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(54) Process for obtaining non-ferrous metal castings by greensand mould casting

(57) The process lies in drying the cavity (3) of the greensand moulds (1) in which molten metal is cast for obtaining respective castings, wherein drying of said cavity (3) is made before the mould filling step in order to eliminate humidity and prevent porosities from being formed on the finished casting. In order for the cavity in the moulds (1) to be dried, the moulds are provided with recesses (2) in order that hot air may be applied through the top hood (4) of a drying station and negative pressure or vacuum may be applied through a bottom sink (6), which results in a hot air stream flowing between the cavities (3) in the moulds (1), directed towards the mould recesses (2), extracting the humidity from such moulds (1) and redirecting the extracted water towards the bottom sink (6).

In a different embodiment, the moulds (1') have through recesses (2'), which recesses are provided in the sector of the facility in which the moulds (1') proper are conveyed from the moulding chamber to the filling station, the through recesses (2') being provided by means of the piercing ends or points (21) of respective rods (20) that may be moved up and down.

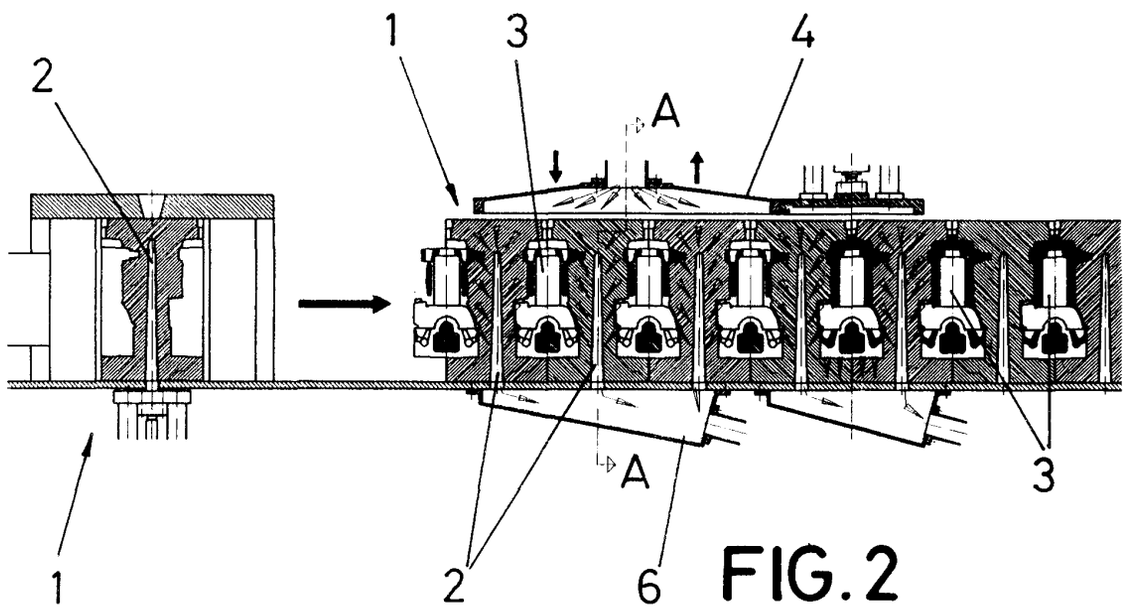

FIG. 2

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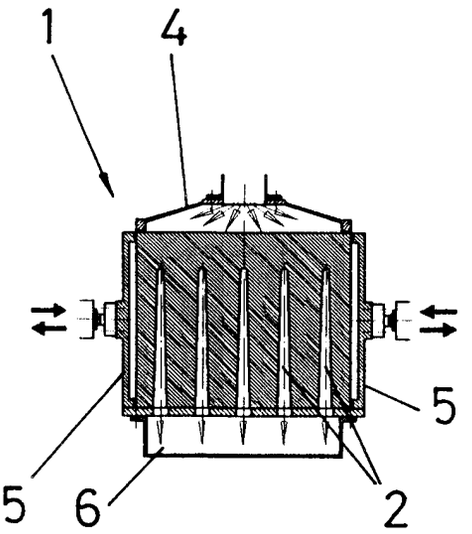


A-A

FIG.3

Description

OBJECT OF THE INVENTION

[0001] The invention relates to a process for obtaining non-ferrous metal castings, such as aluminium castings for instance, in which the molten metal is cast on greensand moulds or motes, which is essentially based on drying the moulds prior to casting the metal in order to eliminate the humidity present therein and thus prevent microporosities from being formed in the finished casting.

[0002] The object of the invention is to obtain a vertical greensand type mould or mote with spaces or recesses through which the respective mould cavity is subjected to a hot air stream in order to be dried, by means of a vacuum. Another object of the invention is the particular manner of drying the mould, filling the mould and then singularly plugging the casting runner using a cooled plunger in order for said casting runner to solidify fast and the mould to be promptly removed.

[0003] Another object of the invention is to provide the recesses in such manner as to expedite the vacuum operation throughout the mould, in order to for the molten metal to fill all the mould interstices or channels as it is cast into the mould, resulting in an enhanced production. The recesses for obtaining the latter performance will be provided when the moulds are on the actual line conveying them from the filling station.

BACKGROUND OF THE INVENTION

[0004] The casting of non-ferrous metal castings in greensand moulds or motes is inconvenient in that the greensand carries a large quantity of water with it, between 3.5% and 4%, which will mean that the resulting casting will present a number of porosities on its outer surface.

[0005] Porosities in a finished casting are due to the fact that essentially the outer surface in contact with the high-temperature molten metal undergoes a heavy heating which causes the evaporation of the water present in the mould, thereby for the aluminium to absorb hydrogen from the water, resulting in a large quantity of microporosities on the casting surface.

[0006] One way of improving the outer surface of castings obtained lies in providing for a fast solidification of the molten metal within the mould, and several methods are known to allow the molten metal to be rapidly cooled, of which the following may be mentioned:

- Casting the molten metal in metal moulds, which allows a fast cooling to be obtained, which method is however inconvenient due to the high cost of making the moulds, and the limited production capacity obtained.

- Making the mould from a magnetic mineral, which also allows the molten metal to cool and solidify fast, and castings to be produced having a better microstructure. This method is described in PCT patent WO96/11761.

- Obtaining the mould from several parts of different materials, wherein one of the parts is made of a metal having a high metal conductivity acting as the means removing the heat from the molten metal. This method is described in European patent no. 0,557,374.

[0007] Cores are known to exist in the foundry industry with spaces or recesses designed to lighten their weight or cost and yet greensand motes have never been produced with spaces or recesses for an easier elimination of the water contained in the greensand.

[0008] Furthermore, when aluminium is to be cast, practice shows that it is convenient to maintain the natural humidity of the greensand moulds, because such humidity results in the instantaneous formation during the casting process of an acid surface film which self-protects the casting.

[0009] Nevertheless, because of the formal complexity of the castings which are currently made of aluminium, it is usually difficult for the molten aluminium to fully fill all the nooks and gaps in the mould, which filling may be enhanced and fostered by applying a vacuum, for which purpose the provision of recesses or holes through the mould is extremely useful.

DESCRIPTION OF THE INVENTION

[0010] The process disclosed herein has been devised to fully solve the aforesaid drawbacks, based upon drying the moulds before the molten metal casting process, the foregoing in order to eliminate the humidity present in the moulds and prevent porosities from being formed on the outer surface of the obtained or finished castings.

[0011] The process of the invention therefore consists of the following:

[0012] Providing the greensand moulds with a number of spaces or recesses that enable a hot air stream to flow through the moulds and thereby eliminate the greensand humidity.

[0013] Incorporating a drying station as part of the foundry facility, at which the mould is applied a hot air stream to entrain the humidity contained therein, which entrainment is made towards the spaces or recesses for eliminating said humidity, being especially particular in that said drying station has a top hood, side plates and a bottom extracting sink, thereby for the moulds to lie within a perfectly sealed chamber, allowing negative pressure to be applied through an extractor to produce a hot air flow, entraining the humidity within the mould, from the inner walls of its cavity, towards the spaces or recesses and from the latter to the extractor proper.

[0014] The process also includes the insertion of the dry mould in a chamber comprising a top closing plate (driven by hydraulic cylinders), side plates and a bottom gas extracting system, all in order that, before casting, the chamber undergoes a vacuum which eliminates the air and gases that may lie within the mould cavities.

[0015] The process also includes a stage consisting of plugging the casting runner, once the mould is full, which plugging takes place with a plunger driven by a cylinder, the plunger being fitted with an inner chamber through which an air or liquid stream is made to flow to allow its end to be cooled and thus cause a fast solidification of the casting runner, thereby allowing the mould to be rapidly removed and a new cycle to begin, the foregoing in order to achieve a higher machine productivity.

[0016] In order that when aluminium is cast, the metal fills absolutely all the mould nooks and spaces, it is important for the aforesaid recesses to be provided through the mould, in order to enhance and foster the application of a vacuum, such recesses being further provided to be made in the mould once the moulds are on the line conveying them towards the filling or casting station, the molten aluminium being cast by applying a vacuum that enhances filling of the mould.

[0017] In this case, the recesses or holes obtained in the mould are designed to expedite the vacuum operation throughout the mould, in order for the molten metal to fill absolutely all the ducts or nooks in the mould.

[0018] Another characteristic of the invention relates to the device for providing such recesses through the mould, which device is based on a number of rods provided with a sharp point, the rods being driven by means of a motor in order for the same to bore through the moulds, resulting in through bores in the moulds.

[0019] The device for providing the through recesses or holes is finally provided with a central piston and guides enabling the rods proper with which the aforesaid through recesses or holes are provided to be lifted/ lowered, a side piston also being provided which allows the position of the rods to be varied at will relative to the moulds, thereby allowing most ideal bores to be provided depending on their size, the base upon which the row of moulds is supported and slides being therefore provided with longitudinal slots that allow the rods through in the various possible positions they may take up.

DESCRIPTION OF THE DRAWINGS

[0020] In order to provide a fuller description and contribute to an easier understanding of the characteristics of the invention, in accordance with a preferred practical embodiment thereof, a set of drawings is attached to the present specification as an integral part thereof which, while purely illustrative and not fully comprehensive, shows the following:

[0021] Figure 1.- Is the mould used in the process of the invention.

[0022] Figure 2.- Shows the forward movement of the mould towards the area in which the drying station is provided.

[0023] Figure 3.- Is a sectional view along line A-A of the preceding figure.

[0024] Figure 4.- Is the dry mould inserted in the filling station, the latter having a top closure plate, side plates and a vacuum and gas extracting system located on the bottom.

[0025] Figure 5.- Is the mould at the filling stage, after the top and side plates shown in the preceding figure separated from the mould are closed.

[0026] Figure 6.- Is the full mould and the casting runner plugged.

[0027] Figure 7.- Shows the release of the mould after the casting ladle is depressurised and the casting runner cooling time is over.

[0028] Figure 8.- Is a view of an installation in which the recesses or holes through the moulds are made, which operation takes place before the metal is cast.

[0029] Figure 9.- Is a sectional view along line B-B of the preceding figure.

[0030] Figure 10.- Is finally an elevation view of the device with which recesses or holes are made through the moulds in accordance with the embodiment shown in figures 8 and 9.

PREFERRED EMBODIMENT OF THE INVENTION

[0031] The process for obtaining non-ferrous metal parts is based, as noted before, on the dry production of the moulds before casting the molten metal, in order for the drying process to eliminate the humidity present in the moulds and prevent microporosities from being formed in the finished castings.

[0032] In order to do so, with reference to the above-mentioned figures, it is necessary for the moulds (1) used to be obtained with a number of cavities or recesses (2) distributed throughout the mould, which recesses or cavities (2) are obtained using a bottom plate provided with spikes acting as rods. The recesses or cavities (2) may obviously be obtained using a spiked side plate instead of a bottom plate, in which case the recesses (2) of the moulds (1) would be horizontally arranged.

[0033] The mould obtained enters the relevant filling machine and comes to lie at the end of the row of moulds, shown in figure 2, in which a drying station is established. The spaces or cavities (2) of the moulds (1) allow hot air to flow from the inner cavity (3) of every mould (1) towards said spaces or recesses (2), the drying station being provided precisely to cause such hot air flow, the station comprising a top hood (4) and side closing plates (5) keeping the moulds (1) tightly sealed, the drying station being supplemented with a bottom water collecting and extracting sink (6), and therefore by blowing hot air through the hood (4) and applying a negative or vacuum pressure through the sink (6), a stream of hot air will be produced and flow from the inner cavity (3) of the respective mould (1) towards the spaces or

cavities (2) therein, entraining the humidity contained in the mould to the extracting sink (6). This method essentially results in the inner walls of the mould cavity (3) being dried, and therefore the outer surface of the castings obtained will have a better finish.

[0034] When the above drying step is over, the moulds (1) will pass into the filling station one by one where, as shown in figure 1, the mould is placed between a top closing plate (7) driven by hydraulic cylinders, side plates (8) and a vacuum and gas extracting system (9) located on the bottom, as shown in figure 4. The mould (1) is provided with the appropriate filling channel (10) facing the casting runner (11), and this figure 4 shows the casting ladle (12) leading into the molten metal tank in which a closing element (13) is provided, wherein after the plates (7) and (8) are tightly fixed and the ladle (12) is pressurised, through a duct (14), which pressurisation can be made by means of a pneumatic and electromagnetic pump system, the molten metal will be cast over the mould (1), as shown in figure 5, and once the mould is full, the casting runner (10) will be plugged by means of a plunger (15) driven by a hydraulic or pneumatic cylinder (16), which plunger (15) defines an inner chamber (17) through which a stream of air or liquid flows which allows the end (18) to be cooled down and thereby cause the casting runner (10) to solidify fast, whereupon the mould (1) may be rapidly removed for a new cycle to begin.

[0035] When the casting runner (10) cooling time is over and the casting ladle (12) is depressurised, the plates (7) and (8) are removed to allow the mould (1) out of the filling station and for a new cycle to begin.

[0036] In an alternative embodiment, shown in figures 8, 9 and 10, the recesses (2') cross through the moulds (1') and therefore the moulds (1') from the moulding chamber, marked (29) in figure (8), pass to the molten metal filling or casting station, and are provided at the sector marked (18) of said station with said recesses (2') which are to be through holes, as is clearly shown in figures 8 to 10, said through recesses or holes (2') being provided to expedite the vacuum operation throughout the mould (1'), thereby for the molten metal to fill absolutely all the interstices, spaces or nooks therein.

[0037] The through recesses (2') are made with a device generally marked (19) and shown in figures 8 and 10, which includes a plurality of rods (29) provided at their free end with a piercing point (21), and therefore a motor (22) and the respective pulley and gear-tooth belt (23) transmission, said rods (20) will turn and hence pierce the respective mould (1') through their points (21), thereby for said through recesses (2') to be obtained, as is clearly shown in figures 8 to 10, wherein in order for such through bores or recesses to be provided, the rods (20) need to move up, driven by a central piston (24), lifting and lowering of which is assisted by guides (25).

[0038] A lateral piston (26) has also been provided which allows the position of the rods (20) to be varied at will relative to the moulds (1') in order to provide the through recesses (2') in the most appropriate position, depending on the morphological characteristics of the mould.

[0039] The base upon which the moulds (1') are supported and slide will be provided in the respective sector (18) with longitudinal slots (27) allowing the rods (20) through in the various positions they can take up.

[0040] As shown in figures 8 and 9, each mould (1') is kept tightly sealed by closing the top (7') and side (8') plates, a vacuum collector (28) also being provided through which a vacuum may be applied to improve the casting of the molten metal within the moulds, filling all their interstices, for this vacuum is provided across the through recesses (2') of each mould (1').

Claims

1. A process for obtaining non-ferrous metal castings by greensand mould casting, characterised by comprising the following operative steps:

   - Obtaining the greensand moulds (1-1') with recesses (2-2') to allow a hot air stream to flow through the same to eliminate the greensand humidity or to achieve a vacuum allowing all the mould interstices and recesses to be filled;

   - Inserting the mould (1-1') in a drying station established in the appropriate filling machine, which drying station comprises a top hood (4) and side plates (5) keeping a number of moulds (1-1') tightly sealed between each other;

   - Applying a negative pressure or vacuum through a bottom sink (6) and simultaneously blowing hot air to flow between the cavities (3) in the moulds (1-1') toward the mould recesses (2-2'), extracting the humidity and diverting the water removed towards the bottom sink (6);

   - Passing the mould (1-1') after drying to the appropriate filling station, which comprises a top closing plate (7-7'), side plates (8-8') and a vacuum and gas extracting system (9) located on the bottom;

   - Filling the mould by pressuring the appropriate casting ladle (12), gases contained in the inner cavities of said mould (1-1') being simultaneously extracted through the bottom vacuum and gas extracting system (9);

   - Plugging the casting runner (10) after filling the mould (1-1') using a plunger (15) driven by a hydraulic cylinder (16), gas or liquid being simultaneously applied through the inside of a

chamber (17) established in the plunger (15) to cool and accordingly solidify the runner (10) leading into the mould (1-1');

- Depressurising the casting ladle (12), keeping the runner (10) leading into the mould (1-1') plugged, and extracting gases; and

- Removing the top (7-7') and side (8-8') plates from the filling station, after the cooling time of the casting runner (10) leading into the mould (1-1') is over, to allow the removal thereof and a new cycle to begin.

2. A process for obtaining non-ferrous metal castings by greensand mould casting, as in claim 1, characterised in that the recesses (2') pass through the mould (1') proper, and are provided at the sector (18) in which said moulds (1') are conveyed from the respective moulding chamber (29) to the molten metal filling or casting station, which through recesses (2') are obtained by means of piercing points (21) provided at the respective free end of appropriate rods (20) turning simultaneously driven by a motor (22) and moved vertically by a piston (24).

3. A process for obtaining non-ferrous metal castings by greensand mould casting, as in claim 2, characterised in that the position of the rods (20) can be varied relative to the moulds (1'), longitudinal slots (27) being therefore provided on the base upon which the moulds (1') are supported and slide to allow the rods (20) through in the various positions they can take up.

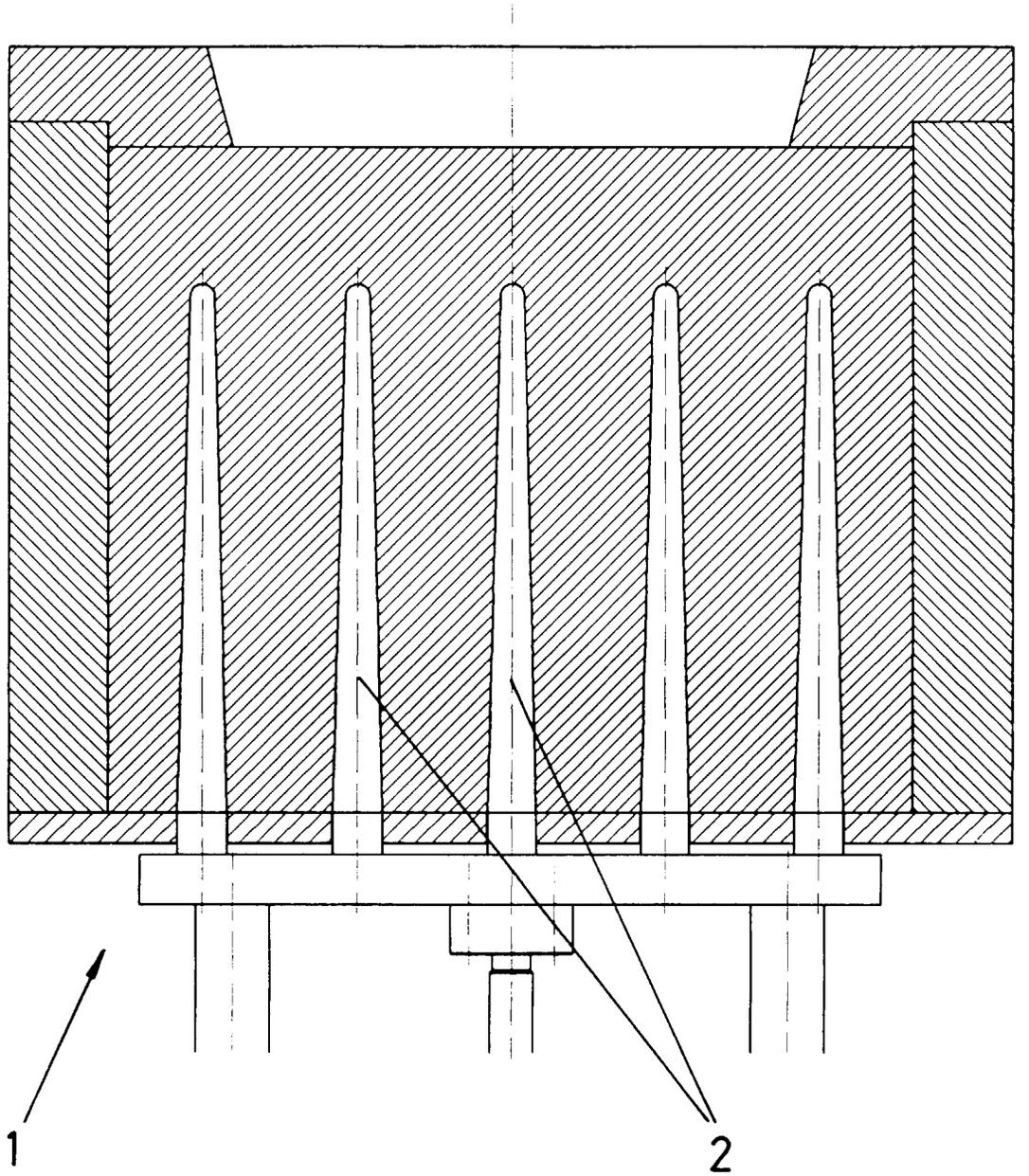
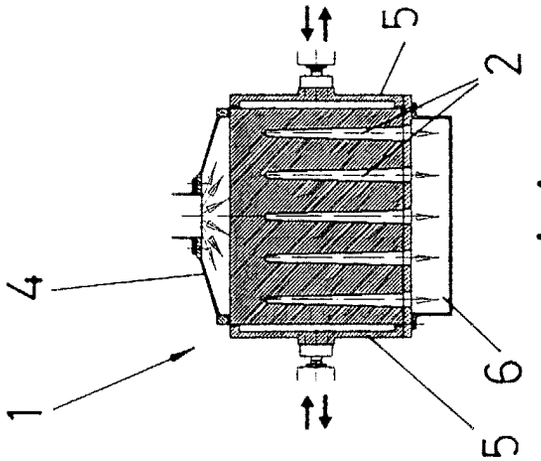


FIG.1



A-A
FIG.3

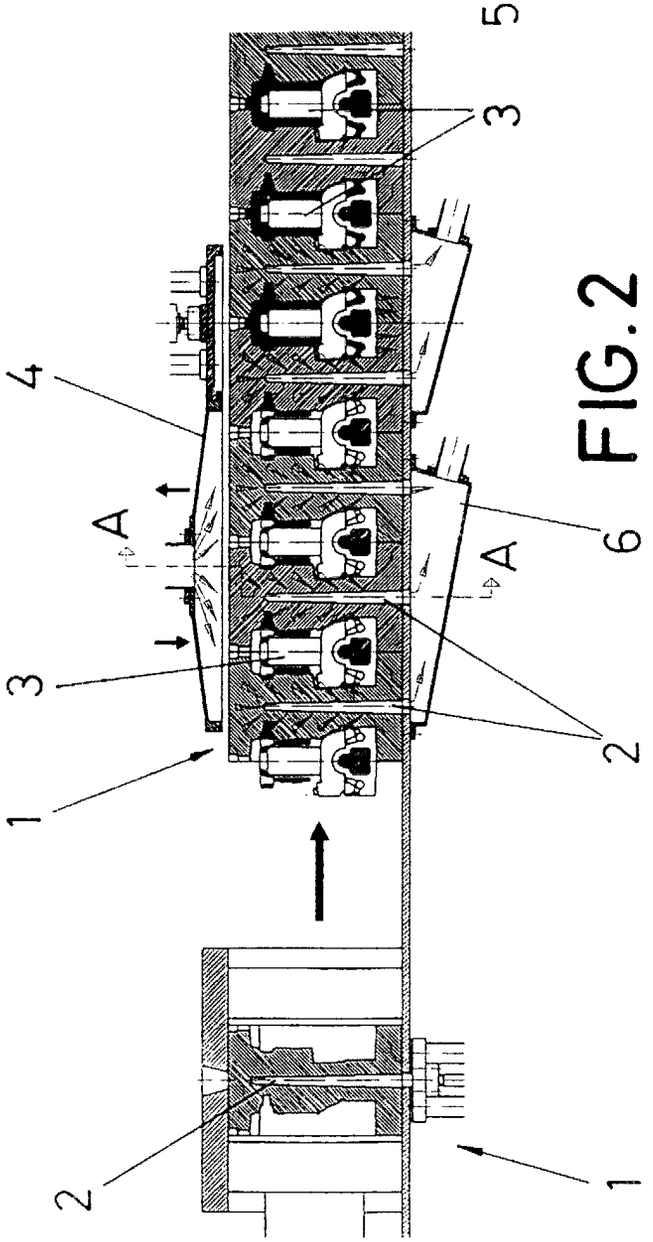


FIG.2

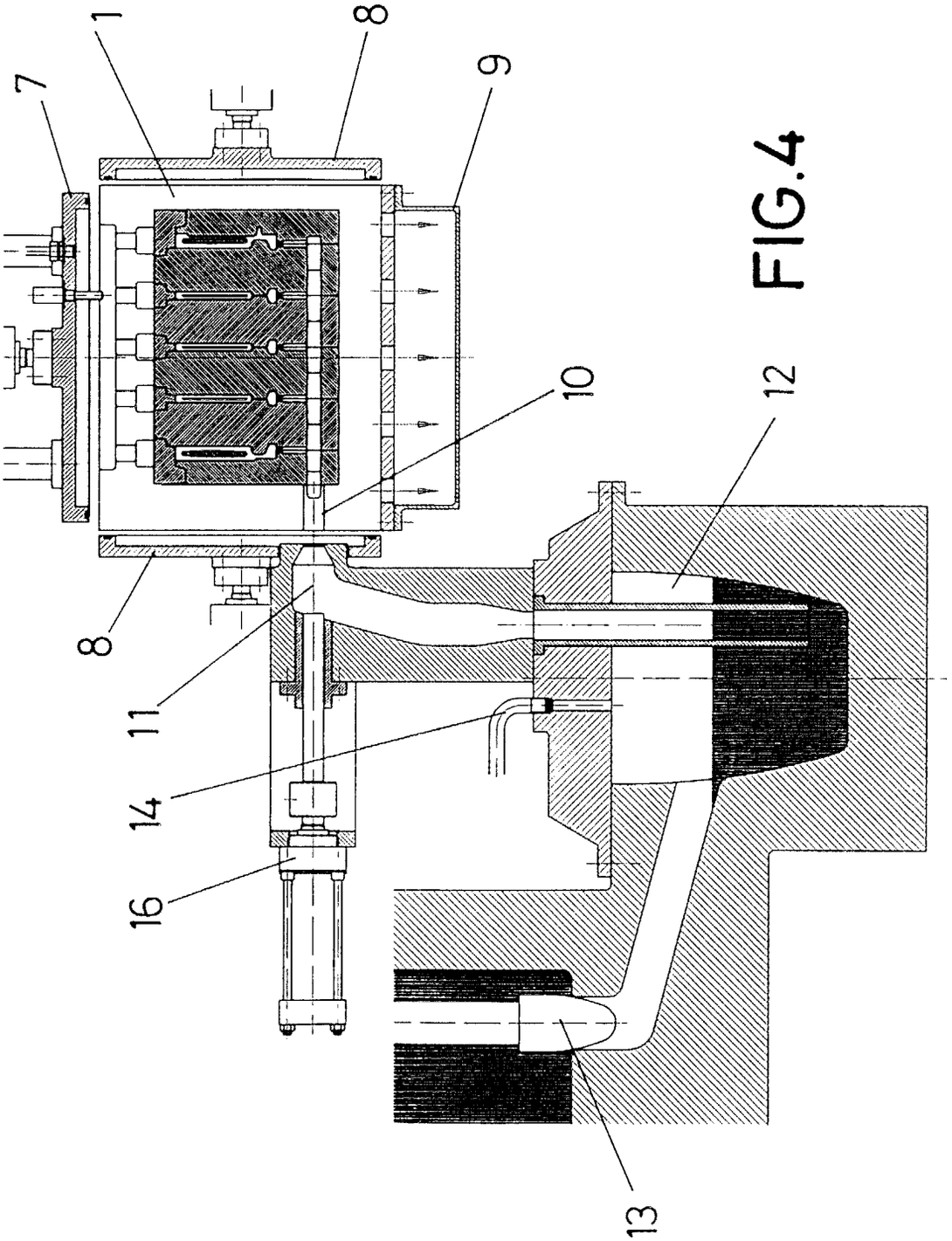


FIG.4

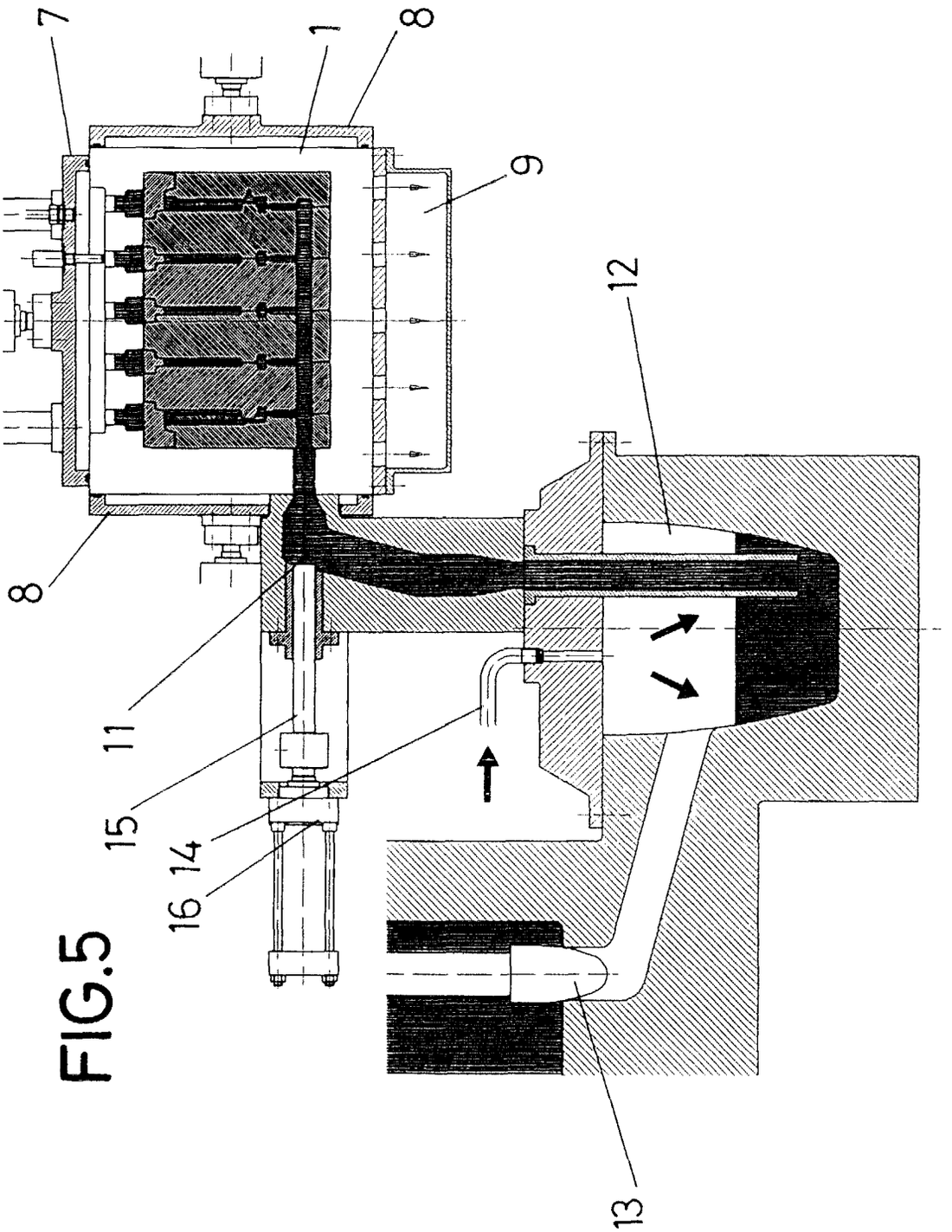


FIG.5

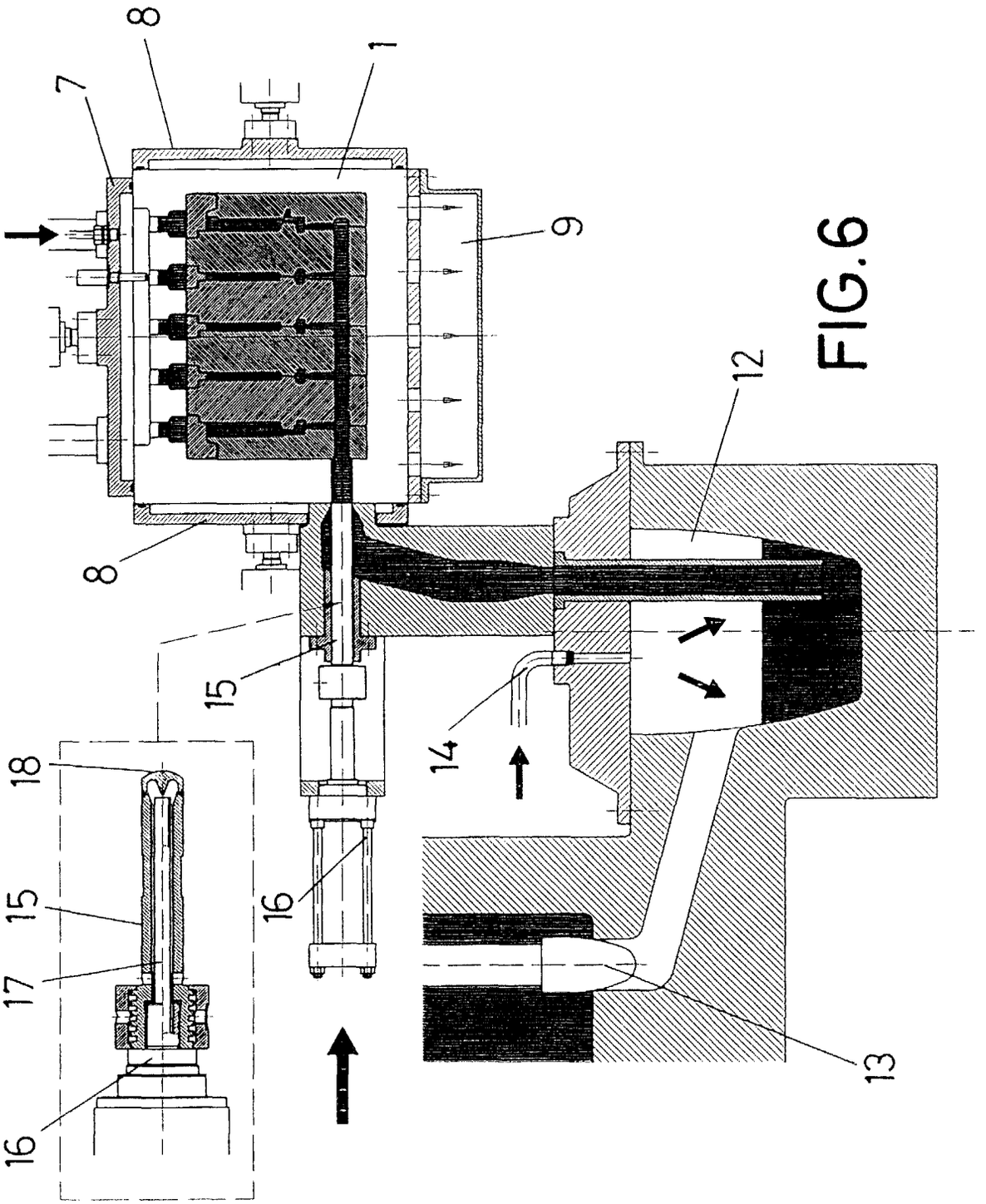


FIG.6

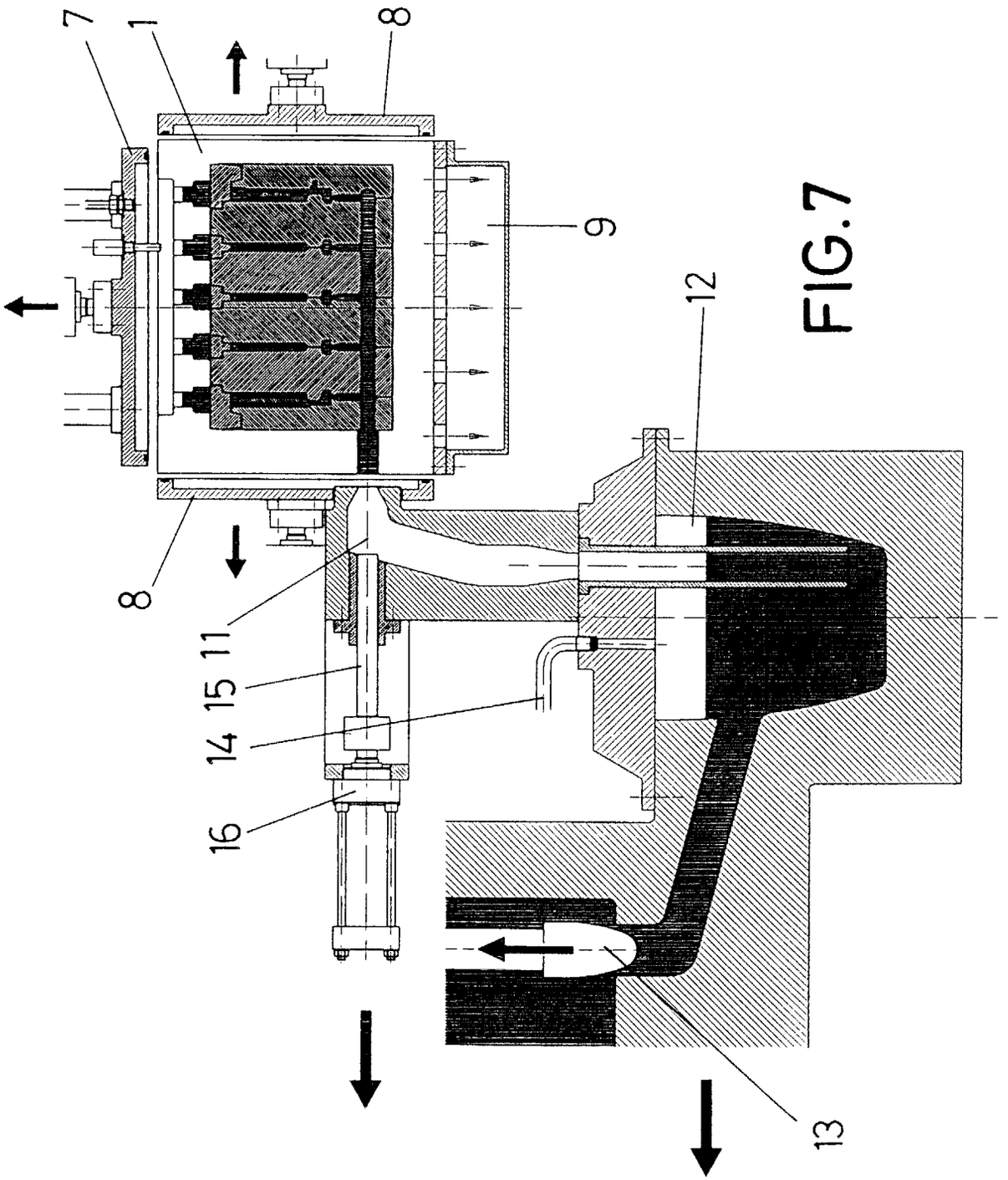


FIG.7

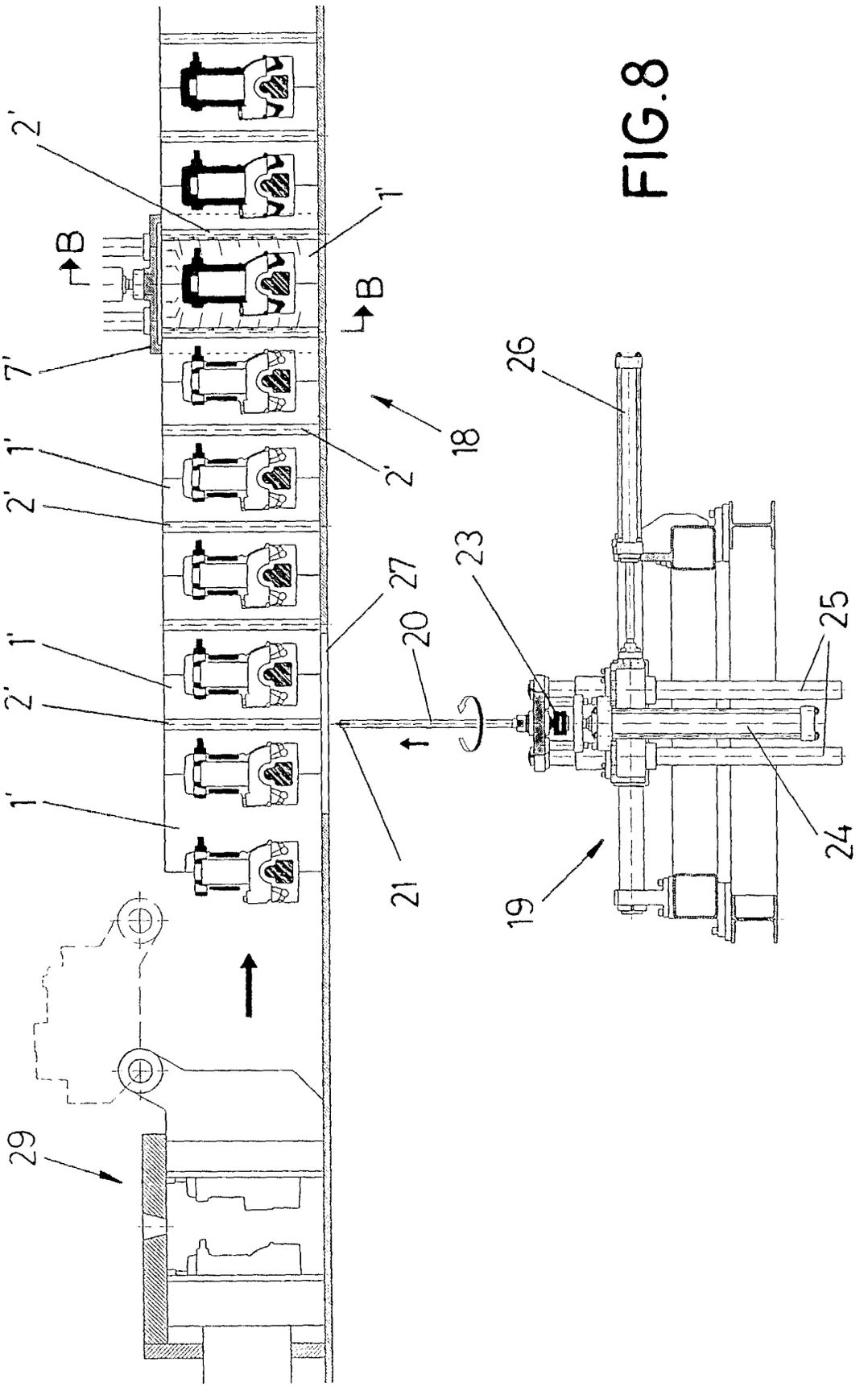


FIG.8

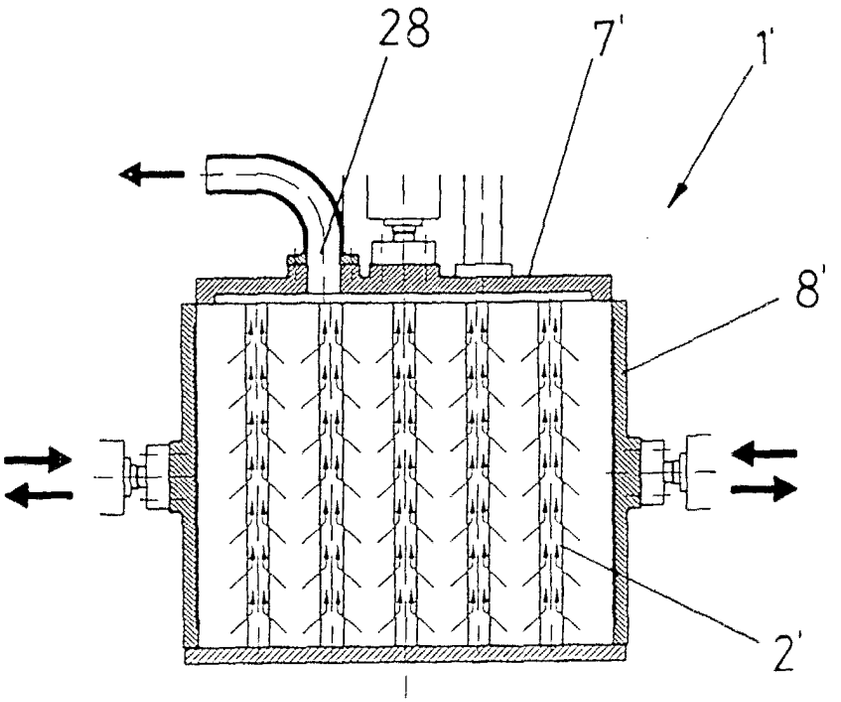


FIG.9

B-B

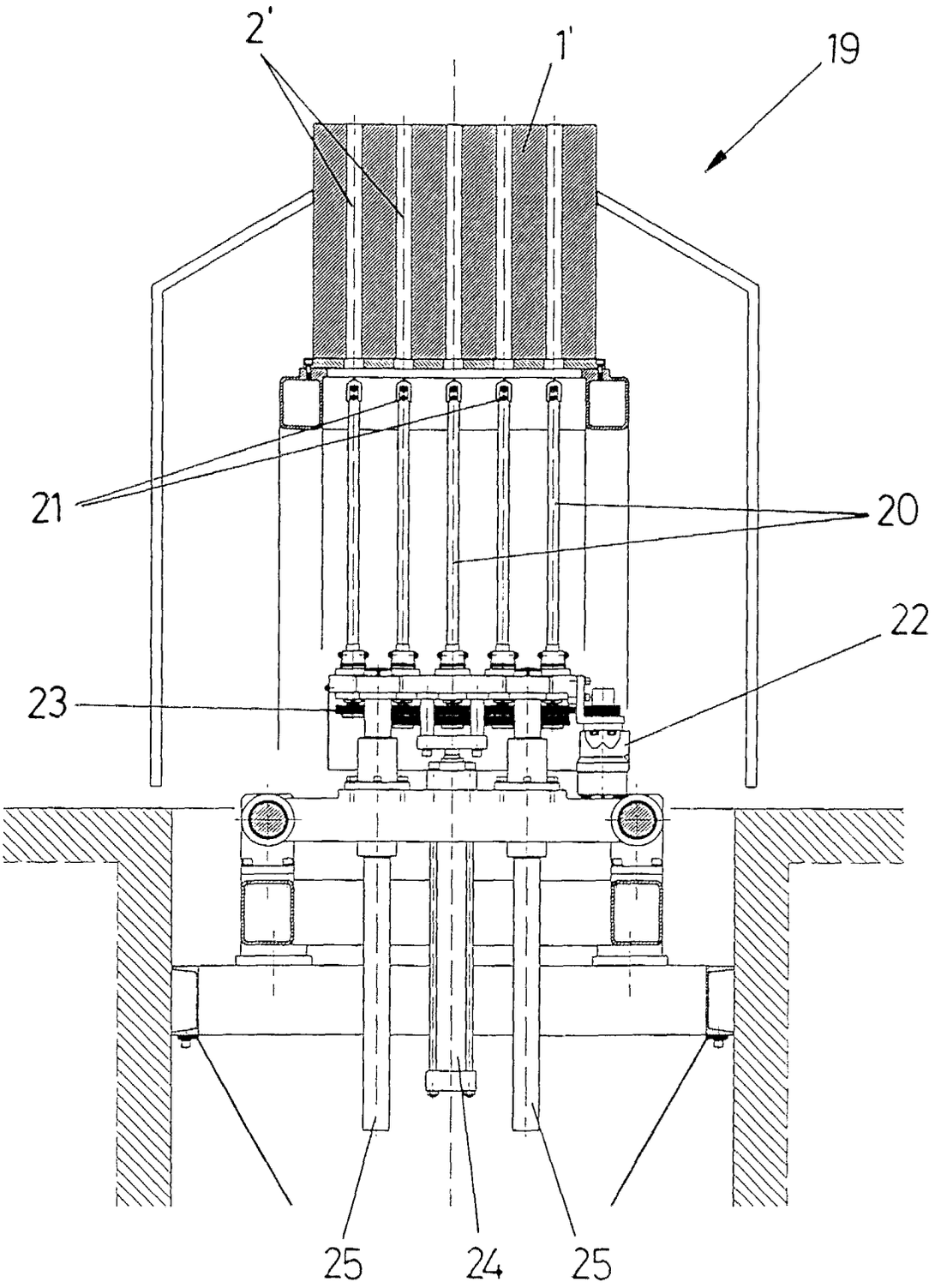


FIG.10

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 50 0010

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	PATENT ABSTRACTS OF JAPAN vol. 017, no. 256 (M-1413), 20 May 1993 (1993-05-20) & JP 05 000356 A (MAZDA MOTOR CORP), 8 January 1993 (1993-01-08) * abstract * ---	1	B22D47/02 B22D18/04 B22D27/15 B22C11/10 B22C9/12
A	PATENT ABSTRACTS OF JAPAN vol. 009, no. 063 (M-365), 20 March 1985 (1985-03-20) & JP 59 197340 A (SHINTO KOGYO KK), 8 November 1984 (1984-11-08) * abstract * ---	1	
A	WO 93 11892 A (BAXI PARTNERSHIP LTD) 24 June 1993 (1993-06-24) * page 6, line 12 - page 7, line 20; figures 9-11 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) B22D B22C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 January 2000	Mailliard, A

CATEGORY OF CITED DOCUMENTS

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12-01-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 05000356 A	08-01-1993	NONE	
JP 59197340 A	08-11-1984	NONE	
WO 9311892 A	24-06-1993	AT 179101 T	15-05-1999
		AU 3090692 A	19-07-1993
		BR 9206879 A	28-11-1995
		CA 2125276 A	24-06-1993
		DE 69228998 D	27-05-1999
		DE 69228998 T	02-12-1999
		EP 0615476 A	21-09-1994
		ES 2132138 T	16-08-1999
		JP 7501750 T	23-02-1995
		NO 942088 A	06-06-1994
		US 5735334 A	07-04-1998

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