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(54) **METHOD AND DEVICE FOR UPHILL
CASTING, COMPRISING A CHILL OR CORE
STACKINGS WITH AN OPEN POURING
GATE**

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(57) **ABSTRACT**

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A method for uphill/low-pressure casting, especially of light metal alloys, with a casting table having a flow-through opening, with a casting furnace lying below the casting table with a riser pipe forming an upwardly open mouth opening, with a mould having a base plate which has a downwardly open pouring-in opening; the mouth opening is positioned against the flow-through opening in a sealing fashion from below, the mould is brought with its pouring-in opening over the flow-through opening, melt is conveyed from the casting furnace via the riser pipe into the mould until it is filled, the mould is displaced horizontally on the casting furnace with open melt-filled communication between the casting furnace and the mould until the pouring-in opening is closed by the casting table below and the flow-through opening is closed by the base plate above, the melt is allowed to drop in the riser pipe as far as below the mouth opening.

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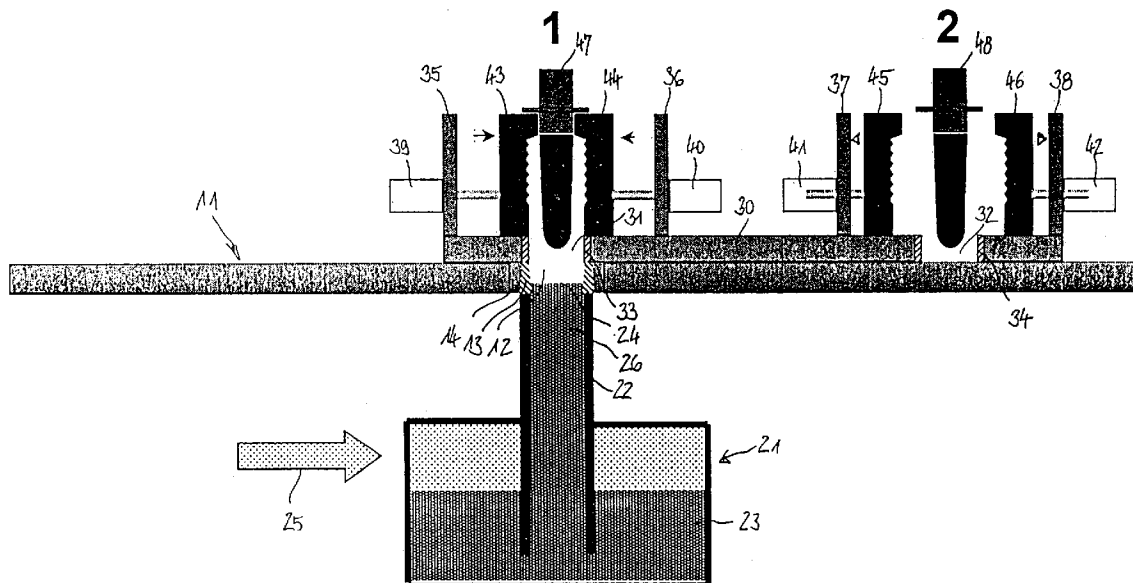


FIG. 1

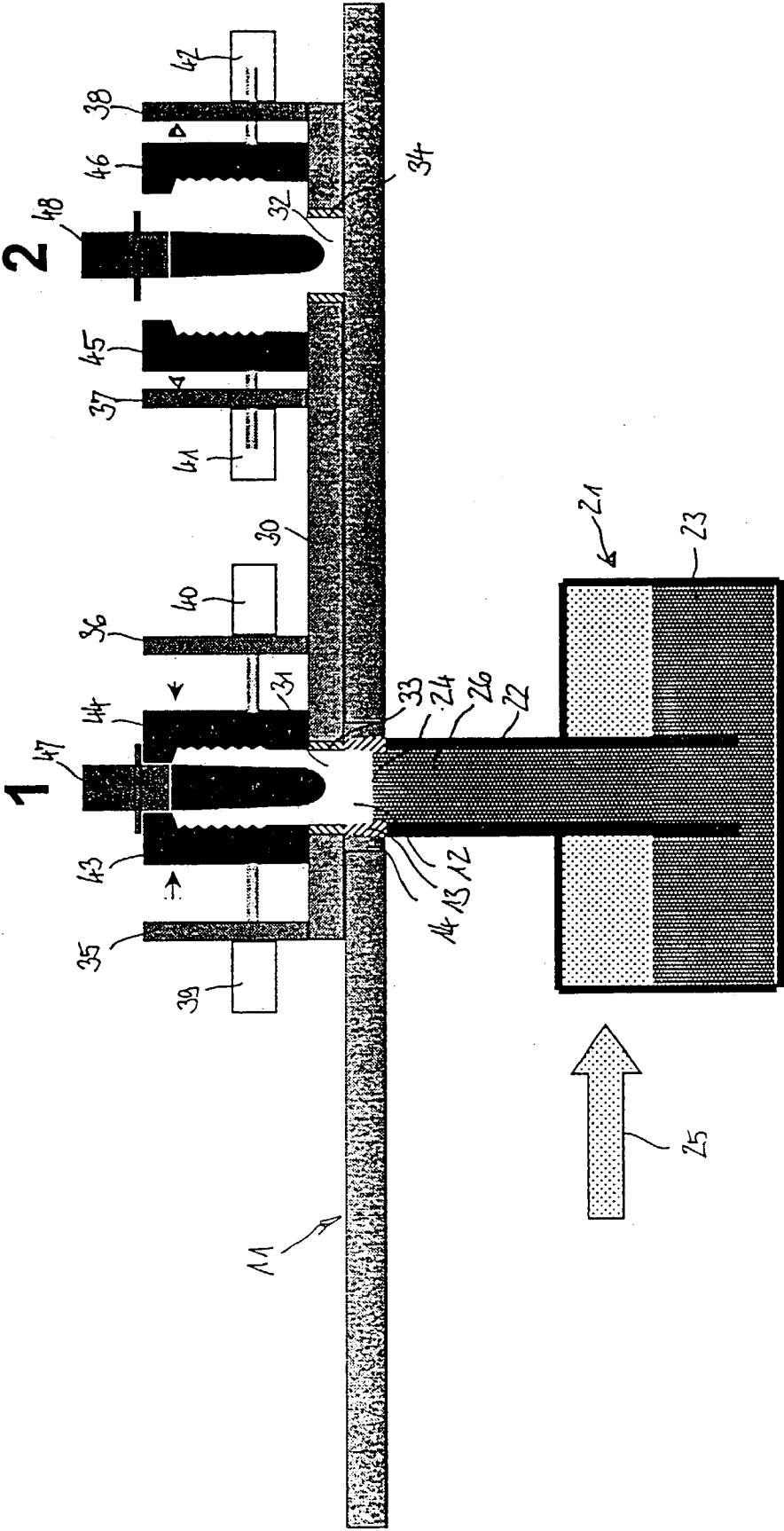


FIG. 2

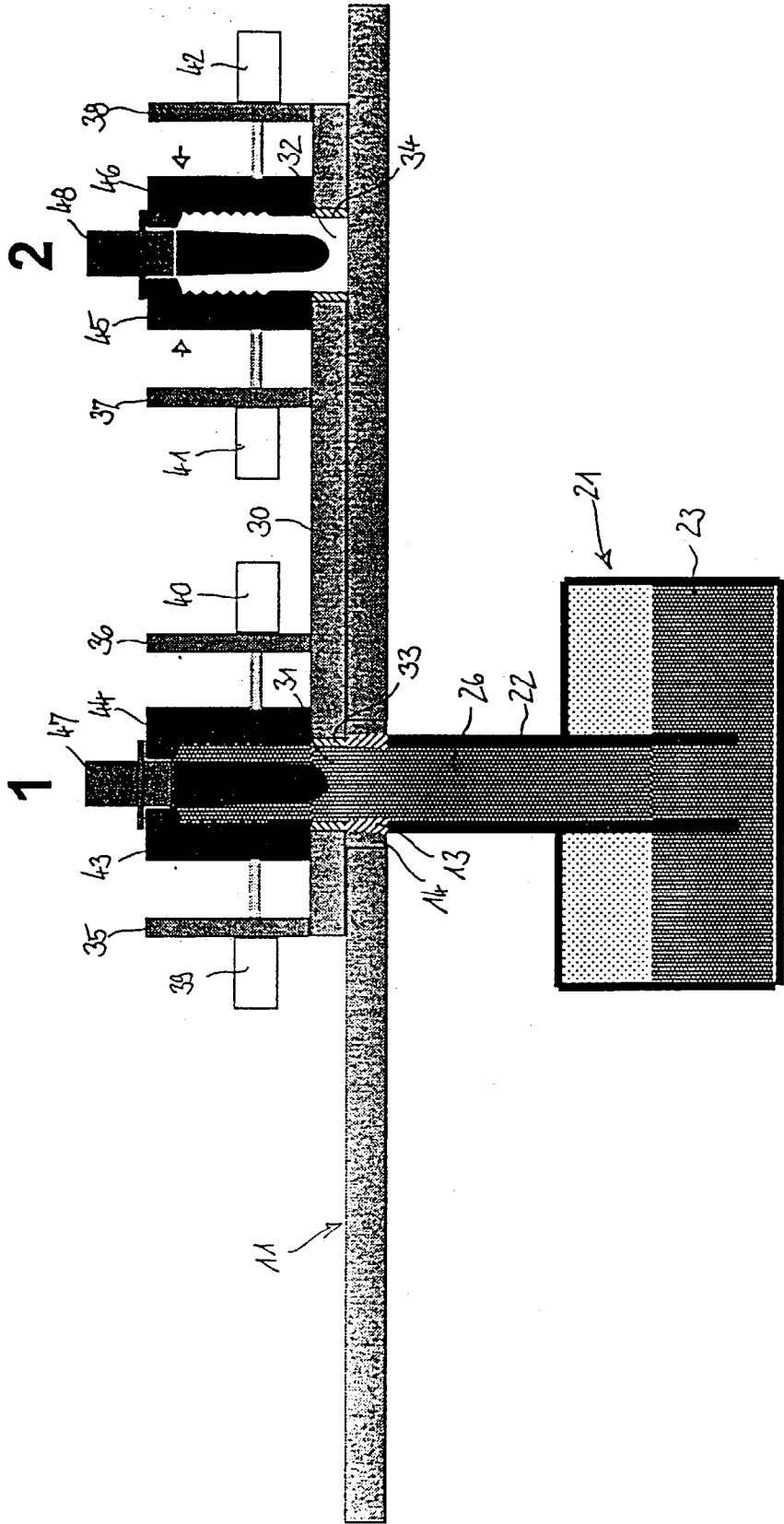


FIG. 3

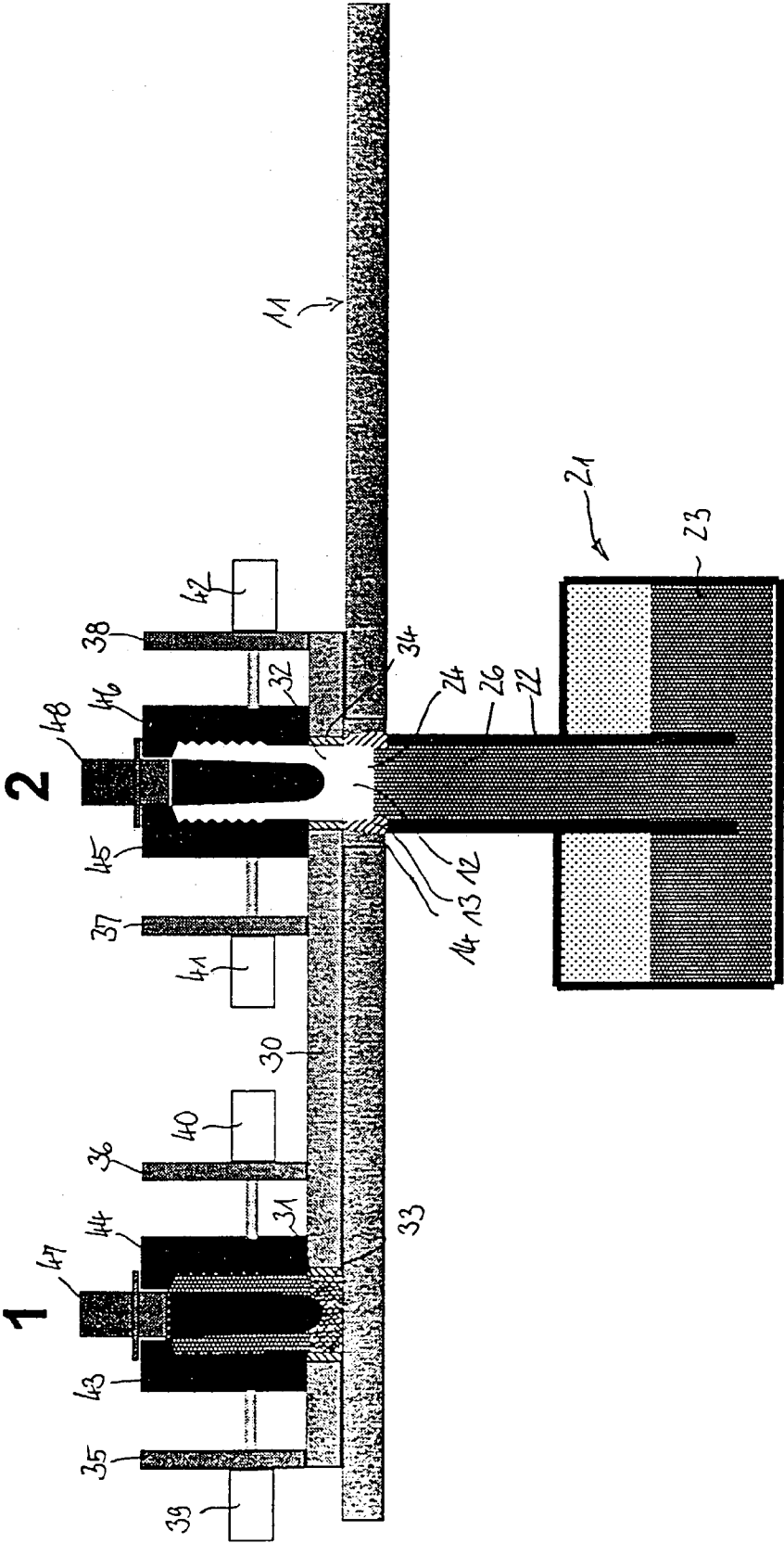


FIG. 4

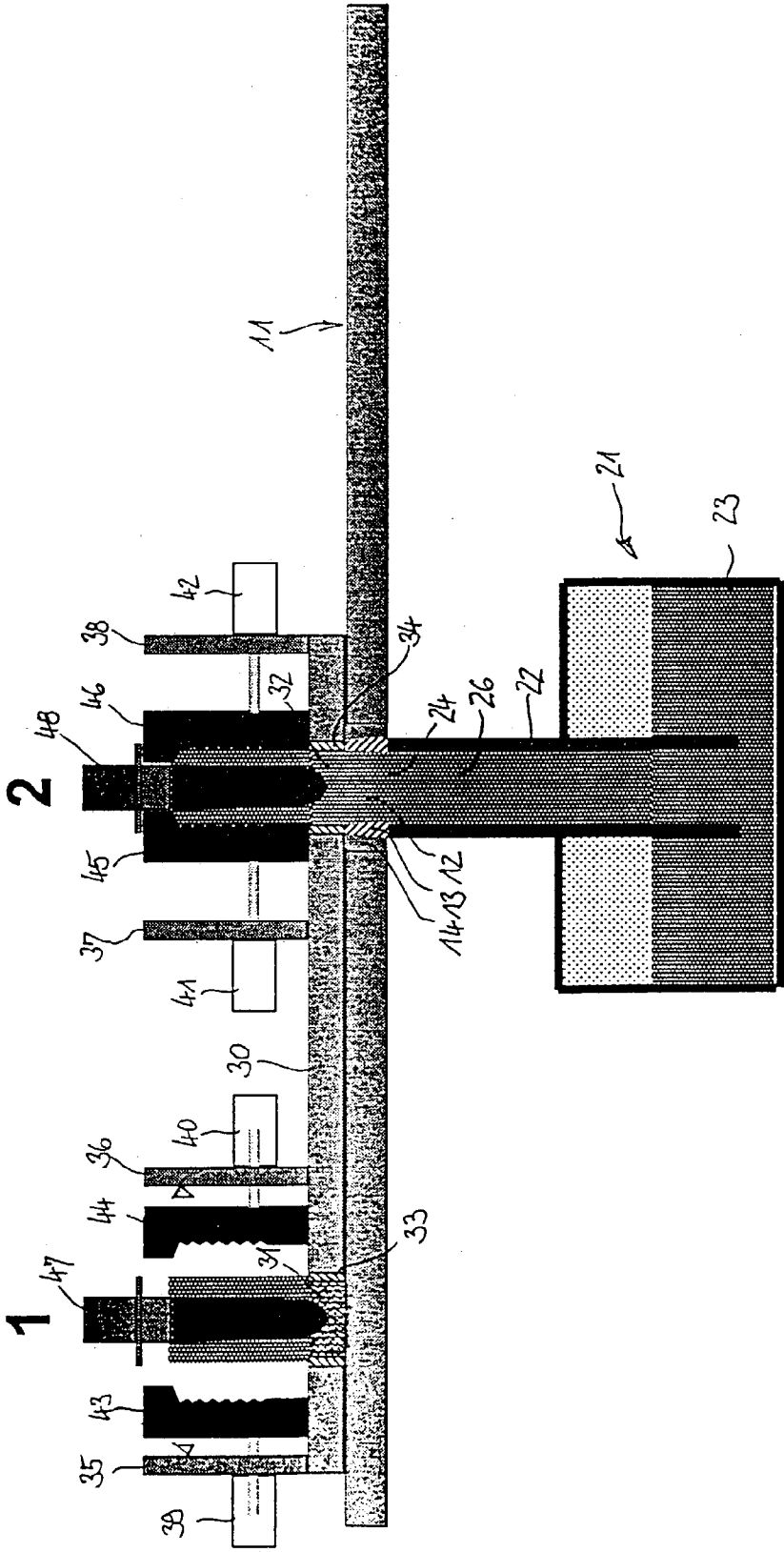


FIG. 5

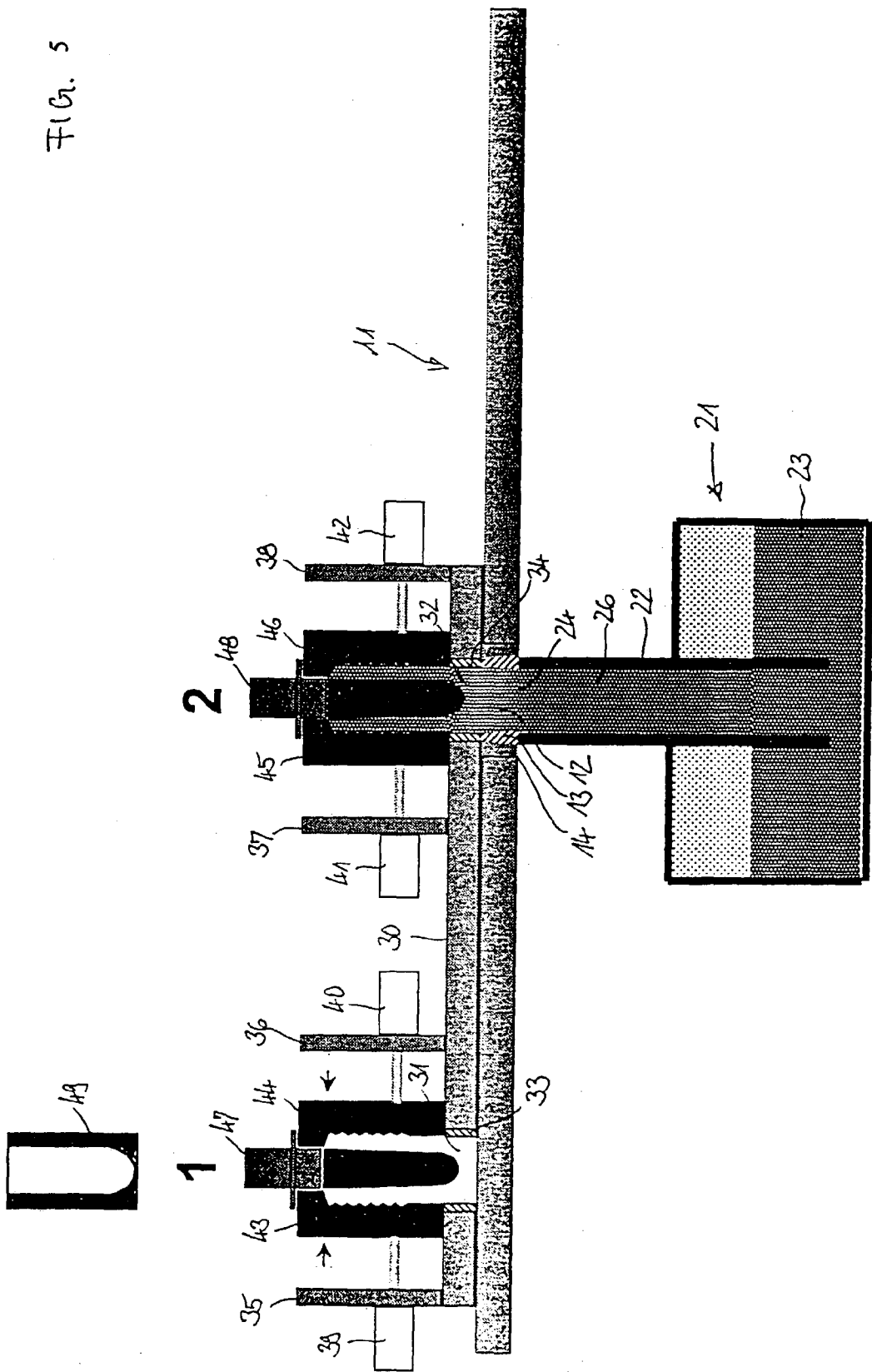


FIG. 6

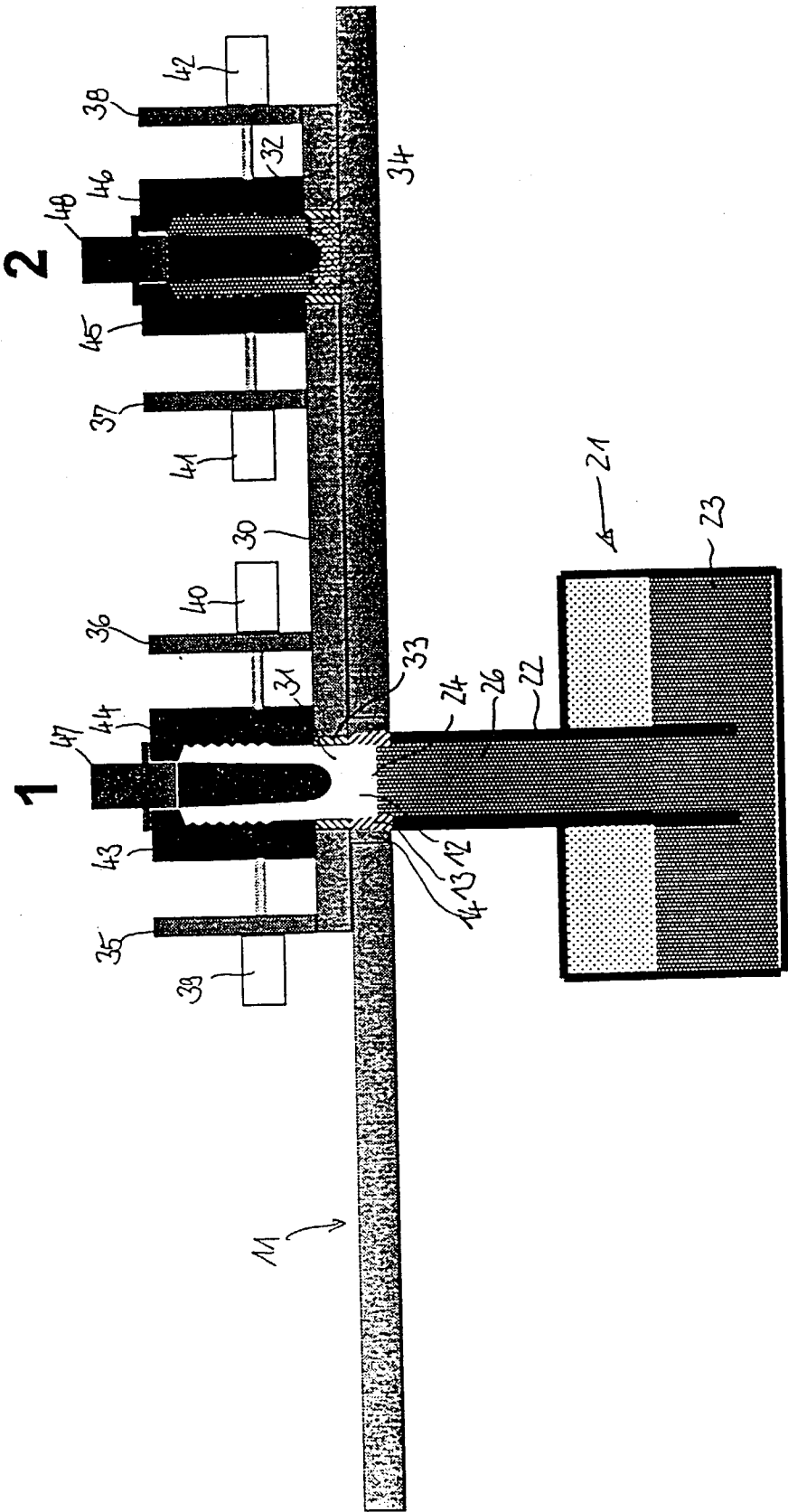
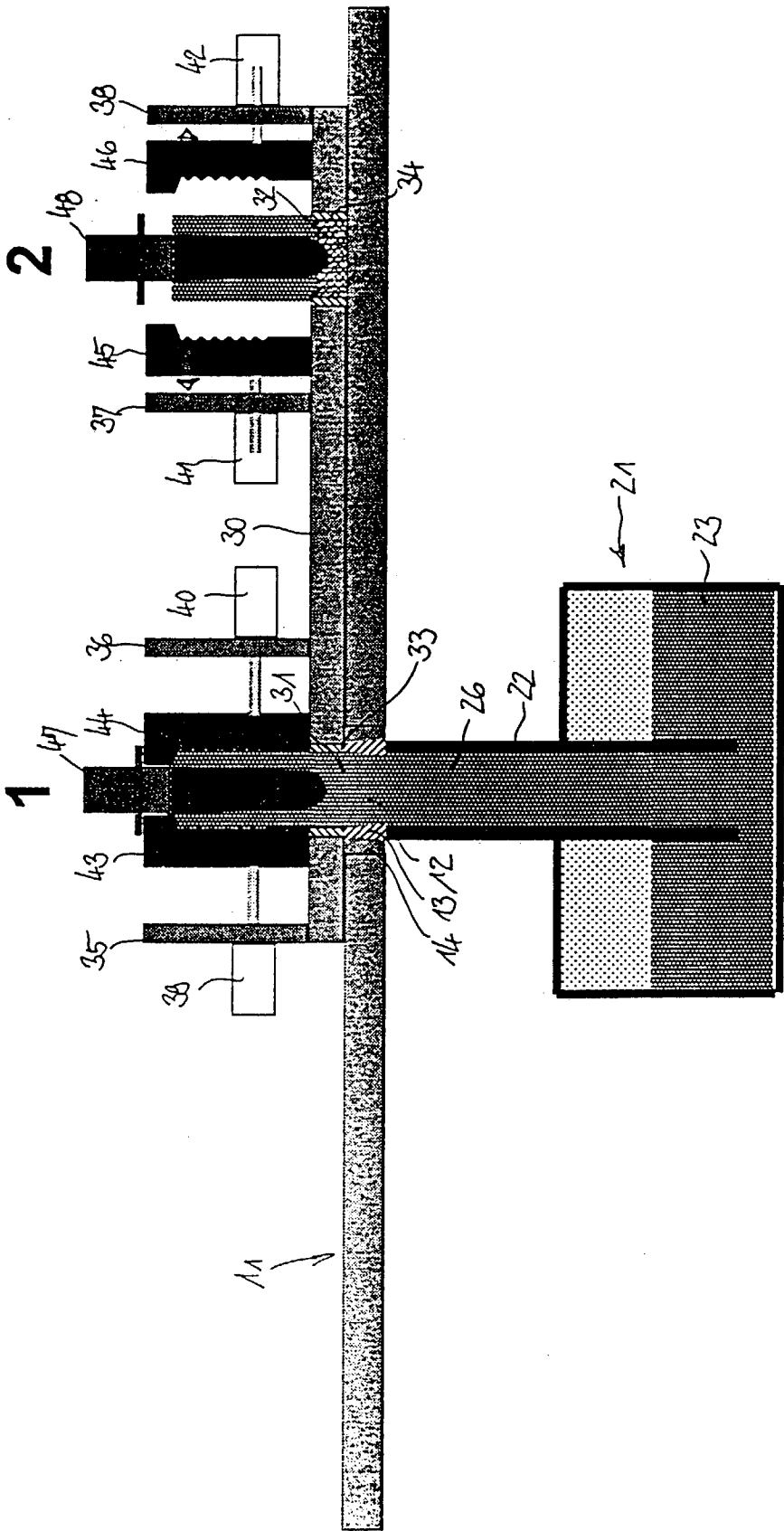


FIG. 7



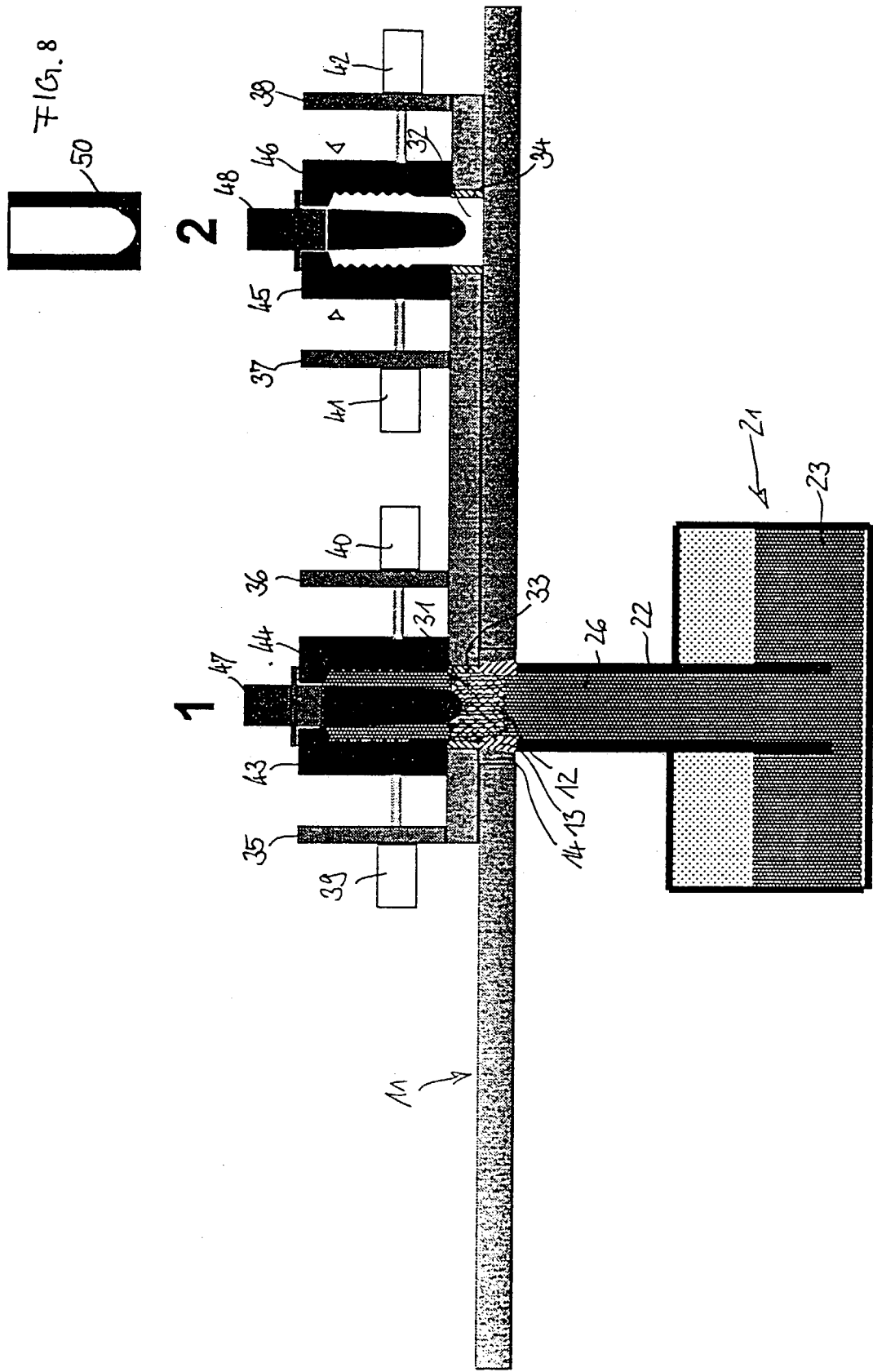
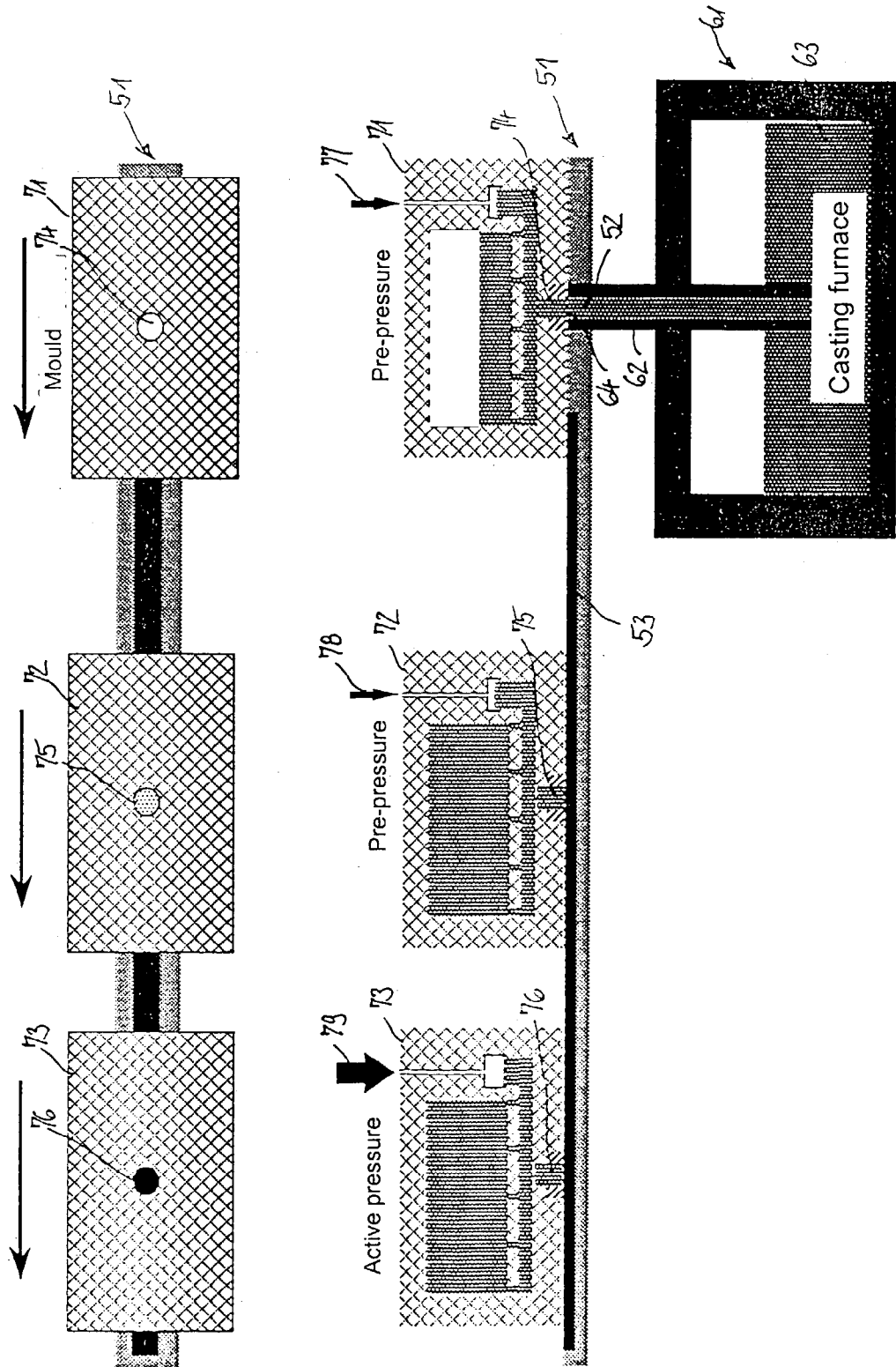
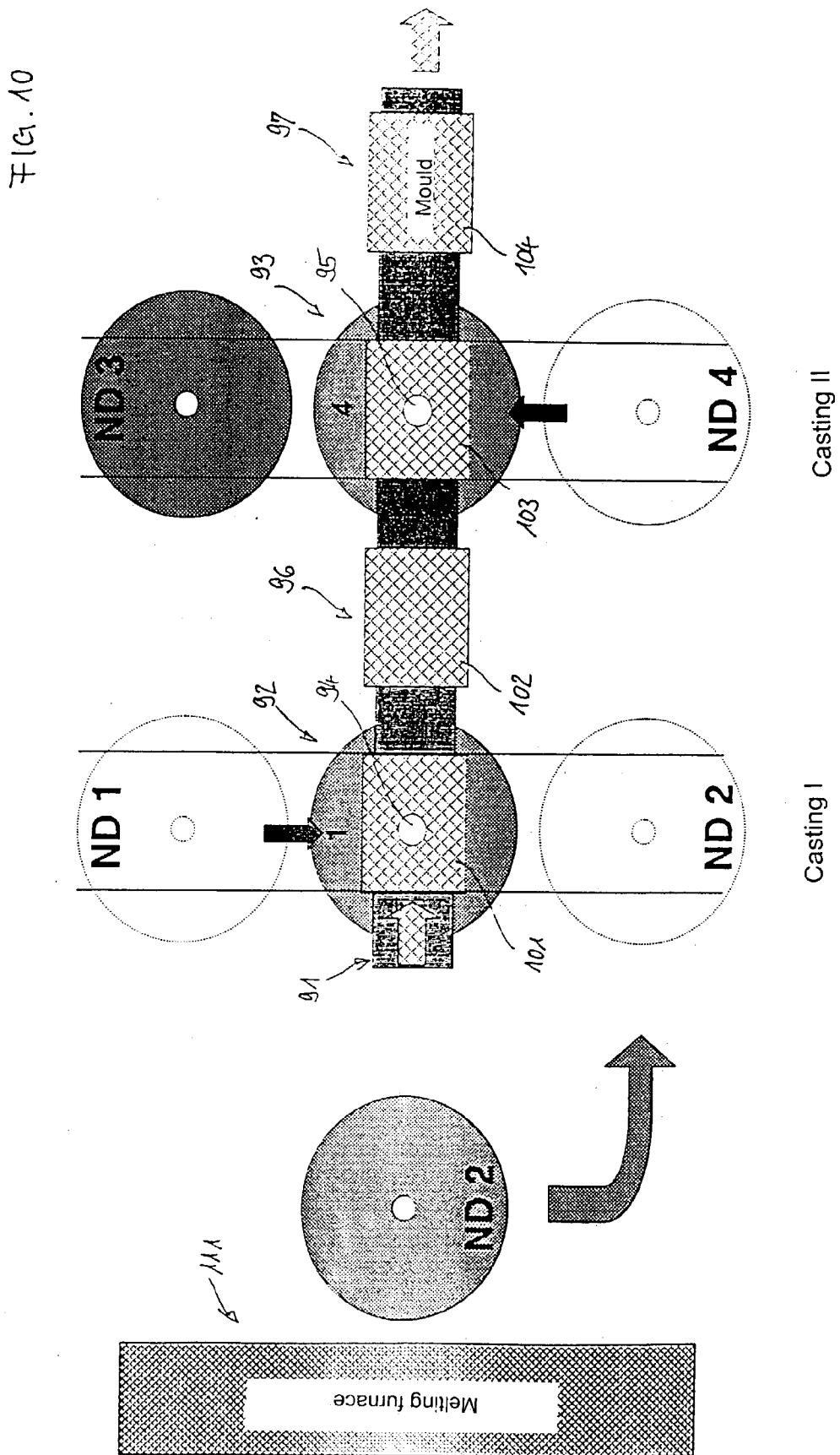


FIG. 9





**METHOD AND DEVICE FOR UPHILL CASTING,
COMPRISING A CHILL OR CORE STACKINGS
WITH AN OPEN POURING GATE**

[0001] The invention relates to a method and an apparatus for uphill casting, especially for the casting of light metal alloys. Compared with gravity casting, uphill casting has the substantial advantage of a smooth controlled casting process. By this means the entrance of air bubbles and oxidation skin which is associated with any turbulence of the melt during casting is avoided. When using core packages as moulds, the separation and entrainment of moulding material in the gate and in the runner can be avoided which otherwise leads to a deterioration in the quality of the castings.

[0002] A disadvantage with uphill casting is that in general it is necessary to wait for the solidification process of up to 15 minutes duration before the mould just filled can be removed and the next mould can be brought over the casting furnace. In order to rectify this disadvantage, it has already been proposed that moulds should be closed directly after the low-pressure casting in the pouring-in opening and removed immediately from the riser pipe.

[0003] DE 198 21 419 A1 and DE 198 07 623 A1 disclose methods of the specified type in which boxless mould bodies (core packages) or moulding boxes each having a downwardly open pouring-in opening are pushed over the mouth of the riser pipe of a casting furnace which lies beneath a conveyer for these mould bodies (core packages) or moulding boxes. After the uphill casting, in each case a closure at the upper end of the riser pipe is first closed before the mould body (core package) or the moulding box is transported further and replaced by a following one.

[0004] The object of the invention is to improve a method and an apparatus of said type in order to increase the reliability. The solution for this according to a first approach consists in a method for uphill/low-pressure casting, especially of light metal alloys, with a casting table having a flow-through opening, with a casting furnace lying below the casting table with a riser pipe forming an upwardly open mouth opening, with a mould having a base plate which has a downwardly open pouring-in opening; the mouth opening is positioned against the flow-through opening in a sealing fashion from below, the mould is brought with its pouring-in opening over the flow-through opening, melt is conveyed from the casting furnace via the riser pipe into the mould until it is filled, the mould is displaced horizontally on the casting furnace with open melt-filled communication between the casting furnace and the mould until the pouring-in opening is closed by the casting table below and the flow-through opening is closed by the base plate above, and the melt is allowed to drop in the riser pipe as far as below the mouth opening.

[0005] According to a second approach a method for uphill/low-pressure casting, especially of light metal alloys, is proposed with a casting table having a flow-through opening, with a casting furnace lying below the casting table with a riser pipe forming an upwardly open mouth opening, with a mould having a base plate which has a downwardly open pouring-in opening, the mouth opening is positioned against the flow-through opening in a sealing fashion from below, the mould is brought with its pouring-in opening over the flow-through opening, melt is conveyed from the casting

furnace via the riser pipe into the mould until it is filled, the mould is left in this position until the casting has solidified, the melt is allowed to drop in the riser pipe as far as below the mouth opening, the mould is displaced horizontally on the casting table with its flow-through opening emptied of melt, until the pouring-in opening is closed by the casting table below and the mouth opening is closed by the base plate above.

[0006] An apparatus suitable for implementing these methods comprises a casting table with a flow-through opening, a casting furnace lying below the casting table with a riser pipe, forming an upwardly open mouth opening, a mould with a base plate having a downwardly open pouring-in opening; the mouth opening is positioned against the flow-through opening in a sealing fashion from below, the mould is positioned with its pouring-in opening against the flow-through opening from above, means for horizontal displacement of the mould on the casting table and means for simultaneously maintaining a positive pre-pressure of the mould base plate towards the casting table.

[0007] With the means specified hereby it is possible to completely dispense with a slide valve closure, rather in each case for casting/mould filling, the sprue of the mould and the flow-through opening in the casting table or the mouth opening of the riser pipe are brought together so that they connect and melt is conveyed into the mould until it is filled. Then, according to the first attempt, directly after the casting/mould filling, the mould with still-liquid melt in the downwardly open sprue is displaced with respect to the flow-through opening of the casting table or the mouth of the riser pipe on the casting table such that the previously uniform melt column in the riser pipe and in the sprue is directly and exclusively sheared by the displacement of the sprue of the mould with respect to the flow-through opening in the casting table or the mouth opening of the riser pipe. Acting as closure means here are the upper side of the casting table which can be reinforced with an inserted ceramic plate or rail, and the underside of the base plate of the mould which lie flat one on top of the other. According to the second attempt, however, after casting/mould filling, solidification of the casting is first awaited until only the sprue still contains liquid melt, which is then allowed to drop in the riser pipe by lowering the pressure before the emptied sprue is displaced with respect to the flow-through opening of the casting table or the mouth of the riser pipe on the casting table such that next mould can be transferred.

[0008] Whereas in the first method an active pressure application from above is suitable, in the second method the pressure is produced via the melt in the riser pipe.

[0009] In order that floating of the mould is avoided during casting, said surfaces can be pressed onto one another with contact pressure. This is possible by means of horizontal rails or sets of rollers secured elastically to the casting table, which act on fixed horizontal edges or rails of the mould to press the mould on the casting table during displacement or by means of horizontal rails or sets of rollers arranged elastically on the mould which interact with horizontal edges or rails arranged fixed on the casting table to press the mould on the casting table. Suitable pairs of materials for these surfaces are to be selected according to the type of casting metal.

[0010] The moulds can be conveyed into the casting position in various ways, wherein either the mould is in each

case placed from above on the casting table so that the flow-through opening or the mouth opening is in open communication with the pouring-in opening or wherein alternatively, the mould is in each case transferred horizontally over the casting table so that the flow-through opening or the mouth opening is in open communication with the pouring-in opening.

[0011] After casting and displacement, the mould can be held in a position in which the casting table under the pouring-in opening of the mould is cooled. In addition to this, the mould with the pouring-in opening can be moved during displacement over the cooled section of the casting table. By means of these two measures rapid solidification of the melt is in the sprue achieved after which the mould can be lifted from the casting table or the corresponding conveying means with solidification not yet completed.

[0012] For rapidly solidifying small castings it is favourable to arrange two moulds in a tandem arrangement on the base plate with two pouring-in openings. For larger, more slowly solidifying castings it is possible to provide a carousel arrangement in which a plurality of moulds are mounted on a common base plate with a ring of pouring-in openings.

[0013] Further advantageous embodiments of the method and suitable apparatus are deduced from the dependent claims to which reference is hereby made.

[0014] Insofar as uphill casting/low-pressure casting according to the invention is discussed heretofore, this initially relates to methods and apparatus wherein a controllable gas pressure is applied to the melt level in the sealed casting furnace, which makes the melt in the riser pipe rise or fall. Also included however are other methods and apparatus which can controllably convey the melt in the riser pipe, e.g. magnetic pumping arrangements at the lower end of the riser pipe in the casting furnace.

[0015] Preferred embodiments of the invention are explained in the following with reference to the drawings wherein:

[0016] FIGS. 1 to 8 show an apparatus according to the invention with a casting table, casting furnace and two moulds, with the individual phases:

[0017] FIG. 1 Build-up of a pre-pressure in the casting furnace; mould 1 in casting position;

[0018] mould 2 is opened;

[0019] FIG. 2 Casting of mould 1; mould 2 is closed;

[0020] FIG. 3 Mould 2 in casting position; mould 1 in solidification position;

[0021] FIG. 4 Casting of mould 2; mould 1 is opened;

[0022] FIG. 5 Casting of mould 2; demoulding of mould 1;

[0023] FIG. 6 Mould 1 in casting position; mould 2 in solidification position;

[0024] FIG. 7 Casting of mould 1; mould 2 is opened;

[0025] FIG. 8 Casting of mould 1; demoulding of mould 2;

[0026] FIG. 9A casting installation according to the invention with a plurality of moulds

[0027] a) viewed from the top

[0028] b) viewed from the side;

[0029] FIG. 10 shows a casting installation according to the invention with a smelting furnace, two casting stations and four casting furnaces.

[0030] FIGS. 1 to 8 are first described jointly insofar as the details agree. A horizontal casting table 11 has a flow-through opening 12 which is lined with an outer lining 13 and an inner lining 14. Below the casting table 11 there is a casting furnace 21 having a riser pipe 22 which is inserted in the casting furnace in a sealing fashion and at the bottom is immersed in the melt 23 contained therein and at the top has a mouth opening 24. An arrow 25 indicates that compressed air can be applied to the casting furnace 21 so that a melt column 26 rises in the riser pipe 22. On the casting table are located two moulds designated by the numbers "1" and "2" which have a common base plate 30. This base plate 30 has pouring-in openings 31, 32 which can be brought to cover the flow-through opening 12 alternatively by transverse displacement of the base plate 30. The pouring-in openings 31, 32 are each provided with linings 33, 34. The moulds 1, 2 mounted on the base plate 30 each have holders 35, 36, 37, 38 with adjusting cylinders 39, 40, 41, 42 which act on mould halves 43, 44, 45, 46. Midway between the mould halves there is a central mandrel 47, 48, respectively, whose suspension is not shown in detail. Together with the closed mould halves this mandrel 47, 48 respectively forms a hollow cylinder with slightly conical inner shape and external ribbing. The casting to be produced using the moulds 1, 2 shown can especially be a light-metal cylinder liner for combustion engines. Changes in volume and shape of the casting during solidification are neglected in all representations.

[0031] In the embodiment shown the riser pipe 22 adjoins the casting table 11 at the bottom in the area of the flow-through opening 12 in a sealing fashion. For this purpose the casting furnace 21 can be adjustable in height from below towards the casting table 11 with the riser pipe 22 suspended elastically in the casting furnace 21. The respective pouring-in opening 31, 32 in the base plate 30 in each case lies on the upper outlet of the flow-through opening 12 in a sealing fashion.

[0032] Lowering of the casting furnace is especially advantageous to exchange an empty casting furnace for a filled casting furnace.

[0033] In FIG. 1 a pre-pressure is built up in the casting furnace which makes the melt column 26 rise as far as slightly above the mouth opening 24. The mould 1 is allocated to the casting furnace 21 by displacing the base plate 30 to the right into a first casting position. The mould 1 is closed, as indicated by arrows and ready for casting. The mould 2 is opened, as indicated by arrows and demoulded.

[0034] In FIG. 2 the pre-pressure in the casting furnace 21 is increased so that the melt column 26 has risen and the mould 1 is completely filled. The casting process as such is already ended here. The mould 2 is now shown closed, as indicated by the arrows.

[0035] In FIG. 3 the base plate 30 is displaced to the left into a second casting position wherein the melt column in the mould 1 has been sheared between the casting table 11 and the base plate 30 and a finished casting has formed in mould 1. Mould 2 is allocated to the casting furnace 21 by displacing the base plate 30 to the left into a second casting position and is in the closed position ready for casting. Immediately after shearing at the mould 1, the melt column 26 is initially made to drop again in the riser pipe 22 as far as slightly above the mouth opening 24. In FIG. 4 mould 1 is opened as indicated by arrows, wherein the finished casting is held still on the central mandrel 47. In mould 2 the melt column has risen as a result of a pressure increase in the casting furnace so that the mould is completely filled. The actual casting process has already ended here.

[0036] In FIG. 5 the mould 1 is re-closed wherein the finished casting 49 is completely demoulded. Mould 2 is shown as in FIG. 4 during the casting process.

[0037] In FIG. 6 the base plate 30 has been displaced to the right again into the first casting position so that the mould 1 is again allocated to the casting furnace 21. The melt column in mould 2 has thereby been sheared so that a finished casting can be identified in the mould. Mould 2 is still closed to wait for the solidification process. Mould 1 is prepared for the next casting process wherein the melt column 26 ends slightly above the mouth opening 24 in the riser pipe 22.

[0038] In FIG. 7 mould 2 is opened as shown by arrows wherein a finished casting still sits on the central pin 48. In mould 1 the melt column 26 has risen as a result of increasing the pre-pressure in the casting furnace 21 and is thus filled, so that the actual casting process is completed here.

[0039] In FIG. 8 the casting 50 is removed from mould 2 and the mould is re-closed for the next casting process. Mould 1 is in the same position as in FIG. 7 and by displacing the mould with the base plate the melt column 26 is sheared in the next moment between the base plate 30 and the casting table 11.

[0040] FIG. 9 shows a casting table 51 with a flow-through opening 52 and cooling positions 53, 54 indicated by arrows. Below the casting table is a casting furnace 61 with a riser pipe 62 filled with melt. The mouth opening 64 of the riser pipe 62 adjoins the flow-through opening 52 from below. Three individual moulds 71, 72, 73 are placed on the casting table 51. The mould 71 has its sprue 74 over the casting furnace 61 and is directly engaged in the casting process. The mould 72 has already been displaced left with respect to the flow-through opening 52 wherein the melt column has been sheared and is located in a position where the sprue 75, 76 in the mould 72, 73 lies above a cooling region 53 of the casting table. The mould 73 is displaced further and is located in a position in which the sprue 75, 76 in the mould 72, 73 lies over a cooling region 53, 54 of the casting table wherein solidification has taken place in the sprue 76. From here the mould can be displaced further or lifted directly from the casting table. Arrows 77, 78 indicate the effect of a pre-pressure which prevents escape of the melt during filling of the mould. An arrow 79 indicates the effect of a higher active pressure for feeding.

[0041] FIG. 10 shows a top view of an apparatus according to the invention wherein a casting table 91 is only

constructed as a narrow path. The casting table here has two casting stations 92, 93 with flow-through openings 94, 95 and two solidification stations 96, 97. Moulds 101, 102 can each be placed on the casting stations from above for casting wherein, after casting, they can be displaced and then take on the positions of the moulds 103, 104 shown here during solidification. Casting furnaces ND1, ND2, ND3, ND4 can be brought into the vicinity of a melting furnace 111 and from there can be moved into a holding position before the casting stations 92, 93, into a casting position and into a holding position behind the casting stations 92, 93 so that empty casting furnaces can each be refilled at the melting furnace 111 and after a casting furnace has been emptied, a filled casting furnace can immediately be refilled from a waiting position into the casting position under the casting table. At least one of the casting stations 92, 93 of the casting table should always be ready for casting so that there is no interruption of production during changing a casting furnace. In the normal case, the two casting stations can also be run in parallel to increase the production rate.

1. A method for uphill/low-pressure casting, especially of light metal alloys, with a casting table having a flow-through opening,

with a casting furnace lying below the casting table with a riser pipe forming an upwardly open mouth opening,

with a mould having a base plate which has a downwardly open pouring-in opening;

the mouth opening is positioned against the flow-through opening in a sealing fashion from below,

the mould is brought with its pouring-in opening over the flow-through opening,

the melt is conveyed from the casting furnace via the riser pipe into the mould until it is filled,

the mould is displaced horizontally on the casting table with open melt-filled communication between the casting furnace and the mould until the pouring-in opening is closed by the casting table below and the flow-through opening is closed by the base plate above,

the melt is allowed to drop in the riser pipe as far as below the mouth opening.

2. The method for uphill/low-pressure casting, especially of light metal alloys, with a casting table having a flow-through opening,

with a casting furnace lying below the casting table with a riser pipe forming an upwardly open mouth opening,

with a mould having a base plate which has a downwardly open pouring-in opening,

the mouth opening is positioned against the flow-through opening in a sealing fashion from below,

the mould is brought with its pouring-in opening over the flow-through opening,

melt is conveyed from the casting furnace via the riser pipe into the mould until it is filled,

the mould is left in this position until the casting has solidified,

the melt is allowed to drop in the riser pipe as far as below the mouth opening,

the mould is displaced horizontally on the casting table with its flow-through opening emptied of melt, until the pouring-in opening is closed by the casting table below and the mouth opening is closed by the base plate above.

3. The method according to one of claims 1 and 2, wherein the mould is in each case placed on the casting table from above so that the flow-through opening or the mouth opening is in open communication with the pouring-in opening.

4. The method according to one of claims 1 and 2, wherein the mould is in each case transferred horizontally over the casting table so that the flow-through opening or the mouth opening is in open communication with the pouring-in opening.

5. The method according to one of claims 1 to 4, wherein during the uphill casting and the displacement of the mould, the mould is held under pre-pressure against the casting table or the riser pipe.

6. The method according to one of claims 1 to 5, wherein during the uphill casting and the displacement of the mould, the riser pipe is held under pre-pressure against the casting table or the base plate of the mould.

7. The method according to one of claims 1 or 3 to 6, wherein after the displacement of the mould, the mould is held in a position in which the casting table is cooled under the pouring-in opening.

8. The method according to one of claims 1 or 3 to 7, wherein during displacement of the mould, the mould together with the pouring-in opening is guided over a section of the casting table which is cooled.

9. The method according to one of claims 1 to 8, wherein two moulds are alternately mounted on a base plate with two pouring-in openings, cast and demoulded, wherein the base plate alternately with the pouring-in openings is displaced over the flow-through opening or onto the mouth opening.

10. The method according to one of claims 1 to 8, wherein a plurality of moulds are sequentially mounted on a base plate with a ring of pouring-in openings, cast and demoulded, wherein the base plate is turned in a carousel fashion with the pouring-in openings over the flow-through opening or the mouth opening.

11. An apparatus for uphill casting/low-pressure casting, especially for casting light metal alloys, with a casting table with a flow-through opening,

with a casting furnace lying below the casting table with a riser pipe, forming an upwardly open mouth opening,

with a mould with a base plate having a downwardly open pouring-in opening;

the mouth opening is positioned against the flow-through opening in a sealing fashion from below,

the mould is positioned with its pouring-in opening against the flow-through opening from above,

characterised by means for horizontal displacement of the mould on the casting table and means for simultaneously maintaining a positive pre-pressure of the mould base plate towards the casting table.

12. The apparatus according to claim 11,

characterised in

that the mould has coolant above a non-cooled sprue region.

13. The apparatus according to one of claims 11 or 12, characterised by horizontal rails or sets of rollers secured elastically to the casting table which act on fixed horizontal edges or rails of the mould to press the mould on the casting table during displacement.

14. The apparatus according to one of claims 11 or 12, characterised by horizontal rails or sets of rollers arranged elastically on the mould which interact with horizontal edges or rails arranged securely on the casting table to press the mould on the casting table.

15. The apparatus according to one of claims 11 to 14, characterised by means for pressing the riser pipe on the casting table or the mould.

16. The apparatus according to claim 15, characterised by a riser pipe suspended elastically in the casting furnace and height adjustment means for the casting furnace.

17. The apparatus according to one of claims 11 to 16, characterised by two moulds placed on a common base plate with two pouring-in openings, especially permanent moulds, as well as means of displacement for alternating displacement of the base plate.

18. The apparatus according to one of claims 11 to 16, characterised by a plurality of moulds placed on a common base plate with a ring of pouring-in openings, especially permanent moulds, as well as rotating drive means for rotating drive of the base plate.

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