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(54) **PUMP FOR PUMPING CORROSIVE FLUIDS**

(57) Pump for pumping corrosive fluids comprising two or more heads (2), each of which provided with a pumping chamber (3), with a suction channel (4) and with a dispensing channel (5), and such suction (4) and dispensing (5) channels are connected to the pumping chamber (3) in order to suction and dispense a corrosive fluid respective into and from the aforesaid pumping chamber (3). The pump also comprises a casing (6) made of metallic material, which carries the heads (2) mounted thereon and is provided with a feed circuit (7), placed in fluid communication with the suction channels (4) of the heads (2), and a delivery circuit (8), placed in fluid communication with the dispensing channels (5) of the heads (2). The feed circuit (7) and the delivery circuit (8) are provided with a first conveyance surface (43) for the corrosive fluid. In addition, the pump comprises a first shaped protection body (9) made of polymeric material, which is molded in a single body directly on top of the first conveyance surface (43).

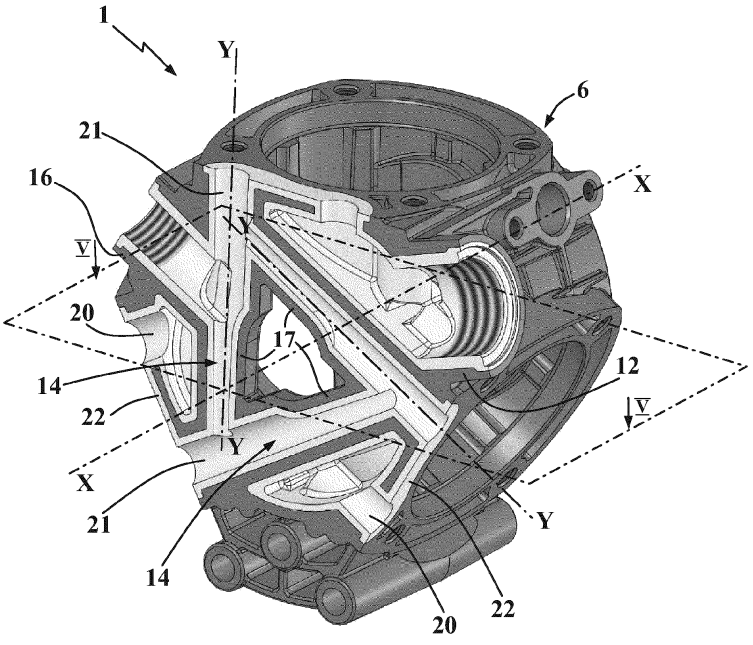

Fig. 4

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Description

Field of application

[0001] The present invention regards a pump for pumping corrosive fluids according to the preamble of the independent claim number 1.

[0002] The present pump is intended to be advantageously employed in making volumetric pumps, in particular of membrane or piston type, employable in particular in the agricultural field for the irrigation or disinfestation of the cultivations, i.e. also in other fields of the art where it is necessary to pump a corrosive liquid.

[0003] More in detail, the pump, object of the present invention, is of the type intended to process high flows of fluids having chemical characteristics of corrosion.

State of the art

[0004] In the field of production of volumetric pumps, it is known to mount multiple heads on a same casing, in particular so as to process large flows, reducing the discontinuities in the dispensing of fluid, which instead occurs with the single-head volumetric pumps.

[0005] In an entirely conventional manner, on each head of the pump there is a pumping chamber, whose volume is expanded and reduced by means of a corresponding membrane or a corresponding piston moved in reciprocating motion by actuator members housed inside the casing, e.g. cam or connecting rod-crank thrust mechanisms acting against the membrane or piston.

[0006] More in detail, the heads of the pump suction a fluid to be pumped through a suction channel thereof, placed in fluid communication with a feed source, for example with a tank. For such purpose the aforesaid actuator members move the corresponding membrane or the corresponding piston, cyclically increasing and reducing the volume of the pumping chamber, so as to expel the fluid through a dispensing channel for the distribution of the product, for example to be introduced on the ground.

[0007] Generally, such pump is placed in fluid communication with the tank of fluid to be pumped by means of a main feeding duct connected, at a first end thereof, to the tank itself and, at a second end thereof, to a first manifold, from which secondary multiple feeding ducts are branched, each in turn connected to a corresponding suction channel of one of the heads of the pump and, therefore, placed alongside of the casing once connected.

[0008] In an analogous manner, the aforesaid pump is placed in fluid communication with the dispenser by means of a main dispensing duct connected, at a first end thereof, to the dispenser itself and, at a second end thereof, to a second manifold from which multiples secondary dispensing ducts are branched, each in turn connected to a corresponding dispensing channel of one of the heads and, therefore, placed alongside the casing once connected.

[0009] An example of a pump of the abovementioned type is described in the document US 5,649,809.

[0010] The pump of known type briefly described up to now has in practice demonstrated that it does not lack drawbacks.

[0011] The main drawback lies in the fact that the connection of the pump to the tank and to the dispenser is complex and arduous and requires a considerable amount of time. Indeed, it is necessary to join the main feeding and dispensing ducts, respectively, with the tank and the dispenser on one side and with the corresponding manifolds on the other and joining the secondary feeding and dispensing ducts, respectively, with the suction and delivery channels of the heads.

[0012] A further drawback lies in the fact that the pump of known type is provided with a large bulk due to the plurality of ducts and manifolds which are extended outside the casing, which therefore complicate the use of the aforesaid pump in reduced spaces. In addition, such plurality of main and secondary feeding and dispensing ducts during use could easily be connected to obstacles that damage them or disconnect them from each other, leading to an accidental spreading of fluid to be pumped and the need to substitute the ducts themselves, in the event in which the ducts have been damaged, or to reconnect, in the event in which the ducts have been simply disconnected.

[0013] In order to at least partially overcome the problems of the above-described prior art, pumps with multiple heads are known having a casing provided with a feed circuit, placed in fluid communication with the suction channels of the heads in order to provide thereto the fluid to be pumped, and with a delivery circuit, placed in fluid communication with the dispensing channels of the heads in order to dispense the fluid pumped thereby, and such feed and delivery circuit define a conveyance surface for the fluid to be pumped.

[0014] In particular, the arranging of a delivery circuit and a feed circuit made directly on the casing allows considerably reducing the times necessary for connecting the heads to the tank and to the dispenser. Indeed, it is sufficient to employ only one feeding duct connected, at a first end thereof, to the tank and, at a second end thereof, to the feed circuit of the casing in order to place the suction channels of the heads in fluid communication with the tank. In addition, in an entirely analogous manner, it is sufficient to employ only one dispensing duct connected, at a first end thereof, to the dispenser, and, at a second end thereof, to the delivery circuit in order to place the dispensing channels of the heads in fluid communication with the dispenser. In addition, the pump with feed and delivery circuits made directly on the casing have a lower bulk with respect to the pumps that lack these and they have a greater reliability. Nevertheless, also the pump with feed and delivery circuit incorporated in the casing briefly described up to now has in practice demonstrated that it does not lack drawbacks.

[0015] The main drawback lies in the fact that, for sev-

eral applications, especially intended for the agricultural field, the fluid to be pumped is an insecticide agent, an herbicide, a fertilizer or a similar product, and hence always an aqueous solution containing chemical compounds capable of deteriorating and corroding the metallic materials with which the casing of a pump is normally made.

[0016] Therefore, the continuous pumping of one such corrosive fluid involves a progressive damaging of the conveyance surface of the casing which can even lead to the formation of perforations, from which the corrosive fluid itself could flow out in an uncontrolled manner, with the consequent risk that such corrosive fluid accidentally enters in contact with the actuator members of the heads, ruining them.

[0017] The document DE 102005050009 describes a pump of known type comprising a head formed by multiple parts fixed together and adapted to define the pumping chamber and the suction and delivery ducts. Each of the aforesaid parts of the head is internally covered by a corresponding separate protection layer made of plastic material.

[0018] The document US 6,464,475 describes a further pump of known type provided with a head which comprises a body made of plastic material which defines the pumping chamber and the suction and delivery ducts, and an internal framework made of metallic material embedded in the plastic material body in order to confer greater structural strength to the latter.

[0019] The latter solutions of known type, even if they allow better protecting the pump from corrosion, cannot be optimized for all applications.

Presentation of the invention

[0020] In this situation, the problem underlying the present invention is therefore that of eliminating the problems of the abovementioned prior art, by providing a pump for pumping corrosive fluids, in which the conveyance surface of the casing is not corroded by the fluid to be pumped.

[0021] A further object of the present invention is to provide a pump for pumping corrosive fluids, which ensures that the actuator members housed inside the casing do not come into contact with the fluid to be pumped, in the event in which the casing itself is corroded and damaged by the corrosive fluid.

[0022] A further object of the present invention is to provide a pump for pumping corrosive fluids, which is entirely reliable in operation.

[0023] A further object of the present invention is to provide a pump for pumping corrosive fluids, which is entirely safe over time.

Brief description of the drawings

[0024] The technical characteristics of the invention, according to the aforesaid objects, can be clearly seen in the contents of the below-reported claims and the advantages thereof will be more evident in the following detailed description, made with reference to the enclosed drawings, which represent a merely exemplifying and non-limiting embodiment of the invention, in which:

- figure 1 shows a perspective view of a pump for pumping corrosive fluids according to the present invention;
- figure 2 shows a perspective view of a head of the pump of figure 1;
- figure 3 shows a perspective view of the pump of figure 1 with first shaped protection body represented detached from the casing of the pump and with the heads removed in order to better show other parts of the pump;
- figure 4 shows a perspective view of the pump of figure 1 sectioned at a plane passing through feed circuit and dispensing circuit and with the heads removed in order to better show other parts of the pump;
- figure 5 shows a sectional schematic view of the pump of figure 1, attained along the plane V-V shown in figure 4.

Detailed description of a preferred embodiment

[0025] With reference to the enclosed figures, reference number 1 overall indicates a pump for pumping corrosive fluids according to the present invention.

[0026] The present invention has particular application in the industrial field of production of volumetric pumps with multiple heads for corrosive fluids, which must be able to pump fluids having chemical characteristics of corrosion against the metallic materials generally employed for producing the components of the pumps themselves.

[0027] In particular, the present pump 1 is advantageously intended to be employed in the agriculture field, so as to pump herbicide agents, insecticides or fertilizers that must be dispensed on a cultivated terrain, i.e. aqueous solutions containing chemical compounds with corrosive properties.

[0028] More in detail, the present pump 1 for pumping corrosive fluids comprises two or more heads 2, each of which provided with a pumping chamber 3, with a suction channel 4 and with a dispensing channel 5.

[0029] As will be discussed more in detail hereinbelow, in accordance with the embodiment illustrated in the enclosed figures, the pump 1 has three heads 2 placed at 120° with respect to each other.

[0030] The suction 4 and dispensing 5 channels are connected to the pumping chamber 3 in order to suction and dispense the corrosive fluid respectively into the pumping chamber 3 and from the pumping chamber 3.

[0031] The pump 1 also comprises a casing 6 made of metallic material, carrying the heads 2 mounted thereon and provided with a feed circuit 7, placed in fluid

communication with the suction channels 4 in order to feed the heads 2 with the fluid to be pumped, and with a delivery circuit 8, placed in fluid communication with the dispensing channels 5 in order to distribute the aforesaid corrosive fluid dispensed by the heads 2, and such feed circuit 7 and delivery circuit 8 are provided with a first conveyance surface 43 for the corrosive fluid itself. In order to render the casing 6 - one of the heaviest components of the present pump 1 - as light as possible, the casing 6 itself is advantageously made of aluminum and, more preferably, of an alloy thereof.

[0032] In accordance with the preferred embodiment illustrated in the enclosed figures, the casing 6 has substantially prismatic form, is extended along a main extension axis X between a first base 25 and a parallel second base 26 and is provided with multiple lateral faces 27, in particular one for each head 2 of the present pump 1, substantially planar, parallel to the main extension axis X and perpendicular to the first and second bases 25, 26.

[0033] In addition, each head 2 advantageously comprises a shaped body 28 provided with a rear face 29, directed in the opposite sense with respect to the casing 6 and thus intended to remain visible, and with a front face 30, which, like the lateral faces 27 of the casing 6, has substantially planar extension in order to be mechanically connected to one of these lateral faces 27. For such purpose, between the rear face 29 and the front face 30, multiple through holes 31 are preferably made on the shaped body 28 of the head 2, and multiple threaded holes 32 are made on each lateral face 27 of the casing 6, corresponding to the through holes 31 of the heads 2 in order to make a bolted connection between each head 2 and the casing 6. Preferably, the pumping chamber 3 of each head 2 is made by means of a concavity with substantially cap-like shape on the front face 30 and is closed by a membrane (not illustrated) advantageously retained between the shaped body of the head 2 itself and the casing 6. More in detail, the aforesaid membrane is movable by actuator members (not illustrated), advantageously housed in a containment volume 42 made inside the casing 6. The aforesaid actuator members move the membrane in order to increase the volume of the pumping chamber 3 and hence suction therein the corrosive fluid to be pumped through the corresponding suction channel 4 and in order to decrease the volume of the pumping chamber 3 itself and hence dispense the corrosive fluid through the corresponding dispensing channel 5 in a reciprocating manner.

[0034] More in detail, the actuator members comprise connecting rod-crank or cam thrust mechanisms mechanically connected to the membranes, which are generally known by the man skilled in the art and therefore are not better described hereinbelow.

[0035] Otherwise, the actuator members can comprise pneumatic or hydraulic circuits arranged for moving the membranes by exerting on the face of each of these, directed opposite the corresponding pumping chamber 3, a pressure and a reduced pressure that are alternated with each other.

[0036] In accordance with a further embodiment not illustrated in the enclosed figures, the pumping chambers 3 of the heads 2 can have substantially cylindrical shape and be closed by pistons slidably inserted within the pumping chambers 3 themselves.

[0037] According to the idea underlying the present invention, the pump 1 comprises a first shaped protection body 9 made of polymeric material, which is molded in a single body directly on top of the first conveyance surface 43.

[0038] Advantageously, the polymeric material is a chemically inert polymeric material.

[0039] In particular, with the expression "chemically inert" it is to be intended a plastic material capable of resisting corrosion by the corrosive fluids intended to be moved by the pump 1.

[0040] In particular, the shaped protection body 9 is directly placed to cover the first conveyance surface 43 of the casing 6, i.e. that surface of the casing 6 that is wet by the liquid to be pumped. Such conveyance surface of the casing 6 is defined by the feed circuit 7 and by the delivery circuit 8 which are, during use, intended to be wet by the corrosive fluid to be pumped. Consequently, the metallic material constituting the casing 6 is protected from the corrosive action of the fluid to be pumped by means of the aforesaid shaped protection body 9, made of polymeric material, and more particularly plastic that is chemically inert with respect to the corrosive fluid to be pumped, and hence provided with an improved resistance to corrosion with respect to the metallic material of the casing 6. Therefore, the molding of the shaped protection body 9 on the first conveyance surface 43 ensures optimal chemical resistance performances for the covered casing 6. Advantageously, the first shaped protection body 9 also at least partly collaborates with the mechanical structure of the casing 6 such that it is possible to decrease the layer made of metallic material and thus have a savings in terms of metallic material employed as well as in terms of weight of the casing 6.

[0041] Advantageously, the first shaped protection body 9 is made of polypropylene, so as to ensure that the casing 6 covered thereby has an optimal chemical resistance towards the substances contained in the fluid to be pumped, which, without such first shaped protection body 9 made of polymeric material, and more particularly chemically inert plastic, would deteriorate the metallic material of the casing 6 itself.

[0042] Otherwise, the first shaped protection body 9 can be made of polyparaphenylene sulfide (PPS), polyether-ether-ketone (PEEK), polytetrafluoroethylene (PTFE), or any other polymeric material, in particular a thermoplastic technopolymer, selected based on the chemical characteristics of the particular corrosive fluid to be pumped.

[0043] In particular, the polypropylene is selected as polymeric material also to ensure, in addition to a suitable chemical resistance, a good adherence of the first

shaped protection body 9 to the metallic material of the casing 6 without cracks occurring in the presence of the strong pressures to which the casing 6 is subjected during the operation of the present pump 1. In addition, such polymeric material at the molten state has, during the molding in a single body of the first shaped protection body 9, a fluidity sufficient for reaching the entire first conveyance surface 43, which is provided with a complex geometry since it is defined by the feed circuit 7 and delivery circuit 8 which must distribute the fluid to be pumped respectively to multiple heads 2 and from the same heads 2.

[0044] Advantageously, the first shaped protection body 9 has a thickness comprised in the 1 - 5 mm interval, preferably 2 - 4 mm and, still more preferably, substantially equal to 3 mm. In particular, a thickness of the first shaped protection body 9 smaller than 1 mm would require, during molding, the arranging of one or more counter-molds defining, with the first conveyance surface 43 to be covered, an opening so thin that the load and friction losses that occurred with the passage of the polymeric material into the opening would prevent or make it hard to attain the correct flow of the polymeric material itself on the entire first conveyance surface 43. Therefore, in case of thickness smaller than 1 mm, there is a high risk that a first shaped protection body 9 will be produced that does not completely cover the first conveyance surface 43. In addition, a thickness of the first shaped protection body 9 smaller than 1 mm would not ensure the seal against the chemical agents due to the inevitable porosity and the always-present surface defects of the constituent polymeric material, through which the corrosive fluid to be pumped would come into contact with the metallic material of the casing 6, deteriorating it via corrosion. On the other hand, a thickness of the first shaped protection body 9 greater than 5 mm would not lead to any practical advantage, hence involving a waste of material and a useless increase of the production costs.

[0045] Of course, without departing from the protective scope of the present patent, the polymeric material for making the first shaped protection body 9 can also be of any other polymer that is non-corrodible by the fluids generally employed in the agricultural field and intended to be spread on a cultivated terrain, which are well known to the man skilled in the art and are different from the abovementioned polypropylene.

[0046] Advantageously, the pumping chamber 3, the suction channel 4 and the dispensing channel 5 of each head 2 are provided with a second conveyance surface for the corrosive fluid and each head 2 comprises a second shaped protection body 10 made of polymeric material, which is molded in a single body directly on top of the aforesaid second conveyance surface.

[0047] In this manner, each head 2 can be provided with a shaped body 28 made of metallic material, in a manner such that the head 2 itself is provided with a mechanical strength suitable for sustaining the high pressures that are developed during the operation of the present pump 1, without the metallic material constituting each head 2 being deteriorated by the corrosive action of the fluid to be pumped since it is protected by the second shaped protection body 10. Therefore, the maintenance on the pump 1 is considerably reduced, since the second shaped protection body 10 made of chemically inert polymeric material prevents the head 2 from being deteriorated by the corrosive fluid to be pumped and the shaped body 28 made of metallic material of the head 2 usually withstands breakage or deformation by the mechanical stresses to which the head 2 itself is subjected in operation, in a manner entirely similar to the casing 6, which is in turn made of metallic material but provided with the first shaped protection body 9 in order to not be deteriorated by the corrosive action of the fluid to be pumped.

[0048] Similar to the casing 6 and to its first shaped protection body 9, the shaped body of each head 2 is preferably made of aluminum or of an alloy thereof and the second shaped protection body 10 is made of polypropylene.

[0049] In accordance with an embodiment not illustrated in the enclosed figures, each head 2 can be made via overmolding of chemically inert polymeric material on an internal framework made of metallic material, such that the aforesaid internal framework at any rate ensures good mechanical strength characteristics to the head 2 and that the external surface of the head 2 in its entirety, and not only at the second conveyance surface, is made of the aforesaid polymeric material.

[0050] Advantageously, the feed circuit 7 of the casing 6 advantageously comprises a first manifold volume 11, at least one inlet duct 12 placed in fluid communication with the first manifold volume 11 and at least one first connector channel 13 for each head 2. More in detail, each first connector channel 13 is placed in fluid communication with the first manifold volume 11 and with the suction channel 4 of the corresponding head 3 in order to feed it with the corrosive fluid collected in the first manifold volume 11.

[0051] Preferably, the inlet duct 12 allows the connection of the feed circuit 7 to a source of the corrosive fluid to be pumped, such as for example a tank of fertilizing agents, herbicides or pesticides that must be spread on a cultivated terrain. In particular, the shaped protection body 9 at the inlet duct 12 is internally provided with a thread or with multiple grooves, so as to ensure a coupling via screwing or shape coupling to a feed tube joined to the aforesaid fluid tank.

[0052] In particular, the arrangement of the first manifold volume 11 allows collecting the corrosive fluid to be pumped before being suctioned into the pumping chamber 3 of each head 2 through the corresponding first connector channel 13 of the feed circuit 7 and the corresponding suction channel 4 of the head 2 itself, therefore acting as a tank for the fluid to be pumped upstream of the heads 2.

[0053] In addition, the delivery circuit 8 of the casing 6

advantageously comprises a second manifold volume 14, at least one second connector channel 15 for each head 2 and at least one delivery duct 16 placed in fluid communication with the second manifold volume 14. More in detail, each second connector channel 15 is placed in fluid communication with the second manifold volume 14 and with the dispensing channel 5 of the corresponding head 2 in order to distribute the corrosive fluid from the corresponding head 2 to the second manifold volume 14.

[0054] Preferably, the delivery duct 16 allows the connection of the delivery circuit 8 to a dispenser of the corrosive fluid to be pumped, such as for example a plurality of sprayers arranged for spraying fertilizing agents, pesticides or herbicides on a cultivated terrain. In particular, the shaped protection body 9 at the delivery duct 16 is internally provided with a thread or with multiple grooves, so as to ensure a coupling via screwing or shape coupling to a delivery tube joined to the aforesaid dispenser.

[0055] In particular, the arrangement of the second manifold volume 14 allows collecting the corrosive fluid coming from the pumping chamber 3 of each head 2 through the corresponding dispensing channel 5 of the head 2 itself and the corresponding second connector channel 15 of the delivery circuit 8 before being delivered into the delivery duct 16, therefore acting as a tank for the fluid to be pumped downstream of the heads 2 and upstream of the delivery duct 16 itself.

[0056] Advantageously, the first connector channel 13 and the second connector channel 15 corresponding to a same head 2 are at least partly extended parallel to each other.

[0057] In addition, the first shaped protection body 9 advantageously comprises multiple first tubular portions 20, each placed as an internal covering of a first connector channel 13 and multiple second tubular portions 21, each placed as an internal covering of a second connector channel 15.

[0058] In accordance with the preferred embodiment illustrated in the enclosed figures, each first connector channel 13 is extended through the casing 6 along a direction perpendicular to the lateral face 27 carrying the corresponding head 2 mounted thereon starting from the first manifold volume 11 up to emerging with a feed mouth 33 made on the same lateral face 27. Analogously, also each second connector channel 15 is extended, at least for part of its length, along a direction perpendicular to the lateral face 27 carrying the corresponding head 2 mounted thereon and emerges with a reception mouth 34 made on the same lateral face 27 itself and placed adjacent to the feed mouth 33 of the corresponding first connector channel 13.

[0059] In this manner, it is possible to make the first and second tubular portion 20, 21 of a first and second connector channel 13, 15 corresponding to a same head 2 simply by means of the insertion of counter-molds having rectilinear and parallel extension, and that therefore they can be integral with each other or also be made in a single body, and by means of the injection of the polymeric material at the molten state into the opening formed between each counter-mold and the respective first or second connector channel 13, 15.

[0060] In addition, since the feed mouth of the first connector channel 13 and the reception mouth of the second connector channel 15 are made adjacent to each other on the lateral face of the casing 6 on which the corresponding head 2 is mounted, the suction 4 and dispensing 5 channels of each head 2 are preferably extended starting from the corresponding pumping chamber 3 and both emerge on the front face 30 of the shaped body 28 of the head 2 itself respectively with a suction mouth 35, corresponding to the feed mouth 33 of the first connector channel 13, and a dispensing mouth 36, corresponding to the reception mouth 34 of the second connector channel 15. The aforesaid suction 35 and dispensing 36 mouths are placed side-by-side on the front face 30 and at the same distance at which the feed mouth 33 and the reception mouth 34 are placed from each other.

[0061] In this manner, the fluid communication is therefore ensured between the first connector channels 13 of the feed circuit 7 and the suction channels 4 of the heads 2 and between the second connector channels 15 of the delivery circuit 8 and the dispensing channels 5 of the heads 2, without having to arrange ducts outside the casing 6 itself.

[0062] Advantageously, the second manifold volume 14 is obtained with multiple collection ducts 17, advantageously tilted with respect to each other, one for each head 2, which are connected to each other two-by-two.

[0063] In accordance with the preferred embodiment illustrated in the enclosed figures, there are three heads 2 and the second manifold volume 14 is obtained with three collection ducts 17 connected to each other two-by-two in a triangular configuration.

[0064] More in detail, the aforesaid three heads 2 are advantageously equally distributed around the main extension axis X of the casing 6 at 120° intervals between adjacent heads 2.

[0065] Otherwise, there can be more than three heads 2, e.g. four, and the second manifold volume 14 can be obtained with four collection ducts 17 connected to each other two-by-two in a square configuration.

[0066] More in detail, each collection duct 17 is preferably extended starting from a corresponding second connector channel 15 along a same extension direction Y up to intersecting another adjacent collection duct 17. In addition, each second tubular portion 21 of the first shaped protection body 9 is extended as an internal covering of the collection duct 17 at the corresponding second connector channel 15.

[0067] In this manner, the attainment of the first shaped protection body 9 at the second manifold volume 14 can be executed for each collection duct 17 by employing the same counter-mold of the respective second connector channel 15. The aforesaid counter-mold must therefore have rectilinear extension and length substantially equal

to that of the second connector channel 15 and of the corresponding collection duct 17.

[0068] In addition, during the injection of the polymeric material at the molten space in the openings defined between the counter-mold and second connector channel 15 and collection duct 17, each counter-mold will have its own free end placed in abutment against the counter-mold inserted in an adjacent second connector duct 15 and collection duct 17, such that the polymeric material at the molten state cannot insert itself therebetween and hence that the fluid communication between adjacent collection ducts 17 will not be prevented once the polymeric material has solidified.

[0069] In addition, the delivery duct 16 of the delivery circuit 8 is preferably extended starting from one of the collection ducts 17 with rectilinear extension through the casing 6 and, therefore, the first shaped protection body 9 comprises a third tubular portion 37 placed as an internal covering of the aforesaid delivery duct 16.

[0070] More in detail, such third tubular portion 37 is made during molding only by means of the insertion of a suitable counter-mold having extension in turn rectilinear and length substantially equal to that of the delivery duct 16 itself and by means of the injection of the polymeric material at the molten state in the opening defined between the suitable counter-mold and the delivery duct 16. Such counter-mold inserted in the delivery duct 16 will have, during molding, its free end placed in abutment against the counter-mold of the collection duct 17 and of the second connector duct 15 with which it intersects, such that the polymeric material at the molten state cannot be inserted therebetween and hence that the fluid communication between second manifold volume 14 and delivery duct 16 itself cannot be prevented once the polymeric material is solidified for forming the first shaped protection body 9.

[0071] Advantageously, the external surface of the second connector channels 15 and of the collection ducts 17 of said delivery circuit 8 at least partially delimit the first manifold volume 11 of said feed circuit 7. In addition, the first shaped protection body 9 comprises multiple concave portions 23 for collecting the corrosive fluid and multiple convex portions 24 placed as an external covering of the second connector channels 15 and of the collection ducts 17 and connected to the concave portions 23.

[0072] In accordance with the preferred embodiment illustrated in the enclosed figures, the first manifold volume 11 has substantially circular shape, in section transverse to the main extension axis X of the casing 6, and is made adjacent to the first base 25. In addition, the casing 6 is preferably provided with an access opening 38 made on the same first base 25 thereof having the same shape and size of the first manifold volume 11 in section.

[0073] In this manner, during molding, it is possible to make the first shaped protection body 9 at the first manifold volume 11 only by means of the insertion through the access opening 38 of a counter-mold substantially counter-shaped with respect to the external surface of the second connector channels 15 and of the collection ducts 17 and to the internal surface of the casing 6, which delimits together with the second connector channels 15 and with the collection ducts 17 the first manifold volume 11, and by means of the injection of the polymeric material in the opening formed between the aforesaid counter-mold and the casing 6.

[0074] In addition, still during molding, the counter-molds inserted in the first connector ducts 13 for forming the first tubular portions 20 will be placed with the free end thereof in abutment against the the counter-mold inserted through the access opening, in a manner such that the polymeric material at the molten state is not inserted therebetween, coming to prevent the fluid communication between the first manifold volume 11 and the first connector channels 13 once the polymeric material is solidified for forming the first shaped protection body 9. Preferably, the inlet duct 12 of the feed circuit 7 is extended starting from the first manifold volume 11 with rectilinear extension through the casing 6 and, therefore, the first shaped protection body 9 comprises a fourth tubular portion 39 placed as an internal covering of the aforesaid inlet duct 12.

[0075] More in detail, such fourth tubular portion 39 is attained during molding only by means of the insertion of a suitable counter-mold having extension in turn rectilinear and length substantially equal to that of the feeding duct 12 itself and by means of the injection of the polymeric material at the molten state into the opening defined between the suitable counter-mold and the feeding duct 12. In a manner entirely analogous to the counter-molds inserted in the first connector channels 13, during molding, such counter-mold inserted in the feeding duct 12 will have the free end thereof placed in abutment against the counter-mold inserted through the access opening 38 for forming concave 23 and convex 24 portions of the first shaped protection body 9.

[0076] Advantageously, the collection ducts 17 of the second manifold volume 14 centrally delimit a through opening 18.

[0077] More in detail, such through opening 18 allows the insertion of the rotary shaft (not illustrated) of a motor in the containment volume 42 made inside the casing 6, such rotary shaft arranged for driving the actuator members of the membranes of each head 2.

[0078] Preferably, the rotary shaft of the motor is sealingly inserted in the delimited through opening 18 of the collection ducts 17, in a manner such that, during the operation of the present pump 1, the corrosive fluid that is pumped through the first manifold volume 11 does not flow out therefrom through the through opening 18 itself and comes to deteriorate the actuator members housed in the containment volume 42 of the casing 6.

[0079] In addition, the counter-mold employed during molding in order to define the concave portions 23 and the convex portions 24 placed to cover the external sur-

face of the second connector channels 15 and of the collection ducts 17 in the first manifold volume 11 must be provided with an obstruction portion insertable in the through opening 18 in order to prevent the polymeric material at the molten state from flowing through the through opening 18 towards the interior of the containment volume 42 of the present pump 1.

[0080] In addition, the first manifold volume 11 of the feed circuit 7 is preferably closed at the access opening by a cover (not illustrated), which is made at least at one face thereof directed towards the first manifold volume 11 itself with a polymeric material, preferably chemically inert with respect to the fluids intended to be pumped by the pump 1.

[0081] More in detail, such cover can for example be made of metallic material and be covered with the polymeric material only at the face thereof directed towards the first manifold volume 11 or over the entire surface thereof, or it can be completely made of the aforesaid polymeric material.

[0082] Therefore, during use, the corrosive fluid to be pumped is collected in the concave portions 23 of the first shaped protection body 9 before flowing through the delivery duct 16, hitting the convex portions 24 to externally cover the second connector channels 15 and the collection ducts 17 of the delivery circuit 8 and internally wetting the cover, which cannot be deteriorated by the corrosive action of the fluid since it is attained at least on the face thereof directed towards the first manifold volume 11 in the chemically inert polymeric material. Preferably, the casing 6 comprises multiple second threaded holes 40 made perimetrically around the access opening 38 to the first manifold volume 11 and the cover is traversed by multiple second through holes corresponding to the aforesaid second threaded holes 40 in order to allow the insertion of screws or bolts and hence ensure the mechanical connection between cover and casing 6.

[0083] In a manner analogous to the collection ducts 17 placed to delimit the through opening 18, the cover placed to close the first manifold volume 11 is provided with a further opening facing the through opening 18, in order to allow the rotary shaft to traverse the first manifold volume 11 and the insertion of such shaft in the containment volume 42 of the casing 6 through the through opening 18.

[0084] Advantageously, the first shaped protection body 9 comprises multiple bridge portions 22, each placed to connect between a first tubular portion 20, to internally cover a first connector channel 13, and a second tubular portion 21, to internally cover a second connector channel 15, corresponding to a same head 2.

[0085] In accordance with the preferred embodiment illustrated in the enclosed figures, each lateral face 27 of the casing 6 preferably comprises a recessed cavity 41 placed to delimit the feed mouth 33 of the first connector channel 13 and the reception mouth 34 of the second connector channel 15 that are side-by-side and, additionally, the corresponding bridge portion 22 is housed in the aforesaid recessed cavity 41.

[0086] More in detail, such bridge portion 22 is made during molding from the polymeric material at the molten state that flows into the openings formed between the counter-molds and the first and second connector channel 13, 15 adjacent to each other, and which comes to occupy the recessed cavity 41 on the corresponding lateral face 27 of the casing 6.

[0087] In particular, the bridge portions 22 decrease possible movements of the first shaped protection body 9 to be separated from the first conveyance surface 43 of the feed circuit 7 and delivery circuit 8, since the constrain the first tubular portions 20, which are placed through the casing 6 and connected to the concave 23 and convex 24 portions in order to maintain them in position in the first manifold volume 11, to the second tubular portions 21, which internally cover the second connector channels 17 and the collection ducts 17.

[0088] The invention thus conceived therefore attains the pre-established objects.

Claims

1. Pump (1) for pumping corrosive fluids, which comprises:

- two or more heads (2), each of which provided with:
  - a pumping chamber (3),
  - a suction channel (4) and a dispensing channel (5), connected to said pumping chamber (3) in order to suction and dispense a corrosive fluid respectively in said pumping chamber (3) and from said pumping chamber (3);
- a casing (6) made of metallic material, carrying said heads (2) mounted thereon and provided with:
  - a feed circuit (7), placed in fluid communication with the suction channels (4) of said heads (2) in order to feed said heads (2) with said fluid to be pumped; and
  - a delivery circuit (8), placed in fluid communication with the dispensing channels (5) of said heads (2) in order to distribute said corrosive fluid dispensed by said heads (2);

said feed circuit (7) and said delivery circuit (8) being provided with a first conveyance surface (43) for said corrosive fluid;

said pump (1) being **characterized in that** it comprises a first shaped protection body (9) made of polymeric material, which is molded in a single body directly on top of said first conveyance surface (43).

2. Pump (1) according to claim 1, **characterized in that** said first shaped protection body (9) has a thickness comprised in the 1 - 5 mm interval.

3. Pump (1) according to claim 1 or 2, **characterized in that** said casing (6) is made of aluminum.

4. Pump (1) according to any one of the preceding claims, **characterized in that** the pumping chamber (3), the suction channel (4) and the dispensing channel (5) of each said head (2) are provided with a second conveyance surface for said corrosive fluid; said head (2) comprising a second shaped protection body (10) made of polymeric material, which is molded in a single body directly on top of said second conveyance surface.

5. Pump (1) according to any one of the preceding claims, **characterized in that** said first shaped protection body (9) is made of polypropylene.

6. Pump (1) according to any one of the preceding claims, **characterized in that** the feed circuit (7) of said casing (6) comprises:

- a first manifold volume (11);
- at least one inlet duct (12) placed in fluid communication with said first manifold volume (11);
- at least one first connector channel (13) for each head (2), placed in fluid communication with said first manifold volume (11) and with the suction channel (4) of the corresponding said head (3) in order to feed it with said corrosive fluid collected in said first manifold volume (11).

7. Pump (1) according to any one of the preceding claims, **characterized in that** the delivery circuit (8) of said casing (6) comprises:

- a second manifold volume (14);
- at least one second connector channel (15) for each head (2), placed in fluid communication with said second manifold volume (14) and with the dispensing channel (5) of the corresponding said head (2) in order to distribute said corrosive fluid from the corresponding said head (2) to said second manifold volume (14);
- at least one delivery duct (16) placed in fluid communication with said second manifold volume (14).

8. Pump (1) according to claim 6 and 7, **characterized in that** the first connector channel (13) of said feed circuit (7) and the second connector duct (15) of said delivery circuit (8) corresponding to a same head (2) are at least partly extended parallel to each other;
said first shaped protection body (9) comprising multiple first tubular portions (20), each placed as an internal covering of a first connector channel (13) and multiple second tubular portions (21), each placed as an internal covering of a second connector channel (15).

9. Pump (1) according to any one of the claims from 6 to 8, **characterized in that** said second manifold volume (14) is obtained with multiple collection ducts (17), one for each said head (2), which are connected to each other two-by-two.

10. Pump (1) according to claim 9, **characterized in that** there are three of said heads (2) and that the second manifold volume (14) is obtained with three collection ducts (17) connected to each other two-by-two in a triangular configuration.

11. Pump (1) according to claim 9 or 10, **characterized in that** each said collection duct (17) is extended starting from a corresponding said second connector channel (15) along a same extension direction (Y) up to intersecting another adjacent collection duct (17);
each second tubular portion (21) of said first shaped protection body (9) extended as an internal covering of the collection duct (17) at the corresponding said second connector channel (15).

12. Pump (1) according to claims 6, 7 and 9, **characterized in that** the external surface of the second connector channels (15) and of the collection ducts (17) of said delivery circuit (8) at least partially delimit the first manifold volume (11) of said feed circuit (7); said first shaped protection body (9) comprising multiple concave portions (23) for collecting said corrosive fluid and multiple convex portions (24) placed as an external covering of said second connector channels (15) and of said collection ducts (17) and connected to said concave portions (23).

13. Pump (1) according to claims 6 and 7, **characterized in that** said casing (6) has substantially prismatic form, is extended along a main extension axis (X) between first base (25) and a parallel second base (26) and is provided with multiple lateral faces (27), one for each said head (2), substantially planar, parallel to said main extension axis (X) and perpendicular to said first and second bases (25, 26);

in which each said first connector channel (13) is extended through said casing (6) along a direction perpendicular to said lateral face (27) carrying the corresponding said head (2) mounted thereon, starting from said first manifold volume (11) up to emerging with a feed mouth (33) made on the same said lateral face (27);
in which each said second connector channel (15) is extended, at least for part of its length,

along a direction perpendicular to said lateral face (27) carrying the corresponding said head (2) mounted thereon, and emerges with a reception mouth (34) made on the same said lateral face (27) and placed adjacent to the feed mouth (33) of the corresponding said first connector channel (13).

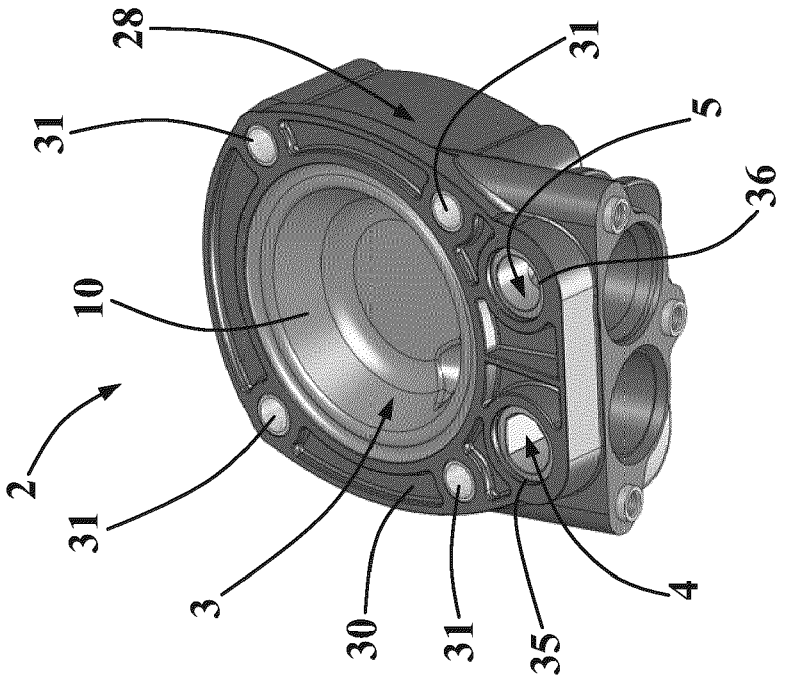

Fig. 2

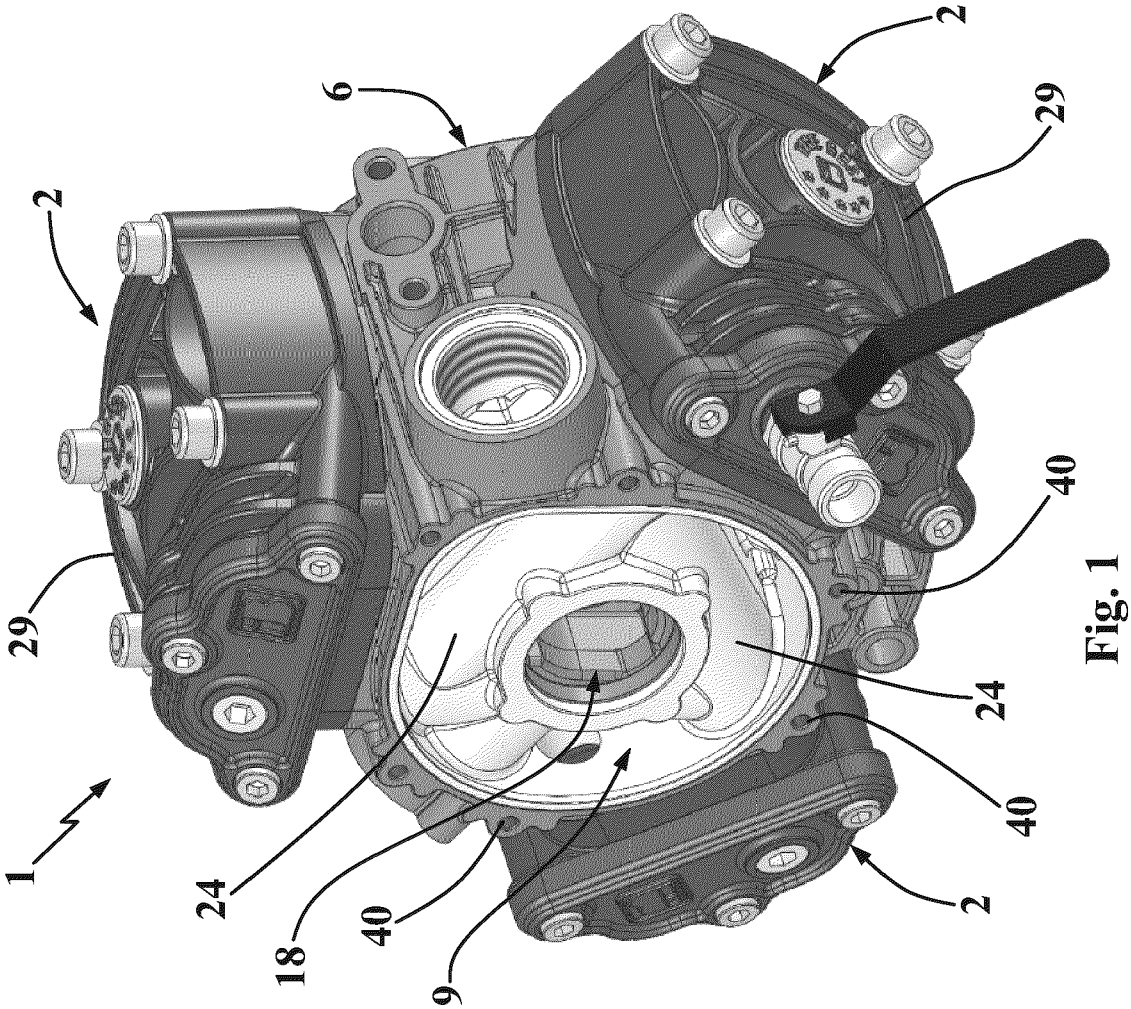

Fig. 1

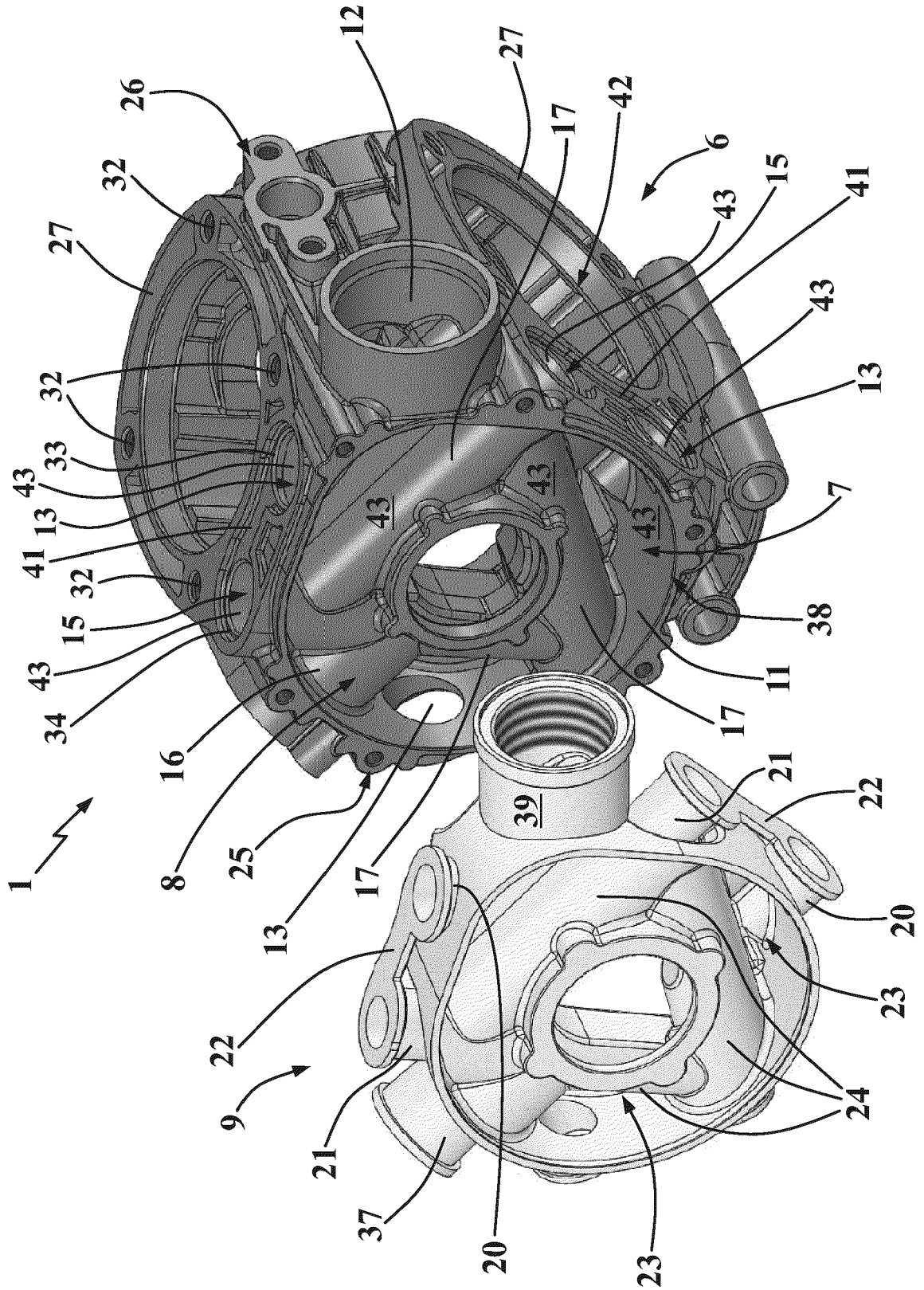
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Fig. 3

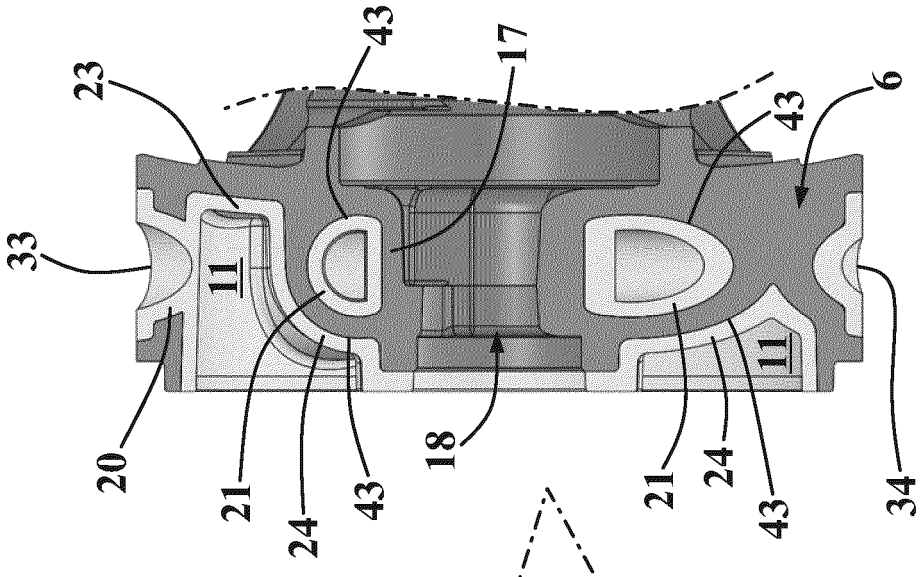
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Fig. 5

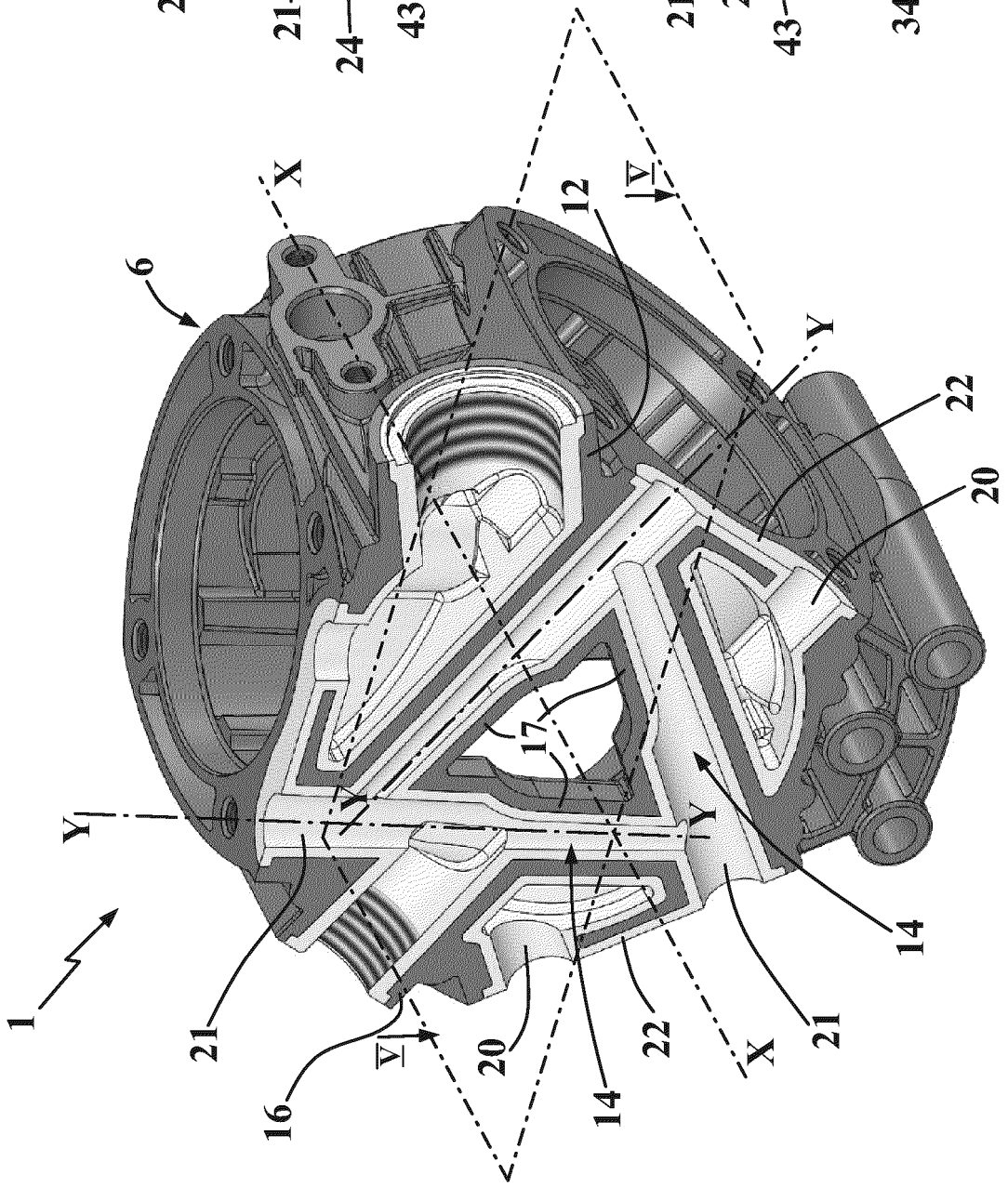
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Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 7317

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Place of search	Date of completion of the search	Examiner
Munich	3 February 2022	Pinna, Stefano

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