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(54) A METHOD OF PREPARING A PIPELINE SYSTEM FOR MAINTENANCE

(57) A method of preparing a system (100) for a maintenance operation, said system (100) comprising
- a first subsystem (110) containing a super-atmospheric gas,
- a second subsystem (120) connected with said first subsystem (110), and
- a third subsystem (130) between the first and second subsystems;
via intermediate subsystems (170a, 170b) comprising valve seats with a vent opening (246) in between. The intermediate subsystems are for example ball valves. To avoid gas escaping from the system (100), subatmospheric is applied to the vent openings (246) to discharge the gas and prevent it from leaking.

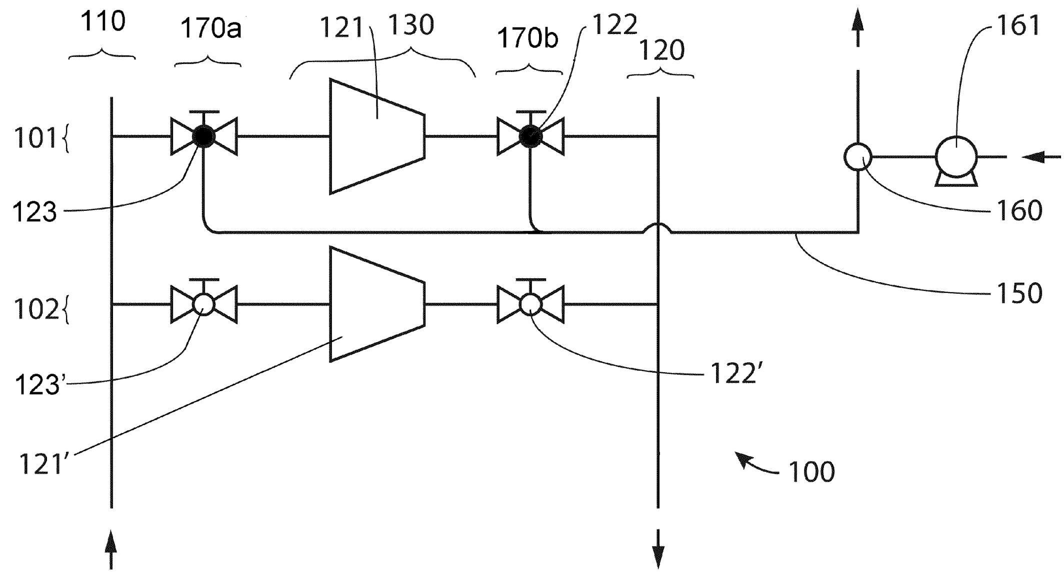

Fig. 1

EP 3 006 813 A1

Description

[0001] The present invention relates to a method of preparing a system for a maintenance operation, said system comprising

- a first subsystem containing a super-atmospheric gas,
- a second subsystem, and
- a third subsystem between the first subsystem and the second subsystem;

said first subsystem and said second subsystem being connected via an intermediate subsystem capable of allowing gas to flow between the first subsystem and the second subsystem via the third subsystem, said intermediate subsystem comprising

- a first sealing valve seat,
- a second valve seat between the first sealing valve seat and the second subsystem, and
- a vent opening between the first sealing valve seat and the second valve seat;

said third subsystem and said second subsystem being connected via a further intermediate subsystem capable of allowing gas to flow between the third subsystem and the second subsystem, said further intermediate subsystem comprising

- a third sealing valve seat,
- a fourth valve seat between the third sealing valve seat and the third subsystem, and
- a second vent opening between the third sealing valve seat and the fourth valve seat;

said method comprising

- the discharge of gas present between the first sealing valve seat and the second valve seat via the vent opening before performing a maintenance step of the maintenance operation downstream of said second valve seat with respect to the first sealing valve seat, and
- the discharge of gas present between the third sealing valve seat and the fourth valve seat via the second vent opening before performing a maintenance step of the maintenance operation between the second valve seat and the fourth valve seat.

[0002] Systems comprising super-atmospheric gas are well known in the art. They are for example systems comprising natural gas, syngas, or carbon dioxide, where the gas is treated, or increased or reduced in pressure. Such a gas may thus be flammable, toxic or otherwise constitute a hazzard. Often it is paramount that a plant comprising such a system remains operational despite the maintenance, or that the downtime for maintenance is kept to a minimum. The presence of gas escaped from the system at the location where maintenance is to be performed may however pose a risk for people performing the maintenance. Depending on the job at hand, these may be expensive specialists and the number of them can be considerable. If ambient gas measurements at the location where maintenance is to be performed show that the leaked gas levels are above what is acceptable according to safety procedures or allowable, the resulting delay can be very costly. To prevent gas in the intermediate system from passing to the (ambient) atmosphere at the location where the maintenance operation is to be performed, it is known to block gas from passing from the first subsystem into the intermediate subsystem using the first sealing valve seat, and then bleed the gas from the intermediate subsystem via a vent opening into the outside atmosphere.

[0003] The object of the present invention is to provide a method with a reduced risk of delay and/or an increased level of safety and/or to improve the availability of a plant or a larger part thereof. This in particular in case of leaky or potentially leaking seals of the valve seats.

[0004] To this end, a method according to the preamble is characterized in that the method comprises before performing a maintenance step of the maintenance operation

- applying suction to the vent opening for discharging the gas present between the first sealing valve seat and the second valve seat before performing said maintenance step
- the discharge of gas present between the third sealing valve seat and the fourth valve seat via the second vent opening between the second valve seat and the fourth valve seat by applying suction to the second vent opening;

wherein the suction is applied to achieve sub-atmospheric pressure in at least one intermediate system of the system.

[0005] By applying suction to both the first vent opening and the second vent opening the risk is effectively reduced that gas present in the first subsystem can pass the second valve seat and reach the location where maintenance is to be performed. This may occur if the first sealing valve seat and the second valve seat don't properly seal. Thus, according to the invention, the third subsystem can be isolated from the first and second subsystem and subjected to maintenance without having to depressurize either of the first and second subsystems.

[0006] In the present application, maintenance includes any work on a third subsystem, whether it is inspection, cleaning, repair, modification, or replacement of a part. A maintenance operation is a series of one or more maintenance steps, and the method according to the invention specifies that at least one of these is not performed before the discharge of gas using suction. The third subsystem typically comprises an apparatus such as a compressor, a flow metering systeem, a gas drying equipment, a tank or a vessel, a filter separator, a heat exchanger, a well head, or a vapour recovery unit.

[0007] The intermediate subsystems comprise for example a ball valve, said ball valve comprising the valve seats and the vent opening.

[0008] Active discharge (suction) of gas is achieved using a vacuum-pump.

[0009] By way of example, a sub-atmospheric pressure between the first sealing valve seat and the second valve seat prevents gas from flowing past it to the second subsystem. Any sub-atmospheric pressure is effective, however minute. For practical purposes, the sub-atmospheric pressure is at least 0.02 Bar below ambient atmospheric pressure, preferably at least 0.05 Bar and more preferably at least 0.08 Bar. A deeper sub-atmospheric pressure makes the method less susceptible to any changes in sub-atmospheric pressure applied or other disturbances.

[0010] It is preferred that both intermediate subsystems are at sub-atmospheric pressure.

[0011] In the present application, the term gas also encompasses vapour. The term 'sealing valve seat' is a seat for blocking the flow of pressurized gas from a pressurized subsystem to a subsystem at a lower pressure, such as a depressurized subsystem.

[0012] Preferably, the gas is discharged using a bleed conduit that releases the gas from the intermediate subsystem into the outside atmosphere at a safe location away from the location where maintenance is to be performed. The bleed line comprises between a pressure gauge and a vacuum pump a valve, e.g. an on-off valve, a control valve, a pressure regulator, or a non-return valve.

[0013] WO2005/026603 discloses a method of vacuum-purging gas in a pipe or tank.

[0014] According to a favourable embodiment, the intermediate subsystem, the third subsystem and the further intermediate subsystem define a branche connecting the first subsystem with the second subsystem, the system further comprising a second branch connecting the first subsystem and the second subsystem.

[0015] Such a system allows for maintenance of the third subsystem of one branch while the other branch remains operational, albeit the system operates possibly at a lower capacity.

[0016] According to a favourable embodiment, the system comprises a pressure gauge for measuring the pressure of an intermediate subsystem of the system.

[0017] This gives an indication of the safety of the area where maintenance is to be carried out. The pressure gauge can also be used to control the vacuum pump used to provide suction. Also, the pressure gauge can be used in combination with a PLC to detect a sudden leak rate (exceeding of a preset pressure gradient limit) or a leak rate beyond the capacity of the suction system (exceeding of a preset pressure limit) and can be used to generate an alarm at the location where the maintenance is performed and/or in the Control Room without delay in case of a developping potential dangerous situation.

[0018] According to a favourable embodiment, the system comprises a pressure gauge for measuring the pressure upstream of a vacuum pump providing said suction, the flow resistance $R_{vv\text{-}pg}$between i) the location of the gas between the first sealing valve seat and the second valve seat and ii) the location of the pressure gauge being lower than the flow resistance $R_{pg\text{-}vp}$ between i) the location of the pressure gauge and ii) the vacuum pump.

[0019] Thus the risk can be reduced that in case of strong leakage by the first sealing valve seat, the pressure measured by the pressure gauge represents the pressure between the first sealing valve seat and the second valve seat, with a sub-atmospheric reading indicating that no gas will pass from the first subsystem past the second valve seat. The relatively high flow resistance between the pressure gauge and the vacuum pump can be achieved using a constriction. For practical purposes, the constriction will be balanced by the desire to effectively extract gas to be discharged by the vacuum pump.

[0020] According to a favourable embodiment, the gas extracted by suction is diluted to below the its Lower Explosion Limit.

[0021] For example, natural gas will be diluted to below 5% by volume of natural gas in air. Thus it cannot explode.

[0022] According to a favourable embodiment, dilution is done with an inert gas.

[0023] The inert gas is for example carbon dioxide. According to an interesting embodiment, the inert gas is flue gas obtained by combustion, e.g. by combusting a hydrocarbon such as methane, propane, butane, or a liquid fuel such as diesel or gasoline. Thus it is possible to reduce the oxygen content of air before dilution. This saves significantly in the amount of gas used for dilution. Advantageously, the inert gas is nitrogen or steam, both of which are often available at plants.

[0024] According to a favourable embodiment, the suction is applied using a venturi-based vacuum pump.

[0025] Thus the gas extracted from the intermediate system does not pass any mechanical moving parts that might cause ignition if the gas is flammable. The venturi-based pump is an ejector or a jet pump. In case the gas extracted is flammable, the venturi-based pump is preferably fed with an inert gas such as nitrogen or steam instead of air, reducing the risk of an explosive atmosphere in the means used for discharging the gas.

[0026] According to a favourable embodiment, the intermediate subsystems comprise a ball valve, said ball valve comprising the first sealing valve seat, the second valve seat and the vent opening.

[0027] Venting ball valves is an important area of application of the method according to the invention.

[0028] According to a favourable embodiment, the second valve seat is a second sealing valve seat.

[0029] In such a case, it is easier to achieve a sub-atmospheric pressure. Also, the second sealing valve seat acts as a safety measure should there be a failure in the system that provides for the sub-atmospheric pressure. A ball valve comprising both first and second sealing valve seats is commercially available as a ball valve with double-piston effect, a.k.a. as a double isolation and bleed valve.

[0030] According to a favourable embodiment, the fourth valve seat is a fourth sealing valve seat.

[0031] In such a case, it is easier to achieve a sub-atmospheric pressure.

[0032] According to a favourable embodiment, the sub-atmospheric pressure is maintained while the at least one maintenance step of the maintenance procedure is performed.

[0033] Thus the method is a method for performing maintenance. Preferably, the sub-atmospheric pressure is maintained during the full maintenance procedure, thus reducing the risk of gas leakage via an intermediate system to the depressurized third subsystem during the full maintenance procedure.

[0034] According to a favourable embodiment, the pressure in the intermediate subsystem is monitored using a pressure gauge, and a vacuum pump used for applying suction is controlled by the pressure gauge.

[0035] This allows for a saving in energy and/or, if an inert gas such as nitrogen is used (e.g. as used as a motive gas), in a saving of inert gas. This control of the suction is for example achieved by controlling the flow of the motive gas for a venturi-based vacuum pump.

[0036] According to a favourable embodiment, the bleed line comprises between the pressure gauge and the vacuum pump a non-return valve.

[0037] When a sufficiently low pressure in the intermediate subsystem is achieved, measured by the pressure gauge, the vacuum pump can be stopped upon which this non-return valve closes. In case the pressure in the intermediate subsystem then raises due to leakage of pressured gas and/or air into the intermediate subsystem, and exceeds a certain preset level, the vacuum pump can be started again, until the pressure is sufficiently low to stop the pump again, etcetera. If there is very little leakage of pressured gas and/or air into the intermediate system, limited uptime of the pump needs to be applied and a significant saving in energy and/or inert gas is achieved.

[0038] According to a favourable embodiment, the third subsystem comprises a compressor.

[0039] Thus more specifically the method according to the present invention relates to a method of preparing a system comprising a compressor, which is an important area of application of the method.

[0040] The present invention will now be illustrated with reference to the drawing where

Fig. 1 shows a schematic layout of a super-atmospheric pressure system;

Fig. 2 shows a cross-sectional view through an intermediate subsystem of the system of Fig. 1; and

Fig. 3 shows a schematic layout of an alternative super-atmospheric pressure system similar to Fig. 1.

[0041] Fig. 1 shows a schematic layout of a system 100 comprising a first subsystem 110 and a second subsystem 120. The system 100 comprises a first branch 101 connecting the first subsystem 110 to the second subsystem 120; and comprises a second branch 102, also connecting the first subsystem 110 with the second subsystem 120.

[0042] In the embodiment discussed here, natural gas in the first subsystem 110 with a pressure of 90 Bar is raised in pressure to 200 Bar using compressors 121, 121'. If compressor 121 of the first branch 101 needs maintenance, it needs to be isolated from any subsystem that remains pressurized and be brought to atmospheric pressure. To this end there is an intermediate subsystem 170a between the first subsystem 110 and a third subsystem 130 comprising the compressor 121; and a further intermediate subsystem 170b between the third subsystem 130 and the second subsystem 120. The intermediate subsystem of the first branch comprises an upstream ball valve 123, and the further intermediate subsystem 170b comprises a downstream ball valve 122. To perform maintenance on the compressor 121, both of these ball valves are closed. Conveniently, said ball valves are double piston effect ball valves.

[0043] The internal volume of the ball valves contain gas under high pressure. This gas is, as is known in the art, discharged via a bleed opening into the (outside) atmosphere.

[0044] If, for example, the upstream ball valve 123 is leaky, gas may stil leak from the first subsystem 110 towards the compressor 121, causing a dangerous situation to exist.

[0045] According to the present invention, a sub-atmospheric pressure is applied to the ball valves by connecting a bleed line 150 and a vacuum pump 160 to the bleed opening. This will be discussed in more detail with reference to Fig. 2.

[0046] To apply the sub-atmospheric pressure, the bleed line 150 is provided with an ejector vacuum pump 160, driven by an air pump 161. This air pump 161 preferably provides so much motive air that the gas in the bleed line 150 is diluted to below the Lower Explosion Limit, eliminating the danger of an explosion, and discharged via a section of the bleed line 150 downstream of the ejector vacuum pump 160 to a safe location.

[0047] By keeping the valves 122', 123' of the second branch 102 open, the second branch 102 can remain operational, whereas maintenance can be performed on the first branch 101.

[0048] Fig. 2 shows a cross-sectional view through an intermediate subsystem 170 of the system of Fig. 1, embodied in a ball valve comprising a housing 205. The ball valve is a standard double-piston-effect ball-valve comprising a first sealing valve seat 231 and a second sealing valve seat 241. The valve seats can slide in a corresponding seat pocket. In general, there will be O-rings (not shown) for sealing the valve seats against the seat pocket. The first sealing valve seat 231 comprises a through-hole 232 and the second sealing valve seat 241 comprises a through-hole 242.

[0049] The ball valve further comprises a ball 233 having a through-hole 234. Springs 291 are present to push the valve seats against the ball 233. The ball 233 can be rotated using spindle 292 so as to open and close the ball valve. In Fig. 2 it is closed. If the ball 233 is rotated over 90°, the through-holes 232, 234 and 242 are aligned and the ball 233 allows gas to be transported through the ball valve.

[0050] To discharge gas present in the cavity 245 of the ball valve, a vent opening 246 is provided, which is connected to bleed line 150.

[0051] A ball valve as disclosed above is known in the art.

[0052] According to the present invention, suction is applied. Thus, not only is gas actively discharged from the cavity 245, but more importantly leakage of gas via the first sealing valve seat 231 through the second valve seat 241 is reduced and - if sub-atmospheric pressure is achieved in the cavity of the ball valve - prevented. Thus, escape of gas from the first subsystem 110 downstream of the second valve seat 241 can be prevented, helping to create a safe working environment for performing a maintenance operation.

[0053] In the embodiment shown, there is a pressure gauge 270 for determining whether sub-atmospheric pressure has been achieved, indicating that no gas will escape from the ball valve. The pressure gauge 270 can be used to control the air pump 161, which can save energy and/or save inert gas such as nitrogen if that is used as motive gas. In the embodiment shown in Fig. 2, the bleed line 150 comprises between the pressure gauge 270 and the vacuum pump 160 a non-return valve 287. When a sufficiently low pressure in the intermediate subsystem is achieved, meassured by the pressure gauge, the vacuum pump can be stopped upon which this non-return valve closes. In case the pressure in the intermediate subsystem then raises due to leakage of pressured gas and/or air into the intermediate subsystem, and exceeds a certain preset level, the vacuum pump can be started again, until the pressure is sufficiently low to stop the pump again, etcetera. If there is very little leakage of pressured gas and/or air into the intermediate system, limited uptime of the pump needs to be applied and a significant saving in energy and/or inert gas is achieved.

[0054] The bleed line 150 contains a constriction 251. As a result, the flow resistance in an upstream section 252 of the bleed line 150 where the pressure gauge 270 is located is lower than the flow resistance in a downstream section 253 between the pressure gauge 270 and the ejector vacuum pump 160. Thus the reliability of the pressure gauge 270 being capable of indicating that a sub-atmospheric pressure is present in the cavity 245 is improved when the pump is in operation and the non-return valve 287 is open.

[0055] A drain opening 293 may be present between the first sealing valve seat 231 and the second valve seat 241. During normal operation this drain opening 293 is closed using a plug. While not preferred because gas might escape via it, an open drain opening 293 is allowable if strong suction is applied by the vacuum pump (here ejector vacuum pump 160), in particular if the flow resistance via said drain opening 293 is larger than the flow resistance in the bleed line 150 from the cavity to the ejector vacuum pump 160. Thus, ambient air is sucked in, preventing gas from escaping from the cavity 245 through the drain opening 293.

[0056] The drain opening 293 may be advantageously provided with the pressure gauge 270, to ensure the reading on the pressure gauge corresponds with the pressure in the cavity and is not affected by any dynamic pressure losses in the bleed line 150.

[0057] Fig. 3 corresponds substantially to Fig. 1, with the difference that instead of (double piston effect) ball valves use is made of two pairs of single sealing seat valves 330. Each pair has a bleed line 336 provided between the two single sealing seat valves 330 of that pair.

[0058] By closing said single sealing seat valves 330, and opening valves 335 of the bleed lines 336, suction can be applied and gas present between the single sealing seat valves 330 of each pair discharged.

[0059] By keeping, for the second branch 102 which connects the pressurized first subsystem 110 with the pressurized subsystem 120, the valves 330 open and the valves 335 closed, the second branch 102 can remain operational, whereas maintenance can be performed on the first branch 101 safely.

[0060] The method according to the present invention can be varied in many ways within the scope of the appending claims. For example, if one of the pressurized subsystems 110, 120 is depressurized during maintenance, only one intermediate subsystem 170 is necessary. The bleed lines 150 may be present permanently in a system, or are connected to an intermediate system using a mobile vacuum system before maintenance and removed after maintenance. Each individual intermediate subsystem may have an individual suction system, independent of other intermediate subsystems, or they can be combined in any favourable combination, depending on the situation at hand.

Claims

1. A method of preparing a system (100) for a maintenance operation, said system (100) comprising

   - a first subsystem (110) containing a super-atmospheric gas,
   - a second subsystem (120), and
   - a third subsystem (130) between the first sub-

system (110) and the second subsystem (120);

said first subsystem (110) and said second subsystem (120) being connected via an intermediate subsystem (170a) capable of allowing gas to flow between the first subsystem (110) and the second subsystem (120) via the third subsystem (130), said intermediate subsystem (170a) comprising

- a first sealing valve seat (231),
- a second valve seat (241) between the first sealing valve seat (231) and the second subsystem (120), and
- a vent opening (246) between the first sealing valve seat (231) and the second valve seat (241);

said third subsystem (130) and said second subsystem (120) being connected via a further intermediate subsystem (170b) capable of allowing gas to flow between the third subsystem (130) and the second subsystem, said further intermediate subsystem (170b) comprising

- a third sealing valve seat (231),
- a fourth valve seat between the third sealing valve seat (231) and the third subsystem (130), and
- a second vent opening (246) between the third sealing valve seat (231) and the fourth valve seat (241);

said method comprising

- the discharge of gas present between the first sealing valve seat (231) and the second valve seat (241) via the vent opening (246) before performing a maintenance step of the maintenance operation downstream of said second valve seat (241) with respect to the first sealing valve seat (231), and
- the discharge of gas present between the third sealing valve seat (231) and the fourth valve seat (241) via the second vent opening (246) before performing a maintenance step of the maintenance operation between the second valve seat (241) and the fourth valve seat (241);

characterized in that the method comprises before performing a maintenance step of the maintenance operation

- applying suction to the vent opening (246) for discharging the gas present between the first sealing valve seat (231) and the second valve seat (241) before performing said maintenance step
- the discharge of gas present between the third sealing valve seat (231) and the fourth valve seat (241) via the second vent opening (246) between the second valve seat (241) and the fourth valve seat (241) by applying suction to the second vent opening (246);

wherein the suction is applied to achieve sub-atmospheric pressure in at least one intermediate system (170a, 170b) of the system (100).

2. The method according to claim 1, wherein the intermediate subsystem (170a), the third subsystem (130) and the further intermediate subsystem (170b) define a branche (101) connecting the first subsystem (110) with the second subsystem (120), the system (100) further comprising a second branch (102) connecting the first subsystem (110) and the second subsystem (120).

3. The method according to claim 1 or 2, wherein the system (100) comprises a pressure gauge (270) for measuring the pressure of an intermediate subsystem (170a, 170b) of the system (100).

4. The method according to claim 3, wherein the system (100) comprises a pressure gauge (270) for measuring the pressure upstream of a vacuum pump (160) providing said suction, the flow resistance $R_{vv\text{-}pg}$ between i) the location of the gas between the first sealing valve seat (231) and the second valve seat (241) and ii) the location of the pressure gauge (270) being lower than the flow resistance $R_{pg\text{-}vp}$ between i) the location of the pressure gauge (270) and ii) the vacuum pump (160).

5. The method according to any of the preceding claims, wherein the gas extracted by suction is diluted to below the its Lower Explosion Limit.

6. The method according to any of the preceding claims, wherein dilution is done with an inert gas.

7. The method according to any of the preceding claims, wherein the suction is applied using a venturi-based vacuum pump (160).

8. The method according to any of the preceding claims, wherein the intermediate subsystems (170a, 170b) comprise a ball valve (123), said ball valve (123) comprising the first sealing valve seat (231), the second valve seat (241) and the vent opening (246).

9. The method according to any of the preceding claims, wherein the second valve seat (241) is a second sealing valve seat (241).

10. The method according to any of the preceding claims, wherein the fourth valve seat (241) is a fourth sealing valve seat (241).

11. The method according to any of the preceding claims, wherein the sub-atmospheric pressure is maintained while the at least one maintenance step of the maintenance procedure is performed.

12. The method according to any of the preceding claims, wherein the pressure in the intermediate subsystem (170a) is monitored using a pressure gauge (270), and a vacuum pump (160) used for applying suction is controlled by the pressure gauge (270).

13. The method according to claim 12, wherein the bleed line (150) comprises between the pressure gauge (270) and the vacuum pump (160) a non-return valve (287).

14. The method according to any of the preceding claims, wherein the third subsystem (130) comprises a compressor (121).

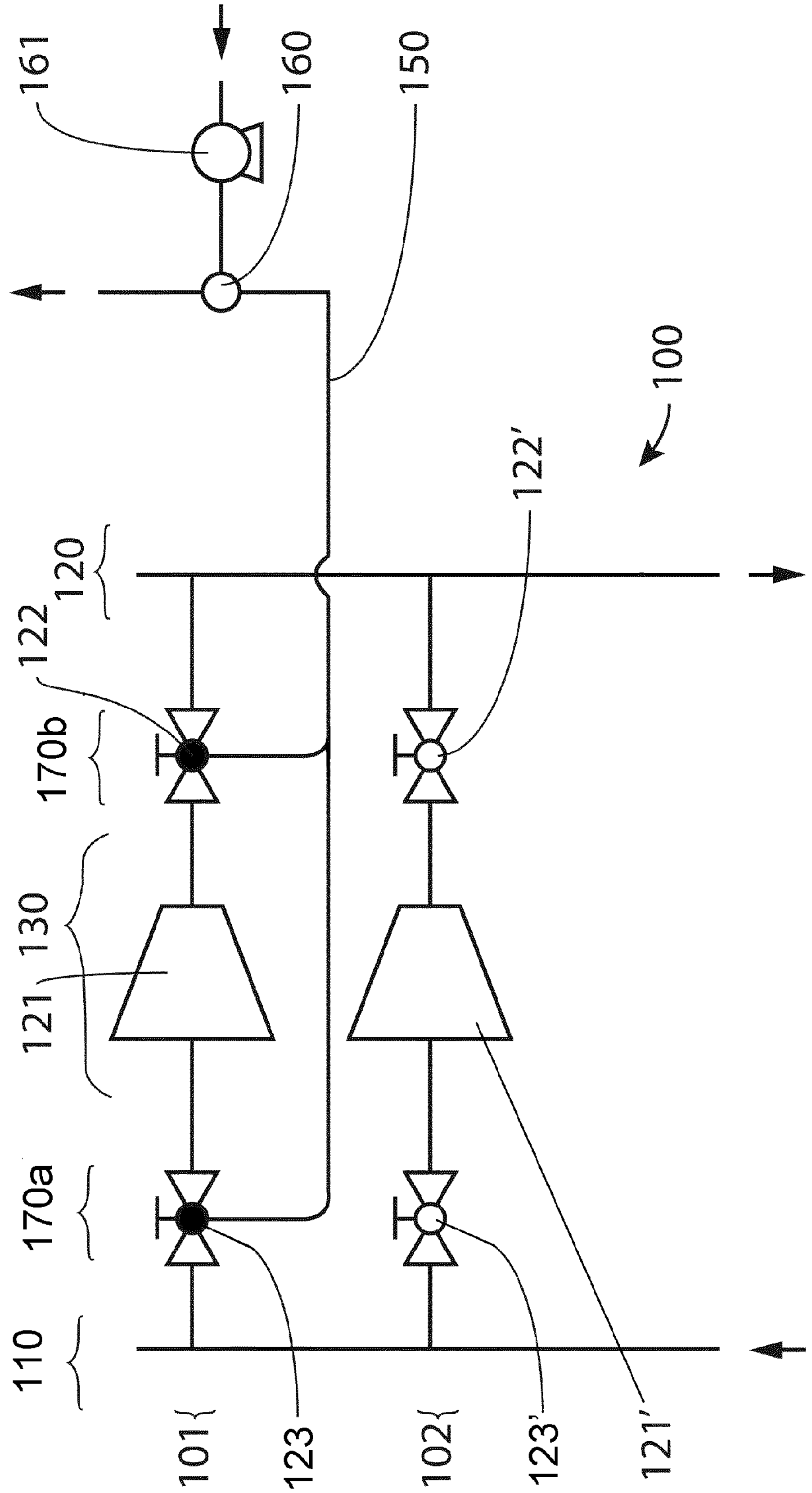
161
160
150
100
122'
120
122
170b
130
121
170a
110
101
123
102
123'
121'

Fig. 1

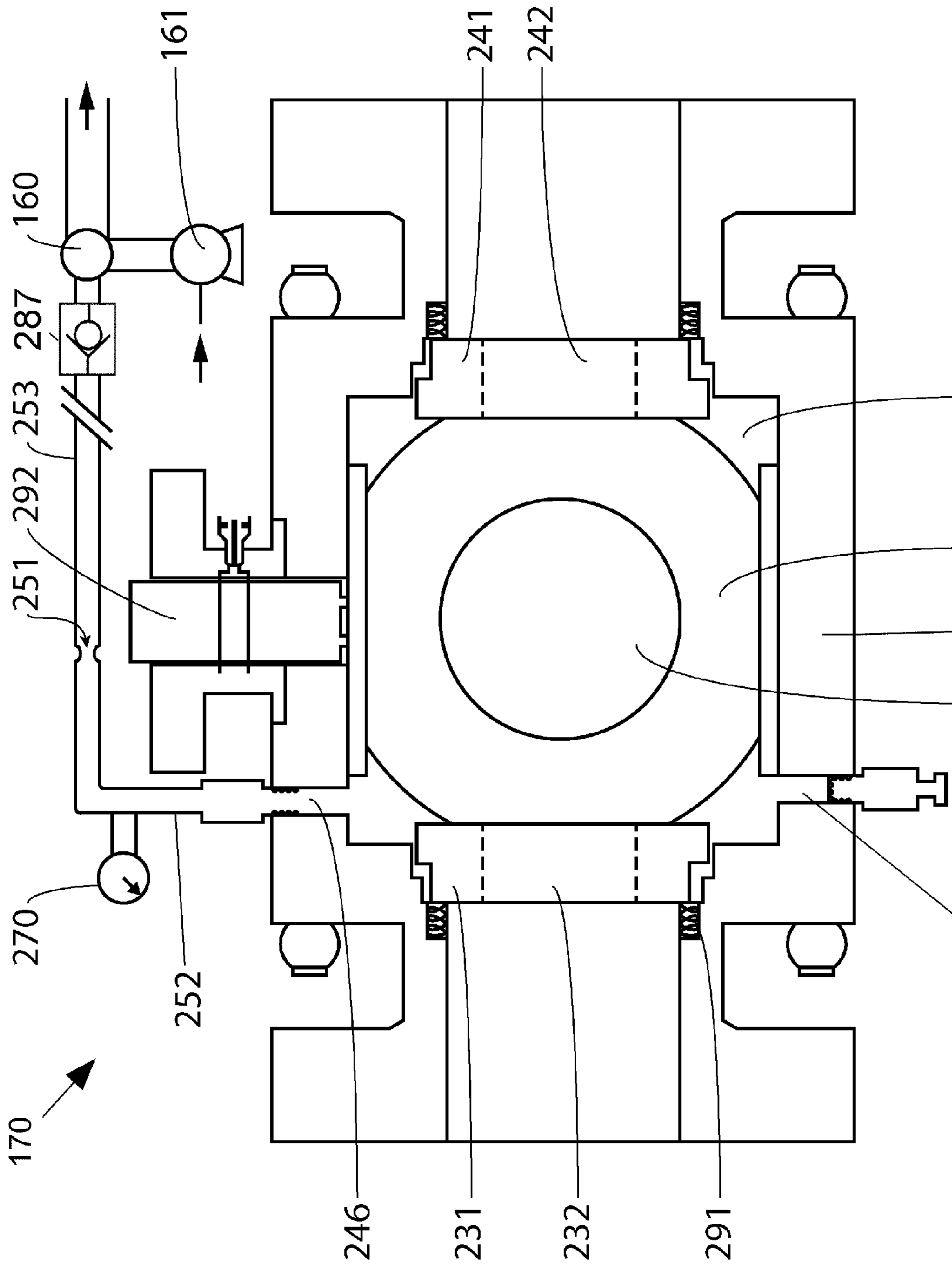
161
160
287
253
292
251
241
242
245
233
205
234
293
270
252
170
246
231
232
291

Fig. 2

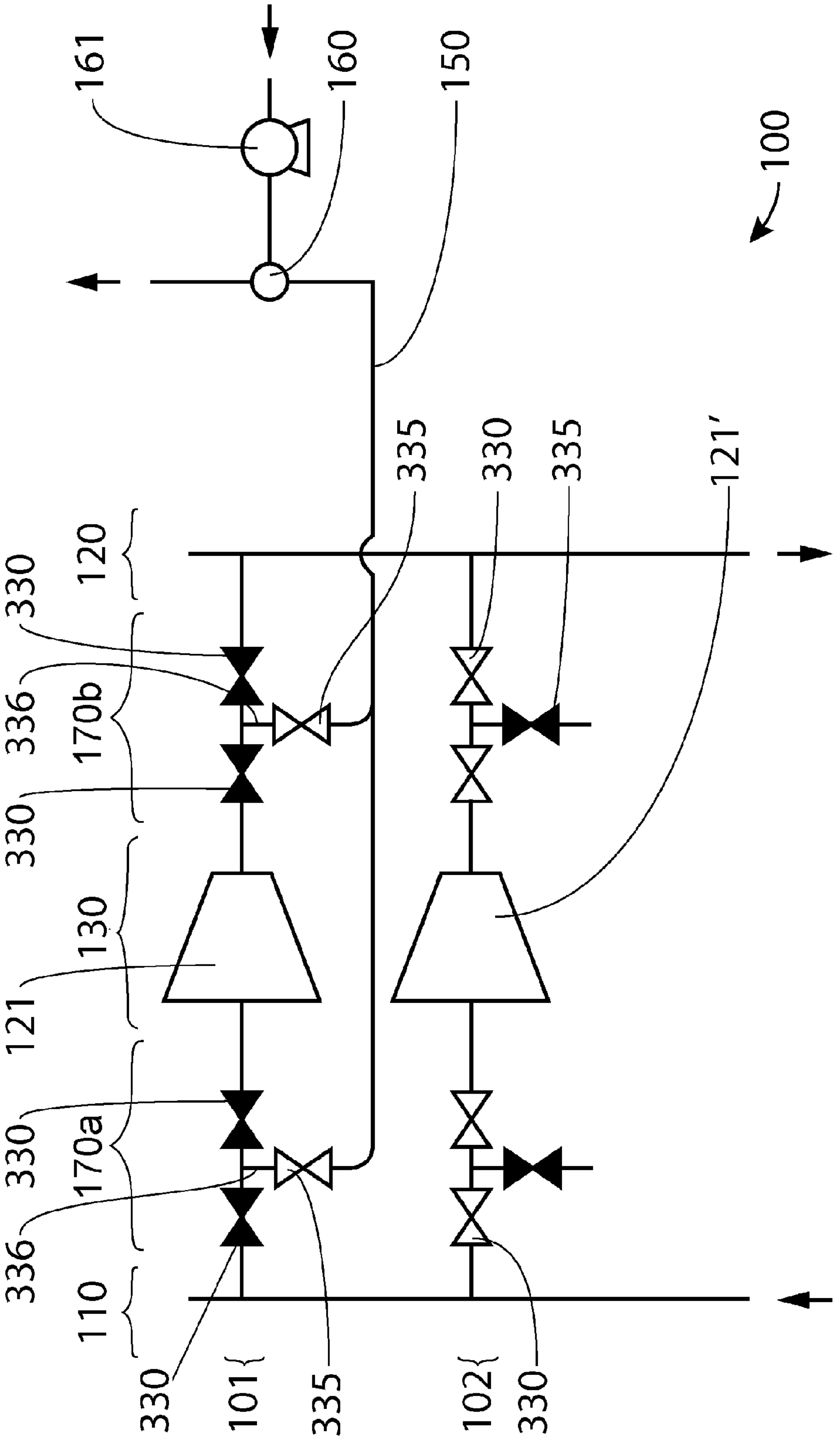
161
160
150
100
335
330
335
121′
120
330
336
170b
330
130
121
330
170a
336
110
330
101
335
102
330

Fig. 3

EUROPEAN SEARCH REPORT

Application Number
EP 15 18 4966

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	Dale Millward: "Emergency pipeline repair systems developed to facilitate pipeline repair of unpiggable defects", PPSA seminar 2012 , 2012, XP002754559, Retrieved from the Internet: URL:http://ppsa-online.com/papers/12-Aberdeen/2012-07-STATS-Group-paper.pdf [retrieved on 2016-02-19] * fig.1, fig.2, V1, V2, B; p.1, l.1-5, p.3, l.14-20; * -----	1-14	INV. F17D1/04 F17C7/00
A	National Gas STAR partners: "Using Pipeline Pump-Down Techniques To Lower Gas Line Pressure Before Maintenance", United States Environmental Protection Agency , 2006, XP002754560, Retrieved from the Internet: URL:http://www3.epa.gov/gasstar/documents/ll_pipeline.pdf [retrieved on 2016-02-19] * p.1, paragraph 2; p.2, paragraph 2; p.3, "Exhibit 4: Gas Pipeline Block-valve Manifold System" * ----- -/--	1-14	

TECHNICAL FIELDS SEARCHED (IPC)

F17D
F17C
F16L
F16K
B08B

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
Munich	22 February 2016	Todor, H

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EUROPEAN SEARCH REPORT

Application Number
EP 15 18 4966

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	R Palmer Jones: "The development of an emergency repair system, and a case study for a remote gas pipeline", Penspen Proceedings of the 7th international pipeline conference IPC2008, 29 September 2008 (2008-09-29), XP002754561, Alberta, Canada Retrieved from the Internet: URL:http://www.penspen.com/wp-content/uploads/2014/09/emergency-repair-system.pdf [retrieved on 2016-02-19] * p.4, first paragraph; page 1 - page 7; figures 9,10,11,13 * -----	1-14	
A	US 2011/133942 A1 (FLANDERS PATRICK S [SA]) 9 June 2011 (2011-06-09) * fig.1, 11, 12, 13, 14, 41, 42, 106; [0002]-[0004]; [0027], [0045], [0048]; * -----	1-14	
			TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
Munich	22 February 2016	Todor, H

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2005026603 A **[0013]**