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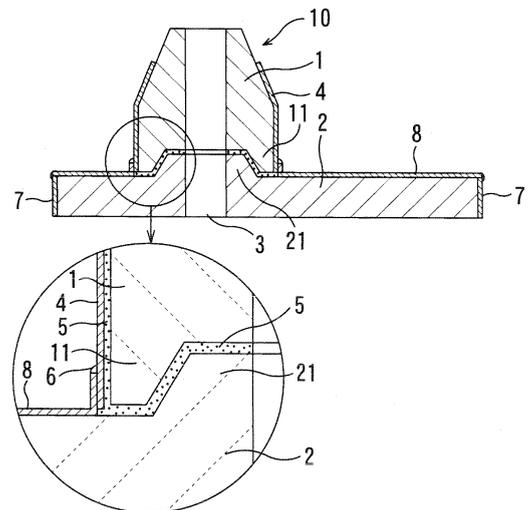
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(54) **UPPER NOZZLE-INTEGRATED PLATE AND METHOD OF SEPARATING THEM**

(57) Disclosed is an upper nozzle/plate integral unit comprising an upper nozzle and an upper plate integrated together, which is capable of being easily split into the upper nozzle and the upper plate after use, while adequately maintaining a thickness of a joint between the upper nozzle and the upper plate during use. A metal casing 4 is bent inwardly along an outer peripheral surface of a lower end portion of an alumina carbon-based refractory body of the upper nozzle 1 to form a metal member. The metal member formed by bending the metal casing 4 inwardly has a length of 15 mm. A gap between the metal casing and the refractory body is filled with mortar having a thickness of about 0.5 mm. A recess 11 of the lower end portion of the upper nozzle 1 is fitted onto a raised portion 21 of the upper plate 2 through mortar, and the metal casing 4 of the upper nozzle 1 is in contact with a metal casing of the upper plate 2. A peripheral edge of the metal casing of the upper plate 2 is fixedly joined to the metal casing 4 of the upper nozzle 1 through a plurality of welded portions 6.

Fig. 2



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Description

TECHNICAL FIELD

[0001] The present invention relates to an upper nozzle/plate integral unit for a sliding nozzle assembly adapted to be attached to a bottom of a molten metal vessel, such as a tundish or ladle, and used for controlling a flow rate of molten metal, such as molten steel.

BACKGROUND ART

[0002] A sliding nozzle assembly comprises a plurality of refractory members formed with respective nozzle holes and assembled together in such a manner as to be clamped at a high pressure, wherein at least one of the refractory members is adapted to be slidably moved so as to adjust an opening degree of a molten metal passage consisting of the nozzle holes communicated with each other, to control a flow rate of molten metal, such as molten steel.

[0003] Typically, in cases where the sliding nozzle assembly is attached to a tundish, five refractory members consisting of an upper nozzle, an upper plate, an intermediate plate, a lower plate and a lower nozzle, are arranged in this order in a downstream direction of a molten metal stream, although there is a type using no intermediate plate.

[0004] An operation of assembling such refractory members to form a sliding nozzle assembly is roughly classified into an on-site operation and an off-site operation. The on-site operation means an operation of attaching the refractory members to a bottom of a tundish while setting a metal frame in an open position, to form a sliding nozzle assembly on site (i.e., in an on-site manner). The off-site operation means an operation of replacing an entirety of a sliding nozzle assembly detachably attached to a tundish (detachable-type sliding nozzle assembly), with a new one, wherein used refractory members of the detached sliding nozzle assembly are replaced with new ones at a location distant from the tundish (i.e., in an off-site manner).

[0005] The operation of assembling the refractory members to form a sliding nozzle assembly in an on-site manner is performed in the following process. Firstly, the upper nozzle is applied with mortar on an outer peripheral surface thereof, and inserted into an inner hole of a nozzle-seating brick inside a tundish. Then, the upper plate is pressed against a lower surface of the upper nozzle through a joint material, and fixed to a metal frame of the sliding nozzle assembly. Subsequently, the intermediate plate and the lower plate are fixed to the metal frame. Lastly, the lower nozzle is pressed against a lower surface of the lower plate through a joint material, and fixed to the metal frame through a bayonet coupling or the like.

[0006] As for the joint material, such as a shaped joint material or mortar, to be placed between the upper nozzle and the upper plate and between the lower plate and the

lower nozzle, it is necessary to accurately manage a thickness of the joint material, preferably within control limits of ± 1 mm.

[0007] However, a joint between respective ones of the refractory members, particularly a joint between the upper nozzle and the upper plate, is likely to have a problem about a variation in thickness thereof, due to variation factors, such as a position of the nozzle-seating brick, a size of the inner hole of the nozzle-seating brick, an outer diameter of the upper nozzle, an amount of the mortar applied onto the outer peripheral surface of the upper nozzle, and a hardness of the mortar. If the thickness of the joint is excessively small, a gap will be likely to occur around the joint during use. If the thickness of the joint is excessively large, wear of the joint will be accelerated to increase a risk of molten metal leakage.

[0008] In the above situation, various techniques for replacing the refractory members have been proposed. For example, as a technique of replacing plates in an off-site manner, the following Patent Document 1 discloses a technique of replacingly attaching a stationary plate and a slide plate fixed to a slide plate-supporting plate, to a retainer plate provided on an outer shell of a ladle, while holding by a plate-handling rod the stationary plate and a slide plate fixed to a slide plate-supporting plate.

[0009] Further, the following Patent Document 2 discloses a detachable-type sliding nozzle assembly adapted to be replaced by a slide-valve replacement machine together with a slide-valve casing provided on a bottom of a tundish. In the Patent Document 2, refractory members other than an upper nozzle, i.e., a slide valve (plate) and a lower nozzle, are replaced simultaneously. Specifically, the slide-valve casing is gripped and pulled out by a clamp arm attached to a replacement carriage, and replaced with a slide-valve casing assembled with new refractory members.

[0010] In this operation of replacing the refractory members, it is difficult to accurately manage a thickness of a joint between the upper nozzle and the upper plate, not only in on-site replacement but also in off-site replacement.

[0011] As one of the measures against the above problem, the following Patent Document 3 proposes an upper nozzle/plate integral unit comprising an upper nozzle and an upper plate integrated together without any joint therebetween. Although this upper nozzle/plate integral unit is suitable for simultaneously replacing an upper nozzle and an upper plate as in a tundish, the upper nozzle is liable to rigidly stick to a molten metal vessel during repetitive use. Thus, if the upper nozzle/plate integral unit is used in the replacement system as disclosed in the Patent Document 2, the stuck upper nozzle causes a problem about difficulty in detaching the sliding nozzle assembly from the tundish. Further, if the upper nozzle/plate integral unit is used in the type incapable of moving away the retaining metal frame as disclosed in the Patent Document 1, the plates will conflict with the retaining metal frame to cause difficulty in pulling out and detaching

the entire assembly.

[Patent Document 1] JP 05-318061A

[Patent Document 2] JP 06-000602A

[Patent Document 3] JP 05-507029A

DISCLOSURE OF THE INVENTION

[0012] It is an object of the present invention to provide an upper nozzle/plate integral unit comprising an upper nozzle and an upper plate integrated together, which is usable in a sliding nozzle assembly, and capable of being easily split into the upper nozzle and the upper plate after use, while adequately maintaining a thickness of a joint between the upper nozzle and the upper plate during use.

[0013] The present invention is made with a focus on a fact that, when an upper nozzle and an upper plate in a sliding nozzle assembly are fixedly joined together by a joining force which allows the upper nozzle and the upper plate to be easily disjoined from each other after use, while maintaining the joining during use together with other refractory members, instead of being fully fixed together, an obtained upper nozzle/plate integral unit can be easily split into the upper nozzle and the upper plate, after use.

[0014] Specifically, the present invention provides an upper nozzle/plate integral unit capable of being split into an upper nozzle and an upper plate and detached from a molten metal vessel, after use, wherein: the upper nozzle is in contact with the upper plate through a joint material, in such a manner that respective nozzle holes of the upper nozzle and the upper plate are aligned with each other; the upper nozzle has a metal member provided on a lower end portion thereof; and the upper plate has a metal sheet provided on an upper surface thereof, wherein the metal member of the upper nozzle is weldingly joined to the metal sheet of the upper plate at two or more positions, in such a manner that a weld leg is set in the range of 2 to 5 mm, and a total weld length is set in the range of 5 to 60 mm.

[0015] In the upper nozzle/plate integral unit of the present invention, the metal member on the lower end portion of the upper nozzle is weldingly joined to the metal sheet on the upper surface of the upper plate at two or more positions. That is, the upper nozzle is joined to the upper plate only by means similar to spot welding, i.e., only by a joining force which allows the upper nozzle and/or the upper plate to be easily detached from a joined portion therebetween. Thus, in an operation of replacing refractory members, the upper nozzle/plate integral unit can be easily split into the upper nozzle and the upper plate.

[0016] As a specific example of the metal member to be attached onto the lower end portion of the upper nozzle, it is preferable to use a metal casing which covers an outer peripheral surface of an intermediate portion and the lower end portion of the upper nozzle, or a metal band disposed on the outer peripheral surface of the low-

er end portion of the upper nozzle, in view of capability to retain the upper nozzle in an attached state thereto.

[0017] As a specific example of the metal sheet to be attached onto the upper surface of the upper plate, it is preferable to use a metal casing which covers a lateral surface and the upper surface of the upper plate, in view of capability to retain the upper plate in an attached state thereto. Alternatively, a doughnut disk-shaped metal sheet may be attached onto the upper surface of the upper plate. That is, the metal sheet of the upper plate in the present invention is provided as a member to be weldingly joined to the metal member on the lower end portion of the upper nozzle, and may be provided on at least a welding area of the upper surface of the upper plate. For example, the metal sheet may be a type formed by laminating a plurality of metal sheets, or may be a type a part of which is buried in the upper surface of the upper plate. The metal casing which covers the lateral surface and the upper surface of the upper plate may be formed by providing a metal band or hoop around the lateral surface of the upper plate, and welding a metal sheet covering the upper surface of the upper plate, to the metal band or hoop.

[0018] In an operation of welding between the upper nozzle and the upper plate, a weld leg is set in the range of 2 to 5 mm, and a total weld length is set in the range of 5 to 60 mm. If the weld leg is less than 2 mm, the welding operation becomes technically difficult, and a joining force is liable to become insufficient. If the weld leg is greater than 5 mm, it becomes an unrealistically large value as compared with a thickness of the metal member or sheet. If the total weld length is less than 5 mm, the upper nozzle/plate integral unit is liable to be unexpectedly disjoined into the upper nozzle and the upper plate during handling. If the total weld length is greater than 60 mm, the upper nozzle/plate integral unit is liable to have difficulty in being split into the upper nozzle and the upper plate after use. As used herein, the terms "weld leg" and "weld length" are defined, respectively, as a width S and a length L of a weld bead in a welded portion between the upper nozzle 1 and the upper plate 2, as shown in FIG. 1.

[0019] In the present invention, a method of splitting the upper nozzle/plate integral unit into the upper nozzle and the upper plate may comprise pulling the upper plate or the sliding nozzle assembly from outside the molten metal vessel. In this case, a crowbar or the like may be used for manually scooping out the upper plate so as to pull the upper plate. Alternatively, a driving source, such as a hydraulic cylinder, may be used for pulling the upper plate or the sliding nozzle assembly.

[0020] Depending on a configuration of the upper nozzle or a mounting structure for the upper nozzle, the above method may comprise pulling or pushing the upper nozzle toward an inside of the molten metal vessel to detach the upper nozzle from the welded portion. Further, solidified metal may be pulled away from a bottom of the molten metal vessel to allow the upper nozzle to be de-

tached together with the solidified metal.

[0021] In the above method, if a joining force based on welding is excessively strong, a pullout force required for detaching the upper nozzle and/or the upper plate from the welded portion will be considerably increased to cause a problem about difficulty in the detaching, and occurrence of distortion in the sliding nozzle assembly.

[0022] In order to prevent disjoining between the upper nozzle and the upper plate during transportation and during on-site handling, while facilitating detachment from the welded portion after use, a product W of the weld leg S [mm] and the total weld length $L2$ [mm] is preferably set in the range of 25 to 300. A condition that the product W is 25 corresponds to a condition that a calculated value of the joining force based on welding is about 0.5 t (ton), and a condition that the product W is 300 corresponds to a condition that the calculated value of the joining force based on welding is about 7 t. That is, if the product W is less than 25, the joining force becomes insufficient, and the upper nozzle/plate integral unit is likely to be disjoined into the upper nozzle and the upper plate during transportation and during on-site handling. If the product W is greater than 300, a joining force becomes excessively strong, which is likely to cause difficulty in detaching the upper nozzle and/or the upper plate from the welded portion, and occurrence of distortion in the sliding nozzle assembly.

[0023] In the present invention, the upper nozzle and the upper plate are welded together while ensuring a gap therebetween in advance. Thus, a mortal joint between the upper nozzle and the upper plate can be formed at a constant thickness, and the joint thickness can be accurately managed by a manufacturer or the like. This makes it possible to eliminate the risk of wear of the joint due to excessive increase in joint thickness, or the risk of abnormal refractory wear or molten metal leakage due to a gap caused by excessive decrease in joint thickness, so as to achieve a stable casting operation.

[0024] The upper nozzle/plate integral unit of the present invention is suitably used in a detachable-type sliding nozzle assembly. The detachable-type sliding nozzle assembly is pulled out after use, for example, by the replacement carriage as disclosed in the Patent Document 2. Thus, the upper nozzle and/or the upper plate can be detached from the welded portion therebetween by use of the pullout force. If the pullout force for the detachable-type sliding nozzle assembly is insufficient, a driving force of a driving source, such as a motor or a hydraulic cylinder, may be additionally used. The upper nozzle/plate integral unit installed in the detachable-type sliding nozzle assembly also has an advantage of allowing the upper nozzle to be mounted to the molten metal vessel in conjunction with an operation of attaching the detachable-type sliding nozzle assembly to the molten metal vessel, so as to achieve enhanced operating efficiency.

[0025] The welding portion between the upper plate and the upper nozzle may be broken by a hydraulic driv-

ing force of a hydraulic ram cylinder interposed between a retaining metal frame of the detachable-type sliding nozzle assembly and the molten metal vessel. Thus, even when a pullout force for the detachable-type sliding nozzle assembly is insufficient, the detachable-type sliding nozzle assembly can be detached from the molten metal vessel.

[0026] A retaining metal frame formed with a concave portion having a crowbar insertion groove may be provided. In this case, the upper nozzle/plate integral unit can be easily split into the upper nozzle and the upper plate by inserting a crowbar into the crowbar insertion groove, and moving the crowbar to scoop out the upper plate. The use of a crowbar makes it possible to split the upper nozzle/plate integral unit in a simple and easy manner based on the principle of leverage. Preferably, the upper nozzle/plate integral unit has a weld leg of 2 to 4 mm and a total weld length of 10 to 20 mm to allow one person to perform the splitting operation by himself/herself, using a crowbar having an adequate length.

[0027] Preferably, the product W of the weld leg S [mm] and the total weld length $L2$ [mm] is set in the range of 25 to 100 to more facilitate the splitting operation using a crowbar. A condition that the product W is 25 corresponds to a condition that the calculated value of the joining force based on welding is about 0.5 t (ton), and a condition that the product W is 100 corresponds to a condition that the calculated value of the joining force based on welding is about 2 t. As long as the product W is set in the above range, one or two persons can split the upper nozzle/plate integral unit using a crowbar.

[0028] As above, the upper nozzle/plate integral unit of the present invention makes it possible to manage a joint thickness between the upper nozzle and the upper plate to eliminate the risk of molten metal leakage and abnormal refractory wear, so as to achieve a stable casting operation. In addition, the upper nozzle/plate integral unit can be split into the upper nozzle and the upper plate to reduce the time and effort required for detaching the upper plate from the molten metal vessel. The upper nozzle/plate integral unit installed in the detachable-type sliding nozzle assembly allows the upper nozzle to be mounted to the molten metal vessel in conjunction with an operation of attaching the detachable-type sliding nozzle assembly to the molten metal vessel, so as to achieve enhanced operating efficiency.

BRIEF DESCRIPTION OF DRAWINGS

[0029]

FIG. 1 is a schematic diagram for explaining a weld leg and a weld length.

FIG. 2 is a front sectional view showing an upper nozzle/plate integral unit according to a first embodiment of the present invention.

FIG. 3 is a top plan view of the upper nozzle/plate integral unit in FIG. 2.

FIG. 4 is a perspective view showing an upper nozzle/plate integral unit according to a second embodiment of the present invention.

FIG. 5 is a perspective view for explaining an operation of detaching a detachable-type sliding nozzle assembly having an upper nozzle/plate integral unit of the present invention, from a tundish.

FIG. 6 is a sectional view for explaining one example of a method of splitting an upper nozzle/plate integral unit of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0030] The present invention will be described based on an embodiment thereof.

[FIRST EMBODIMENT]

[0031] An upper nozzle/plate integral unit according to a first embodiment of the present invention will be shown as one example where a metal casing which covers an outer peripheral surface of an upper nozzle is used as "a metal member provided on a lower end portion of an upper nozzle", and a metal sheet which covers an upper surface of an upper plate is used as a "metal sheet provided on an upper surface of an upper plate".

[0032] FIG. 2 is a front sectional view showing the upper nozzle/plate integral unit according to the first embodiment, and FIG. 3 is a top plan view of the upper nozzle/plate integral unit.

[0033] In FIGS. 2 and 3, the reference numeral 10 indicates the upper nozzle/plate integral unit which comprises an upper nozzle 1 and an upper plate 2 adapted to be fitted into a lower end portion of the upper nozzle 1, and the reference numeral 3 indicates a nozzle hole.

[0034] The upper nozzle 1 is a generally cylindrical-shaped refractory member having a nozzle hole 3. The upper nozzle 1 has a metal casing 4 which is formed to have a thickness of 0.8 mm and provided to cover an outer peripheral surface of an intermediate portion and the lower end portion thereof, except an upper end portion.

[0035] As shown in an enlarged view of the circled region in FIG. 2, a gap between the upper nozzle 1 and the metal casing 4 is filled with mortar 5.

[0036] As shown in FIG. 3, the upper plate 2 is a rectangular plate-shaped alumina carbon-based refractory member having a nozzle hole 3 and a cutout in each corner. The upper plate 2 has a metal band 7 which is formed to have a thickness of 3 mm and provided on a lateral surface thereof, and a metal sheet 8 which is formed to have a thickness of 3 mm and provided on an upper surface of the upper plate 2 while being weldingly fixed to the band 7. The metal sheet 8 has a circular-shaped cutout concentric with a raised portion 21 of the upper plate 2, and a cylindrical portion 9 formed around the cutout. The cylindrical portion 9 is formed to have a thickness of 3 mm.

[0037] The lower end portion of the upper nozzle 1 has a recess 11 formed in a bottom surface thereof and fitted onto the raised portion 21 of the upper plate 2 through mortar 5 as a joint material. A portion of the metal casing 4 on an outer peripheral surface of the lower end portion of the upper nozzle 1 is fixedly joined to the cylindrical portion 9 of the metal sheet 8 through four welded portions 6. The mortar 5 in the fitting region between the raised portion 21 and the recess 11 has a thickness of 3 mm. This joint thickness can be reliably managed by measuring a joint thickness around the nozzle hole 3 using a measuring instrument after welding. Each of the four welded portions 6 has a weld leg of 3 mm, and a weld length of 4 mm. Thus, a total weld length is 16 mm.

[0038] An upper nozzle/plate integral unit different only in weld length from that in FIG. 3 was subjected to a weld split/break test. As a result, an upper nozzle/plate integral unit having a weld leg of 3 mm, a weld length of 8 mm and a total weld length of 32 mm (a product W of the weld leg S and the total weld length $L2$ is 96) was split at 3.4 t, and an upper nozzle/plate integral unit having a weld leg of 3 mm, a weld length of 15 mm and a total weld length of 60 mm (the product W of the weld leg S and the total weld length $L2$ is 180) was split at 4.7 t.

[SECOND EMBODIMENT]

[0039] FIG. 4 is a perspective view showing an upper nozzle/plate integral unit according to a second embodiment of the present invention.

[0040] The upper nozzle/plate integral unit according to the second embodiment will be shown as one example where a metal band attached onto an outer peripheral surface of a lower end portion of an upper nozzle is used as the "metal member provided on a lower end portion of an upper nozzle", and a metal casing which covers an upper surface of an upper plate is used as the "metal sheet provided on an upper surface of an upper plate".

[0041] An upper nozzle 1 has a metal band 7 which is formed to have a width of 30 mm and a thickness of 1 mm, and attached onto an outer peripheral surface of a lower end portion thereof to serve as the metal member.

[0042] The band 7 has a convex portion (not shown) formed on an inner surface thereof and adapted to be fitted into a concave portion (not shown) formed in the outer peripheral surface of the upper nozzle 1 so as to facilitate retaining therebetween. Further, the band 7 and the upper nozzle 1 are joined together by filling a gap therebetween using mortar with a high bonding force.

[0043] An upper plate 2 has a metal casing 4 which is formed to have a thickness of 1.6 mm, and provided to cover a lateral surface and an upper surface (except a raised portion) thereof.

[0044] A lower end of the band 7 attached onto the outer peripheral surface of the lower end portion of the upper nozzle 1 is fixed to the metal casing 4 through four welded portions 6. Each of the four welded portions 6 has a weld leg of 2 mm, and a weld length of 4 mm. Thus,

a total weld length is 16 mm.

[THIRD EMBODIMENT]

[0045] A method of splitting the upper nozzle/plate integral unit according to the first or second embodiment will be described based on one example where a detachable-type sliding nozzle assembly having the upper nozzle/plate integral unit is attached to a tundish. More specifically, an operation of detaching a used detachable-type sliding nozzle assembly from a tundish to replace it with a detachable-type sliding nozzle assembly having new refractory members will be described below.

[0046] Although not illustrated, a detachable-type sliding nozzle assembly 100 in FIG. 5 comprises the upper nozzle/plate integral unit as shown in FIG. 2, an intermediate plate, a lower plate and a lower nozzle, which are housed in a metal frame, and adapted to be detachably attached to a bottom of a tundish together with the metal frame.

[0047] The sliding nozzle assembly 100 illustrated in FIG. 5 is fixedly attached to a tundish (not shown) by fastening a fixing bracket (not shown) provided on a lateral surface of the assembly to a bolt provided on a shell (not shown) of the tundish, using a nut.

[0048] The sliding nozzle assembly 100 has two splitting brackets 20 provided on respective ones of opposed longitudinally-extending lateral surfaces thereof, and a hydraulic ram cylinder 30 having an output of 5 t of force is detachably attached to each of the splitting brackets 20.

[0049] In an operation of detaching the above sliding nozzle assembly 100, a hook of a crane is attached to an upper portion of the sliding nozzle assembly 100, and then the fixing between the tundish and the sliding nozzle assembly 100 is released by loosening the nut fastened to the bolt provided on the shell of the tundish. Subsequently, the sliding nozzle assembly 100 is hung by the crane, and the hydraulic ram cylinders 30 are attached to the respective brackets 20 in such a manner as to be interposed between the tundish and the sliding nozzle assembly 100.

[0050] Then, a hydraulic pressure of the hydraulic ram cylinders 30 is increased to break the welded portions between the upper nozzle and the upper plate by a hydraulic driving force of the hydraulic ram cylinders 30. In this embodiment, the welded portions between the upper nozzle and the upper plate can be broken when the output force of the hydraulic ram cylinders 30 is in the range of 1 to 2 t. Subsequently, the upper nozzle left in the tundish can be detached in such a manner that it is pulled out from outside the tundish or pushed out from inside the tundish.

[FOURTH EMBODIMENT]

[0051] A method of splitting the upper nozzle/plate integral unit according to the first or second embodiment will be described based on one example of an operation

of replacing a refractory member in an on-site manner without detaching the entire upper nozzle/plate integral unit from a tundish.

[0052] FIG. 6 is a sectional view for explaining the operation. In this example, a retaining metal frame 12 has a concave portion for receiving therein the upper plate 2, and the concave portion is formed with a groove 13.

[0053] In an operation of detaching the upper plate 2 from a tundish after use, a crowbar 14 is manually inserted into the groove 13, and moved to scoop out the upper plate 2 so as to break welded portions based on the principle of leverage to split the upper nozzle/plate integral unit into the upper nozzle 1 and the upper plate 2. Then, the upper nozzle 1 can be pulled out using a hydraulic power unit or the like.

[0054] In this embodiment, the upper nozzle/plate integral unit has three welded portions, wherein a weld leg is 3 mm, and a total weld length is 9 mm. In this case, one adult person can split the upper nozzle/plate integral unit into the upper nozzle and the upper plate by himself/herself, using a crowbar having a length of 1 m.

Claims

1. An upper nozzle/plate integral unit capable of being split into an upper nozzle and an upper plate and detached from a molten metal vessel, after use, wherein:

said upper nozzle is in contact with said upper plate through a joint material, in such a manner that respective nozzle holes of said upper nozzle and said upper plate are aligned with each other; said upper nozzle has a metal member provided on a lower end portion thereof; and said upper plate has a metal sheet provided on an upper surface thereof, wherein said metal member of said upper nozzle is weldingly joined to said metal sheet of said upper plate at two or more positions, in such a manner that a weld leg is set in the range of 2 to 5 mm, and a total weld length is set in the range of 5 to 60 mm.

2. The upper nozzle/plate integral unit as defined in claim 1, wherein a product (W) of said weld leg (S [mm]) and said total weld length (L2 [mm]) is set in the range of 25 to 300.

3. The upper nozzle/plate integral unit as defined in claim 1 or 2, which is installed in a detachable-type sliding nozzle assembly.

4. A method of splitting the upper nozzle/plate integral unit as defined in claim 3, comprising:

interposing a hydraulic ram cylinder between the

detachable-type sliding nozzle assembly and the molten metal vessel; and moving said hydraulic ram cylinder in such a manner that said detachable-type sliding nozzle assembly is detached from said molten metal vessel while splitting said upper nozzle/plate integral unit into said upper nozzle and said upper plate. 5

5. A method of splitting the upper nozzle/plate integral unit as defined in claim 1 or 2, comprising: 10

providing a retaining metal frame formed with a concave portion having a crowbar insertion groove; and 15
inserting a crowbar into said crowbar insertion groove, and moving said crowbar to scoop out said upper plate, so as to split said upper nozzle/plate integral unit into said upper nozzle and said upper plate. 20

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Fig. 1

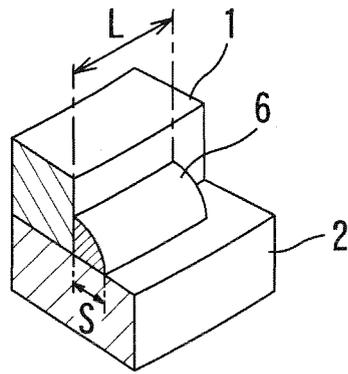


Fig. 2

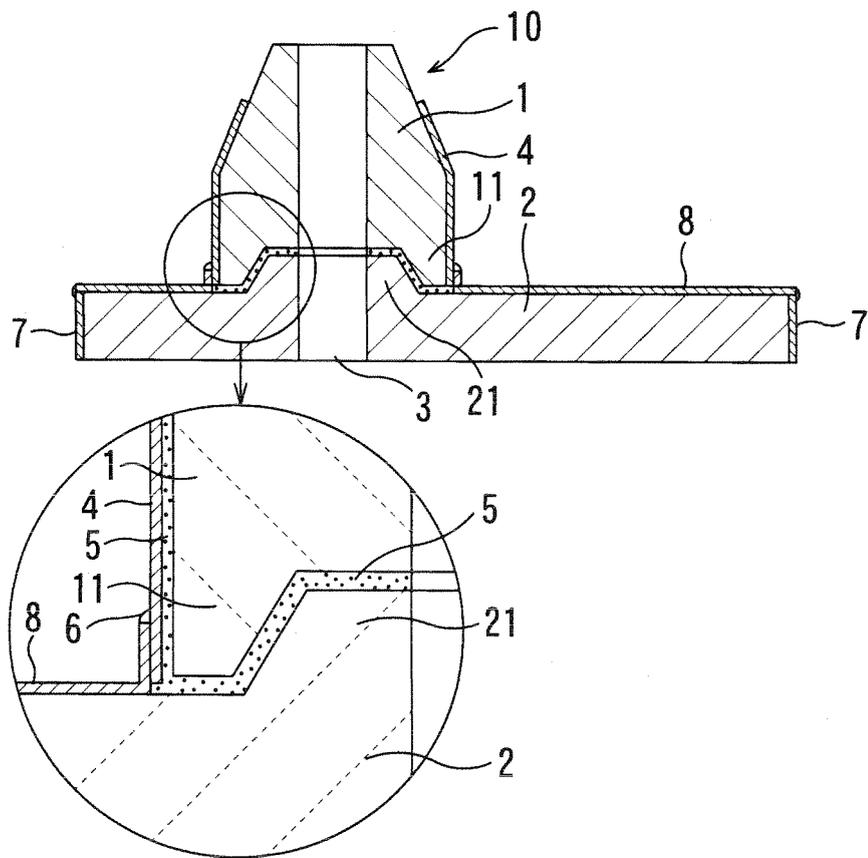


Fig. 3

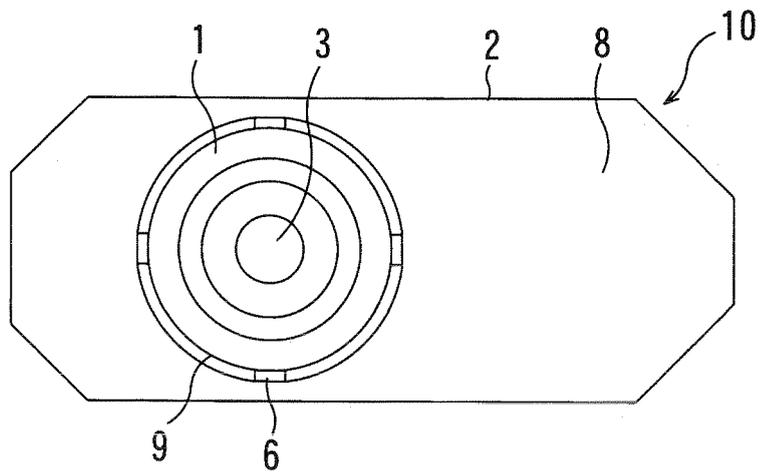


Fig. 4

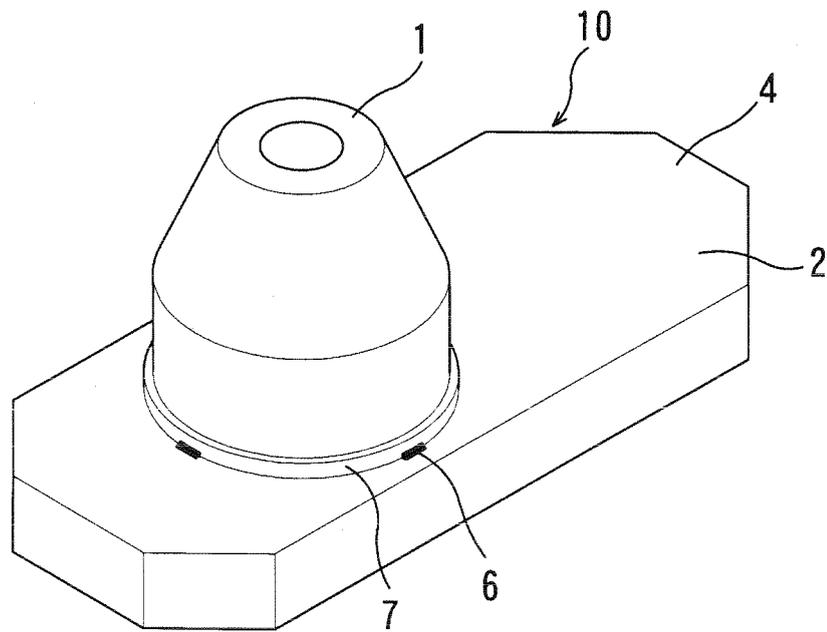


Fig. 5

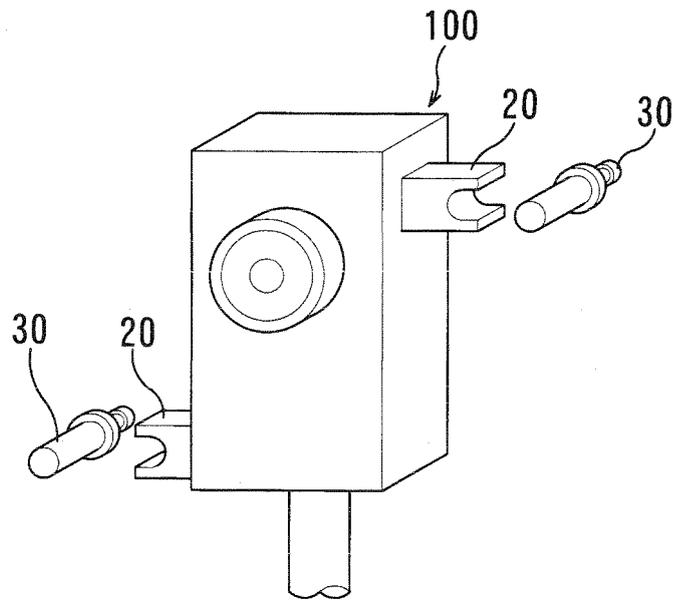
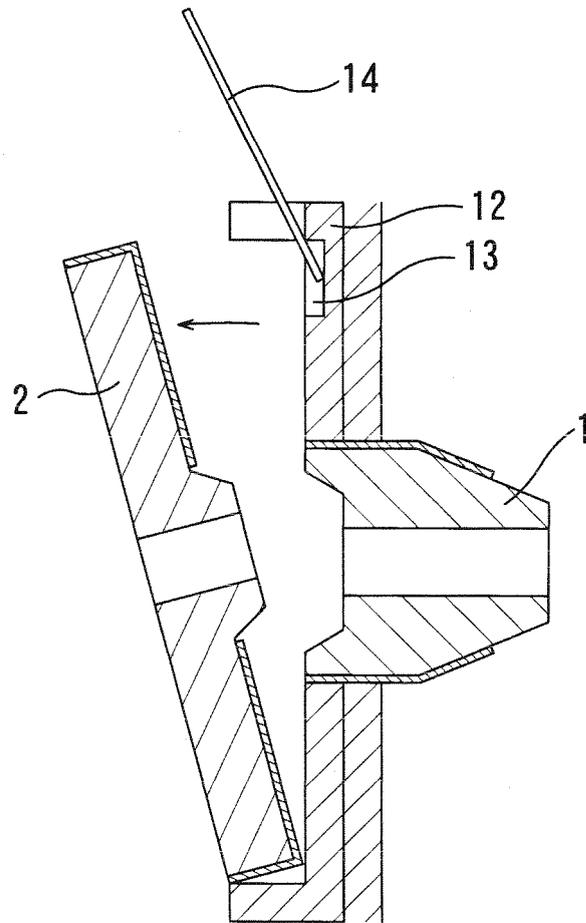


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/060372

A. CLASSIFICATION OF SUBJECT MATTER B22D41/34(2006.01) i, B22D11/10(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) B22D41/34, B22D11/10		
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 1996-2007 Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007		
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.
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