes. The flux slag distributing assembly has the roller disposed at an end thereof. During the operation of the automatically adding slag system the roller is hanged in the air. When it is needed to remove the flux slag distributing assembly from the mold cover after stopping work, the quick change couplers are first pulled out from the slag tube and the gas tube, and then the end of the flux slag distributing assembly where the slag enters into is lifted up, the roller consequently falls to the ground, one operator can remove the flux slag distributing assembly from the mold cover.

[0062] A method for adding flux slag to mold of continuous casting machine according to the invention will be described in the following.

[0063] The method for adding flux slag to mold of continuous casting machine according to the invention includes the following steps: 1) arranging a group of slag spraying ports along a long side of the copper mouth of the mold; 2) causing the flux slag being uniformly distributed in the range of the section of the molten steel of the mold where the flux slag falls by adjusting the pressure of the compressed gas which blows the flux slag during each of the slag spraying ports spraying slag.

[0064] As a selected implementing manner of adjusting the pressure of the compressed gas, the pressure value of the above mentioned compressed gas can be adjusted between a first predetermined pressure value and a second predetermined pressure value. The compressed gas of the first predetermined pressure value causes the flux slag to fall on the surface which is close to the inner arc and is of the molten steel of the mold; the compressed gas of the second predetermined pressure value causes the flux slag to fall on the surface which is close to the outside arc and is of the molten steel of the mold. Further, the above mentioned compressed gas can also have a third predetermined pressure vale between the first and second predetermined pressure vales. The above mentioned first predetermined pressure, the second predetermined pressure, and the spraying time can be determined by test according to specific molds.

[0065] As another selected implementing manner of adjusting the pressure of the compressed gas, the spraying slag speed can be uniformly adjusted between the first predetermined pressure vale and the second predetermined pressure vale. Apparently, the advantages of doing so are clearer. However, two to five grades of predetermined pressure vales are generally set to obtain uniformly distributed flux slag on the section of the molten steel of the mold

[0066] The different predetermined pressure vales of the compressed gas can be implemented through corresponding pressure adjusting branches. Opening or closing of each pressure controlling branch is controlled by the control valves of the pressure controlling branch. Further, each pressure adjusting branch is connected to the same gas supplying source, and the size of the pressure in each pressure adjusting branch can be realized by the pressure reducing valves reducing pressure. For example, when the pressure of the gas supplying source is 2Mpa, a plurality of predetermined pressure values such as 1.0Mpa, 0.4Mpa and the like can be realized after each pressure adjusting branch uses corresponding pressure reducing valves to reduce pressure.

[0067] As a selected implementing manner of the setting of the spraying slag ports, each group of spraying slag ports can be divided into a plurality of small groups, and the compressed gas can be distributed to each small group of spraying slag ports through distributing conduits. A valve is respectively set in each distributing conduit to control opening or closing of the each distributing conduit, and compressed gas is alternately supplied to each small group of spraying slag ports by controlling the open frequency of the valves. Further, the spraying time of each small group of spraying slag ports, that is, supplying time of compressed gas, can be determined by the time interval between opening and closing the valves of the distributing conduits. At this point, by controlling the time interval between opening and closing each valve, the consumption amount of the flux slag by the molten steel of the mold coincides with the spraying amount of the flux slag.

[0068] In addition, a plurality of spraying slag ports with different diameters for replacement can be prepared, so that the diameter of each spraying slag port can be adjusted to spray different amounts of flux slag per unit time.

[0069] The description of the reference signs of Figs. 1-6 is shown in table 1.

Table 1 description of the reference signs

101	Slag hopper
102	Gas tank
103	controller
104	Gas control cabinet
104a	Electric control high pressure ball valve

(continued)

$104b_1$	Pressure reducing valve for high pressure
$104b_2$	Pressure reducing valve for low pressure
$104c_1$	High pressure electromagnetic valve
$104c_2$	Low pressure electromagnetic valve
$104d_1$	electromagnetic valve
$104d_2$	
$104d_3$	
104e	Clamping electromagnetic valve
105	Flux slag pipeline assembly
$105a_1$	Electric control adding slag ball valve
$105a_2$	manual adding slag ball valve
105b	Pneumatic clamping valve
$105c_1$	Quick connector
$105C_2$	
105d	down slag tube
106	flux slag distributing assembly
106a	motor
106b	speed-down box
106c	coupling assembly
106d	transporting slag screw rod
$106e_1$	Front end bearing seal assembly
$106e_2$	Rear end bearing seal assembly
106f	Receiving slag box
106h	slag collecting and discharging box
106j	ration chamber
106k	slag spraying ports
107a	Compressed air supplying tube
$107b_1$	Compressed air distribution tube
$107b_2$	
$107b_3$	
$107c_1$	Compressed air branch tube
$107c_2$	
$107c_3$	
107d	Compressed air branch duct
108	Pneumatic valve gas supplying tube
109	Roller

(continued)

110	Tundish operating platform
111	Mold cover
112	Flux slag
113	Mold
114	Molten steel
115	Tundish car column

[0070] It can be appreciated by those skilled in the art that the above mentioned spraying slag method can be completed by components or devices capable of completing this function in the existing technology, in addition to be completed by the device of the preferred embodiment of the invention, and is not limited to the device or components of the preferred embodiment of the invention.

[0071] The foregoing are only preferred embodiments of the invention and are not for use in limiting the protection scope thereof. All modifications, equivalent replacements or improvements in accordance with the spirit and principles of the invention shall be included in the protection scope of the invention.

Claims

1. A device for adding flux slag to mold of continuous casting machine, comprising:

   a slag hopper for containing flux slag;
   a flux slag distributor having a spiral conveyor for conveying the flux slag and a plurality of ration chambers arranged in a pipe shell length direction of the spiral conveyor with slag spraying ports;
   a flux slag pipeline assembly for connecting the slag hopper with the spiral conveyor;
   a compressed gas supply device for supplying compressed gas to each of the ration chambers for blowing the flux slag; and
   a controller for controlling the spiral conveyor and the compressed gas supply device.

2. The device of claim 1, wherein the flux slag pipeline assembly includes a down slag tube, an electric control adding slag valve and a manual adding slag valve connected to each other.

3. The device of claim 2, wherein the flux slag pipeline assembly further includes a first quick connector and a second quick connector installed at top and bottom sides of the down slag tube;
   a roller being disposed at another end of the flux slag distributor far away from the flux slag pipeline as-

sembly; and
the spiral conveyor has fixtures for supporting the weight of the spiral conveyor and the ration chambers.

4. The device of claim 1, wherein the spiral conveyor includes a transporting slag tube, a transporting slag screw rod located in the transporting slag tube, a receiving slag box located at a front end of the transporting slag tube, a slag collecting and discharging box located at a terminal end of the transporting slag tube, and a power unit for driving the transporting slag screw rod to rotate.

5. The device of claim 1, wherein the plurality of ration chambers includes at least two ration chambers with different volumes.

6. The device of any one of claims 1-5, wherein the compressed gas supply device includes a gas tank, a first pressure branch and a second pressure branch at least connected to the gas tank, and a gas distribution tube connected to the first pressure branch and the second pressure branch.

7. The device of claim 6, wherein the gas distribution tube includes a plurality of pressure distribution tubes, a plurality of compressed air branch tubes connected to each of the pressure distribution tubes, a plurality of compressed air branch ducts connected to each of the compressed air branch tubes; wherein each of the pressure distribution tubes has the control valves set therein, and each compressed air branch ducts is communicated with corresponding ration chambers.

8. The device of claim 7, wherein open frequency of the control valves and/or speed of the spiral conveyor for conveying the flux slag are controlled by the controller.

9. A method for adding flux slag to mold of continuous casting machine, comprising following steps:

1) arranging a group of slag spraying ports along a long side of a copper mouth of the mold; and
2) causing the flux slag being uniformly distributed in the range of a section of a molten steel of the mold where the flux slag falls by adjusting the pressure of a compressed gas which blows the flux slag during each of the slag spraying ports spraying slag.

10. The method of claim 9, wherein a pressure value of the compressed gas is adjustable between a first predetermined pressure value and a second predetermined pressure value; wherein the compressed gas of the first predetermined pressure value causes the flux slag to fall on one surface of the molten steel of the mold which is close to an inner arc and is; the compressed gas of the second predetermined pressure value causes the flux slag to fall on one surface of the molten steel of the mold which is close to an outside arc.

11. The method of claim 10, wherein the compressed gas has a first predetermined pressure vale, a second predetermined pressure, and a third predetermined pressure vale between the first and second predetermined pressure vales.

12. The method of claim 10 or 11, wherein the different predetermined pressure vales of the compressed gas are implemented through corresponding pressure adjusting branches, and opening or closing of each pressure controlling branch is controlled by control valves of the each pressure controlling branch.

13. The method of claim 12, wherein each pressure adjusting branch is connected to the same gas supplying source, and size of the pressure in each pressure adjusting branch is realized by a pressure reducing valve reducing pressure.

14. The method of any one of claims 9-11, further comprising dividing each group of spraying slag ports into a plurality of small groups and distributing the compressed gas to each small group of spraying slag ports through distributing conduits, wherein a valve is respectively set in each of the distributing conduits to control opening or closing of the each of the distributing conduits, and the compressed gas is alternately supplied to each small group of spraying slag ports by controlling the open frequency of the valves.

15. The method of claim 14, wherein a supplying time of compressed gas of each small group of spraying slag ports is determined by a time interval between opening and closing the valves of the distributing conduits.

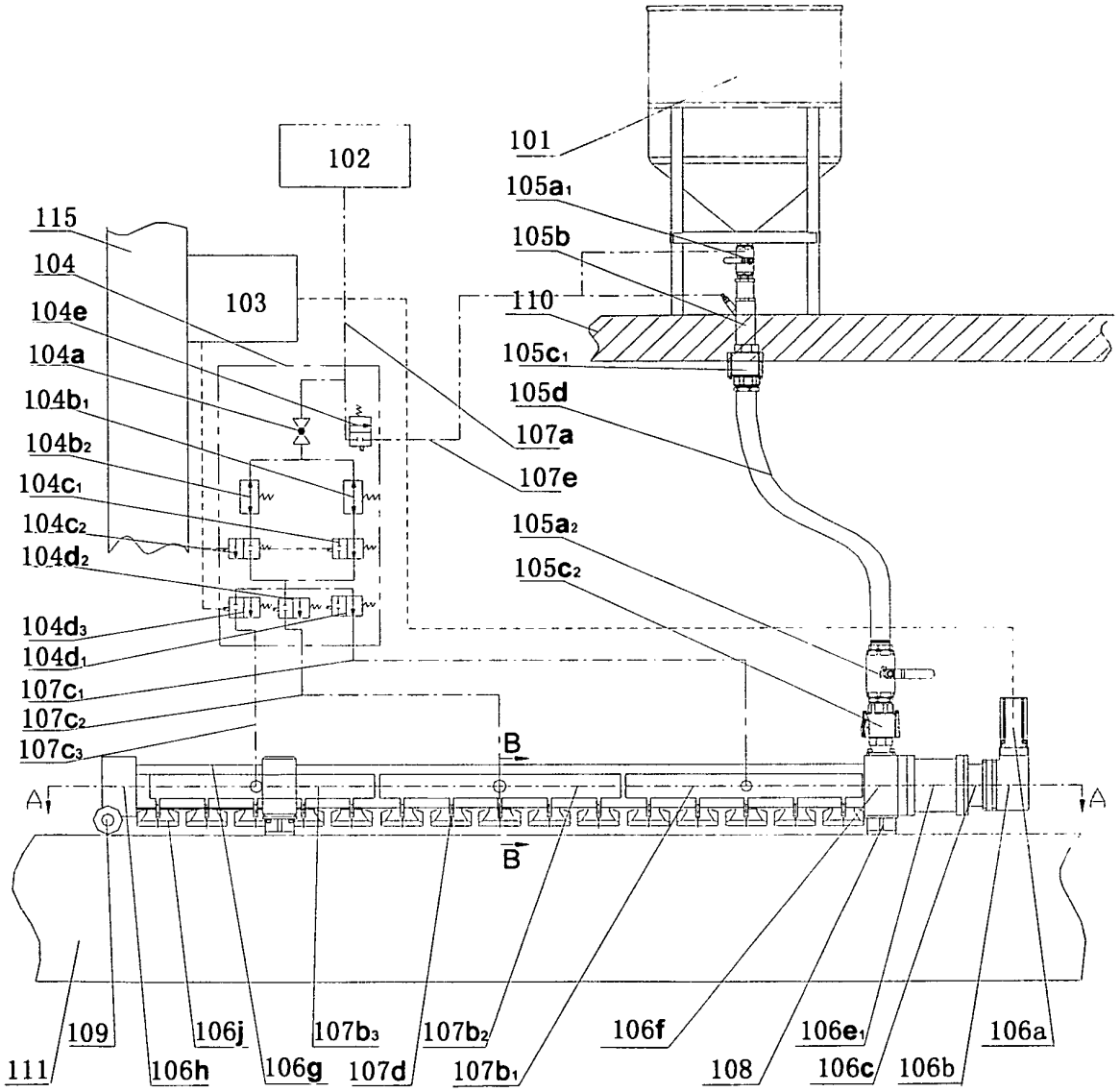

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105b
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105d
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107e
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105c2
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104e
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104c1
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104d2
104d3
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107c3
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A
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106a

Fig. 1

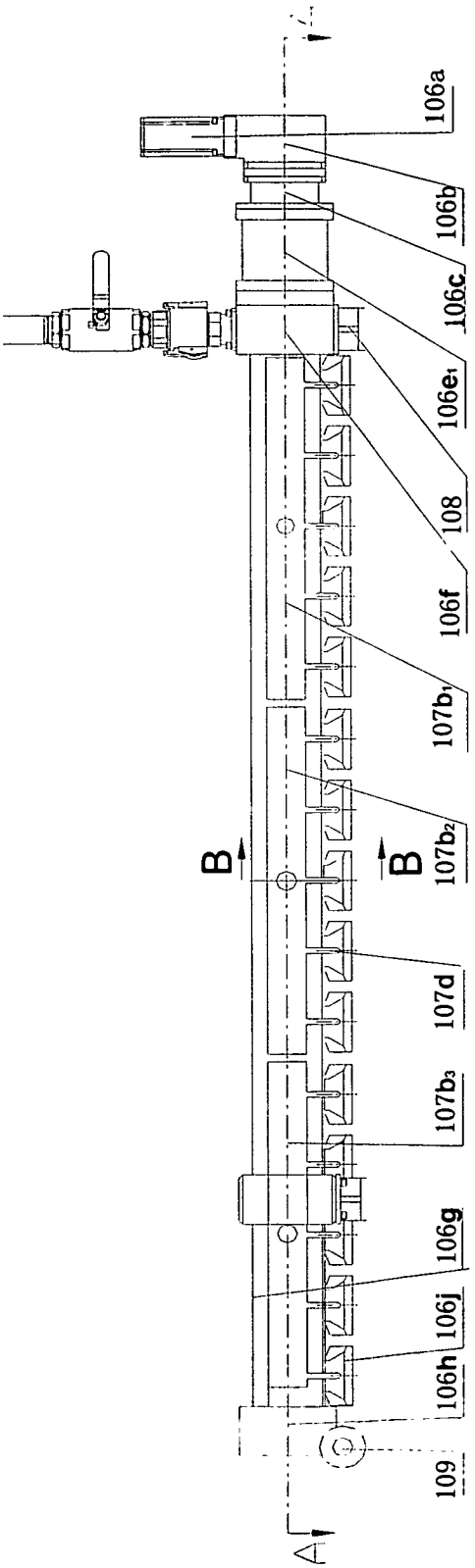

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B
A

Fig. 2

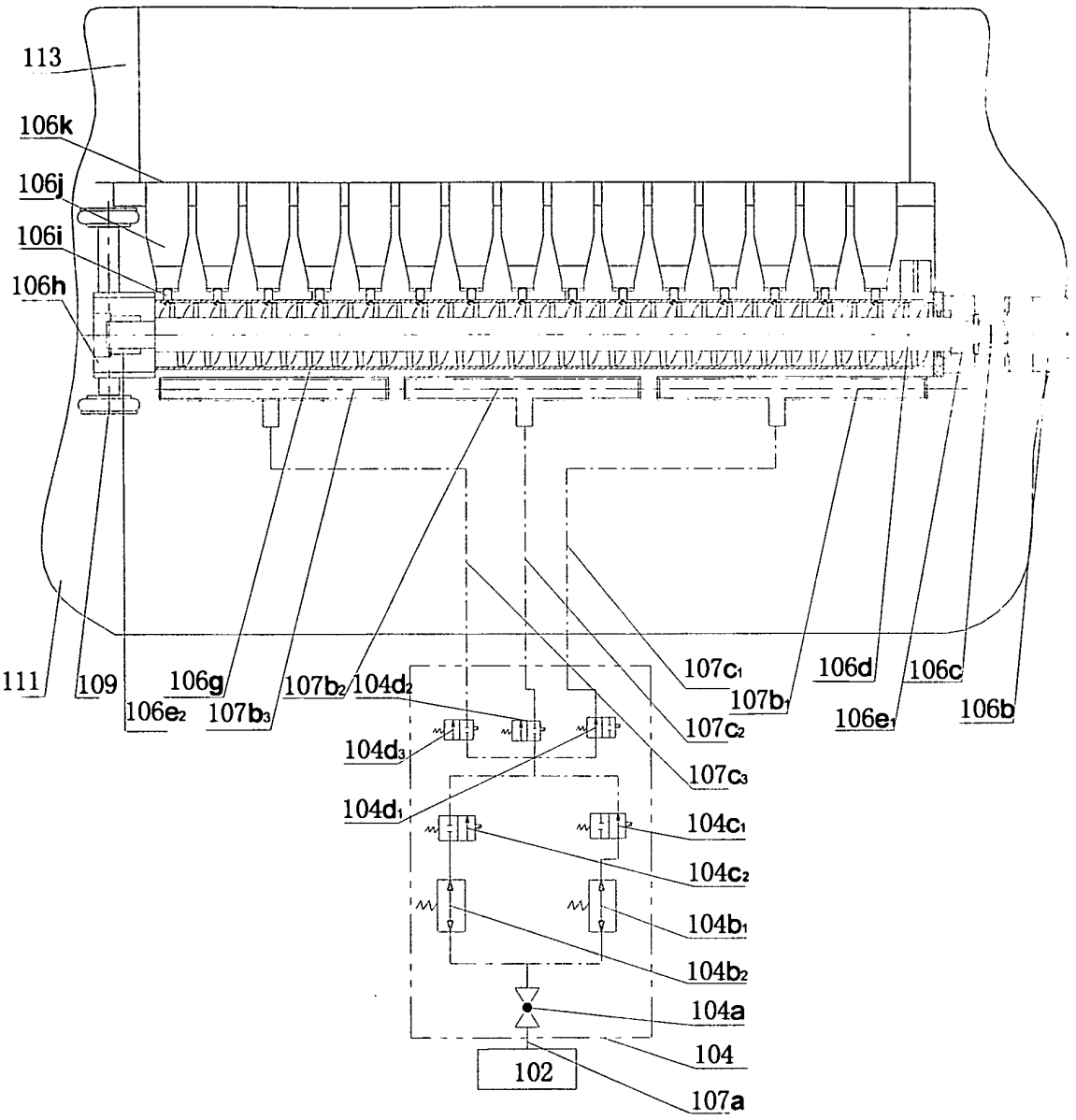

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107b1
107c2
107c3
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104b1
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104a
104
102
107a
106d
106c
106e1
106b

Fig. 3

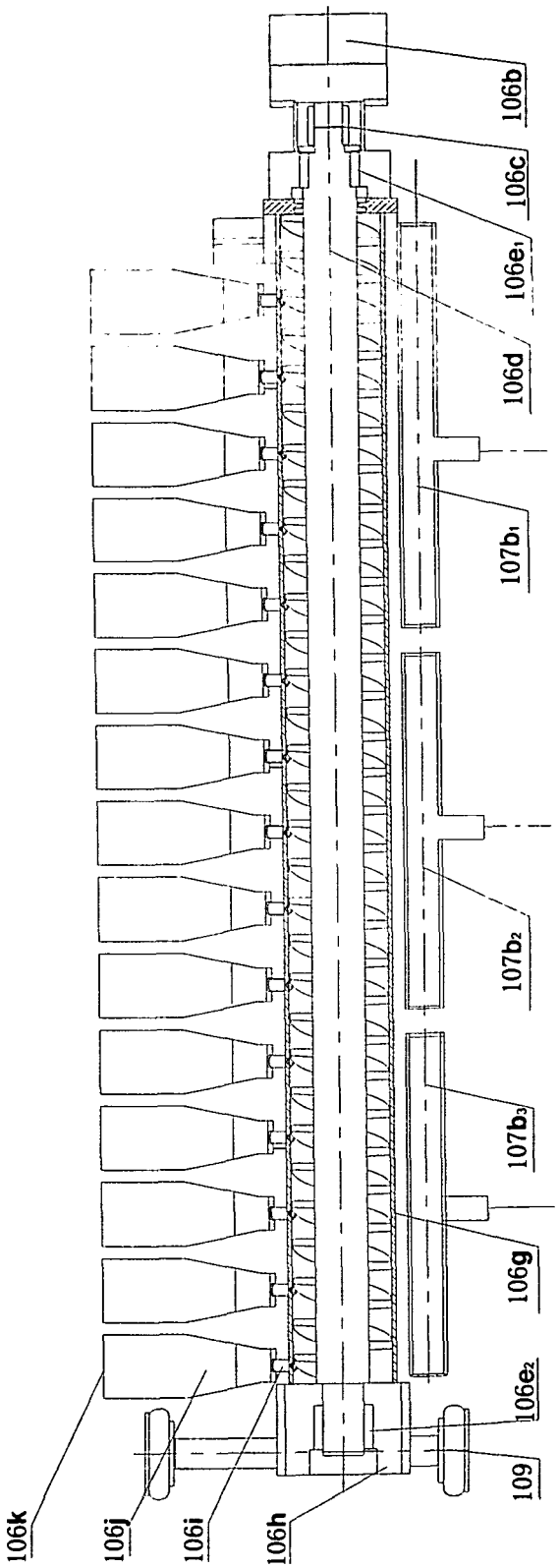

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106i
106h

Fig. 4

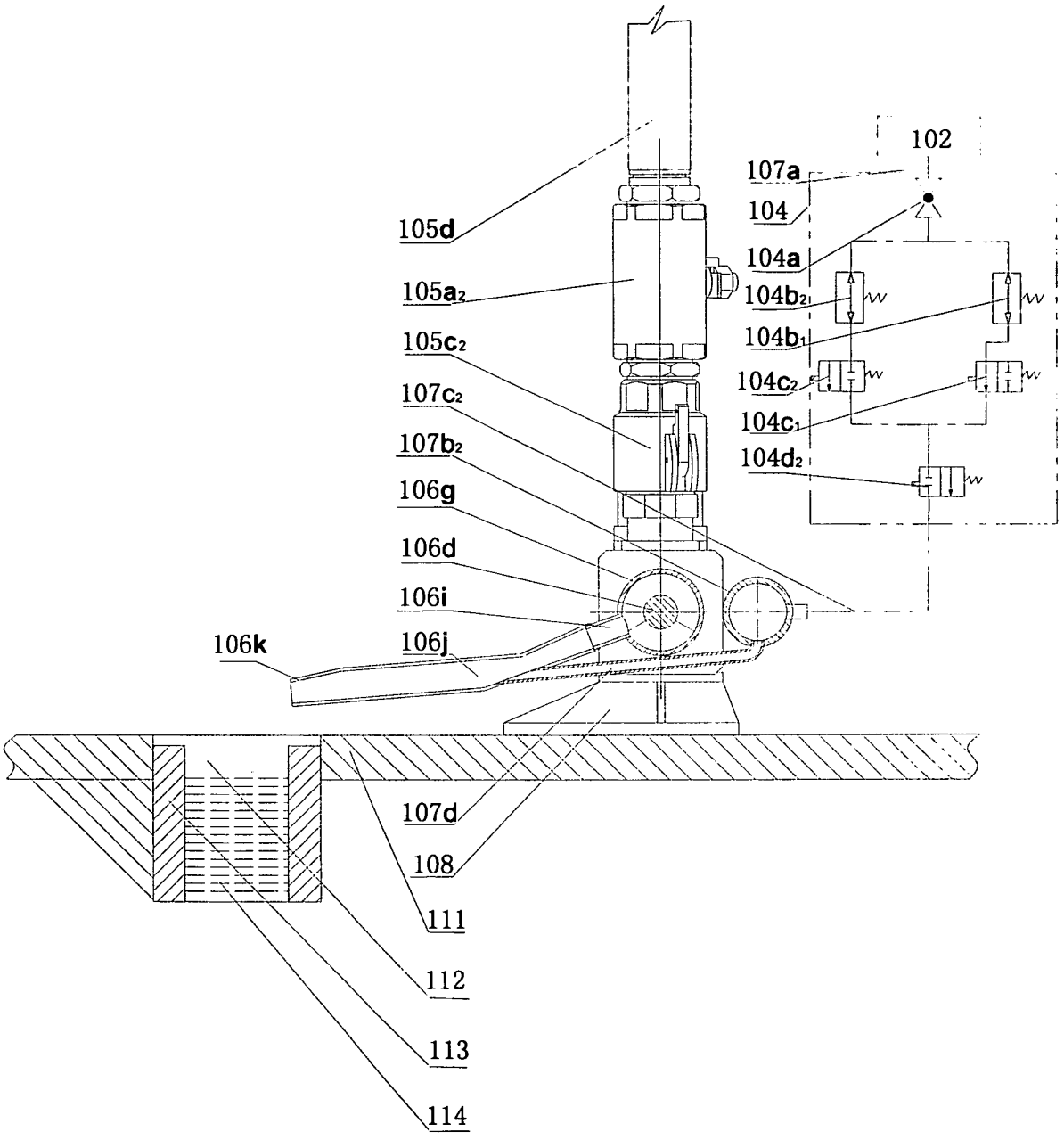

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107d
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114

Fig. 5

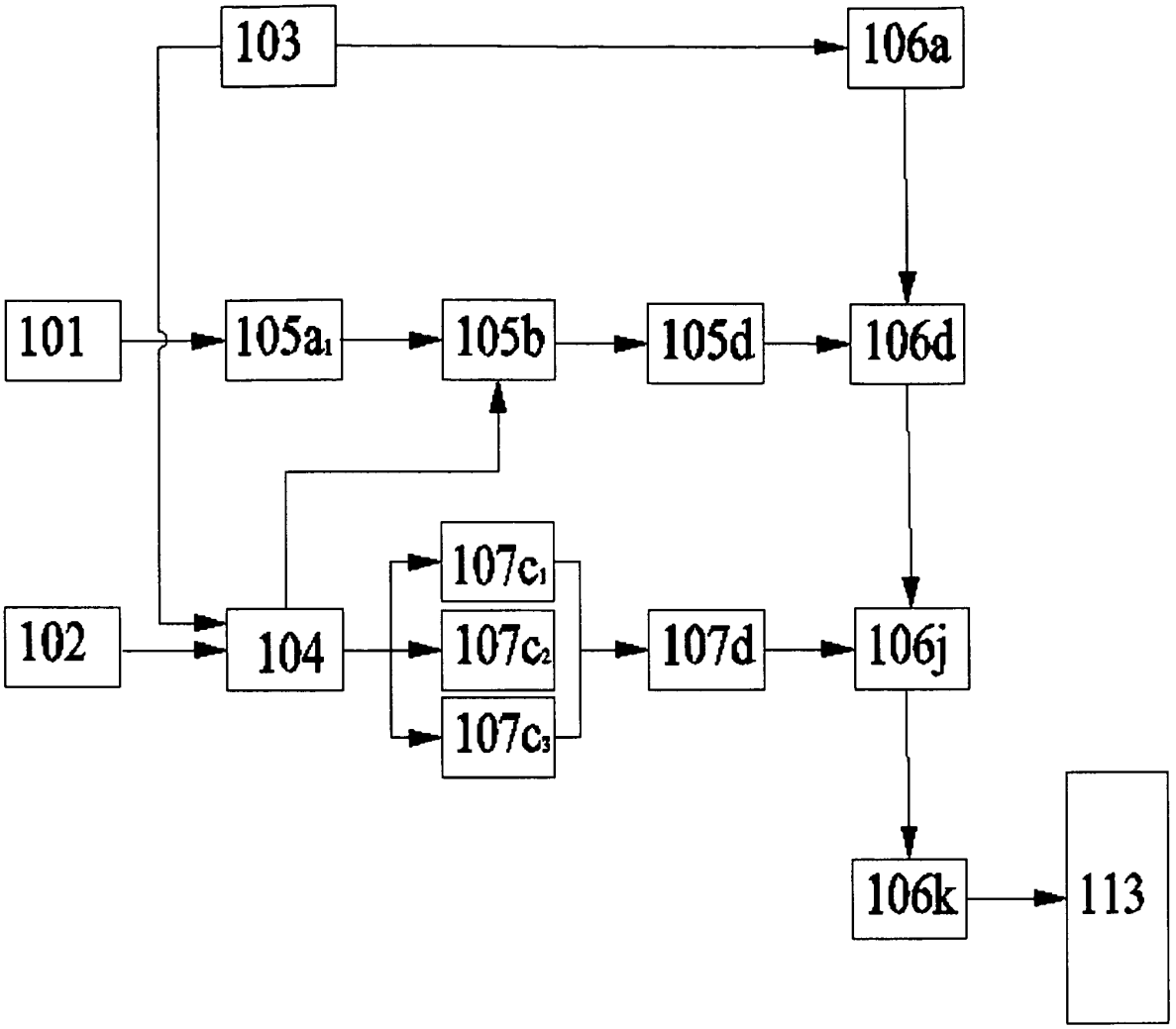

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113

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2010/071262

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B22D 11/111; B22D 11/108

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI;EPODOC;CNKI;CPRS: gas, control+, pressure

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 62-84858 A (NIPPON SPENG CO) 18 Apr.1987 (18.04.1987) Abstract and figures	1-6
Y	US 4084628 A (CONCAST AG) 18 Apr.1978 (18.04.1978) Description column 4 lines 3-51and Fig.1	1-6
P,X	CN 101497114 A (TIAN, Zhiheng et al.) 05 Aug.2009 (05.08.2009) claims 1-16	1-16
Y	CN 101147962 A (JIANG, Hong) 26 Mar.2008 (26.03.2008) Abstract	1-6
P,Y	CN 201217064 Y (ZHU, Cuihan) 08 Apr.2009 (08.04.2009) Abstract	1-6
A	US 5647908 A (FOSECO INT LTD) 15 Jul.1997 (15.07.1997) The whole document	1-16

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07Jun.2010 (07.06.2010)	**24 Jun. 2010 (24.06.2010)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer LI, Chunhua Telephone No. (86-10)62085540

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2010/071262

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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US 4084628 A	18.04.1978	JP 52065723 A	31.05.1977
		FR 2336200 A	22.07.1977
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CN 101497114 A	05.08.2009	None	
CN 101147962 A	26.03.2008	WO 2008154810 A	24.12.2008
CN 201217064 Y	08.04.2009	None	
US 5647908 A	15.07.1997	None	

Form PCT/ISA /210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2010/071262

Continuation of : second sheet A: classification of subject matter

B22D 11/111 (2006.01) i
B22D 11/108 (2006.01) i

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