



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.01.2009 Bulletin 2009/02

(51) Int Cl.:
B22D 41/22 (2006.01) B22D 41/24 (2006.01)
B22D 41/30 (2006.01) B22D 41/40 (2006.01)

(21) Application number: **08159059.8**

(22) Date of filing: **26.06.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT
RO SE SI SK TR
 Designated Extension States:
AL BA MK RS

(71) Applicant: **Indref Oy**
10440 Bollsta (FI)

(72) Inventor: **Helanto, Erkki**
02400 Kirkkonummi (FI)

(74) Representative: **Laako, Tero Jussi**
Berggren Oy Ab
P.O. Box 16
00101 Helsinki (FI)

(30) Priority: **06.07.2007 FI 20070533**

(54) **Apparatus for dispensing molten metal and method of manufacturing such an apparatus**

(57) The invention relates to a closing mechanism (1) for dispensing molten metal from a hole-bottomed ladle, said closing mechanism containing three at least partially superimposed ceramic plates (2, 3, 4), each of said plates (2, 3, 4) being provided with a hole (5), said

three ceramic plates (2, 3, 4) being cast in a ceramic mass (7), said mass (7) being present on at least two sides of the ceramic plates (2, 3, 4), and the ceramic plates (2, 3, 4), the ceramic mass (7), and a metal shell (10), used as a casting mold, establishing together an integrated unit.

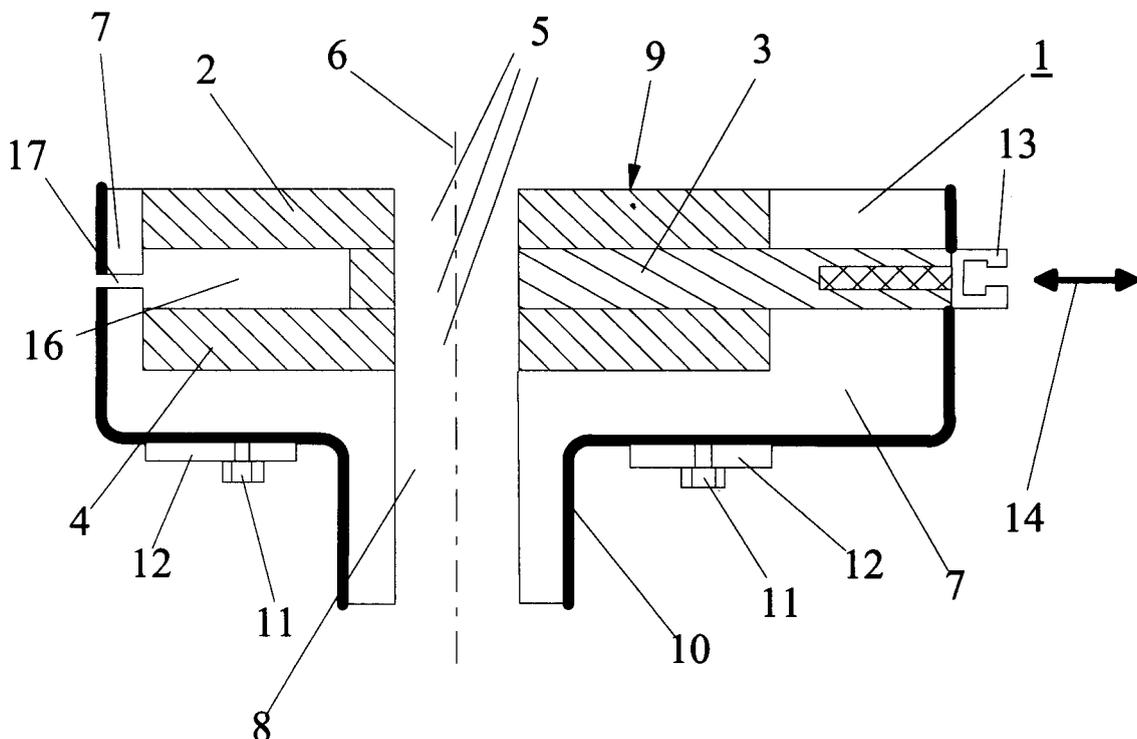


Fig. 1

Description

[0001] The invention relates to a closing mechanism for a hole-bottomed container for dispensing molten metal and to a method of manufacturing such a closing mechanism.

[0002] The closing element for a funnel originating from the bottom of a molten-metal holding ladle used to comprise an upward and downward movable stopper rod, which was coupled with a lifting bar extending across the surface of molten metal. The trouble here relates to guiding the stopper rod precisely to the taphole for closing the funnel after a molten metal pouring process. In addition, the stopper rod became rapidly worn in use.

[0003] Due to these problems, taphole stoppers have since been replaced by slide gates, as described e.g. in FI publication print 92022. The slide gate is constituted by a horizontal plate, which is set against the bottom end of a vertical funnel and which is rotatable about a vertical axis, and which is provided with hole which can be aligned with the end of a funnel for opening the funnel, and which can be rotated aside from the alignment with a funnel for closing the funnel. The plate establishing a slide gate is supported on a bulky frame responsible for transmitting a rotation to the plate. Such an assembly is difficult to build, awkward, and unreliable in operation.

[0004] On the other hand, publication EP 0 332 867 A1, included in the prior art, discloses a closing mechanism connected to the bottom of a container, wherein a funnel for pouring molten metal out by way of a bottom hole is established by rotating a hole present in a circular rod to the concentricity with a hole extending through the rest of the closing assembly. Such a structure is complicated and inconvenient, as well as expensive in terms of its manufacturing costs.

[0005] Further known from publication WO 2005/042190 A1 is a metal-structured apparatus assembled from sliding plates, wherein the middle plate of a plate stack consisting of three plates is capable of being slid with respect to the upper and lower stationary plates for closing and opening a spout extending through the plates. The steel-fabricated plate stack has been assembled by means of a separate, erectable, bulky steel frame, which holds the entire package together. Such a structure is complicated and quite heavy, as well as bulky.

[0006] An object of the invention is to provide a closing mechanism adaptable to the holed bottom of a metal pouring ladle, which is devoid of drawbacks found in the foregoing closing elements, but which functions well also at high temperatures required by metal casting.

[0007] The solution according to the invention enables manufacturing an economically efficient closing mechanism and having said closing mechanism integrated for a single piece.

[0008] Advantages of the invention include simplicity, low manufacturing costs, and easy replacement of the assembly.

[0009] The invention will now be described more close-

ly with reference to the accompanying figures, in which

fig. 1 shows a closing mechanism in one embodiment of the invention, and

fig. 2 shows a closing mechanism in a second embodiment of the invention.

[0010] Fig. 1 illustrates a closing mechanism 1 in cross-section. The closing mechanism 1 consists of three superimposed ceramic plates 2, 3 and 4, each provided with a hole 5. As shown in fig. 1, the closing mechanism 1 is in a completely open condition when all three holes 5 are in alignment along a common axis 6. Displacing the middle plate 3 relative to the upper and lower plates 2 and 4 into the interior of the closing mechanism, as indicated by an arrow 14, enables the hole 5 extending through the plates to be closed and the flowing of molten mass out of a hole-bottomed ladle to be stopped.

[0011] The plate package of three plates 2, 3 and 4 has been assembled together by casting it in a ceramic frame structure 7, which in this embodiment extends continuously around the plate package over five sides, with the exception of a downward pouring spout 8 which is aligned on the same axis 6 as the hole 5 of the fixedly mounted lower and upper plates, and with the exception of a top surface 9 of the upper plate 2 which comes to bear against the bottom of a ladle (not shown in the figure). Around the frame structure 7 to be cast of ceramic mass is its metallic casting mold/outer housing 10, in which the plate package and refractory casting mass are placed in a manufacturing stage of the closing mechanism 1. Adapted to set directly against the bottom surface of a ladle and its taphole in this embodiment is the plate package's upper plate 2. The closing mechanism 1 can be secured to the bottom of a ladle for example by bolts 11 and by brackets/washers 12 associated therewith. The closing mechanism 1 has its middle plate 3 manipulated by means of a guide element 13 for opening and closing a pouring spout, as indicated by the arrow 14. As the cast structure is substantially airtight, there is provided an air conduit 17 for enabling a displacement of the middle plate 3 from a vacant space 16, said air conduit extending through the ceramic frame structure 7 and the metallic casting mold 10. This same conduit 17 can be used for the expulsion of a material used during a casting process, a so-called filler/blocker, which prevents the casting material from reaching certain areas (the middle plate operating range). Useful as such a filler is any material familiar in casting technology, such as for example urethane, beeswax or the like.

[0012] Another option for attaching the closing mechanism 1 to the bottom surface of a ladle is provided for example by clamp mechanisms, which are permanently fixed to the ladle's bottom surface and which can be released and secured for a simple replacement of the entire closing mechanism. An essential feature of the invention is the simple closing mechanism 1, which is easy to re-

place as a single unit.

[0013] The ceramic casting 7 is molded on at least two sides of the plate stack. In this case, the discussed sides of the plate stack would be those present in the viewing plane of the figure. The process can be continued from here in a stepwise manner with different variations for enclosing the plate stack on all six sides within the casting, of course with the exception of spots essential from the standpoint of operation (the air conduit 16, the pouring spout 8, a supply hole in the upper part of the structure for delivering molten mass to the plate stack, and a recess necessary for manipulating the middle plate).

[0014] Fig. 2 illustrates a closing mechanism 1 of the invention in a second embodiment. If desired, the ceramic plates 2, 3 and 4 can be further fitted along the sides thereof with ceramic, substantially vertical support blocks 15 for facilitating an assembling process of the plate package and a manufacturing process of the closing mechanism 1. Neither of the illustrated embodiments requires separate springs for pressing the plates 2, 3 and 4 against each other as opposed to earlier solutions described in the prior art. In order to facilitate the assembly thereof, the ceramic plates 2, 3 and 4 can be at least partially secured to each other by any prior known method, such as a bonding agent or a mechanical coupling.

[0015] A closing mechanism 1 according to the invention also enables designing embodiments, displaying one or more of the features described as follows:

- the casting mass 7 can be applied on just two sides, namely on both long sides of the plate package,
- the casting mass 7 can be applied not only on these two sides but also arbitrarily on one or more additional sides, including a top face and a bottom face of the plate package,
- the pouring spout 8 of the closing mechanism 1, which leads out of the ceramic casting 7 and the metallic casting mold/outer housing 10, can be fabricated also from a ceramic bushing 18 and preset in contact with the lowermost ceramic plate 4, whereby the ceramic casting need not be necessarily extended all the way to the mouth of the pouring spout (the bushing 18 shown in the figure in dashed lines),
- 1-4 pieces of support blocks 15 can be present in a position mounted arbitrarily on a vertical side perpendicular to the plate level of the plates.

[0016] The ceramic plates 2, 3 and 4 can be manufactured by firing or casting and are integrated for a single unit by casting the same in the refractory casting mass 7 with the assistance of the metallic outer housing 10.

[0017] The closing mechanism 1 according to the invention is particularly suitable for use in association with molten steel (temperature about 1500°C), but it naturally useful in association with any molten metal (molten zinc

370°C). A limiting factor is the thermal resistance of ceramic plates, which is appr. 1600° in common commercial products used in association with steel casting processes. On the other hand, if plates are manufactured by using special ceramics, temperatures even higher than this can be reached.

[0018] A method of manufacturing the closing mechanism 1 comprises the following steps of:

- 10 - assembling a plate package, consisting of three finished plates 2, 3 and 4 from precision-machined closing plates used in steel making industry, and optional upright support blocks, the assembling process being performed by using, if necessary, for example a bonding agent, a mechanical coupling or the like option,
- 15 - aligning the plate package of three plates 2, 3 and 4 inside a casting mold 10 in a correct position by using necessary casting support blocks,
- 20 - fitting the plate package with necessary plugging means for preventing the ceramic casting 7 from reaching undesired sites (an air space 16 at the end of a middle plate 3, an air communication 17 out of the air space 16 at the middle plate 3, a pouring spout 8) by the application of methods known in casting engineering,
- 25 - performing the casting of a ceramic mass 7 at room temperature either in the position shown in fig. 1 or alternatively in the upside-down position,
- 30 - drying/curing the ceramic casting mass 7 at room temperature for a period required by the casting mass (typically about a week) or, alternatively, using a casting mass good for dry pressing.
- 35

[0019] In addition to these steps, the method may, if necessary, involve one or more of the following steps:

- 40 - in case the ceramic casting 7 is effected so as to cover also a top face of the closing mechanism 1 (the uppermost plate 2), the pouring spout can have its inlet end between the closing mechanism and the ladle fitted beforehand with necessary connecting bodies/seals to be embedded at least partially within the casting,
- 45
- 50 - the final stage of manufacturing is performed by raising the temperature from about 400°C, the casting mass 7 being vacated of possible water (the casting mass may also be originally water-free or it is possible to use for example masses which are good for dry pressing) and/or a so-called filling/plugging medium used in the mold.
- 55

[0020] It is obvious for a person skilled in the art that

various embodiments of the invention are not limited to the foregoing example, but may vary within the scope of protection defined in the appended claims.

Claims

1. A closing mechanism (1) for dispensing molten metal from a gate-bottomed ladle, said closing mechanism (1) containing three at least partially superimposed ceramic plates (2, 3, 4), each of said plates (2, 3, 4) being provided with a hole (5), **characterized in that** said three ceramic plates (2, 3, 4) are cast in a ceramic mass (7), said mass (7) being present on at least two sides of the ceramic plates (2, 3, 4), and the ceramic plates (2, 3, 4), the ceramic mass (7), and a metal shell (10), used as a casting mold, establish together an integrated unit. 5
2. A closing mechanism (1) according to claim 1, **characterized in that** the ceramic mass (7) is optionally present on 3-6 of the six sides of the ceramic plates (2, 3, 4). 10
3. A closing mechanism (1) according to claim 1, **characterized in that** the side/sides perpendicular to the plate level of the ceramic plates (2, 3, 4) is/are provided with 1-4 ceramic support blocks (15). 15
4. A closing mechanism (1) according to claim 1, **characterized in that** a pouring hole (5) of the ceramic plates (2, 3, 4) has additionally a ceramic bushing (18) mounted as its extension. 20
5. A closing mechanism (1) according to claim 1, **characterized in that**, when the ceramic casting mass (7) comprises a top face of the uppermost ceramic plate (2), the ceramic mass (7) has additionally cast therein a connecting block and/or a sealing block abutting against the bottom hole of a ladle. 25
6. A method of manufacturing a closing mechanism (1) used for dispensing molten metal, said method comprising the following steps of: 30
 - producing three ceramic plates (2, 3, 4), each of which is provided with a hole (5) for establishing a pouring spout,
 - positioning the plates (2, 3, 4) in such a way that a displacement of the middle plate (3) with respect to the uppermost and lowermost plates (2, 4) enables the pouring spout to be closed or opened,
- characterized in that** 35
 - the access of a casting mass (7) to undesired areas is denied by plugging or filling such areas,
- the ceramic plates (2, 3, 4) are positioned in a metallic outer housing (10), which functions as a casting mold,
- the outer housing (10) is filled with the refractory casting mass (7), such that some casting mass (7) will be present on at least two sides of the plates (2, 3, 4),
- the refractory casting mass (7) is cured,
- the plugging/filling media are removed. 40
7. A method according to claim 6, **characterized in that** it further comprises an installation process of necessary casting support blocks prior to filling the outer housing (10) with the casting mass (7). 45
8. A method according to claim 6, **characterized in that** it further comprises a casting process of the casting mass (7) over 3-6 sides of the ceramic plates (2, 3, 4). 50
9. A method according to claim 8, **characterized in that**, when the casting mass (8) covers a top face of the uppermost plate (2), the casting mass (7) has beforehand inserted therein a connecting block and/or a sealing block for a hole-bottomed ladle. 55
10. A method according to claim 6, **characterized in that** the final step comprises heating the closing mechanism (1) from about 400°C for dewatering the casting mass (7). 60
11. A method according to claim 6, **characterized in that** a curing process of the refractory casting mass (7) is effected at room temperature in about a week, depending on a type of mass being used. 65
12. A method according to claim 6, **characterized in that** a curing process of the refractory casting mass (7) is effected by pressing when using a casting mass suitable for dry pressing. 70
13. A method according to claim 6, **characterized in that** a hole (5) of the lowermost ceramic plate (4) is fitted with a ceramic bushing (18) as its extension. 75

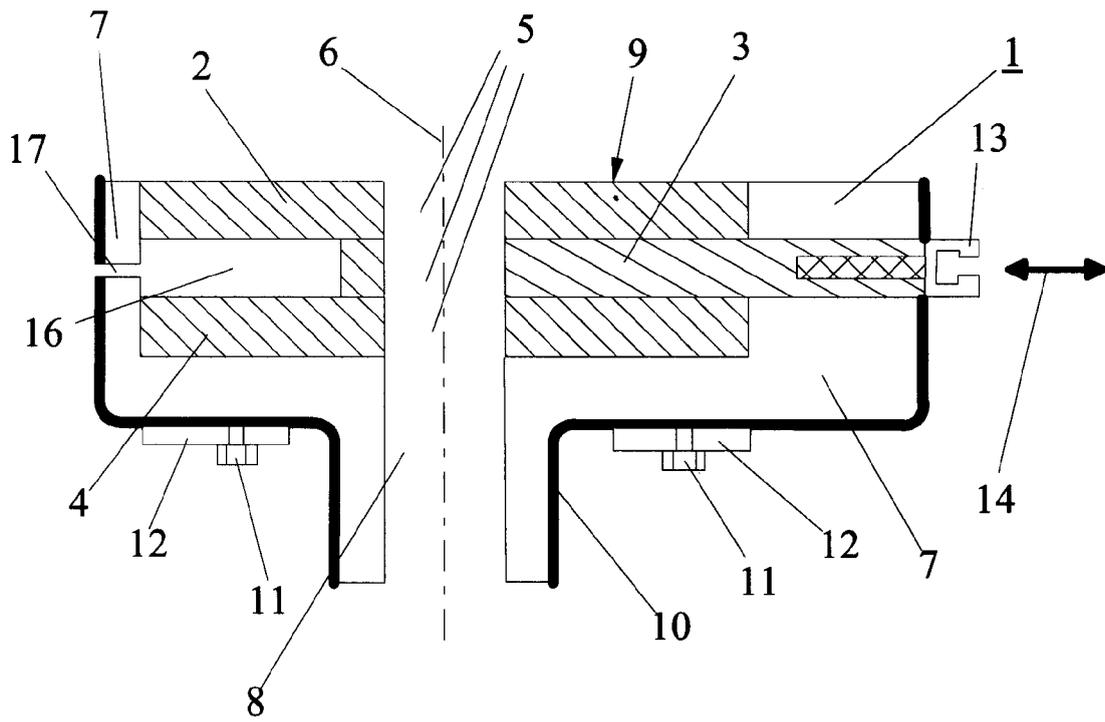


Fig. 1

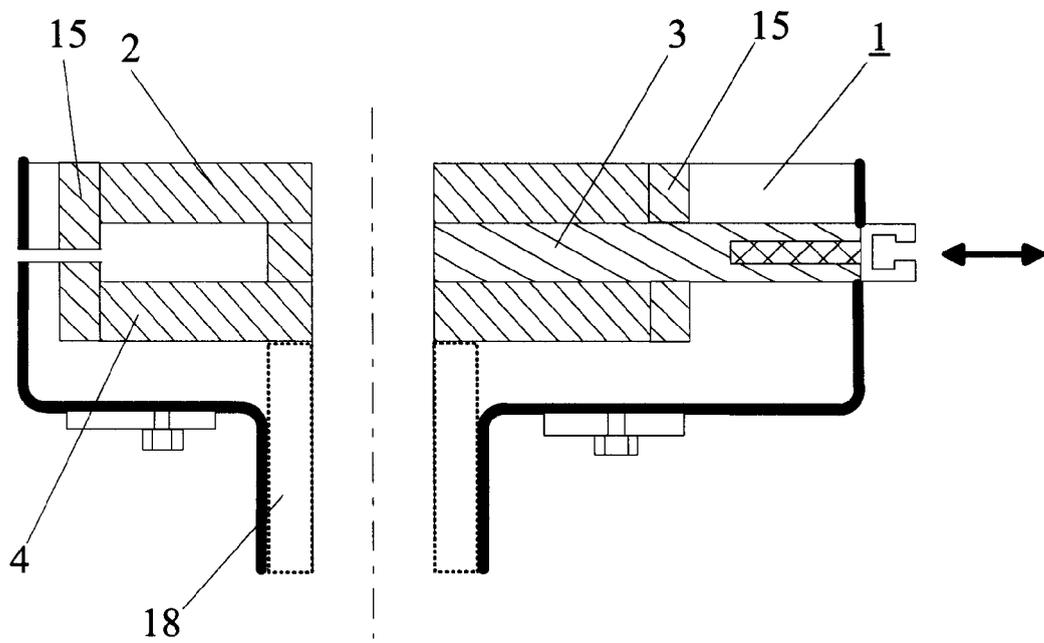


Fig. 2

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- FI 92022 [0003]
- EP 0332867 A1 [0004]
- WO 2005042190 A1 [0005]