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(71) Applicant *(for all designated States except US)*: **FISHER CONTROLS INTERNATIONAL LLC** [US/US]; 310 East University Drive, McKinney, TX 75070 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **LIN, Chun** [CN/US]; 623 Bandera Street, McKinney, TX 75070 (US). **PELFREY, Roy, Ronald** [US/US]; 1331 S. Travis Street, Sherman, TX 75090 (US).

(74) Agent: **READ, David, C.**; Marshall, Gerstein & Borun LLP, 233 S. Wacker Drive, Suite 6300, Sears Tower, Chicago, IL 60606-6357 (US).

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(54) **Title**: APPARATUS TO DETERMINE A POSITION OF A VALVE

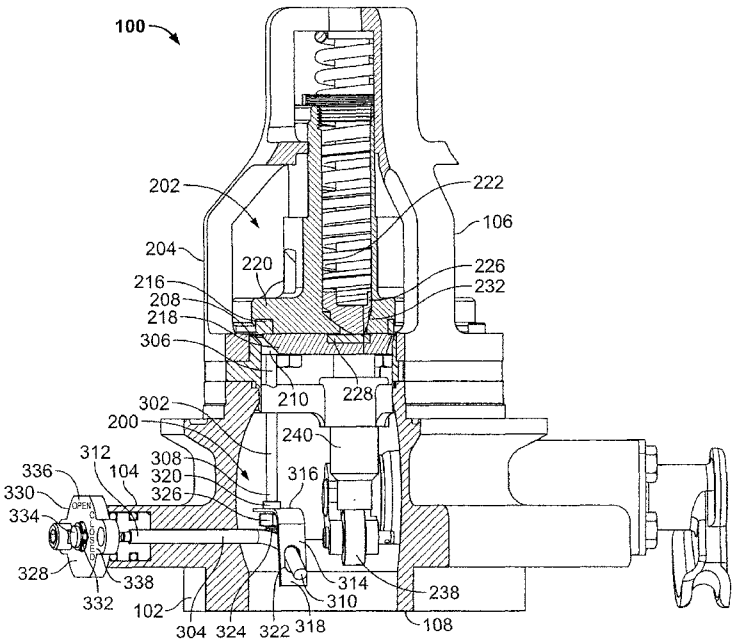

FIG. 3

(57) **Abstract**: An apparatus to indicate a position of a valve is described. An example position indicator apparatus includes a follower (302) operatively coupled to a flow control member (202) of a valve to sense a displacement of the flow control member. The example apparatus further includes a status indicator (304) to provide an indication that corresponds to the displacement of the flow control member to determine one of a plurality of predetermined operational positions of the valve and a visual display (328) to cooperate with the status indicator to indicate a position of the valve corresponding to one of the plurality of predetermined operational positions of the valve.

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APPARATUS TO DETERMINE A POSITION OF A VALVE

FIELD OF THE DISCLOSURE

[0001] The present disclosure relates generally to valves and, more particularly, to apparatus to determine a position of a valve.

BACKGROUND

[0002] Internal, self-closing stop valves which are commonly referred to as internal valves, provide protection against discharge of hazardous materials, compressed liquids, and/or gases such as, for example, propane, butane, NH3 (anhydrous ammonia), etc., when transferring the hazardous material between a first location and a second location. Internal valves employ flow control mechanisms that will close in response to a sudden excess flow condition due to, for example, a broken, severed, or otherwise compromised flow path. Such flow control mechanisms are commonly referred to as excess flow valves, which are often used in applications requiring an automatic, safe cutoff of fluid flow in response to potential leaks, spills, etc. of potentially dangerous (e.g., combustible, toxic) fluids.

[0003] An internal valve typically includes an excess flow function or integrated excess flow valve that closes when a flow through the internal valve exceeds an established flow rating. For example, an internal valve installed on a cargo tank typically provides protection against the discharge of hazardous materials during an unloading operation in the event that a pump and/or piping attached to the internal valve is sheared off and/or otherwise breached. Similarly, an internal valve installed on a stationary tank provides protection against the discharge of hazardous materials in the event that a pump and/or piping attached to the internal valve is sheared off and/or otherwise breached.

[0004] Such internal valves may be designed to operate automatically, free from external control and dependent solely or primarily on system conditions (e.g., pressure values). While these internal valves are safeguarded from certain dangers (e.g., mechanical damage from external impact), the limited access to such valves often makes it difficult or impossible to determine the position or the operational state (e.g., an open position, a closed position, a bleed state position, etc.) of the valve.

SUMMARY

[0005] In one example, a valve position indicator apparatus includes a follower operatively coupled to a flow control member of a valve to sense a displacement of the flow control member. The example apparatus further includes a status indicator to provide an indication that corresponds to the displacement of the flow control member to determine one of a plurality of predetermined operational positions of the valve and a visual display to cooperate with the position indicator to indicate a position of the valve corresponding to one of the plurality of predetermined operational positions of the valve.

[0006] In another example, a valve position indicator apparatus includes a flow control member and a valve seat disposed within a body of a valve. The flow control member moves between a first position in which the flow control member engages the valve seat to restrict the flow of fluid through the valve and a second position in which the flow control member is spaced from the valve seat to allow the flow of fluid through the valve. A position indicator operatively coupled to the flow control member senses the location of the flow control member relative to the valve seat and the position indicator is to provide a signal that correlates with a location of the flow control member relative to the valve seat to determine one of a plurality of

predetermined operational states of the valve. A sensor operatively coupled to the position indicator indicates a position of the valve corresponding to one of the plurality of predetermined operational states of the valve.

[0007] In yet another example, a valve position indicator apparatus includes means for determining a rectilinear displacement of a flow control member of a valve relative to a valve seat. The example valve position indicator includes a means for generating a signal that corresponds to one of a plurality of predetermined operational positions of the valve that correlates with the rectilinear displacement of the flow control member relative to the valve seat and a means for processing the signal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 illustrates an example valve described herein.

[0009] FIG. 2 is a cross-sectional view of the example valve of FIG. 1.

[0010] FIG. 3 illustrates a partial cutaway view of a portion of the example valve of FIGS. 1 and 2.

[0011] FIG. 4 illustrates another partial cutaway view of a portion of the example valve of FIGS. 1 and 2.

DETAILED DESCRIPTION

[0012] The example valve position indicator apparatus and methods described herein detect a position or operational state of a flow control apparatus such as, for example, an internal valve or self-closing stop valve. Typically, internal valves open or close based on a pressure and/or fluid flow rate of a system in which the internal valve is coupled to or installed. As a result, when operating a system employing an internal valve having an integral excess flow valve, it is typically necessary to equalize the pressure between the valve inlet and outlet before fluid is pumped through the valve.

However, in some cases, the valve position or status (e.g., an open position, a closed position, an intermediate position, etc.) is not always clear to an operator.

[0013] Where the position of a valve is not available or clear, an operator may be forced to employ manual methods (e.g., operator intervention or involvement may be required) to operate the control system in which the valve is installed. Such an approach may be inefficient if, for example, several attempted equalizations are performed due to operator error. For example, without knowledge of the position or operational status of the internal valve (i.e., whether the pressure is equalized) the operator may, for example, prematurely begin to pump fluid based on an estimation of whether the valve is equalized, thereby causing the valve to close and prevent the flow fluid through the valve.

[0014] In contrast to known internal valves, the example valve position indictor apparatus described herein determine or provide a position or operational status of the internal valve that may otherwise remain unknown to system operators and/or any other persons or equipment associated with the system. More specifically, the example valve position indicator apparatus described herein provide signals to detect one of a plurality of predetermined or distinct operational positions of an internal valve or excess flow control valve. Such signals may include, for example, a mechanical signal, an electrical signal, an audio signal, a visual signal, etc., and/or any other suitable signal. Additionally or alternatively, an operator may utilize the position information to operate, troubleshoot, test, and/or otherwise manipulate the system. For example, in a system that employs multiple internal valves, an operator may quickly troubleshoot or determine if a valve becomes stuck in an open position.

[0015] In one example, an example valve position indicator apparatus described herein includes a follower operatively coupled to a flow control member to detect the

operational position of the flow control member. The follower generates or provides a signal to a position indicator operatively coupled to the follower. The position indicator correlates to the position of the flow control member and corresponds to one of a plurality of predetermined or distinct operational states of the valve such as, for example, an open position, a closed position, an intermediate position, etc. An example apparatus described herein includes a mechanical display to communicate the operational position of the valve to an operator. The example apparatus described herein may be factory installed or may be retrofit to existing valves in the field.

[0016] FIG. 1A illustrates an example valve 100 described herein. The example valve 100 is depicted as a self-closing stop valve such as, for example, an internal valve. The valve 100 includes a body 102 having a flanged portion 104 for coupling or mounting the example valve 100 to a piping system, a storage tank, a bobtail truck system, or any other suitable distribution system. In other examples, the body 102 may include a double flanged portion or a threaded outer portion to couple or mount the valve 100 to a system (e.g., a tank). Although the example valve 100 is depicted as an internal valve, the valve position indicator apparatus described herein may be implemented with any other suitable flow control apparatus and/or valve(s).

[0017] The body 102 has a first end or inlet 106 in fluid communication with a first or upstream pressure source (e.g., a pipeline or a tank) at which relatively high pressure process fluid is presented and a second end or outlet 108 in fluid communication to a second or downstream pressure source (e.g., a pump, a piping, a hose, etc.) to which the example valve 100 provides the process fluid. For example, the first pressure source may include a tank containing a pressurized gas or liquid to be delivered to a destination via, for example, the valve 100. In other words, the inlet 106 of the valve 100 may be surrounded by relatively high pressure fluid.

[0018] The outlet 108 of the valve 100 may be disposed outside of the first pressure source to receive a hose, a pipe, or any other suitable fluid transport component. In other words, fluid flows from the first pressure source to a transport component (e.g., a hose) via the valve 100 to a destination (e.g., another storage tank and/or additional process control elements).

[0019] The example valve 100 operates between at least a first operating position and a second operating position in which the valve 100 is closed and opened, respectively. In the illustrated example, the example valve 100 includes a third operating position or bleed position that may be selected by an operating lever 110 as described below. The lever 110 may be operated manually to open and close the example valve 100. In other examples, the lever 110 may be operated via cable controls, a linkage mechanism, or an actuator (e.g., air cylinder), etc. The example valve 100 may also include a strainer 112 coupled to the body 102 to filter unwanted particles or contaminates from the fluid as the fluid flows from the inlet 106 to the outlet 108 of the valve 100.

[0020] FIG. 2 illustrates a cross-sectional view of the example valve 100 of FIG. 1 implemented with an example valve position indicator apparatus 200 described herein. The example valve position indicator apparatus 200 described herein determines the operational position or state of the valve 100 (e.g., an open position, a closed position) and conveys the position status of the valve 100 to, for example, an operator. The example valve position indicator apparatus 200 is described in greater detail below in connection with FIGS. 3 and 4. The example valve position indicator apparatus 200 is operatively coupled to a flow control member or main poppet 202, which opens and closes to control the fluid flow rates through the body 102 of the valve 100. A cage 204 supports the main poppet 202 and is coupled to the body 102

via fasteners 206. The body 102 is the main pressure boundary of the valve 100 and supports a seating surface or seat ring 208 that is mounted in the body 102 and defines an orifice 210 that provides a fluid flow passageway to establish communication between the inlet 106 and the outlet 108 when the main poppet 202 is moved away from the seat ring 208. A retainer 212 couples the strainer 112 to the body 102 via fasteners 214.

[0021] In the illustrated example, the main poppet 202 is depicted as a disc-type valve assembly that includes a disc 216 (e.g., a metal disc, a rubber disc, etc.) that engages the seat ring 208 to restrict the flow of fluid through the valve 100. A disc retainer 218 couples the disc 216 to a disc holder 220 (e.g., via screws), which includes an aperture 222 defining a bleed flow path. A biasing element 224 such as, for example, a spring, is disposed within the aperture 222 and biases the main poppet 202 toward the seat ring 208 to restrict the fluid flow through the orifice 210 when the flow rate through the valve exceeds a specified or predetermined flow rate.

[0022] To accomplish the fluid control, the valve 100 includes an equalization member 226 (e.g., a valve plug) disposed within the aperture 222 of the disc holder 220 to engage a bleed disc 228 coupled to the disc retainer 218 to restrict the flow of fluid through a bleed port 230. The bleed port 230 provides a fluid flow passageway between the inlet 106 and the outlet 108 and is formed by a reduced diameter portion or tapered portion 232 of the aperture 222 and an aperture 234 of the disc retainer 218. Furthermore, a biasing element 236 (e.g., a spring) along with the pressure of the first pressure source biases the equalization member 226 toward the bleed disc 228 (i.e., in a closed position) to restrict flow of fluid through the bleed port 230 when the lever 110 is in a first position. A cam 238 operatively coupled to the lever 110 engages a stem 240 coupled to the equalization member 226 when the lever 110 is

rotated from the first position to a second position to cause the equalization member 226 to move away from the disc seat 228 to allow fluid to flow from the inlet 106 or first pressure source to the outlet 108. The second position may be an intermediate position between a closed position and an open position of the equalization member 226. In the intermediate position, the stem 240 may include a rapid bleed portion (e.g., a reduced diameter) to allow a relatively high bleed flow rate through the bleed port 230.

[0023] Referring to FIGS. 3 and 4, the example valve position indicator apparatus 200 includes a follower or linear member 302 operatively coupled to a status indicator or rotational member 304. The linear member 302 is coupled to the main poppet 202 at a first end 306 and operatively coupled to the rotational member 304 at second end 308. The linear member 302 includes an elongated member or rod that may be integrally formed with the main poppet 202 and/or may be fastened to the main poppet 202 via screws, clips, rivets and/or any other suitable mechanical or chemical fastener(s). The linear member 302 is linearly displaced between a first position and a second position that correlate to a first operating position (e.g., a closed position) and a second operating position (e.g., an open position) of the main poppet 202. In other words, the linear member 302 follows the movement (e.g., rectilinear displacement) of the main poppet 202 relative to the seat ring 208 to sense or indicate the operational position of the main poppet 202 relative to the seat ring 208.

[0024] The rotational member 304 provides a signal or an indication that correlates to the operational position of the main poppet 202 relative to the seat ring 208. The rotational member 304 rotates between a first position and a second position that correlate with the first and the second positions of the linear member 302. The

rotational member 304 includes an elongated member or rod having a first end 310 substantially perpendicular, bent, angled, or curved relative to a second end 312.

[0025] In the illustrated example, a coupling member 314 couples the linear member 302 to the rotational member 304. In the example, the coupling member 314 is depicted as a bracket, but may be any other suitable connector such as, for example, a clip connector, a tang-like connector, yoke connector, etc. The coupling member 314 includes a first portion 316 that is substantially perpendicular or curved relative to a second portion 318. The first portion 316 includes an aperture 320 to receive the second end 308 of the linear member 302 and the second portion 318 includes a slot 322 to receive the first end 310 of the rotational member 304. In the illustrated example, the second end 308 of the linear member 302 includes a threaded portion 324 that couples to the coupling member 314 via a fastener 326 and the first end 310 of the rotation member 304 engages the slot 322. However, in other examples, the linear member 302 and/or the rotational member 304 may be coupled to the coupling member 314 in any other suitable manner(s). In yet other examples, the linear member 302 includes a tang-like connector integrally formed at the second end 308 to operatively couple the linear member 302 to the rotational member 304.

[0026] A sensor or indicator such as, for example, a display 328 may be disposed on an outer surface 330 of the body 102 to communicate to an operator the operational state of the valve 100. In the illustrated example, the display 328 is a visual, mechanical signal that includes a pointer 332 coupled to the second end 312 of the rotational member 304 via a fastener 334. The pointer 332 rotates along with the rotational member 304 which, in turn, rotates between the first and second positions that correlate to the operational position of the main poppet 202 via the linear member 302 and provides the position of the valve 100. As more clearly shown in FIGS. 3

and 4, the display 328 may include visual indicators or text 336 and 338 to indicate the operational position of the example valve 100 such as, for example, an opened position or a closed position. In other examples, the display 328 may include a digital display to indicate the operational position of the valve 100. Additionally or alternatively, a sealing member such as, for example, an o-ring, a chevon packing mechanism, and/or any other suitable sealing member may be disposed between the rotational member 304 and the body 102 to prevent undesired leakage along the rotational member 304.

[0027] In other examples, the valve position indicator apparatus 200 may include a rack and pinion gear assembly to determine the operational position of the valve 100. For example, a portion of the linear member 302 may include a rack gear and the rotational member 304 may include a pinion gear. In other examples, the sensor 328 may be a pneumatic sensor, a hydraulic sensor, an electrical sensor, and/or any other suitable sensors that provide output signals that sense and/or provide an indication of the operational position of the valve 100. For example, an electronic position transmitter may be coupled to the valve 100 to determine displacement (e.g., rectilinear displacement) of the main poppet 202 and transmit an electrical signal output (e.g., via wiring or a wireless connection) corresponding to the displacement of the main poppet 202, which correlates to one of the plurality of operating position of the valve 100. In yet other examples, the output signal may include an audio signal to indicate to an operator that the valve 100 is in the open position and/or the close position.

[0028] In operation, the main poppet 202 and the equalization member 226 are biased toward the closed position by the biasing element 236 and the pressure of the first pressure fluid source at the inlet 106 of the valve 100. FIGS. 3 and 4 illustrate the

example valve 100 in the first operational position (e.g., the closed position) and the second operational position (e.g., the open position), respectively. The equalization member 226 and the main poppet 202 provide an excess flow functionality that maintains system safety. More specifically, the excess flow function protects the system (e.g., fluid delivery system, etc.) by automatically restricting fluid flow from the inlet 106 when a flow rate becomes too high. In other words, the biasing element 224 causes the poppet 202 move toward the seat ring 208 when the flow rate across the valve exceeds a specific or predetermined flow rate.

[0029] The main poppet 202 operates based on a pressure differential between the inlet pressure and the outlet pressure of the valve 100. When the inlet pressure is substantially greater than the outlet pressure, the main poppet 202 remains biased toward the seat ring 208 in a closed position (FIG. 3). On the other hand, when the inlet pressure is approximately equal to the outlet pressure, the main poppet 202 opens to allow fluid to flow through the valve 100 at a relatively high rate (FIG. 4). The equalization member 226 is used to equalize or balance the pressure between the inlet 106 and outlet 108. For example, the equalization member 226 may place the valve 100 in a bleed state that allows a certain amount of flow to equalize pressure across the valve 100, which in turn, opens the main poppet 202 to provide a relatively high fluid flow through the valve 100.

[0030] Referring to FIG. 3, the valve 100 is in the closed position as indicated by the position indicator 328. As stated above, in the closed position, the main poppet 202 engages the seat ring 208 to prevent fluid flow through the valve 100. When the poppet 202 is in the closed position, the linear member 302 displaces the coupling member 314 in a direction toward the outlet 108 which, in turn, causes the rotational member 304 to rotate the pointer 332 in a first direction toward a first position

indicated by the close position 338. An operator may clearly determine that the valve 100 is in the close position via the position indicator 328.

[0031] To equalize the pressure across the valve 100 and, thus, open the valve 100 to allow fluid flow, the lever 110 is moved to a second position. Rotation of the lever 110 between the first position and the second position causes the cam 238 to rotate and displace the stem 240 in a direction toward the retainer 212. The displacement of the stem 240 causes the equalization member 226 to move away from the bleed disc 228 to allow fluid flow through the bleed port 230. Additionally, displacement of the stem 240 compresses the biasing elements 224 and 236 toward the retainer 212 so that the biasing elements 224 and 236 do not bias the main poppet 202 toward the seat ring 208.

[0032] As the fluid flows from the inlet 106 to the outlet 108 through the bleed port 230, the pressure differential across the valve 100 (e.g., the main poppet 202) substantially equalizes. Equalization of the pressure across the main poppet 202 causes the main poppet 202 to move away from the seat ring 208 and toward the retainer 212 to the open position. As the main poppet 202 moves to the open position, the linear member 302 follows the linear displacement of the main poppet 202. The linear displacement of the linear member 302 causes the coupling member 314 to move in a linear direction toward the retainer 212 which, in turn, causes the rotational member 304 to rotate the pointer 332 in a second direction toward a second position indicated by the open position 336. As shown in FIG. 4, an operator may clearly determine that the valve 100 is in the open position via the position indicator 328.

[0033] Although certain example methods and apparatus have been described herein, the scope of coverage of this patent is not limited thereto. On the contrary, this patent

covers all methods, apparatus and articles of manufacture fairly falling within the scope of the appended claims either literally or under the doctrine of equivalents.

What is claimed is:

1. A valve position indicator apparatus comprising:

a follower operatively coupled to a flow control member of a valve to sense a displacement of the flow control member;

a status indicator operatively coupled to the follower to provide an indication that corresponds to the displacement of the flow control member to determine one of a plurality of predetermined operational positions of the valve; and

a visual display to cooperate with the position indicator to indicate a position of the valve corresponding to one of the plurality of predetermined operational positions of the valve.

2. An apparatus as described in claim 1, wherein the status indicator comprises a rotational member operatively coupled to the follower to convert a rectilinear displacement of the flow control member into a rotational displacement of the rotational member corresponding to one of the plurality of predetermined operational positions of the valve.

3. An apparatus as described in claim 2, further comprising a coupling member to operatively couple the follower and the rotational member.

4. An apparatus as described in claim 3, wherein the coupling member includes a first portion substantially perpendicular to a second portion.

5. An apparatus as described in claim 4, wherein the first portion of the coupling member includes an aperture to receive an end of the follower and the second portion includes a slot to receive an end of the rotational member.

6. An apparatus as described in claim 5, wherein the end of the rotational member is curved relative to another end of the rotational member.

7. An apparatus as described in claim 5, wherein the end of the follower includes a threaded portion.

8. An apparatus as described in claim 1, wherein the follower is integrally formed with the flow control member.

9. An apparatus as described in claim 1, wherein in the visual display comprises a pointer operatively coupled to the status indicator that moves between a first position and a second position as the flow control member moves between an open position and a closed position.

10. An apparatus as described in claim 1, wherein the follower comprises an elongated rod.

11. An apparatus as described in claim 1, wherein the one of the plurality of predetermined operational positions of the valve comprises an open position, a closed position, or an intermediate position.

12. An apparatus as described in claim 1, wherein the valve comprises;

a body having a valve seat disposed between an inlet and an outlet, wherein the flow control member is disposed within the body and engages the valve seat to restrict the flow of fluid through the valve and moves away from the valve seat to allow the flow of fluid through the valve;

a stem operatively coupled to an equalization member disposed within an aperture of the flow control member; and

a cam to engage the stem to position the equalization member between at least a first position and a second position.

13. An apparatus as described in claim 12, further comprising a cage coupled to the body to support the flow control member.

14. An apparatus as described in claim 12, further comprising a lever to drive the cam between at least the first position and the second position.

15. A valve position indicator apparatus comprising;

a flow control member and a valve seat disposed within a body of a valve, wherein the flow control member moves between a first position in which the flow control member engages the valve seat to restrict the flow of fluid through the valve and a second position in which the flow control member is spaced from the valve seat to allow the flow of fluid through the valve;

a position indicator operatively coupled to the flow control member to sense the location of the flow control member relative to the valve seat, wherein the position indicator is to provide a signal that correlates with a location of the flow control member relative to the valve seat to determine one of a plurality of predetermined operational states of the valve; and

a sensor operatively coupled to the position indicator to indicate a position of the valve corresponding to one of the plurality of predetermined operational states of the valve.

16. An apparatus as described in claim 15, wherein the position indicator comprises a first elongated member operatively coupled to a second elongated member via a coupling member having a first portion substantially perpendicular to a second portion, wherein the first portion includes an aperture to receive an end of the first elongated member and the second portion includes a slot to receive a curved end of the second elongated member.

17. An apparatus as described in claim 16, wherein the first elongated member is operatively coupled to the flow control member and moves the coupling member between a first position and a second position corresponding to the first and second positions of the flow control member, and wherein displacement of the coupling member in a first direction by the first elongated member causes the curved end to rotate the second elongated member in a first direction and displacement of the coupling member in a second direction by the first elongated member causes the curved end to rotate the second elongated member in a second direction.

18. An apparatus as described in claim 15, wherein the sensor comprises a pointer operatively coupled to the position indicator that moves between a first position and a second position corresponding to the first position and the second position of the flow control member relative to the valve seat of the valve.

19. A valve position indicator apparatus, comprising:

means for determining a rectilinear displacement of a flow control member of a valve relative to a valve seat;

means for generating a signal that corresponds to one of a plurality of predetermined operational positions of the valve that correlates with the rectilinear displacement of the flow control member relative to the valve seat; and

means for processing the signal.

20. An apparatus as described in claim 19, wherein the plurality of predetermined operational positions of the valve comprise an open position, a closed position, or an intermediate position.

21. An apparatus as described in claim 19, wherein the means for generating a signal comprises means for converting the rectilinear movement of a closure member relative to the valve seat to rotational movement of an indicator.

22. An apparatus as described in claim 21, wherein the means for converting the rectilinear movement of the closure member to rotational movement of the indicator comprises coupling a first elongated member to a second elongated member via a coupling member having an aperture to engage an end of the first elongated member and a slot to engage an end of the second elongated member, wherein the end of the second elongated member is substantially perpendicular relative to another end of the second elongated member.

23. An apparatus as described in claim 22, wherein the means for processing the signal comprises a pointer coupled to the other end of the second elongated member that rotates along with the second elongated member between a first position and a second position that correlate with one of the plurality of predetermined operational states of the valve.

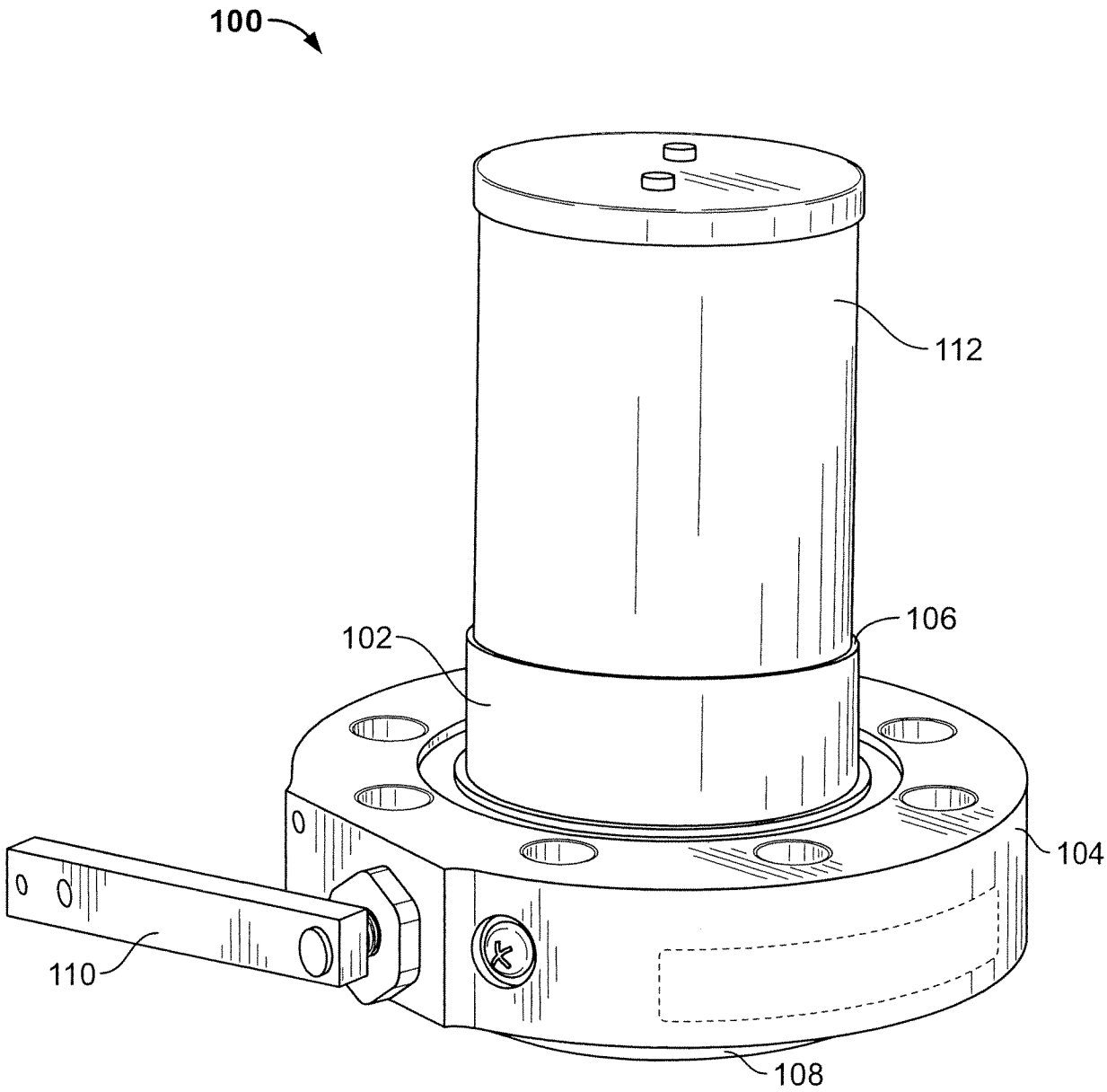

FIG. 1

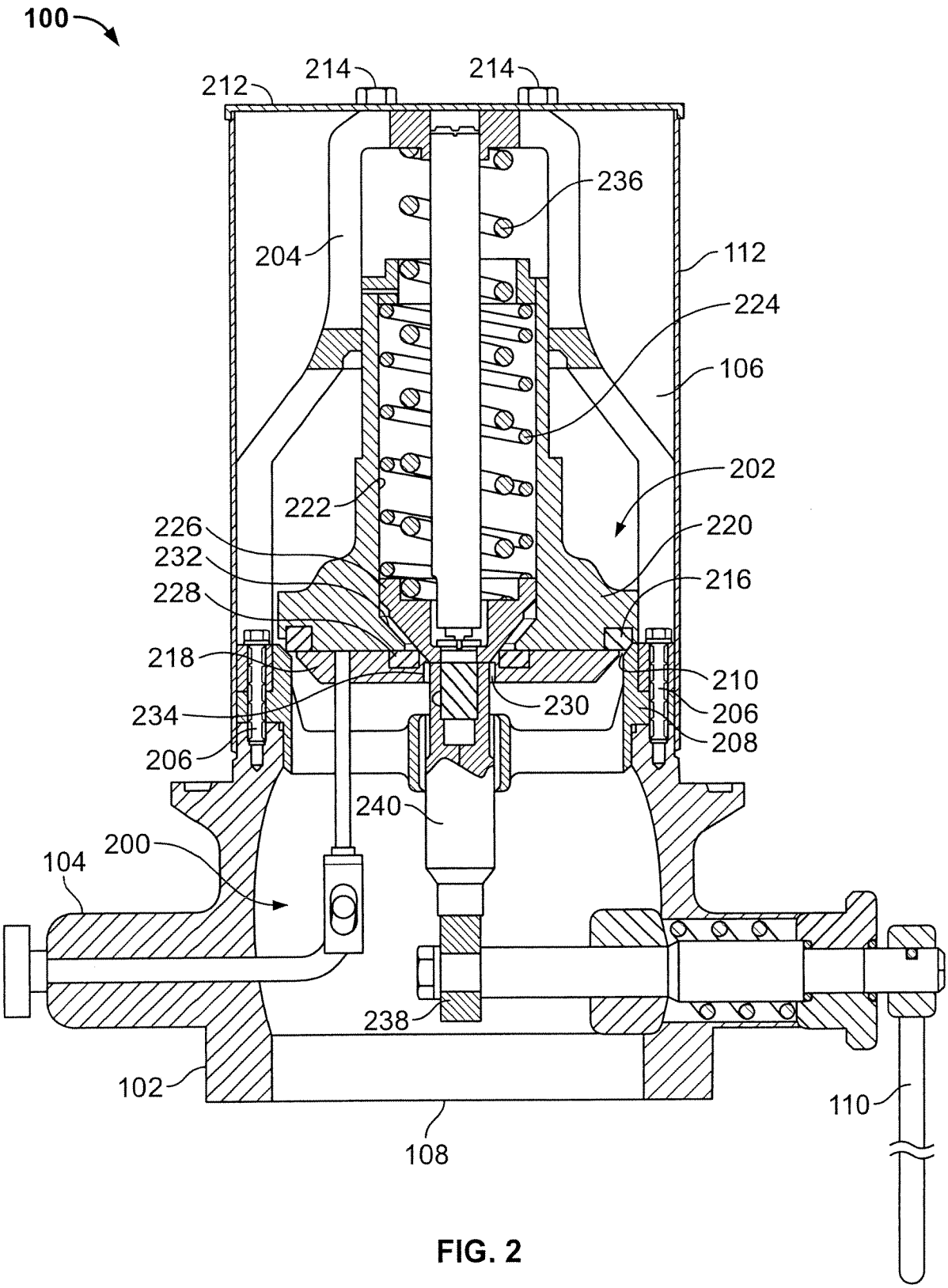
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FIG. 2

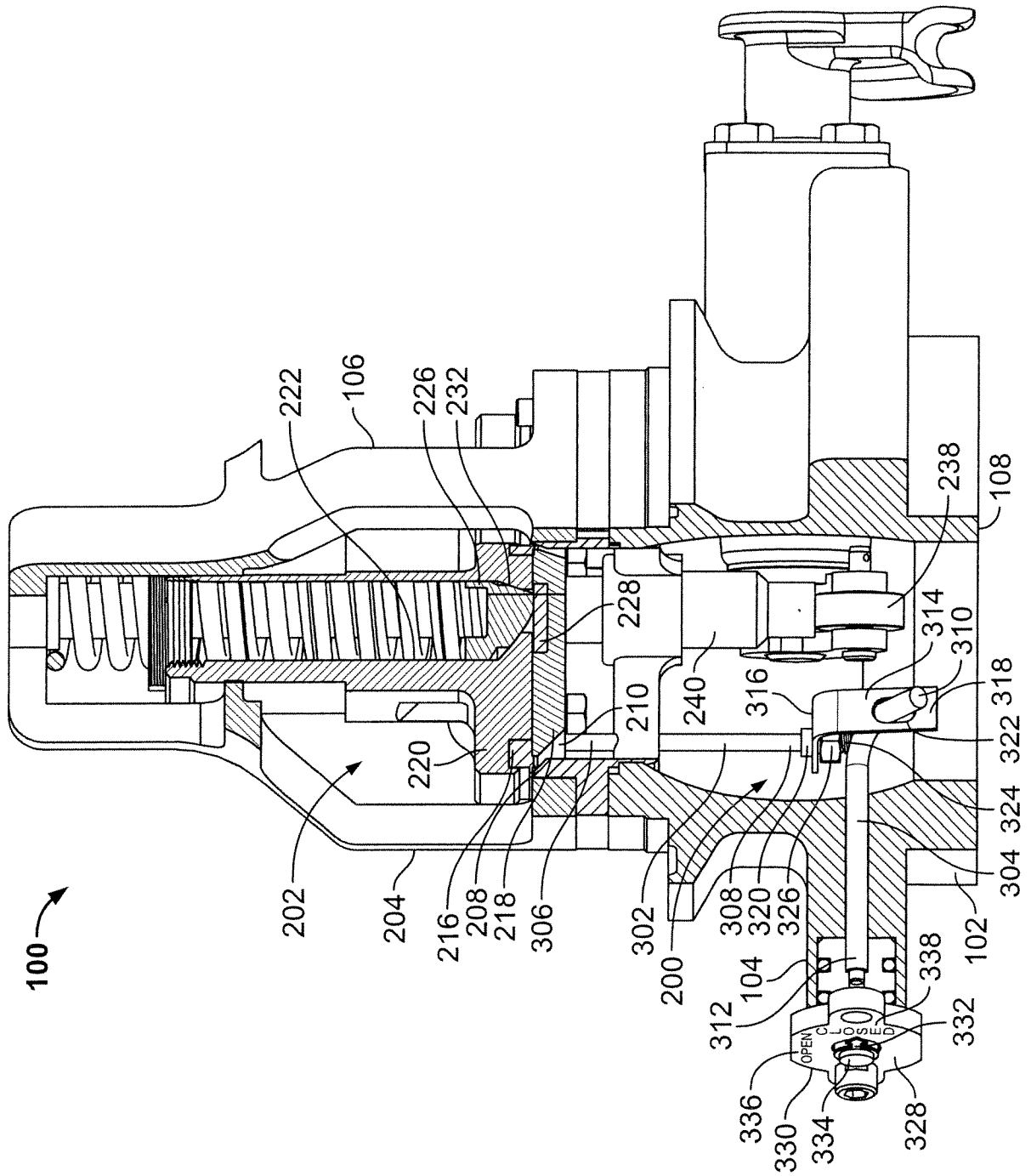
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FIG. 3

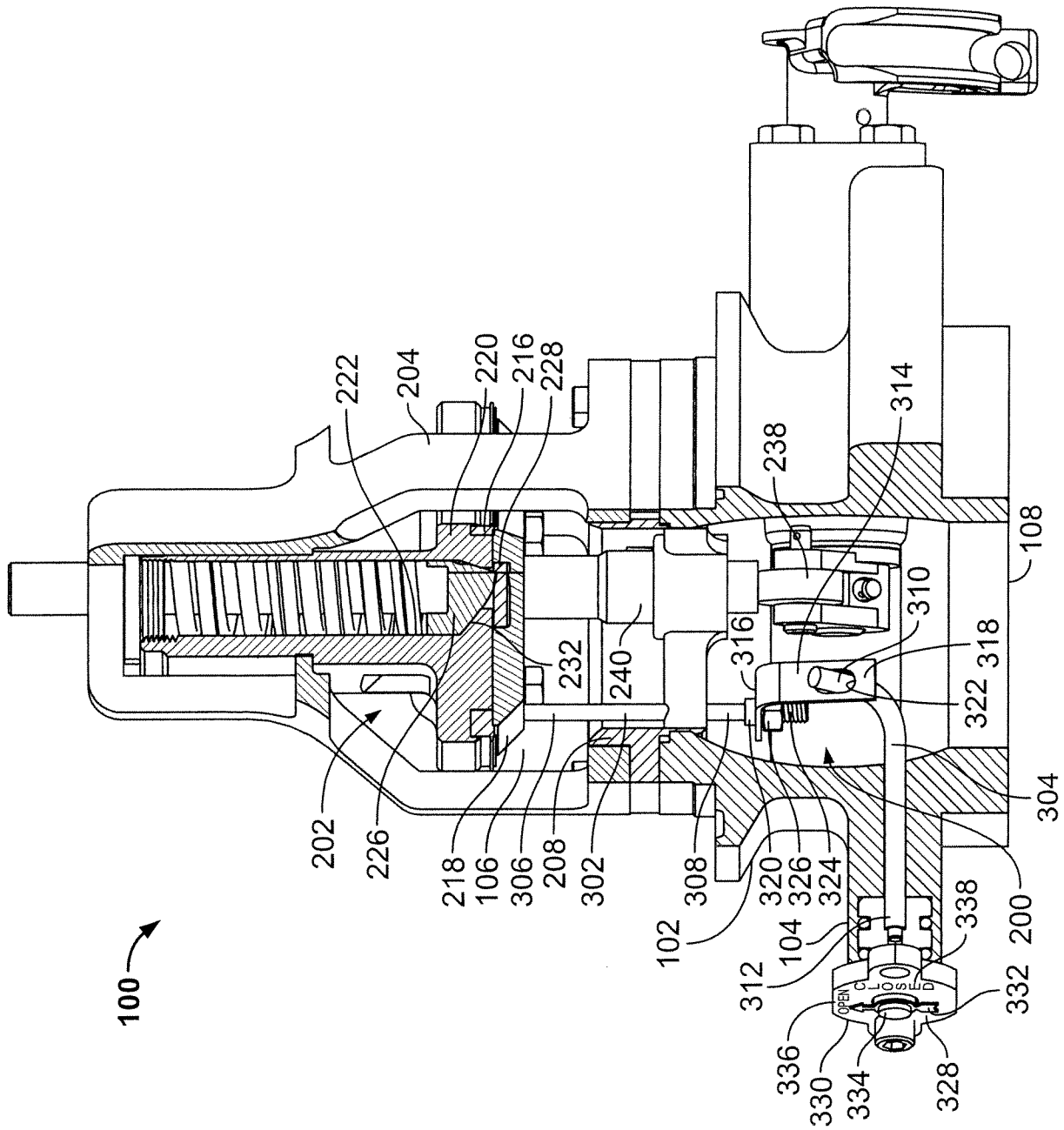
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FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/054620

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16K37/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 11 15 090 B (KLEIN SCHANZLIN & BECKER AG) 12 October 1961 (1961-10-12) column 2, line 32 - column 3, line 10; figure	1-4,9, 11,15, 18-21
X	DE 26 31 100 A1 (GERDTS GUSTAV F KG) 12 January 1978 (1978-01-12) page 6, line 1 - page 8, line 8; figures	1-4, 8-11,15, 18-21
X	GB 911 576 A (WILLIAM HUME & COMPANY LTD; ANDREW MORE BINNIE) 28 November 1962 (1962-11-28) column 1, line 27 - column 2, line 46; figures 1-3	1-4,9, 11,15, 18-21

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 November 2009	12/11/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Hatzenbichler, C

INTERNATIONAL SEARCH REPORT

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2005 009989 B3 (ERHARD GMBH & CO KG [DE]) 1 June 2006 (2006-06-01) paragraphs [0014] - [0021]; figures 1,2	1-4, 8-11,15, 18-21
X	WO 94/27069 A (FISCHER GEORG ROHRLEITUNG [CH]; SCHALK ADELBERT [DE]) 24 November 1994 (1994-11-24) page 2, line 9 - page 5, line 30; figure 1	1-4, 8-11,15, 18-21
Y		12-14
Y	US 3 844 312 A (SUMMER W ET AL) 29 October 1974 (1974-10-29) column 3, line 7 - column 7, line 5; figures 1,4-7	12-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2009/054620

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