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(54) WATER TREATMENT SYSTEM; METHOD FOR CONTROLLING A WATER TEMPERATURE AND PROCESSOR

(57) A water treatment system comprising a cold water feed line (106) and a hot water feed line (104) coupled to a mixing valve (108), wherein the mixing valve (108) comprises an output which is coupled to a treatment outlet (114) via a mixed water feed line (124, 126). An electronically operated mixed water valve (118) is included in the mixed water feed line (124, 126). In addition to the mixed water feed line (126) a cold water bypass line (115) is coupling the cold water feed line (106) to the treatment outlet (114) via an electronically operated cold water valve (116) included in the cold water bypass line (115). A controller (102) is coupled to the mixed water valve (118) and the cold water valve (116) and is configured to operate the mixed water valve (118) and/or the cold water valve (116) to change the water temperature at the treatment outlet (114) according to a water treatment procedure. One advantage of the invention is that a user is enabled to easily set a relaxing warm temperature with the mixing valve, while being able to activate an automated water treatment procedure using the electronically operated valves.

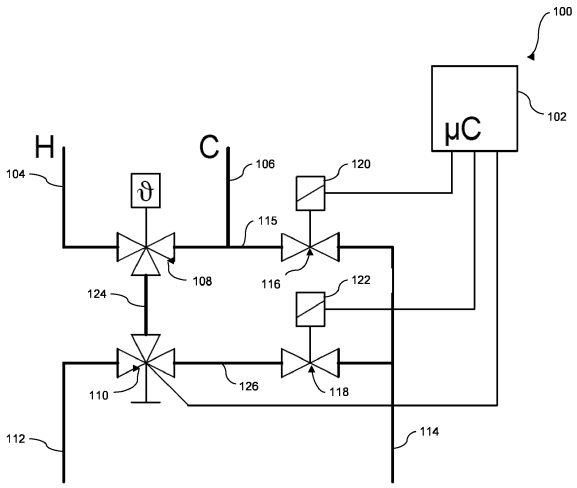

Fig. 1

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Description

[0001] The invention relates to a water treatment system comprising a cold water feed line, and a hot water feed line coupled to a mixing valve, wherein the mixing valve comprises an output which is coupled to a treatment outlet via a mixed water feed line.

[0002] The invention also relates to a method for controlling a water temperature at a treatment outlet. Furthermore the invention relates to a processor.

[0003] A treatment with different water temperatures may be useful to achieve certain effects on a user. For example, hot water dilates blood vessels, increasing blood flow to the skin and muscles. This improves circulation and the immune system. Waste products may be effectively removed, while nutrients and oxygen are carried around the body. Cold water stimulates the blood vessels near the skin surface to constrict, sending blood away from the skin and towards the internal organs, improving their functioning and reducing inflammation. An existing treatment method with different water temperatures is known as contrast bath therapy.

[0004] EP 0 581 192 B1 generally relates to a shower shifter for a sanitary fitting having a water inlet, two water outlets, whereof one leads to a shower, and a valve element which, as a function of the position, closes one of the two water outlets.

[0005] The object of the present invention is to facilitate a user-friendly water treatment with an appliance that is suitable for use in a bath, shower or healthcare environment.

[0006] This object is achieved by a water treatment system comprising a cold water feed line and a hot water feed line coupled to a mixing valve, wherein the mixing valve comprises an output which is coupled to a treatment outlet via a mixed water feed line, wherein an electronically operated mixed water valve is included in the mixed water feed line. In addition to the mixed water feed line a cold water bypass line is coupling the cold water feed line to the treatment outlet via an electronically operated cold water valve included in the cold water bypass line. Furthermore, a controller is coupled to the mixed water valve and the cold water valve. The controller is configured to operate the mixed water valve and/or the cold water valve to change the water temperature at the treatment outlet according to a water treatment procedure.

[0007] One advantage of the invention is that a user is enabled to easily set a relaxing warm temperature with the mixing valve, while being able to activate an automated water treatment procedure using the electronically operated valves. These valves allow to supply from time to time cold water to a water treatment outlet, like e.g. a hand shower.

[0008] The mixing valve may be any of the commonly known types like a single-lever mixer or a thermostatic mixer. This facilitates hydrotherapy applications that involve changing predetermined water temperatures of a water treatment outlet.

[0009] In a further aspect of the present invention the mixed water feed line includes a diverter valve arranged upstream of the mixed water valve, wherein the diverter valve is configured to divert mixed water to the water treatment outlet via the mixed water valve or to another outlet. This allows that a user is enabled to easily switch the water flow between the treatment outlet and any alternative outlet like e.g. a head shower or bathtub outlet by using the diverter valve, while an unwanted impact of cold water through the alternative outlet can be prevented or at least be reduced. The invention facilitates the use of water treatment outlets using varying water temperatures for water treatment such as hydrotherapy together with a diverter valve in home, healthcare and/or spa appliances.

[0010] In a further aspect of the present invention the controller is coupled with at least one sensor that provides data representing a valve position of the diverter valve, and that the controller is configured to operate the mixed water valve and/or the cold water valve depending on the position of the diverter valve. It becomes thus possible to prevent or reduce an undesired cold water impact on the user through the water treatment outlet when the position of the diverter valve is changed, namely the treatment outlet or an alternative outlet is chosen. The sensor data can also be used to activate e.g. cold water output only from the water treatment outlet while the alternative outlet at the same time provides normal mixed water output. In general, one may think of various activation procedures for the electronically actuated valves depending on the sensor data. The sensor may acquire the valve position directly e.g. by a magnetic sensor or indirectly e.g. by a flow sensor in at least one of the lines downstream of the diverter valve.

[0011] In a further embodiment the controller is configured to initiate the water treatment procedure only if the valve position of the diverter valve allows providing mixed water to the treatment outlet. Thus a correct functioning of the water treatment procedure may be ensured. Furthermore, this prevents a user from a cold water shock from an alternative outlet.

[0012] In a variant of this embodiment the controller is configured to interrupt the water treatment procedure if the position of the diverter valve is changed. Thereby it is possible to prevent that a user of the water treatment outlet receives a cold water shock when the position of diverter valve is accidently changed during a water treatment procedure.

[0013] In one embodiment the cold water valve and the mixed water valve are bi-stable valves. Such use of bi-stable valves may be advantageous for rapidly and effectively changing the water temperature at the treatment outlet.

[0014] In another aspect the controller is configured to operate the cold water valve and the mixed water valve in alternate positions when a water treatment procedure is being performed. The user-perception of the water treatment procedure may thus be enhanced. Further-

more, the cold water valve and the mixed water valve may be realized as one common 3/2-valve such that only one actuator is needed.

[0015] In yet a further aspect the controller is configured to close the cold water valve if no water treatment procedure is being performed. This facilitates the use of the water treatment outlet as a water outlet without a particular water treatment procedure. The versatility of use may be improved. In particular, the cold water valve is closed by default such that no electrical power is need to keep the cold water valve closed.

[0016] The object of the present invention is also achieved by a method for controlling a water temperature at a treatment outlet, wherein water is provided to the treatment outlet through a first water feed line with a first water temperature and through a second water feed line with a second water temperature, wherein at least one valve in the first water feed line and at least one valve in the second water feed line are operated to change the water temperature at the treatment outlet according to a water treatment procedure, wherein the position of at least one diverter valve having an output to the first water feed line is monitored, and wherein the water treatment procedure is only initiated if the diverter valve is set to a position in which water provided by the diverter valve is directed to the first water feed line. Advantages of the method can be at least partially derived by analogy from the advantages of the system.

[0017] In one embodiment of the method the water treatment procedure is interrupted if the diverter valve is set to a position in which water provided by the diverter valve is not directed to the first water feed line. Thereby an undesired impact perceived by the user receiving the water treatment may be prevented or mitigated.

[0018] In a further embodiment the valve in the second water feed line is closed if no water treatment procedure is being performed. This enhances the use possibilities of the treatment outlet.

[0019] In an advantageous embodiment the position of the valve in the first water feed line and the position of the valve in the second water feed line are switched alternatingly when a water treatment procedure is being performed. Thus different water temperatures suitable for a hydrotherapy treatment can be made available at the treatment outlet in a favorable manner.

[0020] In a further embodiment the first water feed line is a mixed water feed line and the second water feed line is a cold water feed line.

[0021] The object is also achieved by a processor configured to execute computer-program instructions according to the aforementioned method or one of its embodiments.

[0022] These and other objects, features and advantages of the present invention will be better understood when consideration is given to the following description in connection with the accompanying schematic drawings wherein:

Figure 1 illustrates a system for water treatment;

Figure 2 illustrates, in a flowchart format, a sequence for water temperature control;

Figure 3 illustrates, in a flowchart format, a sequence for a water treatment procedure;

Figure 4 illustrates, in a flowchart format, a sequence for a water treatment session;

Figure 5 illustrates, in a flowchart format, a safety sequence;

Figure 6 illustrates, in a flowchart format, a treatment sequence.

[0023] As required, detailed embodiments of the present invention are disclosed herein. However, it is to be understood that the disclosed embodiments are merely exemplary of the invention that may be embodied in various and alternative forms. The figures are provided for illustrative purpose. Therefore the figures may be simplified in certain aspects and are not necessarily to scale. Specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for teaching one skilled in the art to variously employ the present invention.

[0024] Figure 1 illustrates an example of a water treatment system 100 comprising a hot water feed line 104, a cold water feed line 106 and a mixing valve 108. The output of the hot water feed line 104 is coupled to the mixing valve 108. The cold water feed line 106 is split and has two outputs. A first output of the cold water feed line 106 is coupled to the mixing valve 108. A second output of the cold water feed line 106 is coupled to a treatment outlet 114 via a cold water bypass line 115.

[0025] The illustrated mixing valve 108 is a three-way valve for receiving water from both the hot water feed line 104 and from the cold water feed line 106. The mixing valve 108 has an output to a mixed water line segment 124. The mixing valve 108 allows blending the received hot water and cold water to provide mixed water at its output. Mixed water with a mixed temperature is provided from the output of the mixing valve 108 to the mixed water line segment 124. Mixed water is water for which the temperature could be adjusted by varying the portions of water from the hot water feed line 104 and the cold water feed line 106. As non-limiting examples, a mixing valve 108 may be a manual mixing valve, a pressure compensating mixing valve or a thermostatic mixing valve. The mixing valve 108 may be manually and/or automatically operated.

[0026] The mixed water line segment 124 has an output to a diverter valve 110. In some embodiment and as illustrated in Figure 1, the diverter valve 110 may be a mechanical valve that is manually operated. The illustrated diverter valve 110 is a three-way valve with two

outputs and one input for receiving water from mixed water line segment 124. The diverter valve 110 allows controlling the direction of the water received at its input to its outputs. In the given example a first output of the diverter valve 110 provides water to a first outlet 112. A second output of the diverter valve 110 provides water to a mixed water feed line 126. The output of the mixed water feed line 126 is coupled to a treatment outlet 114.

[0027] The first outlet 112 may include without being limited to a spout, a bath filler or a shower head. In some exemplary embodiments the treatment outlet 114 may be a treatment device, for example but not limited to a hand shower, a mounted shower, an arrangement of one or several nozzles, e.g. the nozzles of a tub or the nozzles of a shower arrangement.

[0028] The water treatment system 100 further comprises a controller 102, preferably a microcontroller. In one embodiment commands may be sent to the controller 102 via a user-interface. The link between the controller 102 and the user-interface may be wireless or wired. One or more elements of a user-interface associated with the controller 102 may include (without being limited to) one or more of a touch pad, a push-button, a control dial, a keyboard, a touch screen, a LED display.

[0029] The treatment outlet 114 may receive input from both the cold water feed line 106 and from the mixed water feed line 126. The cold water feed line 106 is split to allow providing cold water to the mixing valve 108 and to the treatment outlet 114. A cold water valve 116 is inserted in the section of the cold water feed line 106 that provides water to the treatment outlet 114. A mixed water valve 118 is inserted in the mixed water feed line 126 that provides water to the treatment outlet 114. The cold water valve 116 and the mixed water valve 118 are electro-mechanically operated valves, for example solenoid valves. In a preferred embodiment the cold water valve 116 and the mixed water valve 118 may be bi-stable valves. The cold water valve 116 may be operated by means of an electro-mechanical actuator 120 that is connected to the controller 102. The mixed water valve 118 may be operated by means of an electro-mechanical actuator 122 that is connected to the controller 102.

[0030] The controller 102 is coupled with the diverter valve 110 to receive data indicating the position of the diverter valve 110. As an example, the controller 102 may be connected to a sensor which is capable to determine the position of the diverter valve 110. The controller 102 may be configured to monitor the position of the diverter valve 110 using such sensor. A sensor which is capable to determine the position of the diverter valve 110 maybe mechanically integrated within the diverter valve 110.

[0031] In one embodiment the diverter valve 110 may be a user driven mechanical valve. A manually operable diverter valve 110 may be perceived by many users as intuitive and easy to handle.

[0032] In a preferred embodiment the treatment outlet 114 may be hand shower. A hand shower may be handled in a versatile and user-friendly manner both when used with a water treatment procedure, i.e. for hydrotherapy with changing water temperatures, and when used for showering without a water treatment procedure. When the treatment outlet 114 is used without a water treatment procedure, the water temperature at the treatment outlet 114 is predetermined by the mixing valve 108.

[0033] In one embodiment the controller 102 comprises a processor, preferably a micro-processor. The processor is configured to execute computer-program instructions. Such computer-program instructions include instructions relating to a method for controlling the water temperature at the treatment outlet 114. The computer-program instructions may include instructions relating to one or several water treatment procedures.

[0034] Figures 2 to 6 illustrate non-limiting examples of sequences for controlling the water temperature at the treatment outlet 114. A sequence may be programmed in the format of computer-program instructions. In one embodiment such sequence may be executed by the processor of the controller 102. The programming of the processor may include hardwired computer-program instructions and/or computer-program instructions in a software format.

[0035] Figure 2 refers to an illustrative basic sequence 200 for controlling the water temperature. After the start 202 of this sequence the water treatment system is initialized 204. During the basic sequence 200 it is repeatedly verified if there is a treatment command for a water treatment procedure 300 as illustrated by the decision point 206 in the given flowchart. Such treatment command may for example be induced by means of a user-interface of the controller 102. If a treatment command is verified a water treatment procedure 300 is started. After termination of the water treatment procedure 300 the sequence returns to the decision point 206. If no treatment command is verified it is verified if the cold water valve 116 is closed as illustrated by the decision point 208. If the cold water valve 116 is closed the sequence returns to the decision point 206. If the cold water valve 116 is not closed at least one valve operation 210 is performed. The valve operation 210 includes closing the cold water valve 116. In addition the mixed water valve 118 may be opened to permit the use of the treatment outlet 114 without a water treatment procedure 300 being performed. The sequence then returns to the decision point 206.

[0036] A treatment command that starts a water treatment procedure 300 may for example be induced by user by wireless means and/or using a keypad and/or push-button.

[0037] In one non-limiting embodiment the treatment outlet 114 is a shower head that can be used as a normal shower when no there is no active treatment command. When no treatment command is verified a solenoid valve in the cold water feed line 106 for the treatment outlet 114 is closed and a solenoid valve in the mixed water feed line 126 for the treatment outlet 114 is opened. In a variant of this embodiment the solenoid valves are bi-

stable valves.

[0038] Figure 3 refers to an illustrative basic sequence 310 for a water treatment procedure 300. After the start 302 of the water treatment procedure 300 it is verified if the treatment command is still valid as illustrated by the decision point 304. If the treatment command is not valid the water treatment procedure 300 will skip to its end 308. If the treatment command is valid it is verified, preferably as illustrated by the decision point 306, if the diverter valve 110 is set to a position in which its output is directed to the mixed water feed line 126. If the diverter valve 110 is set to this position a procedure sequence 400 is started. If the diverter valve 110 is set to another position the basic sequence 310 will skip to its end 308. After termination of the procedure sequence 400 the basic sequence 310 will skip to its end 308.

[0039] When a water treatment procedure 300 is started it needs to be ensured that the diverter is positioned in the direction of the treatment outlet 114. In one embodiment this involves the use of a sensor that is connected to one or several mechanical parts of the diverter valve 110.

[0040] Figure 4 refers to an illustrative main procedure sequence 400 of a water treatment session. A configuration 404 is performed after the start 402 of the procedure sequence 400. The configuration 404 may include setting and/or pre-configuring a treatment sequence 600. This may include a pre-configuration of pulses for the treatment sequence 600. After the configuration 404 a safety sequence 500 is performed. If the result of the safety sequence 500 is that the procedure sequence 400 needs to be interrupted the procedure sequence 400 will skip to its end 406. If the result of the safety sequence 500 is that there is no need to interrupt the procedure sequence 400 the treatment sequence 600 is performed. After termination of the treatment sequence 600 the main procedure sequence 400 may return to the configuration 404.

[0041] Figure 5 refers to an illustrative safety sequence 500 for a water treatment procedure. After the start 502 of the safety sequence 500 it is verified if there is a treatment command as illustrated by the decision point 504 and it is verified if the diverter valve 110 is set to a position in which its output is directed to the mixed water feed line 126 as illustrated by the decision point 506. If both are positively verified as indicated by the respective flowchart symbol 508 no interruption is needed and the treatment sequence 600 is performed. Otherwise as indicated by the respective flowchart symbol 510 the procedure sequence 400 will skip to its end 406 as a result 512 of the safety sequence 500.

[0042] Figure 6 refers to an illustrative treatment sequence 600, which is a sub sequence of the main procedure sequence 400 of a water treatment session. After the start 602 of the treatment sequence 600 it may be validated 604 if the system is ready to perform one or more treatment sub-sequences 606, 608, 610. If the system is not ready the treatment sequence 600 may skip to its end 612. If the system is ready at least one treatment sub-sequences 606, 608, 610 may be performed. A first treatment sub-sequence 606 may include a build-up sequence. A second treatment sub-sequence 608 may include a stress sequence. A third treatment sub-sequence 610 may include a swing-off sequence after which the treatment sequence 600 may skip to its end 614.

[0043] As described in connection with the illustrative figures 2 to 6 it is ensured that the diverter valve 110 is set to the appropriate position for water treatment before a treatment session is initiated. The actual water treatment may start for example by setting the mixed water valve 118 to its closed position and by setting the cold water valve 116 to its opened position. After a predefined pulse time the mixed water valve 118 and the cold water valve 116 are then set to their respective alternate positions. The mixed water valve 118 and the cold water valve 116 may then continue to be alternately switched until the treatment session ends.

[0044] As a non-limiting example with reference to figures 2, 3 and 5 a treatment command may be invalidated by a user-interface action and/or by expiry of a timer, which may be running in the controller 102.

[0045] A concept that summarizes an underlying aspect of the invention relates to a water treatment system comprising a controller 102, a cold water feed line 106, a mixed water feed line 126, a diverter valve 110 and a treatment outlet 114, wherein at least one valve is included in a water feed line that is coupled to the treatment outlet 114, wherein the controller is coupled with at least one sensor that provides data of a position of the diverter valve 110, and wherein the controller 102 is configured to operate the at least one valve that is included in a water feed line depending on the position of the diverter valve 110. One advantage of such water treatment system is that a user may easily switch the water flow from the treatment outlet 114 to another outlet 112 by using the diverter valve 110, while an unwanted impact of such use of the diverter valve 110 on the water treatment 114 can be effectively prevented or at least mitigated.

Claims

1. A water treatment system comprising
a cold water feed line (106) and a hot water feed line (104) coupled to a mixing valve (108), wherein the mixing valve (108) comprises an output which is coupled to a treatment outlet (114) via a mixed water feed line (124, 126)
characterized in that
an electronically operated mixed water valve (118) is included in the mixed water feed line (124, 126), that
in addition to the mixed water feed line (126) a cold water bypass line (115) is coupling the cold water feed line (106) to the treatment outlet (114) via an electronically operated cold water valve (116) includ-

ed in the cold water bypass line (115), and that a controller (102)

is coupled to the mixed water valve (118) and the cold water valve (116) and
is configured to operate the mixed water valve (118) and/or the cold water valve (116) to change the water temperature at the treatment outlet (114) according to a water treatment procedure.

2. The water treatment system of claim 1, **characterized in that** the mixed water feed line (124, 126) includes a diverter valve (110) arranged upstream of the mixed water valve (118), wherein the diverter valve (110) is configured to divert mixed water to the water treatment outlet (114) via the mixed water valve (118) or to another outlet (112).

3. The water treatment system of claim 2, **characterized in that** the controller (102) is coupled with at least one sensor that provides data representing a valve position of the diverter valve (110), and that the controller (102) is configured to operate the mixed water valve (118) and/or the cold water valve (116) depending on the position of the diverter valve (110).

4. The water treatment system of claim 3, **characterized in that** the controller (102) is configured to initiate the water treatment procedure only if the position of the diverter valve (110) allows providing mixed water to the treatment outlet (114).

5. The water treatment system of claim 4, **characterized in that** the controller (102) is configured to interrupt the water treatment procedure if the position of the diverter valve (110) is changed.

6. The water treatment system of any of claims 3 to 5, **characterized in that** the cold water valve (116) and the mixed water valve (118) are bi-stable valves.

7. The water treatment system of any of claims 3 or 6, **characterized in that** the controller (102) is configured to operate the cold water valve (116) and the mixed water valve (118) in alternate positions when a water treatment procedure is being performed.

8. The water treatment system of any of claims 3 to 7, **characterized in that** the controller (102) is configured to close the cold water valve (116) if no water treatment procedure is being performed.

9. A method for controlling a water temperature at a treatment outlet (114),
characterized in that
water is provided to the treatment outlet (114) through a first water feed line with a first water temperature and through a second water feed line with a second water temperature, that
at least one valve in the first water feed line and at least one valve in the second water feed line are operated to change the water temperature at the treatment outlet (114) according to a water treatment procedure, that
the position of at least one diverter valve (110) having an output to the first water feed line is monitored, and that
the water treatment procedure is only initiated if the diverter valve (110) is set to a position in which water provided by the diverter valve (110) is directed to the first water feed line.

10. A processor configured to execute computer-program instructions according to the method of claim 9.

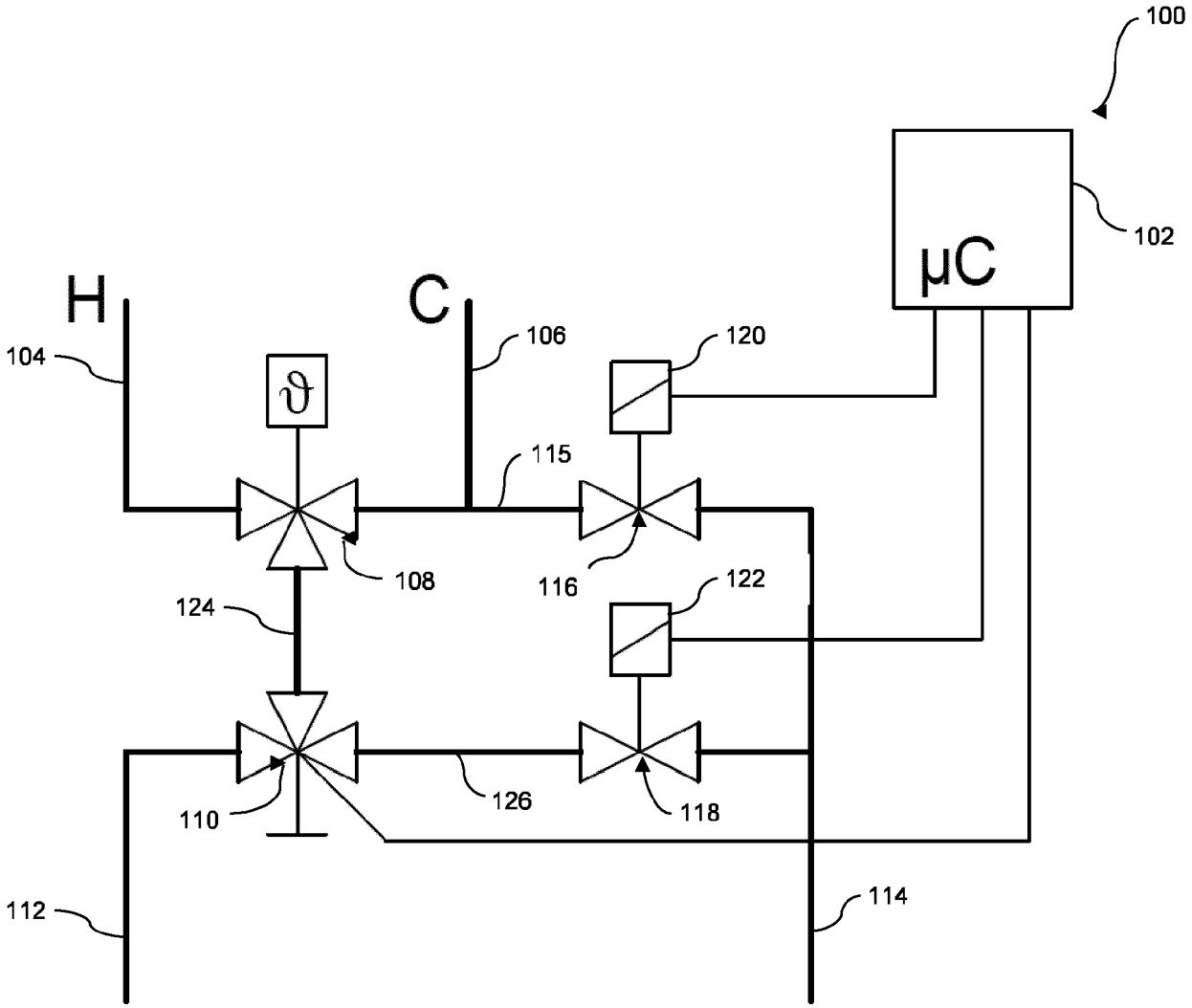

Fig. 1

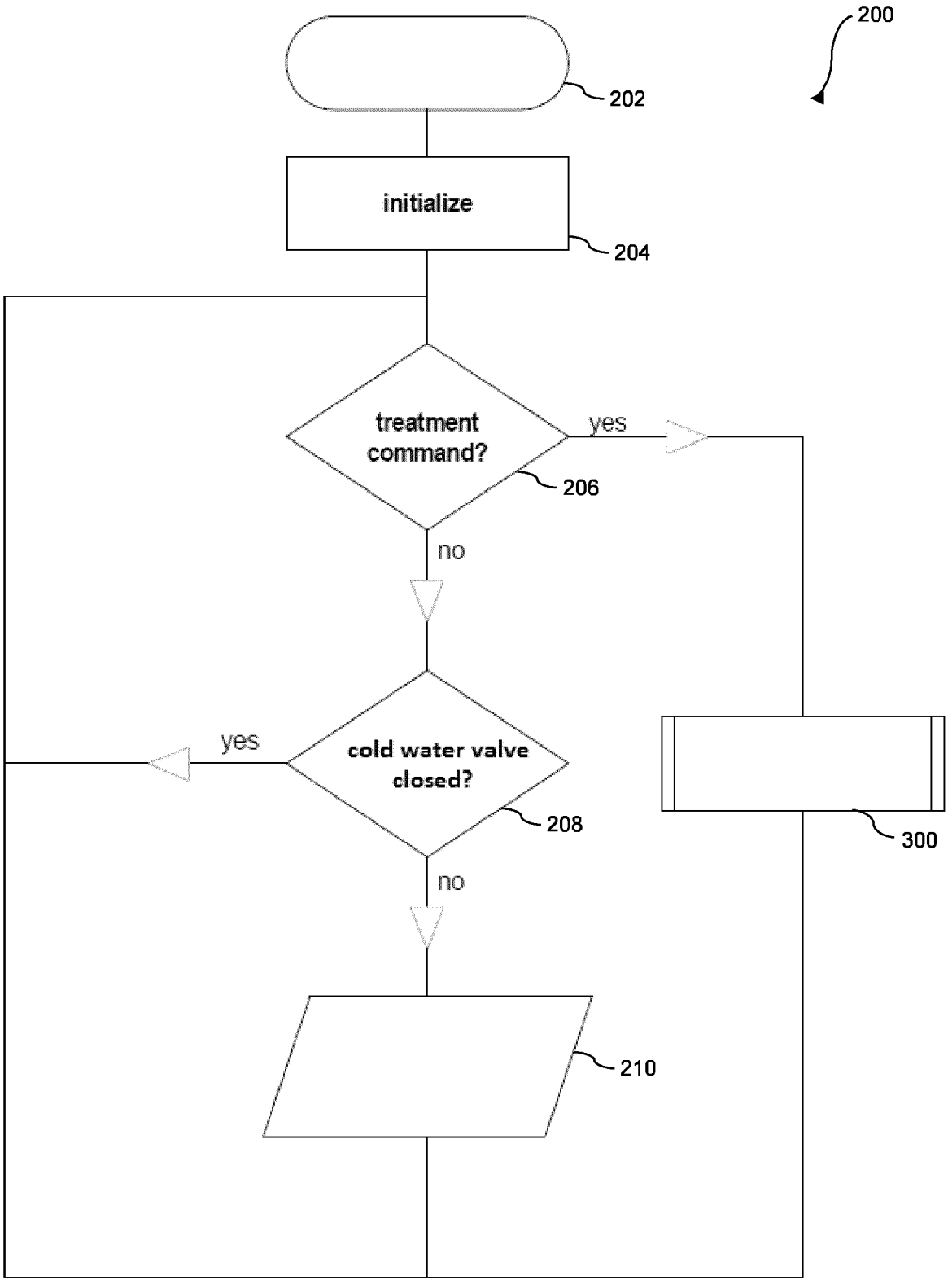
200
202
initialize
204
treatment command?
206
yes
no
cold water valve closed?
208
yes
no
300
210

Fig. 2

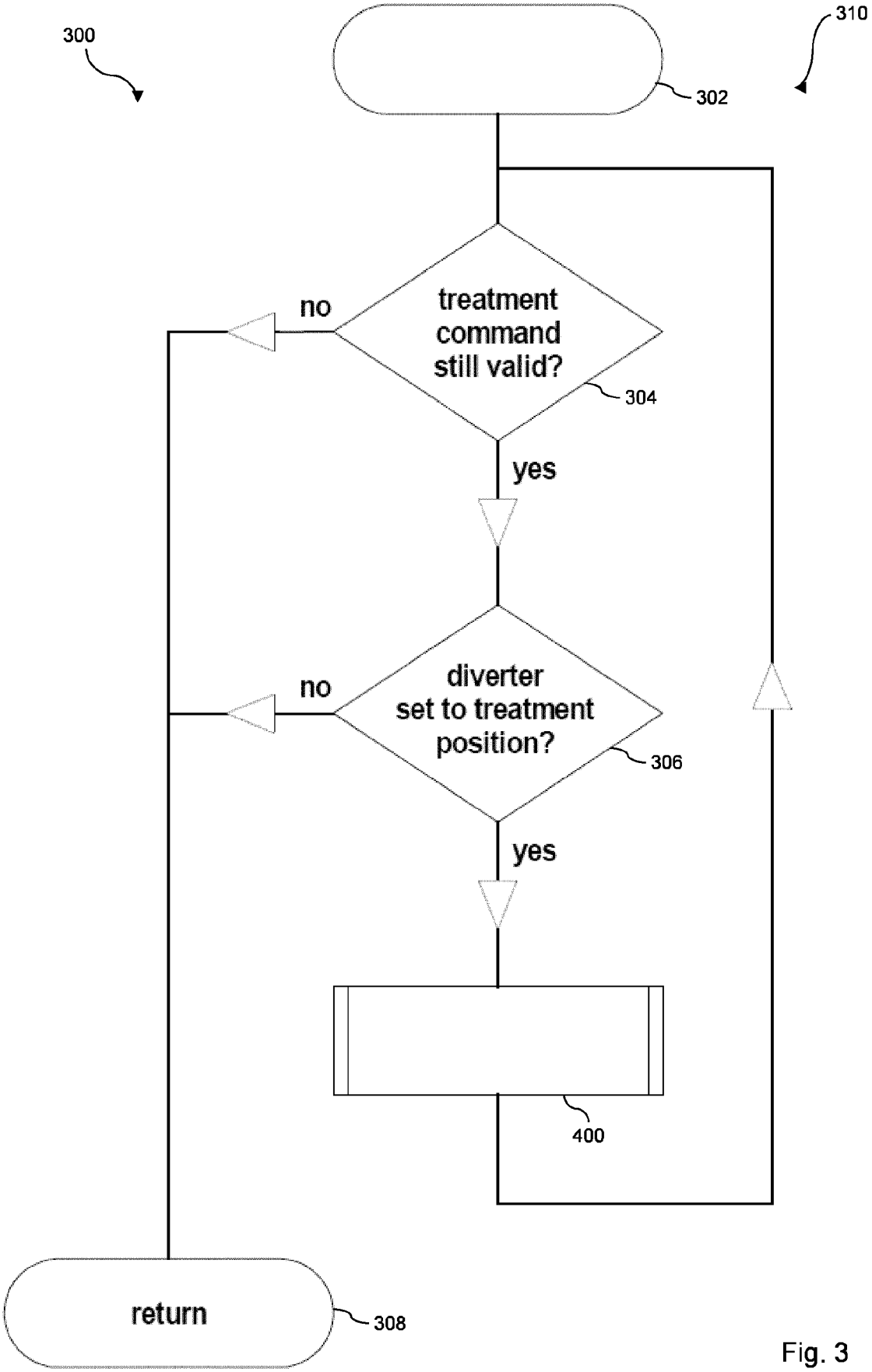
300
310
302
treatment command still valid?
304
no
yes
diverter set to treatment position?
306
no
yes
400
return
308

Fig. 3

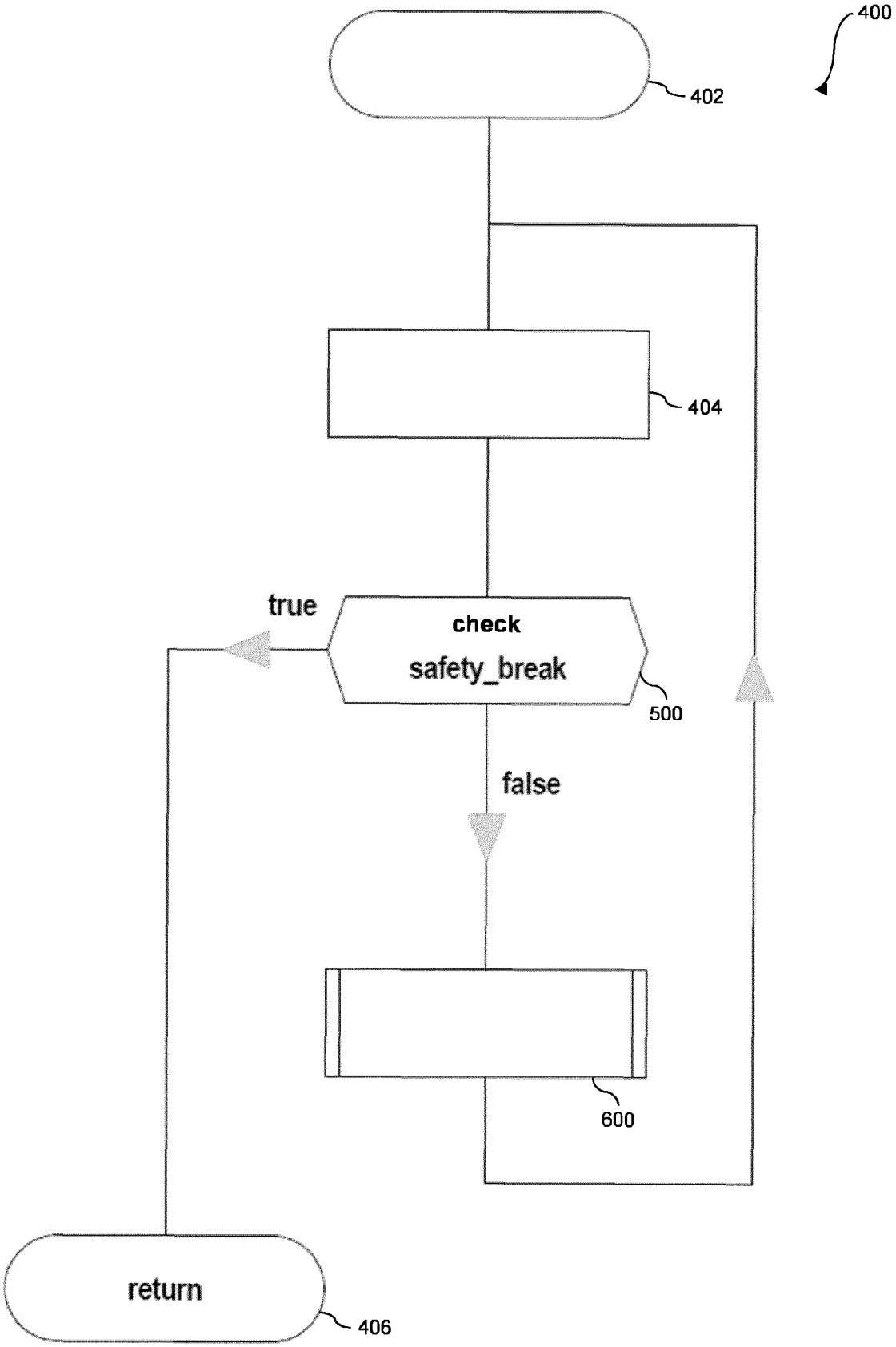

Fig. 4

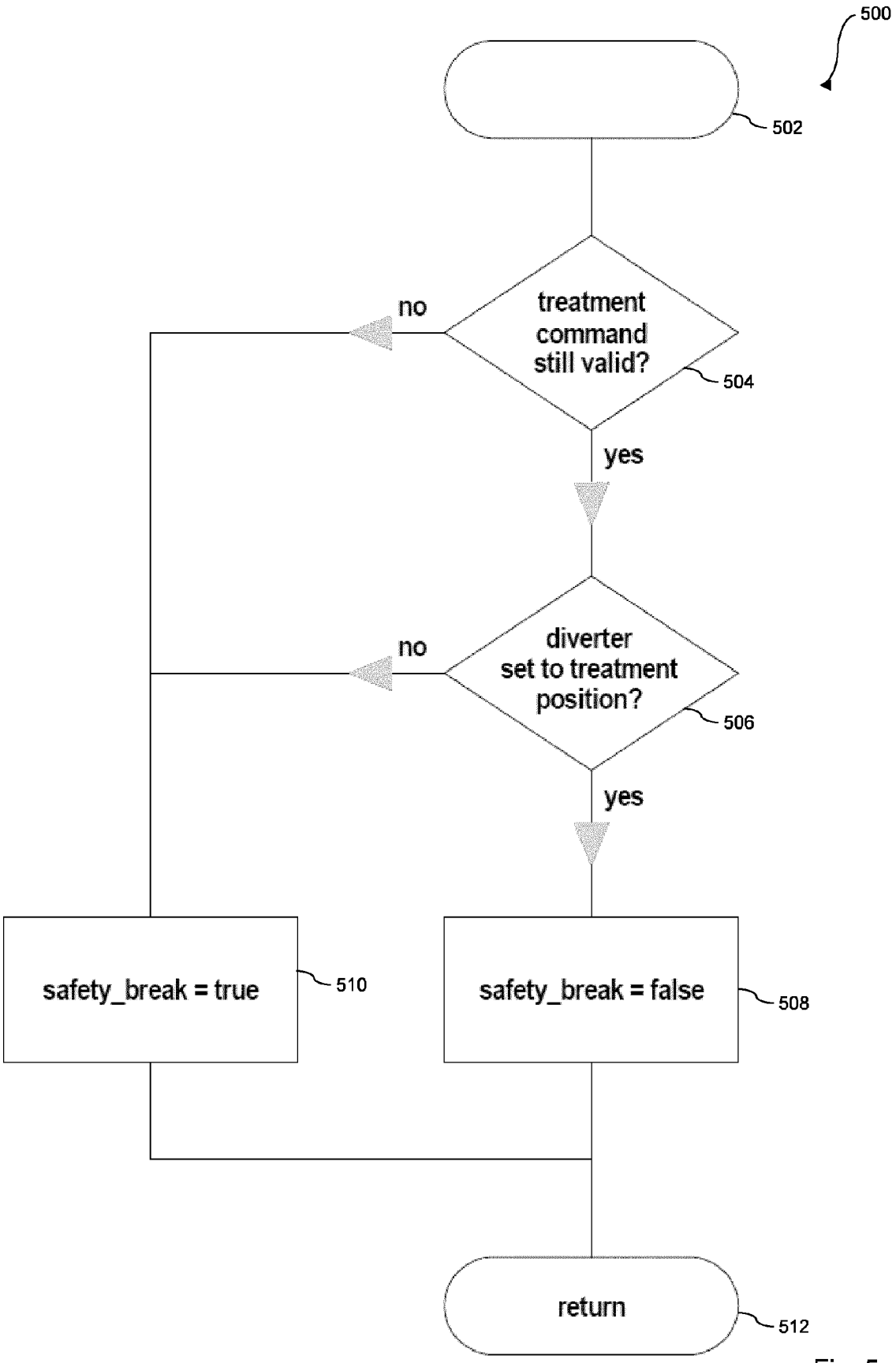
500
502
treatment command still valid?
504
no
yes
diverter set to treatment position?
506
no
yes
safety_break = true
510
safety_break = false
508
return
512

Fig. 5

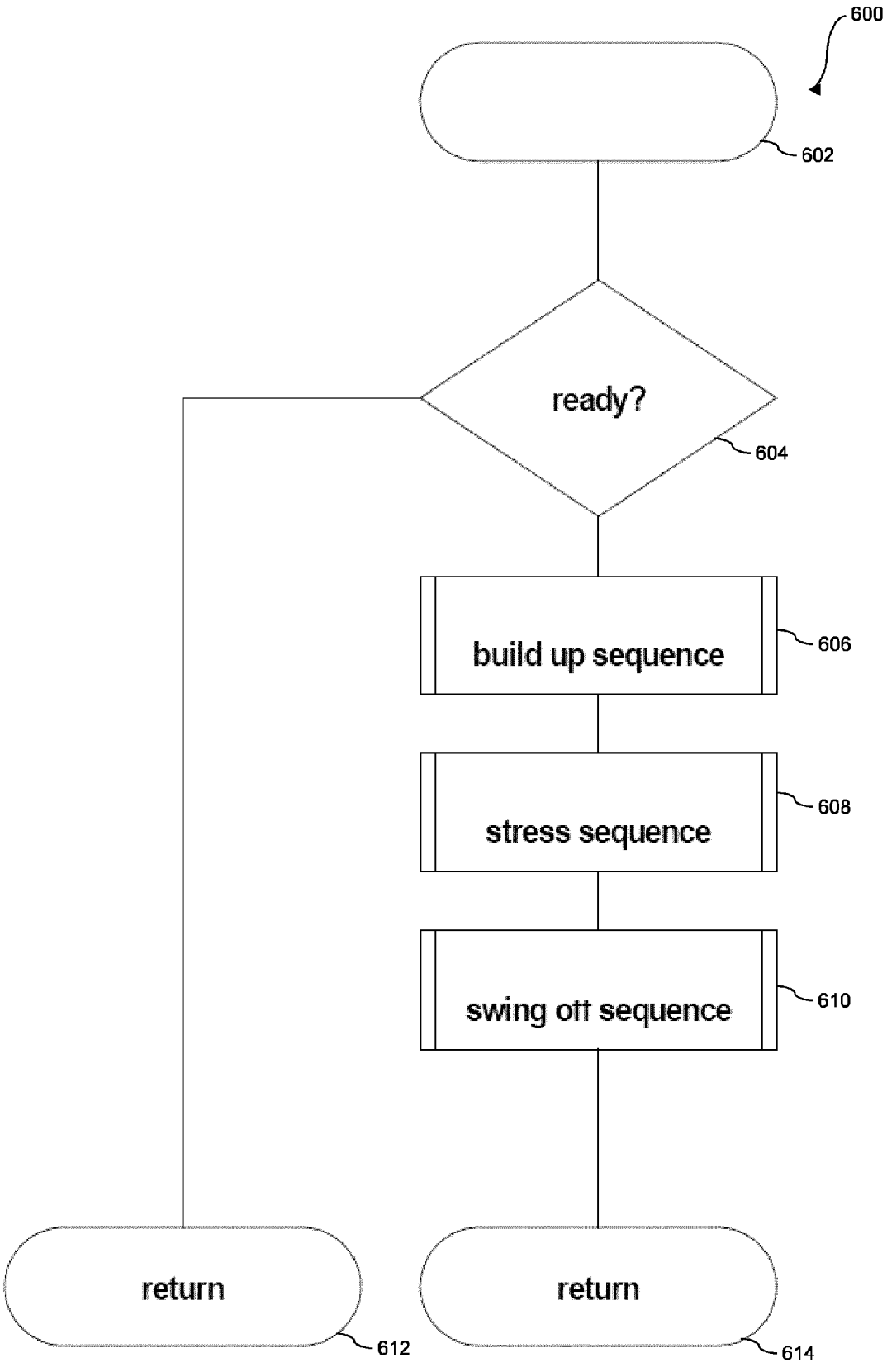
600
602
ready?
604
build up sequence
606
stress sequence
608
swing off sequence
610
return
612
return
614

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 18 15 9367

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

E03C
F16K
G05D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 September 2018	Schnedler, Marlon

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

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03-09-2018

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