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- 2 DEC 2004

EP 0 493 397 B4

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to flame arresting or quenching plugs for use with transmitter housings.

2. Description of the Prior Art

Flammable mixtures many times are present in an atmosphere outside a pressure transmitter or in a process fluid which is being sensed by a pressure sensor in the transmitter. Various types of protection reduce the likelihood that an ignition of flammable gas inside the transmitter will ignite a flammable mixture outside the transmitter. Transmitter openings and covers for the openings are now made so as to cool ignited gas inside the transmitter housing as it is venting to a temperature below that needed to ignite a flammable mixture outside the transmitter. The ignited gasses in the transmitter are cooled as they travel along narrow passageways such as flanges or threads between a housing and a cover of the transmitter. As the hot gases move along the passageway, heat is transferred from the flame to the walls forming the passageway. If the passageway is narrow enough, more heat is transferred from the flame to the housing and cover than is produced by the flame, and the flame front cools. If the passageway is also long enough, the flame front can be cooled to a temperature low enough to quench the flame, thereby preventing ignited gases from moving further down the passageway and igniting a flammable mixture outside the transmitter.

Multiple protection can be provided in a single transmitter so that, even if one protection is damaged or fails, another protection arrangement still reduces the likelihood of igniting the flammable mixture outside the transmitter. It is desired in some applications that a flame quenching path effectively contain ignition of a flammable mixture inside the housing even after resilient seals such as O-rings and thin foil barriers such as isolator diaphragms have been damaged or removed, or after isolator liquids have leaked out, or welds have failed.

Flame quenching between the sensor, which includes electrical circuitry capable of generating a spark under fault conditions, and the outside of the transmitter is a problem because there is a need to expose the sensor to the process fluid pressure, and, in the case of a gauge pressure transmitter, there is also a need to expose the sensor to atmospheric pressure outside the transmitter, as well. Flame quenching paths between sensors in a transmitter housing and the outside of the transmitter have been provided, but prior art arrangements such as class I

threads are difficult to make in applications for holding a sensor in place and expensive to manufacture.

There is thus a need to provide an easily produced, low cost mounting for a sensor which exposes the sensor to the sensed pressure, while at the same time providing a simple, economical arrangement for containing gases ignited in the sensor cavity.

SUMMARY OF THE INVENTION

The present invention relates to a transmitter providing an output indicating a pressure difference between a line and an atmosphere outside the transmitter, comprising a housing forming a wall around an axis of a hole extending into a cavity formed in the housing; a circuit in the cavity for sensing the pressure difference; and a plug in the hole having a sensor cavity holding the sensor, a fitting couplable to the line along the axis at a distal end of the plug, and a diaphragm therein coupling line pressure to the sensor via a liquid in a first passageway formed in the plug, the first passageway having a shape which flame-isolates the sensor from the line and said fitting being a sleeve-like fitting having a bore, a first block mounted in said bore forming part of said plug the first block closing the sensor cavity in a second block and having the diaphragm mounted thereon and the first passageway therein the space between the first block and the bore having a shape which flame-isolates from the line, the bore further including a capture ring between the first block and the process fluid to ensure that the first block remains in the bore if the first block is separated from the second block and no longer closes the sensor cavity. In a preferred embodiment the peripheral surface of the plug and the adjacent wall form an interspace shaped to resist the passage of flame thus flame-isolating any ignited gases from the atmosphere.

In a further preferred embodiment, the plug has a second passageway coupling the sensor to the atmosphere. The second passageway is formed in a shape that resists travel of a flame, and thus flame-isolating the sensor from the atmosphere. The second passageway couples to the atmosphere via the interspace.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional view through a typical transmitter housing having a plug and sensor arrangement made according to the present invention;

Figure 2 is an enlarged vertical sectional view of the plug and sensor used in the transmitter housing of Figure 1; and



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the periphery. The recess 91 is a sensor mounting recess, and a suitable pressure sensor 92 is mounted therein on an inner surface. The recess 91 forms a chamber that is open to the passageway 86B. The underside of the diaphragm 86A, the recess 91 and passageway 86B are filled with a silicone oil or other suitable noncompressible fluid. An oil fill passageway indicated at 94 is provided and opens to the recess 91. A ball closure valve 95 held in place with a suitable plug 96 closes the passageway 94 after filling fluid into the sensor isolator chambers and passageways.

An atmospheric pressure chamber 98 is provided on the opposite side of the sensor diaphragm portion 110 from the isolator block 86. Chamber 98 is connected with a small diameter flame arresting passageway 100 to an interspace 101 between the inner surface defining hole 22 and the outer periphery of the sensor mounting block 90. This interspace 101 is precisely sized with about 0.1016mm (.004 inches) total diameter difference, for forming a flame quenching path to atmosphere through threads 24. The hole 100 is formed of suitable size and length to also form a flame quenching path leading to the interspace. It should also be noted that the sensor support block 90 is welded to the sleeve-like fitting 81 with a suitable weld 102.

A lead 103 is attached to the sensor 92 and passes outwardly through a suitable passageway 104 in this form of the invention. The sensor 92 is supported on its edges on the inner end of recess 91 and the diaphragm 110 will deflect under differences in pressure acting through the isolator diaphragm 86A with respect to atmosphere pressure in chamber 98.

A suitable pressure line connector or fitting 105 is threaded into the interior of a threaded portion 106 of the sleeve-like fitting 81, using conventional threads to provide process fluid pressure to the diaphragm 86A, and thus through passageway 86B and the noncompressible fluid in the chamber 91 to the diaphragm portion 110 of the pressure sensor 92. An O-ring 112 seals the outer surface of the sensor block 90 with respect to the surface of the bore or opening 22.

In each instance, again, the sensor recess or cavity 91, where ignition of combustible gases can occur is connected through flame arresting paths in all outlet paths leading toward the ambient atmosphere, which may be combustible. This includes the conventional class 1 threads 24 which have a long path length and low clearance, the annular space between the exterior surface of the isolator block 86 and the surface of bore portion 85, which has a clearance of about 0.1016mm (.004 inches) and a path length of about 12.7mm (1/2 inch). This passageway would be open to atmosphere if the weld 91A failed, and flame from chamber 91 was present and was travelling toward the atmosphere. The capture ring 87 will hold the isolator block 86 within bore portion 85 so that the

flame arresting path is maintained regardless of failure of such weld.

The passageway 86B, that is the isolator fluid passageway leading to recess 91, has a small diameter (0.381mm, .015 in.) and a sufficient length so that it will quench flames that tend to travel to atmosphere through such opening 86B if there is a failure of the diaphragm 86A and discharge and loss of the isolating fluid.

The atmospheric chamber 98 is connected to atmosphere through a flame quenching passageway 100 which has a shape (0.381mm, .015 in. diameter) sufficient for causing flame quenching, as does the interspace 101 between the periphery of the sensor plug 90 and the bore 22.

Thus by selecting the paths through the isolator 86 for presenting process fluid pressure to the sensor to have a configuration that provides flame quenching characteristics, and also selecting the paths that provide atmospheric pressure to such sensor to have flame quenching configurations or shapes, the transmitter is made to be intrinsically safe. The conventional threads on the cap shown at 14 for the transmitter housing also provide flame quenching paths. Flame quenching shapes also can be made by filling wider passageways with sintered or porous material.

The assembly shown provides for a low cost, safe sensor mounting plug without having a large number of high cost thread interfaces, the flame quenching paths are maintained in case of a failure of a weld or an isolator diaphragm with the present configuration to make the assembly intrinsically safe.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the terms of the claims.

Claims

1. A transmitter (10) providing an output indicating a pressure difference between a line and an atmosphere outside the transmitter, comprising:
 - a housing (11) forming a wall around an axis of a hole (22) extending into a cavity (12) formed in the housing;
 - a circuit (20) in the cavity (12) controlling the output;
 - a sensor (45, 92) coupled to the circuit (20) for sensing the pressure difference; and
 - a plug (40, 89) in the hole (22) having a sensor cavity (44, 91) holding the sensor (45, 92), a fitting (26, 81) couplable to the line along the axis at a distal end of the plug (40, 89), and a diaphragm (35A, 86A) therein coupling line pressure to the sensor (45, 92) via a liquid in a first passageway (35B, 86B) formed in the plug, the first

- passageway (35B, 86B) having a shape which flame-isolates the sensor (45, 92) from the line, and said fitting being a sleeve-like fitting having a bore (33, 85), a first block (35, 86) mounted in said bore (33, 85) forming part of said plug (40, 89) the first block (35, 86) closing the sensor cavity in a second block (41, 90) and having the diaphragm (35A, 86A) mounted thereon and the first passageway (35B, 86B) therein the space between the first block (35, 86) and the bore (33, 85) having a shape which flame-isolates from the line, the bore (33, 85) further including a capture ring (34, 87) between the first block (35, 86) and the process fluid to ensure that the first block (35, 86) remains in the bore (33, 85) if the first block (35, 86) is separated from the second block (41, 90) and no longer closes the sensor cavity (12).
2. The transmitter of claim 1 wherein the plug (40, 89) has a peripheral surface in the hole (22) adjacent the wall forming an interspace (52) having a shape which flame-isolates the circuit (20) from the atmosphere.
 3. The transmitter of claim 2 wherein the plug (40, 89) has a second passageway (51, 100) coupling the sensor (45, 92) to the atmosphere, the second passageway (51, 100) being formed in a shape which flame-isolates the sensor from the atmosphere.
 4. The transmitter of claim 3 wherein the second passageway (51, 100) couples to the atmosphere via the interspace (52).
 5. The transmitter of claim 1 wherein said fitting is a sleeve-like fitting having a bore (33, 85), a first block (35, 86) mounted in said bore (33, 85) forming part of said plug (40, 89) the first block (35, 86) closing the sensor cavity in a second block (41, 90) and having the diaphragm (35A, 86A) mounted therein and the first passageway (35B, 86B) therein, the space between the first block (35, 86) and the bore (33, 85) having a shape which flame-isolates from the line.
 6. The transmitter of claim 5 wherein the bore (33, 85) in the sleeve-like fitting includes a capture ring (34, 87) between the first block (35, 86) and the process fluid to ensure that the first block (35, 86) remains in the bore (33, 85) if the first block (35, 86) is separated from the second block (41, 90) and no longer closes the sensor cavity (12).
 7. The transmitter of claim 1 wherein the plug comprises a fitting having an interior bore (33, 85), a first isolator block (35, 86), a second sensor mounting block (41, 90) having the sensor cavity (44, 91) in one end, the first isolator block (35, 86) being sealingly attached to the second block (41, 90) and closing the sensor cavity (44, 91), the first block (35, 86) fitting into the bore (22) to define a passageway around the first block having a shape which flame-isolates the junctures between the first (33, 85) and second (41, 90) blocks from the exterior.
 8. The transmitter of claim 7 wherein the fitting has an end surface and the sensor block (41, 90) has a shoulder (41B) defined thereon forming a neck which fits into the interior bore (33, 86), and the shoulder fitting on the end surface.

Patentansprüche

1. Transmitter (10), der eine Ausgabe liefert, welche eine Druckdifferenz zwischen einer Leitung und einer Atmosphäre außerhalb des Transmitters anzeigt, und aufweist:
 - ein Gehäuse (11), das eine Wand um eine Achse eines Lochs (22) bildet, welches sich in einen in dem Gehäuse ausgebildeten Hohlraum (12) erstreckt;
 - einen Schaltkreis (20) im Hohlraum (12), der die Ausgabe steuert;
 - einen mit dem Schaltkreis (20) verbundenen Sensor (45, 92) zum Abtasten der Druckdifferenz; und
 - einen Pfropfen (40, 89) im Loch (22) mit einem den Sensor (45, 92) aufnehmenden Sensorhohlraum (44, 91), einem mit der Leitung entlang der Achse an einem entfernten Ende des Pfropfens (40, 89) verbindbaren Verbindungsstück (26, 81) und einer Membran (35A, 86A) darin, die den Leitungsdruck über eine Flüssigkeit in einem ersten in dem Pfropfen ausgebildeten Durchgang (35B, 86B) mit dem Sensor (45, 92) koppelt, wobei der erste Durchgang (35B, 86B) eine Form hat, die den Sensor (45, 92) gegen die Leitung flammenisoliert.
2. Transmitter aus Anspruch 1, wobei der Pfropfen (40, 89) eine Manteloberfläche im an die Wand angrenzenden Loch (22) hat, die einen Zwischenraum (52) mit einer Form bildet, welche den Schaltkreis (20) gegen die Atmosphäre flammenisoliert.
3. Transmitter aus Anspruch 2, wobei der Pfropfen (40, 89) einen zweiten, den Sensor (45, 92) mit der Atmosphäre verbindenden Durchgang (51, 100) hat und der zweite Durchgang (51, 100) in einer Form ausgebildet ist, die den Sensor gegen die Atmosphäre flammenisoliert.
4. Transmitter aus Anspruch 3, wobei der zweite Durchgang (51, 100) über den Zwischenraum (52) mit der Atmosphäre verbindet.
5. Transmitter aus Anspruch 1, wobei das Verbindungsstück ein hülsenähnliches Verbindungsstück mit einer Bohrung (33, 85) ist und ein erster Block (35, 86) in die Bohrung (33, 85) montiert ist und einen Teil des Pfropfens (40, 89) bildet, wobei der erste Block (35, 86) den Sensorhohlraum in einem zweiten Block (41, 90) abschließt und die Membran (35A, 86A) darin montiert ist und der erste Durchgang (35B, 86B) darin ist, und wobei der Raum zwischen dem ersten Block (35, 86) und der Bohrung (33, 85) eine Form hat, die gegen die Leitung flammenisoliert.