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

(11) EP 1 520 995 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.04.2005 Bulletin 2005/14

(51) Int Cl.[7]: **F15B 1/26**

(21) Application number: **04396068.1**

(22) Date of filing: **29.09.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(30) Priority: **29.09.2003 FI 20035166**

(71) Applicant: **Fluid House Oy**
40630 Jyväskylä (FI)

(72) Inventors:
- **Viinonen, Reijo**
  40100 Jyväskylä (FI)
- **Mäkinen, Jarkko**
  40640 Jyväskylä (FI)
- **Elo, Lauri**
  FI-33300 Tampere (FI)

(74) Representative: **Tanhua, Pekka Vilhelm**
Berggren Oy Ab,
P.O. Box 16
00101 Helsinki (FI)

(54) Hydraulic apparatus and method for manufacturing and using thereof

(57) The invention relates to a hydraulic apparatus comprising one or more oil tanks (3). The oil tank (3) according to the invention comprises means (36, 48, 49) for guiding the hydraulic oil flow to the tangential direction.

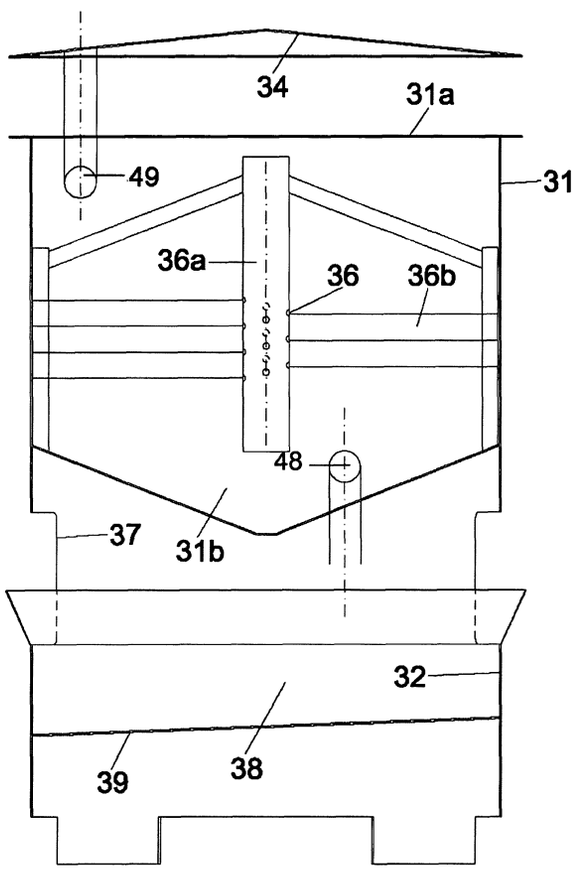

Fig. 5

EP 1 520 995 A2

Description

Technical background

[0001] This invention relates to a hydraulic apparatus comprising one or more oil tanks.

[0002] The oil tank of a hydraulic apparatus is generally a rectangular container in which the oil flow is non-uniform. This being the case, part of the oil may remain in the tank even for a long time without being brought to the circulation. For example, the separation of air and water may be defective, and the oil volume is also otherwise poorly utilized.

[0003] In a hydraulic apparatus the electric motor and hydraulic components are traditionally located on top of the oil tank or in its immediate vicinity, e.g. on the same assembly base. On one hand, this type of apparatus is easy to service and use, but on the other hand, noise produced by the apparatus is very difficult to eliminate from the operation site. Due to a high noise level, it is generally necessary to locate the apparatus in a separate hydraulic unit room, away from the operation site. Locating in a separate room adds to the construction costs, on one hand, and on the other, also remarkably increases the need of hydraulic piping and oil.

Description of invention

[0004] A hydraulic apparatus has now been invented in which the oil tank is in an extremely efficient use. To achieve this objective, the invention is characterized by the features that are specified in the independent claims. Some of the preferred embodiments of the invention are set forth in the other claims.

[0005] The term 'hydraulic apparatus' as used in this patent application refers to any apparatus with one or more hydraulic actuators connected thereto. A 'hydraulic component' refers to any component connected to a hydraulic apparatus. 'Other hydraulic component' in turn refers to any hydraulic component connected to a hydraulic apparatus with the exception of the electric motor, hydraulic pump and oil tank.

[0006] The hydraulic apparatus according to the invention comprises one or more oil tanks provided with means for controlling the hydraulic oil flow to the tangential direction.

[0007] This technical solution increases for its part the adaptability of the apparatus to various applications. A tangential flow decreases blind spots in relation to the flow in the oil tank. Due to this, for example the separation of air and water also improves compared to a traditional oil tank. The oil tank volume is then efficiently used and thus the total volume of the hydraulic apparatus is preferably used as well as possible. Another essential advantage of this is improved oil purification, as the total oil volume can be brought to the purification circulation.

[0008] According to one embodiment of the invention, the oil tank comprises an at least partially spiral guide plate for controlling the oil flow tangentially and spirally. This technical solution essentially improves for its part the utilization of space in the oil tank, for example, by increasing the oil path length.

[0009] According to one embodiment of the invention, the upper part of the oil tank is provided with an oil supply pipe having a tangentially directed supply. Preferably in the lower part of the oil tank there is a discharge pipe with a tangentially directed discharge. The oil tank preferably has an inclined bottom plate. With these solutions, applied either in combination or separately, the oil flow in the oil tank is further improved.

[0010] According to one embodiment of the invention, one or more separate power units that are disconnected from the oil tank are attached to the hydraulic apparatus, these power units having an at least partially opening external cladding, and one or more electric motors and hydraulic pumps as well as one or more other hydraulic components can be installed in the power unit.

[0011] This type of apparatus design is extremely flexible. Due to the external cladding, the apparatus can be installed directly at the operation site and thus no separate hydraulic unit room is required. In addition, the piping of the apparatus and the whole hydraulic system is simplified, as the operation site can be in the immediate vicinity of the hydraulic apparatus. Another advantage of a power unit that is separate from the oil tank is that the oil tanks and power units can be modularly combined. Hydraulic apparatuses can be assembled with a varying number of oil tanks and a varying number of power units. According to the requirements of use, for example an oil tank or a power unit or both can be later added to the hydraulic apparatus.

[0012] The power unit preferably comprises an internal wall for installing the electric motor, hydraulic pump and/or one or more other hydraulic components. Preferably the internal wall is provided with one or more perforated plates for installing the hydraulic components.

[0013] According to one embodiment of the invention, the external cladding of the power unit is at least partially sound-insulated for reducing the noise produced by the apparatus.

[0014] According to one embodiment of the invention, the power unit comprises at least one separate pump compartment and one separate component compartment and an at least partially opening external cladding part, and the electric motor and hydraulic pump are installed in the separate pump compartment of the power unit and one or more other hydraulic components are installed in the separate component compartment of the power unit. This is especially advantageous as regards the installation and use of the machinery. This type of hydraulic apparatus produces relatively little noise to the environment, because the components creating a lot of noise, electric motor and hydraulic pump, are located in a separate pump compartment. In addition, the external cladding parts can be sound-insulated, which further reduces the noise caused by the hydraulic apparatus.

[0015] According to one embodiment of the invention, a combination of an electric motor and hydraulic pump is installed in an essentially vertical position in the power unit. The advantage of the vertical assembly is e.g. that it takes little floor installation space. Around the vertically mounted electric motor/hydraulic pump combination, it is preferable to make a vertically shaped pump compartment. This kind of vertical pump compartment, having thus a greater height than width, can carry noise upwards, as it allows installing the power unit more freely in different positions. This enables to further reduce the noise at the working level compared to e.g. traditional hydraulic power units.

[0016] According to one embodiment of the invention, the power unit comprises a replaceable and/or adjustable adapter plate for installing electric motors and/or hydraulic pumps of various sizes. This essentially diversifies the use of the power unit and hydraulic apparatus, because the same apparatus can then be used in various applications. On the other hand, increasing/decreasing the power of the apparatus can be carried out without a need to change the power unit itself at the same time.

[0017] According to one embodiment of the invention, the bottom of the power unit is provided with one or more drain basins for improving safe operation and/or facilitating the maintenance.

[0018] According to one embodiment of the invention, there is a sound insulator between the two or more separate compartments of the power unit. Preferably the sound insulation of the partition wall essentially reduces noise in the component compartment. Consequently, it is possible to work with reduced noise for example during the adjustment and use of the hydraulic apparatus. The assembly and use of an apparatus, which is essentially totally sound-insulated for its external cladding and comprises a sound-insulated partition wall between its pump compartment and component compartment, is extremely flexible in various applications. The sound insulator used for the partition wall can be e.g. 50-200 mm wide mineral wool, preferably such as 75-125 mm mineral wool.

[0019] Preferably between the two or more separate compartments of the power unit there are one or more air channels for guiding the cooling air for one or more separate compartments. The air channel, for its part, improves the sound insulation. The air channel also carries noise increasing thus further the installation possibilities of the apparatus. Preferably the air channel is essentially vertical in which case it preferably carries noise away from the power unit. The walls of the air channel are preferably made partly or completely of the wall components of the partition wall. The air channel can be made structurally curvy, whereby the noise carried to the air channel is damped relatively efficiently due to a large noise abatement area. The air channel can be preferably located inside a sound insulator, such as mineral wool.

[0020] According to one embodiment of the invention, above one or more compartments of the power unit there is provided a ceiling part equipped with air guides for guiding the cooling air to and/or from the power unit compartment. This for its part enables efficient cooling of the components in the compartment. The air guide can be preferably connected to the ventilation of the operating room and in this case it is possible to utilize the heat created by the apparatus for the heating of the operating room, for example, by guiding the exhaust air to the heat exchange equipment. Leading the air out of the power unit to the ventilation channels improves for its part the installation possibilities and use of the apparatus by reducing heat and noise load at the operation site.

[0021] According to one embodiment of the invention, the air guide of the power unit and the air channel of the partition wall are connected to the air guides in the ceiling part for cooling one or more compartments. This improves cooling and sound insulation of the apparatus and increases, for its part, the installation possibilities of the apparatus.

[0022] Ventilation of the power unit can be based either on free ventilation or forced ventilation or a combination thereof. For ventilation, for example separate fans can be used to improve ventilation. Along with air, heat is removed from the power unit at the same time. The fan of one of the components, such as the fan of the electric motor, is preferably used for ventilation.

[0023] The air guides can be preferably installed for example in such a manner that the air supply guide is above the electric motor of the pump compartment and the air exhaust guide is above the air cooler of the component compartment. The cooling air preferably circulates from the electric motor to the air channel and further out via the air cooler.

[0024] Preferably the ceiling part of the power unit can be at least partially sound-insulated for improving the sound insulation of the apparatus. Sound insulation is preferably made at least in the ceiling part of the pump compartment of the power unit.

[0025] According to one embodiment of the invention, the external cladding part of the power unit is essentially completely sound-insulated. Also the ceiling part is preferably essentially completely sound-insulated. These solutions, for their part, improve the installation possibilities of the apparatus in various applications. The sound insulator can vary according to the application. Preferably it can be e.g. 10-100 mm mineral wool, such as 20-50 mm or 50-100 mm.

[0026] A hydraulic apparatus according to the invention can be used in very many applications. Further, the size and capacity of the apparatus can be freely variable. The configuration of the apparatus can also vary. The output of the electric motor can be e.g. 10-100 kW. As for the oil tank, it can be e.g. 100-5.000 dm3. The volumetric flow of the apparatus can be e.g. 10-500 dm3/min.

[0027] A hydraulic apparatus according to the invention can be used e.g. in applications, in which the vis-

cosity of hydraulic oil is 10-100 cSt, such as 32 and 46 cSt.

[0028] The apparatus according to the invention can be adapted e.g. in the following industrial hydraulic applications:

- power source for hydraulically operated machines integral to the machine or separately located,
- modernization of hydraulically operated machines, freely located and sound-insulated,
- a freely located apparatus enables reducing the piping need when located in connection with the actuators,
- located in spaces subjected to noise limits without a specific hydraulic room
- can be located in open spaces in the vicinity of the personnel,
- power source for hydraulic test benches.

[0029] Applications of the marine hydraulics include e.g. power sources for ship deck equipment and power sources for other equipment operated with ship hydraulics.

[0030] Other hydraulic components that can be installed in the power unit of the hydraulic apparatus according to the invention can comprise the following, for example:

- air cooler
- water cooler
- cooling circuit filter
- block
- directional valve
- pressure reducing valve
- pressure switch, pressure sensor
- pressure tapping
- manometer
- pressure filter
- pressure accumulator with shut-off and safety valves
- electric cabinet, electric equipment
- hydraulic hoses and pipes
- quick connectors.

Detailed description of invention

[0031] Some of the embodiments of the invention are described below in detail making reference to the enclosed drawings.

[0032] Figure 1 shows a hydraulic apparatus according to the invention with the power unit wall partially opened.

[0033] Figure 2 shows a hydraulic apparatus according to Figure 1, in which the external cladding part is removed, seen from one direction.

[0034] Figure 3 shows a hydraulic apparatus according to Figure 1, in which the external cladding part is removed, seen from another direction.

[0035] Figure 4 shows a power unit provided with a ceiling part.

[0036] Figure 5 is a sectional view of the oil tank 3.

[0037] Figure 6 is a sectional view of the power unit.

[0038] Figure 1 shows a hydraulic unit 1 with a power unit 2 and an oil tank 3 located outside the power unit 2. The power unit 2 comprises a pump compartment 4 and a component compartment 5. The external cladding part 6a, 6b of the power unit 2 is partially opened. Figure 1 also shows an electric motor 7 installed in the pump compartment 2. The outer surface of the oil tank 3 is additionally provided with connecting pipes 9.

[0039] Figure 2 shows a hydraulic unit 1 according to Figure 1 with a power unit 2 and an oil tank 3 located outside the power unit 2. The external cladding part 6a, 6b of the power unit 2 is completely removed for showing the assembly of the components of the hydraulic apparatus 1. The power unit 2 comprises a pump compartment 4 and a component compartment 5. The power unit 2 comprises a bottom part 23 and an internal partition wall 11. The pump compartment 4 comprises a catchment basin 19 on the bottom part 23. Installed in the pump compartment 4 there are an electric motor 7 and a hydraulic pump 8 connected to each other and supported by a mounting frame 21 that is connected to the partition wall 11. The hydraulic pump 8 is connected to the other hydraulic components (not shown) of the component compartment 5 with hydraulic hoses 10, while these components are connected to the oil tank 3 with another set of hydraulic hoses 10. In the oil tank 3 there are shown a tank part 31, an intermediate part 37 and a base part 32 with a drain basin 33 at its upper edge. Above the oil tank 3 there is a conical ceiling 34 with hydraulic equipment 35 of the oil tank on top.

[0040] Figure 3 shows a hydraulic unit 1 according to Figure 1 with a power unit 2 and an oil tank 3 located outside the power unit 2. The external cladding part 6a, 6b of the power unit is completely removed for showing the assembly of the components of the hydraulic apparatus. The power unit 2 comprises a pump compartment 4 and a component compartment 5. The power unit comprises a bottom part 23 and an internal partition wall 11. The internal partition wall 11 is fastened to the bottom part 23 with a support bar 20. The internal partition wall is provided with a perforated plate 18 for installing the hydraulic components. The pump compartment 4 and the component compartment 5 have a catchment basin 19 on the bottom part 23. For providing an example, in the component compartment 4, other hydraulic components 12-16 are shown of which some are connected to the oil tank 3 with hydraulic hoses 10. The other hydraulic components 12-16 shown in Figure 3 include a cooler 12, a valve 13, a pressure accumulator 14, a filter 15 and a circulation pump 16. In the oil tank 3 there are shown a tank part 31, an intermediate part 37 and a base part 32 with a drain basin 33 at its upper edge. Above the oil tank 3 there is a conical ceiling 34 with hydraulic equipment 35 of the oil tank on top. The

outer surface of the oil tank 3 is additionally provided with connecting pipes 9.

[0041] Figure 4 shows a power unit 2 of the hydraulic apparatus having a ceiling part 41 above the pump compartment 4 and component compartment 5. The ceiling part 41 is provided with an inlet air guide 44 and an outlet air guide 43. A vertically adjustable guide closure 42 can be installed above the inlet air guide 44. The power unit 2 comprises a pump compartment 4 and a component compartment 5. The figure also shows the external cladding part 6a of the pump compartment 4. The power unit comprises a bottom part 23 and an internal partition wall 11. The pump compartment 4 and the component compartment 5 have a catchment basin 19 on the bottom part 23. In the pump compartment 4 there is installed a combination of an electric motor and hydraulic pump 7-8 connected to each other and supported by a mounting frame 21 present on the partition wall 11. The internal partition wall 11 is fastened to the bottom part 23 with a support bar 20. The internal partition wall is provided with a perforated plate 18 for installing the hydraulic components. The internal partition wall is provided with a sound insulator 24 and an air channel 22 for guiding the cooling air. The outlet air guide 43 of the ceiling part 41 is installed above the air channel 22 for guiding the air removed from the compartments 4, 5 via the air channel 22. In the component compartment 4, other hydraulic components 12-16 and hydraulic hoses 10 are shown.

[0042] Figure 5 shows a sectional view of the oil tank 3. It comprises a tank part 31, an intermediate part 37 and a base part 32 with a drain basin 33 at its upper edge. A conical ceiling 34 can be installed supported by the edge 31 a of the tank part 31 of the oil tank. Inside the tank part 31 there is a spiral guide plate 36 comprising a center pipe 36a and spiral wings 36b. The base part 32 has an inclined basin bottom 39, on top of which a catchment basin 38 of the tank is formed. For supplying and removing oil the tank part 31 additionally comprises a tangentially directed supply pipe 49 and a discharge pipe 48.

[0043] Figure 6 shows a sectional view of a power unit 2 comprising a pump compartment 4 and a component compartment 5 with a ceiling part 41 on top. The ceiling part 41 is provided with an inlet air guide 44 and an outlet air guide 43. The figure also shows the external cladding part 62 of the pump compartment 4 having also an inlet air grill 45. The power unit comprises a bottom part 23 and an internal partition wall 11. In the connection points of the bottom part 23 and the ceiling part 41 as well as of the external cladding part 6a there is a sealing 46 for sealing the constructions. The pump compartment 4 and the component compartment 5 have a catchment basin 19 on the bottom part 23. Installed in the pump compartment 4 there is a combination of an electric motor and hydraulic pump 7-8 connected to each other and supported by an adapter plate 21 present on the partition wall 11. The internal partition wall is provided with a perforated plate 18 for installing the hydraulic components. The internal partition wall 11 is provided with a sound insulator 24 and an air channel 22 for guiding the cooling air. The air channel 22 is formed of the wall components 11 a of the partition wall 11. The component compartment 5 is additionally provided with an air cooler 47.

Claims

1. A hydraulic apparatus comprising one or more oil tanks (3), **characterized in that** the oil tank (3) has means (36, 48, 49) for guiding the hydraulic oil flow to the tangential direction.

2. A hydraulic apparatus as set forth in claim 1, **characterized in that** the oil tank (3) comprises an at least partially spiral guide plate (36) for guiding the oil flow to the tangential direction.

3. A hydraulic apparatus as set forth in claim 1 or 2, **characterized in that** in the upper part of the oil tank (3) there is an oil supply pipe (49) with a tangential supply.

4. A hydraulic apparatus as set forth in any of the above claims, **characterized in that** in the lower part of the oil tank (3) there is an oil discharge pipe (48) with a tangential discharge.

5. A hydraulic apparatus as set forth in any of the above claims, **characterized in that** the hydraulic apparatus (1) comprises one or more power units (2) connected thereto and separated from the oil tank (3), the power units having at least one separate pump compartment (4) and one separate component compartment (5) and an at least partially opening external cladding part (6a, 6b), and that the electric motor (7) and the hydraulic pump (8) are installed in the separate pump compartment (4) of the power unit (2) and one or more other hydraulic components (12-16) are installed in the separate component compartment (5) of the power unit (2).

6. A hydraulic apparatus as set forth in claim 5, **characterized in that** a combination of an electric motor and hydraulic pump (7, 8) is installed in an essentially vertical position in the power unit (2).

7. A hydraulic apparatus as set forth in claims 5-6, **characterized in that** the power unit (2) comprises a replaceable and/or adjustable adapter plate (21) for installing electric motors and/or hydraulic pumps (7, 8) of various sizes.

8. A hydraulic apparatus as set forth in claims 5-7, **characterized in that** between the two or more

separate compartments (4, 5) of the power unit (2) there is a sound insulator (24).

9. A hydraulic apparatus as set forth in claims 5-8, **characterized in that** between the two or more separate compartments (4, 5) of the power unit (2) there are one or more air channels (22) for guiding the cooling air and/or improving the sound insulation of one or more separate compartments (4, 5) of the power unit (2).

10. A hydraulic apparatus as set forth in claims 5-9, **characterized in that** the power unit (2) comprises a ceiling part (41) with one or more air guides (43, 44) for guiding the inlet air and/or outlet air.

11. A hydraulic apparatus as set forth in claim 10, **characterized in that** the air guide (43, 44) of the ceiling part (41) is connected to one or more air channels (22) for guiding the cooling air.

12. A hydraulic apparatus as set forth in claims 5-11, **characterized in that** the external cladding part (6a, 6b) of the power unit (2) is at least partially sound-insulated.

13. A method for manufacturing a hydraulic apparatus comprising one or more oil tanks (3), **characterized in that** connected to the oil tank (3) are means (36, 48, 49) for guiding the hydraulic oil flow to the tangential direction.

14. A method for using a hydraulic apparatus as set forth in claims 1-12 or a hydraulic apparatus manufactured according to claim 13, **characterized in that** the hydraulic apparatus (1) is used in the industrial hydraulics and/or marine hydraulics.

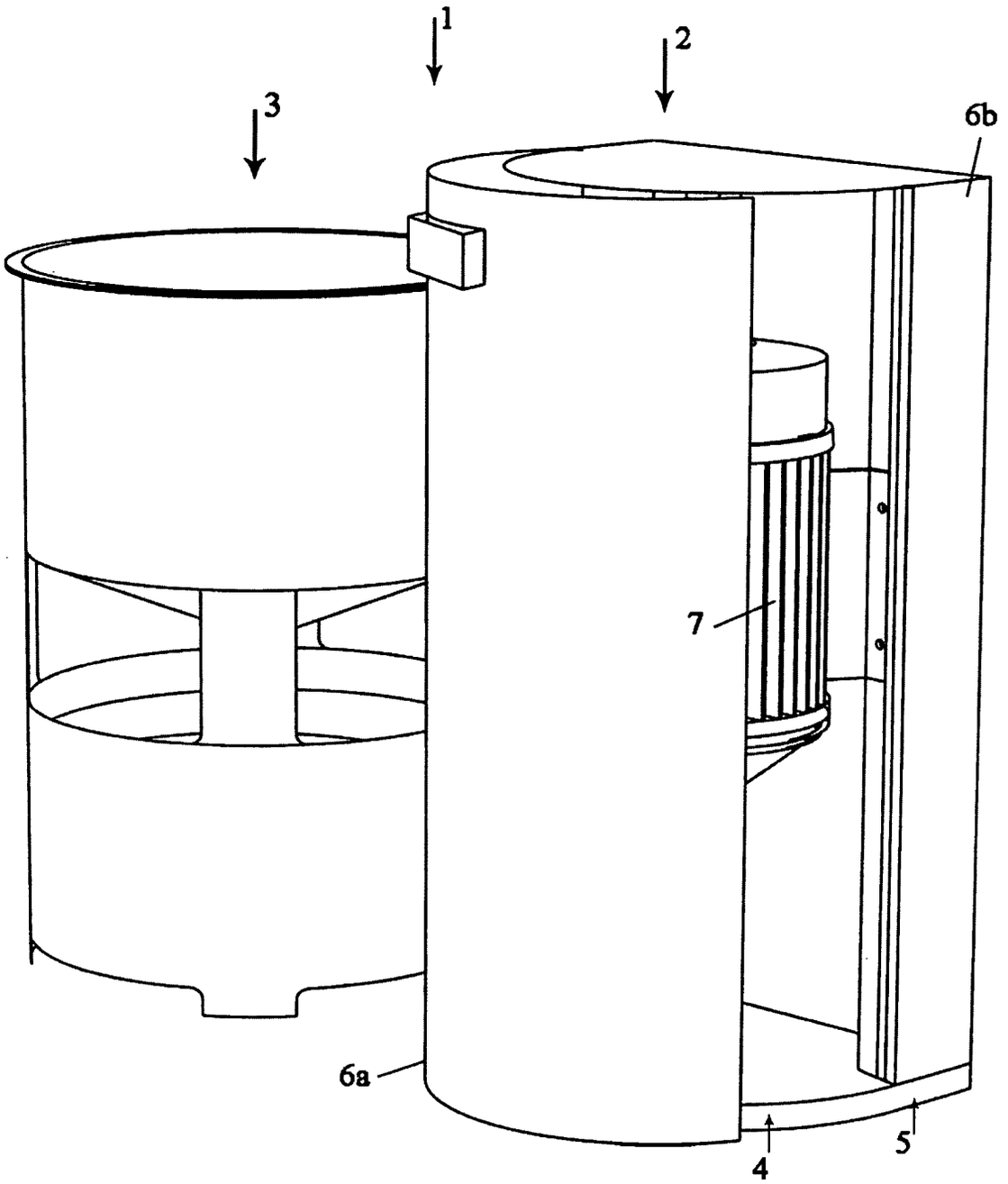

Fig. 1

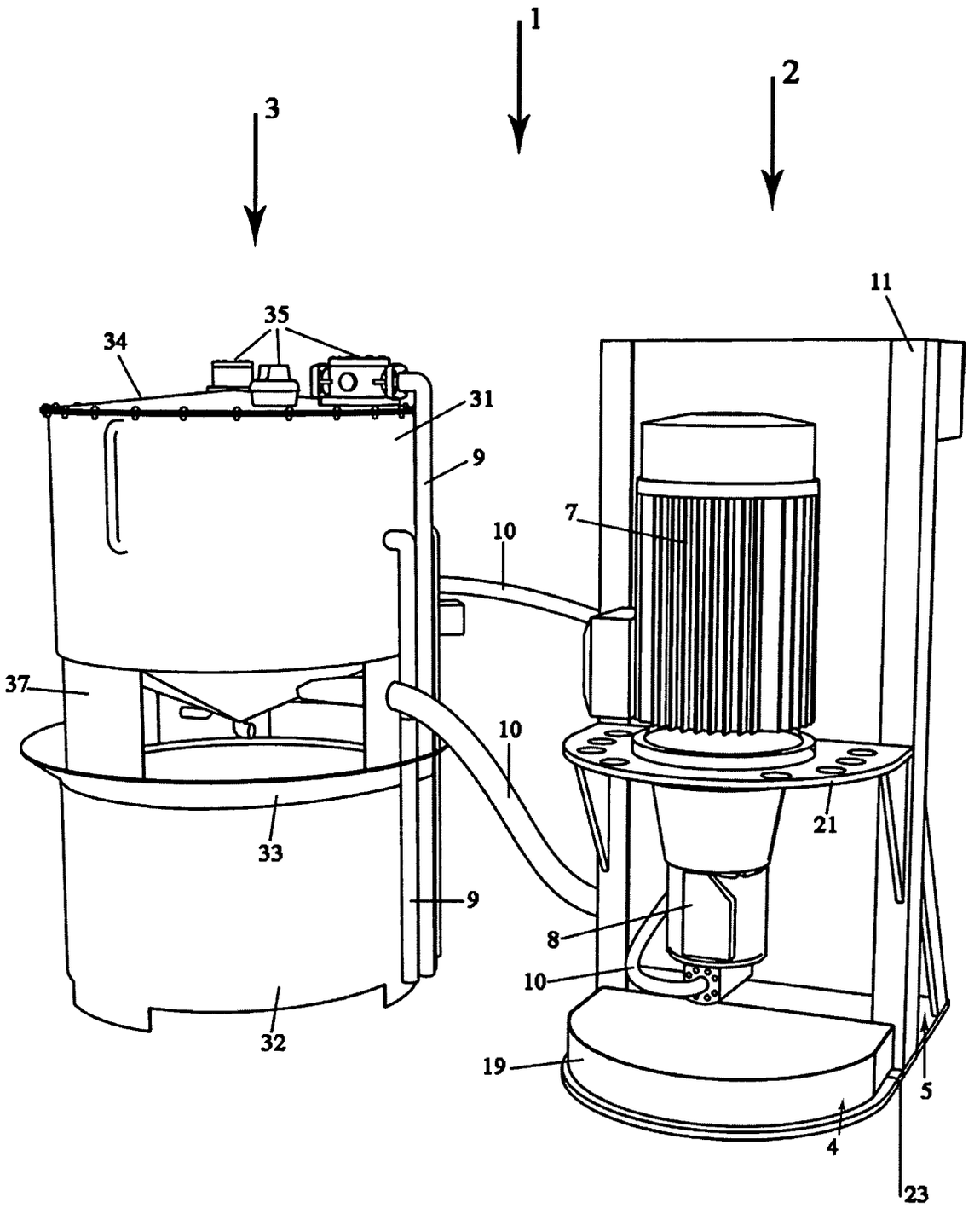

Fig. 2

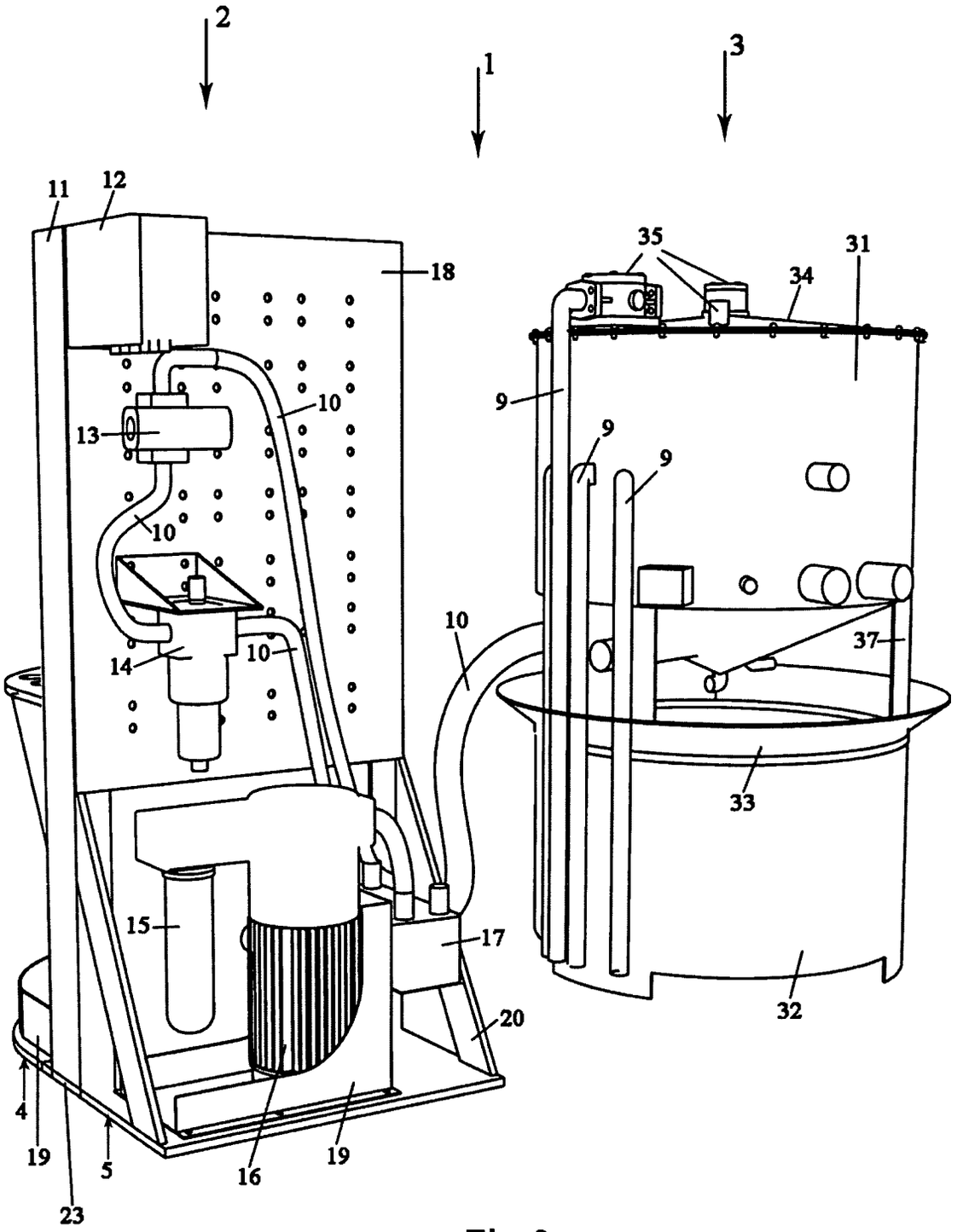

Fig. 3

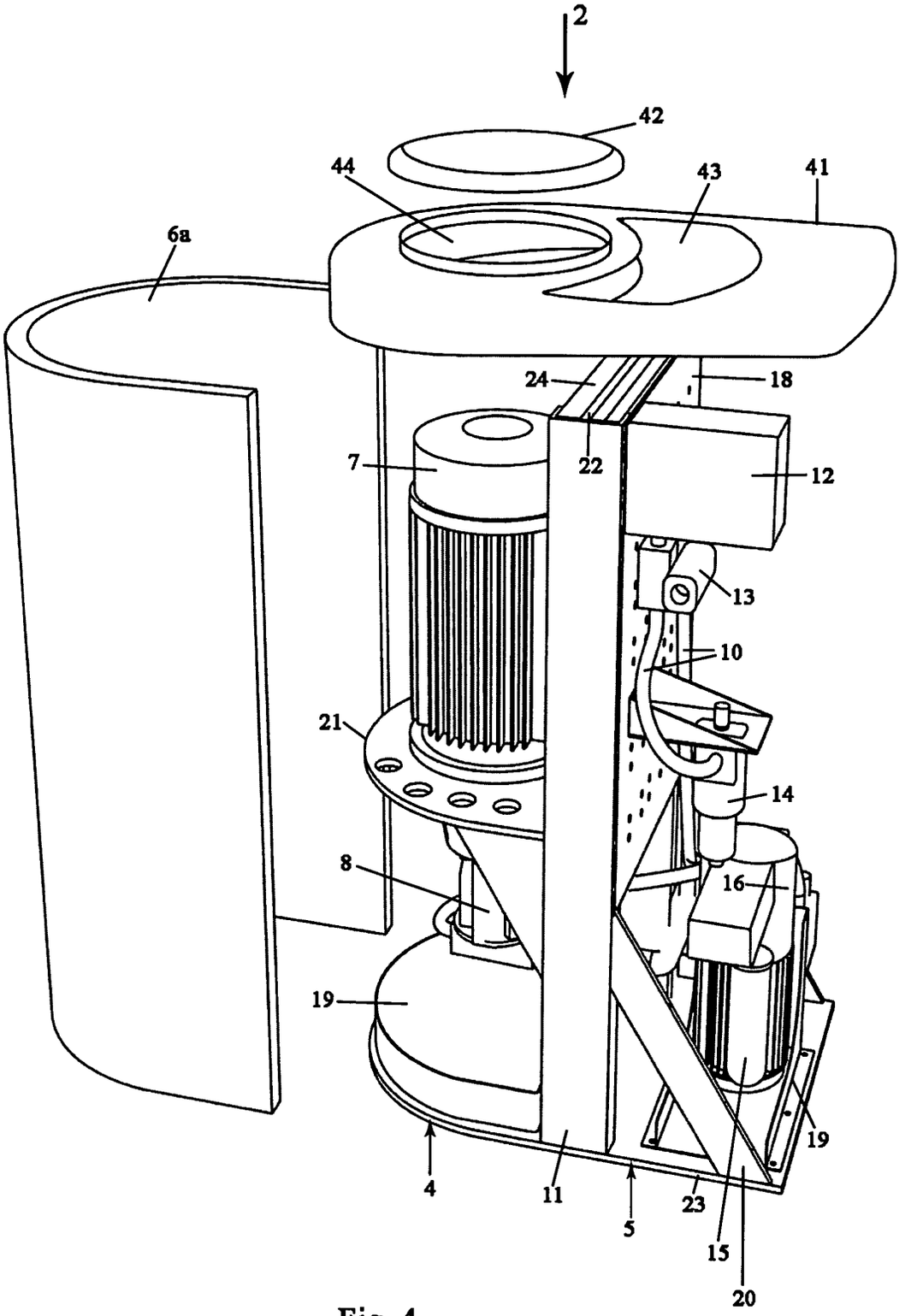

Fig. 4

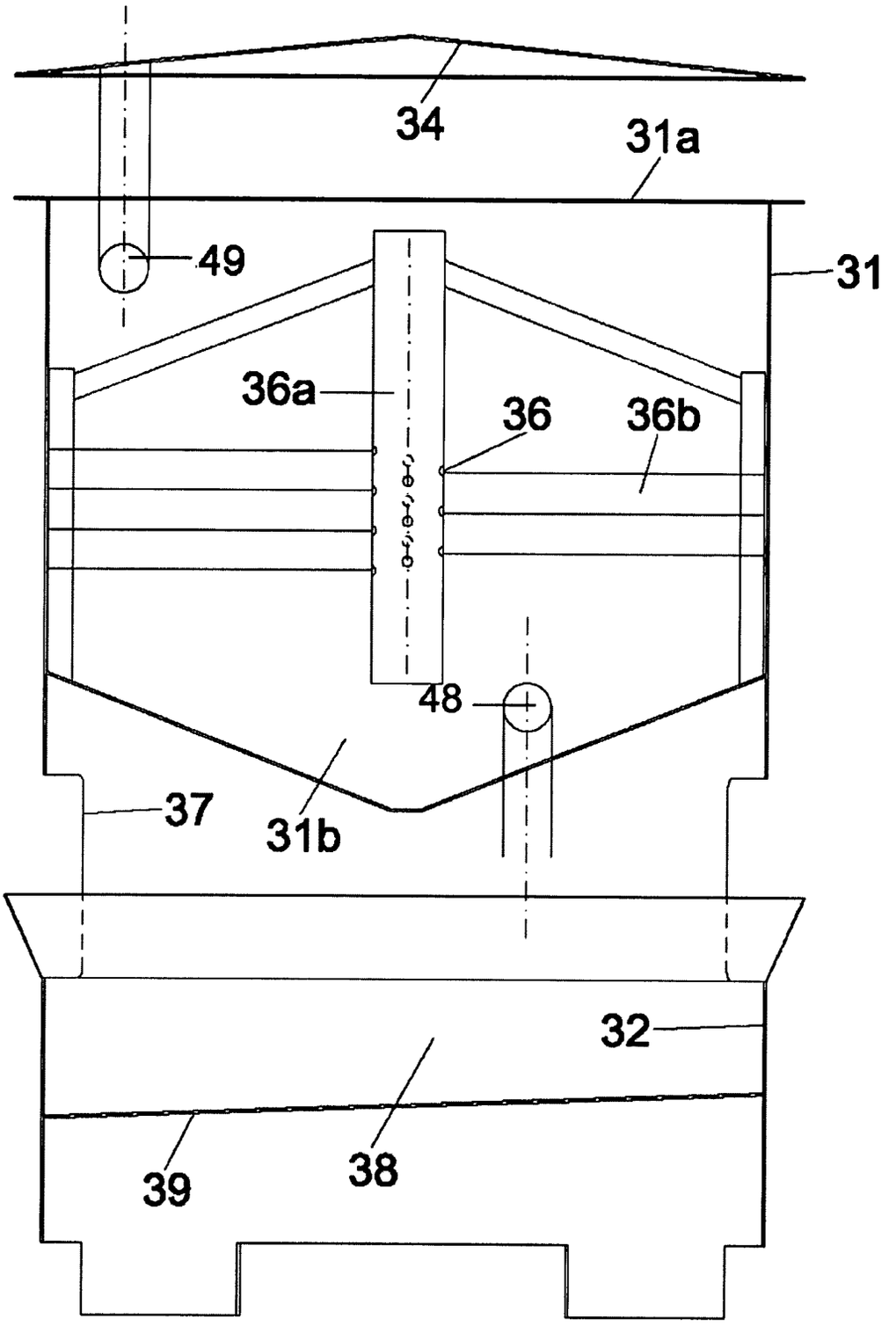

Fig. 5

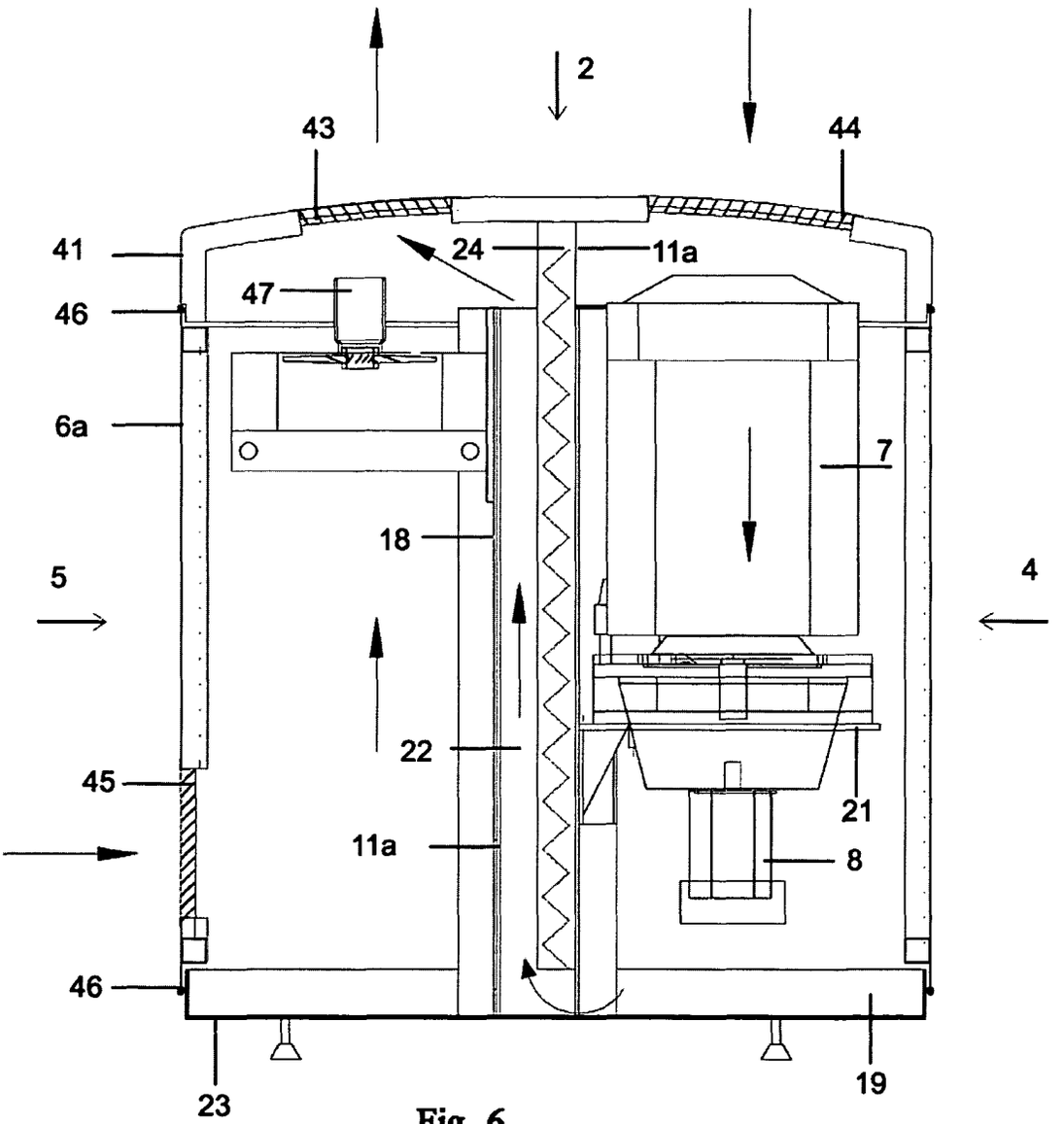

Fig. 6