



(51) International Patent Classification:

F04B 23/04 (2006.01) *F04D 13/14* (2006.01)
F04B 53/16 (2006.01) *F04D 29/40* (2006.01)
E03B 5/02 (2006.01) *F04C 15/06* (2006.01)
F04C 11/00 (2006.01)

(21) International Application Number:

PCT/EP2012/056462

(22) International Filing Date:

10 April 2012 (10.04.2012)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

11003043.4 12 April 2011 (12.04.2011) EP

(71) Applicant (for all designated States except US): **GRUND-FOS MANAGEMENT A/S** [DK/DK]; Poul Due Jensens Vej 7 - 11, DK-8850 Bjerringbro (DK).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **HASSAN, Abdul-Sattar** [DK/DK]; Annekaervej 28, DK-8250 Egå (DK).

(74) Agent: **VOLLMANN & HEMMER**; Wallstraße 33a, 23560 Lübeck (DE).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

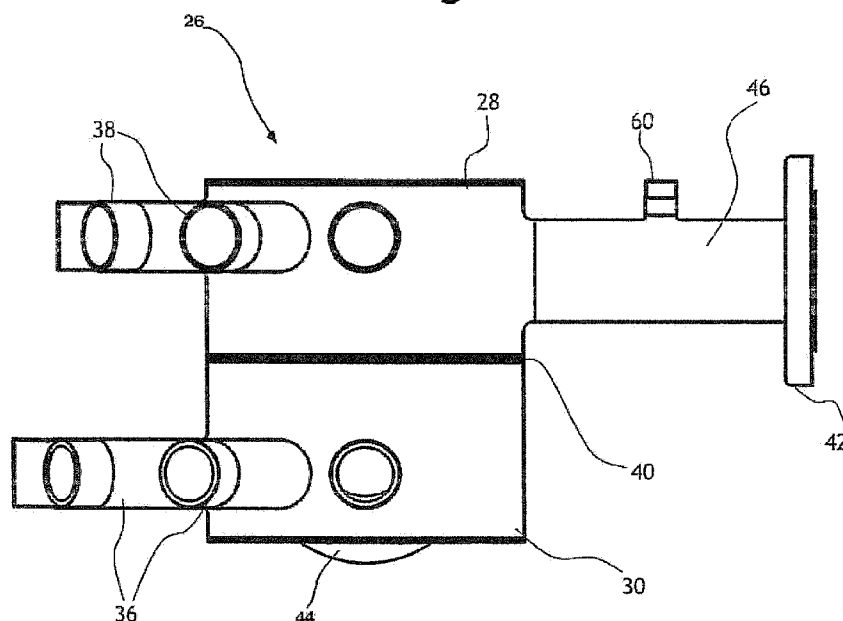
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: MANIFOLD SYSTEM

Fig. 4



(57) Abstract: The present invention relates to a manifold system (26) for a pressure boosting system (2). The manifold system (26) comprises a manifold (30, 28) having a manifold space (58) configured to receive a fluid; a main connection pipe (46, 48) configured to connect the manifold space 5 (58) to a main pipe; and a number of connection pipes (36, 38) each configured to connect the manifold space (58) to a pump (4). At least some of the connection pipes (36, 38) of the manifold (28, 30) are angled relative to each other, wherein the at least some of the connection pipes (36, 38) are non-parallel to each other.

5

Description

A pressure boosting system is a multi-pump system that is used to pressurise fluids. Pressure boosting systems are used in various applications. Normally, pressure boosting systems comprise of a plurality of pumps (typically two, three or four pumps) that are connected to a common
10 pipe system. In the prior art pressure boosting systems, the inlet pipes of the pumps are connected to an inlet manifold having a flange that is configured to be directly connected to a main inlet pipe. In the same manner, the outlet pipes of the pumps are connected to an outlet manifold having a flange that is configured to be directly connected to
15 a main outlet pipe. The manifolds typically have a tubular elongated geometry and the pumps are arranged along the longitudinal axis of the manifolds.

In the prior pressure boosting system, the inlet manifold and the outlet
20 manifold extend parallel to one another and are individually spaced from one another. The weight of the manifolds is often exposed to the pump sleeves and accordingly, the pumps are often exposed to high mechanical stress, especially at the pump sleeve where the inlet pipes or outlet pipes are connected to the pump. Due to the mechanical
25 stress caused by the manifolds and valves during transportation or operation, the pipe connection of pump sleeve is often subject to damages. Leakages may result from the above mentioned stress. To overcome these mechanical stresses it is possible to support the manifolds by a mechanical support structure. This introduces higher costs and
30 mechanical restrictions regarding service of the pressure boosting system.

Moreover, replacement and service of pumps requires that all pumps are disconnected. This procedure is time-consuming and introduces the risk of failure to the system.

5

In addition to the above, the prior art pressure boosting systems require a rather huge clearance area all around the system in order to carry out inspection and service of the booster system. The manifolds of a pressure boosting system constitute a manifold system, and a manifold system is required in all pressure boosting systems.

10

In the prior art pressure boosting systems stagnant water is present at the blind end of the manifold even when fluid is pumped through the manifold. This stagnant water will give rise to bacteria growth. Therefore, it is an object of the present invention to provide a manifold system in which stagnant water can be avoided or minimised.

15

It is also an object of the present invention to provide a manifold system that subjects the pump sleeves to less mechanical stress.

20

It is also an object of the present invention to provide a manifold system that avoids the requirement to disconnect all pumps during replacement and service of a pump.

25

Furthermore, it is an object of the present invention to provide a manifold system that requires less clearance area in order to carry out inspection and service of the pumps of the pressure boosting system.

30

This object can be achieved by a pressure boosting system having the features defined in claim 1. Preferred embodiments are disclosed in the dependent claims, the following description and the drawings.

The manifold system according to the invention comprises a manifold having:

- a manifold space configured to receive a fluid;
- a main connection pipe configured to connect
- 5 the manifold space to a main pipe; and
- a number of connection pipes each configured to connect the manifold space to a pump.

At least some of the connection pipes of the manifold are angled rela-
10 tive to each other.

Hereby, the manifold system may be arranged centrally relative to the pumps of the pressure boosting system, and thus, the pressure boosting system can be made very compact. It is also achieved that less me-
15 chanical stress is exposed to the pump sleeve compared with the prior art pressure boosting systems.

Moreover, the manifold system makes it possible to build a pressure boosting system that allows replacement and service of a pump with-
20 out disconnecting all pumps.

When the manifold system is used, the pressure boosting system requires less clearance area in order to carry out inspection and service of the pressure booster system compared to prior art pressure boosting sys-
25 tems.

The term "angled relative to each other" means that the longitudinal axes of the pipes or connection pipes are non-parallel. The angle between adjacent pipes or connection pipes may be fixed so that the
30 pumps are uniformly distributed. However, it is also possible to arrange the pipes or connection pipes with different angles between different sets of adjacent pipes or connection pipes.

Advantageously, all the connection pipes of the manifold are angled relative to each other. This way of arranging the connection pipes enables a simplified way of producing the manifold system and makes it possible to build a very compact pressure boosting system.

It may be beneficial if the manifold is cylindrical and the connection pipes are arranged at the outer periphery of the cylindrical manifold. Hereby, a robust manifold can be produced in an easy manner.

It is possible to arrange the connection pipes such that they extend basically perpendicular to the longitudinal axis of the manifold.

Moreover, a diaphragm tank may be arranged on the outlet manifold, or alternatively it may be built into the outlet manifold space. Hereby, a pressure can be maintained in the outlet manifold when the last pump in operation is switched off. Hereby, pressure energy can be stored in the manifold, and a fluid can be pressurised even if there is no pump activity.

Further, it is possible to configure the manifold system such that the longitudinal axes of the connection pipes span a first plane that is basically perpendicular to the longitudinal axis of the manifold and such that the main connection pipe extends basically parallel to the first plane. This configuration will take up less space than prior art manifold systems, and allows for easily connecting pumps of a similar type to the manifold system.

Preferably, the manifold system comprises an inlet manifold having a longitudinal axis and being arranged adjacent to an outlet manifold having a longitudinal axis. Furthermore, the axes of the inlet manifold and the outlet manifold are basically parallel to each other. Advanta-

geously, a manifold system according to this configuration may be used because both the inlet manifold and the outlet manifold make it possible to achieve a very compact pressure boosting system.

- 5 It is possible to arrange the inlet manifold and the outlet manifold in several configurations. By way of example, the inlet manifold and the outlet manifold may be individually spaced from each other. However, it is also possible to weld the inlet manifold and the outlet manifold or connect the inlet manifold and the outlet manifold together by me-
10 chanic means. The inlet manifold and the outlet manifold may, for instance, be arranged on top of each other or in a side-by-side configuration.

- It is possible that the inlet manifold and the outlet manifold are ar-
15 ranged adjacent to each other and that the longitudinal axes of the inlet manifold and the outlet manifold are basically parallel to each other. Hereby, a compact manifold system can be achieved.

- It is possible that the inlet manifold and the outlet manifold are integral-
20 ly built in one unit. Still, the two manifolds may be produced separately. Building the manifolds in one and the same unit may be achieved in several ways. By way of example, two manifolds may be welded together or fixed to each other by mechanical means. For example, it would be possible to produce the manifold by one or more moulding
25 processes.

- Advantageously, the connection pipes of the inlet manifold are evenly distributed so that the angle between the longitudinal axes of all adjacent connection pipes are basically the same and/or that the connec-
30 tion pipes of the outlet manifold are evenly distributed so that the angle between the longitudinal axes of all adjacent connection pipes are basically the same. This embodiment allows for distributing the pumps

evenly around the inlet manifold and the outlet manifold and for providing a very compact pressure boosting system.

It is possible to provide a pressure boosting system comprising a manifold system according to any of the described manifold systems.

Advantageously, the inlet manifold and the outlet manifold have the same diameter. Accordingly, it is possible to produce the inlet manifold and the outlet manifold in the same way by using the same production tools.

It also is preferable to arrange the connection pipes of the inlet manifold in a manner such that the longitudinal axes of the connection pipes of the inlet manifold span a second plane that is basically perpendicular to the longitudinal axis of the inlet manifold, and the main connection pipe extends basically parallel to a first plane, and the connection pipes of the outlet manifold are arranged in a manner such that the longitudinal axes of the connection pipes of the outlet manifold span a third plane that is basically perpendicular to the longitudinal axis of the outlet manifold, and wherein the main connection pipe extends basically parallel to the second plane, and wherein the second plane and the third plane are basically parallel to each other.

Hereby, a very compact and robust pressure boosting system can be made. Moreover, this embodiment may be beneficial due to the fact that all pumps may be arranged on a common pump level, that all inlets may be arranged on a common inlet level, that all outlets may be arranged on a common outlet level, and that all outlet pipe members and all inlet pipe members may be arranged in parallel.

The manifold system according to the invention may be used in a pressure boosting system.

Preferably, the manifold system is formed such that the manifold and the connection pipes are arranged in a star connection wherein the manifold is the centre of the star.

5

The pressure boosting system may comprise multistage pumps that may be arranged horizontally or vertically.

Advantageously, the inlet pipes of the pumps extend basically horizontally from the pumps to the inlet manifold, and the outlet pipes of the pumps comprise a bent section connecting the outlets with the straight outlet pipe members. The straight outlet pipe members may extend basically horizontally to the outlet manifold, and the outlet manifold of the manifold system may be arranged above and adjacent to the inlet manifold of the manifold system, and the outlet manifold of the manifold system and the inlet manifold of the manifold system may be separated from each other.

This embodiment makes it possible to provide a very compact and robust pressure boosting system.

The present invention will become apparent from the following detailed description and the accompanying drawings, which are given by way of illustration only, and thus, they are not limiting for the present invention, wherein:

Fig. 1 shows a top view of a manifold system according to an embodiment of the present invention arranged in a pressure boosting system;

30

Fig. 2 shows a schematic bottom view of the manifold system shown in Fig. 1;

- Fig. 3 shows a perspective side view of the manifold system shown in Fig. 1 and 2;
- 5 Fig. 4 shows a front view of a manifold system according to a further embodiment of the invention;
- Fig. 5 shows a perspective view of the manifold system shown in Fig. 4;
- 10 Fig. 6 shows a top view of the manifold system shown in Fig. 4 and Fig. 5;
- Fig. 7 shows a cross sectional view of a manifold system according to another embodiment of the invention; and
- 15 Fig. 8 shows various embodiments of the manifold system according to the invention.
- 20 Other objects and further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. It should be understood, however, that the detailed description and specific examples, an indication of preferred embodiments of the invention, are given by way of illustration only, since various changes and
- 25 modifications within the spirit and scope of the invention will be become apparent to those skilled in the art from this detailed description.

Referring now in detail to the drawings for the purpose of illustrating preferred embodiments of the present invention, elements of a pressure

30 boosting system comprising a manifold system 26 according to an embodiment of the present invention are illustrated in Fig. 1. The pressure boosting system 2 comprises four pumps 4 arranged along a section of

a circle C. The pumps 4 have longitudinal axes X_1 , X_2 , X_3 , X_4 which are rotational axes of the rotor and which are angled relative to each other. The angle α_1 between the pump having a longitudinal axis X_1 and the pump having a longitudinal axis X_2 is similar to the angle α_2 between the pump having the longitudinal axis X_2 and the pump having the longitudinal axis X_3 . In fact, the angle α_3 between the pump having the longitudinal axis X_3 and the pump having the longitudinal axis X_4 is similar to both, the angle α_1 and the angle α_2 .

It would, however, be possible to arrange the pumps 4 differently with the pumps 4 still being arranged along a section of a circle. This may be done by choosing the angle α_1 differently from the angle α_2 and α_3 .

The pumps 4 are connected to a manifold system 26 comprising an outlet manifold 28 and an inlet manifold 30 (shown in Fig. 3). The outlet manifold 28 is connected to a main outlet pipe 10. The outlet manifold 28 is connected to the outlets 8 of the pumps 4 via a pipe system 22. Since Fig. 1 shows a top view of the pumps 4, only the pump outlet 8 can be seen. The input manifold 30 (as can be seen in Fig. 2 and 3) comprises a main connection pipe 48 that is provided with a flange 44. This flange 44 is bearing against flange 44' of the main outlet pipe 12. Preferably, the flanges 44 and 44' may be mechanically attached to each other with a sealing in between. The output manifold 28 comprises a main connection pipe 46 that has a flange 42 bearing against a flange 42' of a main outlet pipe 10.

For each pump 4, an outlet line ω_1 , ω_2 , ω_3 , and ω_4 , respectively, connecting the pump outlets 8 to the corresponding connection at the outlet manifold 28 is indicated. The angles β_1 , β_2 , and β_3 between the outlet lines ω_1 and ω_2 , ω_2 and ω_3 , and ω_3 and ω_4 , respectively, are indicated. It can be seen that even though all outlet lines ω_1 , ω_2 , ω_3 , and ω_4

are angled relative to each other, the angles β_1 , β_2 , and β_3 between the outlet lines are equal.

Fig. 2 illustrates a bottom view of the pressure boosting system 2 basically similar to the one shown in Fig. 1. The four pumps 4 are shown from the bottom side, and thus, the inlet pipes 20 can be seen. The inlet lines λ_1 , λ_2 , λ_3 , λ_4 connecting the pumps inlet 6 and their corresponding connection at the inlet manifold 30 are indicated. The angles α_1 , α_2 , and α_3 between the inlet lines λ_1 and λ_2 , λ_2 and λ_3 , and λ_3 and λ_4 respectively, are shown. All inlet lines λ_1 , λ_2 , λ_3 and λ_4 are angled relative to each other, however all of the angles α_1 , α_2 , and α_3 between the inlet lines are equal.

Fig. 3 illustrates a perspective view of the pressure boosting system 2 basically similar to the one shown in Fig. 1. The four pumps 4 of the pressure boosting system 2 comprise inlet pipes 20 connecting the inlet manifold 30 of the manifold system 26, and outlet pipes 18 connecting the outlet manifold 28 of the manifold system 26. The outlet manifold 28 of the manifold system 26 is connected to a main outlet pipe 10, and the inlet manifold 30 of the manifold system 26 is connected to a main inlet pipe 12. The inlet pipes 20 of all pumps 4 comprise a straight inlet pipe member 16, and the outlet pipes 18 of all pumps comprise a straight outlet pipe member 14. A non-return valve 62 is provided between each pump outlet 8 and the outlet manifold 28. During operation of the pressure boosting system 2 one or more pumps 4 can be turned on. The non-return valves 62 make sure that no fluid can enter the pump outlet 8 of a pump that has been switched off.

The fluid that is pressurised by the pressure boosting system 2 enters the inlet manifold 30 through the main connection pipe 48 via the main inlet pipe 12, and the inlet manifold 30 distributes the fluid to the pumps 4 via the inlet pipes 20. The fluid enters a pump 4 through the inlet 6 and

leaves the pump 4 through the outlet 8 from where it is pumped through the outlet pipe 18 and enters the outlet manifold 28 of the manifold system 26 that is connected to a main outlet pipe 10.

- 5 Each pump 4 has an inlet 6 and an outlet 8. The inlets 6 are provided at the axial extremity of the pumps 4 facing the manifold system 26. Each inlet 6 is connected to an inlet pipe 20 that is further connected to a connection pipe 36 of the inlet manifold 30 of the manifold system 26. The outlets 8 of the pumps 4 are provided at the radial surface of the pump sleeve and a bent section 34 is connected to each outlet 8. The bent section 34 is further connected to an outlet pipe 18 that is connected to a connection pipe 38 of the outlet manifold 28 of the manifold system 26 through the main pipe connection 46.
- 10
- 15 A valve 24 is arranged in each straight inlet pipe member 16 and straight outlet pipe member 14. When a pump is removed, installed or exposed to service the valve 24 may be closed so that there is no access of fluid into the pump. The valves may be of any suitable type. Both the straight outlet pipe member 14 and the straight inlet pipe member 16 of each pump 4 extend parallel to the rotational axis of the pump X_1, X_2, X_3, X_4 . Both the inlet manifold 30 and the outlet manifold 28 of the manifold system 26 have a cylindrical geometry and the longitudinal (cylinder) axis B of the inlet manifold 30 as well as the longitudinal (cylinder) axis A of the outlet manifold 28 of the manifold system 26 extend basically perpendicular to the straight outlet pipe members 14, the straight inlet pipe members 16, the axes of the pump X_1, X_2, X_3, X_4 , the inlet lines $\lambda_1, \lambda_2, \lambda_3, \lambda_4$ (from which only λ_1 and λ_2 can be seen in the figure) and the outlet lines $\omega_1, \omega_2, \omega_3$ and ω_4 . In fact, the longitudinal axis B of the inlet manifold 30 and the longitudinal axis A of the outlet manifold 28 of the manifold system 26 are basically parallel to one another.
- 20
- 25
- 30

The pressure boosting system 2 is fastened to a base plate 32 by a number of screws. The base plate 32 is configured to be arranged in a 90 degree corner; however it may be possible to arrange the pressure boosting system 2 on a base plate 32 having another shape or geometry. By way of example, it is possible to arrange five to eight pumps on a 180 degree section of a circle.

The manifold system 26 has an inlet manifold 30 and an outlet manifold 28, and the bottom part of the outlet manifold 28 is mechanically and hermetically separated from the top part of the inlet manifold 30. The outlet manifold 28 is arranged on the top of the inlet manifold 30 and the two manifolds 28, 30 are separated from each other by a flexible thin intermediate plate 40. It would, however, be possible to attach the outlet manifold 28 and the inlet manifold 30 to each other by welding or any other suitable kind of attachment. The outlet manifold 28 and the inlet manifold 30 may also be individually separated and displaced from one another.

Fig. 4 illustrates a perspective view of the manifold system 26 according to the invention. The manifold system 26 consists of an outlet manifold 28 arranged on top of an inlet manifold 30. Both manifolds 28, 30 are cylindrical and connection pipes 36, 38 are arranged on the cylindrical periphery thereof. The outlet manifold 28 comprises a main connection pipe 46 having a flange 42 that is configured to be connected to a main outlet pipe. The main connection pipes 46, 48 (see Fig. 5 for main connection pipe 48) are provided with sensor inlets 60 that are configured to receive a sensor. For example, a pressure sensor (not shown in the figures) may be inserted into the sensor inlet. In the same manner the inlet manifold 30 comprises a main connection pipe 48 having a flange 44 that is configured to be connected to a main inlet pipe (this is indicated in Fig. 5).

Fig. 5 illustrates a perspective view of the manifold system 26 shown in Fig. 4.

In Fig. 6 a top view of a manifold system 26 according to the embodiment shown in Fig. 4 and Fig. 5. It can be seen that the connection pipes 36, 38 (see Fig. 5 for connection pipe 36) of the inlet manifold 30 (see Fig. 5) and of the outlet manifold 28 are arranged on the same side of the respective manifold system 26. It can also be seen that the main connection pipes 46, 48 are angled at 90 degrees relative to each other. It is possible to arrange the main connection pipes 46, 48 in another way. For example, the main connection pipes 46, 48 may be arranged parallel to one another.

Fig. 7 illustrates a cross sectional view of an outlet manifold 28 according to an embodiment of the invention. The manifold 28 has a manifold space 58 configured to receive a fluid. The main connection pipe 46 connects the manifold space 58 to a main pipe (not shown). Further, the connection pipes 38 connect the manifold space 58 to a pump 4 (see Fig. 3). A diaphragm tank 50 is built into the outlet manifold 28 so that pressure may be maintained in the outlet manifold 28 even with the pumps not being active. In the top of the diaphragm tank 50 an air screw 56 is arranged. Through this screw 56 pressurised air 52 can be filled into the diaphragm tank 50. The diaphragm tank 50 will change its geometry according to the pressure conditions on both sides of it, and it is adapted to transfer pressure forces between the air side of the diaphragm 54 and the fluid side of the diaphragm 54. The outlet manifold 28 comprises a main connection pipe 46 with a flange 42 and four connection pipes 38 as well as a sensor inlet 60.

The diaphragm tank 50 is also known as an expansion tank or an expansion vessel that typically is used in domestic hot water systems and closed water heating systems. The diaphragm tank 50 may be divided

into two by a rubber diaphragm 54 or a diaphragm of another suitable material. As the fluid pressure increases the diaphragm moves compressing the air on its fluid-free side.

- 5 Fig. 8 illustrates four different embodiments of the manifold systems 26 according to the invention. It can be seen that the manifold connections 46, 48 can be oriented in different ways. Fig. 8 a) shows an embodiment according to which the manifold connection 46 of the outlet manifold 28 extends vertically while the manifold connection 48 of the
10 inlet manifold 30 extends horizontally. In Fig. 8 b), both the manifold connection 46 of the outlet manifold 28 and the manifold connection 48 of the inlet manifold 30 extend vertically. In Fig. 8 c), the manifold connection 46 of the outlet manifold 28 extends horizontally while the manifold connection 48 of the inlet manifold 30 extends vertically. In
15 Fig. 8 d), a diaphragm tank is integrated in the outlet manifold 28, and both the manifold connection 46 of the outlet manifold 28 and the manifold connection 48 of the inlet manifold 30 extend horizontally.

List of reference numerals

	2	-	Pressure boosting system
	4	-	Pump
5	6	-	Inlet
	8	-	Outlet
	10	-	Main outlet pipe
	12	-	Main inlet pipe
	14	-	Straight outlet pipe member
10	16	-	Straight inlet pipe member
	18	-	Outlet pipe
	20	-	Inlet pipe
	22	-	Pipe system
	24	-	Valve
15	26	-	Manifold system
	28	-	Outlet manifold
	30	-	Inlet manifold
	32	-	Base plate
	34	-	Bent section
20	A	-	Axis
	B	-	Axis
	X ₁ , X ₂ , X ₃ , X ₄ ,	-	Axes of the pumps
	36, 38	-	Connection pipes
	40	-	Intermediate plate
25	$\omega_1, \omega_2, \omega_3, \omega_4$	-	Outlet lines
	$\lambda_1, \lambda_2, \lambda_3, \lambda_4$	-	Inlet lines
	42, 44, 42', 44'	-	Flanges
	46, 48	-	Main connection pipes
	50	-	Diaphragm tank
30	52	-	Pressurised air
	54	-	Flexible diaphragm
	56	-	Air screw

- 58 - Manifold space
- 60 - Sensor inlet
- C - Section of a circle
- 62 - Non-return valve

Claims

1. A manifold system (26) for a pressure boosting system (2), the manifold system (26) comprising:
- 5 a manifold (30, 28) having
- a manifold space (58) configured to receive a fluid;
 - a main connection pipe (46, 48) configured to connect the manifold space (58) to a main pipe; and
 - a number of connection pipes (36, 38) each configured to
- 10 connect the manifold space (58) to a pump (4),

characterised in that

at least some of the connection pipes (36, 38) of the manifold (28, 30) are angled relative to each other, wherein the at least some of the connection pipes (36, 38) are non-parallel to each other.2.

15

2. Manifold system (26) according to claim 1 **characterised in that** all of the connection pipes (36, 38) of the manifold (28, 30) are angled relative to each other, wherein the connection pipes (36, 38) are non-parallel to each other.
- 20 3. Manifold system (26) according to claim 1 or claim 2 **characterised in that** the manifold (28, 30) is cylindrical, and that the connection pipes (38, 36) are arranged at the cylindrical periphery of the manifold (28, 30).

4. Manifold system (26) according to any one of the preceding claims **characterised in that** a diaphragm tank (50) is arranged on the outlet manifold, or is built into the manifold space (58).
- 5 5. Manifold system (26) according to any one of the preceding claims **characterised in that** the connection pipes (38, 36) are arranged in a manner such that the longitudinal axes (X_1 , X_2 , X_3 , X_4) of the connection pipes (38, 36) span a first plane that is basically perpendicular to the longitudinal axis (A, B) of the manifold (28, 30), and that the main connection pipes (46, 48) extend basically
10 parallel to the first plane.
6. Manifold system (26) according to any one of the preceding claims **characterised in that:**
 - the manifold system (26) comprises an inlet manifold (30) hav-
15 ing a longitudinal axis (B) and being arranged adjacent to an outlet manifold (28) having a longitudinal axis (A), and
 - that the axes (A, B) of the inlet manifold (30) and the outlet manifold (28) are basically parallel to each other.
7. Manifold system (26) according to claim 6 **characterised in that:**
 - the connection pipes (36) of the inlet manifold (30) are ar-
20 ranged in a manner such that the longitudinal axes of the connection pipes (36) of the inlet manifold (30) span a second plane that is basically perpendicular to the longitudinal axis (B)

of the inlet manifold (30), and that the main connection pipe (48) extends basically parallel to the second plane, and that

- the connection pipes (38) of the outlet manifold (28) are arranged in a manner such that the longitudinal axes of the connection pipes (38) of the outlet manifold (28) span a third plane that is basically perpendicular to the longitudinal axis (A) of the outlet manifold (28), and that the main connection pipe (46) extends basically parallel to the third plane, and that
- the second plane and the third plane are basically parallel to each other.

8. Manifold system (26) according to any one of the preceding claims **characterised in that** the inlet manifold (30) and the outlet manifold (28) are mechanically connected to each other.
9. Manifold system (26) according to any one of claims 5 to 8 **characterised in that** the connection pipes (36) of the inlet manifold (30) are evenly distributed so that the angle between the longitudinal axes (X_1 , X_2 , X_3 X_4) of all adjacent connection pipes (36) are basically the same and/or that the connection pipes (38) of the outlet manifold (28) are evenly distributed so that the angle between the longitudinal axes (X_1 , X_2 , X_3 X_4) of all adjacent connection pipes (38) are basically the same.
10. Manifold system (26) according to any one of the preceding claims characterised in that the manifold (30, 28) and the connection pipes (36, 38) are arranged in a star connection wherein the manifold (30, 28) is the center of the star.

11. A pressure boosting system (2) comprising a manifold system (26) according to any one of the preceding claims.

Fig. 1

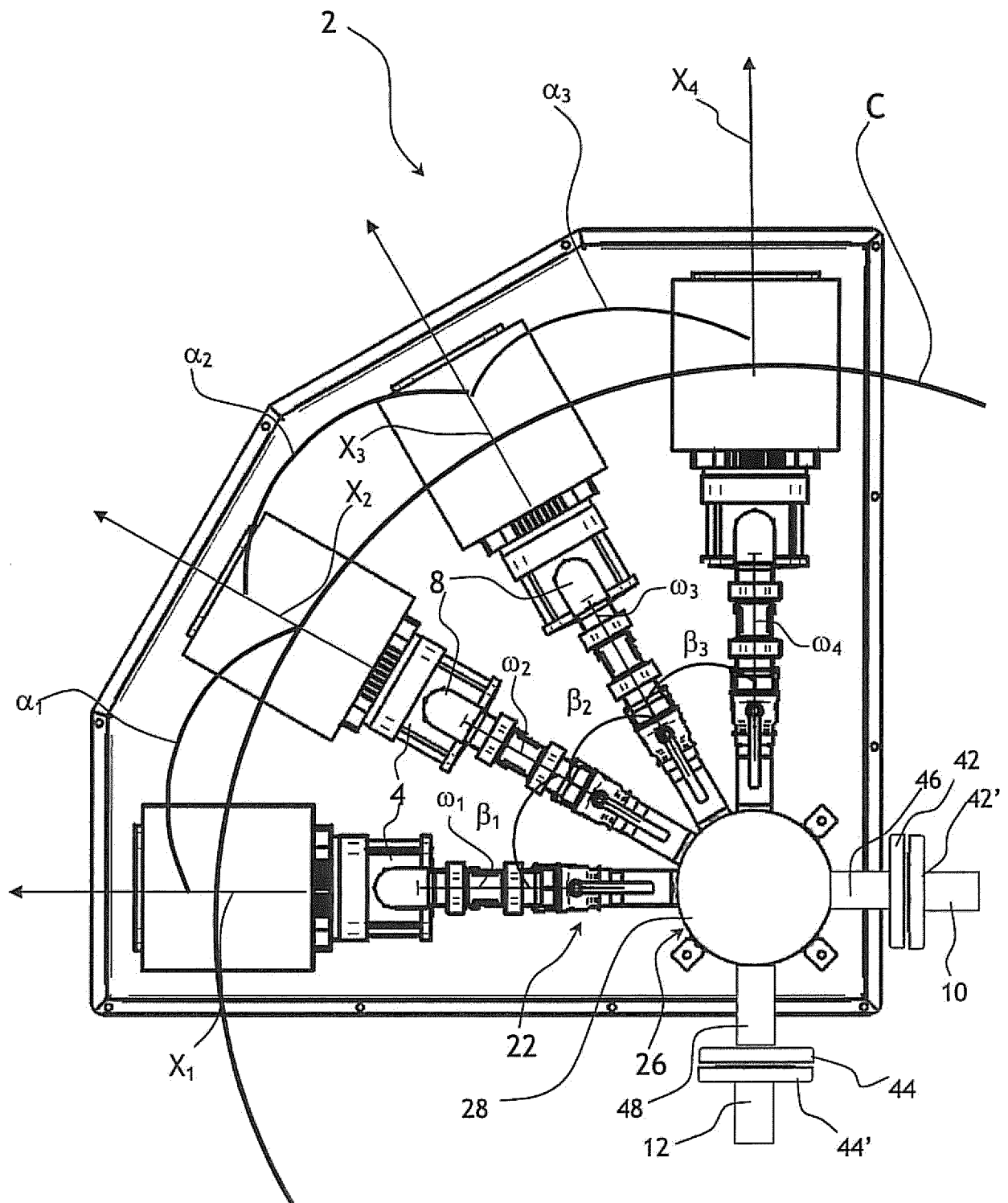


Fig. 2

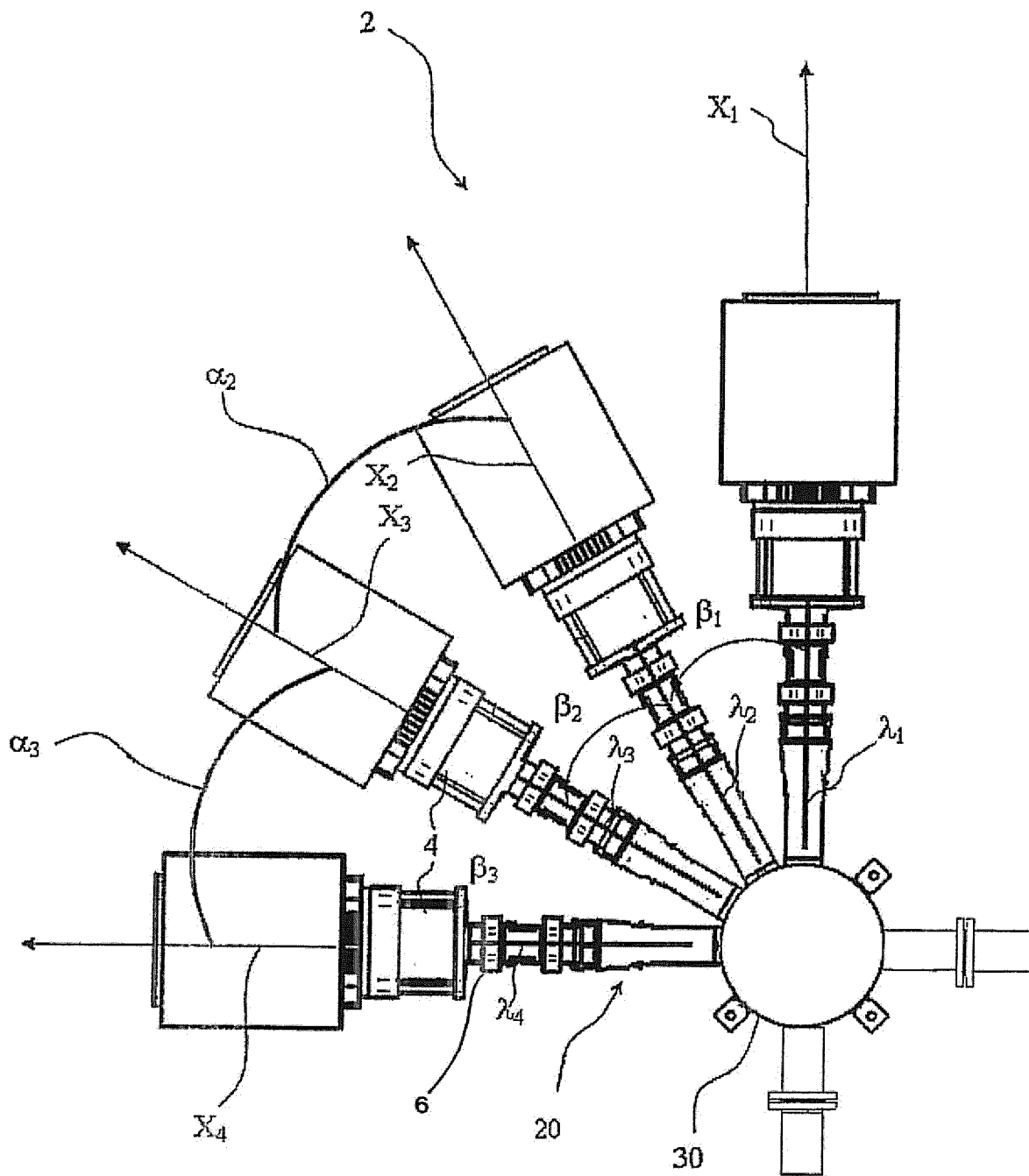


Fig. 3

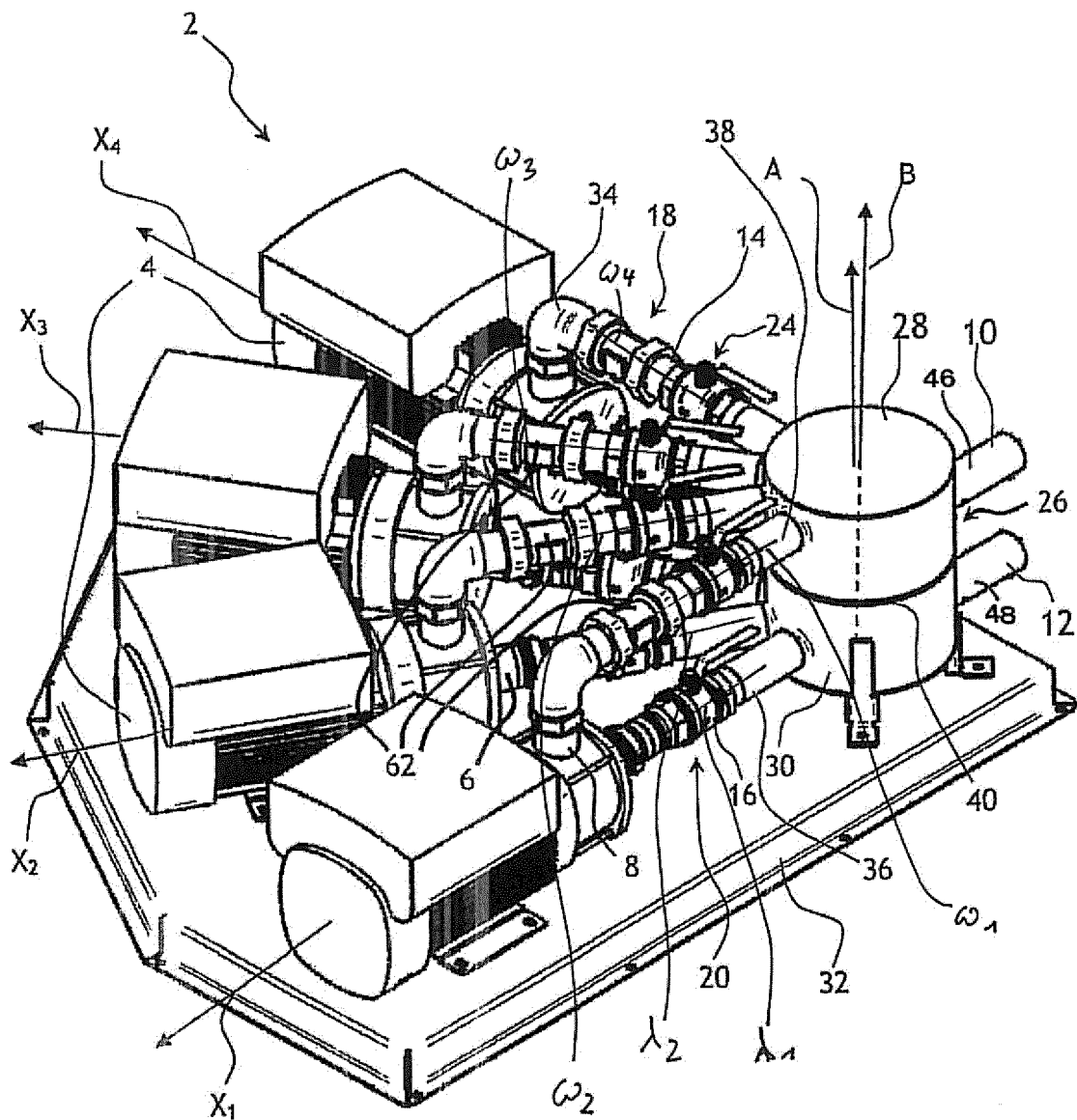


Fig. 4

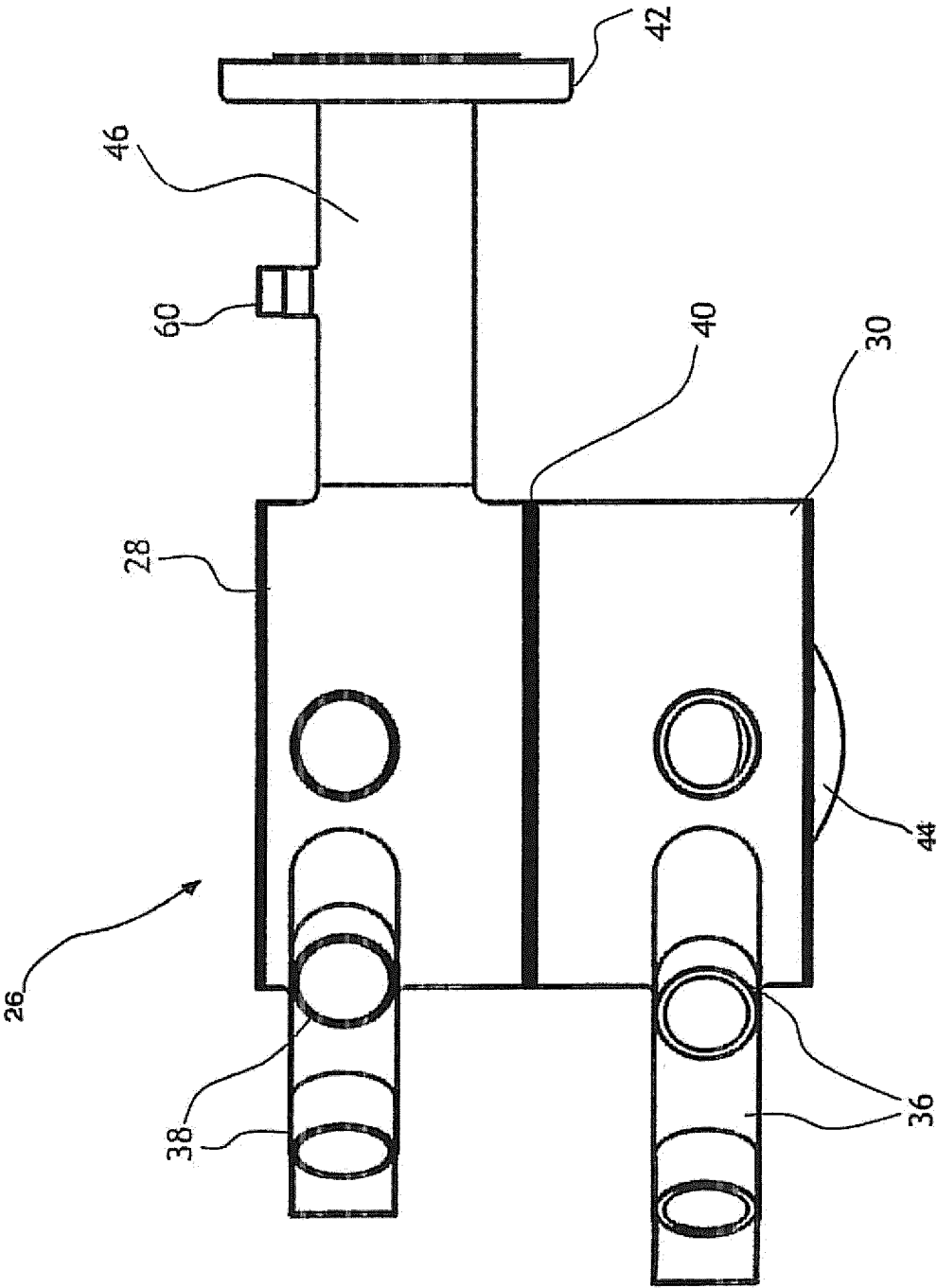


Fig. 5

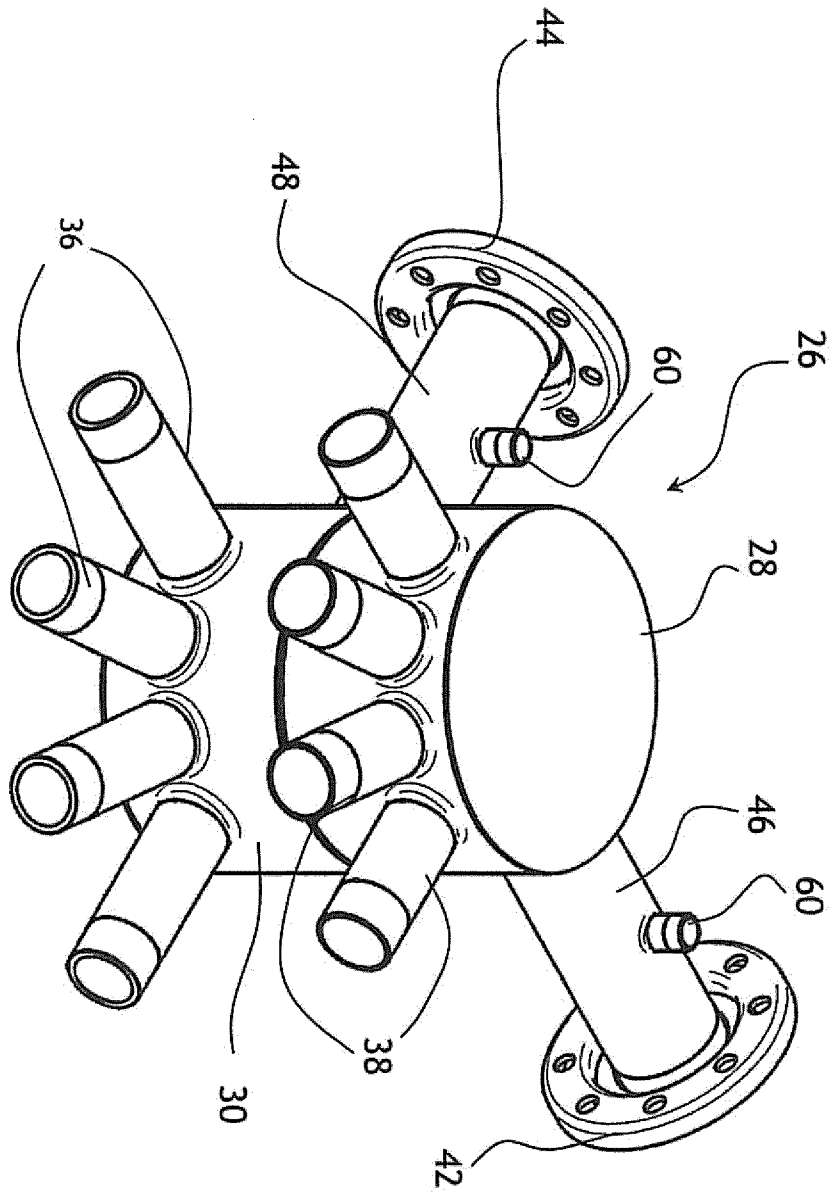


Fig. 6

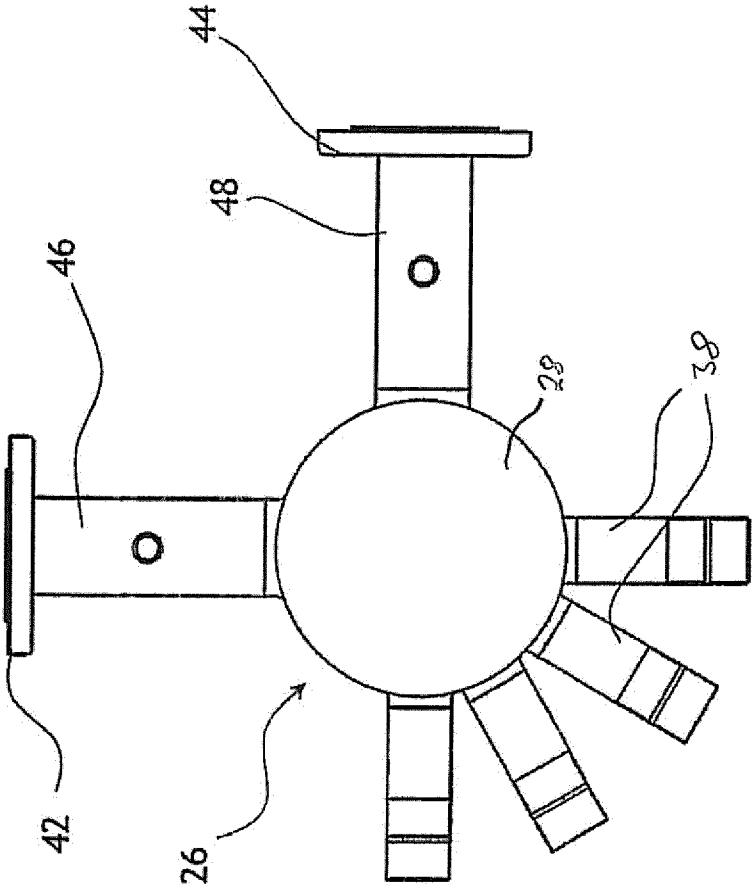


Fig. 7

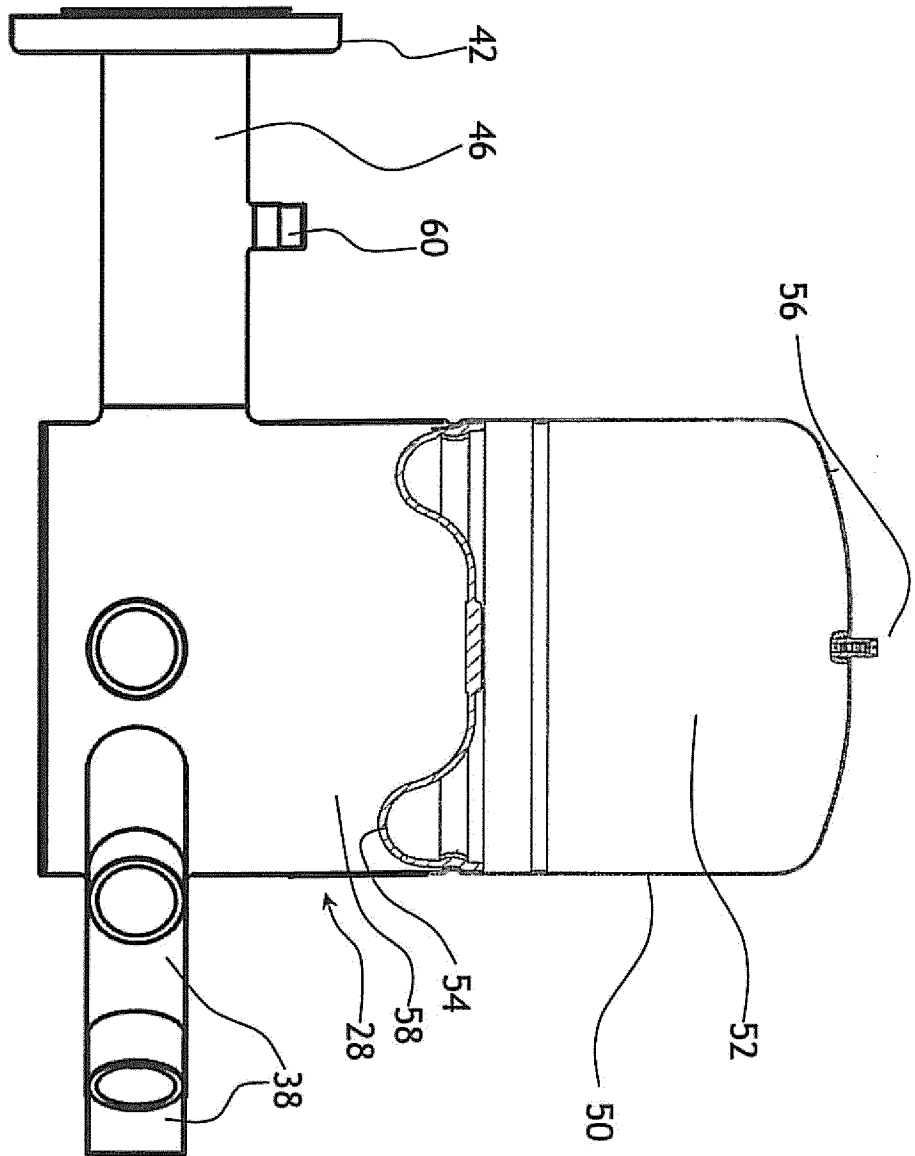
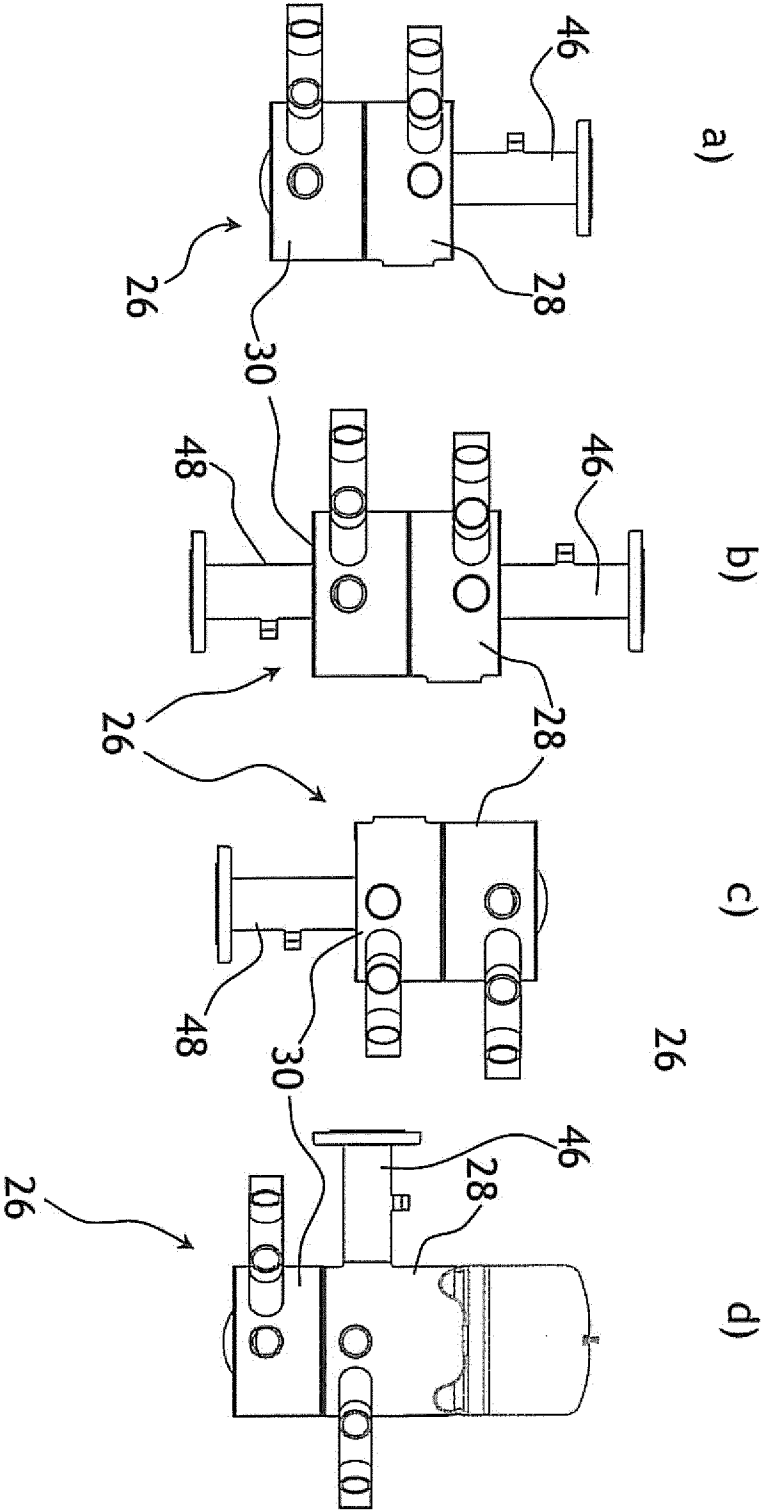


Fig. 8



International application No
PCT/EP2012/056462

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2012/056462

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 663 553 A1 (CO GE S R L [IT] DAB PUMPS S P A [IT]) 19 July 1995 (1995-07-19) column 2, lines 29-31; figure 1 -----	4

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/056462

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 782446	A	04-09-1957	NONE
US 4897022	A	30-01-1990	NONE
US 5848878	A	15-12-1998	DE 19726281 A1 02-01-1998 GB 2314884 A 14-01-1998 JP 10054372 A 24-02-1998 US 5848878 A 15-12-1998
US 2001027817	A1	11-10-2001	CN 1452704 A 29-10-2003 EP 1272790 A1 08-01-2003 US 2001027817 A1 11-10-2001 WO 0171236 A1 27-09-2001
EP 0663553	A1	19-07-1995	AT 184083 T 15-09-1999 DE 69511733 D1 07-10-1999 DE 69511733 T2 16-03-2000 EP 0663553 A1 19-07-1995 IT PD940004 A1 14-07-1995