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(54) PRESSURE-RESPONSIVE ELECTRIC SWITCHING DEVICE

(71) We, EBOSA S.A., a Swiss Company, of Kapellstrasse 6,2540, Grenchen (Canton of Soleure) Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to a pressure-responsive electric switching device having a piston movable under the action of a pressure difference within a cylinder chamber for actuating a switch without contact therewith.

Switching devices of this kind may be used in monitoring or measuring apparatus, e.g., in order to check automatically, and in quantity, the shape, condition, or position of a surface on workpieces coming from a production line. A calibrated nozzle is set up at a permanent location, and the workpieces to be checked are conveyed past this nozzle, the nozzle being connected to the cylinder chamber in order to affect the pressure on one side of the piston. The switch responds whenever the surface to be measured on a workpiece does not pass at a certain predetermined distance from the nozzle.

However, there is a need for improving switching devices of the aforementioned kind in order to make them much more sensitive and, above all, quicker to jump back into their starting position than is presently the case. Such an improved switching device could thus be used for checking smaller workpieces much more economically than has heretofore been possible.

According to the present invention, there is provided a pressure-responsive electric switching device having a piston slidable within a cylinder chamber for actuating a switch without contact therewith, means providing a reference pressure and one side of the piston including two reference ports opening into the chamber and a port opening into the chamber so as to provide an actuation pressure on the opposite side of the piston, the piston being a hollow piston having a rigid metal base, the switch being an inductive proximity switch disposed coaxially with and projecting into the piston, and at least one of the reference ports being provided with a restrictor, the piston being slidable under the action of a pressure difference caused by the variation of the actuation pressure in order to actuate the switch, the piston being arranged such that in actuating the switch the piston acts as a valve with respect to one of the reference ports in order to enhance the pressure difference operative to return the piston after the switch has been actuated.

A preferred embodiment of the invention will now be described in detail with reference to the accompanying drawing, in which: —

Figure 1 is a longitudinal section through the switching device;

Figure 2 is a section taken on the line II—II of Figure 1, and

Figure 3 is a section taken on the line III—III of Figure 1.

The switching device illustrated in the drawing comprises a cylinder block 1 of rectangular profile, through the entire length of which there passes a bore 2. A locking ring 3 and a closure plug 4 close off the bore 2 at its respective ends, thus delimiting in the central portion of the block 1 a cylinder chamber 2*a* within which a piston 5 moves. A cylindrical inductive proximity switch 7, axially disposed in the block 1 slides within the ring 3. The right-hand end of the switch 7 (as viewed in Figure 1) projects beyond the ring 3 and into the piston 5. Owing to the means by which the switch 7 is secured, viz., a rubber ring 8 held within an inside groove of the locking ring 3, the switch 7 can easily be displaced and adjusted in its position. The locking ring 3 comprises an annular front shoulder 9 which rests against a corresponding stop of the bore 2, and it is held fast by a screw 10 which rests against a flat-milled recess 3*a* of the locking ring 3. The locking ring 3 also comprises two parallel slots and a groove for receiving a sealing ring 11. The closure plug 4, which is held against a stop in the bore 2 by a circlip 25, comprises blocks 26 projecting from its left-hand end surface (as viewed

in Figure 1); the blocks 26 serve as stops for the piston 5 and prevent it from sticking. The tubular piston 5 bears at its right-hand end (as viewed in Figure 1) a metal switchplate 6 which, when the piston 5 is displaced within the cylinder chamber 2*a*, acts upon the inductive proximity switch 7 and switches the latter on or off.

The movements of the piston 5 are brought about by differences in pressure spaces to the left and right of the plate 6; a reference pressure is applied to the left-hand space and the pressure to be sensed is applied to the right-hand space communicating with a conduit for the fluid at the pressure to be sensed. The fluid at the reference pressure is supplied through a nipple 13 provided with a fine-adjusting restictor 12; the nipple 13 is secured to the block 1 about halfway along the length of the latter (see Figure 2) and communicates with the left-hand end (as viewed in Figure 1) of the cylinder chamber 2*a* means of bores 14 and 14*a*. The bore 14*a*, opening out the wall of the cylinder chamber 2*a*, is so situated that it is closed off by the outer surface of the piston 5. However, the piston 5 comprises an annular groove 15, the bottom of which communicates with the interior of the piston 5 by means of radial holes. A radial bore 16 in the block 1, situated slightly to the left of the bore 14*a* communicates with a bore 18 provided with a coarse-adjusting restrictor 17. By connection of the bore 18 to a vacuum pump via a pipe 27 and by appropriate adjustment of the restrictors 17 and 12, a vacuum is produced in the left-hand space, i.e., within the piston 5 and to the left of the plate 6, which vacuum, when the piston 5 is situated at the left-hand end of its path, is dependent upon the adjustment of the restrictors 17 and 12, for the groove 15 then communicates with the bore 14. When, however, the piston 5 is displaced from that position, the opening which is regulated by the fine-adjusting restrictor 12 is closed, and the vacuum increases in the space to the left of the plate 6.

The vacuum in the space to the right of the plate 6 is dependent upon the pressure to be sensed. By means of bores 20 and 21, the right-hand space communicates with a connection recess 22, which in turn communicates via pipes 24 and 28 with the vacuum pump 19 and with a calibrated nozzle 23 by means of a bypass arrangement. If a surface F of a workpiece W is situated in immediate proximity to the nozzle 23, the vacuum increases in the pipe 24 and thus in the bores 20 and 21. As soon as the vacuum in the space to the right of plate 6 is greater than the vacuum set in the left-hand space by means of the restrictors 12 and 17, the piston 5 moves to the right, causing the switch 7 to respond. Since, however, the opening of the fine restrictor 12 is then closed, the vacuum increases in the left-hand space. When the surface F now moves away from the nozzle 23, and the latter is open again, the vacuum decreases in the right hand space. The piston 5 is then very quickly returned under the influence of the greater vacuum in the left-hand space. Through opening of the fine-adjusting restrictor 12, the vacuum then drops in the left-hand space, so that the device is ready for switching again. In this way, some 100 movements per second can be controlled.

Because the reference pressure supply provided in the block 1 is connected as a branch in the pipeline between the nozzle 23 and the vacuum pump 19, a large-diameter pipe can be used for the connection 24, thus adding to the sensitivity and relability of the operations. The design of the piston 5 as a hollow piston surrounding the switch 7 has likewise proved advantageous in that the piston is light in weight and has a large piston area. Furthermore, every usable space is utilized, and this, too, contributes towards rapid operation. Further advantages of the device described are the short switching path of the piston and the possibility of moving the inductive switch 7 used as a detector member, and thus of adjusting the switching point to the optimum setting. The switching device described has proved particularly advantageous when used in transfer machines, for monitoring the delivery of workpieces to or their removal from processing stations when the workpieces are held to the transport members by suction.

WHAT WE CLAIM IS:—

1. A pressure-responsive electric switching device having a piston slidable within a cylinder chamber for actuating a switch without contact therewith, means for providing a reference pressure on one side of the piston including two reference ports opening into the chamber and a port opening into the chamber so as to provide an actuation pressure on the opposite side of the piston, the piston being a hollow piston having a rigid metal base, the switch being an inductive proximity switch disposed coaxially with and projecting into the piston, and at least one of the reference ports being provided with a restrictor, the piston being slidable under the action of a pressure difference caused by variation of the actuation pressure in order to actuate the switch, the piston being arranged such that in actuating the switch the piston acts as a valve with respect to one of the reference ports in order to enhance the pressure difference operative to return the piston after the switch has been actuated.

2. A switching device as claimed in claim 1, in combination with a vacuum pump, the other reference port and the port providing the actuation pressure being connected in common to the vacuum pump.

3. A switching device as claimed in claim 1, in combination with a vacuum pump and a calibrated nozzle, the calibrated nozzle and the port providing the actuation pressure being commonly connected to the vacuum pump.

4. A switching device in combination with a calibrated nozzle and a vacuum pump as claimed in claim 3, wherein piston stops are provided within the portion of the cylinder chamber which is provided with the actuation pressure.

5. A switching device in combination with a vacuum pump as claimed in claim 2, wherein a coarse-adjusting restrictor and a fine-adjusting restrictor are associated with a, or with a respective reference port.

6. A switching device in combination with a vacuum pump as claimed in claim 5, wherein the coarse-adjusting restrictor is disposed between the cylinder chamber and the vacuum pump, the fine-adjusting restrictor being disposed between a free suction opening and the cylinder chamber.

7. A switching device in accordance with claim 1, wherein the inductive proximity switch is axially adjustable with respect to the cylinder chamber.

8. A pressure-responsive electric switching device substantially as hereinbefore described with reference to the accompanying drawing.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG. 1

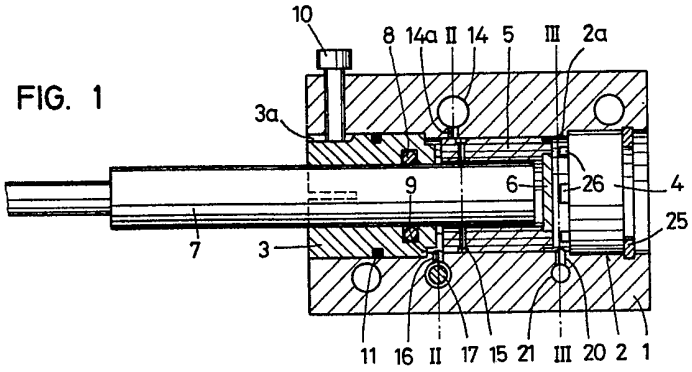

FIG. 2

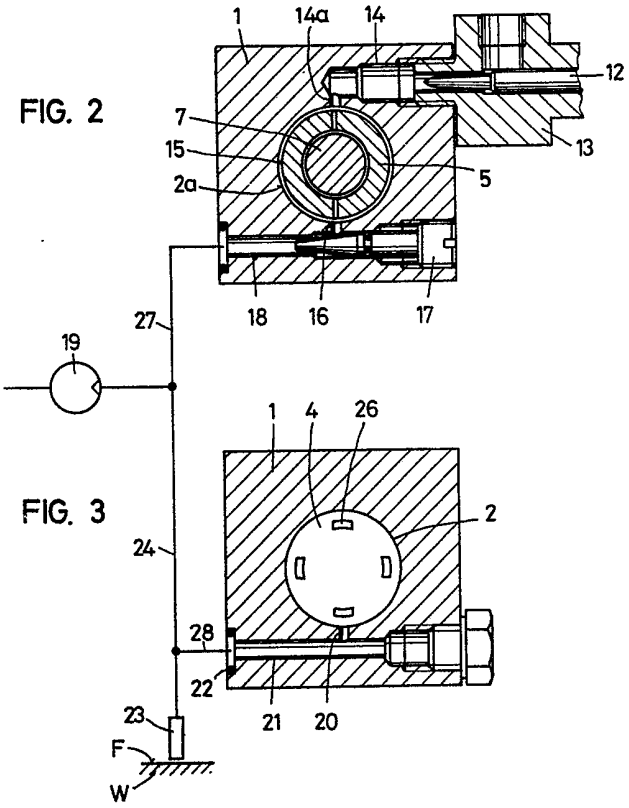

FIG. 3