

Description

Title of Invention: VALVE ASSEMBLY FOR A DIFFERENTIAL PRESSURE SENSOR WITH AUTOMATIC ZERO POINT CALIBRATION AND FLUSHING

Technical Field

- [1] Present invention relates to a valve assembly for a differential pressure sensor for measuring of pressures in a fluid system, for instance in a heating or cooling system and where the assembly is mounted via measuring hoses on a measuring nipple to, as an example, a valve or a measuring nipple direct on a container or piping and where the assemble secure a good accuracy of the measuring result by automatic zero point calibration and automatic flushing through of the valve assembly.

Background Art

- [2] By measuring of pressure in fluid systems differential pressure sensors is used, often combined with some sort of valve assembly which is aimed to protect the differential pressure sensor against to high continuous pressures or pressure shocks, higher than the sensor can handle. Those assemblies often also has functions for flushing through the assembly to get rid of enclosed air in cavities and functions to calibrate the differential pressure sensor, so called zero point calibration, where a calibration procedure is intended to provide for that both measuring sides of the pressure sensor has the same pressure, before measuring has to begin.
- [3] There are several examples of constructions with a manual function of flushing through, for instance US 5868155 A1 and WO 2005019713.
- [4] There are also constructions that solve the problem with the zero point calibration and flushing through of the valve assembly by a manual procedure. One example of such a solution is evident from GB 2 410 332 A, where a manual controllable valve (30, 40) connects both sides of pressure according to fluid and accordingly, the system is flushed through and zero point calibrated.

Disclosure of Invention

Technical Problem

- [5] The problem with earlier solutions, for instance the solution described by GB 2 410 332 A, is that by the zero point calibration of the differential pressure sensor, the high and low pressure side is connected by fluid, which results in that the zero point will be dependent on the rate of flow of the fluid through the valve assemble and the thereby caused pressure drop, which leads to that an error will be caused by the calibration. There is a solution of this problem according to the device in JP 63011827 A where the high and low pressure side, by calibration, isn't in contact with the fluid, but this

device don't solve the problem of at the same time and automatically be rid of enclosed air in the valve.

Summary of the invention

- [6] The object of the present invention is to solve the problem with connection by fluid of the high and low pressure side by the zero point calibration and at the same time solve the problem to get rid of in the valve enclosed air. This is obtained by that both the measuring sides of the differential pressure sensor are arranged in a way that they don't are in contact with the flowing fluid by the zero point calibration since a calibration cone by means of seals separates the measuring sides from the fluid. This position constitutes the initial position of the assembly. Accordingly, the advantage of eliminate the calibration error is achieved. Moreover a function of flushing through is obtained, to be rid of any enclosed air in the complete valve assembly, in those cases when the measuring position of the assembly don't exists, i.e. in its initial position, since the calibration cone has a design that permits an open flowing passage between high and low pressure side in this initial position. Accordingly, the valve assembly is always flushed through in this initial position, which is an advantage compared to older solutions that don't have this automatic function of flushing through.
- [7] According to a preferred embodiment of the invention the differential pressure sensor is only in contact with the fluid circuit when measuring is done by that said calibration cone permits this communication only in a measuring position, by the measuring procedure itself. Accordingly, the advantage is obtained that by all the time outside the measuring, there is no pressure/ no load against the connected differential pressure sensor, which is an advantage, especially at longer times of connection.
- [8] According to a preferred embodiment of the invention the device comprises at least one return spring, provided in connection with the calibration cone, which return spring predicts that the calibration cone after performed measuring in the measuring position, returns to the initial position. Thereby the device is always in that position by connection/disconnection from the fluid system. This initial position constitutes, according to the above object, partly the position for zero point calibration and partly also the position for flushing through the complete valve assembly. Accordingly, those for the quality of the measuring result important procedures are always performed before a measuring begins, which then eliminates the risk of forgetting those procedures, which is a problem by known solutions.
- [9] In a further preferred embodiment of the invention secured zero point calibration and flushing through is obtained by that those procedures occurs automatic via an actuator alternative an actuator combined with the above said return spring that moves the calibration cone between its initial position and its measuring position. The device is always brought to return to the position for flushing through and zero point calibration

after finished measuring sequence, either by that the actuator returns the device to this position or alternative by that other stored energy, preferable said return spring, foresees this. Accordingly, when the device is connected to or is disconnected from a measuring point, the device always returns to its initial position, i.e. its position for flushing through and zero point calibration resulting in that those procedures are secured before next measuring.

- [10] In a further preferred embodiment of the invention said actuator is remote controlled by means of a manual unit or a computer system. The possibility of communication with a computer system permits communication to the system for building management, so called BMS-systems (Building Management System). The remote control in turn permits the possibility to remote calibrate and flush through several valve assemblies and thereafter measure for instance the fluid pressure of several valves with secured results and to collect those data and to control flows in the fluid system and consequently adjust the valves included in the fluid system. Another disadvantage by the present solutions is that the service staff/ the adjuster, because of the manual management, has to move to every valve in a fluid system of a building, which costs time as well as power. Consequently, one immediate advantage of the invention is that motor control of the actuator together with remote control permits that the service staff/ adjuster can act from one or a few places in connection with the fluid system.

Advantageous Effects

- [11] To sum up some advantages that is obtained with the present invention related to existing constructions in connection with a measuring that has to be done:
- both sides of the differential pressure sensor is placed outside the flow of fluid by the zero point calibration which leads to that the zero point is independent from the flow rate of the fluid and the thereby occurring pressure drop
 - the valve assembly only open the communication to the differential pressure sensor at the moment of measuring, which implies that for instance by connection/ disconnection and also at a time outside the moment of measuring no pressure/load occurs against the differential pressure sensor
 - secured zero point calibration which results in more secure measuring results
 - secured flushing through to fill up the cavities of the valve assembly and to eliminate the air in the valve assembly which leads to more secure measuring results
 - the motor control permits both automation and remote control of the procedures zero point calibration, flushing through and measuring
 - improved working environment for the service staff/ adjuster
 - saving in time and costs in connection with the putting into service and service/ maintenance

- the device permits communication with the system for building management, a so called BMS-system (Building Management System).

Brief description of the drawings

[12] In detail represents in diametrical, partly schematic cross-sections or perspective views:

- Figure 1 shows a part of a fluid system where a differential pressure measuring system is connected.
- Figure 2 shows included details in the complete valve assembly.
- Figure 3 shows the complete valve assembly in its initial position, i.e. its position of flushing through/zero point calibration.
- Figure 4 shows the complete valve assembly in measuring position.

[13]

Detailed description of the drawings

[14] **Figure 1** shows an example of a complete valve assembly 1 provided with an actuator 2 where the valve assembly 1 is connected to a valve 3 via measuring hoses 4 to the measuring nipples 5 of the valve. The figure also includes a manual unit 6 for preferable wireless communication with the actuator 2 and, where appropriate, communication with a computer or a computer system.

[15] **Figure 2** shows details included in the complete valve assembly. The complete valve assembly is provided with a valve body 7, a safety valve cone 8, with return springs 9 on both sides of the safety valve cone, a calibration cone 10, with an axis 11, connected to the actuator 2, and one, on the valve body 7 mounted sensor carrier 31 with a differential pressure sensor 12. The valve body 7 has an inlet 13 and an outlet 14 where the measuring hoses 4 are connected, and whereby the inlet is intended to be the high pressure side and the outlet is intended to be the low pressure side. Of course those sides can be on the contrary, depending on how the connections lands in relation to the high and low side of the fluid system. Moreover the valve body has a first cavity 15 that by dimensions is coordinated with the outer dimensions of the safety valve cone 8. In the outer end 16 of the cavity 15 there is a safety valve stop 17 provided with sealing elements 18 and in connection with this stop there is the first return spring 9 where the safety valve stop 17 constitutes the base for the return spring. Between this return spring and the other return spring 9, placed at the bottom 19 of the cavity, the safety valve cone 8 is situated, and accordingly, clamped between the two return springs. The safety valve cone preferable includes two interior recessed cavities 24 in axial direction relative the safety valve cone, which cavities emerge into each end of the safety valve cone 8, and where every cavity at its bottom has a recess 25 outwards to the periphery of the cone. Externally the safety valve cone 8 is provided with sealing

elements 20 on the surface of the periphery, at either side of the recesses 25. From the inlet 13 a duct 21 extends, via the cavity 15, at the return spring 9, and further up to a second cavity 22 that by dimensions is coordinated with the outer dimensions of the calibration cone 10. To the cavity 22 also a second duct 23 extends from the outlet 14, via the bottom 19 of the cavity 15. In the cavity 22 the calibration cone 10 is situated which preferably includes an interior recessed cavity 26 in axial direction relative the calibration cone and where the cavity extends through the whole length of the calibration cone 10. Outside the calibration cone 10 is provided with preferable two sealing elements 27 at the peripheral surface of respective end. In the other end 28 of the cavity 22 there is a stop lug 29, provided with sealing elements 30, and this stop lug 29 also constitutes attachment/holder of the actuator 2 and its axis 11, which ends up through the stop lug 29 and where the axis 11 is fastened at the calibration cone 10. Between the bottom of the cavity 22 and the calibration cone a return spring 35 is clamped. From the peripheral surface of the cavity 22 ducts 32 and 33 extends to the differential pressure sensor 12 in the sensor support 31.

[16] **Figure 3** shows the complete valve assembly in its initial position, i.e. its position for flushing through/zero point calibration. Always, except of the moment with measuring, the valve assembly is in its initial position, its position for flushing through/zero point calibration. The device is brought to return to the position of flushing through and zero point calibration after finished measuring sequence, either by that the actuator 2 returns the device to this position or alternative another stored energy, for instance a return spring 35, foresees this. In this initial position the calibration cone 10 is situated between the ducts 21 and 23 and thereby both the sealing elements 27 lands on either side of the ducts 32 and 33, which results in that the ducts 32 and 33 are short circuited, and consequently they are getting the same static pressure. Accordingly the differential pressure sensor 12 will be zero point calibrated and the calibration occurs outside the fluid flow because the ducts 32 and 33 contacts the cavity 22 at its peripheral surface, between booth the sealing elements 27 that seals between the cavity 22 and the calibration cone 10. The flushing through occurs at the same time because the construction of the calibration cone and its position permits an open flowing passage between high and low pressure side, from the inlet 13, via the duct 21, to the cavity 22, through the cavity 26 of the calibration cone 10 and further to the cavity 22, then to the duct 23 and thereafter to the outlet 14. After this process the complete valve assembly 1 is flushed through and is free from enclosed air and also the valve assembly is zero point calibrated.

[17] **Figure 4** shows the complete valve assembly in measuring position. After performed flushing and zero point calibration the actuator 2 moves, via the axis 11, the calibration cone 10 in axial direction towards the bottom 22 of the cavity 34, whereby the cal-

ibration cone 10 is brought to a position for measuring. In this measuring position the sealing elements 27 are, because of the displacing of the calibration cone 10, on both sides of the duct 21 and seals by that between the cavity 22 and the calibration cone 10 and by that is also the flushing passage, via the cavity 26, closed. Moreover one of the sealing elements 27 constitutes in this position a barrier between the ducts 32 and 33. Consequently, the higher fluid pressure will be in contact with the differential pressure sensor 12 since the passage from the inlet 13, via the duct 21 to the peripheral surface of the cavity 22 and further via the ducts 32 up to the differential pressure sensor 12, is open. At the same time the passage at the low pressure side is open to the differential pressure sensor 12, from the outlet 14, via the duct 23 and the cavity 22 and further to the duct 33 and to the differential pressure sensor 12. Accordingly, the differential pressure is registered. To minimize the power that is consumed to move the calibration cone 10 between calibration/flushing position and measuring position and vice versa the calibration cone 10 is balanced by the cavity 26 in a way that the calibration cone always has fluid of the same pressure level on both sides of its top and bottom, i.e. between the bottom of the cavity 22 and the calibration cone and also between the stop lug 29 and the calibration cone. Accordingly, only the frictional force between the sealing elements 27 and the wall of the cavity 22 must be overcome.

[18]

COMPONENT LIST

- 1 valve assembly
- 2 actuator
- 3 valve
- 4 measuring hose
- 5 measuring nipple
- 6 manual unit
- 7 valve body
- 8 safety valve cone
- 9 return spring
- 10 calibration cone
- 11 axis
- 12 differential pressure sensor
- 13 inlet
- 14 outlet
- 15 cavity
- 16 outer end
- 17 safety valve stop

- 18 sealing element
- 19 bottom
- 20 sealing element
- 21 duct
- 22 cavity
- 23 duct
- 24 cavity
- 25 recess
- 26 cavity
- 27 sealing element
- 28 outer end
- 29 stop lug
- 30 sealing element
- 31 sensor carrier
- 32 duct
- 33 duct
- 34 bottom
- 35 return spring

Claims

- [Claim 1] Device included in a system for measuring differential pressures in a fluid system and where the device is a valve assembly (1) including a valve body (7) with an inlet (13) and an outlet (14) for connection to the fluid system, ducts (32, 33) for communication with a differential pressure sensor (12) for registration the differential pressure, a cavity (22) in contact with the ducts (32, 33) where the cavity (22) includes a calibration cone (10) which is moveable in the cavity (22) between a measure position and a position for zero point calibration/ flushing through of the valve assembly (1), and that the calibration cone (10) separates the differential pressure sensor (12) from the fluid system in those cases when there is no measuring position by the device, i.e. in its initial position, by that the calibration cone (10) includes sealing elements (27), which sealing elements shields the ducts (32, 33) from the cavity (22), **characterized** in that a flushing function is obtained in those cases when there is no measuring position of the device, i.e. in its initial position, by that the calibration cone (10) has a design that permits an open passage of flow stream between high and low pressure side, from the inlet (13), via a duct (21) between the inlet (13) and the cavity (22) in the valve body (7), to the cavity (22) in the valve body (7), through a cavity (26) in the calibration cone (10) and further to the cavity (22) in the valve body (7), thereafter to a duct (23) between the cavity (22) in the valve body (7) and the outlet (14) and thereafter to the outlet (14).
- [Claim 2] Device according to claim 1, **characterized** in that the calibration cone (10) in its measuring position leads to communication between the fluid system and the differential pressure sensor (12), by that the sealing element (27) of the calibration cone (10) in the measuring position don't shields the ducts (32, 33) to the differential pressure sensors (12) from the cavity (22).
- [Claim 3] Device according to claim 1-2, **characterized** in that the calibration cone (10) is arranged always to return to its initial position, i.e. when no measuring position exists, by that stored energy, preferably a return spring (35), provides for this.
- [Claim 4] Device according to claim 1-3, **characterized** in that the valve assembly (1) includes an actuator (2) which is arranged to change the position of the calibration cone (10) in the cavity (22).

[Claim 5] Device according to claim 4, **characterized** in that the actuator (2) is remote controlled.