(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 194 272 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.06.2010 Bulletin 2010/23

(21) Application number: **09177762.3**

(22) Date of filing: **02.12.2009**

(51) Int Cl.:
F04B 15/04 *(2006.01)* ***F04B 39/12*** *(2006.01)*
F04B 53/00 *(2006.01)*

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA RS

(30) Priority: **03.12.2008 IT PD20080360**

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(54) **Pump head and method for manufacturing said head**

(57) Pump head (1) formed by a shaped metallic body (2) having a surface (14) for conveying a fluid to be pumped, defined by a pumping chamber (3), by an intake channel (12) and by a delivery channel (13) and formed also by a plastic coating layer (18) which is overmoulded, substantially exclusively, onto the conveying surface (14) of the shaped metallic body (2).

This head (1) is manufactured by means of a method for overmoulding the shaped metallic body (2) with the plastic layer (18).

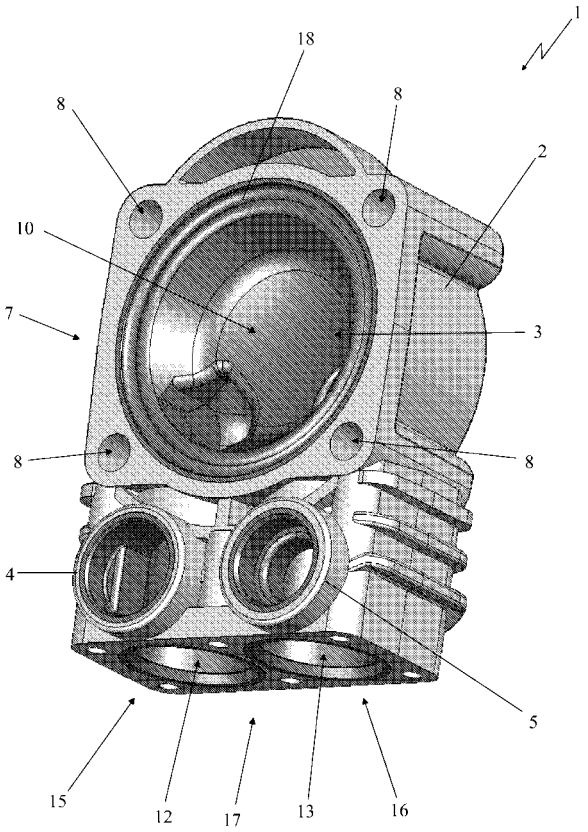

Fig. 2

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Description

Field of application

[0001] The present invention relates to a pump head and a method for manufacturing said head according to the preamble of the associated independent claims.

[0002] The head in question is intended to be advantageously used in the manufacture of pumps, in particular of the diaphragm or piston type, which can be used in the agricultural sector for the irrigation or pest control of crops.

Background art

[0003] As is known, the head of a pump is subject to intense pressure produced by the reciprocating movement of a diaphragm or a piston inside a pumping chamber for drawing in a fluid through an intake channel, which is for example connected to a tank, and conveying it out through a delivery channel, which is for example connected to an irrigation nozzle.

[0004] The known pump heads which are commercially available include those made of bronze, aluminium or brass so as to ensure a suitable mechanical strength during operation of the pump.

[0005] In the case of certain applications, specifically intended for the agricultural sector, the fluid to be pumped typically consists of water-based solutions containing chemical compounds (for example in the form of organic and inorganic electrolytes, crystalline substances or fine powder aggregates) which may attack and corrode the metallic materials and consequently damage the pump head with time.

[0006] In order to overcome this drawback, as is known, pump heads designed with a greater resistance to wear due to chemical compounds have been introduced onto the market. These heads are made using various production techniques.

[0007] For example, known techniques envisage the formation of a metal lining on the head which is in turn coated with a layer of silicone resin or techniques which envisage the arrangement on the head of a protective magnetite layer. Other techniques envisage providing a coating which is composed of cobalt/nickel/molybdenum mixtures using various vaporization methods or forming coatings consisting of carbides or metal borides or metal alloys. Moreover, also known are plasticization methods which envisage heating the pump head and then immersing it in a mixture of plastic powders which, melting upon contact, are distributed on the surface of the head, forming a continuous layer with a thickness of a few millimetres.

[0008] These coating layers, however, owing to their extremely small thickness, are unable to ensure a good performance in terms of durability since they may be easily subj ect to wear as a result of the pressure and friction exerted by the fluid which is drawn into the pumping chamber. Moreover, the techniques for producing these coatings require the implementation of numerous complicated processes, making quality control of the finished product relatively difficult.

[0009] In order to overcome the abovementioned drawbacks, pump heads consisting of a rigid support structure made of plastic and provided with a concave portion which defines a pumping chamber communicating with an intake channel and a delivery channel are known. The plastic material forming the support structure ensures that the walls of the pressure chamber have a good resistance to the chemical corrosion which is due to the action of the substances contained in the liquid to be pumped. Moreover, a metal frame, which is provided with reinforcing ribs, is embedded within the plastic bed of the support structure so as to provide the head with an increased mechanical strength at the points which are subject to the greatest pressure.

[0010] This solution, however, in practice also has a number of drawbacks.

[0011] A first drawback consists in the fact the head in question is made mainly of plastic and, although provided with a reinforcing frame, is unable to withstand pressures in the pumping chamber higher than 15 bar. In the agricultural sector, on the other hand, the irrigation of fields or treatment of crops with liquid pesticides requires the use of pumps which are able to generate a high pressure in the liquid to be pumped. Consequently, the heads of these pumps must be able to withstand very high pressures (for example of up to 40 bar).

[0012] A further drawback consists in the fact that the head manufacturing process envisages the use of moulds which are somewhat complicated and costly. In fact, moulding of the plastic support structure involves arranging the metal frame to be coated between two shells of a mould which are shaped so as to define the surface of the pumping chamber and the outer surface of the head. Moreover, moulding plugs which are mounted on carriages arranged on the opposite sides of the head are required, in order to form the necessary intake and delivery channels. The plastic material injected into the mould surrounds completely the metal frame, forming the support structure of the head. The two shells of the mould have very complicated contours which are needed in order to define precisely the thickness of the plastic in all parts of the head and the numerous reinforcing and heat-exchange ribs. This results in an increase in the constructional and design complexity of the moulds with a consequent increase in the production costs. Moreover, the need to use two carriages during moulding increases further the production costs.

Disclosure of the invention

[0013] The main object of the present invention is therefore to overcome the drawbacks of the solutions of the known type by providing a pump head which is operationally reliable in all the conditions of use and oper-

ation of a pump.

[0014] Another object of the present invention is to provide a pump head which is operationally entirely safe and durable over time.

[0015] A further object of the present invention is to provide a method for manufacturing a pump head which is simple and simple and inexpensive to produce.

Brief description of the drawings

[0016] The technical features of the invention, in accordance with the abovementioned objects, may be clearly determined from the contents of the claims below and the advantages thereof will emerge more clearly from the detailed description which follows, with reference to the accompanying drawings which illustrate a purely exemplary and non-limiting embodiment thereof, where:

- Figure 1 is a perspective front view of the pump head according to the present invention;
- Figure 2 is a perspective rear view of the pump head according to the present invention;
- Figure 3 is a cross-sectional view of the pump head according to the present invention along the line III-III of Figure 1;
- Figure 4 is a cross-sectional view of the pump head according to the present invention along the line IV-IV of Figure 1;
- Figure 5 is a cross-sectional view of the mould used during the method for manufacturing the pump head according to the present invention;
- Figure 6 shows a detail of Figure 5 relating to the moulding chamber;
- Figure 7 shows a plan view of the mould according to Figure 5.

Detailed description of a preferred example of embodiment

[0017] With reference to the accompanying drawings 1 denotes in its entirety the pump head according to the present invention.

[0018] The head 1 in question is intended to be mounted together with a pump housing provided with pumping means of the type known per se to a person skilled in the art and therefore not described in detail.

[0019] In accordance with the accompanying figures, the head 1 comprises a shaped metallic body 2 having an outer surface 11 and a surface 14 for conveying a fluid to be pumped. This latter conveying surface 14, which is situated inside the head 1, defines a pumping chamber 3 together with the pump housing on which the head 1 is mounted, an intake channel 12 and a delivery channel 13 through which the fluid to be pumped enters into and exits from the pumping chamber 3, respectively.

[0020] The fluid to be pumped consists typically of a liquid, such as water or more generally water-based solutions, in which chemical compounds are dissolved in order to form products used in agriculture, such as pesticides, fertilisers, etc.

[0021] In detail, the shaped metallic body 2 has two substantially parallel faces, i.e. a first face 6 which is directed externally and therefore intended to remain visible, and a second face 7 intended to be mechanically joined to the pump housing. For this purpose, a number of through-holes 8 are formed between the two faces 6, 7 in the shaped metallic body 2, inside which through-holes fixing means, such as bolts or screws, are inserted in order to fix the head 1 to the pump housing.

[0022] The second face 7 of the shaped metallic body 2 has, formed therein, a substantially cap-shaped, in particular semi-spherical, concavity 10 which defines the pumping chamber 3. This latter chamber is intended to be closed by a diaphragm retained between the shaped metallic body 2 of the head 1 and the pump housing.

[0023] Advantageously, the intake channel 12 and the delivery channel 13 extend from the pumping chamber 3 parallel to each other and both terminate on the second face 7 of the shaped metallic body 2 in the form of an intake mouth 4 and a delivery mouth 5 respectively, arranged in the vicinity of the same side face 17 of the shaped metallic body 2.

[0024] Usefully, owing to the particularly close arrangement of the intake mouth 4 (which has a diameter preferably of 30 millimetres) and the delivery mouth 5 (which has a diameter preferably of 28 millimetres), a single manifold may be used for drawing off and supplying the fluid, with a consequent reduction in the overall dimensional volume of the pump.

[0025] The shaped metallic body 2 is also provided with a first opening 15 and a second opening 16 formed in its side face 17 and communicating with the intake channel 12 and the delivery channel 13, respectively. These openings 15 and 16 allow access to two seats 37 which are arranged along the intake channel 12 and delivery channel 13 and which house, respectively, a first and second non-return valve for example of the frusto-spherical type made of stainless steel, not shown in the accompanying drawings in that they are known per se. The first valve allows entry of the fluid into the pumping chamber 3 from the intake mouth 4 while, on the other hand, the second valve allows the fluid to flow from the pumping chamber 3 towards the delivery mouth 5. These valves are kept in position in the corresponding seats 37 by a cover, not shown, which is mounted on the side face 17 of the shaped metallic body 2 and which keeps the first opening 15 and the second opening 16 closed during normal operation of the pump.

[0026] Advantageously, the shaped metallic body 2 is made of aluminium, i.e. a material which provides the head 1 with the mechanical strength necessary for withstanding the high hydrostatic pressures (for example up to 40 bar) which are reached during operation of the pump. Moreover, aluminium is a relatively light metal and therefore allows the manufacture of a particularly lightweight pump head 1.

[0027] In accordance with a preferred embodiment of the present invention, the first face 6 of the shaped metallic body 2 is provided with reinforcing ribs 9 which define a reticular structure able to increase the mechanical strength of the head 1.

[0028] In accordance with the underlying idea of the present invention, the head 1 comprises a plastic coating layer 18 which is overmoulded, substantially exclusively, onto the conveying surface 14.

[0029] According to the particular constructional form shown in the accompanying drawings, this conveying surface 14 is defined by the concavity 10 of the pumping chamber 3, by the intake channel 12 and delivery channel 13, by the intake mouth 4 and delivery mouth 5 and advantageously by the openings 15 and 16. Therefore, it defines, once lined with the plastic layer 18, the surface intended to be wetted by the fluid to be pumped and, together with the diaphragm which closes the pumping chamber 3, defines the space through which this fluid flows during normal operation of the pump.

[0030] The outer surface 11 of the head 1 is subject to the normal wear resulting from atmospheric agents and therefore does not require coating with the plastic layer 18. Therefore, moulding of said layer exclusively onto the conveying surface 14 of the shaped metallic body 2 ensures excellent chemical resistance properties of the head 1 and at the same time results in a saving in terms of the materials used, with a consequent reduction in the production costs compared to the heads currently manufactured.

[0031] Advantageously, the plastic layer 18 is made of polypropylene so as to ensure that the head 1 has an excellent chemical resistance to the substances contained in the fluid to be pumped, which substances, in the absence of said plastic layer 18, would attack the shaped metallic body 2, causing gradual deterioration thereof.

[0032] According to a particularly advantageous characteristic feature, the plastic layer 18 is chosen so as to ensure a suitable chemical resistance and at the same time guarantee perfect adhesion to the shaped metallic body 2 without the formation of splits or cracks even in the presence of the high pressures to which the head 1 is exposed during operation of the pump. Moreover, this plastic material in the melted state, once injected inside the moulds, has a fluidity which is sufficient for it to reach all of the conveying surface 14, allowing uniform moulding of the coating layer 18.

[0033] In accordance with an advantageous characteristic feature of the present invention, the plastic layer 18 has a thickness in the range of 2 to 4 millimetres and, preferably, of 3 mm. Thicknesses of the plastic layer 18 substantially smaller than 3 mm (and in particular outside of the above-mentioned range) do not ensure uniform moulding of the plastic layer 18 over the entire conveying surface 14 of the shaped metallic body 2, as will be explained in detail below with reference to the different steps of the manufacturing method. Moreover, thicknesses of the plastic layer 18 smaller than the above-mentioned thicknesses would be unable to ensure sealing against the chemical agents owing to the inevitable porosity and the ever-present surface defects of the plastic, via which the fluid to be pumped would come into contact with the shaped metallic body 2, corroding it. On the other hand, a thickness of the plastic layer 18 greater than 4 mm with not result in any practical advantage, resulting in wasted material and unnecessary increased costs.

[0034] Preferably, the plastic layer 18 comprises at least one projecting element 39 which defines an undercut 40 so as to be securely fixed to the shaped metallic body 2 and adhere perfectly thereto.

[0035] In greater detail, with reference to Figure 4, the projecting element 39 extends towards the shaped metallic body 2 from the plastic layer 18 opposite the concavity 10 of the pumping chamber 3. Said projecting element is mushroom-shaped with a stem 41 defined by a passage 42 formed in the shaped metallic body 2 and extending from the centre of the concavity 10 of the pumping chamber 3 and with a head of 43 connected continuously to the stem 41 and defined by a shoulder 44 formed in the bottom of a recess 45 in the shaped metallic body 2.

[0036] During the overmoulding process, the melted plastic fills the passage 42 and covers the shoulder as far as the bottom of the recess 45.

[0037] The head 43 of the projecting mushroom-shaped element 39 ensures that the plastic layer 18 adheres mechanically to the convex surface of the pumping chamber 3.

[0038] The present invention also relates to a method for manufacturing the pump head 1 of the type described above.

[0039] Below, for the sake of simplicity of the description, reference will be made to the head 1 already described with reference to the accompanying figures, although it must be understood that the method in question is suitable also for the manufacture of pump heads different from that illustrated.

[0040] In accordance with the present invention, the method comprises a first step for manufacturing the shaped metallic body 2 substantially in the form of the head 1. Advantageously, this step is performed by means of a pressure die-casting process where the molten metal is introduced at high speed into a mould and solidified under pressure. Following solidification, after the mould has been cooled by means of a water circulating system, the moulded shaped metallic body 2 is extracted from the mould. The shaped metallic body 2 thus obtained undergoes the following series of steps in the manufacturing process for moulding the plastic layer 18 onto the said body.

[0041] Advantageously, a step involving pre-heating of the shaped metallic body 2 is performed in order to heat said body substantially to the same temperature as the moulds used during the subsequent process steps. This prevents any major temperature fluctuations from

causing significant variations in the volume of the shaped metallic body 2 during the subsequent manufacturing steps of the process, causing problems in terms of adhesion to the moulds.

[0042] In accordance with the embodiment shown in Figure 5, a step for positioning the shaped metallic body 2 inside a die 19 which supports and retains said body is performed, said die 19 being mounted on a mould-holder 20. More particularly, as can be seen in the detail shown in Figure 6, the shaped metallic body 2 is arranged with its first face 6 directed towards the die 19. The latter is shaped with internal projections 35 so as to receive, in contact therewith, corresponding portions of the outer surface 11 of the shaped metallic body 2 so as to exert a force reacting against the high pressures produced during the following step for injecting the plastic material. Advantageously, these internal projections 35 define support and reference points intended to receive in contact therewith the reinforcing ribs 9 formed on the first face 6 of the outer surface 11 of the shaped metallic body 2.

[0043] This is followed by a step involving closing of the die 19 together with at least one counter-die 21 and with at least one carriage 22. The counter-die 21 and the carriage 22 are form-coupled together and with the die 19 so as to close the shaped metallic body 2 inside a moulding chamber where at least one cavity 23 is defined between the counter-die 21 and the carriage 22 on the one hand and the shaped metallic body 2 on the other hand.

[0044] Advantageously, the carriage 22 is slidably mounted on the mould-holder 20 inside suitable guides 25 which allow it to move towards and away from the shaped metallic body 2 so as to be positioned sealingly against the die 19 at the end of the positioning step and separated from it during a following step.

[0045] With reference to Figures 5, 6 and 7, the carriage 22 is provided with a first moulding plug 26 and a second moulding plug 27 which extend from a common base 28 fixed to the carriage 22 and are aligned with the first and second openings 15, 16, respectively. During the positioning step, the carriage 22 advances towards the shaped metallic body 2 so as to bring the base 28 against its side face 17. In this position, the first and second plugs 26, 27 penetrate through the respective openings 15, 16 and extend into the intake channel 12 and delivery channel 13 until they reach the pumping chamber 3. The first plug 26 and the second plug 27 are shaped so as to match the intake channel 12 and delivery channel 13 and are kept at a predefined distance from the conveying surface 14 in order to define the thickness of the plastic layer 18.

[0046] The counter-die 21 is arranged above the die 19 and the base 28 of the carriage 22 opposite the second face 7 of the shaped metallic body 2. Preferably, the counter-die 21 has a first inclined wall 38 which is intended to engage with a corresponding second inclined wall of the carriage 22 so as to push the latter against the shaped metallic body 2.

[0047] According to an important aspect of the present invention, the counter-die 21 has a convexity 29 which is correspondingly shaped to match the substantially semi-spherical cap-shaped concavity 10 of the pumping chamber 3 and is kept at the predefined distance from the conveying surface 14. The counter-die 21 also has two projecting portions 30 which are intended to be inserted into the intake mouth 4 delivery mouth 5 until they engage mechanically with the two plugs 26, 27, forming a single continuous body with them. These projecting portions 30 are also kept at the predefined distance from the conveying surface 14 of the shaped metallic body 2 so as to allow moulding of the plastic layer 18 to the desired thickness.

[0048] The aforementioned predefined distance, which corresponds to the thickness of the plastic layer 18, is chosen within the range of 2 to 4 millimetres and is preferably 3 millimetres in order to ensure correct moulding of the plastic layer 18 over the entire conveying surface 14. In fact, a smaller distance would not allow the plastic material, during the injection step, to be spread uniformly over the entire conveying surface 14, completely filling the cavity 23. This would result in the formation of interruptions or gaps in the plastic layer 18 which would no longer be able to provide a suitable seal against the chemical agents contained in the fluid to be pumped, as already considered above.

[0049] In order to overmould the plastic material only onto the conveying surface 14 of the shaped metallic body 2, the counter-die 21 is provided with peripheral sealing portions 32 adhering to corresponding areas on the second face 7 of the shaped metallic body 2 which surround the concavity 10 and the intake mouth 4 and delivery mouth 5 and which are not intended to come into contact with the fluid to be pumped. For the same reason the base 28 of the carriage 22 is kept against the side face 17 of the shaped metallic body 2 in areas which surround the openings 15 and 16.

[0050] The step for positioning the counter-die 21 and the carriage 22 is followed by a step for injecting the melted plastic into the cavity 23 defined by the conveying surface 14 of the shaped metallic body 2, by the counter-die 21 and by the carriage 22, in order to form the plastic layer 18. The injection of the plastic in fluid form is performed at pressures suitable for allowing said plastic to flow uniformly into the cavity 23 and reach the entire conveying surface 14 to be coated. For this purpose, injection is preferably performed via a central duct 34 formed in the counter-die 21 in the region of the passage 42 formed in the pumping chamber 3.

[0051] Usefully, one of the internal projections 35 of the die 19 is arranged so as to close the recess 45 in the shaped metallic body 2, defining the head 43 of the projecting element 39.

[0052] After the plastic has filled the entire cavity 23, injection is interrupted and followed by a step for cooling the plastic layer 18, during which the latter solidifies, ad-

hering closely and permanently to the conveying surface 14 of the shaped metallic body 2.

[0053] This is then followed by a step involving removal of the carriage 22 and therefore of the counter-die 21 from the shaped metallic body 2 so as to allow extraction of the head 1 from the die 19 by means of a plurality of extractors which are activated passing through corresponding ducts 36 formed in the die 19 and in the mould-holder 20.

[0054] Advantageously, the method according to the present invention comprises a step for anodizing the shaped metallic body 2 after it has been extracted from the die 19. This anodization step involves formation of a thin film of oxide on the first and second faces 6, 7 of the shaped metallic body 2. This oxide film is sufficient to protect the shaped metallic body 2 of the head 1 against the action of atmospheric agents.

[0055] In accordance with the manufacturing method described above, the form of the plastic layer 18 is determined by the moulding plugs 26, 27 of the carriage 22, by the convexity 29, by the portions 30, 32 of the counter-die 21 and by the same conveying surface 14 of the shaped metallic body 2. Moulding of the plastic does not require, according to the present invention, provision of a mould for defining the form of the first face 6 of the head 1, as is instead required in the prior art mentioned, where the whole head is made externally of plastic. The die 19 envisaged in the method according to the present invention is in fact intended simply to receive and retain the shaped metallic body 2, and, therefore, the method according to the present invention is simpler to implement than the methods of the prior art, with a consequent reduction in the design costs and time.

[0056] Moreover, owing to the arrangement of the intake channel 12 and delivery channel 13 with the respective openings 15 and 16 on the same side face 17, a single carriage 22 may be used for moulding the plastic layer 18. This simplifies further the manufacturing method and reduces the associated production costs.

[0057] The invention thus described therefore achieves the predefined objects.

[0058] Obviously it may assume, in its practical embodiment, also forms and configurations different from that described above without thereby departing from the present scope of protection. Moreover, all the details may be replaced by technically equivalent parts and the forms, dimensions and materials used may be of any nature according to requirements.

Claims

1. Pump head (1) **characterized in that** it comprises:

- a shaped metallic body (2), having a surface (14) for conveying a fluid to be pumped, said surface defining:
  - o at least, in part, a pumping chamber (3);
  - o at least one intake channel (12), through which said fluid to be pumped enters said pumping chamber (3),
  - o and at least one delivery channel (13), through which said fluid to be pumped exits from said pumping chamber (3);
- a plastic coating layer (18), which is overmoulded, substantially exclusively, onto said conveying surface (14).

2. Pump head (1) according to Claim 1, **characterized in that** said plastic layer (18) has a thickness in the range of 2-4 mm and preferably of 3 mm.

3. Pump head (1) according to Claim 1, **characterized in that** said intake channel (12) and said delivery channel (13) extend from said pumping chamber (3) parallel to each other and terminate on a same face (7) of said shaped metallic body (2) in the form of an intake mouth (4) and a delivery mouth (5) arranged in the vicinity of the same side face (17) of said shaped metallic body (2).

4. Pump head (1) according to Claim 1, **characterized in that** said shaped metallic body (2) is made of aluminium.

5. Pump head (1) according to Claim 1, **characterized in that** said plastic layer (18) is made of polypropylene.

6. Pump head (1) according to Claim 1, **characterized in that** said plastic layer (18) comprises at least one projecting element (39) which defines an undercut (40) able to be firmly secured to the shaped metallic body (2).

7. Method for manufacturing a pump head (1) according to Claim 1, **characterized in that** it comprises the following operational steps:

- a step for manufacturing said shaped metallic body (2) substantially in the shaped form of said head (1);
- a step for positioning said shaped metallic body (2) inside a die (19) and above internal projections (35) of said die (19);
- a step for closing said die (19) with:
  - o at least one counter-die (21) provided with at least one convexity (29) opposite said pumping chamber (3);
  - o and at least one carriage (22) provided with two parallel plugs (26,27) suitable for insertion into said intake channel (12) and delivery channel (13);

said counter-die (21) and said carriage (22) form-coupling with each and with said die (19), thus closing said shaped metallic body (2) inside a moulding chamber so as to define at least one cavity (23) between said counter-die (21) and said carriage (22) on the one hand and said shaped metallic body (2) on the other hand;
- a step for injecting said melted plastic material into said at least one cavity (23) thus forming said plastic layer (18);
- a step for cooling said plastic layer (18);
- a step for removing said counter-die (21) and said carriage (22) for extraction of said head (1).

8. Method for manufacturing a pump head (1) according to Claim 7, **characterized in that** it comprises a step for preheating said shaped metallic body (2) prior to said step for positioning said shaped metallic body (2).

9. Method for manufacturing a pump head (1) according to Claim 7, **characterized in that** said step for closing said die (19) is carried out by advancing said carriage (22) on a mould-holder (20), causing said plugs (26, 27) to penetrate inside said intake channel (12) and delivery channel (13) through a first opening and a second opening (15, 16) respectively, formed on said side face (17) of said shaped metallic body (2).

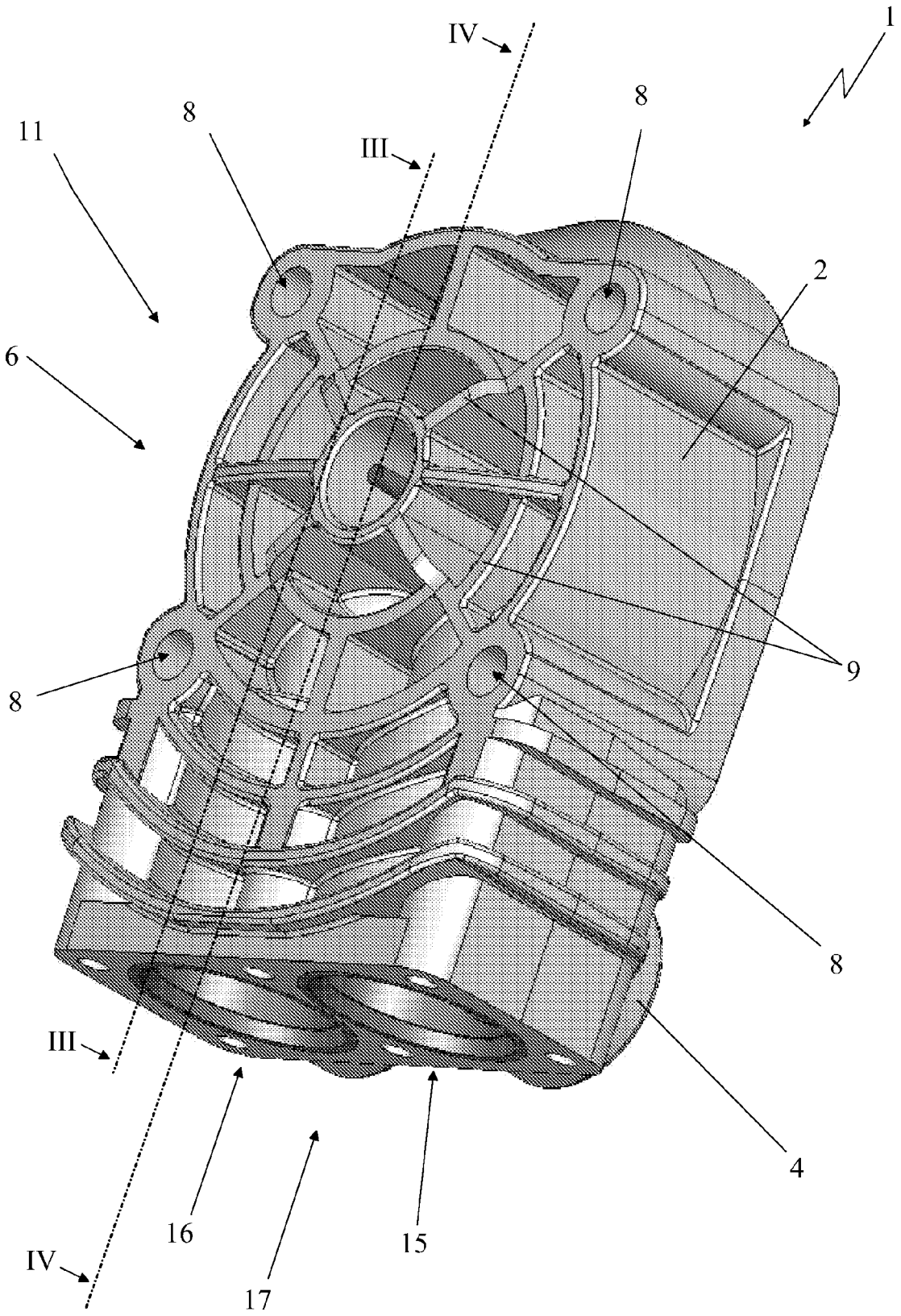

Fig. 1

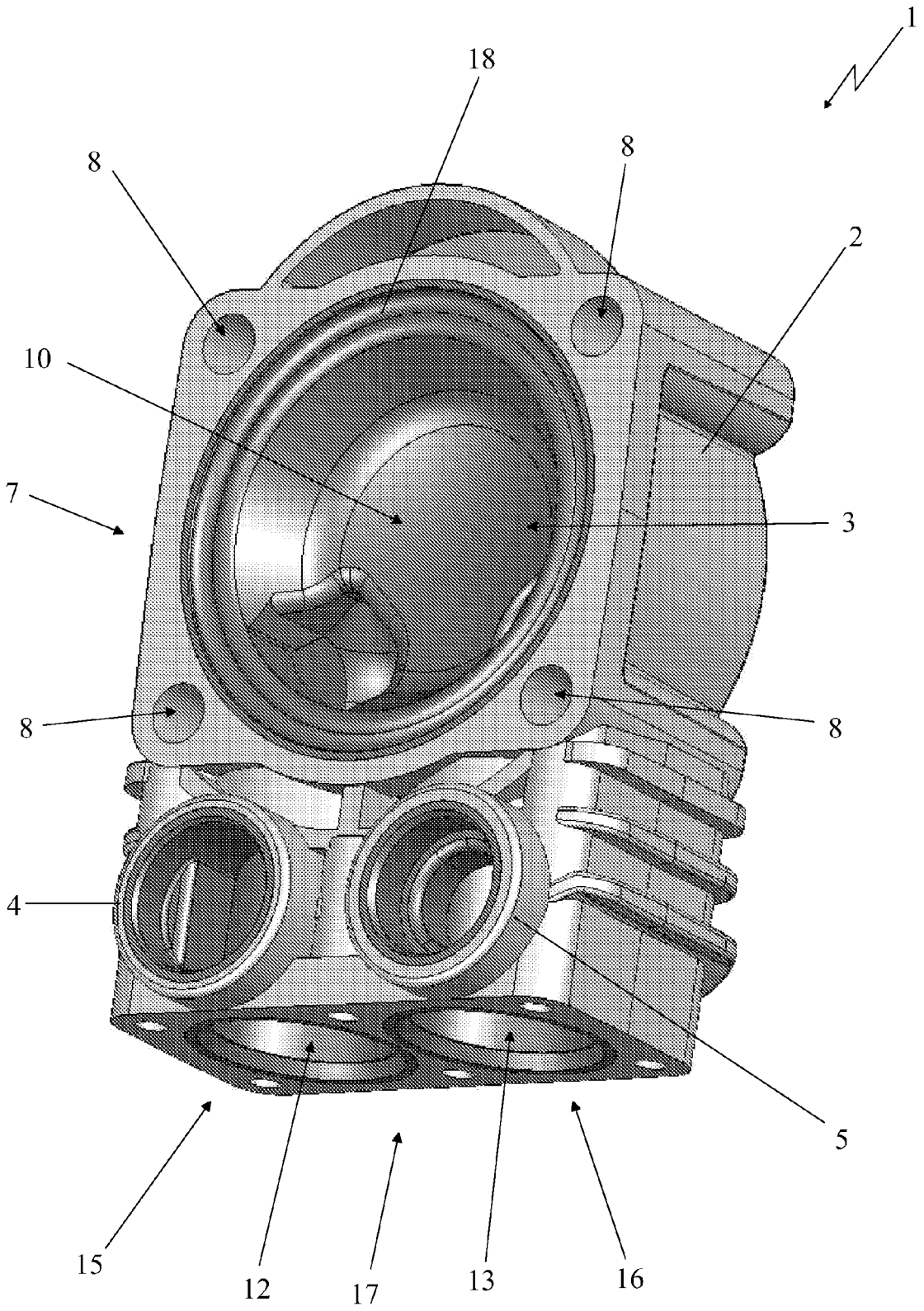

Fig. 2

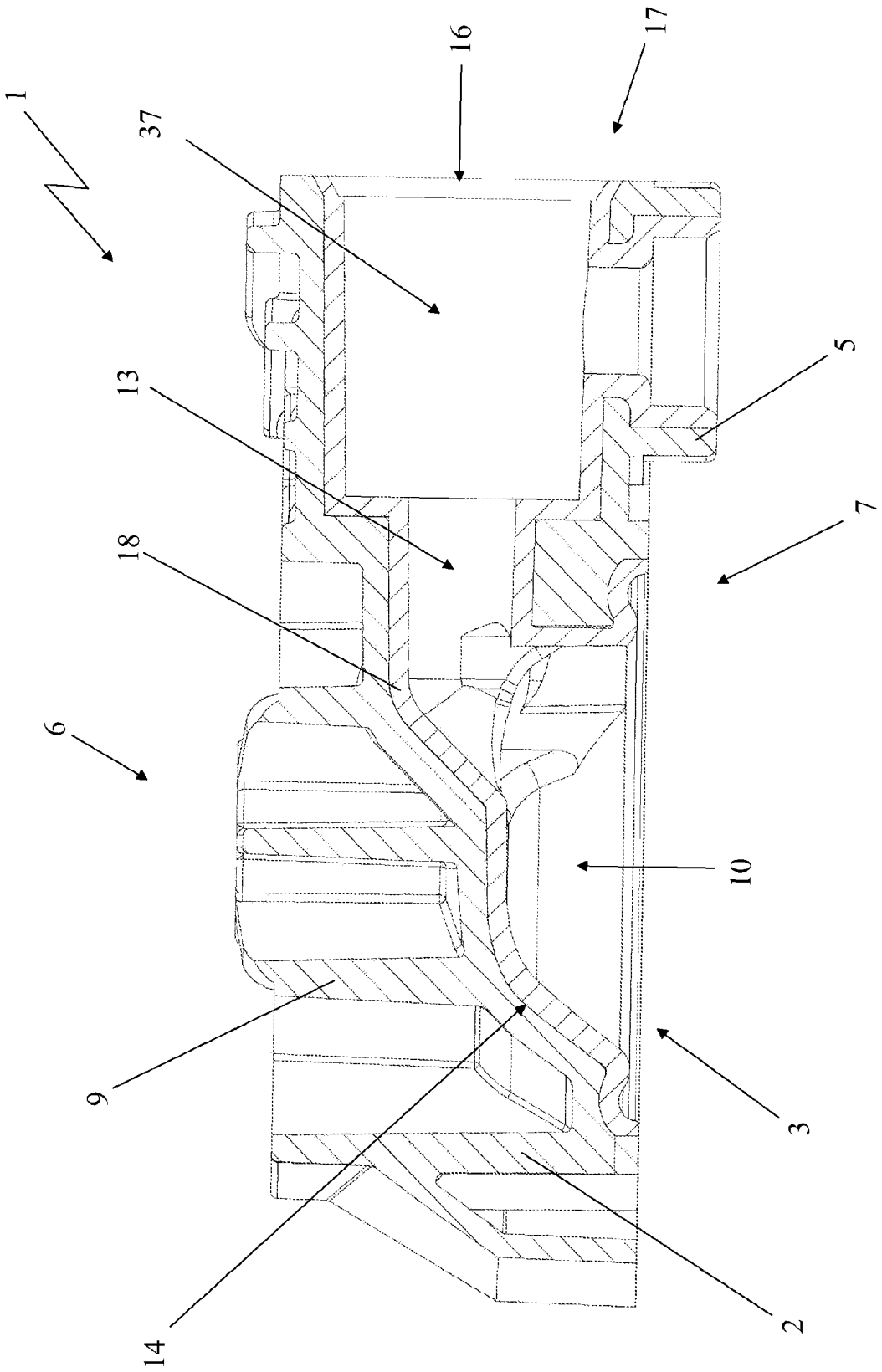

Fig. 3

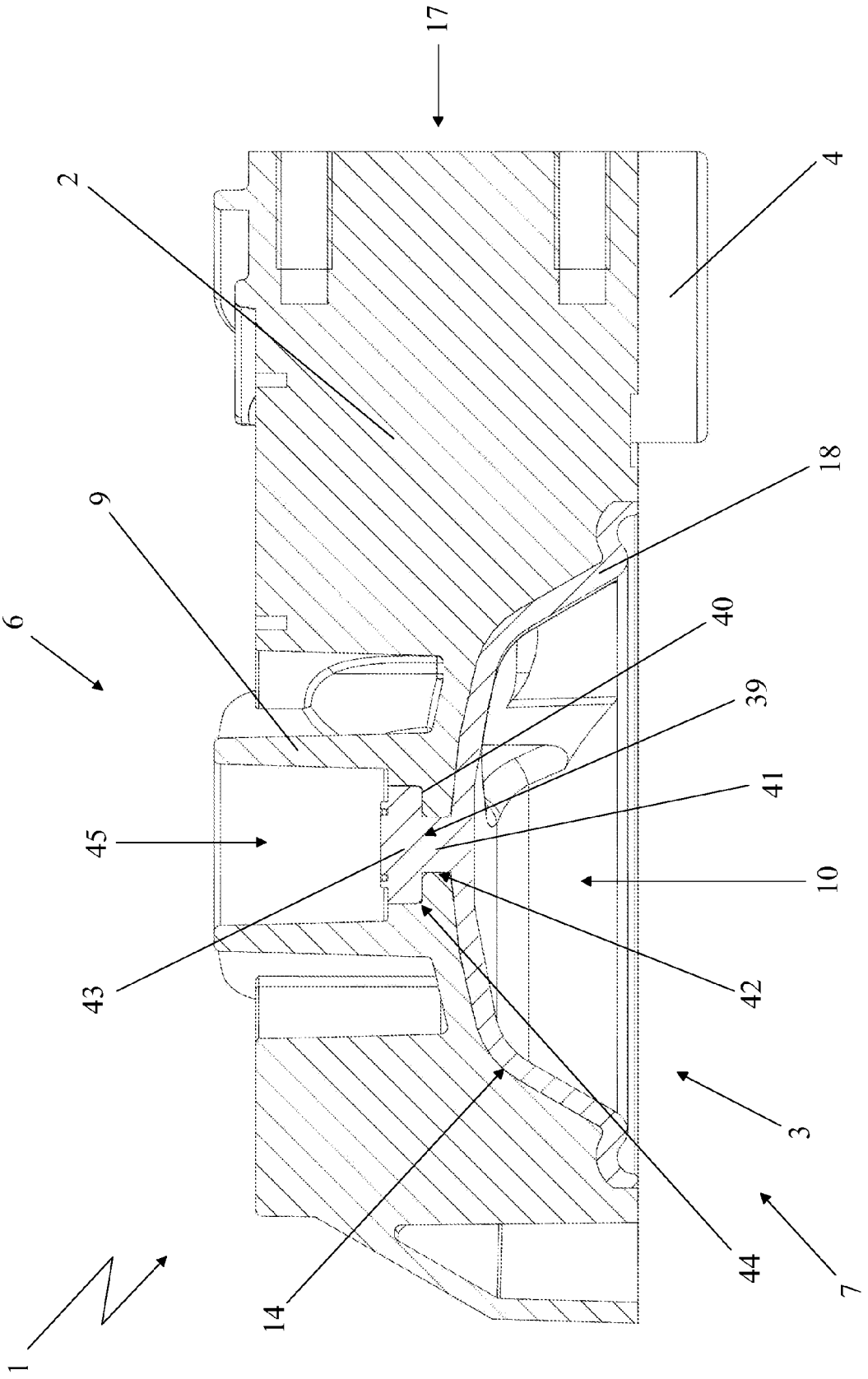

Fig. 4

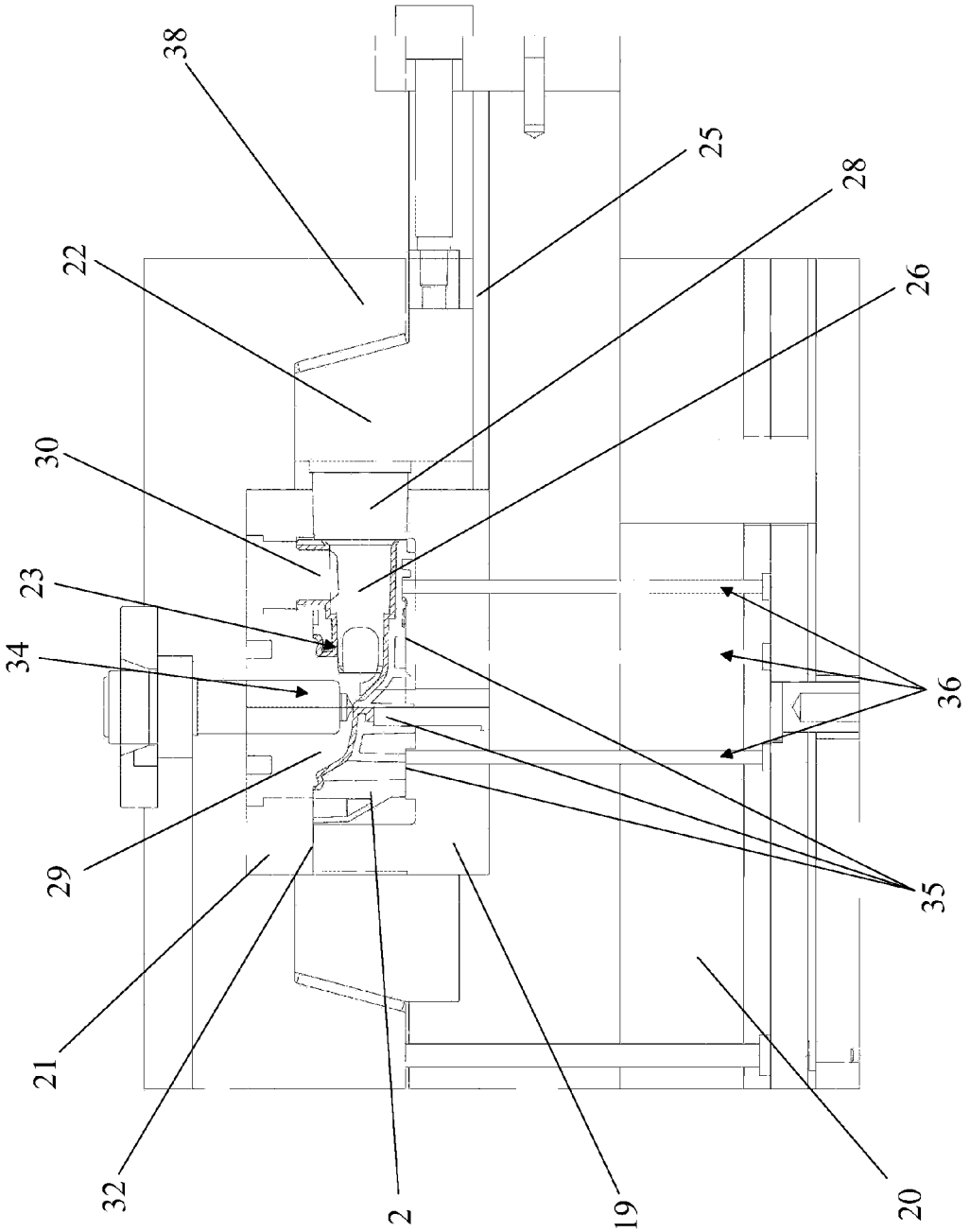

Fig. 5

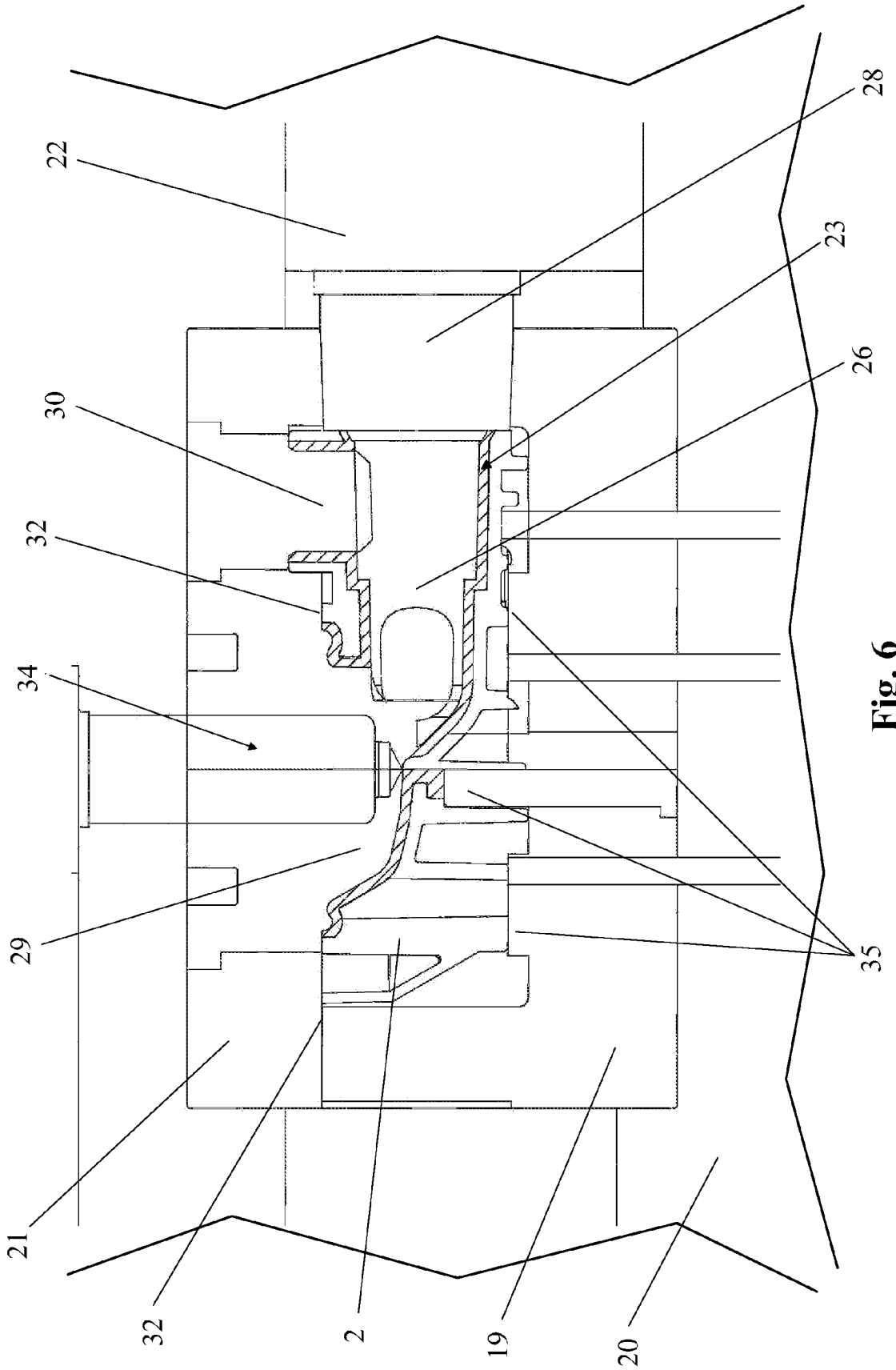

Fig. 6

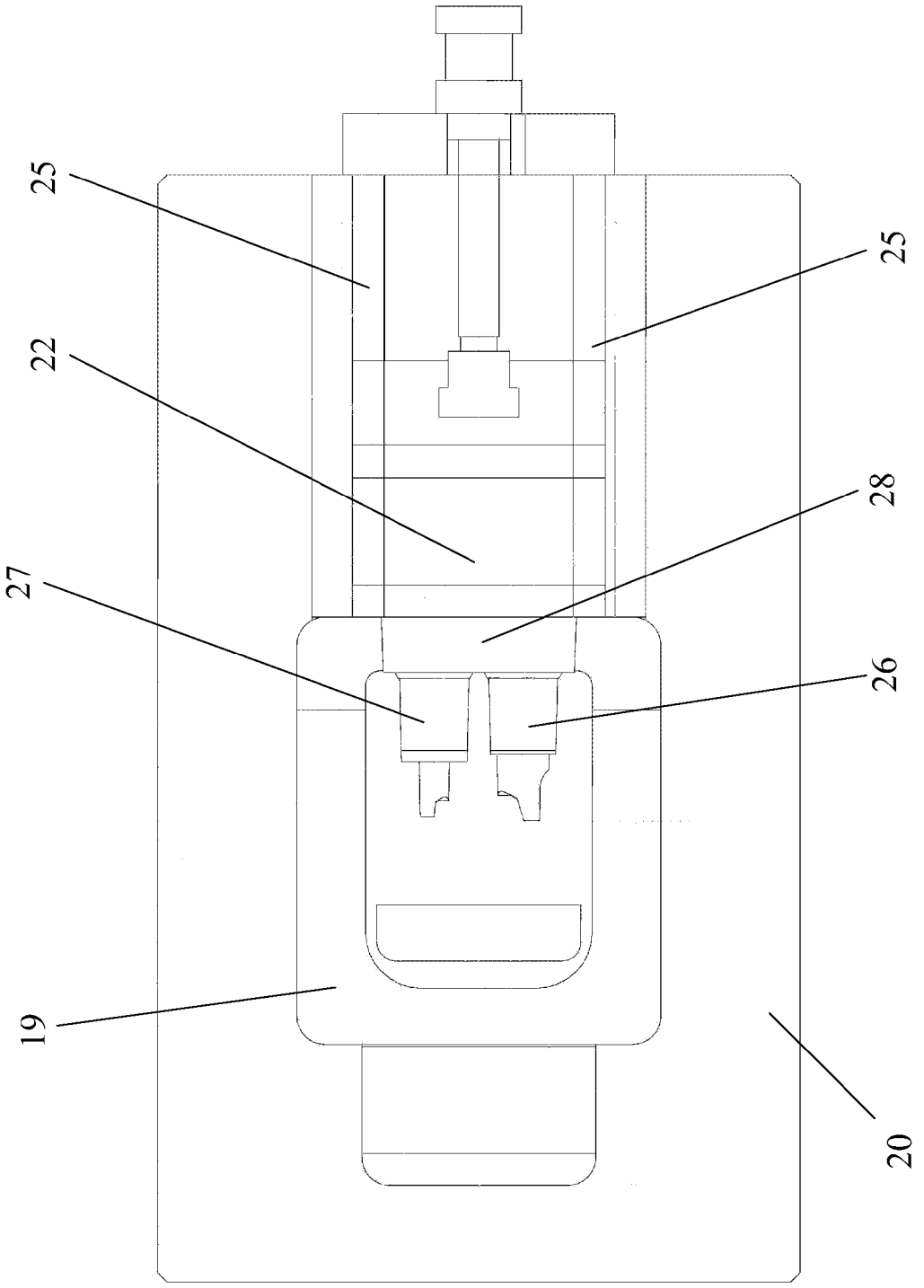

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 09 17 7762

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 10 2005 050009 A1 (KAERCHER GMBH & CO KG ALFRED [DE]) 12 April 2007 (2007-04-12) * abstract * * paragraphs [0003], [0006], [0014], [0015], [0025] - [0029], [0036] * * figures 1,2 *	1-9	INV. F04B15/04 F04B39/12 F04B53/00
X A	US 6 464 475 B1 (BERTOLINI MARIO [IT]) 15 October 2002 (2002-10-15) * column 1, lines 23-28 * * column 2, line 28 - column 3, line 18 * * figures 1-4 *	1,2,4-6 7	
X A	EP 0 308 541 A (KABUSHIKIKAISHA YAMADA CORP [JP]) 29 March 1989 (1989-03-29) * column 2, line 19 - column 3, line 6 * * figures 3-5 *	1,4,5 7	
X A	US 3 000 320 A (SANDIFORD RING) 19 September 1961 (1961-09-19) * column 2, line 39 - column 3, line 13 * * column 3, line 36 - column 4, line 11 * * figure 3 * * claim 1 *	1,2,6 7	TECHNICAL FIELDS SEARCHED (IPC) F04B
A	DE 42 13 841 A1 (RICHTER CHEMIE TECHNIK GMBH [DE]) 4 November 1993 (1993-11-04) * the whole document *	1,2,6,7	

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 2010	Gombert, Ralf

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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