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(54) **Használtlevegő elvezetés rétegképző anyag szivattyúhoz**

EP2951437

EXHAUST AIR CONDUIT FOR A COATING AGENT PUMP

DESCRIPTION

The invention relates to an exhaust air conduit for conducting away exhaust air from a pneumatically powered pump, in particular, from a coating agent pump in a painting plant.

In modern painting plants for painting motor vehicle bodywork components, for pumping the paint to be applied, pneumatically powered pumps are often used which, for their operation, have a pneumatic cylinder and a piston which is displaceably arranged in the pneumatic cylinder, wherein compressed air can be applied to the piston on both sides in order to displace the piston in the desired direction. By means of a common piston rod, the piston in the pneumatic cylinder can deform, for example, two pumping diaphragms, as described in the German patent application DE 10 2013 002 764.0. The exhaust air from the pneumatic cylinder is herein controlled by means of a switch-over unit and is then discharged through a sound damper into the surroundings, wherein the sound damper is directly flange-mounted onto the switch-over unit.

It is disadvantageous in these known pumps that the exhaust air from the pneumatic cylinder is initially under pressure and then expands, which leads to intense cooling of the exhaust air. The cooling of the exhaust air can result in an undesirable condensate formation, so that condensation water can collect in the exhaust air conduit and, in particular, can gather on the switch-over unit and on the sound damper. In an extreme case, the expansion-induced cooling can even be so great that the condensation water freezes and thus, in the worst case, impairs the functional capability of the switch-over unit.

Pumps of this type are known, for example, from DE 44 25 515 A1 and US 5 094 596.

It is therefore an object of the invention to improve the pneumatically powered pump described above such that the functional capability is not impaired by expansion-induced cooling of the exhaust air.

This object is achieved with an exhaust air conduit according to the invention according to the main claim.

In accordance with the prior art, the exhaust air conduit according to the invention has an inlet in order to receive the exhaust air from the pneumatically powered pump. Furthermore, in accordance with the prior art, the exhaust air conduit according to the invention has an outlet in order to discharge the exhaust air to the surroundings. Herein, in accordance with the prior art, an exhaust air channel extends between the inlet of the exhaust air conduit and the outlet of the exhaust air conduit, in which exhaust air channel the exhaust air flows from the inlet to the outlet. The exhaust air channel is herein arranged in a housing member wherein it is to be prevented that the housing member cools down so far that the functional capability of the functional components in the housing member is impaired.

The invention is based upon the technical and physical recognition that the heat transfer from the wall of the exhaust air channel to the cold exhaust air flow in the exhaust air channel is particularly great if the exhaust air flow impacts obtusely or even at a right angle on the wall of the exhaust air channel. In the context of the invention, this means that the approach angle between the exhaust air stream and the wall of the exhaust air channel is in the region of 30°-90°, 45°-90°, 65°-90°, 80°-90° or even 85°-90°.

The invention therefore preferably provides that the exhaust air flow in the exhaust air channel extends almost entirely parallel to the wall of the exhaust air channel, in order to prevent the exhaust air flow meeting the wall of the exhaust air channel obtusely or even perpendicularly, since this would lead to an intense heat transfer from the wall to the cold exhaust air flow which, in turn, would be associated with a severe cooling of the wall, which is undesirable.

However, a change of direction in the exhaust air conduit self-evidently cannot be entirely prevented. The invention therefore provides that in the region of such a direction change of the exhaust air channel, a thermal insulation element is arranged in the exhaust air channel, whereby the exhaust air flow then impacts obtusely on the thermal insulation element and not on the wall of the exhaust air channel. Herein also the expression "obtusely" means that the exhaust air flow impacts on the wall of the thermal insulation element at an impact angle in the range of 30°-90°, 45°-90°, 65°-90°, 80°-90° or even 85°-90°. The cold exhaust air does in fact likewise accumulate at the thermal insulation element, which in principle favours the heat transfer from the thermal insulation element to the cold exhaust air. However, the thermal insulation element consists of a heat-insulating material (e.g. plastics), whereas the wall of the exhaust air channel typically consists of metal, which has a significantly better thermal conductivity than plastics. Thus in the case of an obtuse approach by the cold exhaust air, the first thermal insulation element reduces an intensive cooling of the wall of the exhaust air channel and thus also the other components (e.g. the switch-over unit) which are to be protected against cooling.

In one variant of the invention, the first thermal insulation element lines the inside of the exhaust air channel. The first thermal insulation element is thus herein a separate component which is inserted into the exhaust air channel. In another variant of the invention, however, the first thermal insulation element is a conduit component of the exhaust air channel. For example, a bend in the exhaust air channel can be made of plastics, whereas the unbent conduit parts of the exhaust air channel are made of metal.

The measures according to the invention described above lessen the thermal transfer from the wall of the exhaust air channel and from the components to be protected against cooling (e.g. the switch-over unit) to the cold exhaust air flow and thus prevent excessive cooling of the components to be protected.

Another measure according to the invention provides against the exhaust air of the pump cooling intensely at all. For this purpose, the invention provides that the exhaust air channel has a cross-section which does not broaden in the flow direction, in order to prevent an expansion of the exhaust air and the expansion-induced cooling of the exhaust air in the exhaust air channel associated therewith. For example, the cross-section of the exhaust air channel within the inventive exhaust air conduit can have an essentially constant size. The actual expansion of the exhaust air then only takes place downstream after the outlet of the exhaust air conduit, for example, in a sound damper connected thereto. The site of the expansion-induced cooling is herein therefore displaced in the flow direction out of the exhaust air conduit in the switch-over unit into the sound damper connected thereto, by which means the components to be protected against cooling (e.g. the switch-over unit) are cooled less intensely.

In a preferred exemplary embodiment of the invention, the exhaust air conduit extends through the switch-over unit of the pump. The switch-over unit herein has the task of steering the exhaust air out of the pneumatically powered pump and/or the feed air to the pneumatically powered pump. The exhaust air channel of the exhaust air conduit according to the invention herein thus extends through the switch-over unit and preferably to the sound damper.

The steering of the exhaust air of the pneumatically powered pump in the switch-over unit can take place, for example, by means of a diaphragm valve which has an elastic diaphragm for control. The elastic diaphragm can herein also fulfil the function of the first thermal insulation element described above. In the opened state of the diaphragm valve, the cold exhaust air therefore impacts obtusely on one side of the elastic diaphragm which fundamentally favours the heat transfer from the elastic diaphragm to the cold exhaust air. However, the elastic diaphragm preferably consists of a heat-insulating material (e.g. plastics), by which means an excessive cooling of the diaphragm is prevented.

It has already been mentioned above that the site of the expansion-induced cooling is preferably displaced in the flow direction from the interior of the switch-over unit into the sound damper. The invention thus preferably accepts an expansion-induced cooling of the exhaust air in the sound damper and thus also a corresponding cooling of the sound damper itself. However, the invention preferably prevents this cooling of the sound damper from also leading to a corresponding cooling of the switch-over unit. For this purpose, the invention preferably provides that the sound damper is thermally decoupled from the switch-over unit in order to lessen the heat transfer from the switch-over unit to the sound damper. This thermal decoupling is achieved in that the sound damper is not directly connected to the switch-over unit, but by way of a second thermal insulation element which consists of a thermally insulating material (e.g. plastics). The exhaust air channel therefore herein extends through the switch-over unit and the second thermal insulation element into the sound damper. The low thermal conductivity of the second thermal insulation element has the advantage that the switch-over unit cools only slightly, even on intense expansion-induced cooling of the sound damper.

It was briefly mentioned above that the thermal insulation elements can consist of plastics, whereas the switch-over unit, the housing member of the exhaust air conduit and/or the wall of the exhaust air channel can consist of metal. With regard to material selection, however, the invention is not restricted to these materials. Rather, it is decisive that the materials of the thermal insulation elements have a significantly lower thermal conductivity than the materials of the switch-over unit, the housing member and/or the wall of the exhaust air channel.

It should also be mentioned that the invention does not only claim protection for the inventive exhaust air conduit described above. Rather, the invention also claims protection for a corresponding coating agent pump with an inventive exhaust air conduit.

The inventive coating agent pump preferably has two oppositely arranged pumping cylinders, each having a displaceable piston, wherein the two pistons in the pumping cylinders are linked to a common piston rod and are therefore driven in opposing directions. The driving of the piston rod and thus also the driving of the two pistons in the pumping cylinders is achieved by means of a pneumatic cylinder in which a further piston is provided which acts upon the common piston rod. Compressed air can be admitted to the piston in the pneumatic cylinder on both sides in order to move the piston in the pneumatic cylinder and thus also the two pistons in the pumping cylinders in the desired direction.

Preferably provided in each of the pistons in the pumping cylinders is a non-return valve which closes during a discharge stroke of the respective piston and is open during a filling stroke.

It should finally also be mentioned that the invention is not restricted to the exhaust air conduits of paint pumps, i.e. pumps which pump paint. Rather, an inventive exhaust air conduit can also be realized for other pumps that are pneumatically powered and pump other fluids, for example, adhesives or sealants (e.g. for seam sealing).

Other advantageous developments of the invention are disclosed in the dependent claims or are described below in greater detail together with the description of the preferred exemplary embodiment of the invention, making reference to the drawings, in which:

Fig. 1 shows a perspective view of an inventive coating agent pump for pumping paint in a painting plant,

Fig. 2 shows a cross-sectional view of the coating agent pump of Fig. 1,

Fig. 3 shows another cross-sectional view through the coating agent pump of Figs. 1 and 2,

Fig. 4 shows a cross-sectional view through the switch-over unit of the coating agent pump of Figs. 1-3, and

Fig. 5 shows another cross-sectional view of the switch-over unit.

The drawings show a coating agent pump for pumping paint in a painting plant for painting motor vehicle bodywork components.

The paint to be pumped is herein received via a pump inlet 1 and is discharged via a pump outlet 2 at the desired delivery pressure. The actual pumping is herein achieved by two pumping cylinders 3, 4 in each of which a pumping piston 5, 6 is displaceably arranged.

The two pumping cylinders 3, 4 each have a coating agent inlet 7, 8 and a coating agent outlet 9, 10. The pump inlet 1 is connected via a tube 11 to the two coating agent inlets 7, 8 of the pumping cylinders 3, 4. The pump outlet 2 is connected in the same way via a tube 12 to the two coating agent outlets 9, 10 of the pumping cylinders 3, 4.

Situated in each of the pumping pistons 5, 6 is a respective non-return valve 13, 14 which only opens in one direction. Thus, the non-return valve 13 in the pumping piston 6 in Fig. 2 closes when the pumping piston 6 moves from right to left during a discharge stroke. During a movement of the pumping piston 6 in the contrary direction from left to right, however, the non-return valve 13 opens, so that new coating agent can flow via the coating agent inlet 7 through the non-return valve 13 to the left side of the pumping piston 5.

It should here be mentioned that a non-return valve 15, 16 is also arranged in each of the two coating agent outlets 9, 10. The two non-return valves 15, 16 each open during a discharge stroke of the associated pumping piston 5, 6 and otherwise close.

The mechanical drive of the two pumping pistons 5, 6 takes place by means of a common piston rod 17, so that the two pumping pistons 5, 6 always move in contrary directions. This means that in the two pumping pistons 5, 6, the discharge stroke and the filling stroke each take place in phase opposition.

The mechanical drive of the common piston rod 17 takes place by means of a pneumatic piston 18 which is arranged in a pneumatic cylinder 19 and to which compressed air can be applied on both sides. Figs. 2 and 3 both show the pneumatic piston 18 at a respective dead point.

Two switch-over valves 21, 22 which are actuated by the pneumatic piston 18 when the pneumatic piston 18 reaches one of its deadpoints are arranged in a housing 20 of the pneumatic cylinder 19. Thus the pneumatic piston 18 in Figs. 2 and 3 activates the switch-over valve 22.

The two switch-over valves 21, 22 also control the exhaust air from the pneumatic cylinder 19 on both sides of the pneumatic piston 18. The exhaust air from the pneumatic cylinder 19 is then conducted away by an exhaust air conduit, wherein the exhaust air conduit extends through a switch-over unit 23 into two sound dampers 24, 25. Arranged in the switch-over unit 23 herein is a slide valve 26 which in Fig. 4 can be displaced in the vertical direction, wherein the position of the slide valve 26 is set pneumatically by means of the switch-over valves 21, 22. The position of the slide valve 26 in the switch-over unit 23, in turn, controls two diaphragm valves 27, 28 which are arranged in the exhaust air channel of the exhaust air conduit and, by means of respectively one elastic diaphragm valve 29, 30 made of plastics, release or block the exhaust air flow.

In Fig. 4 the diaphragm valve 27 is shown in a closed position, while the diaphragm valve 28 is opened on the opposite side.

The invention is distinguished by the special design configuration of the exhaust air conduit from the pneumatic cylinder 19.

It should now be mentioned that the exhaust air conduit has an inlet 31 at which the exhaust air from the pneumatic cylinder 19 is received. The exhaust air then flows through an exhaust air channel 32 to an outlet 33 to which the sound damper 24 or 25 is connected. The exhaust air channel 32 herein already belongs to the sound damper 24 or 25.

It is herein important that the cross-section of the exhaust air channel 32 between the inlet 31 and the outlet 33 is approximately constant so that no expansion of the exhaust air takes place in the exhaust air channel 32, so that also no expansion-induced cooling occurs. In this way, the occurrence of a substantial cooling in the region of the switch-over unit 23, which could lead to the formation of condensation water and, in the worst case ice, by which the functional capability of the switch-over unit 23 could be impaired, is prevented.

The exhaust air is then, however, expanded in the sound damper 24 and/or 25, leading to corresponding cooling of the exhaust air and thus also of the sound damper 24 and/or 25. However, the sound damper 24 and/or 25 is thermally decoupled from the switch-over unit 23 by a thermal insulation element 34 and/or 35, and the exhaust air channel 32 extends through the thermal insulation element 34 and/or 35 to the respective sound damper 24 and/or 25. This thermal decoupling by means of the thermal insulation element 34 and/or 35 ensures that the unavoidable intense cooling of the sound damper 24 and/or 25 does not lead to an excessive cooling of the switch-over unit 23.

It should also be mentioned that the exhaust air flow in the exhaust air channel 32 in the region of the direction change does not impact upon the housing of the switch-over unit 23 made of metal, but on the thermal insulation element 32 or on the valve diaphragm 30 made of plastics. This is advantageous since due to a right-angled approach of the cold exhaust air to a housing

part, a good thermal transfer and thus an intense cooling of the housing part are favoured. It is therefore useful to provide thermal insulation elements in these regions with a severe direction change.

The invention is not restricted to the above-described preferred exemplary embodiment. Rather a plurality of variants and modifications is possible falling within the scope of protection of the attached claims.

List of reference signs

1	Pump inlet
2	Pump outlet
3	Pumping cylinder
4	Pumping cylinder
5	Pumping piston in pumping cylinder
6	Pumping piston in pumping cylinder
7	Coating agent inlet at pumping cylinder
8	Coating agent inlet at pumping cylinder
9	Coating agent outlet at pumping cylinder
10	Coating agent outlet at pumping cylinder
11	Tube
12	Tube
13	Non-return valve in pumping piston
14	Non-return valve in pumping piston
15	Non-return valve in coating agent outlet
16	Non-return valve in coating agent outlet
17	Piston rod
18	Pneumatic piston
19	Pneumatic cylinder
20	Housing of pneumatic cylinder
21	Switch-over valve
22	Switch-over valve
23	Switch-over unit
24	Sound damper
25	Sound damper
26	Slide valve in the switch-over unit
27	Diaphragm valve
28	Diaphragm valve
29	Valve diaphragm
30	Valve diaphragm
31	Inlet of the exhaust air conduit
32	Exhaust air channel
33	Outlet of the exhaust air conduit
34	Thermal insulation element
35	Thermal insulation element

EP2951437

HASZNÁLTLEVEGŐ ELVEZETÉS RÉTEGKÉPZŐ ANYAG SZIVATTYÚHOZ

SZABADALMI IGÉNYPONTOK

1. Használtlevegő elvezetés pneumatikusan meghajtott szivattyú, különösen lakkozó berendezésben levő rétegképző anyag szivattyú használt levegőjének elvezetéséhez,

beömlő csatlakozással (31) a szivattyúból érkező használt levegő befogadásához;

kieresztő csatlakozással (33) a használtlevegő leadásához;

használtlevegő csatornával (32), amelyben a használtlevegő a beömlő csatlakozástól (31) a használtlevegő csatorna (32) kieresztő csatlakozásához áramlik; és

házegységgel (23), amelyben a használtlevegő csatorna (32) halad;

azzal jellemezve, hogy a használtlevegő a használtlevegő csatorna (32) irányváltó tartományában tompaszögben lép egy első hőszigetelő elembe (29, 30, 34, 35) a használtlevegő csatornában (32), azaz a használtlevegő áram és a hőszigetelő elem (29, 30, 34, 35) fala közötti 30°-90° szöggel, hogy a használtlevegő felhalmozódása közvetlenül a használtlevegő csatorna (32) belső falán kiküszöbölhető legyen, és ezáltal a házegység (23) kihűlése megakadályozható legyen.

2. Az 1. igénypont szerinti használtlevegő elvezetés,

azzal jellemezve, hogy a használtlevegő csatorna (32) olyan keresztmetszetű, amely áramlási irányba nem bővül, hogy ne következzék be a használtlevegő expanziója és expanzió következtében a használt levegő kihűlése a használtlevegő csatornában (32), és/vagy

hogy a használtlevegő csatorna keresztmetszete áramlási irányban lényegében konstans nagyságú.

3. Az 1. igénypont szerinti használtlevegő elvezetés,

azzal jellemezve, hogy a használtlevegő vezeték kieresztő csatlakozására (33) hangtompító (24, 25) van rácsatolva, úgy, hogy a használtlevegő a használtlevegő vezeték kieresztő csatlakozóján a hangtompítóba (24, 25) áramlik, azután a hangtompítóban expandál, és végül a környezetbe árad szét.

4. A 3. igénypont szerinti használtlevegő elvezetés, **azzal jellemezve, hogy** a házegységben egy átkapcsoló egység (23) van a szivattyú átkapcsolásához, különösen a szivattyú egy pneumatikusan meghajtott dugattyújának (18) ellenkező irányú mozgásirányai között, ahol a használtlevegő csatorna (32) az átkapcsoló egységen (23) keresztül a hangtompítóhoz (24, 25) vezet át.

5. A 4. igénypont szerinti használtlevegő elvezetés, **azzal jellemezve, hogy** az átkapcsoló egységnek (23) membrán szelepe (27, 28) van, rugalmas membránnal (29, 30), ahol az első hőszigetelő elemet a membrán (29, 30) képezi.

6. A 4. vagy 5. igénypont szerinti használtlevegő elvezetés,

azzal jellemezve, hogy az átkapcsoló egység (23) egy második hőszigetelő elemen (34, 35) keresztül mechanikusan össze van kötve a hangtompítóval (24, 25), ahol a használtlevegő csatorna (32) a második hőszigetelő elemen keresztül vezet át; és

hogy a második hőszigetelő elem (34, 35) a hangtompítót (24, 25) termikusan szétkapcsolja az átkapcsoló egységtől (23), hogy a hőátmenetet a hangtompítóra (24, 25) csökkentse.

7. Az előző igénypontok egyike szerinti használtlevegő elvezetés,
azzal jellemezve, hogy az első hőszigetelő elem (29, 30, 34, 35) műanyagból készült, és/vagy
hogy a második hőszigetelő elem (34, 35) műanyagból készült, és/vagy
hogy az átkapcsoló egység (23) lényegében fémből készült, és/vagy
hogy a ház egység lényegében fémből készült, és/vagy
hogy a használtlevegő csatorna (32) fémből készült falai rendelkezik.

8. Az előző igénypontok egyike szerinti rétegképző anyag szivattyú használtlevegő elvezetéssel.

9. A 8. igénypont szerinti rétegképző anyag szivattyú, **azzal jellemezve, hogy** tartalmaz
egy első szállítóhengert (3),
egy első dugattyút (6), amely az első szállítóhengerben (3) eltolható módon van elrendezve,
egy második szállítóhengert (4),
egy második dugattyút (5), amely a második szállítóhengerben (4) eltolható módon van elrendezve,
egy rétegképző anyag bevezetést (7, 8), amely mindkét szállítóhengerbe (3, 4) betorkollik,
egy rétegképző anyag kieresztést (9, 10), amely mindkét szállítóhengerbe (3, 4) betorkollik,
egy dugattyúrudat (17), amely az első dugattyút (6) és a második dugattyút (5) meghajtja,
egy pneumatika hengert (19), és
egy harmadik dugattyút (18), amely a pneumatika hengerben (19) van elrendezve és a dugattyú rudat (17) meghajtja.

10. A 9. igénypont szerinti rétegképző anyag szivattyú, **azzal jellemezve, hogy** az első dugattyúban (6) egy első visszacsapó szelep (13) van elrendezve, és/vagy
hogy a második dugattyúban (5) egy második visszacsapó szelep (14) van elrendezve, és/vagy
hogy az első szállítóhengeren (3) levő rétegképző anyag kieresztésben (9) egy harmadik visszacsapó szelep (15) van elrendezve, és/vagy
hogy a második szállítóhengeren (3) levő rétegképző anyag kieresztésben (9) egy negyedik visszacsapó szelep (16) van elrendezve, és/vagy
hogy az átkapcsoló egység (23) vezérli a bemenő levegőt a pneumatika hengerbe (19), és/vagy a használtlevegőt a pneumatika hengerből (19), és/vagy
hogy az első dugattyú (6), a második dugattyú (5) és a harmadik dugattyú (18) koaxiálisan van elrendezve, és mindegyik szilárdan össze van kötve a dugattyúrúddal (17).

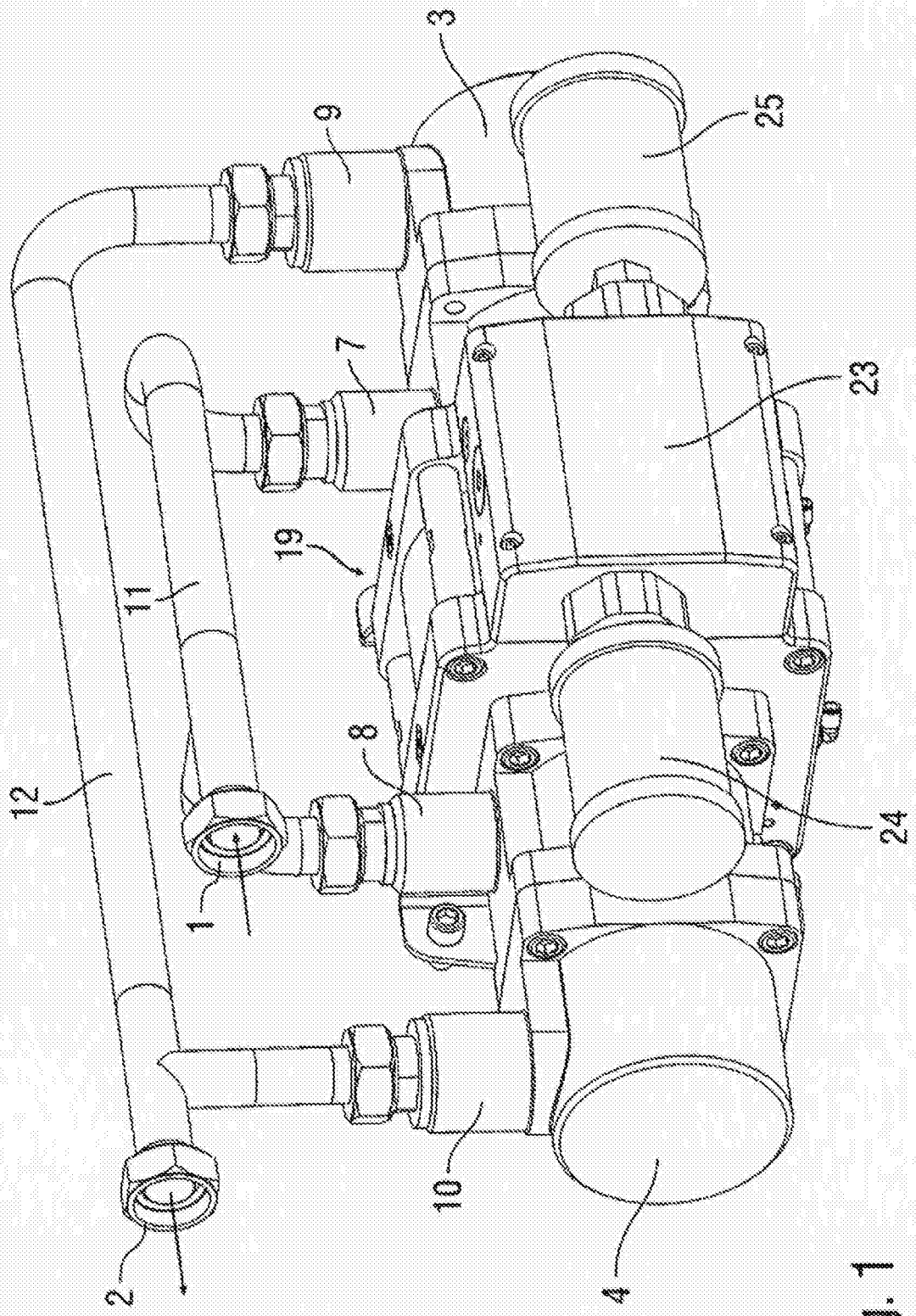

Fig. 1

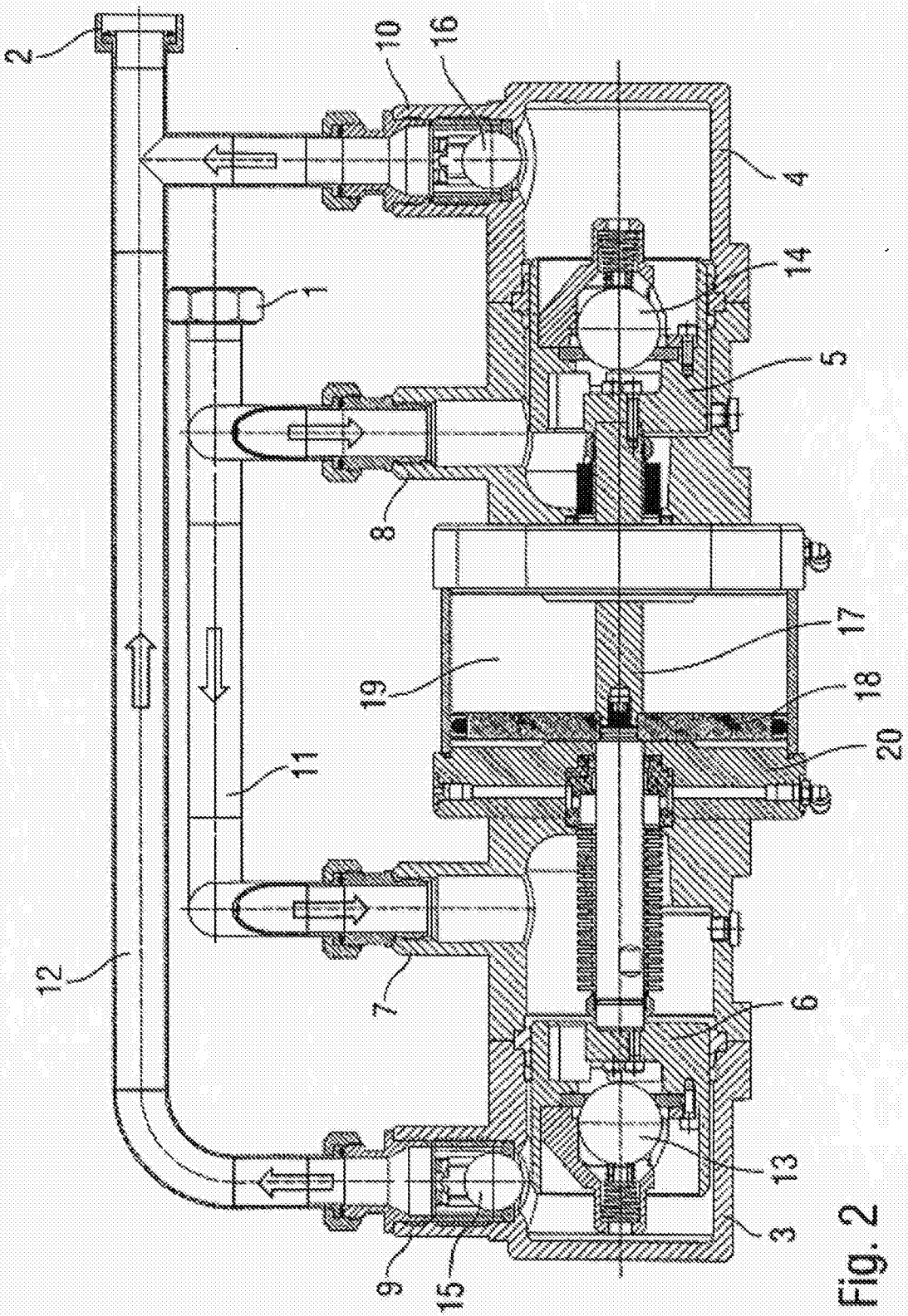

Fig. 2

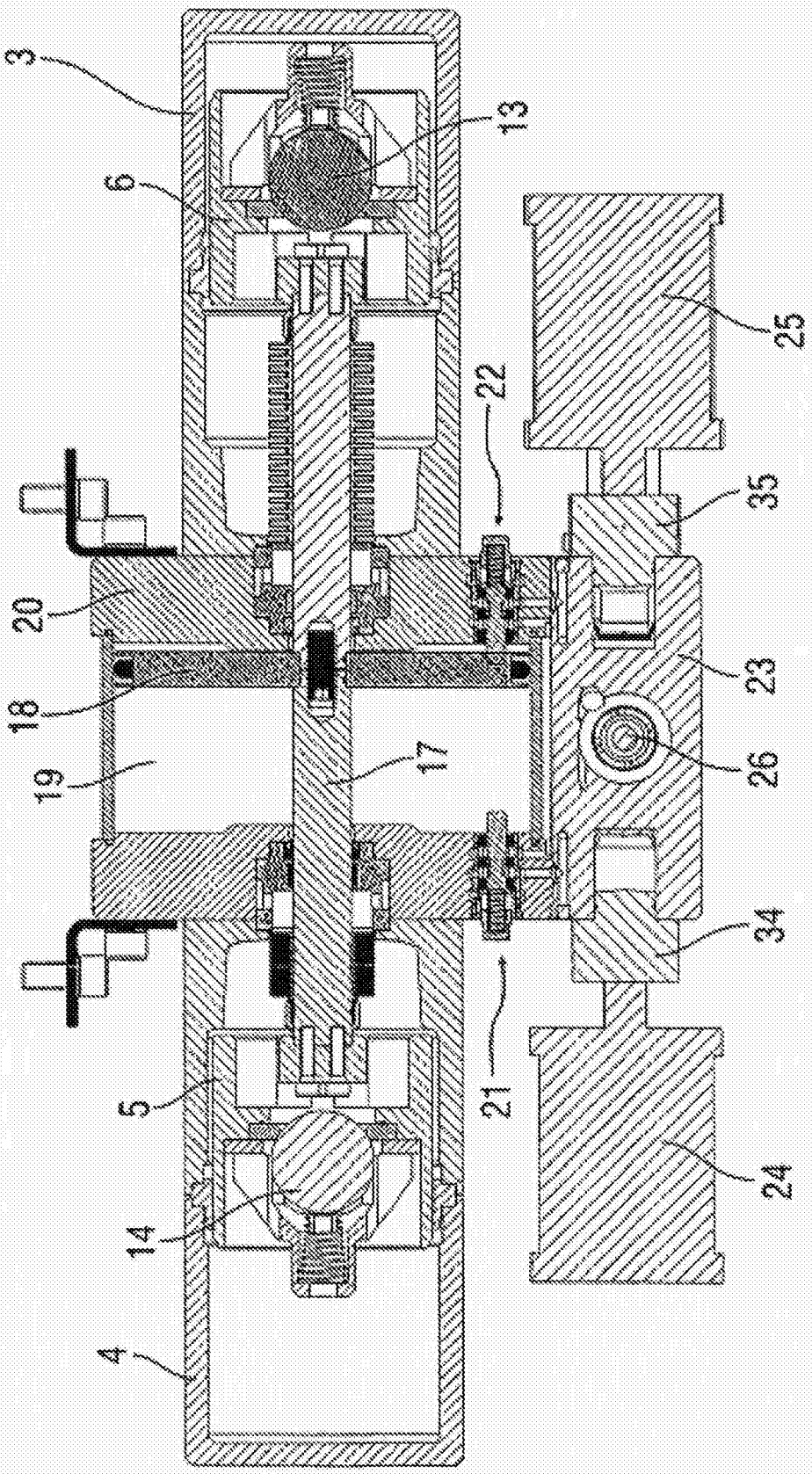

Fig. 3

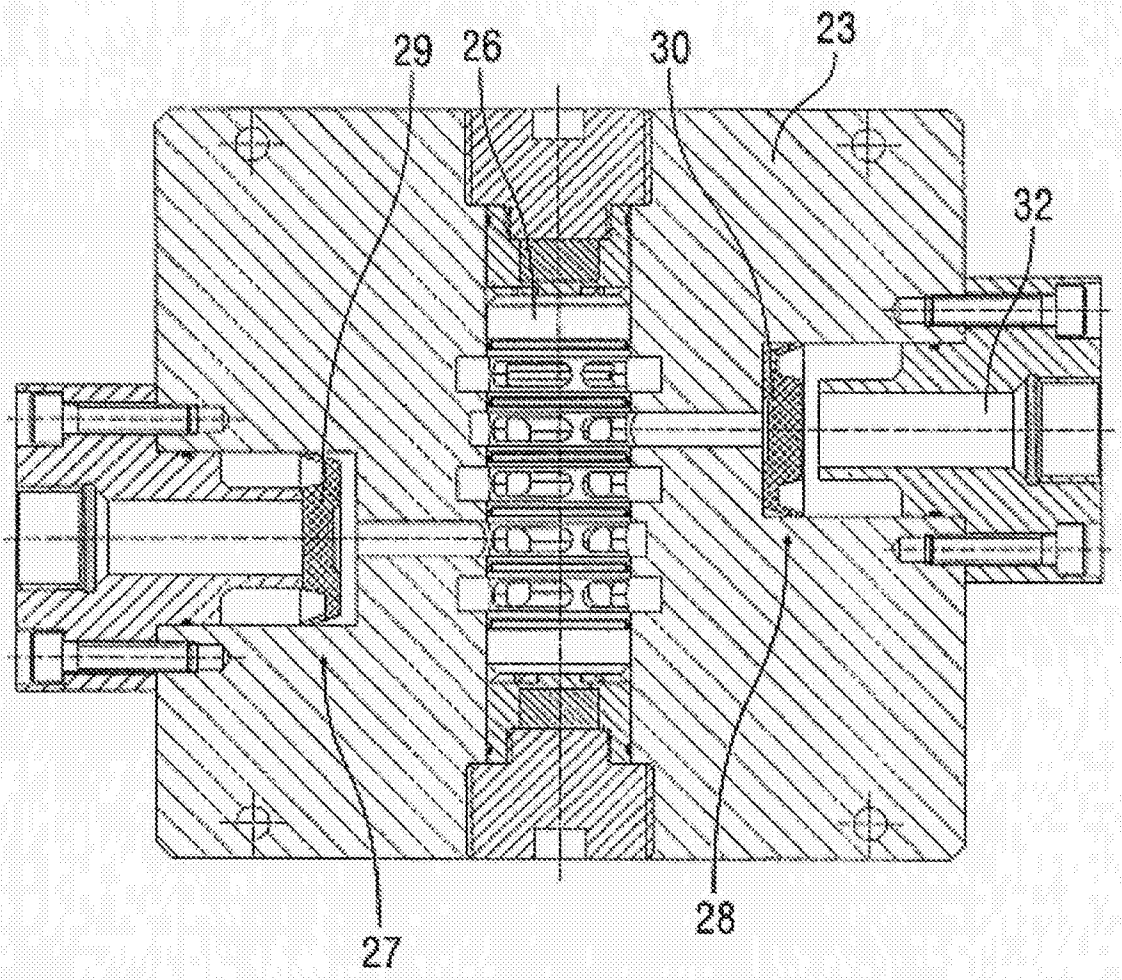

Fig. 4

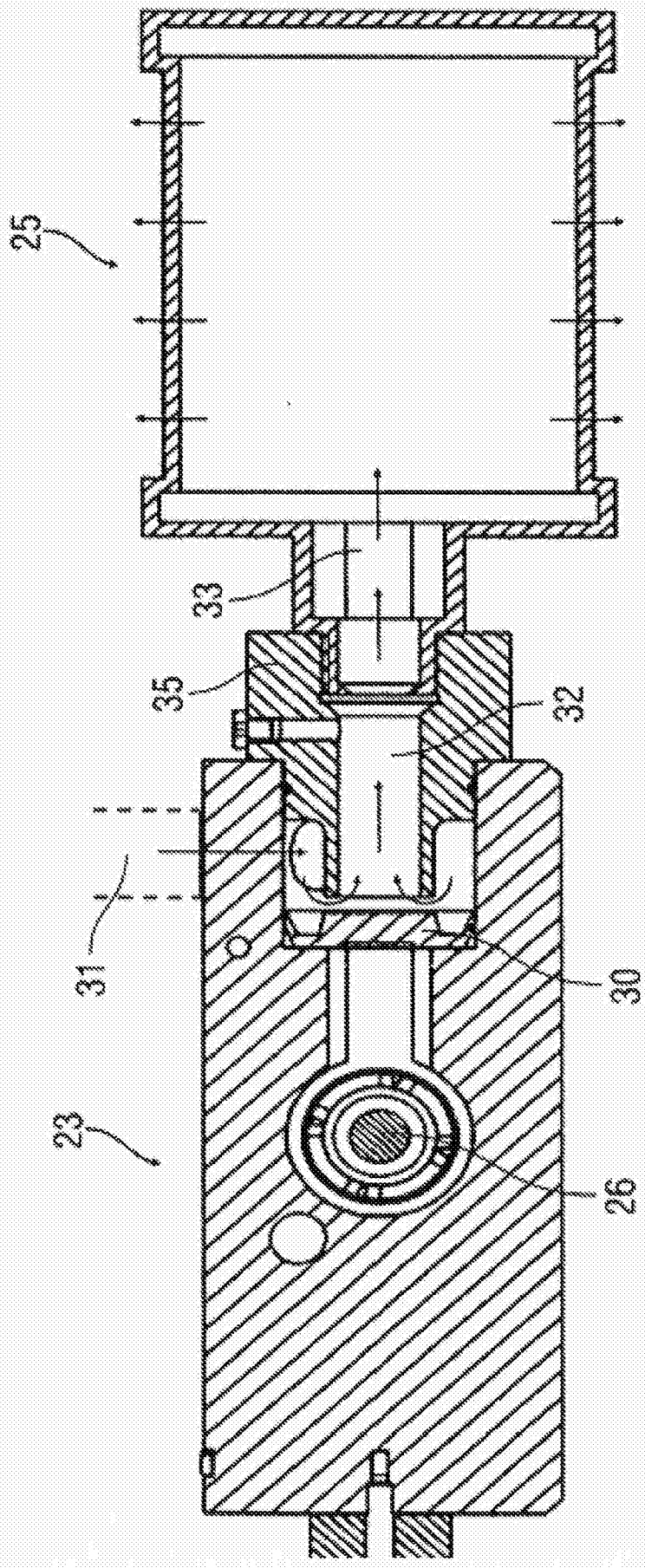

Fig. 5