

May 31, 1960

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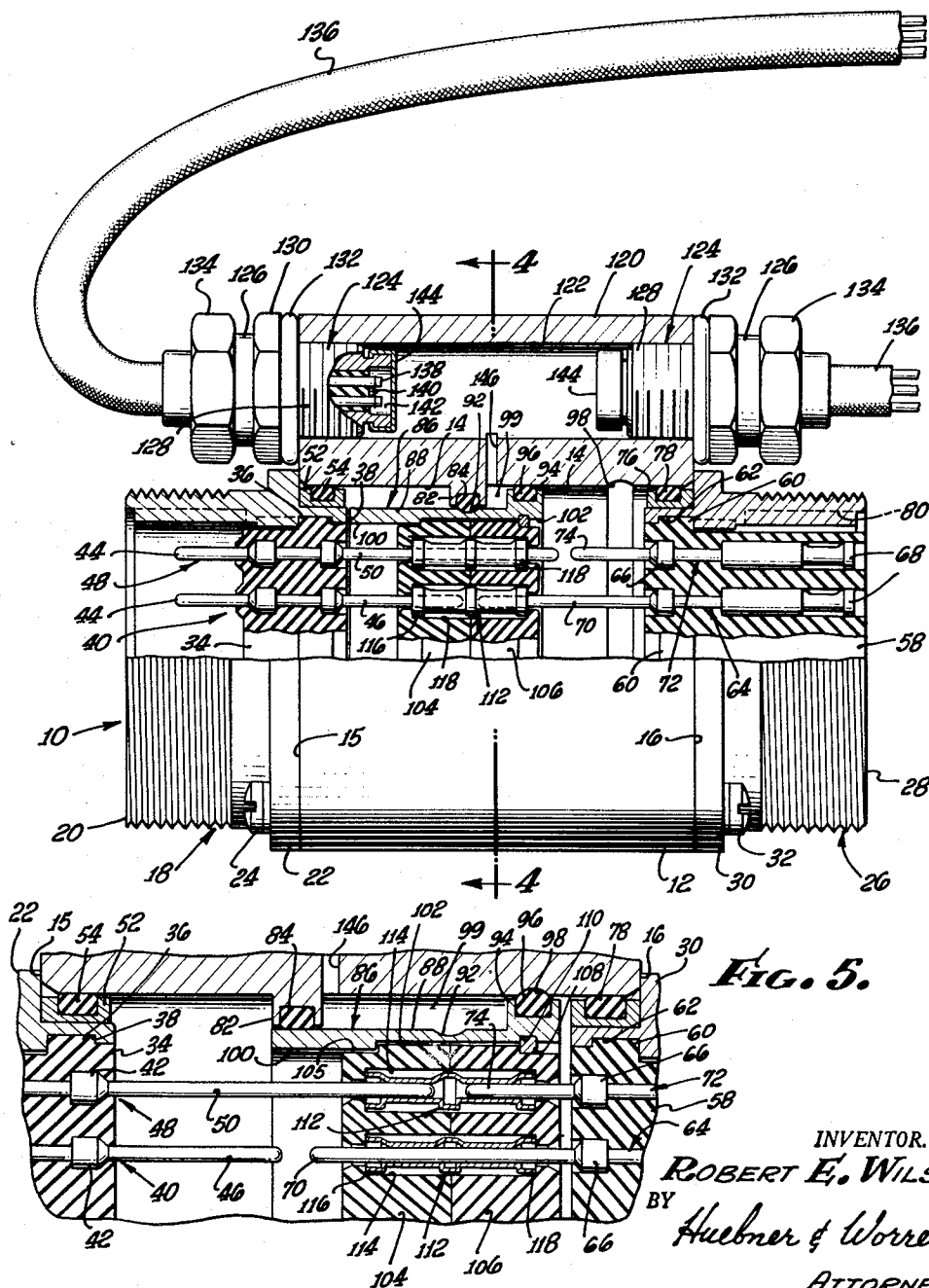
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PRESSURE ACTUATED ELECTRICAL SWITCH

Filed April 28, 1959

2 Sheets-Sheet 1

FIG. 1.



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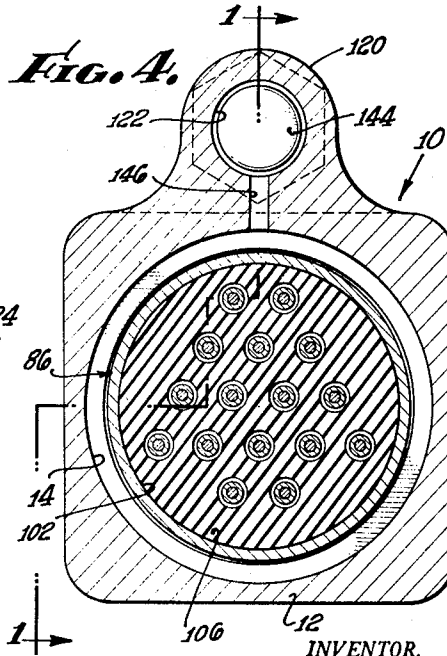
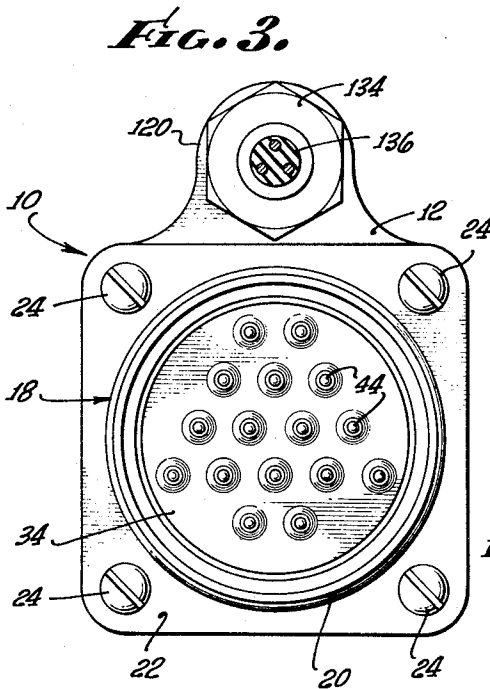
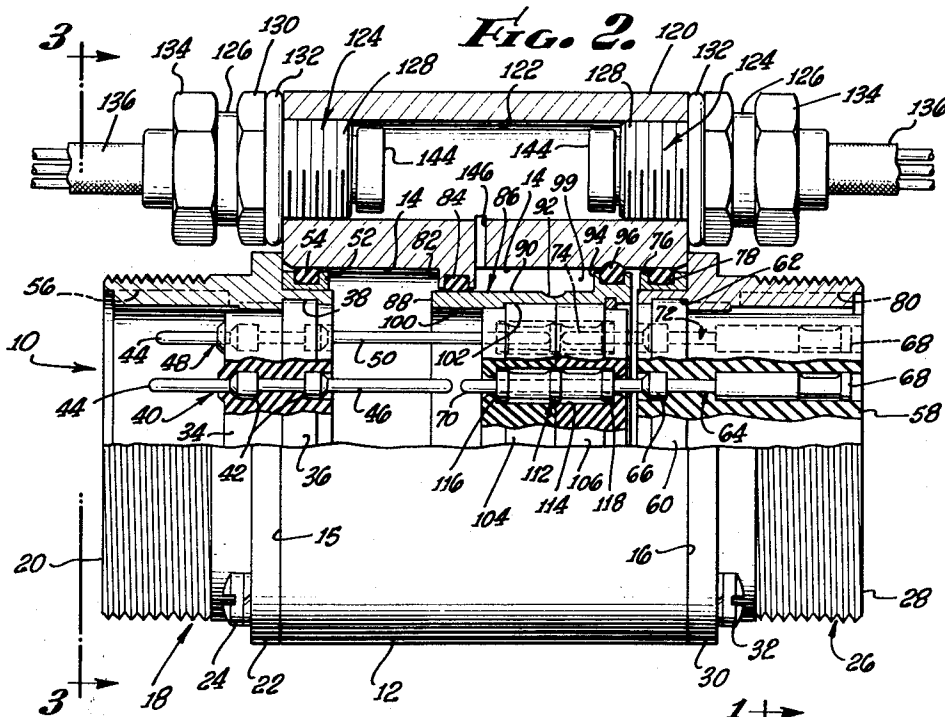
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PRESSURE ACTUATED ELECTRICAL SWITCH

Filed April 28, 1959

2 Sheets-Sheet 2



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2,938,976

PRESSURE ACTUATED ELECTRICAL SWITCH

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Filed Apr. 28, 1959, Ser. No. 809,457

14 Claims. (Cl. 200—82)

The present invention relates to electrical switches, and it relates particularly to an electrical switching device adapted to be used in connection with one or more electrical circuits, which is fluid pressure actuated by pneumatic, hydraulic or explosive means.

It is an object of the present invention to provide a fluid pressure actuated electrical switching device adapted to be used in connection with one or more electrical circuits, wherein actuation of the device will open one or more previously closed circuits, or will close one or more previously open circuits, or will combine the opening and closing of circuits.

Another object of the present invention is to provide a fluid pressure actuated electrical switching device of the character described which includes a switching member that is slidable within a body or housing upon the introduction of fluid pressure into the body, movement of the switching member in the body causing the opening or closing, or both the opening and closing, of one or more electrical circuits.

Another object of the present invention is to provide a fluid pressure actuated electrical switching device of the character described in which one or more electrical circuits through the device include pin and socket terminals in the switch body and on a fluid pressure actuated switching member slidably mounted in the body.

Another object of the present invention is to provide a fluid pressure actuated electrical switching device of the character described in which the circuits are made or broken within the device by the pressure actuated movement of a slidable piston switching element which is substantially instantaneously movable from an initial unactuated position to a final actuated position upon the introduction of fluid pressure into the device by pneumatic, hydraulic or explosive means.

Further objects and advantages of this invention will appear during the course of the following part of this specification wherein the details of construction and mode of operation of a preferred embodiment are described with reference to the accompanying drawings, in which:

Figure 1 is an axial vertical section along the line 1—1 in Figure 4, with portions in elevation, illustrating a pressure actuated electrical switching device according to the present invention, the device being in its initial, unactuated position;

Figure 2 is a central axial vertical section, partly in elevation, illustrating the switching device shown in Figure 1 in its final, actuated position;

Figure 3 is an end elevation view, partly in section, taken along the line 3—3 in Figure 2;

Figure 4 is a vertical section taken on the line 4—4 in Figure 1; and

Figure 5 is an enlarged fragmentary sectional view similar to Figure 1, but with the parts in their final actuated positions as shown in Figure 2.

Referring to my drawings, the presently preferred embodiment of my invention as shown is adapted, upon the application of pneumatic, hydraulic or explosive pressure,

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to substantially instantaneously open a multiplicity of electrical circuits, and, during the same switching operation, to close several electrical circuits. In the particular embodiment illustrated, the circuits that are to be closed are only engaged after contact has been broken in the circuits which are to be opened. It will be apparent from the drawings and from the detailed description hereinafter set forth that the present invention is equally adaptable for the making or breaking of circuits, or for the combined making of some circuits and breaking of others. It will also be apparent that the present invention can be used in connection with a single electrical circuit or with any desired number of circuits.

The presently preferred switch 10 shown in the drawings includes a body portion 12 having a generally cylindrical bore 14 therethrough. The bore 14 opens out at flat front and rear ends 15 and 16, respectively, of the body 12.

A front terminal assembly 18 is mounted at the front end of body portion 12, and includes a tubular shell portion 20 having an integral external mounting flange 22. The right-hand or inner end of shell 20 is received within the front end of bore 14, with the shell flange 22 seating flush against the flat front end 15 of body 12 and being attached thereto by suitable screws 24.

A rear terminal assembly 26 is mounted on the rear end of body 12, and includes a tubular shell portion 28 having an integral external mounting flange 30 that is affixed to the flat rear end 16 of body 12 by means of suitable screws 32.

Referring now particularly to the front terminal assembly 18, an insulation block 34 is mounted within the rear portion of the tubular shell 20, insulation block 34 having an external annular flange 36 which seats within a complementary annular groove 38 in the inner wall of shell 20 to hold insulation block 34 in its operative position.

A plurality of contact units or assemblies 40 are imbedded in the insulation block 34, and have suitable enlargements 42 thereon for fixedly positioning the contact units or assemblies 40 in the insulation block 34.

Contact units 40 include external forwardly directed pin contact terminals 44, and internal rearwardly directed pin contact members 46. The contact units or assemblies 40 form parts of the circuits which are closed in the unactuated position of the switching device, and which become open upon pressure actuation of the device, as will be described in detail hereinafter.

In the presently preferred embodiment of my invention illustrated in the drawings, I have also provided several contact units or assemblies 48 which comprise parts of circuits that are normally open in the unactuated position of the device, and which become closed upon pressure actuation of the device, as hereinafter described. These contact units 48 are identical to the contact units 40, with the exception that the internal rearwardly directed pin contact members 50 of the contact units 48 are substantially longer than the pin contact members 46 of contact units 40.

A bushing 52 fits in sealing engagement over the outside of shell 20 within the bore 14 of body 12, bushing 52 being provided with an annular slot in its outer surface for receiving an O ring 54 which completes the seal between receptacle shell 20 and the body portion 12.

The inner wall of the forward or exposed portion of shell 20 is provided with an axial keyway 56 for proper alignment of a conventional electrical connector plug member (not shown) that is operatively engageable in the forward receptacle portion of terminal assembly 18.

The rear terminal assembly 26 is generally similar to the front terminal assembly 18, the tubular shell portion 28 of rear terminal assembly 26 having a suitable insulation block 58 mounted therein.

The insulation block 58 is provided with an external annular flange 60 near its forward or inner end, the flange 60 engaging within an annular groove 62 in the inner wall of shell 28 to position the insulation block 58 within shell 28.

A plurality of contact units or assemblies 64 are imbedded in insulation block 58, and are provided with suitable positioning enlargements 66. The contact units 64 are axially aligned with respective contact units 40 which form a part of the front terminal assembly 18.

Contact units 64 include external, rearwardly directed socket contact terminals 68 and internal forwardly directed pin contact members 70, these pin contact members 70 being axially aligned with respective pin contact members 46 of the front terminal assembly 18. The inner ends of the pin contact members 46 are adjacent to, but slightly spaced from, the inner ends of the pin contact members 70.

I also provide several contact units 72 in the rear terminal assembly 26 which are axially aligned with the respective contact units 48 in the front terminal assembly 18, and which form a part of the circuits that are normally open in the unactuated position of the device, and which become closed upon actuation of the device. These contact units 72 are the same as the units 64, with the exception that the units 72 have relatively short internal forwardly directed pin contact members 74 which are at their inner ends adjacent to, but slightly spaced from, the inner ends of the respective aligned pin contact members 50.

The rear terminal assembly 26 is provided with a sealed engagement with the body 12 by means of bushing 76 mounted over the inner end of shell 28, the bushing 76 having an external groove for receiving an O ring 78 which engages the cylindrical bore 14 of body 12.

An internal axial keyway 80 is provided in the exposed rear portion of shell 28 for aligning a conventional electrical plug (not shown) that is operatively engageable with the rear receptacle portion of terminal assembly 26.

An inwardly directed annular flange 82 is provided within the cylindrical bore 14 of body portion 12 intermediate the ends of bore 14. The inner surface of flange 82 is grooved to receive an O ring 84.

My presently preferred movable switching member comprises a piston assembly 86 slidably mounted within cylindrical bore 14 between the front and rear terminal assemblies 18 and 26, respectively. Piston assembly 86 includes a generally cylindrical shell or sleeve 88 having a cylindrical outer wall 90 with an annular locking groove 92 therein. A radially outwardly extending flange 94 is provided at the rear end of piston shell 88 as shown in Figures 1, 2 and 5, the outer periphery of flange 94 being grooved to receive an O ring 96.

An annular locking groove 98 is provided in the cylindrical bore 14 of body portion 12 closely adjacent to the front or inner end of the rear terminal assembly shell 28.

Figure 1 illustrates the piston assembly 86 in its unactuated position, which is its forwardmost position in the cylindrical bore 14. In this position, the forwardmost end of piston shell 88 is closely adjacent to the rearwardmost or inner end of the front terminal assembly shell 20, and the O ring 84 on flange 82 is seated in groove 92 in the outer wall of piston shell 88, to lock the piston assembly 86 in this initial, unactuated position until the piston is pressure actuated in the manner hereinafter described. The O ring 84 provides a fluid seal engagement between the flange 82 and the outer wall of the piston shell 88, and the O ring 96 provides a fluid seal between the piston flange 94 and the cylindrical bore 14 of the body 12. Thus, a sealed annular cavity 99 is provided within the cylindrical bore 14 about the piston shell 88, and between the flanges 82 and 94. The piston is moved rearwardly, or to the right in Figures 1, 2 and 5, by the introduction of fluid pressure within this annular cavity 99, this fluid pressure applying a force to the flange 94 to move the piston

assembly 86. Sufficient fluid pressure is applied to dislodge the O ring 84 from the locking groove 92, the piston assembly 86 then sliding rearwardly to its rearwardmost position as shown in Figures 2 and 5, in which the piston flange 94 is closely adjacent to the forward or inner end of rear terminal assembly shell 28, and the O ring 96 on the piston flange 94 seats in locking engagement in the locking groove 98 in the cylindrical bore 14.

Referring now to the internal details of construction of the piston assembly 86, the piston shell 88 has an axial bore 100 with a counterbore 102 opening out at the rear end of piston shell 88. A pair of insulation blocks 104 and 106, comprising an insulation body, are disposed within the piston shell 88. The forward insulation block 104 has a front portion 105 of reduced diameter which fits within the bore 100, thus providing a forwardly facing shoulder on the outside of insulation block 104 which engages against the rearwardly facing shoulder between bore 100 and counterbore 102. The rear insulation block 106 is similarly provided with rear end portion 107 of reduced diameter, to provide a rearwardly facing shoulder which is engaged by a retaining ring 108 that seats within an annular recess 110 in counterbore 102.

A plurality of axial contact units or assemblies 112 are disposed within elongated axial recesses 114 in the insulation blocks 104 and 106, the contact units 112 each comprising coaxial forwardly and rearwardly directed socket terminals 116 and 118, respectively.

The contact units 112, forming a part of the piston assembly 86, are aligned with respective contact units 40 and 48 of the front terminal assembly 18, and contact units 64 and 72 of the rear terminal assembly 26.

In the unactuated or forwardmost position of the piston assembly 86 as shown in Figure 1, it will be seen that the front terminal assembly pin contact members 46 are all engaged in respective piston assembly socket terminals 116, and rear terminal assembly pin contact members 70 are all engaged in piston assembly socket terminals 118, whereby closed circuits are provided. However, in this same forwardmost, unactuated position of piston assembly 86, the piston assembly contact units 112 which are aligned with the pin contact members 50 and 74 are engaged entirely over the front terminal assembly pin contact members 50 without having any contact with the rear terminal assembly pin contact members 74, whereby these circuits are in the open position.

Upon actuation of the device and consequent movement of piston assembly 86 to the actuated position shown in Figures 2 and 5 of the drawings, the piston assembly socket terminals 116 are moved out of engagement with their respective front terminal assembly pin contact members 46 so that the respective piston assembly contact units 112 are engaged entirely over the rear terminal assembly pin contact terminals 70. After the piston assembly socket terminals 116 have become disengaged from the respective front terminal assembly pin contact members 46, the rear terminal assembly pin contact members 74 are engaged by the respective piston assembly socket terminals 118, with the socket terminals 116 remaining operatively engaged with the long front terminal assembly pin contact members 50.

Thus, the originally closed circuits which included the pin contact members 46 and 70 are opened upon actuation of the device, while the originally open circuits including pin contact members 50 and 74 become closed upon actuation of the device.

Referring now to my presently preferred means for providing fluid pressure into the annular cavity 99 to actuate the piston assembly 86, I provide an enlargement 120 on the body 12 of the switch, this enlargement 120 having an axial bore 122 therethrough, the bore 122 extending between the flat front and rear ends 15 and 16, respectively, of body 12.

The bore 122 is internally threaded at its front and rear ends to receive standard pneumatic or hydraulic fit-

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tings (not shown) if desired, or to receive one or more pressure generating explosive squib assemblies 124. Although a single squib assembly 124 may be fitted into one end of bore 122, with the other end being plugged, I presently prefer to employ a squib assembly 124 at each end of the bore 122 in order to increase the reliability of the device.

Although any conventional squib construction may be employed, my presently preferred squib assemblies 124 each include a sleeve 126 having an externally threaded inner end 128 which threadedly engages within an internally threaded end of bore 122. The sleeve 126 has an external flange 130 provided with a hexagonal periphery for receiving a suitable wrench, with an O ring 132 disposed between flange 130 and the flat face of body portion 12 to provide a fluid seal.

Electrical power is provided through a conventional connector plug 134 that is operatively engageable with the outer end of sleeve 126, and through a suitable electrical cable 136. Electrical current is thus applied through a plurality of conductors 138 within the sleeve 126 to a suitable glow ignition element 140 disposed in the explosive containing enclosure 142 at the inner end of the squib assembly. The explosive containing enclosure 142 is covered by a suitable cap 144, which is blown off of the inner end of the squib assembly upon firing.

Upon the firing of one or both of the squib assemblies 124 by the selective introduction of a suitable firing current, the pressure generated within the bore 122 will instantaneously pass through a transfer port 146 from bore 122 to the annular cavity 99 to instantaneously move the piston assembly 86 from its initial unactuated position of Figure 1 to its final actuated position of Figures 2 and 5. The circuits which were initially closed are immediately opened, and the circuits which were initially open will be closed immediately after the other circuits have been broken.

While the instant invention has been shown and described herein, in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is therefore not to be limited to the details disclosed herein, but is to be accorded the full scope of the claims.

What I claim is:

1. An electrical switching device comprising: a body portion having front and rear terminal assemblies thereon, an opening in the body communicating at its opposite ends with the respective front and rear terminal assemblies, a switching member slideably mounted in said body opening between first and second axial positions, an electrical circuit through said device which includes a contact unit having an internal and an external terminal forming a part of each of said terminal assemblies and a contact unit having a forwardly facing terminal and a rearwardly facing terminal forming a part of said slideable switching member, said forwardly facing terminal on said switching member being axially aligned and operatively engageable with said internal terminal of said front terminal assembly, said rearwardly facing terminal on said switching member being axially aligned and operatively engageable with said internal terminal of said rear terminal assembly, both of said switching member terminals being operatively engaged with their respective internal terminal assembly terminals in one of said axial positions of said slideable switching member to close said electrical circuit, and at least one of said switching member terminals being disengaged from its respective internal terminal assembly terminal in the other said axial position of said slideable switching member to open said electrical circuit, and fluid pressure means for moving said switching member from one of its said axial positions to the other.

2. The electrical switching device of claim 1 which

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includes detent means operatively engageable between said slideable switching member and said body for holding said slideable switching member in each of its said axial positions against accidental axial movement.

3. The electrical switching device of claim 1 in which said switching member terminals and said internal terminal assembly terminals are of the pin and socket type.

4. The electrical switching device of claim 1 in which said switching member terminals are socket terminals and said internal terminal assembly terminals are pin terminals.

5. The electrical switching device of claim 1 in which said switching member terminals and said internal terminal assembly terminals are all axially aligned, said switching member terminals comprising socket terminals in open communication with each other at their inner ends to provide a continuous socket terminal passage axially through the switching member, and said internal terminal assembly terminals comprising pin terminals, each of said socket terminals being operatively engaged with its respective said pin terminal in one of said axial positions of said switching member to close said electrical circuit, and both of said socket terminals being operatively engaged over one of said pin terminals and disengaged from the other said pin terminal in the other said axial position of said switching member to open said electrical circuit.

6. The electrical switching device of claim 1 in which a plurality of said electrical circuits are provided.

7. The electrical switching device of claim 1 in which a plurality of said electrical circuits are provided, at least one of said circuits being closed in said first axial position of said switching member and open in said second axial position of said switching member, and at least one of said circuits being open in said first axial position of said switching member and closed in said second axial position of said switching member.

8. An electrical switching device comprising: a body portion having front and rear terminal assemblies thereon, an opening in the body communicating at its opposite ends with the respective front and rear terminal assemblies, said opening including an annular constricted portion and a cylindrical bore extending rearwardly from said constricted portion and having a larger diameter than said constricted portion, a piston switching member slideably mounted in said body opening and axially movable between a forward unactuated position and a rear actuated position, said piston including an annular outer shell having an enlarged rear portion in slideable sealing engagement with said cylindrical bore and having a forwardly extending portion of smaller diameter than said cylindrical bore in slideable sealing engagement with said annular constricted portion of said body opening, whereby a sealed annular cavity is provided between cylindrical body bore and said piston shell, a fluid pressure inlet port in said body communicating with said annular cavity and adapted to selectively provide fluid pressure to said annular cavity to move said piston from said unactuated position to said actuated position, and an electrical circuit through said device which includes a contact unit having an internal and an external terminal forming a part of each of said terminal assemblies and a contact unit having a forwardly facing terminal and a rearwardly facing terminal mounted in said piston shell, said forwardly facing piston terminal being axially aligned and operatively engageable with said internal terminal of said front terminal assembly, said rearwardly facing piston terminal being axially aligned and operatively engageable with said internal terminal of said rear terminal assembly, both of said piston terminals being operatively engaged with their respective internal terminal assembly terminals in one of said axial positions of said piston to close said electrical circuit, and at least one of said piston terminals being disengaged from its respec-

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tive internal terminal assembly terminal in the other said axial position of said piston to open said circuit.

9. The electrical switching device of claim 8 which includes detent means operatively engageable between said piston and said body for holding said piston in each of its said axial positions against accidental axial movement.

10. The electrical switching device of claim 8 in which said piston terminals and said internal terminal assembly terminals are of the pin and socket type.

11. The electrical switching device of claim 8 in which said piston terminals are socket terminals and said internal terminal assembly terminals are pin terminals.

12. The electrical switching device of claim 8 in which said piston terminals and said internal terminal assembly terminals are all axially aligned, said piston terminals comprising socket terminals in open communication with each other at their inner ends to provide a continuous socket terminal passage axially through the piston, and said internal terminal assembly terminals comprising pin terminals, each of said socket terminals being operatively engaged with its respective said pin terminal

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in one of said axial positions of said piston to close said electrical circuit, and both of said socket terminals being operatively engaged over one of said pin terminals and disengaged from the other said pin terminal in the other said axial position of said piston to open said electrical circuit.

13. The electrical switching device of claim 8 in which a plurality of said electrical circuits are provided.

14. The electrical switching device of claim 8 in which a plurality of said electrical circuits are provided, at least one of said circuits being closed in said unactuated position of said piston and open in said actuated position of said piston, and at least one of said circuits being open in said unactuated position of said piston and closed in said actuated position of said piston.

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