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(54) **MOLTEN METAL HOLDING AND POURING BOX WITH DUAL POURING NOZZLES**

EINSCHLUSS- UND AUSGUSSBEHÄLTER FÜR METALLSCHMELZE MIT ZWEI AUSGIESSSDÜSEN
BAC DE STOCKAGE ET DE COULÉE DE MÉTAL FONDU COMPORTANT DEUX BECS DE COULÉE

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Description**Cross Reference To Related Applications**

[0001] This application claims priority to U.S. Provisional Application No. 61/501,235, filed June 26, 2011.

Field of the Invention

[0002] The present invention is related to a pouring and holding box for molten metal having a pyramidal-shaped lower section. The lower section has a bottom region housing a dual nozzle assembly that can be used to independently control the outward flow of molten metal into two casting molds from the box in conjunction with a pair of stopper rods independently controlling the flow of molten metal through two nozzles in the dual nozzle assembly.

Background of the Invention

[0003] In foundry installations, molten metal may be handled by various devices, some of which are disclosed in U.S. Patents: 2,264,740 (Brown); 2,333,113 (Martin et al.); 3,395,840 (Gardner); 3,549,061 (Piene); 3,801,083 (Mantey et al.); 3,848,072 (Dershem et al.); 4,638,980 (Beele); and 4,953,761 (Fishman et al.); U.S. Patent Application Publication No. 2010/0282784 A1 (Pavia et al.); and U.K. Patent Application Publication No. GB 2,229,384 A (Fishman et al.).

[0004] In such foundry installations, molten metal is frequently poured from a rectangularly-shaped, or otherwise flat bottom holding box into a casting mold. The holding box has a bottom region commonly housing a single nozzle that controls the outward flow of the molten metal. The holding boxes for pouring molten metal are sometimes referred to as ladles, and comprise a substantially enclosed container having a single bottom pour spout commonly controlled by a stopper rod extending vertically through the molten metal in the box. U.S. Patent Application Publication No. 2010/0282784 A1 discloses the use of dual nozzles in a launder. Controlling the flow of the molten metal from the ladle or box to the casting molding is extremely important for successful molding of metal parts. In addition, maintaining the temperature of the nozzle so that it corresponds to approximately that of the molten metal is an important aspect of an efficient pouring process. Further maintaining the liquid, molten state of the metal is also an important consideration, especially when the pouring process encounters unexpected interruptions that may last for a relatively long duration.

[0005] As a general rule the flow rate of molten metal being poured from a rectangular box is directly proportional to the square root of the height of the molten metal in the box. This height is commonly referred to as being the "head" parameter. The head parameter (H) directly controls the flow rate (Q) related to the box and both are interrelated by the following relationship:

$$Q \propto \sqrt{H} \text{ [expression (1)]}$$

where Q is equal to the flow rate of the molten metal being poured from the box, and H is equal to the head of molten metal within the box.

[0006] The amount of the molten metal that is poured at the flow rate (Q) of expression (1) is also dependent on the volume of the molten metal within the box itself. This volume (equal to the product of L x W x H) is determined by the length (L) and width (W) dimensions of the box, which remain constant. Further, this volume is also dependent upon the height or head parameter (H) of the molten metal in the box. Since the length and width dimensions of the box remain constant, as the head parameter (H) decreases so does the volume (V) of the molten metal within the box, as well as the flow rate (Q). In fact, this relationship dictates that a 75 percent drop in the volume of molten metal contained within a rectangularly-shaped box corresponds to a 75 percent drop in the head parameter (H) and about a 50 percent drop in the flow rate (Q). It is desired that means be provided to yield a flow rate (Q) that is not so directly dependent upon the head parameter (H) when dual nozzles are utilized in a molten metal holding and pouring box having a pyramidal-shaped lower section.

[0007] It is desired that a pouring box be provided with means that provide a relatively constant flow of molten metal exiting from the box through a pair of nozzles and being received by a pair of adjacent casting molds. Such a provision allows for the use of dual nozzles having small openings so as to reduce slag formation that would otherwise contribute to the clogging of the nozzles. This constant flow also contributes to the successful molding of metal parts.

[0008] Conventional pouring boxes can suffer nozzle clogging problems due to a drop in nozzle temperature during non-pouring delay periods. These delay periods normally occur as the pouring of the molten metal, between the box and the casting molds, is interrupted so as to accommodate sequential mold casting. As the nozzle begins to cool during these sequential delay periods, liquefied slag contained in certain molten metals, as well as the metals themselves, tends to freeze to the inner surface of the pouring nozzle, ultimately leading to clogging of the nozzle.

[0009] A further clogging problem can occur because a conventional pouring nozzle may be made of a refractory material and have a construction that comes into contact with both the outer steel shell and a reinforcing plate located around the nozzle of the pouring box. This contact causes the outer shell and the reinforcing plate, both commonly being metal, to act as heat sinks which draw away heat from the pouring nozzle, and thereby decrease the temperature of the nozzle. These heat sink problems may be compensated for by providing a continuous flow of molten metal into the nozzle which counterbalances the removal of heat by the sinks. However, if the pouring of molten metal is not continuous, such nozzle construction leads to the creation of different temperatures along the nozzle which disadvantageously subjects the nozzle to a cooling effect that contributes to clogging.

[0010] It is desired that a pouring box with a pyramidal-shaped lower section be provided which has dual nozzles maintained in a heat exchange relationship with the molten metal so as to provide for a constant temperature of the nozzle. Such a construction allows the pouring nozzles to remain at a temperature close to the molten metal in the box, and effectively negates any cooling effect encountered from external devices that would otherwise contribute to clogging problems.

[0011] Two (or dual) bottom nozzle pouring boxes can be utilized in mold casting lines where two molds, in-line (in tandem) or side-by-side, are filled with molten metals at the same time. Two individual nozzles 20, as shown, for example, in FIG. 7 may be provided through separate fixed nozzle openings in the bottom of the pyramidal-shaped low section of the box. However this is not preferred since the nozzles will be a fixed distance apart while the distance between sprue cups in a casting line may change. Further replacement of two individual nozzles is time consuming and difficult particular since the change in nozzles is accomplished while the box is extremely hot. Although hot molten metal is drained from the box before nozzle replacement, it is not generally feasible to wait for the box to cool down to around normal room temperature.

[0012] It is one object of the present invention to provide a replaceable single (unitary) dual (twin) nozzle (block) assembly in a molten metal holding and pouring box having a pyramidal-shaped lower section that is capable of accommodating casting lines where the distance between the sprue cups of the two molds that are being filled with molten metal flowing through the two nozzles can change.

[0013] It is another object of the present invention to provide a replaceable unitary dual nozzle assembly in a molten metal holding and pouring box having a pyramidal-shaped lower section that is more easily replaced than two separate nozzles.

[0014] It is another object of the present invention to provide a molten metal holding and pouring box having a pyramidal-shaped lower section with dual pouring nozzles formed from an interchangeable unitary dual nozzle assembly where the spacing between the pair of nozzles in the assembly can be changed based on the selection of a nozzle casting having the same overall dimensions, and where such a molten metal holding and pouring box can be used in combination with two separate stopper rod positioning and control apparatus independently controlling flow from each of the two nozzles in the assembly.

Brief Summary of the Invention

[0015] In one aspect the present invention is a molten metal holding and pouring box having an upper rectangular-shaped section and a pyramidal-shaped lower section. A unitary dual nozzle assembly is located in a bottom region of the lower section.

[0016] In another aspect the present invention is a molten metal holding and pouring box having a pyramidal-shaped lower section with a unitary dual nozzle assembly in its lower section for use in pouring molten metal into two foundry molds at the same time. The pyramidal-shaped lower section provides for a relatively constant flow of the molten metal being poured from the box through each of the two nozzles in the unitary dual nozzle assembly.

[0017] In another aspect the present invention is a molten metal holding and pouring box that has an upper rectangular-shaped section and a lower inverted pyramidal-shaped section housing a unitary dual nozzle assembly with a pair of nozzles. The unitary dual nozzle assembly is positioned within a bottom region of the lower inverted pyramidal-shaped section, and is constructed of a thermally conductive material and insulated from contact with the lower inverted pyramidal-shaped section while being in thermal contact with the molten metal contained within the box during pouring and non-pouring periods through the pair of nozzles. A pair of stopper rods engages the pair of nozzles for controlling the flow of the molten metal to be poured through each of the pair of nozzles. Each of the pair of stopper rods can be arranged so that when the nozzle insertion ends of the pair of stopper rods are inserted in a conical funnel-shaped inlet of the pair of nozzles to stop the flow of the molten metal through the pair of nozzles a portion of the conical funnel-shaped inlet in each of the pair of nozzles is in contact with the molten metal in the box. A unitary dual nozzle retention plate can be removably fastened to the bottom of the pyramidal-shaped lower section of the box around the outlet of each one of the pair of nozzles in the unitary dual nozzle assembly.

[0018] In another aspect the present invention is a method of pouring a molten metal from a molten metal holding and pouring box with an upper rectangular-shaped section and a lower pyramidal-shaped section into a pair of molds. The

box has a unitary dual nozzle assembly located in a bottom of the lower pyramidal-shaped section, and the unitary dual nozzle assembly has a pair of nozzles. The pair of molds are transported into a molten metal receiving relationship with the box, and with the unitary dual nozzle assembly at the same temperature as the molten metal in the box, the molten metal is poured from the box through each of the pair of nozzles in the unitary dual nozzle assembly so that 75 percent of the molten metal contained in the box is poured into the pair of molds with no more than approximately 30 percent decrease in the rate of flow of the molten metal.

[0019] In another aspect the present invention is a method of replacing an existing unitary dual nozzle assembly in a molten metal holding and pouring box with an upper rectangular-shaped section and a lower pyramidal-shaped section for pouring molten metal into a pair of molds. The existing unitary dual nozzle assembly is located in a bottom of the lower pyramidal-shaped section and has a pair of nozzles spaced apart from each other at a first distance. An insulating material surrounds the existing unitary dual nozzle assembly and a unitary dual nozzle retention plate retains the bottom of the existing unitary dual nozzle assembly in the box. The unitary dual nozzle assembly retention plate is removed from the bottom of the existing unitary dual nozzle assembly by removing a pair of retaining fittings from a pair of retaining posts holding the unitary dual nozzle assembly retention plate to the bottom of the box. An insulating material surrounding the sides of the existing unitary dual nozzle assembly is removed to release the existing unitary dual nozzle assembly from the box. A new unitary dual nozzle assembly is inserted into the bottom of the box. The new unitary dual nozzle assembly has the same overall dimensions of the existing unitary dual nozzle assembly with a pair of nozzles spaced apart from each other at a second distance, which distance is different from the first distance for the existing unitary dual nozzle assembly. The insulating material is installed around the sides of the new unitary dual nozzle assembly, and the unitary dual nozzle assembly retention plate is installed to the bottom of the new unitary dual nozzle assembly by inserting the pair of retaining fittings to the pair of retaining posts to hold the unitary dual nozzle assembly retention plate against the bottom of the new unitary dual nozzle assembly.

[0020] These and other aspects of the invention are described in this specification and the appended claims.

Brief Description of the Drawings

[0021] For the purpose of illustrating the invention, there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangement and instrumentality shown.

FIG. 1 is a simplified cross sectional view through line A-A in FIG. 3 of one example of a molten metal pouring and holding box of the present invention illustrating an installed unitary dual nozzle assembly in the pyramidal-shaped lower section of the box.

FIG. 2 is the cross sectional view of FIG. 1 with the unitary dual nozzle assembly removed from the molten metal pouring and holding box.

FIG. 3 is a top perspective view of one example of a molten metal pouring and holding box of the present invention with a unitary dual bottom pour nozzle assembly in the pyramidal-shaped lower section of the box.

FIG. 4 is a bottom perspective view of the molten metal pouring and holding box shown in FIG. 3.

FIG. 5 is a side elevational view of the molten metal pouring and holding box shown in FIG. 3.

FIG. 6 is a bottom plan view of the molten metal pouring and holding box shown in FIG. 3.

FIG. 7 is a perspective view of a single nozzle.

FIG. 8 is a perspective view of one example of a unitary dual nozzle retaining plate used in the present invention to retain the unitary dual nozzle assembly in a molten metal pouring and holding box of the present invention.

FIG. 9(a) is a perspective view of one example of a retaining post used in the present invention to mount the unitary dual nozzle retaining plate shown in FIG. 8 in place on the molten metal holding and pouring box.

FIG. 9(b) is a perspective view of one example of a fitting used to retain the retaining plate shown in FIG. 8 against the molten metal holding and pouring box when it is mounted on the retaining posts shown in FIG. 9(a).

FIG. 10(a) is an isometric view of one example of a unitary dual nozzle assembly used in one example of the molten metal holding and pouring box having a pyramidal-shaped lower section of the present invention; FIG. 10(b) is at

top plan view of the unitary dual nozzle assembly shown in FIG. 10(a); FIG. 10(c) is a cross sectional elevation view of the unitary dual nozzle assembly through line C-C in FIG. 10(b); and FIG. 10(d) is a cross sectional elevation view of the unitary dual nozzle assembly through line D-D in FIG. 10(a).

FIG. 11 is a partial cross sectional elevation view of a molten metal pouring and holding box having a pyramidal-shaped lower section of the present invention with a unitary dual pour bottom nozzle assembly of the present invention being used with two stopper rod positioning and control apparatus.

Detailed Description of the Invention

[0022] Referring now to the drawings, wherein like numerals indicate like elements, there is shown in the figures one example of a molten metal pouring and holding box 10 having a pyramidal-shaped lower section with a unitary dual nozzle assembly 12 that can be used in automated molding systems found in casting foundries. A typical automated molding system comprises a conventional conveyor line that transports a plurality of adjacent molds to a casting station where two adjacent molds that are to be cast are filled with molten metal from box 10 via nozzles 12b and 12c in the unitary dual nozzle assembly. Typically when two molds are filled at the same time, the mold conveyor line advances molds two at a time, either in-line or side-by-side, and at a constant speed. Molten metal holding and pouring box 10 provides the source of molten metal to be used for the casting of the molds.

[0023] The molten metal holding and pouring box 10 has positioned in its pyramidal-shaped bottom region at least one unitary dual nozzle assembly 12. Molten metal holding and pouring box 10 can be positioned directly above a pair of casting molds 80, as shown, for example, in FIG. 11. If required for a particular installation, a pair of orthogonally disposed X-directional and Y-directional trolley assemblies as disclosed, for example in UK Patent Application Publication No. GB 2,229,384 A to allow for adjustment of the positions of the two nozzles relative to the sprue cups 80a in molds 80 into which the molten metal is poured.

[0024] Molten metal holding and pouring box 10 comprises an upper rectangular-shaped section 10a and a lower pyramidal-shaped section 10b. An outer structural shell 14 contains at least a refractory material layer 16 that forms the inner molten metal holding rectangular and pyramidal shaped volumes. As in the prior art, box 10 can have a box cover that extends across the upper portion of the rectangular-shaped section 10a. Molten metal can be fed into box 10 through a closeable opening in the box cover. Box 10 can have a discharge port 92 formed into section 10a for pouring of molten metal from the box when the box is tilted as disclosed, for example, in U.K. Patent Application Publication No. GB 2,229,384 A.

[0025] As in the prior art box 10 can be optionally divided by a vertical baffle of heat refractory material, into a pouring section and a refilling section as further disclosed, for example, in U.K. Patent Application Publication No. GB 2,229,384 A.

[0026] The box cover can have a single, or a pair of separate openings that provides a passageway for the insertion of two stopper rods 94 into box 10. The stopper rods and associated positioning and control apparatus may be as disclosed in U.S. Patent No. 4,953,761 or U.S. Patent Application Publication No. 2010/0282784 A1, both of which are incorporated herein by reference in their entireties. Stopper rods 94 can be independently positioned with stopper rod tips 94a seated (engaged) on the inlets 12b' and 12c' of nozzles 12b and 12c to block flow of molten metal, or independently raised by the associated positioning and control apparatus to allow flow of molten metal through one or both nozzles.

[0027] If required for a particular application, the molten metal holding and pouring box 10 can include means for tilting itself as disclosed, for example, in UK Patent Application Publication No. GB 2,229,384 A, so that unused molten metal can be removed from the box through discharge port 92.

[0028] Unitary dual nozzle assembly 12 is constructed of a thermally conductive material and extends upward within box 10 so that its upper peripheral inlet surfaces 12a and 12a' constantly remain in contact with the molten metal (M) held within box 10 whether or not a stopper rod is in engagement with one or both of the nozzles within assembly 12. Unitary dual nozzle assembly 12 is preferably constructed of an alumina/silica material or other suitable low thermal resistance refractory metal, and the nozzles used therein preferably have circular inner dimensions with conical funnel-shaped inlets 12b' and 12c' and cylindrical-shaped outlets 12b" and 12c". The construction of unitary dual nozzle assembly 12 provides for its constant contact with the molten metal within the interior of box 10, particularly in the central region 12a' of the assembly between the nozzles. This constant contact causes the two nozzles within assembly 12 to always remain in a heat exchange relationship with the molten metal. This heat exchange relationship retards any clogging of the two nozzles that might otherwise occur during any cooling conditions to which the nozzles may be subjected.

[0029] Further the construction of the unitary dual nozzle assembly 12 eliminates the heat sink problem where the metallic structure (shell 14 and a reinforcing plate that is used to support a pouring nozzle as disclosed in U.K. Patent Application Publication No. GB 2,229,384 A) of the box 10 itself draws heat energy away from the pouring nozzles. In the present invention the unitary dual nozzle assembly 12 is surround by an insulating material 18 (as shown in FIG. 1) which insulates the dual nozzle assembly from heat sinks, along with insulation standoffs 70a on dual nozzle assembly retaining plate 70 as further described below.

[0030] Unitary dual nozzle assembly 12 is shown, for example, in FIG. 11 as installed in a molten metal pouring and holding box having a pyramidal-shaped lower section. Details of one example of a unitary dual nozzle assembly 22 that can be used in the present invention is illustrated in FIG. 10(a) through FIG. 10(d). The unitary dual nozzle assembly 22 can also be used in a flat bottom launder as described in U.S. Patent Application Publication No. 2010/0282784 A1. In FIG. 10(a), the overall dimensions of a particular unitary dual nozzle assembly 22 are selected based on the maximum spacing between sprue cups on the pair of molds into which molten metal is to be poured through the nozzles in the unitary dual nozzle assembly. In FIG. 10(a) the maximum spacing between nozzle centers is defined as x_1 between nozzles 24a and 24b as cast, or otherwise formed, within the unitary dual nozzle assembly. Subsequent to installation and use of unitary dual nozzle assembly 22 as shown in FIG. 10(a), a requirement for closer spaced nozzles, such as nozzle pair 24a' and 24b' in FIG. 10(b) with a spacing of x_2 between nozzle centers can be cast, or otherwise formed in a unitary dual nozzle assembly having the same overall dimensions of the unitary dual nozzle assembly shown in FIG. 10(a) to accommodate a distance between sprue cup centers that is less than the maximum spacing.

[0031] Although a nozzle assembly is formed from heat resistant materials, the nozzle assembly will wear over a period of use with exposure to the flow of molten metals and have to be replaced. Typically replacement is accomplished without allowing the pour box structure surrounding the nozzle assembly to cool down, and therefore it is preferable to accomplish nozzle assembly replacement as quickly and efficiently as possible. In a double pour application, the single dual nozzle assembly, such as dual nozzle assembly 12 or 22 in FIG. 10(a) through FIG. 10(d) accomplishes this requirement. Further a single dual nozzle assembly of the present invention allows the distance between the openings of each nozzle in the dual nozzle assembly to be changed when the replacement dual nozzle assembly is originally cast or otherwise formed. For example as shown in FIG. 10(b) the distance x_1 between centers of nozzle openings for nozzle pair 24a and 24b (shown in solid lines) as cast in a first dual nozzle assembly, can be changed to distance x_2 between centers of nozzle openings for nozzle pair 24a' and 24b' (shown in dashed lines) as cast in a second dual nozzle assembly having the same overall dimensions as the first dual nozzle assembly. Thus a significant change in the distance between, and relative positions of each nozzle in a single dual nozzle assembly having the same overall dimensions can be achieved. Comparatively if two single replacement nozzle assemblies are used, the distance between centers of the nozzle openings must be accomplished during the actual fitting of the two single replacement nozzle assemblies in the bottom of a hot pour box. The ability to change the length between centers of the two separate nozzle openings is related to the length (or location) between sprue cups 80a in adjacent molds in a dual pour automated mold line as shown, for example, in FIG. 11. That is, in a dual pour process utilizing a single molten metal holding and pouring box with a pyramidal-shaped lower section, if the relative locations of sprue cups in adjacent molds in an automated line of molds changes, then the relative locations of the dual nozzles will also need to be changed by changing out the nozzle assemblies. The stopper rod positioning features of the stopper rod positioning and control apparatus 10 as disclosed in U.S. Patent Application Publication No. 2010/0282784 A1 can be used to quickly adjust the stopper rod position of each apparatus to changes in positions of the nozzles in a newly installed unitary dual nozzle assembly.

[0032] FIG. 8 illustrates an example of a unitary dual nozzle retaining plate 70 that can be used to provide support for a dual nozzle assembly installed in the molten metal pouring and holding box of the present invention. Retaining posts 72 (in FIG. 9(a)) can be suitably connected to the bottom of box 10 either directly or by intermediate connecting offset brackets 72a. Annular offsets 70a on retaining plate 70 fit up against the bottom of the box with openings 70c around the outlets 12b" and 12c" of each nozzle and the length of retaining posts 72 passing through openings 70b in the retaining plate. A fitting 74, for example, as shown in FIG. 9(b), is inserted into opening 72' in each retaining post to secure the unitary dual nozzle retaining plate in place. In change out of a dual nozzle assembly, fittings 74 are removed from the retaining posts to release the plate to provide a rapid means of removing an installed unitary dual nozzle assembly. After insulating material 18 is removed, the installed unitary dual nozzle can be removed from box 10, and replaced with a new unitary dual nozzle assembly with new insulating material packed around it and the unitary dual nozzle retaining plate is reinstalled. Thus the prior art heat sink problem is substantially eliminated in the present invention, since unitary dual nozzle assembly 12 is substantially surrounded by insulating material 18 and the insulating annular offsets 70a on the unitary dual nozzle assembly. This arrangement, in combination with regions 12a and 12a' of the dual nozzle assembly always being in contact with molten metal in the box, effectively eliminate the previously mentioned clogging problem.

[0033] As shown in the figures, box 10 comprises an upper rectangular-shaped section 10a and a lower inverted pyramidal section 10b housing the unitary dual nozzle assembly 12 in its bottom region. The upper rectangular-shaped section 10a may contain a volume V_1 of molten metal which may be expressed as:

$$V_1 = 0.5 \bullet H \bullet W \bullet L \text{ [expression (2)]}$$

wherein W and L respectively represent the width and length dimensions box 10, and H represents the head (H) dimension.

[0034] The lower inverted pyramidal-section 10b may contain a volume V_2 of molten metal which may be expressed as:

$$V_2 = 1/6 \cdot H \cdot W \cdot L \text{ [expression (3)]}.$$

The total volume V_T of box 10, when full with molten metal, may be expressed as:

$$V_T = V_1 + V_2 = 2/3 \cdot H \cdot W \cdot L \text{ [expression (4)]}.$$

[0035] The shape of box 10, in particular the pyramidal-shaped section 10b, advantageously provides a relatively constant flow (Q) (as previously discussed with reference to expression (1)) of molten metal outward from each nozzle in the dual nozzle assembly to a casting mold. As previously discussed, the relatively constant flow rate (Q) is not only advantageous to the mold casting process itself, but allows for the use of nozzles having small openings which, in turn, ease the task of accurately controlling the outflow of the molten metal from box 10. In particular, the pyramidal-shaped section 10b provides a pouring configuration that makes available approximately 75 percent of the volume (V_T) of the molten contained within box 10, to be poured into a pair of casting molds from the dual nozzles with a corresponding drop of only 50 percent in the pressure head (H), and a drop of only about 30 percent in the flow rate (Q). The flow rate (Q) and the pressure head parameters (H) provided by the present invention forces the molten metal through each of the dual pouring nozzles in a relatively constant manner.

[0036] In some examples of the invention the pair of nozzles in the unitary dual nozzle assembly need not have similar dimensions.

[0037] Indentations 10c can be provided in the exterior of molten melt holding and pouring box 10 as shown in FIG. 4 for locating imaging apparatus for determination of when molten metal has reached a required level in each of the two sprue cups being filled from the nozzles in the unitary dual nozzle assembly as disclosed, for example, in U.S. Patent No. 4,744,407.

[0038] The present invention has been described in terms of preferred examples and embodiments. Equivalents, alternatives and modifications, aside from those expressly stated, are possible and within the scope of the invention.

Claims

1. A molten metal holding and pouring box (10) for holding a volume of a molten metal (M) at a molten temperature, the molten metal holding and pouring box (10) having:

an outer structural supporting layer (14) and at least one inner thermal insulating material layer (16) to maintain the molten temperature of the volume of molten metal (M) within the molten metal holding and pouring box (10);
an upper rectangular-shaped section (10a) for receiving the volume of the molten metal (M) through a closeable opening in the upper rectangular-shaped section (10a) of the molten metal holding and pouring box (10) the closeable opening disposed in an extended cover over the upper rectangular-shaped section;
a unitary dual nozzle assembly (12); and
a pair of stopper rods (94) which engage a pair of nozzles (12b, 12c) in the unitary dual nozzle assembly (12) for controlling a flow of the molten metal (M) poured through each of the pair of nozzles (12b, 12c)

characterised by:

a lower inverted pyramidal-shaped section (10b) comprising a downward sloped region extending from the upper rectangular-shaped section (10a) to a bottom region, the lower inverted pyramidal-shaped section (10b) comprising no greater than one-third of the volume of the upper rectangular-shaped section;
the pair of nozzles (12b, 12c) constructed of a low thermal resistance refractory metal to maintain a heat exchange relationship between the pair of nozzles (12b, 12c) and the molten metal (M); and
the unitary dual nozzle assembly (12) located in the bottom region of the lower inverted pyramidal-shaped section (10b) to pour 75 percent of the volume of the molten metal (M) received through the closeable opening with a corresponding drop of not more than 30 percent in the rate of flow through either of the pair of nozzles (12b, 12c), the unitary dual nozzle assembly (12) thermally insulated from contact with the lower inverted pyramidal-shaped section (10b) by a thermal insulating material (18) while being in thermal contact with the molten metal (M) contained within the molten metal holding and pouring box (10) during pouring and non-pouring periods.

2. A molten metal holding and pouring box (10) according to claim 1 wherein the unitary dual nozzle assembly (12) is constructed of a material selected from alumina and silica.

3. A molten metal holding and pouring box (10) according to any one of claims 1 or 2, wherein each of the pair of nozzles (12b, 12c) has a conical funnel-shaped inlet (12b', 12c') and a nozzle insertion end (94a) of each of the pair of stopper rods (94) is arranged so that, when the nozzle insertion ends (94a) of the pair of stopper rods (94) are inserted in the conical funnel-shaped inlet (12b', 12c') of the pair of nozzles (12b, 12c) to stop the flow of the molten metal (M) through the pair of nozzles (12b, 12c), a portion of the conical funnel-shaped inlet (12b', 12c') in each of the pair of nozzles (12b, 12c) is in contact with the molten metal (M) in the molten metal holding and pouring box (10).

4. A molten metal holding and pouring box (10) according to any one of claims 1, 2 or 3, including a unitary dual nozzle retention plate (70) removably fastened to the bottom region of the lower inverted pyramidal-shaped section (10b) of the molten metal holding and pouring box (10) around an outlet of each one of the pair of nozzles (12b, 12c) in the unitary dual nozzle assembly (12).

5. A molten metal holding and pouring box (10) according to claim 4, wherein the unitary dual nozzle retention plate (70) is removably fastened to the bottom region of the lower inverted pyramidal shaped section (10b) of the molten metal holding and pouring box (10) by a pair of retaining posts (72) fastened to the bottom region of the lower inverted pyramidal-shaped section (10b) and a retention fitting (74) passing through each one of the pair of retaining posts (72) below the unitary dual nozzle retention plate (70).

6. A molten metal holding and pouring box (10) according to claim 5, wherein the unitary dual nozzle assembly (12) is thermally insulated from contact with the lower inverted pyramidal-shaped section (10b) by a combination of a thermal insulating material (18) surrounding the unitary dual nozzle assembly (12) and a thermal insulating standoff (70a) installed around the outlet of each one of the pair of nozzles, the insulating standoff (70a) being disposed between a bottom of the unitary dual nozzle assembly (12) and an upper side of the unitary dual nozzle retention plate (70).

7. A method of pouring a molten metal (M) at a molten temperature from a molten metal holding and pouring box (10) with an upper rectangular-shaped section (10a) into a pair of molds (80), the molten metal holding and pouring box (10) having an outer structural support layer (14), at least one inner thermal insulating material layer (16) to maintain the molten temperature of a volume of the molten metal (M) within the molten metal holding and pouring box (10), and a unitary dual nozzle assembly (12), the unitary dual nozzle assembly (12) having a pair of nozzles (12b, 12c) in engagement with a pair of stopper rods (94), the method comprising:

feeding the volume of the molten metal (M) into the upper rectangular-shaped section (10a) through a closeable opening disposed in an extended cover over the upper rectangular-shaped section;
transporting the pair of molds (80) into a molten metal receiving relationship with the molten metal holding and pouring box (10);

characterised by:

locating the unitary dual nozzle assembly (12) in a bottom region of a lower inverted pyramidal-shaped section (10b) of the molten metal holding and pouring box (10), the lower inverted pyramidal-shaped section (10b) comprising a downward sloped region extending from the upper rectangular-shaped section (10a) to the bottom region, the lower inverted pyramidal-shaped section (10b) comprising no greater than one-third of the volume of the upper rectangular-shaped section;

holding the pair of nozzles (12b, 12c) at the molten temperature by constant contact of the pair of nozzles (12b, 12c) with the molten metal (M) so that the pair of nozzles (12b, 12c) and the molten metal (M) remain in a heat exchange relationship;

surrounding the sides of the unitary nozzle assembly (12) with an insulating material (18) to insulate the unitary dual nozzle assembly (12) from contact with the lower inverted pyramidal-shaped section (10b); and

pouring the molten metal (M) from the molten metal holding and pouring box (10) through each of the pair of nozzles (12b, 12c) in the unitary dual nozzle assembly (12) so that 75 percent of the molten metal (M) contained in the molten metal holding and pouring box (10) is poured into the pair of molds (80) with no more than approximately 30 percent decrease in a rate of flow of the molten metal (M).

8. A method according to claim 7, the unitary dual nozzle assembly (12) having the pair of nozzles (12b, 12c) spaced

apart from each other at a first distance, and a unitary dual nozzle retention plate (70) retaining the bottom of the unitary dual nozzle assembly (12) in the molten metal holding and pouring box (10), the method including the steps of:

removing the unitary dual nozzle retention plate (70) from the bottom of the unitary dual nozzle assembly (12) by removing a pair of retaining fittings (74) from a pair of retaining posts (72) holding the unitary dual nozzle assembly retention plate (70) to the bottom of the molten metal holding and pouring box (10);
removing the insulating material (18) surrounding the sides of the unitary dual nozzle assembly (12) to release the unitary dual nozzle assembly (12) from the molten metal holding and pouring box (10);
inserting a replacement unitary dual nozzle assembly (12) into the bottom of the molten metal holding and pouring box (10), the replacement unitary dual nozzle assembly (12) having the same overall dimensions as the unitary dual nozzle assembly (12) released from the molten metal holding and pouring box (10), the replacement unitary dual nozzle assembly (12) having a pair of replacement nozzles spaced apart from each other at a second distance, the second distance being different from the first distance;
installing the insulating material (18) around the sides of the replacement unitary dual nozzle assembly (12); and
installing the unitary dual nozzle assembly retention plate (70) to the bottom of the replacement unitary dual nozzle assembly (12) by inserting the pair of retaining fittings (74) to the pair of retaining posts (72) to hold the unitary dual nozzle assembly retention plate (70) against the bottom of the replacement unitary dual nozzle assembly (12).

Patentansprüche

1. Halte- und Ausgussbehälter (10) für Metallschmelze zum Halten eines Volumens einer Metallschmelze (M) bei einer Schmelztemperatur, wobei der Halte- und Ausgussbehälter (10) für Metallschmelze Folgendes aufweist:

eine äußere Strukturstüttschicht (14) und mindestens eine innere Schicht (16) aus wärmeisolierendem Material, um die Schmelztemperatur des Volumens der Metallschmelze (M) innerhalb des Halte- und Ausgussbehälters (10) für Metallschmelze aufrechtzuerhalten;
einen oberen rechteckig geformten Abschnitt (10a) zur Aufnahme des Volumens der Metallschmelze (M) durch eine verschließbare Öffnung in dem oberen rechteckig geformten Abschnitt (10a) des Halte- und Ausgussbehälters (10) für Metallschmelze, wobei die verschließbare Öffnung in einer verlängerten Abdeckung über dem oberen rechteckig geformten Abschnitt angeordnet ist;
eine unitäre Doppeldüsenanordnung (12); und
ein Paar Stopp-Stangen (94), die ein Paar Düsen (12b, 12c) in der unitären Doppeldüsenanordnung (12) in Eingriff nehmen, um einen Strom der Metallschmelze (M) zu steuern, die durch jede Düse des Paares Düsen (12b, 12c) ausgegossen wird,
dadurch gekennzeichnet, dass:

ein unterer umgekehrt pyramidenförmiger Abschnitt (10b) einen nach unten abgeschrägten Bereich umfasst, der sich von dem oberen rechteckig geformten Abschnitt (10a) zu einem unteren Bereich erstreckt, wobei der untere umgekehrt pyramidenförmige Abschnitt (10b) nicht mehr als ein Drittel des Volumens des oberen rechteckig geformten Abschnitts umfasst;
das Paar Düsen (12b, 12c) aus einem hochschmelzenden Metall mit geringer Wärmebeständigkeit gefertigt ist, um eine Wärmeaustauschbeziehung zwischen dem Paar Düsen (12b, 12c) und der Metallschmelze (M) aufrechtzuerhalten; und
die unitäre Doppeldüsenanordnung (12) in dem unteren Bereich des unteren umgekehrt pyramidenförmigen Abschnitts (10b) angeordnet ist, um 75 Prozent des Volumens der Metallschmelze (M), die durch die verschließbare Öffnung aufgenommen wurde, mit einem entsprechenden Tropfen von höchstens 30 Prozent in der Strömungsrate durch eine Düse des Paares Düsen (12b, 12c) auszugießen, wobei die unitäre Doppeldüsenanordnung (12) gegenüber Kontakt mit dem unteren umgekehrt pyramidenförmigen Abschnitt (10b) durch ein wärmeisolierendes Material (18) wärmeisoliert ist, während sie mit der Metallschmelze (M), die in dem Halte- und Ausgussbehälter (10) für Metallschmelze enthalten ist, während Gieß- und Nichtgießphasen in Wärmekontakt steht.

2. Halte- und Ausgussbehälter (10) für Metallschmelze nach Anspruch 1, wobei die unitäre Doppeldüsenanordnung (12) aus einem Material gefertigt ist, das ausgewählt ist aus Aluminiumoxid und Siliciumdioxid.
3. Halte- und Ausgussbehälter (10) für Metallschmelze nach einem der Ansprüche 1 oder 2, wobei jede Düse des

Paars Düsen (12b, 12c) einen konischen trichterförmigen Einlass (12b', 12c') aufweist und ein Düseneinführende (94a) jedes Paars Stopp-Stangen (94) so angeordnet ist, dass, wenn die Düseneinführenden (94a) des Paars Stopp-Stangen (94) in den konischen trichterförmigen Einlass (12b', 12c') des Paars Düsen (12b, 12c) eingeführt werden, um den Strom der Metallschmelze (M) durch das Paar Düsen (12b, 12c) zu stoppen, ein Abschnitt des konischen trichterförmigen Einlasses (12b', 12c') in jeder Düse des Paars Düsen (12b, 12c) mit der Metallschmelze (M) in dem Halte- und Ausgussbehälter (10) für Metallschmelze in Kontakt steht.

4. Halte- und Ausgussbehälter (10) für Metallschmelze nach einem der Ansprüche 1, 2 oder 3, der eine unitäre Doppeldüsenhalteplatte (70) aufweist, die abnehmbar an dem unteren Bereich des unteren umgekehrt pyramidenförmigen Abschnitts (10b) des Halte- und Ausgussbehälters (10) für Metallschmelze um einen Auslass jeder Düse des Paars Düsen (12b, 12c) in der unitären Doppeldüsenanordnung (12) befestigt ist.

5. Halte- und Ausgussbehälter (10) für Metallschmelze nach Anspruch 4, wobei die unitäre Doppeldüsenhalteplatte (70) durch ein Paar Haltestäbe (72), die an dem unteren umgekehrt pyramidenförmigen Bereich (10b) befestigt sind, und eine Haltefassung (74), die unterhalb der unitären Doppeldüsenhalteplatte (70) durch jeden des Paars Haltestäbe (72) verläuft, abnehmbar an dem unteren Bereich des unteren umgekehrt pyramidenförmigen Abschnitts (10b) des Halte- und Ausgussbehälters (10) für Metallschmelze befestigt ist.

6. Halte- und Ausgussbehälter (10) für Metallschmelze nach Anspruch 5, wobei die unitäre Doppeldüsenanordnung (12) gegenüber Kontakt mit dem unteren umgekehrt pyramidenförmigen Abschnitt (10b) durch eine Kombination aus einem wärmeisolierenden Material (18), das die unitäre Doppeldüsenanordnung (12) umgibt, und einem wärmeisolierenden Abstandsbolzen (70a), der um den Auslass jeder Düse des Paars Düsen herum installiert ist, wärmeisoliert ist, wobei der isolierende Abstandsbolzen (70a) zwischen einem unteren Teil der unitären Doppeldüsenanordnung (12) und einer Oberseite der unitären Doppeldüsenhalteplatte (70) angeordnet ist.

7. Verfahren zum Ausgießen einer Metallschmelze (M) bei einer Schmelztemperatur aus einem Halte- und Ausgussbehälter (10) für Metallschmelze mit einem oberen rechteckig geformten Abschnitt (10a) in ein Paar Formen (80), wobei der Halte- und Ausgussbehälter (10) für Metallschmelze eine äußere Strukturstützschicht (14), mindestens eine innere Schicht (16) aus wärmeisolierendem Material zum Aufrechterhalten der Schmelztemperatur eines Volumens der Metallschmelze (M) in dem Halte- und Ausgussbehälter (10) für Metallschmelze und eine unitäre Doppeldüsenanordnung (12) aufweist, wobei die unitäre Doppeldüsenanordnung (12) ein Paar Düsen (12b, 12c) aufweist, die mit einem Paar Stopp-Stangen (94) in Eingriff stehen, wobei das Verfahren Folgendes umfasst: Zuführen des Volumens der Metallschmelze (M) zu dem oberen rechteckig geformten Abschnitt (10a) durch eine verschließbare Öffnung, die in einer verlängerten Abdeckung über dem oberen rechteckig geformten Abschnitt angeordnet ist;

Befördern des Paars Formen (80) in eine Metallschmelze aufnehmende Beziehung mit dem Halte- und Ausgussbehälter (10) für Metallschmelze;

gekennzeichnet durch:

Anordnen der unitären Doppeldüsenanordnung (12) in einem unteren Bereich eines unteren umgekehrt pyramidenförmigen Abschnitts (10b) des Halte- und Ausgussbehälters (10) für Metallschmelze, wobei der untere umgekehrt pyramidenförmige Abschnitt (10b) einen nach unten abgeschrägten Bereich umfasst, der sich von dem oberen rechteckig geformten Abschnitt (10a) zu dem unteren Bereich erstreckt, wobei der untere umgekehrt pyramidenförmige Abschnitt (10b) nicht mehr als ein Drittel des Volumens des oberen rechteckig geformten Abschnitts umfasst;

Halten des Paars Düsen (12b, 12c) auf der Schmelztemperatur durch konstanten Kontakt des Paars Düsen (12b, 12c) mit der Metallschmelze (M), so dass das Paar Düsen (12b, 12c) und die Metallschmelze (M) in einer Wärmeaustauschbeziehung bleiben;

Umgeben der Seiten der unitären Doppeldüsenanordnung (12) mit einem isolierenden Material (18), um die unitäre Doppeldüsenanordnung (12) gegenüber Kontakt mit dem unteren umgekehrt pyramidenförmigen Abschnitt (10b) zu isolieren; und

Ausgießen der Metallschmelze (M) aus dem Halte- und Ausgussbehälter (10) für Metallschmelze durch jede Düse des Paars Düsen (12b, 12c) in der unitären Doppeldüsenanordnung (12), so dass 75 Prozent der in dem Halte- und Ausgussbehälter (10) für Metallschmelze enthaltenen Metallschmelze (M) mit höchstens etwa 30 Prozent Abnahme der Strömungsgeschwindigkeit der Metallschmelze (M) in das Paar Formen (80) gegossen werden.

8. Verfahren nach Anspruch 7, wobei bei der unitären Doppeldüsenanordnung (12) das Paar Düsen (12b, 12c) um

einen ersten Abstand beabstandet ist und eine unitäre Doppeldüsenhalteplatte (70) den unteren Teil der unitären Doppeldüsenanordnung (12) in dem Halte- und Ausgussbehälter (10) für Metallschmelze hält, wobei das Verfahren die folgenden Schritte beinhaltet:

- 5 Entfernen der unitären Doppeldüsenhalteplatte (70) von dem unteren Teil der unitären Doppeldüsenanordnung (12) durch Entfernen eines Paares Haltefassungen (74) von einem Paar Haltestäbe (72), die die unitäre Doppeldüsenanordnungshalteplatte (70) am unteren Teil des Halte- und Ausgussbehälters (10) für Metallschmelze halten;
- 10 Entfernen des isolierenden Materials (18), das die Seiten der unitären Doppeldüsenanordnung (12) umgibt, um die unitäre Doppeldüsenanordnung (12) aus dem Halte- und Ausgussbehälter (10) für Metallschmelze zu lösen; Einführen einer unitären Ersatz-Doppeldüsenanordnung (12) in den unteren Teil des Halte- und Ausgussbehälters (10) für Metallschmelze, wobei die unitäre Ersatz-Doppeldüsenanordnung (12) dieselben Gesamtabmessungen aufweist wie die unitäre Doppeldüsenanordnung (12), die aus dem Halte- und Ausgussbehälter (10) für Metallschmelze gelöst wurde, wobei die unitäre Ersatz-Doppeldüsenanordnung (12) ein Paar Ersatz-
- 15 düsen aufweist, die um einen zweiten Abstand voneinander beabstandet sind, wobei der zweite Abstand von dem ersten Abstand verschieden ist; Installieren des isolierenden Materials (18) um die Seiten der unitären Ersatz-Doppeldüsenanordnung (12) herum; und
- 20 Installieren der unitären Doppeldüsenanordnungshalteplatte (70) an dem unteren Teil der unitären Ersatz-Doppeldüsenanordnung (12) durch Einführen des Paares Haltefassungen (74) in das Paar Haltestäbe (72), um die unitäre Doppeldüsenanordnungshalteplatte (70) am unteren Teil der unitären Ersatz-Doppeldüsenanordnung (12) zu halten.

Revendications

- 25 1. Bac de stockage et de coulée de métal fondu (10) pour stocker un volume d'un métal fondu (M) à une température de fusion, le bac de stockage et de coulée de métal fondu (10) ayant :

- 30 une couche de support structurel externe (14) et au moins une couche de matériau d'isolation thermique interne (16) pour maintenir la température de fusion du volume de métal fondu (M) au sein du bac de stockage et de coulée de métal fondu (10) ;
- une section supérieure de forme rectangulaire (10a) pour recevoir le volume du métal fondu (M) à travers une ouverture apte à être fermée dans la section supérieure de forme rectangulaire (10a) du bac de stockage et de coulée de métal fondu (10), l'ouverture apte à être fermée étant disposée dans un couvercle étendu sur la
- 35 section supérieure de forme rectangulaire ;
- un ensemble à deux becs monobloc (12) ; et
- une paire de quenouilles (94) qui viennent en prise avec une paire de becs (12b, 12c) dans l'ensemble à deux becs monobloc (12) pour commander un écoulement du métal fondu (M) versé à travers chaque bec de la paire de becs (12b, 12c)

40 **caractérisé par :**

- 45 une section inférieure en forme de pyramide inversée (10b) comprenant une région à pente descendante qui s'étend de la section supérieure de forme rectangulaire (10a) à une région inférieure, la section inférieure en forme de pyramide inversée (10b) ne comprenant pas plus d'un tiers du volume de la section supérieure de forme rectangulaire ;
- la paire de becs (12b, 12c) constitués d'un métal réfractaire à faible résistance thermique pour maintenir une relation d'échange de chaleur entre la paire de becs (12b, 12c) et le métal fondu (M) ; et
- 50 l'ensemble à deux becs monobloc (12) situé dans la région inférieure de la section inférieure en forme de pyramide inversée (10b) pour verser 75 pour cent du volume du métal fondu (M) reçu à travers l'ouverture apte à être fermée avec une baisse correspondante de pas plus de 30 pour cent en débit à travers l'un ou l'autre bec de la paire de becs (12b, 12c), l'ensemble à deux becs monobloc (12) étant thermiquement isolé vis-à-vis d'un contact avec la section inférieure en forme de pyramide inversée (10b) par un matériau d'isolation thermique
- 55 (18) tout en étant en contact thermique avec le métal fondu (M) contenu au sein du bac de stockage et de coulée de métal fondu (10) au cours des périodes de coulée et de non-coulée.

2. Bac de stockage et de coulée de métal fondu (10) selon la revendication 1, dans lequel l'ensemble à deux becs monobloc (12) est constitué d'un matériau choisi parmi l'alumine et la silice.

3. Bac de stockage et de coulée de métal fondu (10) selon l'une quelconque des revendications 1 ou 2, dans lequel chaque bec de la paire de becs (12b, 12c) a une entrée en forme d'entonnoir conique (12b', 12c') et une extrémité d'insertion de bec (94a) de chaque quenouille de la paire de quenouilles (94) est conçue de sorte que, lorsque les extrémités d'insertion de bec (94a) de la paire de quenouilles (94) sont insérées dans l'entrée en forme d'entonnoir conique (12b', 12c') de la paire de becs (12b, 12c) pour arrêter l'écoulement du métal fondu (M) à travers la paire de becs (12b, 12c), une partie de l'entrée en forme d'entonnoir conique (12b', 12c') dans chaque bec de la paire de becs (12b, 12c) est en contact avec le métal fondu (M) dans le bac de stockage et de coulée de métal fondu (10).
4. Bac de stockage et de coulée de métal fondu (10) selon l'une quelconque des revendications 1, 2 ou 3, comportant une plaque de rétention des deux becs monobloc (70) fixée de manière amovible sur la région inférieure de la section inférieure en forme de pyramide inversée (10b) du bac de stockage et de coulée de métal fondu (10) autour d'une sortie de chaque bec de la paire de becs (12b, 12c) dans l'ensemble à deux becs monobloc (12).
5. Bac de stockage et de coulée de métal fondu (10) selon la revendication 4, dans lequel la plaque de rétention des deux becs monobloc (70) est fixée de manière amovible sur la région inférieure de la section inférieure en forme de pyramide inversée (10b) du bac de stockage et de coulée de métal fondu (10) par une paire de tiges de retenue (72) fixées sur la région inférieure de la section inférieure en forme de pyramide inversée (10b) et un raccord de rétention (74) passant à travers chaque tige de la paire de tiges de retenue (72) en dessous de la plaque de rétention des deux becs monobloc (70).
6. Bac de stockage et de coulée de métal fondu (10) selon la revendication 5, dans lequel l'ensemble à deux becs monobloc (12) est thermiquement isolé vis-à-vis d'un contact avec la section inférieure en forme de pyramide inversée (10b) par une combinaison d'un matériau d'isolation thermique (18) entourant l'ensemble à deux becs monobloc (12) et d'un élément d'écartement d'isolation thermique (70a) installé autour de la sortie de chaque bec de la paire de becs, l'élément d'écartement d'isolation (70a) étant disposé entre une partie inférieure de l'ensemble à deux becs monobloc (12) et un côté supérieur de la plaque de rétention des deux becs monobloc (70).
7. Procédé de coulée d'un métal fondu (M) à une température de fusion à partir d'un bac de stockage et de coulée de métal fondu (10) ayant une section supérieure de forme rectangulaire (10a) dans une paire de moules (80), le bac de stockage et de coulée de métal fondu (10) ayant une couche de support structurel externe (14), au moins une couche de matériau d'isolation thermique interne (16) pour maintenir la température de fusion d'un volume du métal fondu (M) au sein du bac de stockage et de coulée de métal fondu (10), et un ensemble à deux becs monobloc (12), l'ensemble à deux becs monobloc (12) ayant une paire de becs (12b, 12c) en prise avec une paire de quenouilles (94), le procédé comprenant :

le fait d'introduire le volume du métal fondu (M) dans la section supérieure de forme rectangulaire (10a) à travers une ouverture apte à être fermée disposée dans un couvercle étendu sur la section supérieure de forme rectangulaire ;

le fait de transporter la paire de moules (80) dans une relation de réception de métal fondu avec le bac de stockage et de coulée de métal fondu (10) ;

caractérisé par :

le fait de placer l'ensemble à deux becs monobloc (12) dans une région inférieure d'une section inférieure en forme de pyramide inversée (10b) du bac de stockage et de coulée de métal fondu (10), la section inférieure en forme de pyramide inversée (10b) comprenant une région à pente descendante qui s'étend de la section supérieure de forme rectangulaire (10a) à la région inférieure, la section inférieure en forme de pyramide inversée (10b) ne comprenant pas plus d'un tiers du volume de la section supérieure de forme rectangulaire ;

le fait de maintenir la paire de becs (12b, 12c) à la température de fusion par contact constant de la paire de becs (12b, 12c) avec le métal fondu (M) de sorte que la paire de becs (12b, 12c) et le métal fondu (M) restent dans une relation d'échange de chaleur ;

le fait d'entourer les côtés de l'ensemble de becs monobloc (12) avec un matériau d'isolation (18) pour isoler l'ensemble à deux becs monobloc (12) vis-à-vis d'un contact avec la section inférieure en forme de pyramide inversée (10b) ; et

le fait de verser le métal fondu (M) à partir du bac de stockage et de coulée de métal fondu (10) à travers chaque bec de la paire de becs (12b, 12c) dans l'ensemble à deux becs monobloc (12) de sorte que 75 pour cent du métal fondu (M) contenu dans le bac de stockage et de coulée de métal fondu (10) est versé dans la paire de moules (80) avec pas plus d'approximativement 30 pour cent de réduction en débit du métal fondu (M).

8. Procédé selon la revendication 7, l'ensemble à deux becs monobloc (12) ayant la paire de becs (12b, 12c) espacés l'un de l'autre selon une première distance, et une plaque de rétention des deux becs monobloc (70) retenant la partie inférieure de l'ensemble à deux becs monobloc (12) dans le bac de stockage et de coulée de métal fondu (10), le procédé comportant les étapes consistant à :

retirer la plaque de rétention des deux becs monobloc (70) de la partie inférieure de l'ensemble à deux becs monobloc (12) par retrait d'une paire de raccords de retenue (74) d'une paire de tiges de retenue (72) maintenant la plaque de rétention d'ensemble à deux becs monobloc (70) sur la partie inférieure du bac de stockage et de coulée de métal fondu (10) ;

retirer le matériau d'isolation (18) entourant les côtés de l'ensemble à deux becs monobloc (12) pour libérer l'ensemble à deux becs monobloc (12) du bac de stockage et de coulée de métal fondu (10) ;

insérer un ensemble à deux becs monobloc (12) de remplacement dans la partie inférieure du bac de stockage et de coulée de métal fondu (10), l'ensemble à deux becs monobloc (12) de remplacement ayant les mêmes dimensions générales que l'ensemble à deux becs monobloc (12) libéré du bac de stockage et de coulée de métal fondu (10), l'ensemble à deux becs monobloc (12) de remplacement ayant une paire de becs de remplacement espacés l'un de l'autre selon une deuxième distance, la deuxième distance étant différente de la première distance ;

installer le matériau d'isolation (18) autour des côtés de l'ensemble à deux becs monobloc (12) de remplacement ;
et

installer la plaque de rétention d'ensemble à deux becs monobloc (70) sur la partie inférieure de l'ensemble à deux becs monobloc (12) de remplacement par insertion de la paire de raccords de retenue (74) sur la paire de tiges de retenue (72) pour maintenir la plaque de rétention d'ensemble à deux becs monobloc (70) contre la partie inférieure de l'ensemble à deux becs monobloc (12) de remplacement.

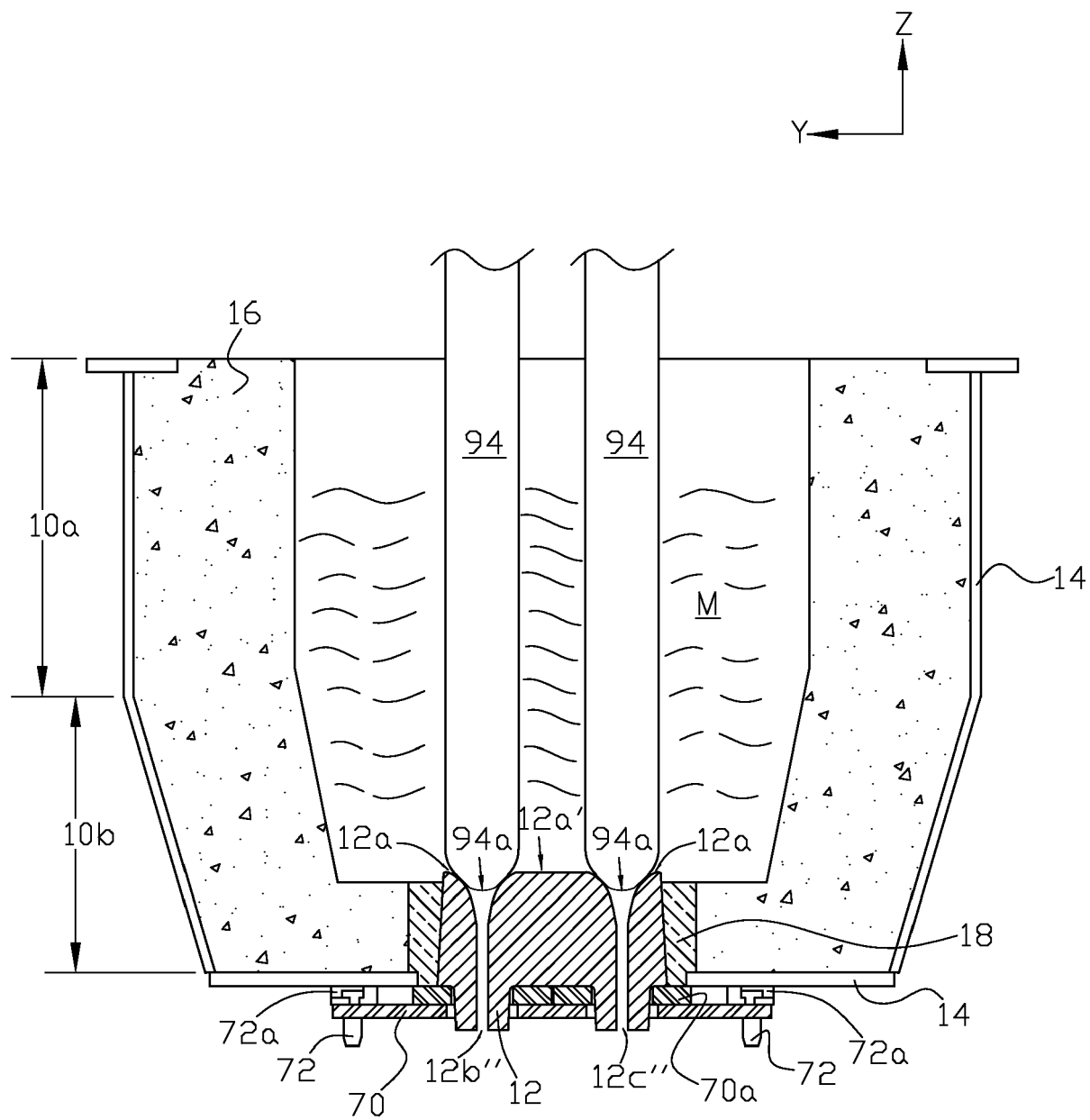


FIG. 1

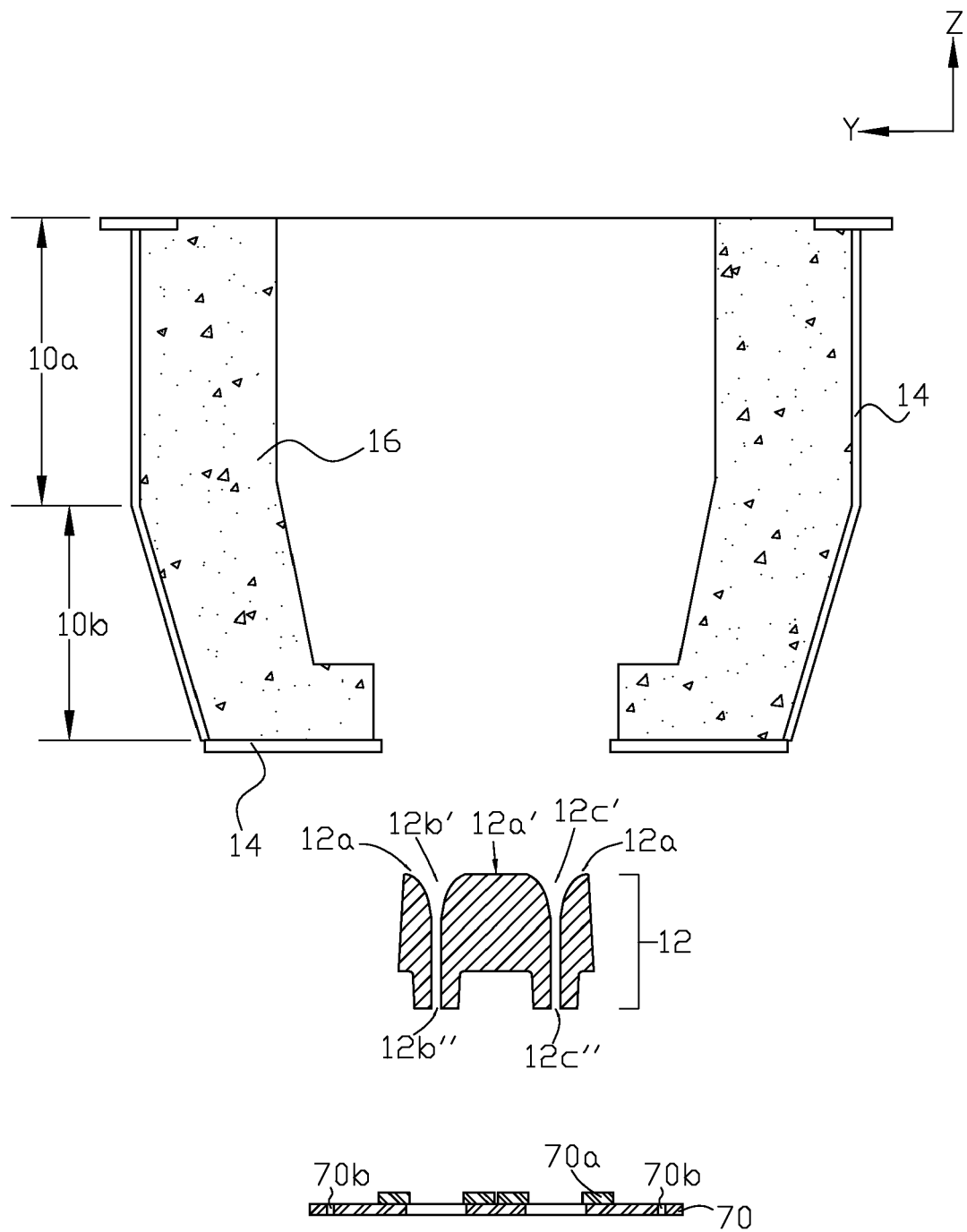


FIG. 2

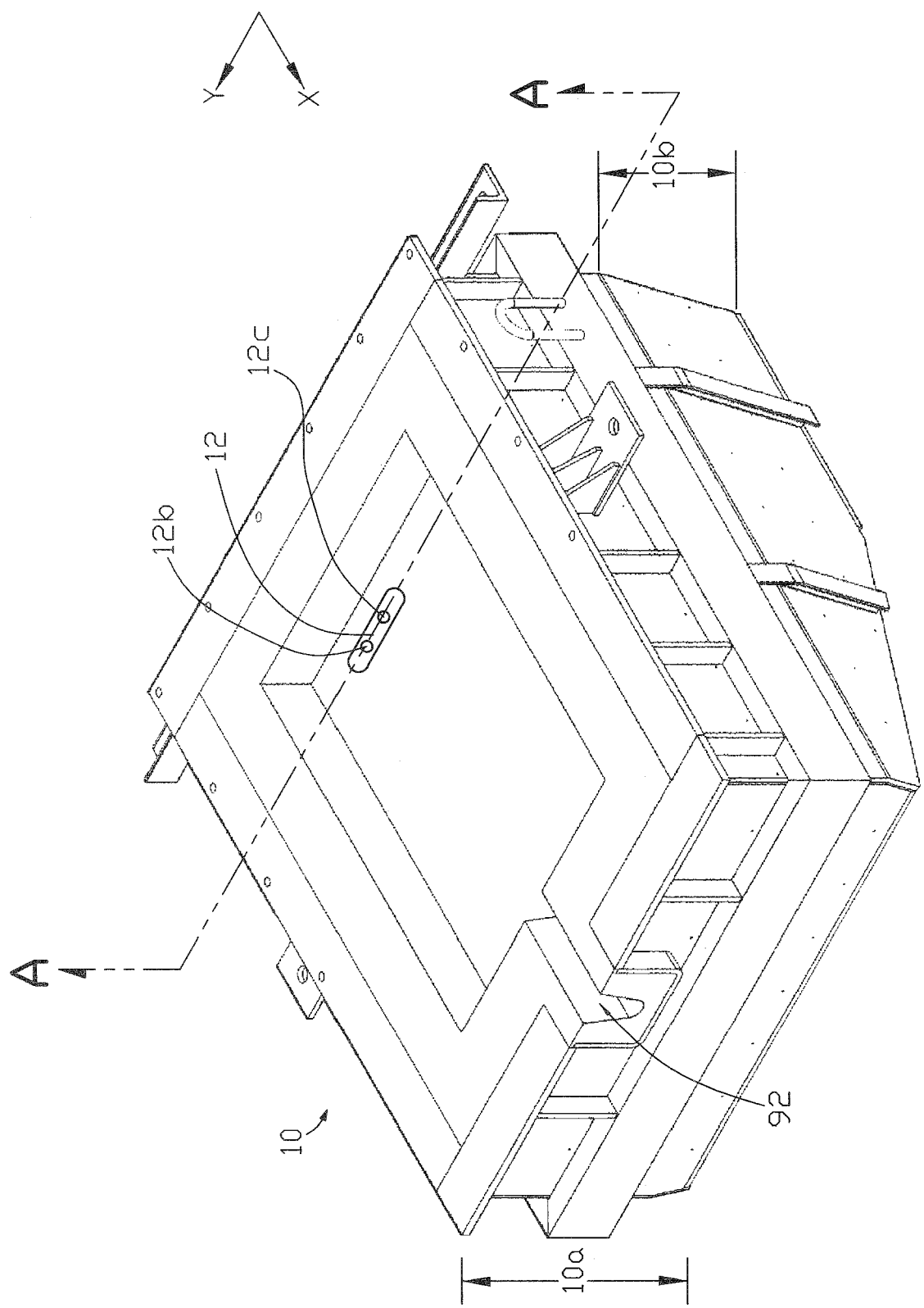
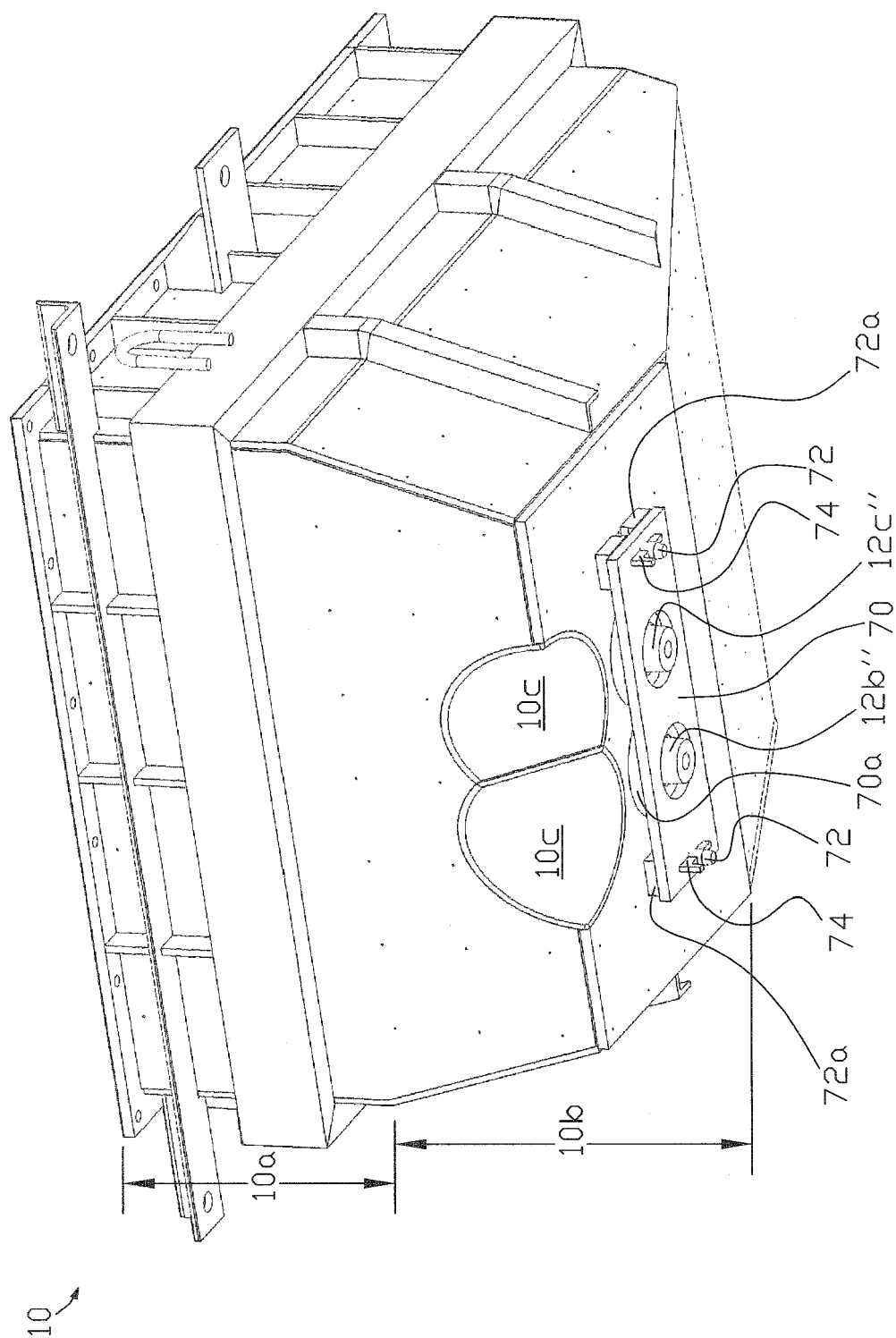
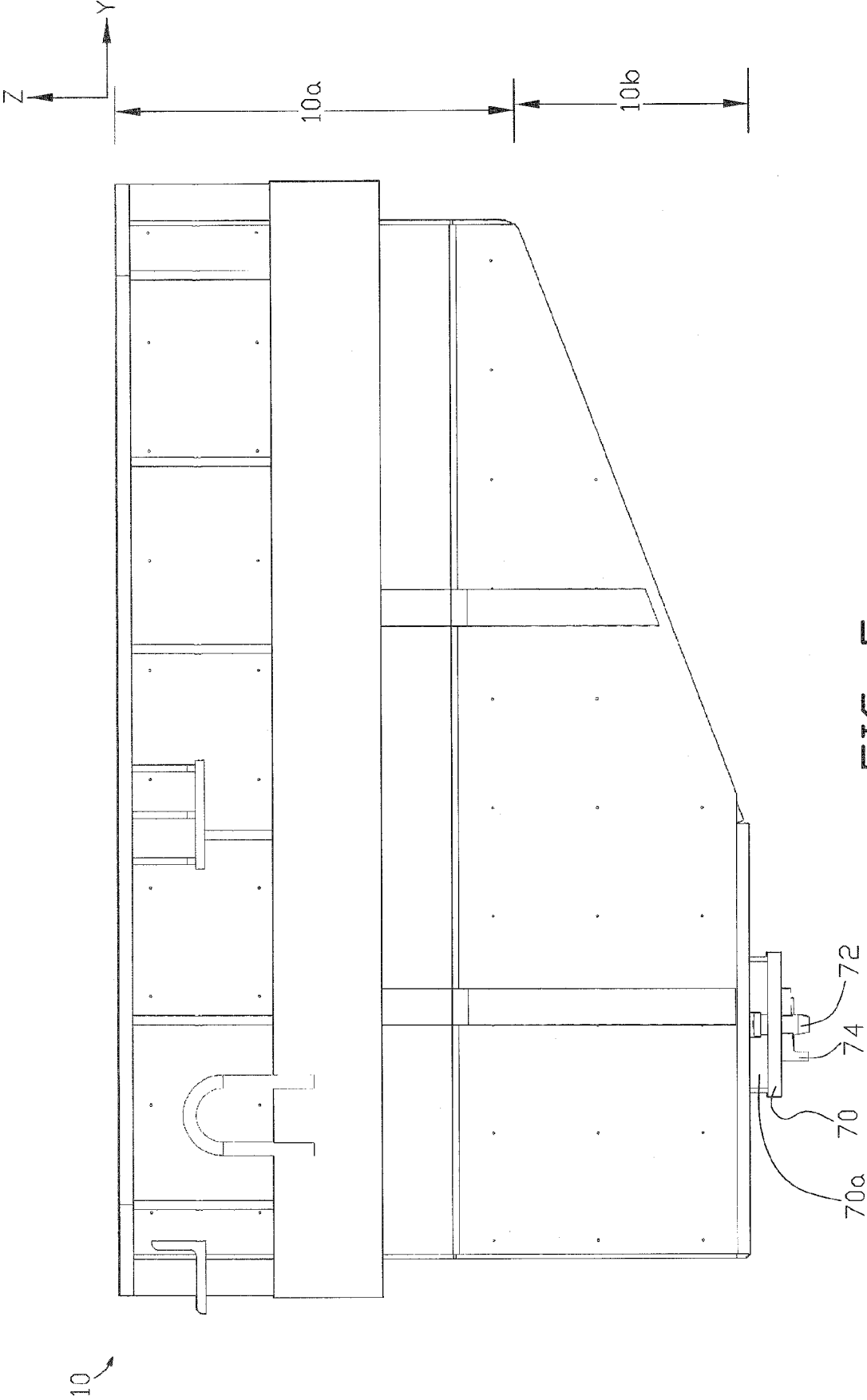


FIG. 3



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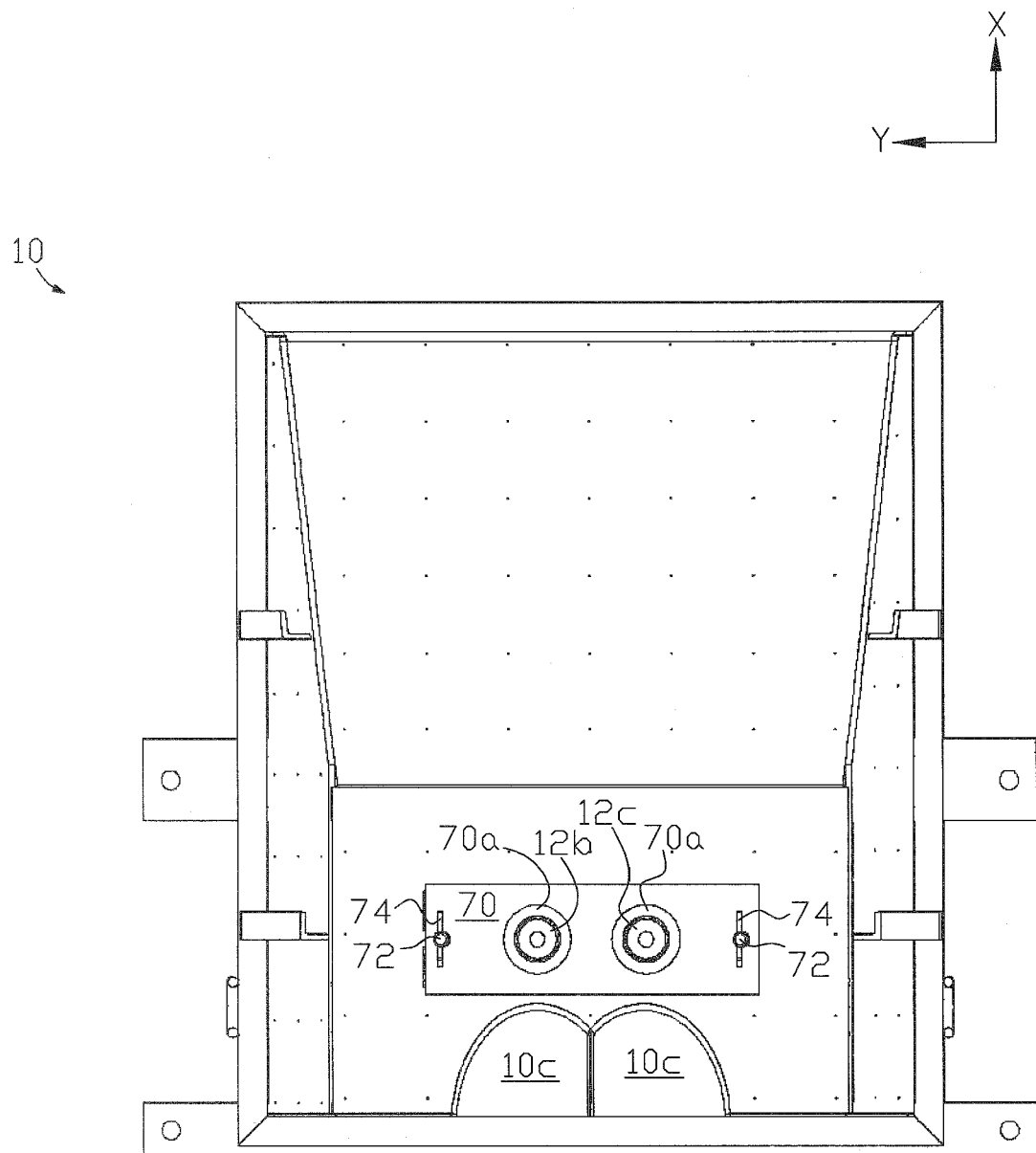


FIG. 6

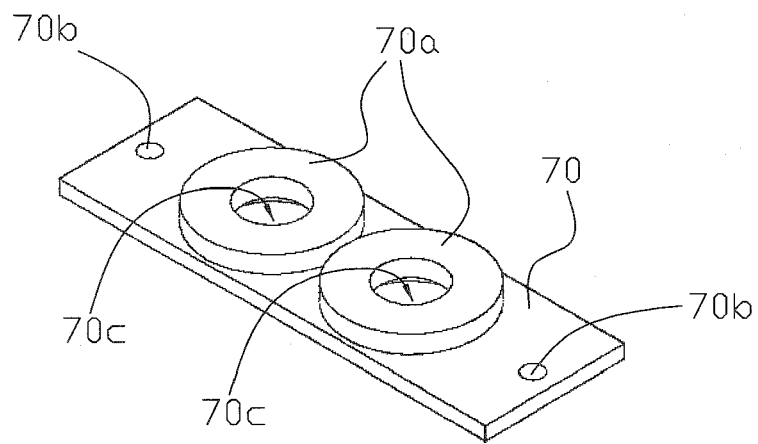


FIG. 8

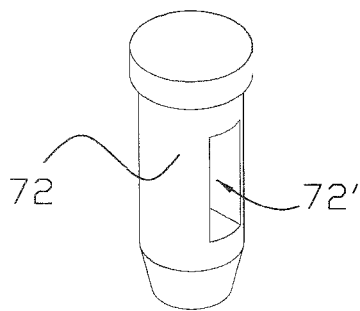


FIG. 9(a)

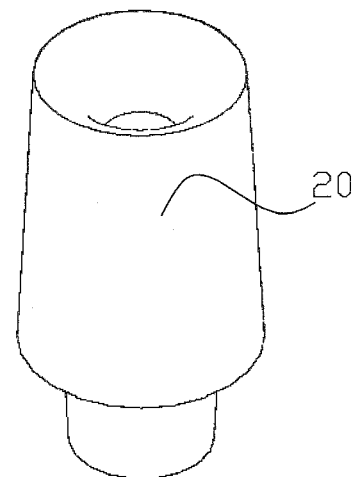


FIG. 7

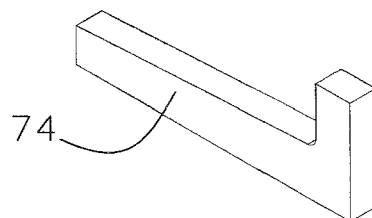


FIG. 9(b)

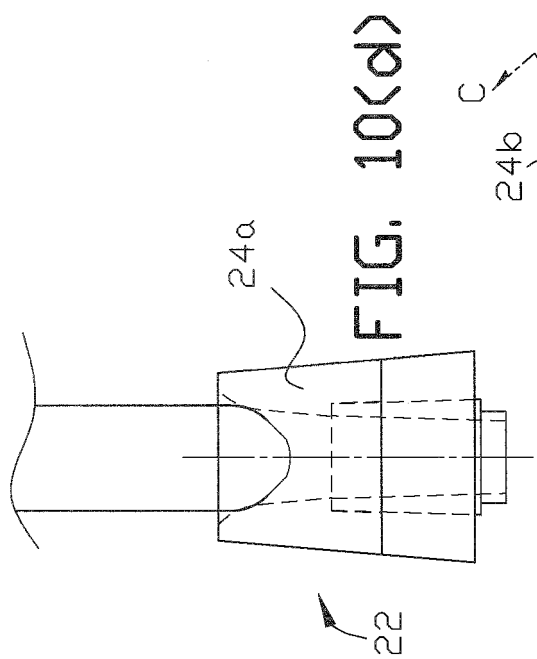


FIG. 10(c)

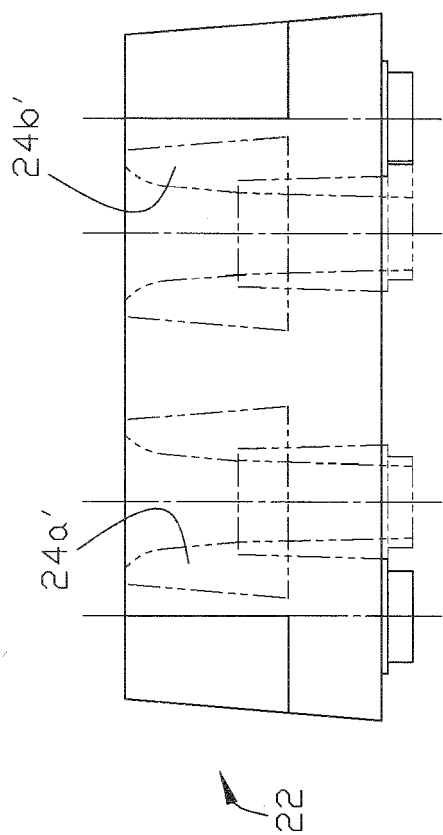


FIG. 10(b)

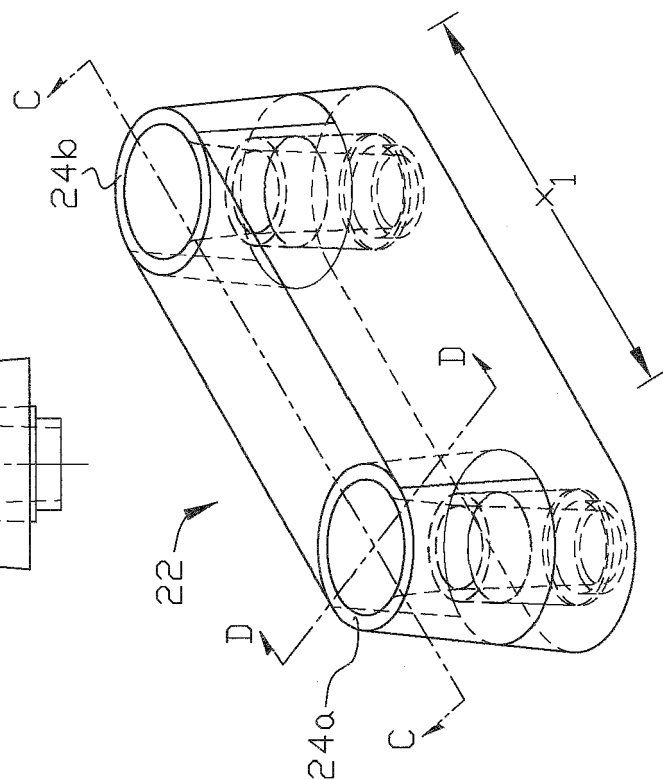


FIG. 10(a)

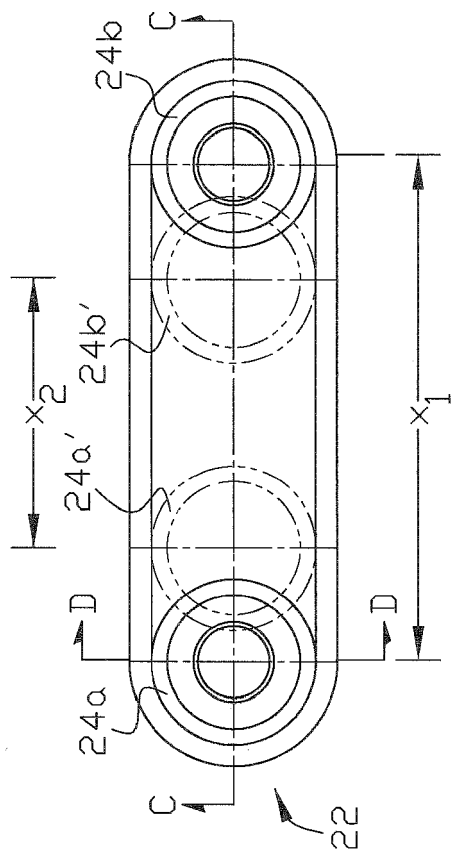


FIG. 10(d)

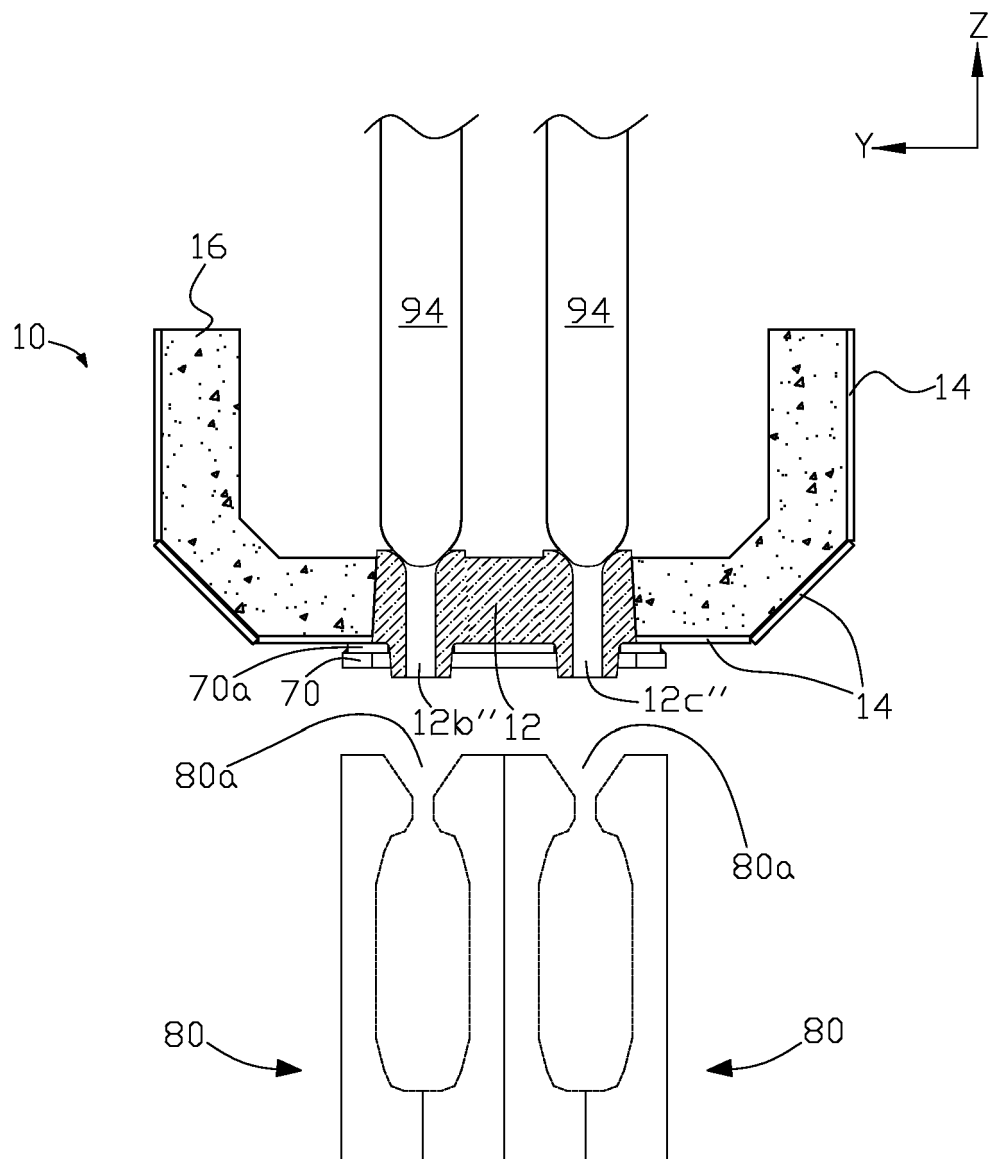


FIG. 11

REFERENCES CITED IN THE DESCRIPTION

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