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(54) Pumps priming adjustable ejector

(57) Pumps priming adjustable device, realized with an ejector provided of a suction inlet and an outlet communicating through a conduit for conveying and exhausting a fluid that has been aspired from a pump or from its suction pipe, using the vacuum effect created inside the ejector itself by the flow of compressed air. The suction inlet of said ejector communicating with the pump and/or the pipe through an on-off valve which, with its opening and closing action, permits the flow of fluid aspired from pump or from its pipe into the said ejector or prevents such flow.

To permit the operation of ejector is also provided an external source of compressed air connected to a feeding valve of the ejector, and between said suction inlet and said outlet there is an injection nozzle injecting compressed air into the conduit, having the injection nozzle a predetermined flow section.

The injection nozzle is adjustable in said flow section, which consists of an annular channel in the peripheral wall of said conduit, which in turn being composed of two parts, a first part static and a second part movable, which may be moved towards and/or away from each other to change the flow section of the channel of injection nozzle.

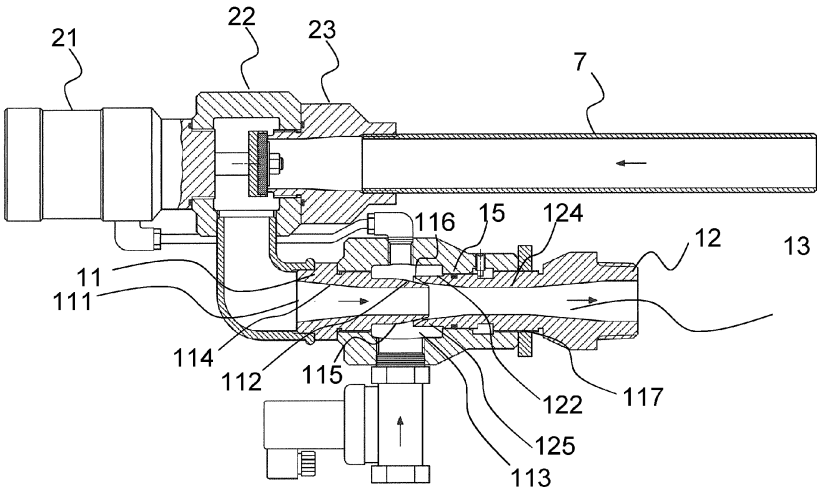

Fig. 2

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Description

[0001] This invention has as object an adjustable device for the priming of pumps, device that includes an ejector with a suction inlet and an outlet, communicating through a conduit for conveying and exhausting a fluid that has been aspired from a pump and/or from its suction pipe, using the vacuum effect produced inside the said ejector by mean the passage of compressed air. To permit the operation of ejector is also provided an external source of compressed air connected to a feeding valve of the ejector, and between suction inlet and outlet there is also an injection nozzle for injecting compressed air into the conduit, having the injection nozzle a predetermined flow section.

[0002] The use of air ejector for the priming of pumps is a common application in pumping systems, widely used in marine/naval systems but also used in industrial systems, to evacuate the air from the suction pipe of the pumps to obtain their complete filling with the liquid and thus to permit the correct start of the pump and the correct working of the system.

[0003] Such priming operation is required in various pumping systems, such as pumps installed above the level of the liquid they have to pump, or in the case of pumps having a suction pipe that does not remain complete full of liquid after valves opening, or pumps that at the starting time have air trapped inside their casing, or pumps that are subject to the formation of air pockets during operation.

[0004] Generally be used for the priming of such pumps ejectors with a suction inlet connected to the pump and communicating to an outlet through a conduit, in which there is an other inlet for the injection of a high speed fluid, such as compressed air.

The injection of said high speed fluid occurs downstream of inlet nozzle and due to the Venturi effect produces vacuum or low pressure zone, depending by the speed of the injected fluid, able to suck the air at the ejector inlet and as consequence able to remove the air present in the pump suction pipe.

[0005] Such ejector priming devices have the drawbacks of an excess consumption of compressed air required for the air suction, because is not possible to adjust the suction capacity of the ejector, neither is possible to adjust the proper vacuum level to realize a correct priming of the pump, according to the actual suction height of each specific installation.

[0006] Such problem is well known on small and medium size ships, where the compressed air excess consumption can not be acceptable or possible.

There is so an unmet necessity to realize a priming device as per above description, that permits to optimize the injection of the required compressed air, according to the priming requirements of the pump, decreasing in this way its consumption and increasing the energy efficiency of the pumping system.

[0007] The invention achieves the above purposes, designing a pumps priming device as described above, where the injection nozzle is adjustable in its flow area, that consists of an annular channel in the peripheral surface of the conduit, being said conduit composed by two parts, i.e. a first part and a second part, which can be moved towards and/or away from each other with the scope of modify the flow section of said channel.

[0008] As the nozzle is responsible of the quantity of compressed air consumed by the ejector to produce the vacuum that permits the evacuation of the air present inside the suction pipe of the pump to be primed, the adjustment of the opening of the said nozzle permits to adjust the flow of compressed air, optimizing its consumption and setting the vacuum grade necessary to perform the pump priming.

[0009] Advantageously the injection nozzle flow area is adjustable due to the co-operation of the two parts of the ejector, which the first part has an end, located downstream the ejector inlet nozzle, which form a male conic surface, while the second part has a female conic surface facing the previous end of the first part.

[0010] The two surfaces are thus complementary and their approaching or moving away, respectively permits the reduction or the increasing of injection nozzle flow area.

[0011] Preferably the compressed air is injected inside the ejector conduit by mean the injection nozzle, through a feeding chamber connected to the said nozzle, which has annular shape and surrounds the conduit upstream from the end of the first part.

[0012] Consequently such feeding chamber is connected to the ejector conduit by mean the annular channel forming the adjustable flow section of the injection nozzle of the compressed air, which in turn is injected into the feeding chamber through the feeding valve.

[0013] In detail the moving towards or away of the two parts occurs in the flow direction of the air to be aspired from the pump, so the first part and the second part are approachable between them along the axis of the ejector conduit, from inlet nozzle to the outlet of the same ejector.

[0014] As consequence is possible to identify a position of minimum and maximum distance of the two parts.

[0015] According to a preferred design of the device object of this invention, the first part has smaller dimension of the second part, so that during the movement the first part can at least partially enter into the second part. Moreover the first part male end, located downstream the suction nozzle can enter inside the female end of the second part facing the end of the first part.

[0016] According to a design improvement it is foreseen an external cover sleeve, coaxial with the first part and with the second part, that is coaxial with the ejector conduit and with the movement axis of the two parts, that is along the same direction of fluid flow. Such cover sleeve at least partially surrounds the outside surfaces of the two said parts forming the feeding chamber, that is in communication with the feeding valve for the introducing of the compressed air into the ejector.

[0017] According to a possible construction, the first part and the second part are made with a tubular element, delimited by an outer and an inner surface and an internal conduit determined by the same inner surface. The first part is in the form of conical male spout, while the inner surface of the second part has a radial throat substantially in the middle, so that the second part has a shape like a female conical funnel, acting as a housing for the said conical spout of the first part.

[0018] While moving of the two parts, the outer surface of the nozzle cone cooperates with the tapered inner surface of the funnel and their particular form allows to find contacts in the condition of closest approach between the two parts.

[0019] The space provided between the tapered outer surface of the nozzle and the inner surface of the funnel represents the conical flow channel of the injection nozzle, so that configuration allows to seal the feeding chamber when the outer surface of the conical nozzle is in contact with the tapered inner surface of the funnel, while allowing the compressed air flow in the ejector conduit in a controlled quantity, when the first part and second part are not in the closest position.

[0020] Therefore the second part appears as a tubular element which has a radial throat between the inlet and the outlet, so it has two radial enlargements at the ends, both in the form of a female tapered funnel, the first of which, around the conical nozzle, has two different inclinations to form with the outer surface of the nozzle a conical annular channel with decreasing-increasing section in the direction of compressed air flow.

[0021] As will see later, that shape beside give advantages to the control of the flow section area of the compressed air, also enhances the level of vacuum attainable in the central conduit, using the principle of the De Laval nozzle and the Venturi effect. Furthermore, the second part with its tubular shape, having a first section that narrows and then widens, contributes to increase the vacuum in the area facing the conical nozzle and increase the flow of aspirated fluid.

[0022] According to an improved design, the device for pumps priming object of the present invention, provides an element of the pressure switch type or similar, connected to the pump discharge with the scope of actuating the compressed air supply valve. In particular, the pressure switch enables an automatic operation of the whole device.

[0023] The device is activated prior or concurrently the start up of the pump, to permit the evacuation of the air inside the suction pipe of the pump. The pressure switch installed on the pump discharge can be set such that when the pressure reaches a certain value, it switches off the feeding valve to which is connected, stopping the working of the ejector, supposing that the achievement of a certain level of pressure indicates the complete priming of the pump.

[0024] Preferably the connection between the pressure switch and the feeding valve is an electrical type connection and the feeding valve is a solenoid valve. In the construction realization here disclosed, the pressure switch is an element external to the device, while in other possible realizations the same pressure switch could be integrated into the same priming device and could be connected to the pump discharge by mean of an hydraulic conduit.

[0025] According to this design, the on-off valve of the aspirated fluid is a pneumatic type, controlled by the same compressed air used to generate the vacuum inside the ejector conduit; however are possible variants that include the use of electrical type valves.

[0026] According to a further improvement, a control element can be provided for the movement of the second part towards the first part. Such control element can be manually actuated to permit an operator to manually adjust the opening of the flow section of the injection nozzle. A possible realization of this control element can be a threaded connection between the two parts.

[0027] It is possible to provide stop elements on the outer surface of the second part and/or on the inner surface of the cover sleeve acts to limit the displacement of the second part relative to the first part, avoiding for example, that the second part for the excessive movement can go off-site or that may damage the contact surfaces due to an excessive approach of the second part to the first part.

[0028] It can also include a locking device for the position of second part towards the first part, in order to adjust the opening of the nozzle in a determined position to achieve the vacuum level and the suction air flow desired by the operator.

[0029] To allow a sliding seal of the second part with the cover sleeve is possible to provide the some gasket elements such o-ring or similar, mounted between the outer surface of the second part and the inner surface of the cover sleeve.

[0030] A further refinement of the device concerns the automatic adjustment of the position of the two parties that limit the flow section of the compressed air injection nozzle.

[0031] One of the possible realizations of such improvement requires that the movable part of the ejector is controlled by the vacuum level present in the conduit of the ejector itself or in the pump which it is sucking from. The automatic nozzle would completely close its flow section once it reaches the maximum vacuum or the desired vacuum, and then automatically and gradually reopen when the vacuum level tends to decrease. Automatic operation would allow an additional compressed air saving, being able to adapt continuously the performance of the ejector to the system conditions.

[0032] It is important to emphasize that the pump priming device object of the present invention can be installed on pipes of different types of pumps, such as horizontal or vertical pumps, either directly on the pumps thyself. Can be provide an exhaust line that connects the suction pipe or the pump to the on-off valve, enabling the entry

of the fluid to be evacuated into the ejector.

[0033] The invention also relates to other features that further refine the pumps priming device above described and that are object of the following claims.

[0034] These and other features and advantages of the present invention will be more clear from the following description of some construction examples illustrated in the attached drawings where:

fig. 1 illustrates the pumps priming device object of the present invention according to one possible construction realization;
fig.2 illustrates a section view of the construction realization of fig. 1;
figg. from 3 to 6 show various installations of the device object of the present invention.

[0035] With reference to figures 1 to 6, the pumps priming device subject of the present invention includes an ejector 1 which has a suction inlet 111 and an outlet 121, connected by a conduit 13 for the passage and expulsion of the fluid aspirated from the suction pipe 51 of a pump 5 through that ejector 1; the suction inlet 111 of the ejector 1 communicates with the suction 51 of a pump 5 through an on-off valve 2.

[0036] This on-off valve 2 with its opening and/or closing enables the passage inside the ejector 1, particularly within the conduit 13, of the fluid aspirated from the suction pipe 51 of the pump 5, or intercepts such passage.

[0037] The ejector 1 is connected to an external source of compressed air via a feeding valve 3, for the supply of the compressed air inside the conduit 13 through an injection nozzle 116, located between the suction inlet 111 and the outlet 121.

[0038] Such injection nozzle 116 is adjustable regarding to the flow section that consists of a annular channel on the peripheral surface of the conduit 13, which in turn consists of two parts, of which a first part 11 and a second part 12, together approachable and/or removable between them to vary the flow area of the annular channel.

[0039] The injection nozzle 116 is formed by one end 112 of the first part 11 downstream of the suction inlet 111 and one end 122 of the second part 12 facing the end 112. Such ends 112 and 122 form two tapered surfaces, a male and a female, that can move one toward the other one.

[0040] With particular reference to figures 1 and 2, the injection nozzle communicates with a compressed air feeding chamber 113 which is annular and surrounds the conduit 13 upstream of the injection nozzle 116.

[0041] Such feeding chamber 113 is then in communication with the conduit 13 of the ejector 1 through the annular channel constituting the adjustable flow section area of the injection nozzle 116, for the injection of the compressed air which in turn is supplied inside the feeding chamber 113 through the feeding valve 3.

[0042] The removal and/or the approach of the first part 11 and the second part 12, is in the flow direction of the fluid to be aspired from the pump 5, so the first part 11 and the second part 12 are adjustable along the axis of the conduit 13 of the ejector 1, from suction inlet 111 to the outlet 121 of the same ejector.

[0043] Consequently, it is possible to identify a position of closest approach of the parts 11 and 12, which corresponds to the position where the part 12 arrives in contact with the part 11 and a position of maximum distance determined by a limiting device that restricts the movement of the part 12. In particular, the first part 11 has the end 112 smaller than the end 122 of the second part 12 in such a way that, during the approach and/or the moving away, the end 112 of the first part 11 remains inside the second part 12.

[0044] According to the construction realization here described, is provided a cover sleeve 14 coaxial with the first part 11 and the second part 12, which partially surrounds the external surfaces of these parts 11 and 12, in such a way that delimits, with the outer surfaces of these parts 11 and 12, the feeding chamber 113 which is in communication with the feeding valve 3 for the compressed air injection into the ejector 1.

[0045] With particular reference to figure 2, the first part 11 is composed by a tubular element which has an inner surface 114 and an outer surface 115, as well as the second part 12 is composed by a tubular element which has an inner surface 124 and a outer surface 125.

[0046] The first part 11 is in the form of tapered nozzle, while the inner surface 124 of the second part 12 is in the form of a substantially radial throat in the central area, so that the second part 12 has at the end 122 a zone with conical funnel shape for the insertion of the conical nozzle of the first part 1.

[0047] The inner surface 124 of the end 122 of the part 12, has conical funnel shape with two different inclinations.

[0048] When moving the two parts 11 and 12, the outer surface 115 of conical nozzle cooperates with the inner surface of the conical funnel and their particular shape permit their contact in the position of closest approach between the two parts 11 and 12. The space between the conical outer surface 115 of the nozzle and the conical inner surface 124 of the conical funnel, is the flow conical channel of the injection nozzle which has a sloped profile with decreasing-increasing section area due to two different inclinations of the inner surface 124 of the end 122 of the part 12; in addition, this configuration concurs to seal the feeding chamber 113 when the outer surface 115 of the conical nozzle is in contact with the conical inner surface 124 of the funnel, whereas allows the injection of controllable quantities of compressed air inside the conduit 13 of the ejector 1 when the first part 11 and the second part 12 are not in the closest position.

[0049] The second part 12, as per the construction realization described in the figure, appears as a tubular element which has a radial throat in a substantially central area, so it has two radial enlargements at the ends, both in the form of conical funnels.

[0050] Consequently, the second part 12 provides a "convergent-divergent" conduit indicating with these terms the particular form of such second part 12 which has two radial enlargements at the extremities of a conduit that looks like a radial throat.

The radial enlargements in the figure corresponding to the ends 122 and 121 of the ejector 1 may be of different dimensions and have predetermined angles depending on the performance required to the device. With particular reference to the construction realization illustrated in figures from 1 to 6, the pumps priming device provides an element of the pressure switch type 4 connected to the outlet 52 of the pump 5 for controlling the operation of the feeding valve 3.

[0051] In the construction realization here described, the position setting of the part 12 relative to the part 11 is achieved by a threading connection 117 between the part 12 and the cover sleeve 14. Furthermore is present a blocking element 6 to retain the part 12 in position respecting to the first part 11 after the manual setting of the device.

[0052] To permit a sliding seal of the second part 12 with the cover sleeve 14, some o-ring seal elements 15 or similar are required, positioned between the outer surface 125 of the second part 12 and the inner surface of the cover sleeve 14.

[0053] With particular reference to figures 3 to 6, the pumps priming device object of the present invention can be installed on pipes 51 and 52 of different types of pumps, such as horizontal or vertical pumps, as shown in figures 3 and 4 either directly on the pump, as shown in figures 5 and 6.

[0054] It is also provided a suction line 7 which connects the pump or the suction pipe 51 to the on-off valve 2, which permits the entry of the fluid to be aspirated into the ejector 1.

[0055] The priming device is activated before or concurrently the activation of the pump 5 to permit the evacuation of the air inside the suction pipe 51 of the same pump. The pressure switch 4 installed on the pump discharge 52 is set such that when the pressure reaches a certain value on the discharge 52, the pressure switch 4 disables the compressed air feeding valve 3 which is connected to, arresting the operation of the ejector 1 because the achievement of a certain level of pressure on the pump discharge indicates that the pump priming has been completed. In the construction realization here described, the connection between the pressure switch 4 and the feeding valve 3 is an electrical connection and the feeding valve 3 is constituted by a solenoid valve.

[0056] According to figures 1 to 6 the pressure switch is electrically connected to the feeding valve 3 through a terminal box 8.

[0057] If there is no pressure in the pump 5 or in the discharge line 52 where the pressure switch 4 is installed, this opens the feeding valve 3 allowing compressed air to flow through the ejector 1 producing the vacuum in the downstream zone of the injection nozzle. The same compressed air opens the on-off valve 2 connecting the area where there is the vacuum with the suction connection on the pump 5 or on the pipe 51.

[0058] The vacuum created inside the ejector, exhausts air from the pump 5 and from pipe 51, making the liquid raising along the pipe. To perform the priming, it is required that in the discharge pipe 52 is installed a check valve, not shown in the figures, not too far from the pump 5 which does not permit air intake from line 52. In the absence of check valve, it is required the interception of the discharge pipe 52 with manual or automatic shut-off valves.

[0059] If the pump 5 has not started simultaneously with the ejector 1, it can be started with some delay when it is full of liquid.

[0060] At a time when the liquid fills the running pump 5, this begins to pump increasing the pressure at the discharge 52. When the pressure reaches the set value of the pressure switch 4, this stops the compress air flow through the feeding valve 3 and then disable the ejector 1 closing also the on-off valve 2.

[0061] If the discharge pressure 52 falls due to the arrival of air aspired by the pump 5, the pressure switch 4 activates the ejector 1 starting again the priming cycle.

[0062] With particular reference to figures 1 to 6 here below is detailed the operation of the device object of the present invention.

[0063] When the feeding valve 3 is open, the compressed air flows in an annular channel formed by the outer surface of the first part 11 and the inner surface of the end 122 of the second part 12. By mean the threaded element 117, the position of the second part 12 can be modified with respect to the first part 11 so that the first part 11 can be inserted more or less deeply the second part 12. The compressed air leaves the feeding chamber 113, passes in the injection nozzle 116 and enters with high-speed in the convergent-divergent channel of the second part 12, producing a vacuum that moves the aspirated fluid which mixes to before being expelled through outlet 121.

[0064] The second part 12 is screwed into the cover sleeve 14 and is secured in position by a locking device 6, which may for example be a locknut. A sliding seal element 15 of the o-ring type makes the seal of the feeding chamber 113 between the second part 12 and the cover sleeve 14.

[0065] Since the vacuum produced inside the ejector 1 depends on the geometry of the conduit 13 and on the injection nozzle 116 and also on the distance between the first part 11 and second part 12, the approach and/or the movement of these two parts change the performance of the ejector 1 regarding vacuum and aspired air capacity.

[0066] In the realization presented in figures 1 and 2, the suction inlet 111 is connected to the valve via a threaded elbow 9.

[0067] According to a construction realization the on-off valve 2 consists of a pneumatic actuator 21 mounted

on a casing 22 and a seat 23. The actuator is connected via a tubing to the feeding chamber 113 in order to be operated by the same compressed air coming from the opening the feeding valve 3.

[0068] The on-off valve 2 is used to intercept the conduit that connects the ejector 1 with the suction line 7, to avoid entering the air into the pump 5 when this is running and the ejector is turned off and also to avoid leakages of fluid in the external environment.

Claims

1. Pump priming device, comprising a compressed-air ejector (1) that has a suction inlet (111) and an outlet (121), communicating through a conduit (13) for carrying and ejecting a fluid that has been sucked in by a pump (5) and/or its pipe (51) by the action of the negative pressure created by the ejector,
the suction inlet (111) of said ejector (1) communicating with the pump (5) and/or the pipe (51) through an on-off valve (2),
the on and/or off states of said on-off valve (2) allowing the fluid sucked in by the pump (5) to flow through said ejector (1) or preventing such flow respectively,
an external compressed air source being provided, which is connected through a feeding valve (3) to said ejector (1),
an injection nozzle (116) for injecting compressed air into said conduit (13) being provided between said suction inlet (111) and said outlet (121), and having a predetermined flow sectional area,
characterized in that:

said injection nozzle (116) is adjustable in said flow sectional area, which flow sectional area consists of an annular gap of the peripheral wall of said conduit (13),
said conduit (13) being composed of two parts, i.e. a first part (11) and a second part (12), which may be moved towards and/or away from each other to change the lumen of said gap.

2. A pump priming device as claimed in claim 1, wherein said injection nozzle (116) consists of one end (112) of said first part (11) downstream from said suction inlet (111) and one end (122) of said second part 812) facing towards the end (112) of said first part (11),
said two ends forming two conical surfaces, a male and a female features, that move relative to each other.

3. A pump priming device as claimed in claim 1 or 2, wherein said injection nozzle (116) communicates with a compressed air feeding chamber (113), which feeding chamber (113) has an annular shape and surrounds said conduit (13) upstream from said end (112) of said first part (11).

4. A pump priming device as claimed in one or more of the preceding claims, wherein said first part (11) and said second part (12) cooperate by moving away from and/or towards each other in the direction of flow suction.

5. A pump priming device as claimed in one or more of the preceding claims, wherein said first part (11) and said second part (12) cooperate, with said second part (12) moving away from and/or towards said first part (11) or vice versa, and define a closest state and a farthest state.

6. A pump priming device as claimed in one or more of the preceding claims, wherein said first part (11) is at least in part smaller than said second part (12), whereby said first part (11) at least partially fits into said second part (12) as said second part (12) moves towards and/or away from said first part (11).

7. A pump priming device as claimed in one or more of the preceding claims, wherein a cover sleeve (14) is provided, which is coaxial with said first part (11) and said second part (12), which cover sleeve (14) at least partially surrounds the outer surfaces of said parts,
said cover sleeve (14) and the outer surfaces of said first part (11) and said second part (12) forming said feeding chamber (113) in communication with said feeding valve (3) for introducing compressed air into said ejector (1).

8. A pump priming device as claimed in one or more of the preceding claims, wherein said first part (11) and said second part (12) are formed of a tubular element that has an inner surface (114, 124) and an outer surface (115, 125) and a conduit delimited by said inner surface,
said first part (11) being in the form of a conical spout, the inner surface (124) of said second part (12) being radially tapered substantially in the central area of said inner surface (124), whereby said second part (12) has a conical funnel area, acting as a lead-in area for the conical spout of said first part (11) so that the outer surface (115) of said conical spout can cooperate with the inner surface (124) of said conical funnel,
the outer surface (115) of said conical spout being in contact with the inner surface (124) of said conical funnel when said first part (11) and said second part (12) are closest together,
said feeding chamber (113) being sealed when said second part (12) is closest to said first part (11), and communicating with the conduit (13) downstream from said first part (11) when there is no closest state.

9. A pump priming device as claimed in one or more of the preceding claims, wherein the end (122) of said second part (12) has a conical funnel inner surface (124) with two different inclinations, to create an oblique annular gap of decreasing-increasing section with the outer surface (115) of the conical spout of said first part (11).

10. A pump priming device as claimed in one or more of the preceding claims, wherein a pressure switch element (4) or the like is provided, which is connected to the discharge (52) of the pump (5), for controlling the operation of said compressed air feeding valve (3).

11. A pump priming device as claimed in one or more of the preceding claims, wherein a threaded adjustment member (6) is provided for moving said second part (12) towards and/or away from said first part (11),
said adjustment member (6) being manually operated.

12. A pump priming device as claimed in one or more of the preceding claims from 1 to 10, wherein an adjustment member is provided for moving said second part (12) towards and/or away from said first part (11),
said adjustment member being automatically operated and said adjustment member being controlled by vacuum conditions in said ejector (1) and/or said pump (5).

13. A pump priming device as claimed in one or more of the preceding claims, wherein abutment elements are provided on the outer surface (125) of said second part (12) and/or the inner surface of said cover sleeve (14) to limit the displacement of said second part (12) relative to said first part (11).

14. A pump priming device as claimed in one or more of the preceding claims, wherein said second part (12) sealably slides within said cover sleeve (14) due to the provision of o-ring seal elements (15) or the like, between the outer surface (125) of said second part (12) and the inner surface of said cover sleeve (14).

15. A pump priming device as claimed in one or more of the preceding claims, wherein said ejector (1) is in communication with the suction (51) of a pump (5) through an on-off valve (2) connected to said suction (51) through a feeding pipe (7).

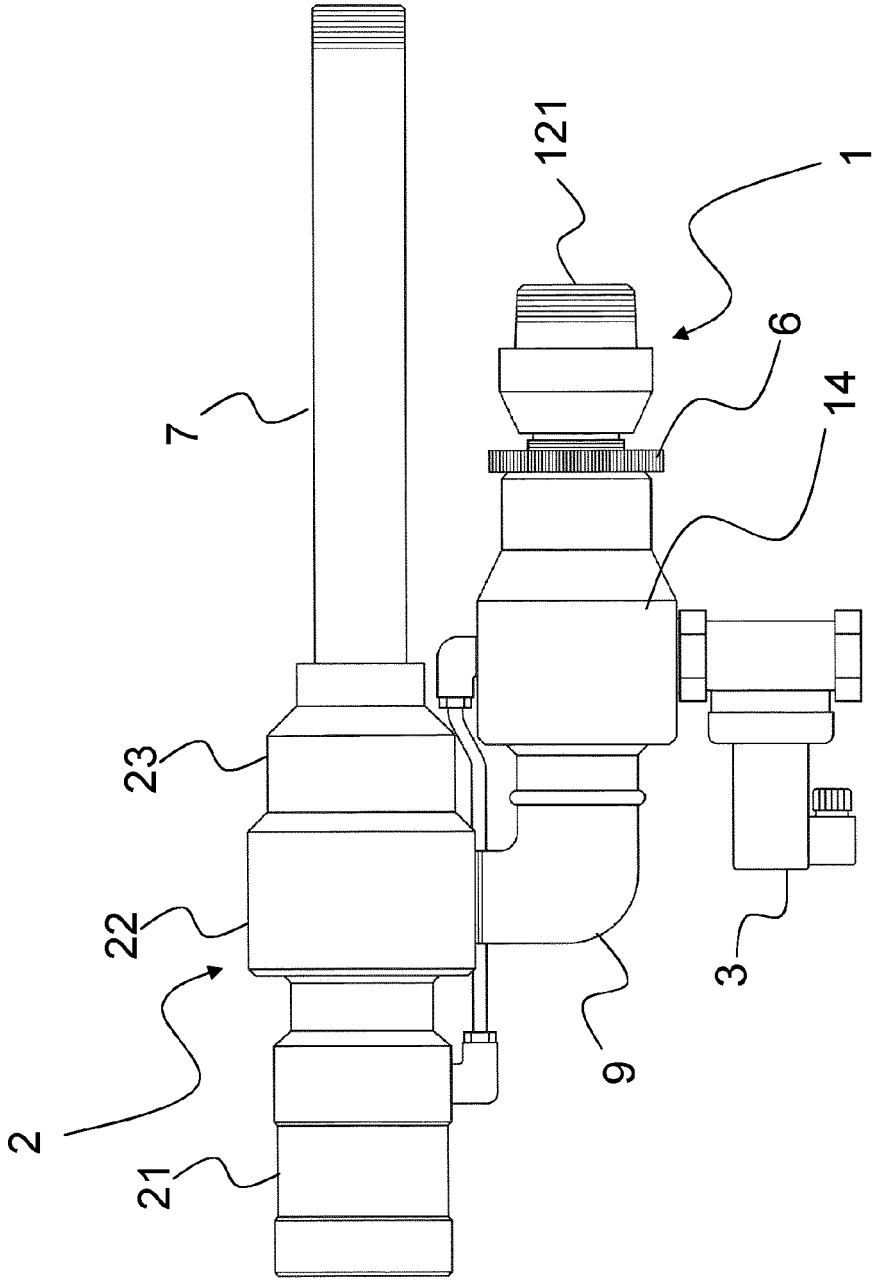

Fig. 1

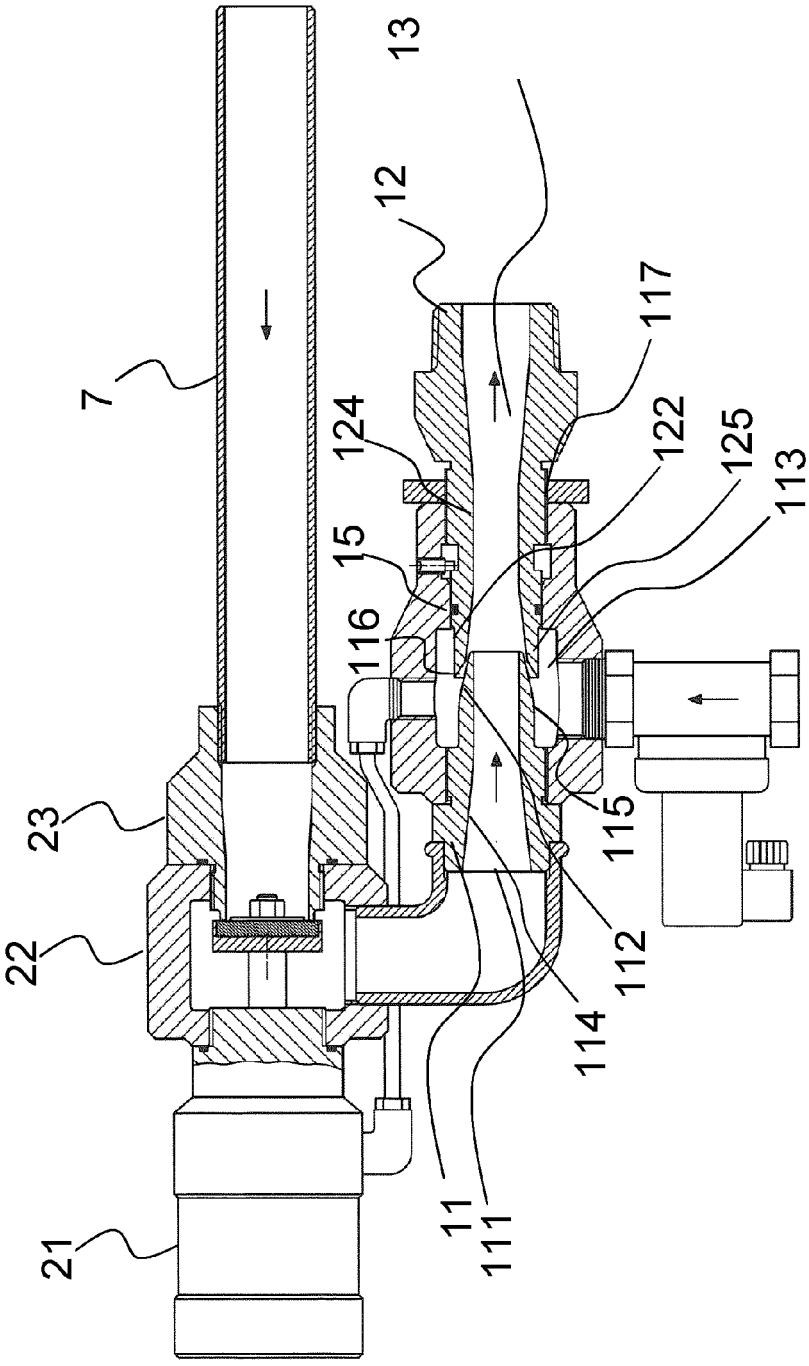

Fig. 2

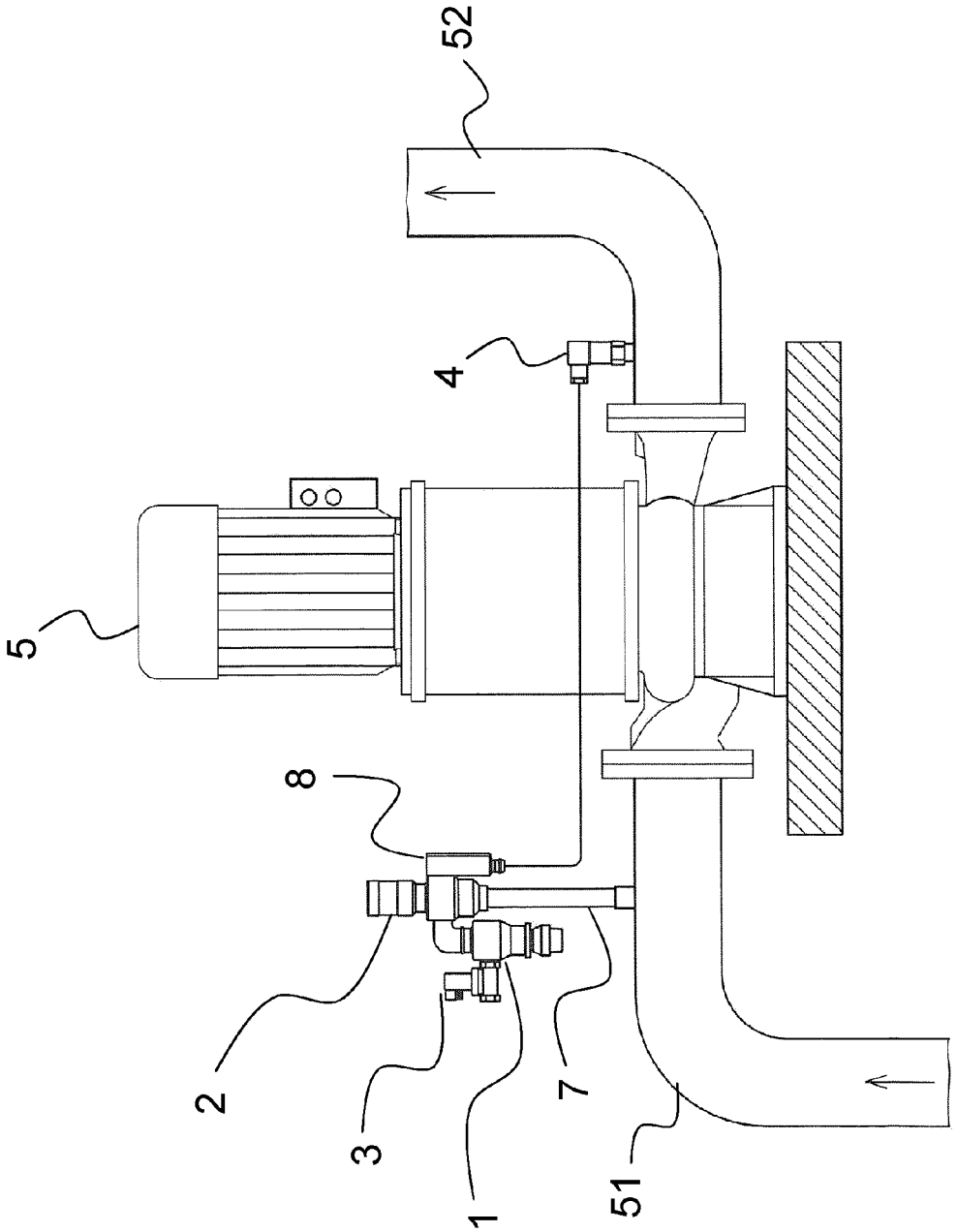

Fig. 3

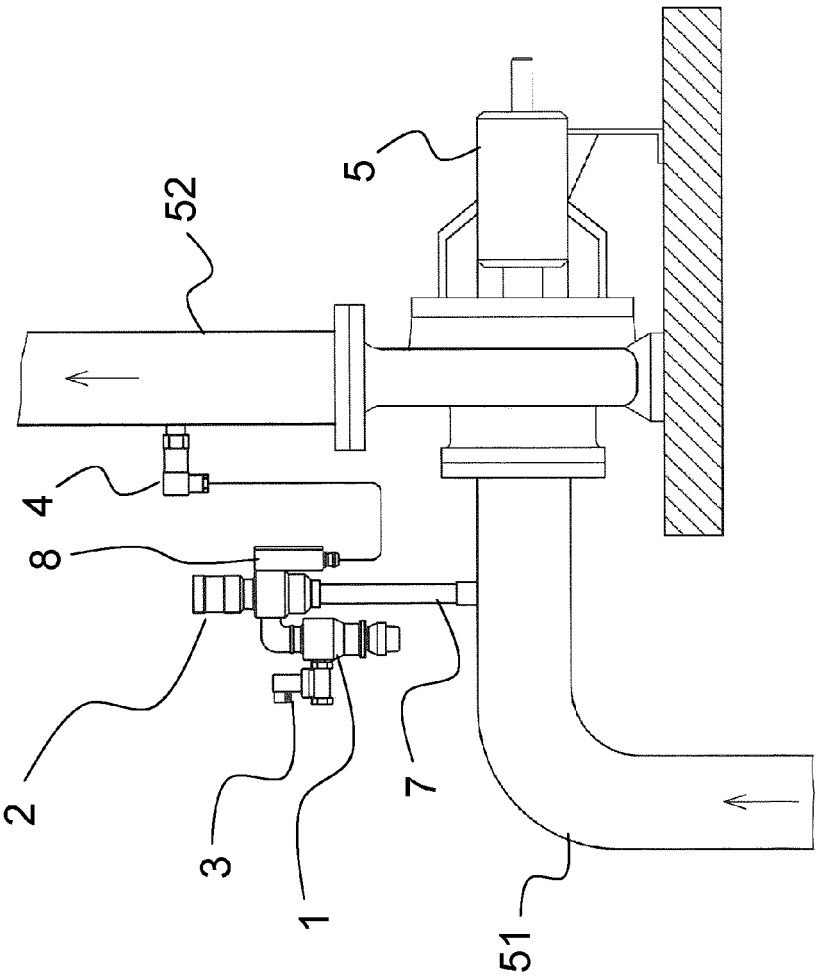

Fig. 4

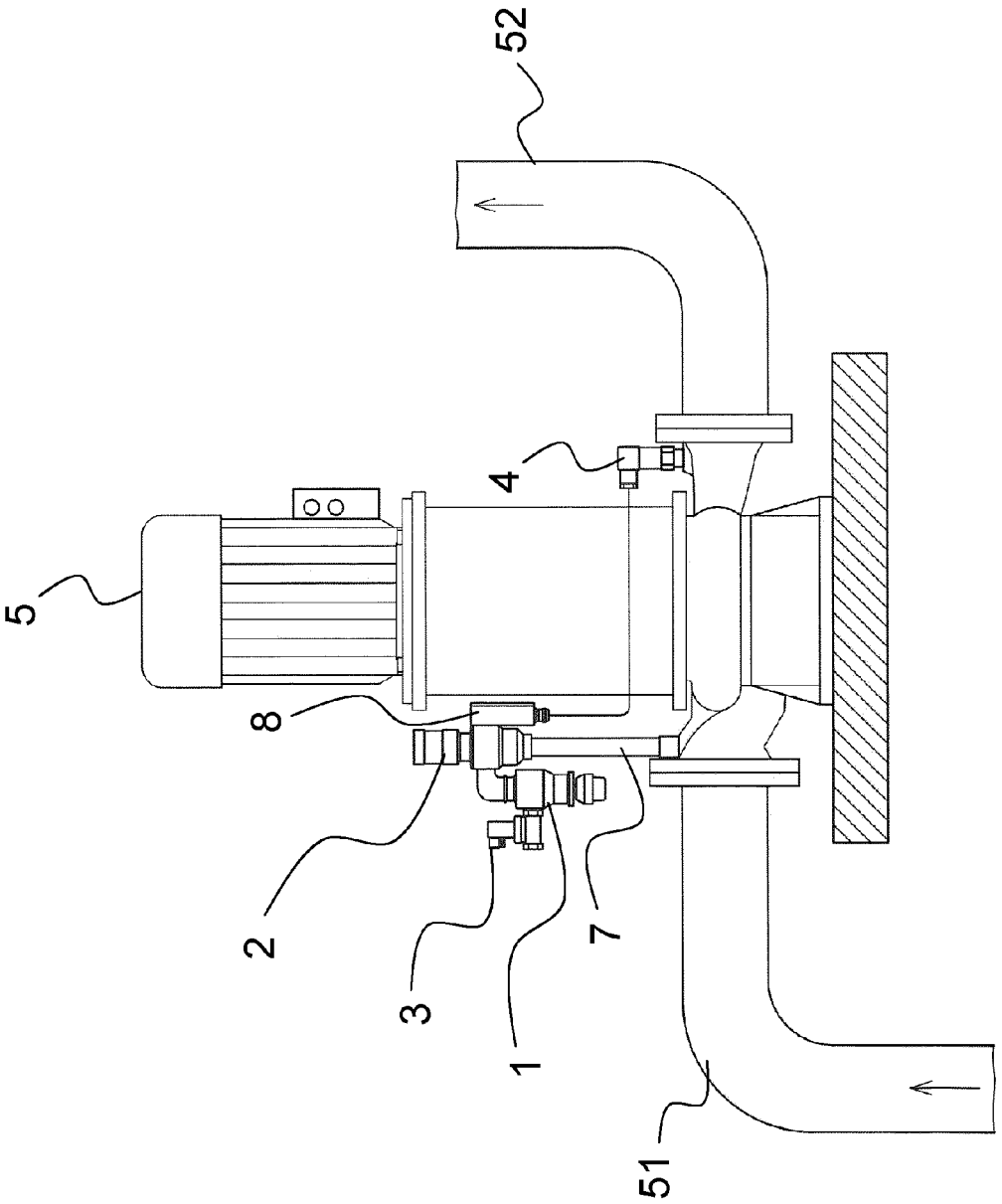

Fig. 5

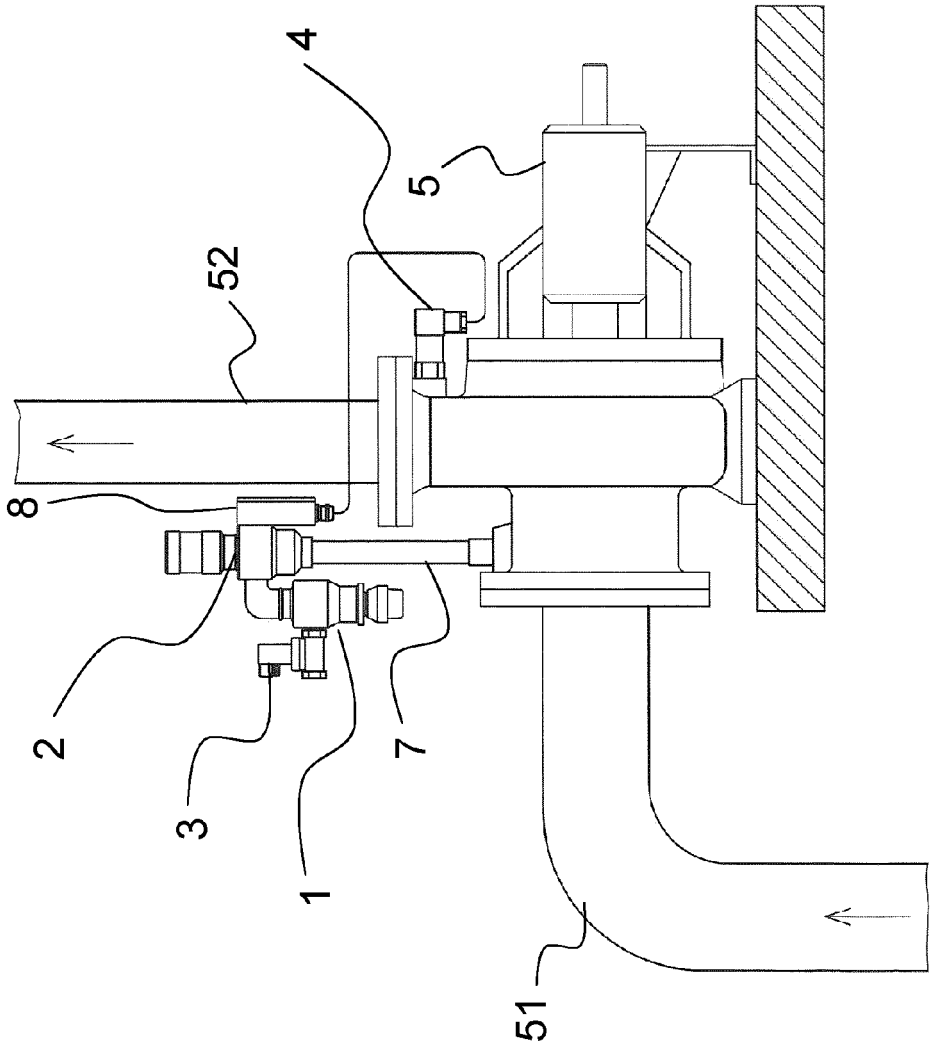

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 12 15 2339

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 6 682 313 B1 (SULMONE MICHAEL [US]) 27 January 2004 (2004-01-27) * abstract; figures * * paragraph [0010] *	1-15	INV. F04B53/06 F04F5/24 F04F5/30 F04F5/46
Y	FR 854 815 A (GUINARD) 25 April 1940 (1940-04-25) * page 1, column 2, line 12 - page 1, column 2, line 16 * * page 2, column 1, line 72 - page 2, column 1, line 76; figures *	1-15	
A	FR 1 194 675 A (BOBARD) 12 November 1959 (1959-11-12) * claims; figures *	1-15	
A	US 2 203 077 A (CARPENTER FRED A) 4 June 1940 (1940-06-04) * claims; figures *	1	

TECHNICAL FIELDS SEARCHED (IPC)

F04B
F04F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 March 2012	Pinna, Stefano

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 15 2339

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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15-03-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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FR 854815 A	25-04-1940	NONE	
FR 1194675 A	12-11-1959	DE 1149614 B FR 1194675 A	30-05-1963 12-11-1959
US 2203077 A	04-06-1940	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82