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SWITCH OPERATING MECHANISM

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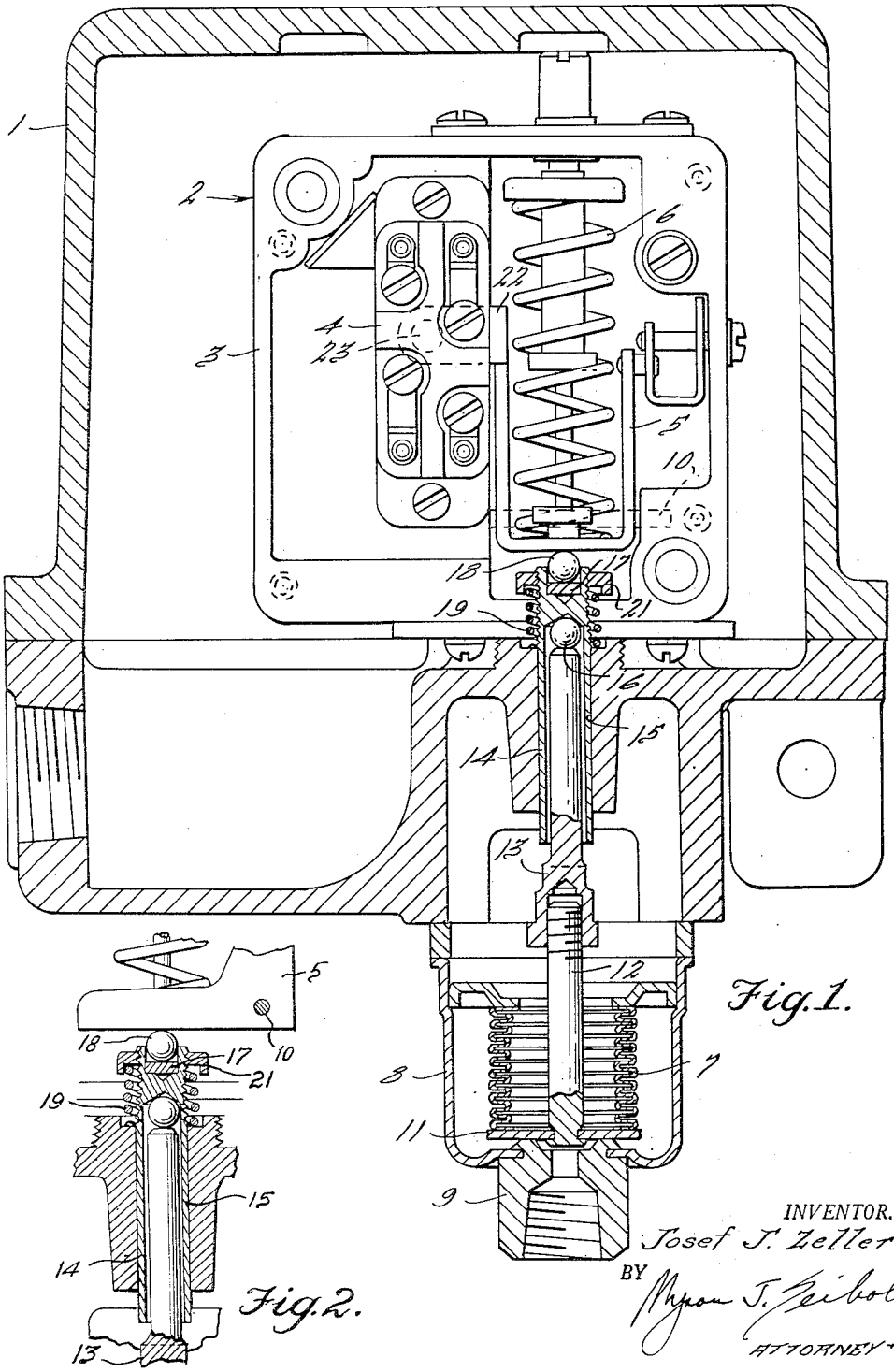

Fig. 1.

Fig. 2.

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SWITCH OPERATING MECHANISM

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10 Claims. (Cl. 74—104)

This invention relates to means for operating control means which are disposed within enclosing structures, and more particularly to means for transmitting the motion of a condition responsive element—for example, a bellows—to an electrical switch which is mounted within an explosion resisting enclosure.

In order to operate an electric switch mounted within an explosion resisting enclosure by means of a bellows, the Underwriters' specify that the bellows extension must go through a path at least 1" long, and the shaft can have a clearance of only 0.0033 inch. It is obvious that under such conditions unless the bellows motion is perfectly straight and the bellows extension accurately lined with a guide hole, the performance of the switch will be erratic. Similar difficulties present themselves whenever switches, or other control means, mounted in enclosing structures are operated in response to the movement of any exteriorly mounted condition responsive device.

Therefore, it is one object of the present invention to provide a new and improved operating mechanism for control means which are mounted within enclosures and operated by exteriorly mounted condition responsive elements.

Another object of the present invention is the provision of a device in accordance with the preceding object in which a switch mounted in an enclosure is operated by virtue of an exteriorly mounted bellows movement.

Another object is a provision of a device in accordance with the preceding object, in which a bellows is provided with a bellows extension pin connected to the switch operator by means comprising a pair of metal balls.

Another object of the present invention is the provision of a device in accordance with the preceding objects in which the switch operating means includes a movable sleeve connected to the bellows extension pin by one ball, and connected to the switch operating lever by another ball.

Other objects and features of the invention will be readily apparent to those skilled in the art from the specification and appended drawing illustrating certain preferred embodiments in which:

Figure 1 is a side view of the device of the present invention in which certain outer parts have been removed, and in which other parts have been shown in section to facilitate the explanation of the device.

Figure 2 is a partial view at right angles to the view shown in Figure 1.

The device of the present invention includes an explosion resisting enclosure 1 of conventional metallic construction, in which there is mounted by suitable means an electrical switch 2. The switch 2 comprises an outer casing 3 in which is mounted the switch mechanism 4. The switch mechanism 4 is provided with an operating button 23, reciprocation of which effects opening and closing of the electrical circuit through the switch mechanism. To effect operation of this button, there is provided a main operating lever 5 pivotally mounted upon

a pin 10 and biased toward the position shown in the figure by a spring 6. Lever 5 carries an integral extension 22 adapted to effect reciprocation of operating button 23. In order to effect pivotal operation of the lever 5, there is provided a bellows 7 mounted within an outer enclosure 8 which is itself mounted to the enclosure 1. To the enclosure 8 there is connected an outlet 9 having a threaded opening for the reception of a nozzle connected to a controlled pressure source. The outer facing end of the bellows 7 is provided with a plate 11 to which there is attached, as by spinning over, a shaft 12. As indicated in the figure, the shaft 12 extends through the bellows and projects toward the enclosure 1. At its inner end it is provided with threads which mate with a cooperating threaded portion of a bellows pin extension 13. The opposite end of the bellows pin extension 13 extends into a sealing sleeve 14, which has an outer diameter of a slightly smaller dimension than the diameter of a hole 15 provided through enclosure 1, in which the sleeve 14 is disposed. As indicated in the figure, the inside diameter of the sleeve 14 is larger than the outside diameter of the bellows pin extension 13 so that extension 13 can tilt without engaging sleeve 14, for a purpose to be subsequently explained. Interposed between the end of the bellows pin extension 13 and the sealing sleeve 14 is a steel ball 16 which is the sole connection between these two elements.

The inwardly projecting portion of the sealing sleeve 14 is provided with a suitable aperture in which there is mounted a hardened steel insert 17. Upon insert 17 is disposed another steel ball 18 against which the switch operating lever 5 is biased by spring 6. Surrounding this end of the sleeve 14 is a spring 19 which is interposed between a shoulder on the enclosure 1 and an adjustable nut 21 cooperating with the threaded, inwardly projecting portion of sleeve 14, and movable to effect a variation in the bias applied to the sealing sleeve 14 by the spring 19.

The operation of the device will now be described:

Upon such a change in condition that a contraction of the bellows 7 is effected, the bellows pin 12 and its extension 13 will be moved upwardly. This upward motion will be transmitted to the sealing sleeve 14 by the steel ball 16, whereby the sleeve 14 will itself move upwardly. This upward movement of the sealing sleeve 14 forces steel ball 18 to rotate the operating lever 5 about pin 10 in opposition to spring 6, and thereby effect movement of extension 22 to reciprocate button 23 and operate switch mechanism 4. As bellows 7 is permitted to return to the position indicated in the figure, spring 6 returns lever 5 to its illustrated position whereby extension 22 permits operating button 23 of switch mechanism 4 to return to its original condition.

It will readily appear that despite slight misalignments in the mechanism or irregularities in the bellows movement, the bellows pin extension will not directly touch the sealing sleeve 14, whereby no friction or side pressure between the sealing sleeve 14 and the opening 15 in which it operates exists. On the contrary, the motion of the bellows pin extension 13 is transmitted to the sleeve 14 through the steel ball 16 so that substantially only vertical components of force are transmitted to the sealing sleeve 14 which, therefore, practically "floats." Movement of the sleeve 14 will also operate the lever 5 (and consequently the switch mechanism 4) despite any slight misalignment between the sleeve 14 and the lever 5, due to the fact that the motion of the sleeve 14 is transmitted to the lever 5 only through the steel ball 18.

It is, therefore, obvious that the device of the present invention provides for the operation of a control device such as an electric switch by virtue of a bellows move-

ment which is in accordance with the Underwriters' requirements for the operation of switches in explosion resisting construction, and yet which operates with accuracy and consistency, despite its low cost. With this device, other control devices could similarly be operated by other condition responsive elements.

While a certain preferred embodiment of the invention has been specifically disclosed, it is understood that the invention is not limited thereto, as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims:

What is claimed is:

1. Apparatus for effecting the operation of control means which are disposed within an enclosure having at least one aperture therethrough, comprising an element movable in response to condition changes, elongated means movable by said element, movable means extending through said aperture, means effecting the operation of said control means in response to movement of said movable means, and a movable ball serving as the sole interconnecting means between said elongated means and said movable means whereby movement of said element in response to condition changes is transmitted to said movable means as movement substantially along the axis of said aperture.

2. Apparatus for effecting the operation of control means which are disposed within an enclosure having at least one aperture therethrough, comprising an element movable in response to condition changes, elongated means movable by said element, a movable sleeve extending through said aperture and provided at its exterior end with a cup-shaped portion, means effecting the operation of said control means in response to movement of said movable sleeve, and a movable ball within said cup-shaped portion, said elongated means extending into said cup-shaped portion and engaging said ball but being free from engagement with said sleeve whereby movement of said element in response to condition changes is transmitted to said sleeve as movement along the axis of said aperture despite a slight lateral component in the movement of said element.

3. Apparatus for effecting the operation of control means which are disposed within an enclosure having at least one aperture therethrough, comprising a movable sleeve extending through said aperture provided at its exterior portion with an elongated cup-shaped portion, means effecting the operation of said control means in response to movement of said movable sleeve, a condition responsive element, a rod connected to said condition responsive element and having one portion extending into said cup-shaped portion but being free of direct engagement therewith, and a movable ball interposed between the end of said rod and the closed part of said cup-shaped portion to transmit movement of said rod to said movable sleeve.

4. The apparatus of claim 3 in which said means effecting the operation of said control means comprise a second movable ball movable in response to movement of said sleeve, and a lever movable in response to movement of said second ball to operate said control means.

5. The apparatus of claim 3 in which said means effecting the operation of said control means comprise a second movable ball mounted to the inwardly projecting portion

of said sleeve and a lever movable in response to movement of said second ball, and in which means are provided for biasing said lever against said second ball.

6. Apparatus for effecting the operation of control means which are disposed within an enclosure having at least one aperture therethrough, comprising movable means provided with an exteriorly directed cup-shaped portion, means effecting the operation of said control means in response to rectilinear movement of said movable means, a condition responsive element, a rod connected to said condition responsive element and movable in response to movement of said condition responsive element, said condition responsive element and said rod being mounted in substantial alignment with said movable means whereby movement of said rod is substantially along the longitudinal axis of said aperture, and a movable ball mounted within said cup-shaped portion serving as the sole connection between said movable means and said rod.

7. The apparatus of claim 6 in which said movable means extend through said aperture and in which said rod has one portion extending into said cup-shaped portion but is free of direct engagement therewith.

8. The apparatus of claim 7 in which said movable means has an interiorly directed portion and said means effecting the operation of said control means includes a second ball mounted to said interiorly directed portion and a lever movable in response to movement of said second ball, and in which means are provided for biasing said lever against said second ball.

9. The apparatus of claim 8 in which further means are provided for applying an adjustable bias to said movable means.

10. Apparatus for effecting the operation of an electric switch disposed within an enclosure having at least one aperture therethrough, movable means extending through said aperture and provided with an exteriorly directed cup-shaped portion; means effecting the operation of said switch in response to rectilinear movement of said movable means comprising a movable ball mounted to said movable means, a pivoted lever, and a spring biasing said lever toward said ball; and means for effecting rectilinear movement of said movable means comprising a bellows, an elongated rod connected to said bellows and movable therewith, said bellows and rod being so constructed and arranged as to be in substantial alignment with said movable means whereby movement of said rod is substantially along the longitudinal axis of said aperture, said rod having one portion extending into said cup-shaped portion but being free of direct connection therewith, and a second movable ball mounted within said cup-shaped portion serving as the sole connection between said movable means and said rod whereby slight misalignments between said rod and said movable means are compensated for.

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