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(54) Method and apparatus for casting articles in sand moulds

(57) In a method of casting articles in cavities (not shown) in a sand mould (1), using a supply unit (4) for introducing molten metal (not shown) into said cavities through a runner (2), the main novel feature is the use of a resilient sealing element, in the example shown a ring (8), preferably made of heat-insulating material, to provide a liquid-tight seal around the connection between a mouthpiece (3) on said unit (4) and said runner (2), when the unit (4) is moved into the filling position shown.

The use of the sealing ring (8) makes it possible to avoid contamination of the mouthpiece (3) by sand from the mould, as well as solidification of molten metal on the mouthpiece, that would otherwise disturb the latter's correct co-operation with the next mould in succession to be filled.

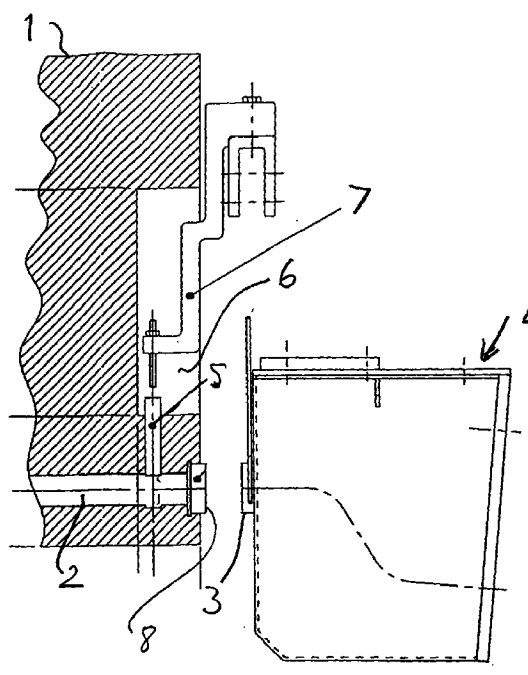


Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a method of casting articles in sand moulds, said method being of the kind set forth in the preamble of claim 1.

BACKGROUND ART

[0002] In previous methods of this kind, problems have been encountered, partly due to sand particles from the mould contaminating the part of the unit for supplying molten metal to the mould adapted to co-operate with the surface of the mould around the inlet end of the filling duct leading to the casting cavities. Such contamination will, of course, make it impossible to achieve a liquid-tight seal with the next mould in succession to be filled. With said previous methods there is also a risk that molten metal can solidify on the part of the supply unit referred to, thus aggravating the difficulties caused by the contamination with sand particles. Even in the absence of these problems, it is difficult to achieve a liquid-tight seal between the supply unit and the surface of each and every sand mould around the inlet end of each filling duct, because the very manner of manufacturing the sand moulds - usually carried out in associated machinery - does not provide a perfectly smooth surface, with which e.g. a mouthpiece on the supply unit can co-operate in a sealing manner.

DISCLOSURE OF THE INVENTION

[0003] It is the object of the present invention to provide a method of the kind referred to above, with which it is possible to avoid the disadvantages with the previous methods referred to above, and this object is achieved by proceeding in the manner set forth in the characterizing clause of claim 1. By using a sealing element in the manner referred to, it is possible to avoid both contamination of the mouthpiece by sand from the mould and solidification of molten metal on the mouthpiece. The use of a sealing element in the manner referred to, the method can be carried out so as to achieve a separation between the functions of sealing the connection between the supply unit, usually a molten-metal pump, and the filling duct or runner, and the function of closing the latter when the filling has been completed. Such a separation can be achieved by proceeding in the manner set forth in claims 6-12.

[0004] Advantageous embodiments of the method of the invention, the effects of which - beyond what is obvious - are explained in the following detailed part of the present description, are set forth in claims 2-12, of which claims 6-12 were mentioned in the preceding paragraph.

[0005] The present invention also relates to an apparatus for carrying out the method of the invention. This

apparatus is of the kind set forth in the preambles of claims 13-16, and, according to various aspects of the present invention, are characterized by the features set forth in the characterizing clauses of these claims 13-16, respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] In the following detailed part of the present description, the invention will be explained in more detail with reference to the exemplary embodiments of apparatus according to the invention shown in the drawings, in which

Figures 1-4 illustrate four steps in the casting process when using moulds having a closure member according to a first embodiment, and Figures 5 and 6 show the relevant part of moulds having closure members according to a second and a third embodiment, respectively.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0007] Figure 1 shows a part of a sand mould 1, preferably one of a number of similar sand moulds forming a so-called mould string used in the mass production of cast metal objects, e.g. by using a combined mould-making and casting machine of the DISAMATIC® type. The mould string extends and moves in a direction at right angles to the drawing. The mould 1 comprises a filling duct in the form of a runner 2, the right-hand end of which is adapted to co-operate sealingly with a mouthpiece 3 on a metal pump 4 adapted to supply molten metal (not shown) under pressure to the runner 2, the latter leading into one or a number of mould cavities (not shown) formed in the mould 1. The mould 1 comprises a closure member 5 extending from an outwardly open recess 6 in the side of the mould 1 facing the metal pump 4 to the runner 2, and can be pushed into the closing position shown in Figures 3 and 4 by a pusher arm 7 adapted to be reciprocated in a vertical or inclined direction by a suitable mechanism (not shown). The right-hand end of the runner 2 is surrounded by a sealing element, in this exemplary embodiment in the form of a ring 8 adapted to make a liquid-tight seal of the connection between the mouthpiece 3 of the metal pump 4 and the runner 2, when the metal pump is brought into engagement as shown in Figure 2. The sealing element can also have other shapes than that of a ring, provided that it can seal the connection between the mouthpiece 3 and the runner 2 outwardly.

[0008] In the situation shown in Figure 1, the mould 1 has just arrived from the mould-making station, the latter comprising means, such as a core setter, for inserting the closure member 5, as well as the sealing ring 8, in the positions in Figure 1.

[0009] In the situation shown in Figure 2, the metal

pump 4 has been moved a short distance to the left so as to make the mouthpiece 3 engage sealingly with the sealing ring 8. At this stage, pressure is applied to the molten metal in the pump 4 so as to flow through the mouthpiece 3 and the runner 2 into the above-mentioned casting cavities.

[0010] When the casting cavities have been filled - this may be ascertained by means of suitable sensors (not shown) - the actuating mechanism (not shown) for the pusher arm 7 is actuated to move the pusher arm into the position shown in Figure 3, thus pushing the closure member 5 into the closing position shown, thus closing the runner 2. When the closure member 5 has been moved into the closing position shown in Figure 3, and the outflow pressure of the metal pump 4 has been reduced, the pump may be withdrawn from the mould 1 to the position shown in Figure 4, so as to be in readiness for filling the next mould in succession. Before the pump 4 is withdrawn, the pusher arm 7 is withdrawn to its initial position shown in Figures 1 and 2, and the closure member 5 will remain in its closing position.

[0011] Before moving the mould 1 towards the next station so as to make it possible to place a new mould in the filling station shown, the pusher arm 7 is moved towards the right out of the recess 6 in order to allow this movement, being moved back into position as soon as the next mould is in the position shown for the mould 1.

[0012] The sealing ring 8 is preferably made of a material providing the best possible seal with the mouthpiece 3. A sealing ring 8 made from fibres of ceramic material, e.g. aluminium oxide or silicon oxide, has proved useful, but other materials are, of course, possible. Practical trials have been based on using so-called ISO tube consisting of 37% aluminium oxide, 58% silicon oxide, 2% iron oxide and the remainder sodium and potassium oxides.

[0013] The sealing ring 8 not only provides a liquid-tight seal, but it also prevents direct contact between the mould 1 and the mouthpiece 3, thus avoiding contamination of the latter with particles of sand that can easily come loose from the mould. Further, because of its resilient properties, the sealing ring 8 is also capable of accommodating minor variations in the relative positions of the runner 2 and the mouthpiece 3, bearing in mind that the latter will have to co-operate with a great number of moulds passing through the filling station. Still further, because of its heat-insulating properties, the sealing ring 8 prevents molten metal from solidifying in contact with the mouthpiece 3 - otherwise, this could disturb the engagement of the latter with the sealing ring on the next mould.

[0014] The movements and activities of the various parts are, of course, controlled by suitable automatic control equipment. Persons skilled in the art of automatic metal casting will know how to devise and construct such control equipment, for which reason it should not be necessary to describe it in detail in the present description.

[0015] Figures 5 and 6 illustrate two altered embodiments of the arrangement for closing the runner 2.

[0016] In the embodiment shown in Figure 5, the plug-like closure member 5 shown in Figures 1-4 is replaced by a closure blade 9 adapted to be pushed into the closing position (not shown) by a pusher finger 10 attached to the pusher arm 7. Like the closure member 5 shown in Figures 1-4, the closure blade 9 is inserted into the mould in the mould-making station, preferably by means of a core setter.

[0017] In the embodiment shown in Figure 6, the mould 1 will arrive in the filling station without a closure member; this can be necessary if the mould-making station does not comprise a core setter or other equipment capable of inserting a closure member. Instead, the closing function is provided by means of a closure blade 11 held temporarily by a gripper 12 secured to the pusher arm 7. With this arrangement, a new closure blade 11 will be inserted into the gripper 12, when the pusher arm 7 is in a position (not shown) away from the mould 1, such as by a suitable control robot (also not shown).

[0018] If the closure member 5 is made from compacted core sand and the closure blades 9 and 11 are made from the same material as is used for casting, it will not be necessary to take special care for removing them from the metal having solidified in the ingate system and to be returned for re-melting surplus metal after extraction and liberation of the castings.

[0019] In an embodiment (not shown), the closure member 5 is replaced by a water-cooled closure member, preferably attached to a movable member externally of the mould 1, such as one similar to the pusher arm 7. In this case, the water-cooled closure member is pulled out and away from the runner 2 as soon as the metal in the latter has solidified to an extent sufficient to prevent the metal closer to the mould cavity from flowing out.

LIST OF PARTS

[0020]

1	sand mould
2	runner
3	mouthpiece
4	metal pump
5	closure member
6	recess
7	pusher arm
8	sealing ring
9	closure blade
10	pusher finger
11	closure blade
12	gripper

Claims

1. Method of casting articles in sand moulds comprising the following steps a-f:

a) providing a sand mould having

- a1) at least one casting cavity with a shape corresponding to the shape of the article or articles to be cast, and
a2) a filling duct leading from an external opening in said mould to said casting cavity or cavities,

b) providing a supply unit for molten metal and having

- b1) a space for accommodating said molten metal,
b2) means for pressurizing said space, and
b3) a duct connector for temporarily connecting said space to said external opening in said mould,

c) bringing said supply unit into operative engagement with said mould in a manner to bring said duct connector into engagement with said external opening,

d) filling said casting cavity or cavities by operating said pressurizing means,

e) bringing said supply unit out of said operative engagement, and

f) when solidified, removing said article or articles from said mould,

characterized by

g) in step a providing a casting mould having around said external opening a sealing element of heat-resistant and heat-insulating material capable of forming a liquid-tight seal between said mould around said external opening and said duct connector.

2. Method according to claim 1, characterized by the use of a sealing element of deformable material and by carrying out step c in claim 1 in a manner to deform said sealing element into sealing engagement.

3. Method according to claim 2, characterized by the use of a sealing element of elastically deformable material.

4. Method according to claim 2 or 3, characterized by the use of a sealing element made of fibres of refractory material.

5. Method according to claim 4, characterized by the

use of a sealing element made in all essentials from fibres of ceramic material, e.g. aluminium oxide or silicon oxide, or so-called ISO tube consisting of 37% aluminium oxide, 58% silicon oxide, 2% iron oxide and the remainder sodium and potassium oxides

6. Method according to any one or any of the claims 1-5, characterized by

a) the use of a mould, in which a recess is formed in the same side as said external opening, from which recess a closure member may be inserted in said filling duct so as to close the latter against flow of molten metal there-through, and

b) between steps d and e in claim 1 inserting said closure member into said filling duct so as to close the latter against flow of metal there-through.

7. Method according to claim 6, characterized by the use of a closure member made of compacted core sand.

8. Method according to claim 6, characterized by the use of a closure member made of substantially the same material as that used for casting said article or articles.

9. Method according to any one or any of the claim 6-8, characterized by the use of a mould, in which said closure member is adapted to move in a direction substantially at right angles to the direction, in which said filling ducts extend at the location, in which the closure member is inserted into said duct to close the latter.

10. Method according to any one or any of the claims 6-9, characterized by the use of a mould, in which the closure member is inserted in a position of readiness close to said filling duct before positioning the mould preparatory to step c of claim 1.

11. Method according to any one or any of the claims 6-9, characterized by the use of a mould not being provided with a closure member until after step d of claim 1, after which step a closure member is made to penetrate said mould from said recess (claim 6, item a) to and into said filling duct so as to close the latter.

12. Method according to any one or any of the claims 6-11, characterized by the use of a closure member adapted to be cooled, such as by water.

13. Apparatus for carrying out the method according to any one or any of the claims 1-12 and of the kind

comprising

- a) a conveyor means for bringing moulds (1) into and out of a filling station, and
- b) mould-filling means (3,4) placed in said filling station and adapted to be brought into temporary engagement with said mould (1) in succession in a manner establishing flow connection to filling ducts (2) in said moulds (1), characterized by
- c) said mould-filling means (3,4) being provided with a mouthpiece (3) capable of co-operating sealingly with a resilient sealing element (8) surrounding the inlet end of said filling duct (2) on each mould (1).

14. Apparatus for carrying out the method according to any one or any of the claims 1-12, and of the kind comprising

- a) a conveyor means for bringing moulds (1) into and out of a filling station, and
- b) mould-filling means (3,4) placed in said filling station and adapted to be brought into temporary engagement with said mould (1) in succession in a manner establishing flow connection to filling ducts (2) in said moulds (1), characterized by
- c) in said filling station having means (7) for pushing a closure member (5;9) already present in said mould (1) into a position, in which it closes said filling duct (2).

15. Apparatus for carrying out the method according to any one or any of the claims 1-12, and of the kind comprising

- a) a conveyor means for bringing moulds (1) into and out of a filling station, and
- b) mould-filling means (3,4) placed in said filling station and adapted to be brought into temporary engagement with said mould (1) in succession in a manner establishing flow connection to filling ducts (2) in said moulds (1), characterized by
- c) in said filling station having means (7,12) for temporarily gripping a closure member (11) and make same penetrate said mould (1) from said recess (6) to and into said filling duct (2) so as to close the latter.

16. Apparatus for carrying out the method according to any one or any of the claims 1-12, and of the kind comprising

- a) a conveyor means for bringing moulds (1) into and out of a filling station, and
- b) mould-filling means (3,4) placed in said fill-

ing station and adapted to be brought into temporary engagement with said mould (1) in succession in a manner establishing flow connection to filling ducts (2) in said moulds (1), characterized by

c) in said filling station having a closure member adapted to be moved into and out of closing relation to said filling conduit and to be cooled, such as by water.

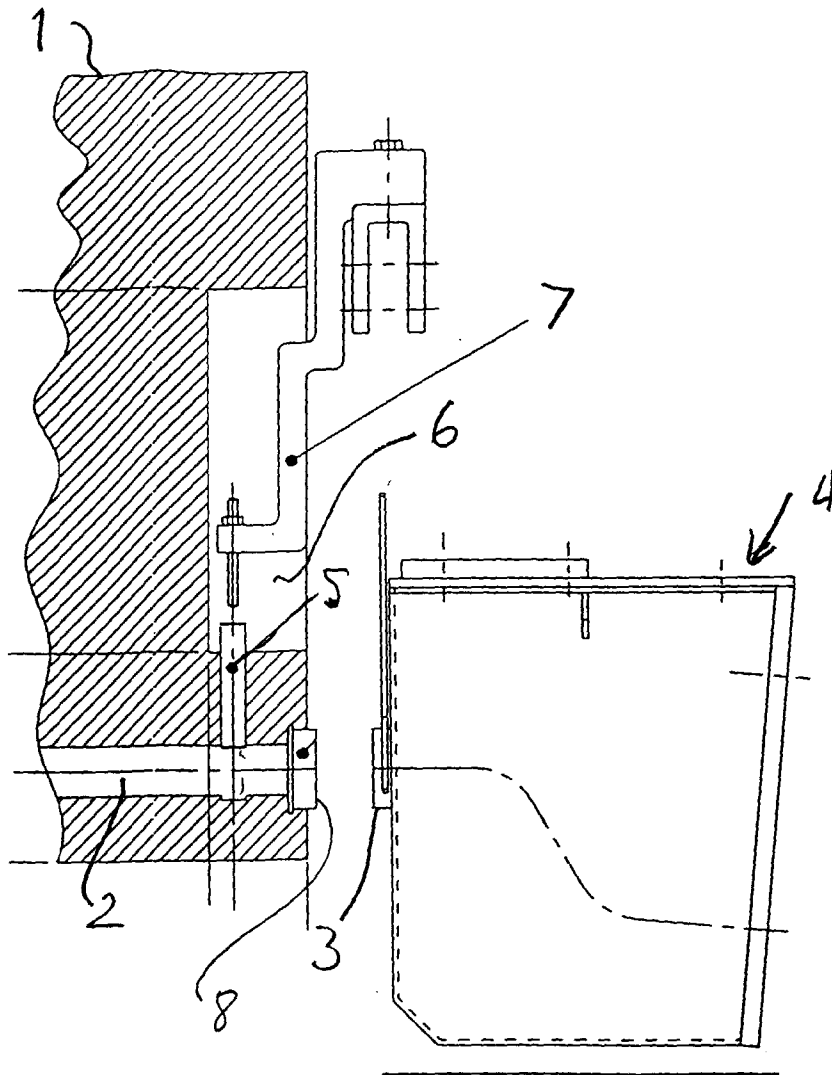


Fig. 1

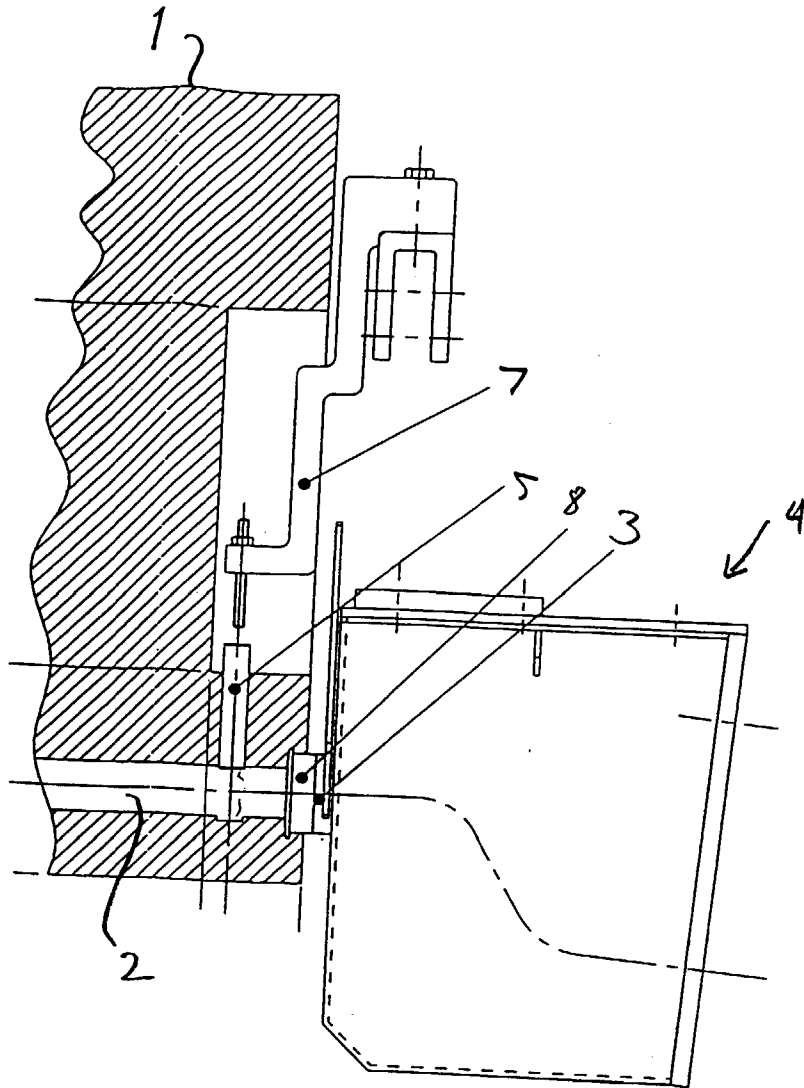


Fig 2

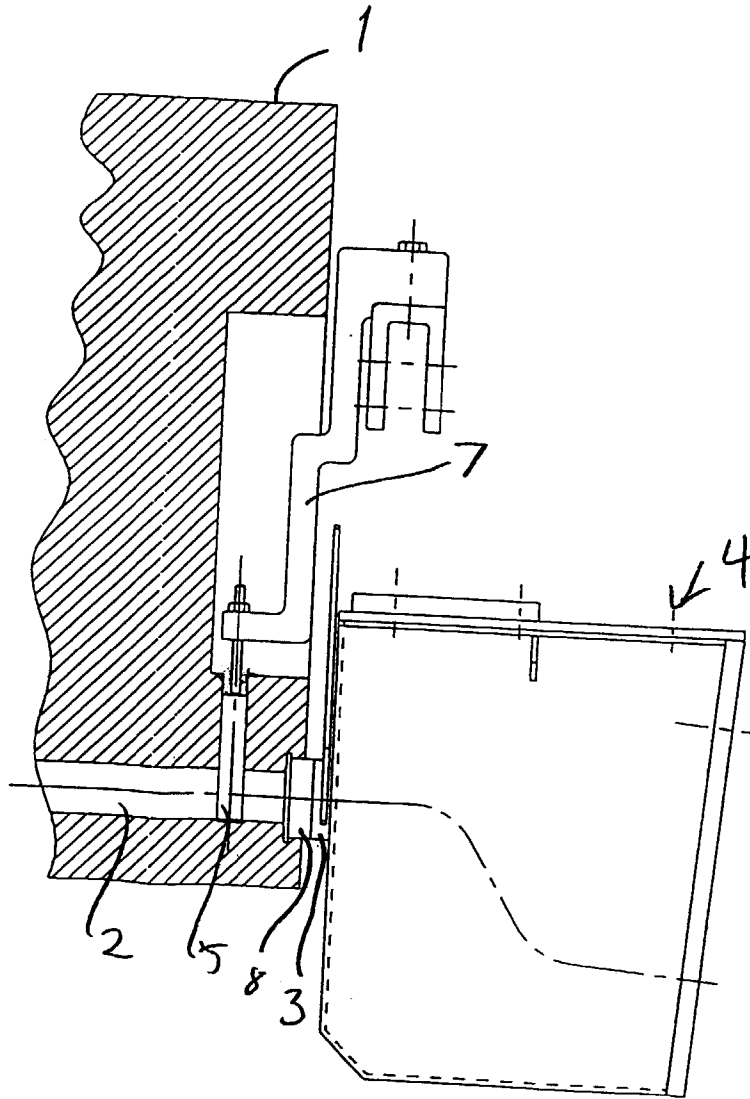


Fig. 3

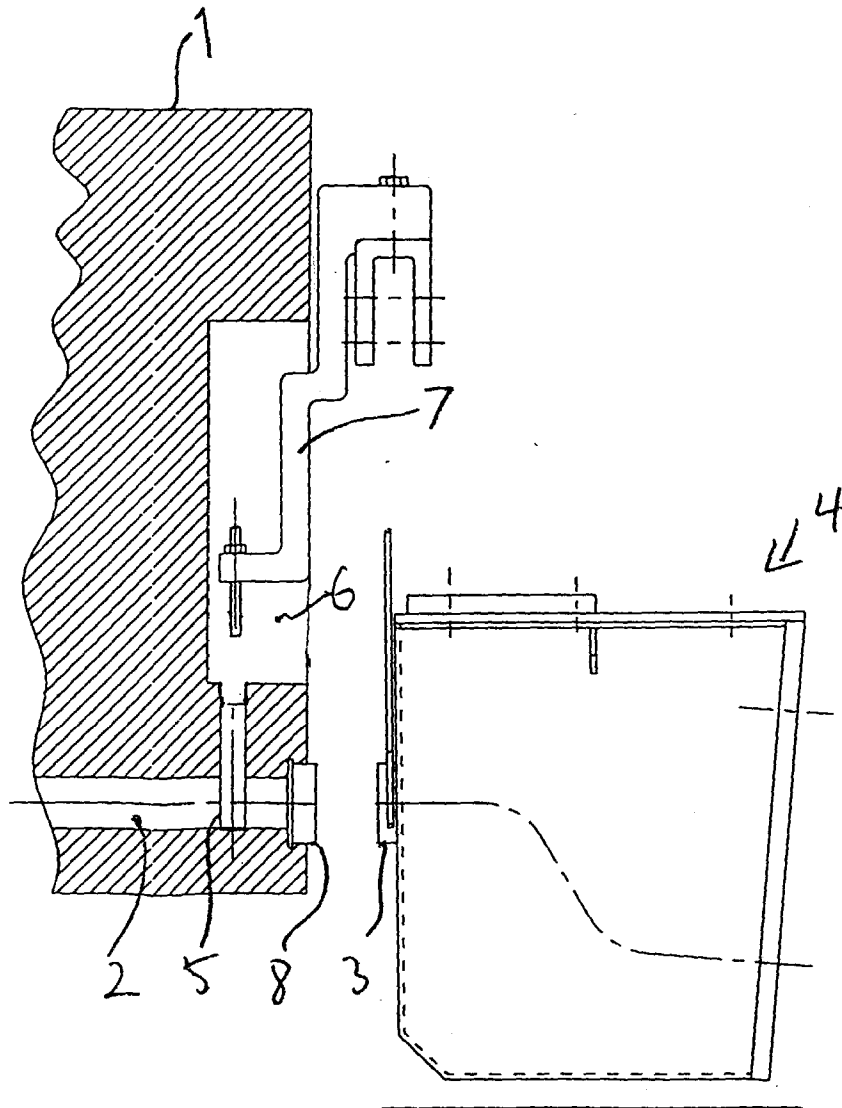


Fig. 4

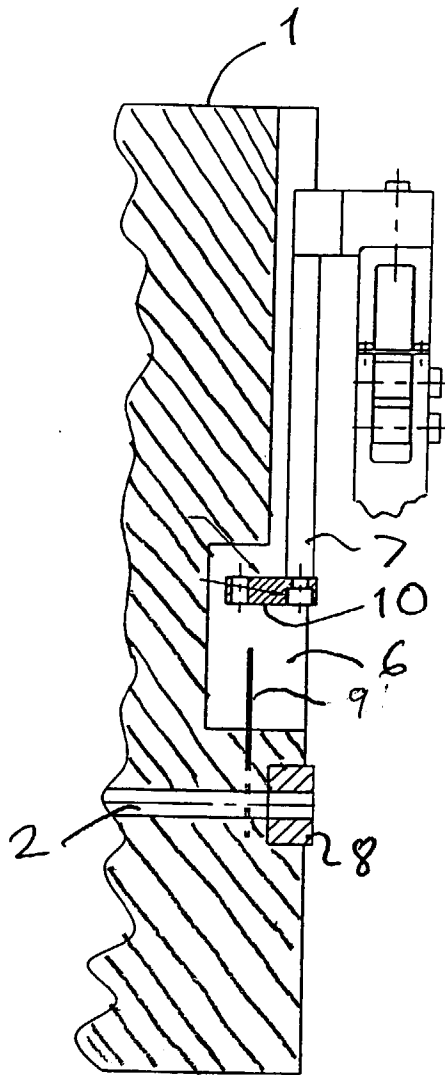


Fig. 5

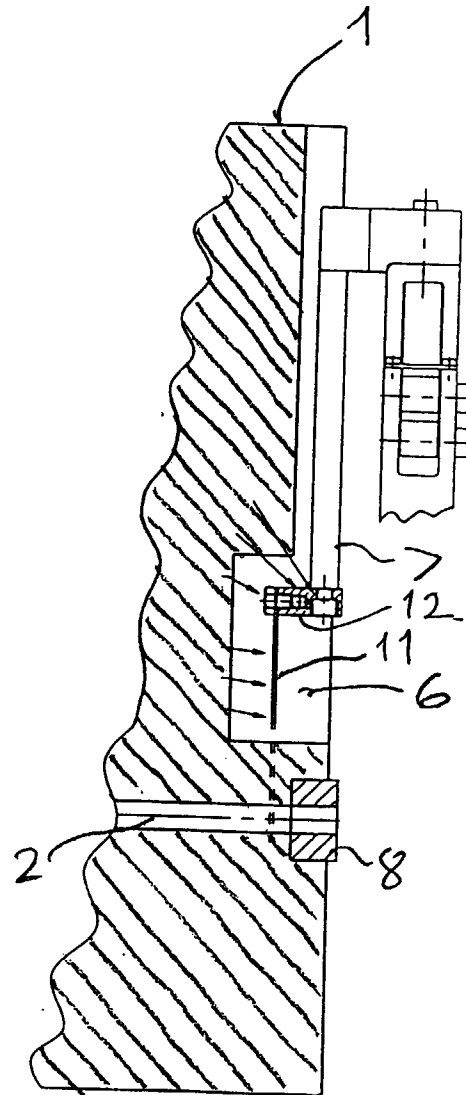


Fig. 6



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Application Number
EP 98 10 7607

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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24 September 1998	Examiner WOUDENBERG, S
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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