

(19)



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(11)

EP 1 458 509 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
28.06.2006 Bulletin 2006/26

(51) Int Cl.:
B22D 17/30 (2006.01) **B22D 17/12** (2006.01)
B22D 35/04 (2006.01) **B22D 37/00** (2006.01)
B22D 39/02 (2006.01)

(21) Application number: **02793071.8**

(86) International application number:
PCT/EP2002/014496

(22) Date of filing: **18.12.2002**

(87) International publication number:
WO 2003/055627 (10.07.2003 Gazette 2003/28)

(54) APPARATUS FOR FORMING METAL CASTINGS

VORRICHTUNG ZUR HERSTELLUNG VON METALLGUSSTEILEN

APPAREIL PERMETTANT DE FORMER DES COULEES DE METAL

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
IE IT LI LU MC NL PT SE SI SK TR**

(30) Priority: **28.12.2001 IT PD20010301**

(43) Date of publication of application:
22.09.2004 Bulletin 2004/39

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- DATABASE WPI Section Ch, Week 200219
Derwent Publications Ltd., London, GB; Class
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Description

Technical Field

[0001] The present invention relates to an apparatus for forming metal castings, particularly with hydraulic connection between the holding furnace and the mold and to a method for forming metal castings performed by the apparatus.

Background Art

[0002] As is known, castings made of metal or light alloys are molded by using pouring processes, such as for example the gravity feeding of the molten metal or alloy into closed molds, and the generation of pressure inside the mold by way of feedheads, which feed the molten casting, increasing the hydrostatic load on the metal or alloy, and prevent the formation of cavities or porosities inside the casting during shrinkage in the solidification step.

[0003] Another method for forming castings by pouring metal or alloys is so-called low-pressure casting, which substantially consists in placing a mold over a closed furnace whose cavity is fed through a riser tube connected to the furnace, inside which pressure is applied to the free surface of the metal so that part of said metal rises through the riser tube and feeds the mold.

[0004] However, in practice, known casting techniques are not always suitable to ensure the formation of castings that are free from structural defects, for example internal tensions and microporosities, especially in the case of the formation of castings having a complex shape, such as wheels of road vehicles made of light alloy and the like.

[0005] In particular, for the low-pressure casting technique the problems are linked, most of all, to poor feeding of the cavity of the mold, especially in the case of castings that have a complex geometry, which generates porosities that can be detected by X-rays as a consequence of the turbulent motions of the metal and of overheating.

[0006] After the solidification step, moreover, the furnace below the mold is depressurized and because of this operation the column of molten metal inside the riser tube, initially at the level of the mold, returns to the level of the metal that is present inside the furnace.

[0007] During this descent, a fraction of the metal remains stuck along the inner wall of the riser tube, forming films of solidified metal and oxides.

[0008] This problem gradually increases, since during production the level of the metal inside the furnace decreases, the path followed by the aluminum during filling increases, and accordingly the exposed surface inside the riser tube increases, generating a greater quantity of films of solidified metal and oxides.

[0009] Films and oxides are of course entrained by the metal into the mold, forming a non-uniform alloy and detracting from the final quality of the provided casting.

[0010] In order to generate the pressure that allows the rise of the metal through the riser tube, a gas is injected into the furnace; said gas is usually air, which generates oxides owing to the presence of oxygen.

[0011] Furthermore, when the metal inside the furnace has been used up, the furnace must be opened to allow to fill it, exposing it fully to contact with air.

[0012] Moreover, the low-pressure casting process is a substantially discontinuous process, since it entails downtimes in the production step due to the time required to fill the riser tube and to the steps for filling said furnace.

[0013] In particular, the problems linked to the furnace are due substantially to the holding times for filling it and to the variation of the internal pressure during said filling.

[0014] Moreover, it is currently difficult to control the quantity of metal that is injected into the cavity of the mold.

[0015] EP-A-0 711 616 discloses an apparatus as defined in the preamble of claim 1.

[0016] US-4 408 651 discloses a pumping mechanism for a die-casting machine.

[0017] US-4 595 044 discloses a die-casting apparatus for pumping molten metal.

[0018] US-A-3 800 986 discloses a pumping mechanism as defined in the preamble of claim 1.

[0019] The aim of the present invention is to solve or substantially reduce the problems of known types of apparatus for forming metal castings.

[0020] Within this aim, an object of the invention is to provide an apparatus that comprises a constantly loaded hydraulic connection between the holding furnace and the mold and in which the molten metal never makes contact with the air.

[0021] Another object is to provide an apparatus that eliminates the upward and downward flows of the metal along the riser tube, eliminating the formation of oxides and films of solidified metal.

[0022] Another object is to provide an apparatus that allows safe control of the level of metal that is present under the mold.

[0023] Another object is to provide an apparatus by way of which it is possible to provide a continuous casting cycle, eliminating the downtimes for loading the furnace connected to the riser tube.

[0024] Another object is to provide an apparatus by means of which the molten metal is exposed to air as little as possible, consequently avoiding the formation of oxides.

[0025] Another object is to provide an apparatus that allows to provide metal castings without limitations to the operating pressure except for those dictated by the technological limitations of the apparatus itself

[0026] Another object is to provide an apparatus that offers high productivity.

[0027] Another object is to provide an apparatus that allows better feeding of the cavity of the mold.

[0028] Another object is to provide an apparatus that allows to obtain improved mechanical characteristics of the solidified casting.

[0029] Another object is to provide an apparatus that does not use the pressure of air or gas to move the metal and feed the mold.

[0030] This aim and these and other objects that will become better apparent hereinafter are achieved by an apparatus for forming metal castings, as defined on claim 1.

[0031] The apparatus performs a method for forming metal castings that consists in:

- controlling the level of the molten metal, keeping it close below said one or more inlets for introducing the metal into the cavity of said die;
- feeding the cavity of the die with a chosen quantity of metal at a controlled pressure, making the level of said metal rise;
- continuing to feed the cavity of the mold, keeping the metal under pressure, to the end of the solidification phase;
- lowering the level of the molten metal to a chosen height close below said inlets;

- ending the formation of the casting;
- removing the casting from the mold.

[0032] Further characteristics and advantages of the invention will become better apparent from the description of a preferred but not exclusive embodiment thereof, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a schematic view of an apparatus particularly for forming metal castings, according to the invention;

Figure 2 is a view of a first portion of the apparatus of Figure 1;

Figure 3 is a view of a second portion of the apparatus of Figure 1.

[0033] With reference to the figures, an apparatus for forming metal castings, particularly with hydraulic connection between the holding furnace and the mold, according to the invention, is generally designated by the reference numeral 10.

[0034] The apparatus 10 comprises a hydraulic connection between a holding furnace 11, which contains the molten metal ready for forming, and a mold 14, which in turn comprises a duct 36 for connecting the holding furnace 11 to one or more inlets 12 for introducing the metal into a the cavity 13 of the mold 14, said one or more inlets 12 being arranged, in this case, under said mold 14, and pumping means 15, which are interposed between portions of said duct 36, for pumping a controlled quantity of metal through one or more inlets 12 into said cavity 13, said means being connected to and controlled by an electronic control unit 16.

[0035] As shown in Figure 3, in this case there is a slot-like inlet 12, which runs continuously and circumferen-

tially over 360 sexagesimal degrees at the lower edge of the cavity 13 of a mold 14, for example for forming a wheel for road vehicles.

[0036] The inlet 12 is formed by a distribution unit 17, which is arranged below the mold 14 and is connected to the upper end of a riser tube 18.

[0037] Induction-type measurement devices 19 for measuring the level of the metal present inside the distribution unit 17 are arranged adjacent and below the inlet 12, at the distribution unit 17, and are connected and managed by the control unit 16, as better described hereinafter.

[0038] Advantageously, the inlets 12 can also be arranged laterally to the mold 14.

[0039] The duct 36 comprises a first portion 20, which extends from the holding furnace 11 and is connected to the pumping means 15, from which a second portion 21 protrudes and leads into a reservoir 22.

[0040] The riser tube 18 rises from the reservoir 22, and the distribution unit 17 is arranged above it.

[0041] The apparatus 10 further comprises devices 23 for heating the molten metal and temperature sensors 24 for sensing the temperature of said metal, which are arranged along the hydraulic connection and are connected to the control unit 16.

[0042] The heating devices 23 are constituted by heating resistors, designated by the same reference numeral, which are arranged inside longitudinally elongated ceramic containers arranged at the pumping means 15, at the first portion 20 and second portion 21 of the duct 36, at the reservoir 22 and at the distribution unit 16.

[0043] The temperature sensors 24 are instead constituted by thermocouples, designated by the same reference numeral, which are also arranged on the apparatus 10, like the heating devices 23.

[0044] The pumping means 15 are constituted by a piston pump 25, upstream and downstream of which there are a first valve 26 and a second valve 27 for controlling the flow of metal that flows respectively within said first and second portions 20 and 21 of the duct 36.

[0045] The first and second valves 26 and 27 are designed to provide controlled one-way flow of the metal in the direction from the mold 14 to the holding furnace 11.

[0046] The piston pump 25 comprises a first piston 28, which can slide hermetically in a corresponding first cylinder 29, which is fixed to the head of a first stem 30 of a hydraulic actuator 31, whose stroke is controlled by the control unit 16.

[0047] The first and second valves 26 and 27 are fully identical, and each valve comprises a second piston 32 that can slide hermetically within a corresponding second cylinder 33, which is fixed to the head of a second stem 34 of a corresponding pneumatic actuator 35.

[0048] As shown in Figure 2, the first valve 26 and the second valve 27 are arranged so as to control respectively the first portion 20 and the second portion 21 of the duct 36 when they are actuated by the control unit 16.

[0049] In particular, the first valve 26 (like the second

valve 27) is arranged between a first part 20a and a second part 20b of the first portion 20 of the duct 36, said parts being arranged with a longitudinal axis at different heights.

[0050] The second piston 32, once lowered, affects the inlet of the second part 20b, whose diameter is smaller than that of the second cylinder 33, and the outlet of the first part 20a, which lies substantially on a horizontal plane and is coaxial to the second piston 32.

[0051] As regards operation, when the piston pump 25 is fully loaded, with the first valve 26 closed and the second valve 27 open, the mold 14 is closed so as to connect the cavity 13 to the inlet 12.

[0052] The induction measurement devices 19 can sense temperatures and sense that the level of the metal is close below the inlet 12.

[0053] At this point, the control unit 16 actuates the advancement of the first cylinder 29 of the piston pump, which allows the injection of the metal into the cavity 13.

[0054] The cycle for forming the casting, which in this case is a road vehicle wheel, begins and consists in the steps of filling, feeding, cooling and solidification; said cycle is allowed by the injection of a preset quantity of material into the cavity 13 following the movement of the piston pump 25 actuated by the control unit 16.

[0055] During the solidification step, the piston pump 25 continues to feed the cavity 13, keeping the metal under pressure.

[0056] At the end of the solidification step, the control unit 16 actuates the piston pump 25 so that it retracts with the first cylinder 29, so as to lower the level of the metal with respect to the inlet 12 by a preset value, for example 5-6 mm, making it separate from the casting.

[0057] At the end of the formation of the casting, the mold 14 is opened and the casting is removed, while the level of the aluminum is kept always directly below the inlets 12.

[0058] The piston pump 25 must now be reloaded, and this occurs by drawing back the first stem 30 when the second valve 27 is closed and the first valve 26 is open, drawing metal from the holding furnace 11.

[0059] Once the piston pump 25 has drawn a sufficient quantity of metal, the cycle can resume.

[0060] Advantageously, a plurality of ducts 36 for corresponding molds can be associated with the holding furnace 11 in order to increase the productivity of said apparatus.

[0061] Since the apparatus 10 is provided with a plurality of heating devices 23, this ensures that the metal always remains liquid, at a temperature that is controlled by the temperature sensors 24.

[0062] The reservoir 22, moreover, is designed to keep the metal at a chosen temperature, which also is determined by heating devices 23 and is measured by the temperature sensors 24.

[0063] The quantity of metal contained in the reservoir is in fact such as to ensure the dissipation of any higher temperatures acquired by the metal in the path from the

piston pump 25 to said reservoir 22.

[0064] In practice, the purpose of the reservoir 22 is to make the metal or alloy more homogeneous before entering the mold 14.

[0065] In practice it has been found that the present invention has achieved the intended aim and objects.

[0066] An apparatus has in fact been provided which allows to use a hydraulic system that is always loaded, a level of the metal that is always present at the lower level of the mold, with a closed hydraulic circuit that avoids the exposure of the metal to the air, avoiding the formation of oxides.

[0067] The metal injected into the cavity is therefore more homogeneous and allows to obtain a solidified casting whose mechanical characteristics are improved with respect to known apparatuses, using even very high operating pressures.

[0068] Moreover, the times for moving the material are reduced, the idle times for loading the furnace arranged below the mold are eliminated, and there is a considerable increase in production, since said production occurs in a continuous cycle.

[0069] The present invention is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0070] The technical details may be replaced with other technically equivalent elements.

[0071] The materials, so long as they are compatible with the contingent use, as well as the dimensions, may be any according to requirements.

Claims

1. An apparatus for forming metal castings, particularly with hydraulic connection between the holding furnace and the mold, comprising:

-- at least one duct (36) for connecting the holding furnace (11), which contains the molten metal ready for molding, to one or more inlets (12) for introducing the metal into the cavity (13) of a corresponding mold (14); and .

-- pumping means (15), interposed between portions (20, 21) of said duct (36), for pumping a controlled quantity of metal through said one or more inlets (12) into said cavity (13), said pumping means (15) being connected to an electronic control unit (16) said pumping means (15) comprise a piston pump (25) and a first and a second valve (26, 27) for controlling the flow of metal, said valves being arranged respectively upstream and downstream of said piston pump (25), said first and second valves (26, 27) being adapted to prevent the return of the metal in the direction from the mold (14) to the holding furnace (11); **characterized in that** said piston pump (25) and said first and second valves (26,

- 27) being actuated by said electronic control unit (16).
2. The apparatus according to claim 1, **characterized in that** it comprises measurement devices (19) for measuring the level of the metal, which are arranged proximate to said one or more inlets (12) and are connected to said control unit (16). 5
 3. The apparatus according to one or more of the preceding claims, **characterized in that** said duct (36) comprises a first portion (20) that extends from said holding furnace (11) and is connected to said pumping means (15), from which at least one second portion (21) extends for connection to the cavity (13) of the mold (14). 10
 4. The apparatus according to claim 1, **characterised in that** said piston pump (25) comprises a first piston (28), which can slide hermetically within a corresponding first cylinder (29), the piston being fixed to the head of a first stem (30) of a first actuator (31) whose stroke is controlled by said control unit (16). 15
 5. The apparatus according to claim 4, **characterized in that** said first actuator (31) is hydraulic. 20
 6. The apparatus according to one or more of the preceding claims, **characterized in that** said first and second valves (26, 27) are each constituted by a second piston (32), which can slide hermetically within a corresponding second cylinder (33), the piston being fixed to the head of a second stem (34) of a second actuator (35) that is controlled by said control unit (16). 25
 7. The apparatus according to claim 6, **characterized in that** the second actuator (35) is pneumatic. 30
 8. The apparatus according to one or more of the preceding claims, **characterized in that** said hydraulic connection comprises a reservoir (22) that is arranged downstream of said second portion (21) and from which at least one riser tube (18) extends for introducing molten metal into said cavity (13). 35
 9. The apparatus according to one or more of the preceding claims, **characterized in that** said hydraulic connection comprises a distribution unit (17), which is suitable to form said one or more inlets (12) for introducing the metal into said cavity (13), said distribution unit (17) being connected to said at least one riser tube (18), at which said level measurement devices (19) are arranged. 40
 10. The apparatus according to one or more of the preceding claims, **characterized in that** said one or more inlets (12) are arranged below said mold (14). 45
 11. The apparatus according to one or more of claims 1 to 9, **characterized in that** said one or more inlets (12) are arranged laterally to said mold (14).
 12. The apparatus according to one or more of claims 1 to 9, **characterized in that** said one or more inlets (12) are arranged laterally and below said mold (14).
 13. The apparatus according to one or more of the preceding claims, **characterized in that** said level measurement devices (19) are induction devices.
 14. The apparatus according to one or more of claims 1 to 12, **characterized in that** said level measurement devices (19) are induction devices adapted to act as temperature measurement devices.
 15. The apparatus according to one or more of the preceding claims, **characterized in that** said hydraulic connection comprises heating devices (23) for heating said molten metal, said devices being connected to said control unit (16).
 16. The apparatus according to claim 15, **characterized in that** said heating devices (23) are constituted by heating resistors, each arranged within a corresponding longitudinally extended ceramic container.
 17. The apparatus according to one or more of the preceding claims, **characterized in that** said hydraulic connection comprises sensors (24) for sensing the temperature of said molten metal, said sensors being connected to said control unit (16).
 18. The apparatus according to claim 17, **characterized in that** said temperature sensors (24) are constituted by thermocouples, each arranged inside corresponding longitudinally extended ceramic containers. 50

Patentansprüche

1. Vorrichtung zur Herstellung von Metallgussteilen, insbesondere mit hydraulischer Verbindung zwischen dem Warmhalteofen und der Gießform, umfassend:

wenigstens einen Kanal (36) zur Verbindung des Warmhalteofens (11), der das für das Formen fertige geschmolzene Metall enthält, zu einem oder mehreren Einlässen (12) zum Einführen des Metalls in die Höhlung (13) einer entsprechenden Gießform (14); und Pumpmittel (15), die zwischen Abschnitten (20, 21) des Kanals (36) eingesetzt sind zum Pumpen einer geregelten Menge von Metall durch den einen oder die mehreren Einlässe (12) in

die Höhlung (13), wobei die Pumpmittel (15) mit einer elektronischen Steuereinheit (16) verbunden sind, wobei die Pumpmittel (15) eine Kolbenpumpe (25) und ein erstes und ein zweites Ventil (26, 27) zum Steuern des Metallflusses umfassen, wobei die Ventile jeweils stromaufwärts und stromabwärts der Kolbenpumpe (25) angeordnet sind, wobei die ersten und zweiten Ventile (26, 27) dazu ausgebildet sind, das Rückströmen des Metalls in die Richtung von der Gießform (14) zu dem Warmhalteofen (11) vorzubeugen;

dadurch gekennzeichnet,

dass die Kolbenpumpe (25) und die ersten und zweiten Ventile (26, 27) durch die elektronische Steuereinheit (16) betätigt werden.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** sie Messeinrichtungen (19) zum Messen des Pegels des Metalls aufweist, die in der Nähe des einen oder der mehreren Einlässe (12) angeordnet und die mit der Steuereinheit (16) verbunden sind.
3. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Kanal (36) einen ersten Abschnitt (20) umfasst, der sich von dem Warmhalteofen (11) erstreckt und der mit den Pumpmitteln (15) verbunden ist, von dem sich wenigstens ein zweiter Abschnitt (21) erstreckt zur Verbindung mit der Höhlung (13) der Gießform (14).
4. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kolbenpumpe (25) einen ersten Kolben (28) umfasst, der hermetisch in einem entsprechenden ersten Zylinder (29) gleiten kann, wobei der Kolben an den Kopf eines ersten Schaftes (30) eines ersten Betätigungsglieds (31) befestigt ist, dessen Hub durch die Steuereinheit (16) gesteuert ist.
5. Vorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** das erste Betätigungsglied (31) hydraulisch ist.
6. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die ersten und zweiten Ventile (26, 27) jeweils gebildet sind durch einen zweiten Kolben (32), der hermetisch in einem entsprechenden zweiten Zylinder (33) gleiten kann, wobei der Kolben an den Kopf eines zweiten Schafts (34) eines zweiten Betätigungsglieds (35) befestigt ist, der von der Steuereinheit (16) gesteuert ist.
7. Vorrichtung nach Anspruch 6, **dadurch gekenn-**

zeichnet, dass das zweite Betätigungsglied (35) pneumatisch ist.

8. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die hydraulische Verbindung ein Reservoir (22) umfasst, das stromabwärts des zweiten Abschnitts (21) angeordnet ist und von dem wenigstens ein Aufstiegsrohr (18) zum Einführen von geschmolzenem Metall in die Höhlung (13) abgeht.
9. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die hydraulische Verbindung eine Verteilereinheit (17) umfasst, die dazu geeignet ist, den einen oder die mehreren Einlässe (12) zum Einführen des Metalls in die Höhlung (13) zu bilden, wobei die Verteilereinheit (17) mit dem wenigstens einen Steigrohr (18) verbunden ist, an welchem die Pegelmesseinrichtungen (19) angeordnet sind.
10. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der eine oder die mehreren Einlässe (12) unter der Gießform (14) angeordnet sind.
11. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass** der eine oder die mehreren Einlässe (12) seitlich zu der Gießform (14) angeordnet sind.
12. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass** der eine oder die mehreren Einlässe (12) seitlich und unterhalb der Gießform (14) angeordnet sind.
13. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Pegelmesseinrichtungen (19) Induktionseinrichtungen sind.
14. Vorrichtung nach einem oder mehreren der Ansprüche 1 bis 12, **dadurch gekennzeichnet, dass** die Pegelmesseinrichtungen (19) Induktionseinrichtungen sind, die dazu ausgebildet sind, als Temperaturmesseinrichtungen zu wirken.
15. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die hydraulische Verbindung Heizeinrichtungen (23) zum Aufheizen des geschmolzenen Metalls umfasst, wobei die Einrichtungen mit der Steuereinheit (16) verbunden sind.
16. Vorrichtung nach Anspruch 15, **dadurch gekennzeichnet, dass** die Heizeinrichtungen (23) gebildet sind durch Heizwiderstände, die jeweils innerhalb ei-

nes entsprechenden sich längs erstreckenden Keramikbehältnisses angeordnet sind.

17. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die hydraulische Verbindung Sensoren (24) zum Erfassen der Temperatur des geschmolzenen Metalls umfasst, wobei die Sensoren mit der Steuereinheit (16) verbunden sind.

18. Vorrichtung nach Anspruch 17, **dadurch gekennzeichnet, dass** die Temperatursensoren (24) gebildet sind durch Thermoelemente, die jeweils innerhalb der entsprechenden sich längs erstreckenden Keramikbehältnisse angeordnet sind.

Revendications

1. Dispositif pour réaliser des pièces coulées en métal, en particulier avec un raccord hydraulique entre le four de maintien et le moule, comprenant :

- au moins un conduit (36) pour raccorder le four de maintien (11), qui contient le métal fondu prêt pour le moulage, à une ou plusieurs entrées (12) pour introduire le métal dans la cavité (13) d'un moule correspondant (14) ; et

- des moyens de pompage (15), intercalés entre des parties (20, 21) dudit conduit (36), pour pomper une quantité contrôlée de métal à travers ladite une ou lesdites plusieurs entrées (12) dans ladite cavité (13), lesdits moyens de pompage (15) étant reliés à une unité de commande électronique (16), lesdits moyens de pompage (15) comprennent une pompe à piston (25) et une première et une seconde soupapes (26, 27) pour contrôler l'écoulement de métal, lesdites soupapes étant agencées respectivement en amont et en aval de ladite pompe à piston (25), lesdites première et seconde soupapes (26, 27) étant adaptées pour empêcher le retour du métal dans la direction allant du moule (14) au four d'attente (11) ; **caractérisé en ce que** ladite pompe à piston (25) et lesdites première et seconde soupapes (26, 27) sont actionnées par ladite unité de commande électronique (16).

2. Dispositif selon la revendication 1, **caractérisé en ce qu'il** comprend des dispositifs de mesure (19) pour mesurer le niveau du métal, qui sont disposés à proximité de ladite une ou desdites plusieurs entrées (12) et sont reliés à ladite unité de commande (16).

3. Dispositif selon une ou plusieurs des revendications précédentes, **caractérisé en ce que** ledit conduit (36) comprend une première partie (20) qui s'étend

à partir dudit four de maintien (11) et est raccordé auxdits moyens de pompage (15), à partir desquels au moins une seconde partie (21) s'étend pour un raccordement à la cavité (13) du moule (14).

4. Dispositif selon la revendication 1, **caractérisé en ce que** ladite pompe à piston (25) comprend un premier piston (28), qui peut coulisser hermétiquement à l'intérieur d'un premier cylindre (29) correspondant, le piston étant fixé à la tête d'une première tige (30) d'un premier actionneur (31) dont la course est commandée par ladite unité de commande (16).

5. Dispositif selon la revendication 4, **caractérisé en ce que** ledit premier actionneur (31) est hydraulique.

6. Dispositif selon une ou plusieurs des revendications précédentes, **caractérisé en ce que** lesdites première et seconde soupapes (26, 27) sont chacune constituées par un second piston (32), qui peut coulisser hermétiquement à l'intérieur d'un second cylindre correspondant (33), le piston étant fixé à la tête d'une seconde tige (34) d'un second actionneur (35) qui est commandé par ladite unité de commande (16).

7. Dispositif selon la revendication 6, **caractérisé en ce que** le second actionneur (35) est pneumatique.

8. Dispositif selon une ou plusieurs des revendications précédentes, **caractérisé en ce que** ledit raccord hydraulique comprend un réservoir (22) qui est disposé en aval de ladite seconde partie (21) et à partir duquel au moins une conduite montante (18) s'étend pour introduire un métal fondu dans ladite cavité (13).

9. Dispositif selon une ou plusieurs des revendications précédentes, **caractérisé en ce que** ledit raccord hydraulique comprend une unité de distribution (17), qui est appropriée pour former lesdites une ou plusieurs entrées (12) pour introduire le métal dans ladite cavité (13), ladite unité de distribution (17) étant raccordée à ladite au moins une conduite montante (18), sur laquelle sont disposés les dispositifs de mesure (19).

10. Dispositif selon une ou plusieurs des revendications précédentes, **caractérisé en ce que** lesdites une ou plusieurs entrées (12) sont disposées en dessous dudit moule (14).

11. Dispositif selon une ou plusieurs des revendications 1 à 9, **caractérisé en ce que** lesdites une ou plusieurs entrées (12) sont disposées latéralement par rapport audit moule (14).

12. Dispositif selon une ou plusieurs des revendications

1 à 9, **caractérisé en ce que** lesdites une ou plusieurs entrées (12) sont disposées latéralement et en dessous dudit moule (14).

13. Dispositif selon une ou plusieurs des revendications précédentes, **caractérisé en ce que** lesdits dispositifs de mesure de niveau (19) sont des dispositifs à induction. 5
14. Dispositif selon une ou plusieurs des revendications 1 à 12, **caractérisé en ce que** lesdits dispositifs de mesure de niveau (19) sont des dispositifs à induction adaptés pour servir de dispositifs de mesure de température. 10
15. Dispositif selon une ou plusieurs des revendications précédentes, **caractérisé en ce que** ledit raccord hydraulique comprend des dispositifs de chauffage (23) pour chauffer ledit métal fondu, lesdits dispositifs étant reliés à ladite unité de commande (16). 15 20
16. Dispositif selon la revendication 15, **caractérisé en ce que** lesdits dispositifs de chauffage (23) sont constitués par des résistances de chauffage, chacune étant disposée à l'intérieur d'un conteneur en céramique s'étendant longitudinalement correspondants. 25
17. Dispositif selon une ou plusieurs des revendications précédentes, **caractérisé en ce que** ledit raccord hydraulique comprend des capteurs (24) pour capter la température dudit métal fondu, lesdits capteurs étant reliés à ladite unité de commande (16). 30
18. Dispositif selon la revendication 17, **caractérisé en ce que** lesdits capteurs de température (24) sont constitués par des thermocouples, chacun étant disposé à l'intérieur des conteneurs en céramique s'étendant longitudinalement correspondants. 35

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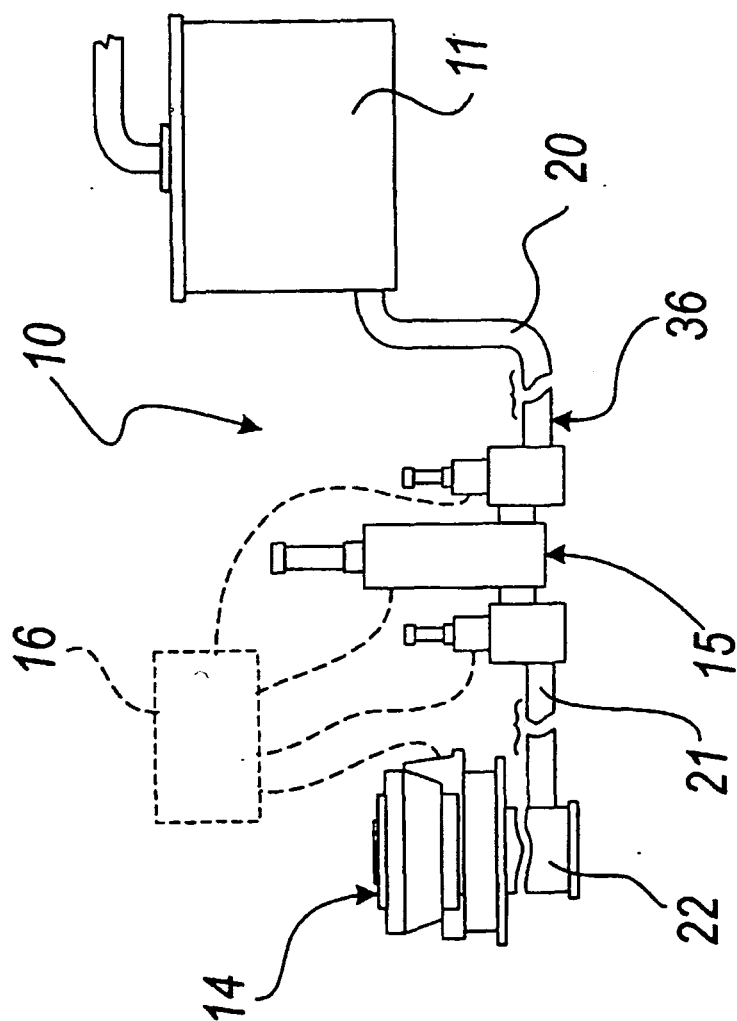


Fig. 1

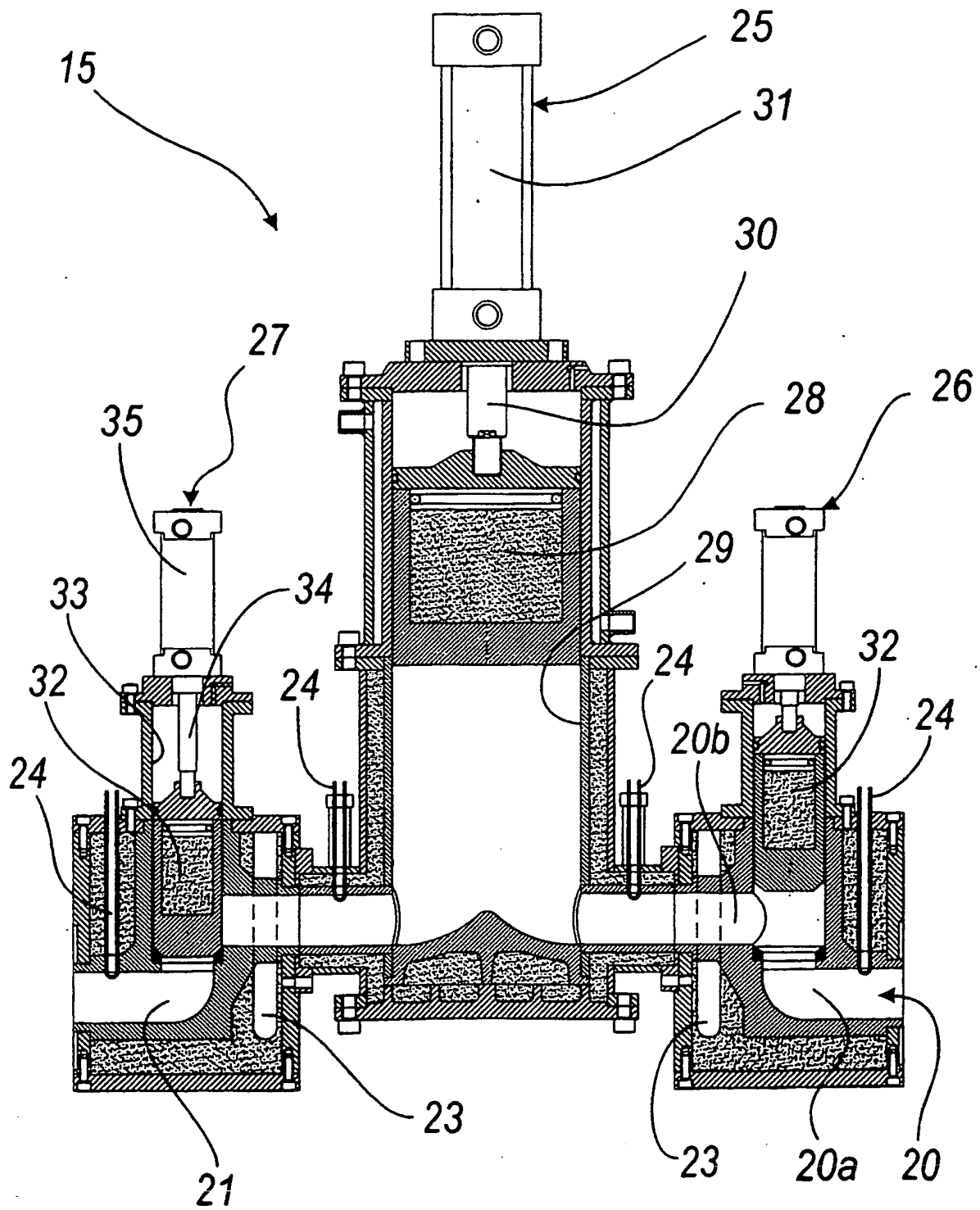


Fig. 2

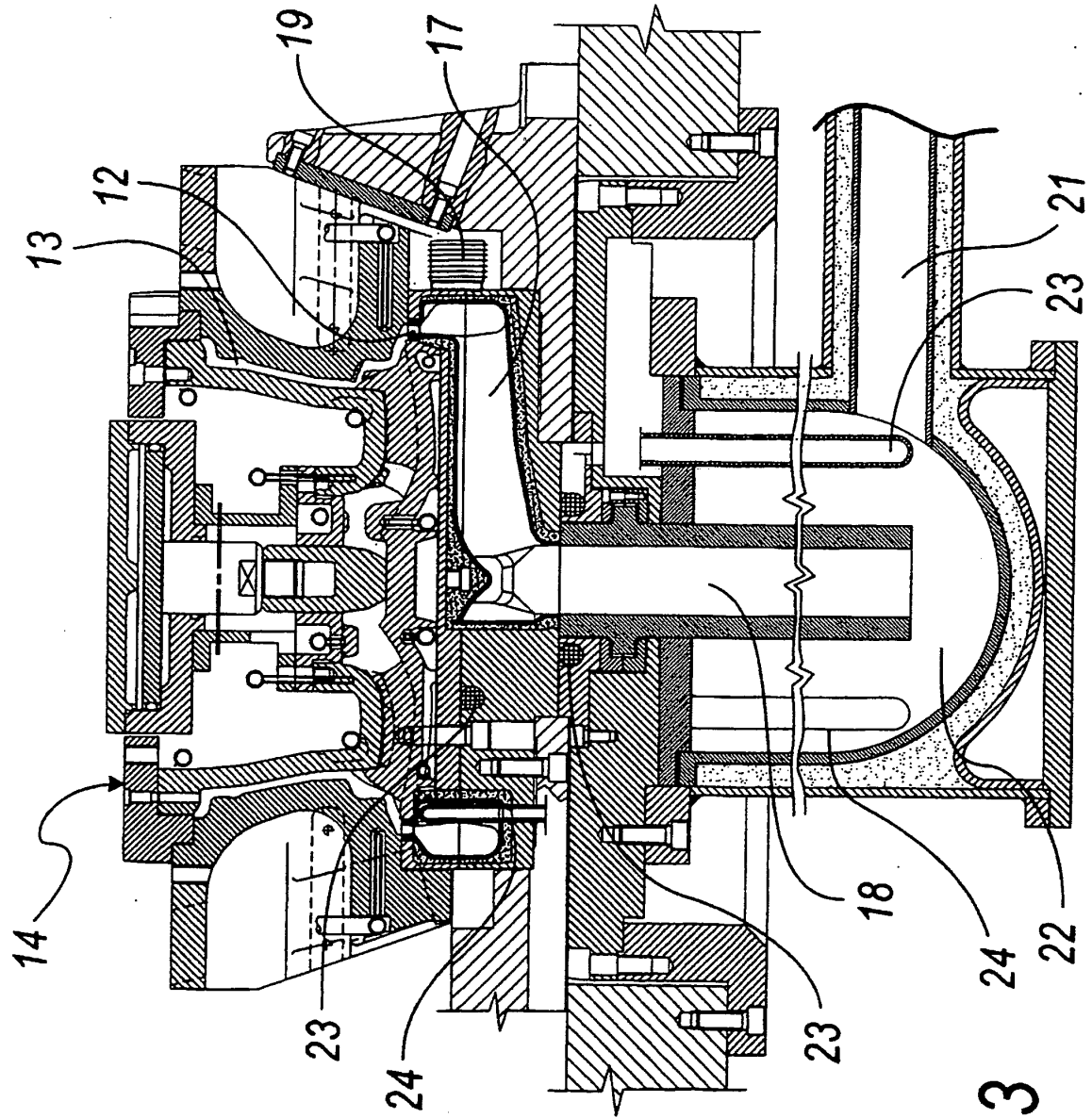


Fig. 3