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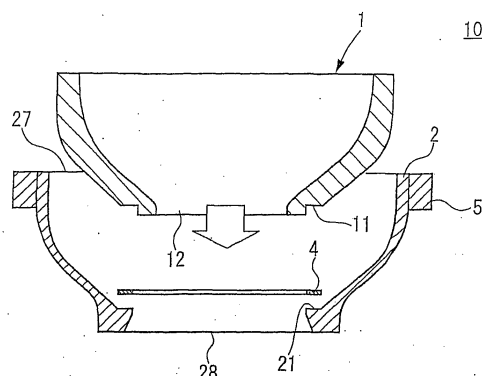
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(54) **INTERMEDIATE STOKE, METHOD FOR PRODUCING THE SAME AND LOW PRESSURE CASTING DEVICE**

(57) An intermediate stalk (10) that is used for a low-pressure die-casting apparatus includes a metal covering material (2), and a precast refractory material (1) that is removably fitted into the metal covering material (2), an air release opening (3) being formed between the metal covering material (2) and the precast refractory material (1) when viewed from above. According to the present invention, an intermediate stalk that allows water to be sufficiently released from the refractory heat insulator during heating, does not explode, does not produce cracks in the refractory heat insulator due to the difference in coefficient of thermal expansion between the refractory heat insulator and the metal covering material, and allows easy replacement of the refractory heat insulator, a method of producing the same, and a low-pressure die-casting apparatus can be provided.

Fig. 4



Description

TECHNICAL FIELD

[0001] The present invention relates to an intermediate stalk for a low-pressure die-casting apparatus used to produce an aluminum casting or the like, and a method of producing the same.

BACKGROUND ART

[0002] As shown in FIG. 6, a low-pressure die-casting apparatus 100 used to produce an aluminum casting or the like is configured so that an aluminum molten metal 102 contained in a molten metal container 101 is supplied to a die 105 through a stalk 104 and an intermediate stalk 103, and cast using the die 105.

[0003] The intermediate stalk 103 used for the low-pressure die-casting apparatus 100 must withstand a molten metal temperature of 600 to 700°C and make it unnecessary to provide an external heating system, for example. In recent years, an intermediate stalk in which the inner side of a metal covering material 113 is lined with a refractory heat insulator 123 has been known.

[0004] JP-A-2006-272448 discloses the intermediate stalk 103 in which the inner side of the metal covering material 113 is lined with the refractory heat insulator 123, and an inorganic material 133 that adjusts and absorbs the difference in thermal expansion between the covering material 113 and the refractory heat insulator 123 is interposed between the covering material 113 and the refractory heat insulator 123, and also discloses the low-pressure die-casting apparatus 100 including the intermediate stalk 103. The intermediate stalk 103 and the low-pressure die-casting apparatus 100 have advantages in that radiation of heat from the intermediate stalk 103 is suppressed so that a decrease in temperature of the molten metal is prevented; cracks that may occur in the refractory heat insulator 123 due to the difference in thermal expansion between the covering material 113 and the refractory heat insulator 123 can be prevented by providing the inorganic material 133 that adjusts and absorbs the difference in thermal expansion between the covering material 113 and the refractory heat insulator 123; and an opening that may be formed between the covering material 113 and the refractory heat insulator 123 due to the difference in thermal expansion is closed by utilizing a thermally expansible sheet that expands due to heating as the inorganic material 133 so that a deterioration in heat insulation effect is prevented, for example.

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

[0005] According to the intermediate stalk 103 and the low-pressure die-casting apparatus 100 including the

same disclosed in JP-A-2006-272448, since the outer side of the refractory heat insulator is closely covered with the covering material 113, water may not be sufficiently released from the refractory heat insulator 123 during heating so that the refractory heat insulator 123 may break due to vaporization and expansion of water contained in the refractory heat insulator 123. Moreover, the inorganic material 133 provided between the refractory heat insulator 123 and the metal covering material 113 cannot sufficiently absorb the difference in thermal expansion between the refractory heat insulator 123 and the metal covering material 113, so that cracks may occur in the refractory heat insulator 123 due to heating during actual use. Since a significant force may be applied to the metal covering material 113 when destroying the refractory heat insulator 123 for replacement, the covering material 113 may break or may be deformed. Furthermore, an adhesive used to bond the inorganic material 133 or a water repellent for the inorganic material 133 may be decomposed to produce smoke or odor due to initial heating during production or actual use.

[0006] Note that water contained in the refractory heat insulator consists of a residue of water used during lining when producing the refractory heat insulator and water absorbed by the refractory heat insulator during storage.

[0007] An object of the present invention is to provide an intermediate stalk that allows water to be sufficiently released from a refractory material during heating, does not explode, does not produce cracks in the refractory material due to the difference in coefficient of thermal expansion between the refractory material and a metal covering material, and allows easy replacement of the refractory material, a method of producing the same, and a low-pressure die-casting apparatus.

Means for Solving the Problems

[0008] The inventors of the present invention conducted extensive studies in order to achieve the above object. As a result, the inventors found that water is sufficiently released from the refractory material during heating, an explosion does not occur, cracks do not occur in the refractory material due to the difference in coefficient of thermal expansion between the refractory material and the metal covering material, and the refractory material can be easily replaced by removably fitting a precast refractory material into a metal covering material, and forming an air release opening between the covering material and the precast refractory material when viewed from above. This finding has led to the completion of the present invention.

[0009] Specifically, the present invention provides an intermediate stalk that is used for a low-pressure die-casting apparatus, the intermediate stalk comprising a metal covering material, and a precast refractory material that is removably fitted into the metal covering material, an air release opening being formed between the metal covering material and the precast refractory material

when viewed from above.

[0010] The present invention also provides a low-pressure die-casting apparatus comprising the above intermediate stalk.

[0011] The present invention further provides a method of producing an intermediate stalk that is used for a low-pressure die-casting apparatus, the method comprising fitting a precast refractory material into a metal covering material, the precast refractory material being formed in advance so that an air release opening is formed between the metal covering material and the precast refractory material when viewed from above in a state in which the precast refractory material is fitted into the metal covering material.

Effects of the Invention

[0012] Since the intermediate stalk and the low-pressure die-casting apparatus according to the present invention are configured so that the precast refractory material is removably fitted into the metal covering material and the air release opening is formed between the covering material and the precast refractory material when viewed from above, water is sufficiently released from the refractory material during heating, an explosion does not occur, cracks do not occur in the refractory material due to the difference in coefficient of thermal expansion between the refractory material and the metal covering material, and the refractory material can be easily replaced. Moreover, since it is unnecessary to replace the refractory material for maintenance purposes, a problem in which the metallic covering material is damaged due to replacement does not occur. According to the method of producing an intermediate stalk according to the present invention, since the precast refractory material is not produced using the metal covering material as a molding box, the production method, the production apparatus, and the like can be conveniently determined so that the degree of freedom of production increases. Moreover, since the intermediate stalk can be substantially produced by merely fitting the precast refractory material into the metal covering material, the production cost can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG. 1 is a cross-sectional view showing an intermediate stalk according to one embodiment of the present invention, FIG. 2 is a plan view of the intermediate stalk shown in FIG. 1, FIG. 3 is a view showing an example of a method of securing a precast refractory material in the intermediate stalk, wherein (A) is a plan view showing another embodiment of an area enclosed by a two-dot chain line in FIG. 2, (B) is a front view of (A), (C) is a front view showing an area secured by a securing plate, and (D) is a

plan view of (C), FIG. 4 is a view illustrative of a method of producing an intermediate stalk according to the present invention, FIG. 5 is a schematic view showing a low-pressure die-casting apparatus according to the present invention, and FIG. 6 is a schematic view showing a related-art low-pressure die-casting apparatus.

BEST MODE FOR CARRYING OUT THE INVENTION

[0014] An intermediate stalk according to one embodiment of the present invention and a low-pressure die-casting apparatus including the same are described below with reference to FIGS. 1 to 5. FIG. 1 is a cross-sectional view showing the intermediate stalk according to this embodiment. FIG. 2 is a plan view of the intermediate stalk shown in FIG. 1. FIG. 3 is a view showing an example of a method of securing a precast refractory material in the intermediate stalk, wherein (A) is a plan view showing another embodiment of an area enclosed by a two-dot chain line in FIG. 2, (B) is a front view of (A), (C) is a front view showing an area secured by a securing plate, and (D) is a plan view of (C). FIG. 4 is a view illustrative of a method of producing the intermediate stalk according to the present invention. FIG. 5 is a schematic view showing a low-pressure die-casting apparatus.

[0015] An intermediate stalk 10 is used for a low-pressure die-casting apparatus. The intermediate stalk 10 includes a metal covering material 2 that is in the shape of a relatively shallow holding bath and has an upper opening 27 having a large opening size and a lower opening 28 that has an opening size smaller than that of the upper opening 27, and a precast refractory material 1 that has almost the same shape as the covering material 2 and is removably fitted into the metal covering material 2. An intermediate stalk has been normally produced using a metal covering material as a molding box since the inner side of the metal covering material is lined with a refractory material. This poses limitations on the production conditions. On the other hand, since the intermediate stalk according to the present invention is not produced using the metal covering material as a molding box, the production method, the production apparatus, and the like can be conveniently determined so that the degree of freedom of production increases. Moreover, since it is unnecessary to replace the refractory material for maintenance purposes, a problem in which the metal covering material is damaged due to replacement does not occur.

[0016] The material for the metal covering material 2 is not particularly limited. For example, the metal covering material 2 may be formed of cast iron. The shape of the metal covering material 2 is not particularly limited. It is preferable that a flat horizontal section 21 that supports the precast refractory material 1 be provided around the lower opening. The placement stability of the precast refractory material 1 having a flat horizontal bottom can be improved by providing the flat horizontal section 21 around the lower opening.

[0017] In the intermediate stalk 10 according to the present invention, the precast refractory material 1 is removably fitted into the metal covering material 2. The precast refractory material 1 may be arbitrarily fitted into the metal covering material 2 insofar as an air release opening 3 is formed between the covering material 2 and the precast refractory material 1 when viewed from above. The intermediate stalk 10 according to the present invention is configured so that the precast refractory material 1 is supported at the bottom. Specifically, a flat horizontal bottom 11 is formed at the bottom of the precast refractory material 1 around the opening of the metal covering material 2. The flat horizontal bottom 11 of the precast refractory material 1 is disposed on the flat horizontal section 21 of the metal covering material 2 through a packing material 4. A situation in which molten metal leaks through the opening between the precast refractory material 1 and the metal covering material 2 can be prevented by providing the packing material 4 in the area where the precast refractory material 1 is supported by (comes in contact with) the metal covering material 2.

[0018] The packing material may be a sheet material that contains 20 to 40 mass% of ceramics fibers, 40 to 70 mass% of unfired vermiculite, and 5 to 20 mass% of an organic binder, for example. The density of such a thermally expansible sheet is preferably 500 to 800 kg/cm³, and particularly preferably 600 to 700 kg/cm³.

[0019] The precast refractory material 1 may be fitted into the metal covering material 2 so that part of the outer side surface (outer circumferential surface) of the precast refractory material 1 is supported by part of the inner side surface (inner circumferential surface) of the metal covering material 2 (e.g., almost the lower half of the outer side surface of the precast refractory material 1 is supported by almost the lower half of the inner side surface of the metal covering material 2). Since an opening through which the air is released upward is formed even if part of the outer side surface of the precast refractory material 1 comes in contact with part of the inner side surface of the metal covering material 2, release of water from the refractory material during heating is not hindered.

[0020] In the intermediate stalk 10 according to the present invention, the air release opening 3 is formed between the covering material 2 and the precast refractory material 1 when viewed from above. This means that the opening 3 is observed between the metal covering material 2 and the precast refractory material 1 when observing the intermediate stalk 10 from above, as shown in FIG. 2. Since the air release opening 3 is formed between the covering material 2 and the precast refractory material 1 when viewed from above, water is sufficiently released from the refractory material during heating, an explosion does not occur, cracks do not occur in the refractory material due to the difference in coefficient of thermal expansion between the refractory material and the metal covering material, and the refractory material can be easily replaced.

[0021] In the intermediate stalk 10, the width of the opening 3 is 0.5 mm or more, preferably 1.0 mm or more, and particularly preferably 2.0 mm or more. The upper limit of the width of the opening 3 is not particularly limited, but is about 5 mm since the placement stability of the precast refractory material 1 decreases if the width of the opening 3 is too large. The opening 3 need not be formed between the metal covering material 2 and the precast refractory material 1 over the entire circumference of the intermediate stalk 10, or may be formed between the metal covering material 2 and the precast refractory material 1 over the entire circumference of the intermediate stalk 10. It is preferable that the opening 3 be formed between the metal covering material 2 and the precast refractory material 1 over the entire circumference of the intermediate stalk 10 from the viewpoint of ease of design and the placement stability of the precast refractory material 1.

[0022] As shown in FIG. 1, the opening 3 formed between the metal covering material 2 and the precast refractory material 1 may be connected to an internal opening 3a that is formed between an inner circumferential surface 25 of the metal covering material 2 and an outer circumferential surface 15 of the precast refractory material 1. For example, when almost the lower half of the outer side surface of the precast refractory material 1 is supported by almost the lower half of the inner side surface of metal covering material 2, the opening 3 formed between the metal covering material 2 and the precast refractory material 1 is connected to an opening formed between almost the upper half of the inner side surface of metal covering material 2 and almost the upper half of the outer side surface of the precast refractory material 1.

[0023] The precast refractory material 1 may be formed using a known insulating material. The precast refractory material 1 may be formed using an unshaped refractory material. Examples of the unshaped refractory material include a material obtained by adding an alumina cement binder and water to calcium silicate or silica (main component) and kneading the mixture, a paste material obtained by adding mica, carbon, a silicon carbide powder, or a silicon nitride powder (non-wettability improver) to inorganic fibers and an alumina powder, adding a silica or alumina-based inorganic binder, a thickener, and water to the mixture, and kneading the mixture, and the like.

[0024] In the intermediate stalk 10 according to the present invention, a heat insulator may be formed on the outer circumferential surface of the precast refractory material 1. The heat insulating properties of the intermediate stalk can be improved by forming the heat insulator on the outer circumferential surface of the precast refractory material 1 (i.e., lining the precast refractory material 1 with the heat insulator) so that a problem due to a decrease in temperature of molten metal can be prevented. The heat insulator also functions as a sealing material that prevents leakage of molten metal due to cracks formed in the precast refractory material 1. Examples of

the heat insulator include inorganic fiber aggregates (e.g., inorganic fiber felt and blanket) and the like. Examples of the inorganic fibers include ceramic fibers, silica fibers, alumina fibers, and the like. Even if the heat insulator is formed on the outer circumferential surface of the precast refractory material 1, the air release opening 3 is formed between the covering material 2 and the precast refractory material 1 provided with the heat insulator when viewed from above. The internal opening 3a may be formed between the inner circumferential surface 25 of the metal covering material 2 and the outer circumferential surface of the heat insulator formed on the precast refractory material 1.

[0025] The intermediate stalk 10 according to the present invention may have a structure in which a thermally expansible sheet that has flexibility and expands due to heating is provided in part of the area (particularly the lower half) between the metal covering material 2 and the precast refractory material 1. This improves the placement stability of the precast refractory material 1. The thermally expansible sheet starts to expand at 300 to 400°C, for example, and expands in the thickness direction. The expansion coefficient is 2, and preferably 2 to 4 in the thickness direction. If the expansion coefficient is within the above range, an opening is not formed between the metal covering material 2 and the precast refractory material 1 in the area where the thermally expansible sheet is provided, so that the placement stability of the precast refractory material 1 can be improved while ensuring a heat insulation effect. In FIG. 1, reference numeral 5 indicates a grip of the metal covering material 2.

[0026] In the intermediate stalk 10 according to the present invention, the four corners or two diagonal corners of the precast refractory material 1 fitted into the metal covering material 2 may be secured using a securing plate. This enables the precast refractory material 1 to be stably secured. A securing method using the securing plate is described below with reference to FIG. 3. The corner of the upper end of the intermediate stalk 10 is provided with a depression 6 that is approximately in the shape of a triangle when viewed from above and has a given dimension in the depth direction. The depression 6 includes a depression 61 formed in the metal covering material 2, and a depression 62 formed in the precast refractory material 1. A bolt hole 7 is formed in the depression 61 formed in the metal covering material 2 (FIG. 3(A)). A securing plate 8 that is fitted into the depression 6 is provided. The securing plate 8 has a through-hole that receives a flush bolt 9 and is formed at a position opposite to the bolt hole 7 after installation (FIG. 3(B)). When the securing plate 8 is fitted into the depression 6 and secured using the bolt, the precast refractory material 1 is strongly secured on the metal covering material 2 due to repulsion of the flexible packing material 4 provided at the bottom (FIGS. 3(C) and 3(D)).

[0027] A method of producing the intermediate stalk according to the present invention is described below.

The intermediate stalk 10 according to the present invention is produced by fitting the precast refractory material 1 into the metal covering material 2, the precast refractory material 1 being formed in advance so that the air release opening 3 is formed between the metal covering material 2 and the precast refractory material 1 when viewed from above in a state in which the precast refractory material 1 is fitted into the metal covering material 2.

[0028] The precast refractory material 1 is produced using an unshaped refractory material described with regard to the intermediate stalk 10 according to the present invention. Since the precast refractory material 1 is not produced using the metal covering material 2 as a molding box, the production method, the production apparatus, and the like can be conveniently determined so that the degree of freedom of production increases. When the metal covering material 2 and the refractory material are integrally formed (e.g., related-art intermediate stalk), since the metal covering material 2 is oxidized and deformed when the heating temperature during production is increased, it is necessary to employ a low heating temperature. In this case, since water remaining in the refractory material may vaporize or shrinkage due to heating may occur during actual use, the refractory material may break. On the other hand, since the intermediate stalk 10 according to the present invention is not produced using the metal covering material 2 as a molding box, the precast refractory material 1 can be fired in advance at a high temperature. This prevents a situation in which water remaining in the refractory material vaporizes or shrinkage due to heating occurs during actual use. Moreover, since the intermediate stalk 10 can be substantially produced by merely fitting the precast refractory material 1 into the metal covering material 2, the production cost can be reduced.

[0029] When the intermediate stalk 10 includes the packing material 4, the packing material 4 is disposed at a given position around the bottom opening of the intermediate stalk 10 before fitting the precast refractory material 1 into the metal covering material 2 (FIG. 4). This enables the intermediate stalk 10 to be produced by a simple method.

[0030] A low-pressure die-casting apparatus 20 according to the present invention includes the intermediate stalk 10. As shown in FIG. 5, the low-pressure die-casting apparatus 20 according to the present invention includes a molten metal container 31 (crucible) that contains molten metal 32, a furnace cover 36 that seals the molten metal container, a stalk tube 34 that is disposed at the center of the furnace cover 36 so that the stalk tube 34 passes through the furnace cover 36 and the lower opening of the stalk tube 34 is positioned in the molten metal 32, the intermediate stalk 10 that is disposed so that the upper opening of the stalk tube 34 communicates with the bottom opening of the intermediate stalk 10, and a die 35 that is disposed over the intermediate stalk 10.

[0031] In the low-pressure die-casting apparatus 20 according to the present invention, the molten metal 32

contained in the molten metal container 31 is heated and melted using a heating means (not shown). A pressure (pressurized air) indicated by arrows P is applied to the surface of the molten metal 32 using a means not shown in FIG. 5 so that the molten metal 32 moves upward toward the die 35 through the stalk tube 34 and the intermediate stalk 10 (molten metal passage). An air vent hole (not shown) is formed in the top of the die 35 so that unnecessary air is removed through the air vent hole.

[0032] A mold that corresponds to the casting target product is disposed in the die 35. The molten metal 32 that has moved upward flows into the mold. The die is cooled at an appropriate timing to obtain a casting (e.g., aluminum casting). Although FIG. 5 shows the structure of the low-pressure die-casting apparatus that causes the molten metal to move upward and to be supplied to the die, the low-pressure die-casting apparatus may have a structure in which the pressure inside the die 35 is reduced to suck up the molten metal, or a structure in which the molten metal is caused to move upward at a positive pressure while reducing the pressure inside the die 35, for example.

[0033] Since the low-pressure die-casting apparatus 20 according to the present invention is configured so that the air release opening is formed between the covering material and the precast refractory material when viewed from above, water is sufficiently released from the refractory material during heating, an explosion does not occur, cracks do not occur in the refractory material due to the difference in coefficient of thermal expansion between the refractory material and the metal covering material, and the refractory material can be easily replaced. Moreover, since it is unnecessary to replace the refractory material for maintenance purposes, a problem in which the metallic covering material is damaged due to replacement does not occur.

EXAMPLES

[0034] The present invention is further described below by way of examples. Note that the present invention is not limited to the following examples.

Example 1

(Production of precast refractory material)

[0035] An appropriate amount of water was added to an unshaped refractory material containing silica (main component) and alumina cement (binder). The mixture was kneaded to prepare mortar. The mortar was injected into a resin mold having a given shape, and cured and hardened overnight at a temperature of 25°C and a relative humidity of 80%. The hardened molding was dried at 110°C for 24 hours, and fired at 600°C for 12 hours to obtain a precast refractory material having a shape shown in FIGS. 1 and 2.

(Production (assembly) of intermediate stalk)

[0036] A ceramic fiber sheet material (packing material) containing unfired vermiculite and provided with a hole having the same shape as the bottom opening of a covering material was disposed at the bottom of a covering material formed of cast iron and having a shape shown in FIGS. 1 and 2. The precast refractory material produced by the above method was disposed inside the covering material on which the packing material was disposed, and a securing plate was attached to each of two diagonal corners over the covering material to obtain an intermediate stalk. The intermediate stalk had an opening (width: 3 mm) between the covering material and the precast refractory material over the entire circumference of the intermediate stalk when viewed from above.

Comparative Example 1

[0037] A ceramic fiber sheet material containing unfired vermiculite was bonded to the entire inner circumference of a covering material formed of cast iron and having a shape shown in FIGS. 1 and 2 using an organic adhesive. A core for forming the inner surface (inner lining material) of an intermediate stalk was disposed inside the covering material. The mortar used in Example 1 was injected between the covering material and the core, and cured and hardened overnight at a temperature of 25°C and a relative humidity of 80%. After removing the core, the product was dried at 110°C for 24 hours. The resulting intermediate stalk did not have an opening between the covering material and the lining material when viewed from above.

(Evaluation method)

[0038] The inside of the intermediate stalk was rapidly heated using a gas burner until the temperature of the atmosphere inside the intermediate stalk reached 900°C as a simulation of actual use of a low-pressure die-casting apparatus. White smoke due to the organic adhesive was produced from the intermediate stalk obtained in Comparative Example 1. The state of the refractory material after heating was visually inspected. Cracks that are considered to be caused by the difference in thermal expansion and removal of the refractory material due to explosion were observed. When subjecting the intermediate stalk obtained in Example 1 to the same evaluation test, no abnormalities were observed during and after heating.

EXPLANATION OF SYMBOLS

[0039]

- 1: Precast refractory material
- 2: Metal covering material
- 3: Air release opening
- 4: Packing material

- 5: Grip
- 10, 103: Intermediate stalk
- 20, 100: Low-pressure die-casting apparatus
- 31: Molten metal container (crucible)
- 32: Molten metal
- 34: Stalk tube
- 35: Die
- 36: Furnace cover

INDUSTRIAL APPLICABILITY

[0040] Since the intermediate stalk and the low-pressure die-casting apparatus according to the present invention allow water to be sufficiently released from the refractory material during heating, do not explode, and do not produce cracks in the refractory material due to the difference in coefficient of thermal expansion between the refractory material and the metal covering material, the intermediate stalk and the low-pressure die-casting apparatus according to the present invention may be suitably used to produce an aluminum casting or the like. According to the method of producing an intermediate stalk according to the present invention, since the precast refractory material is not produced using the metal covering material as a molding box, the production method, the production apparatus, and the like can be conveniently determined so that the degree of freedom of production increases.

Claims

1. An intermediate stalk that is used for a low-pressure die-casting apparatus, the intermediate stalk comprising a metal covering material, and a precast refractory material that is removably fitted into the metal covering material, an air release opening being formed between the metal covering material and the precast refractory material when viewed from above.
2. The intermediate stalk according to claim 1, wherein an opening having a width of 0.5 or more is formed between the covering material and the precast refractory material over the entire circumference of the intermediate stalk.
3. The intermediate stalk according to claim 1 or 2, wherein a heat insulator is formed on an outer circumferential surface of the precast refractory material.
4. The intermediate stalk according to any one of claims 1 to 3, wherein a packing material that prevents entrance of molten metal is provided between the precast refractory material and the covering material around a bottom opening of the intermediate stalk.
5. A low-pressure die-casting apparatus comprising

the intermediate stalk according to any one of claims 1 to 4.

6. A method of producing an intermediate stalk that is used for a low-pressure die-casting apparatus, the method comprising fitting a precast refractory material into a metal covering material, the precast refractory material being formed in advance so that an air release opening is formed between the metal covering material and the precast refractory material when viewed from above in a state in which the precast refractory material is fitted into the metal covering material.

Fig. 1

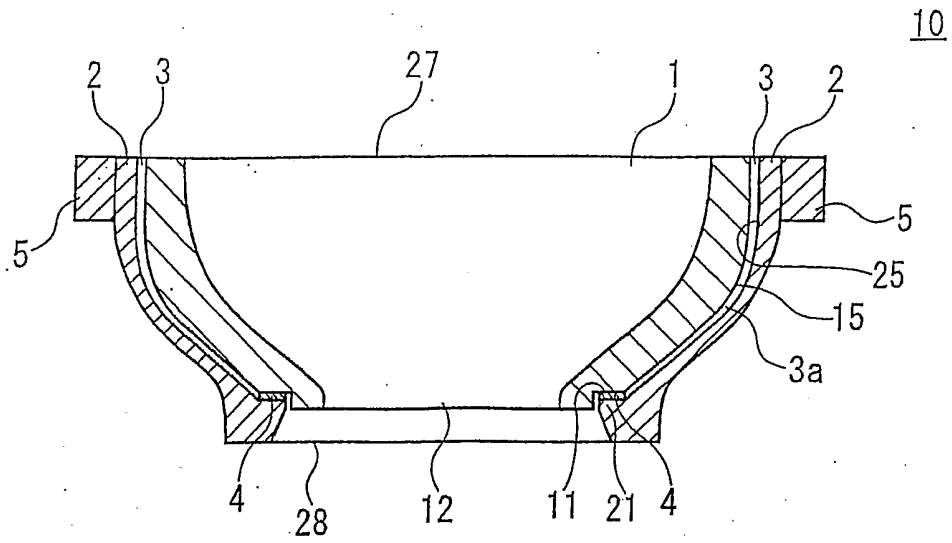


Fig. 2

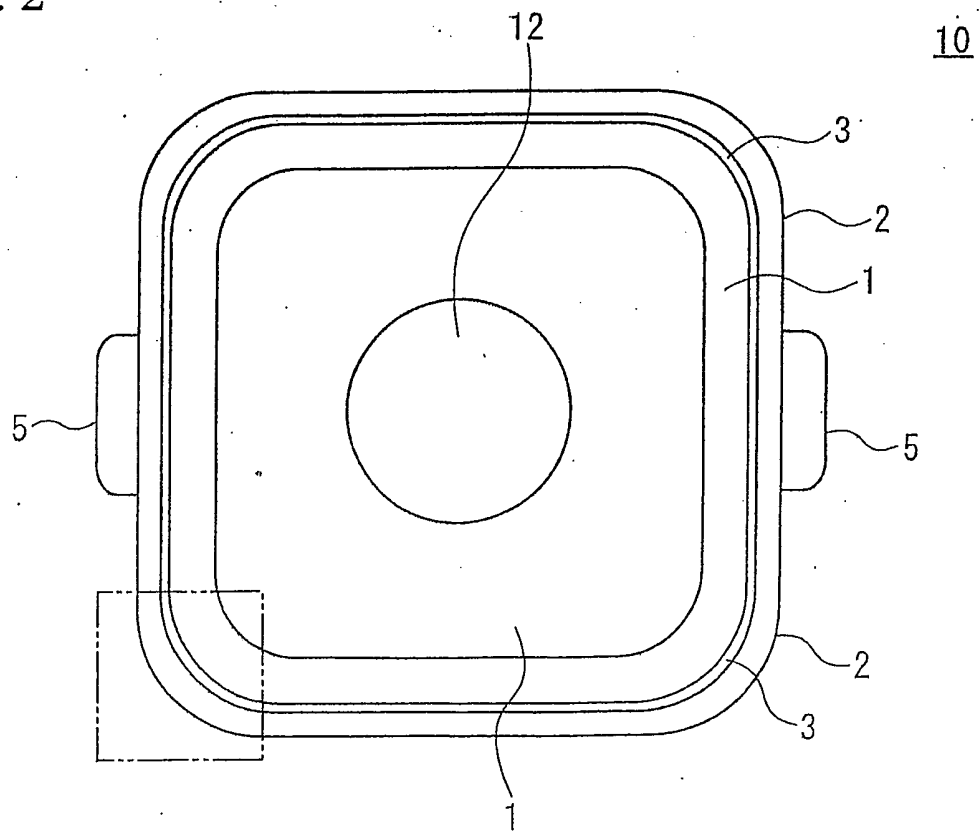


Fig. 3

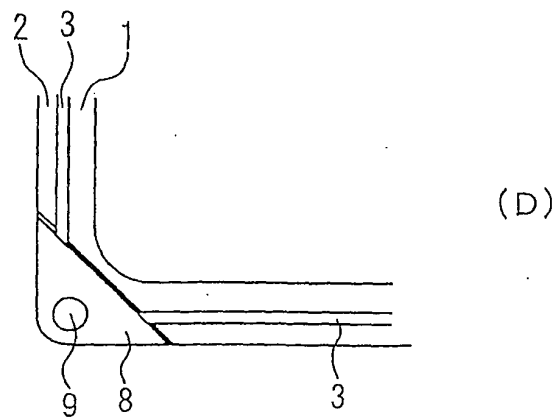
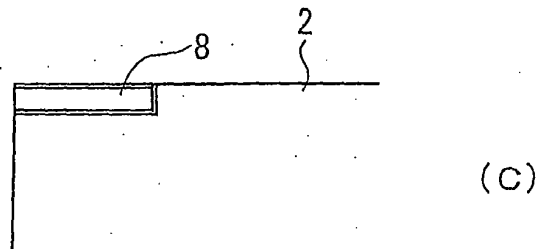
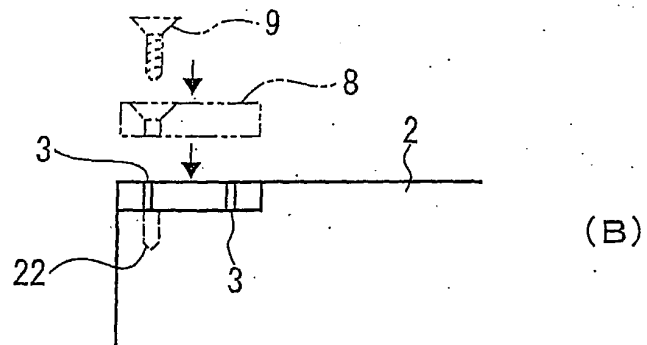
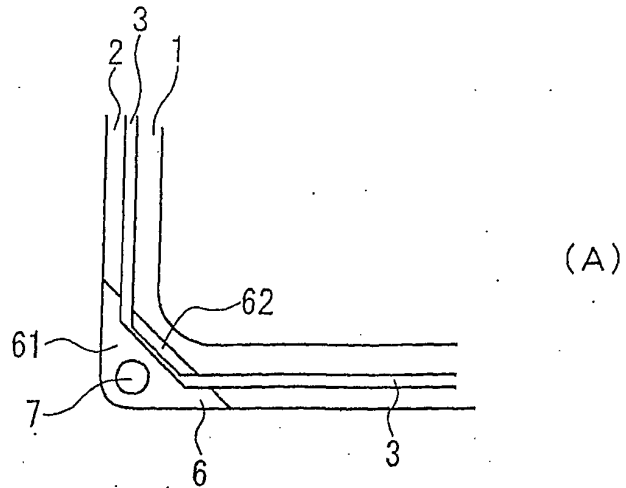


Fig. 4

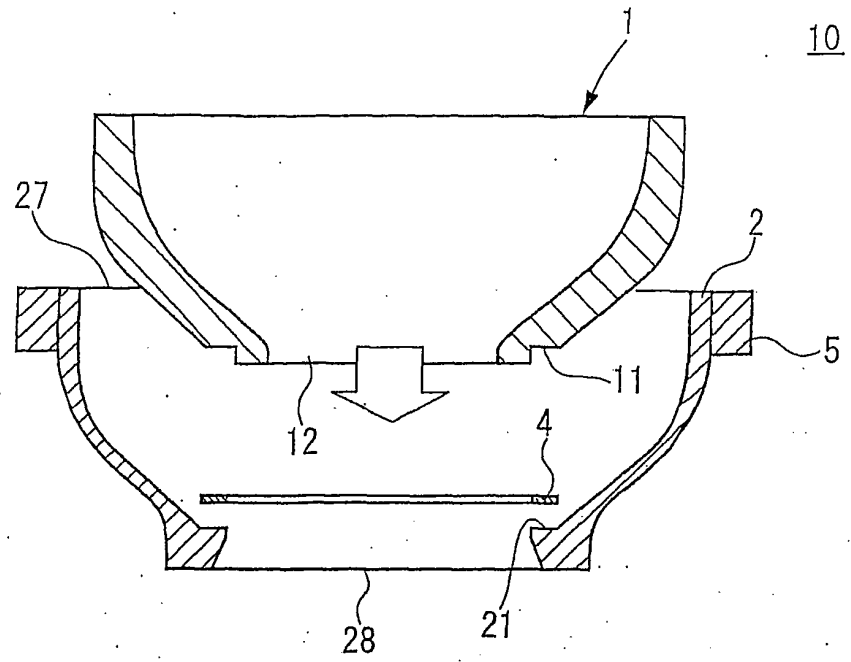


Fig. 5

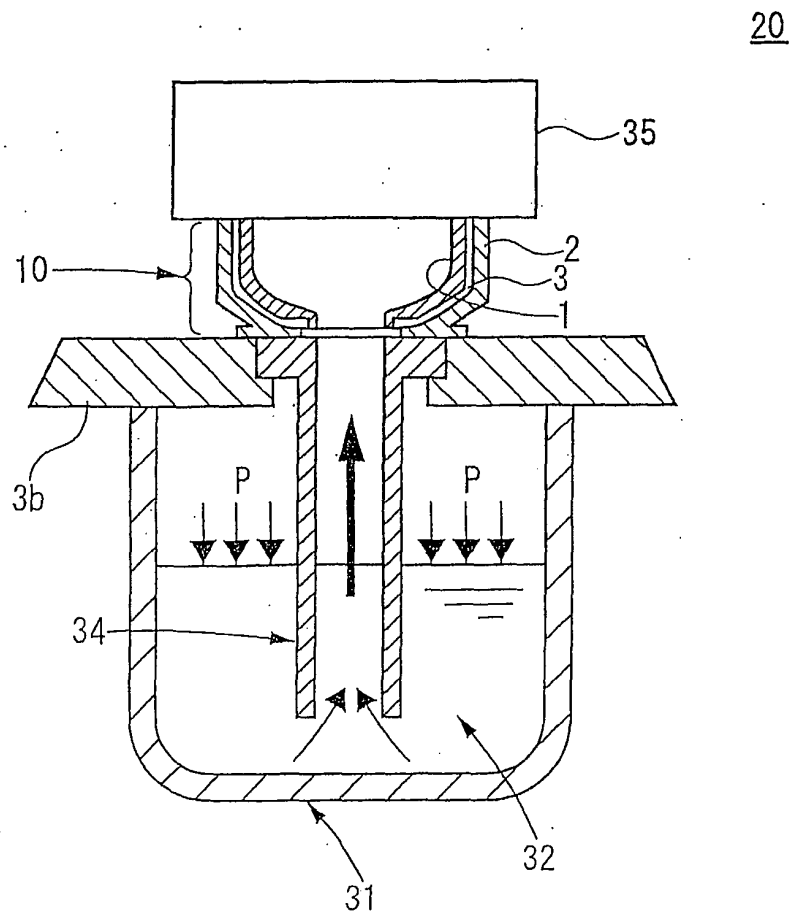
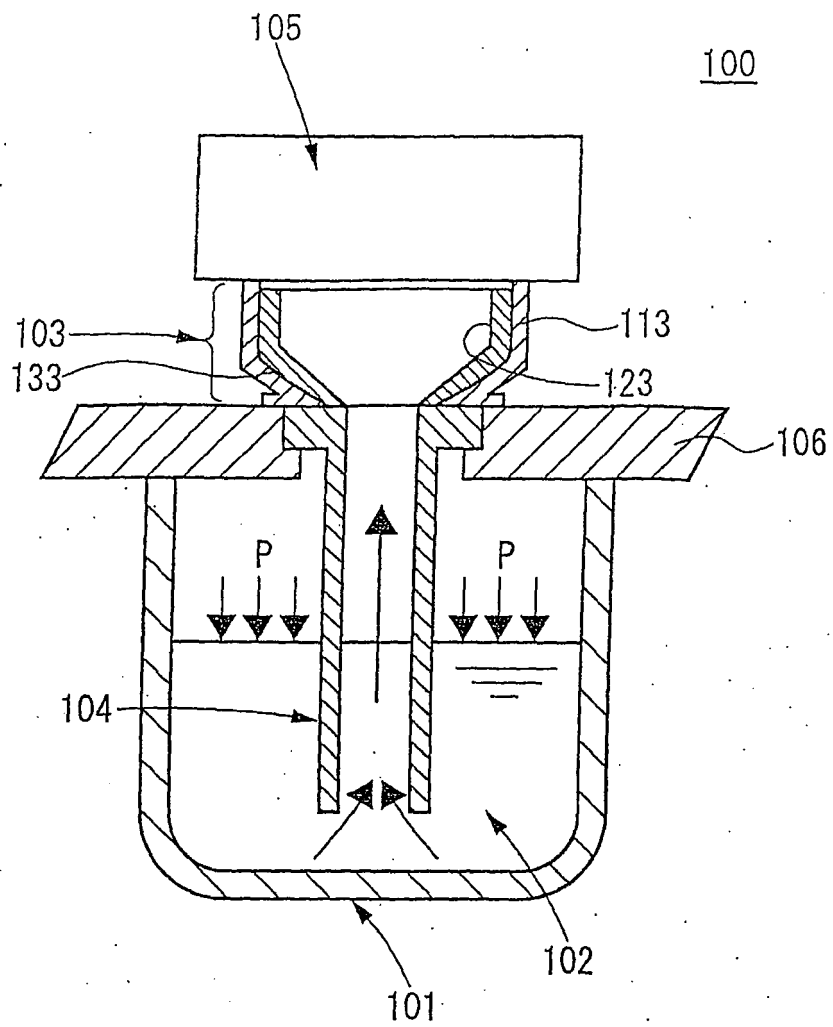


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/061155

A. CLASSIFICATION OF SUBJECT MATTER

B22D18/04 (2006.01) i

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)

B22D18/04

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 89270/1990 (Laid-open No. 47856/1992) (Hitachi Metals, Ltd.), 23 April, 1992 (23.04.92), Full text (Family: none)	1-6
A	JP 3339141 B2 (Hitachi Metals, Ltd.), 28 October, 2002 (28.10.02), Full text (Family: none)	1-6

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2565327 Y2 (Kubota Corp.), 18 March, 1998 (18.03.98), Full text (Family: none)	1-6

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Patent documents cited in the description

- JP 2006272448 A [0004] [0005]