

March 25, 1958

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2,828,376

MULTIPLE FLUID SWITCH DEVICE

Filed Nov. 16, 1954

3 Sheets-Sheet 1

Fig. 1.

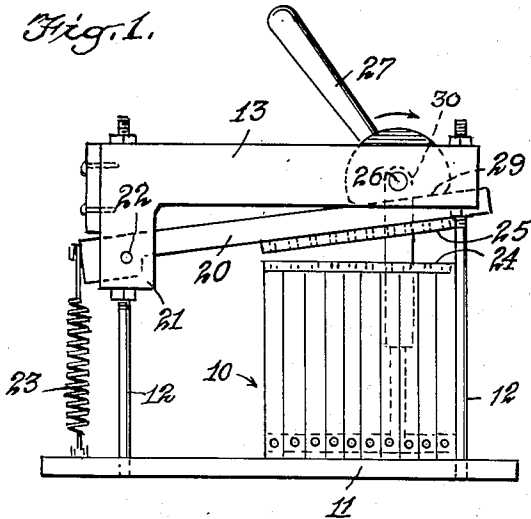


Fig. 3.

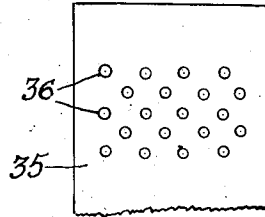
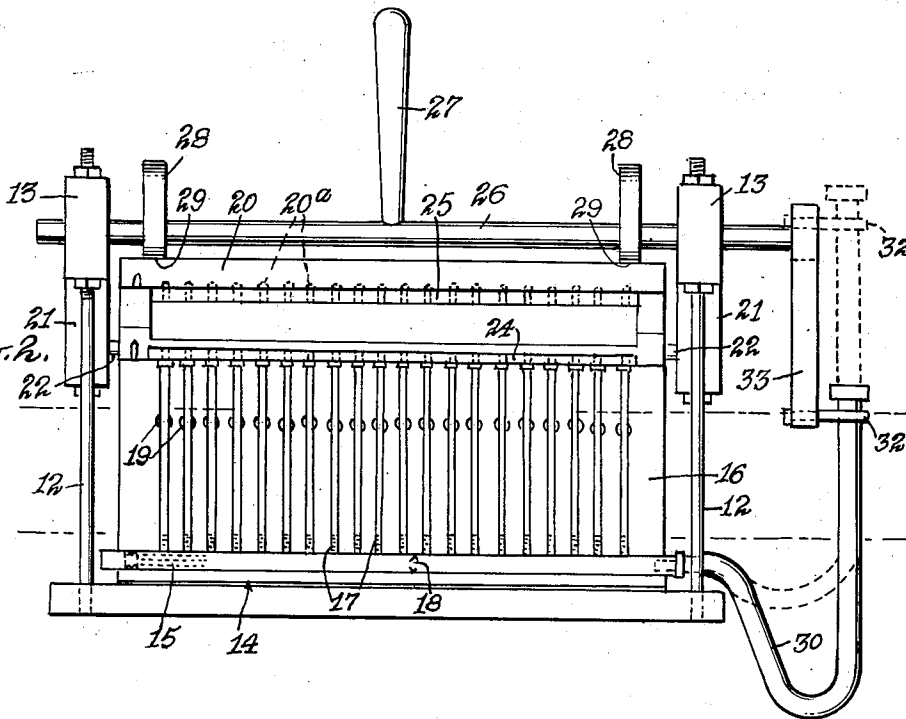


Fig. 2.



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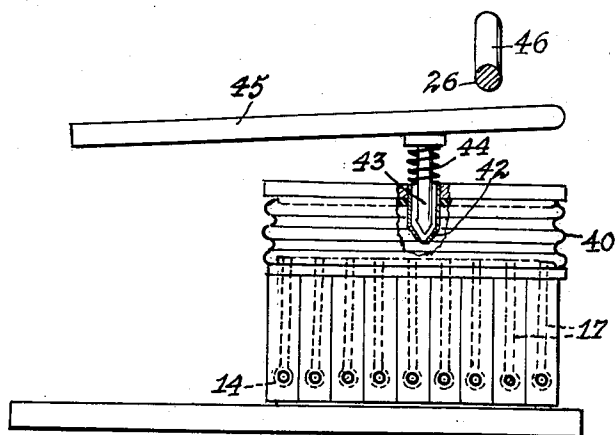
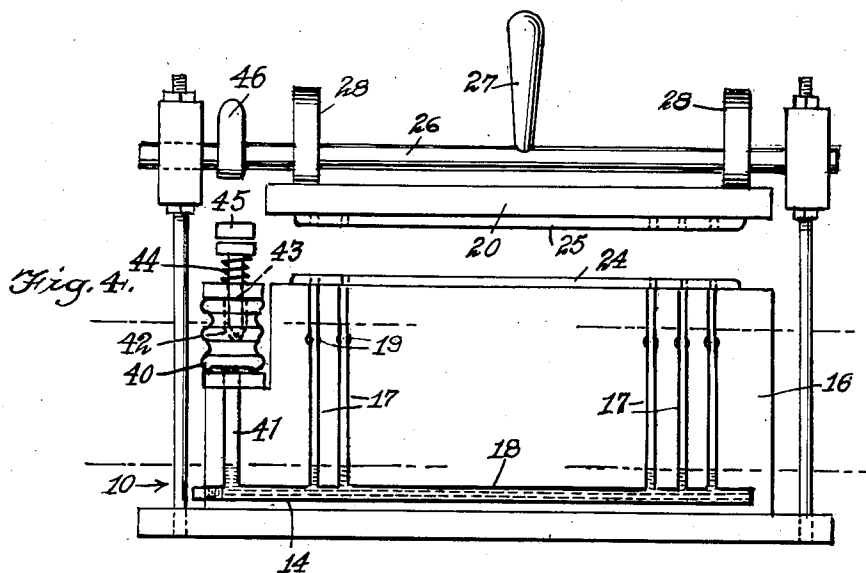
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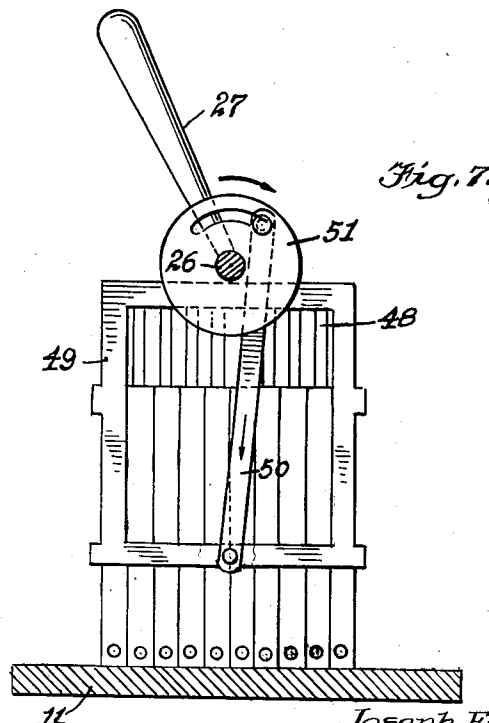
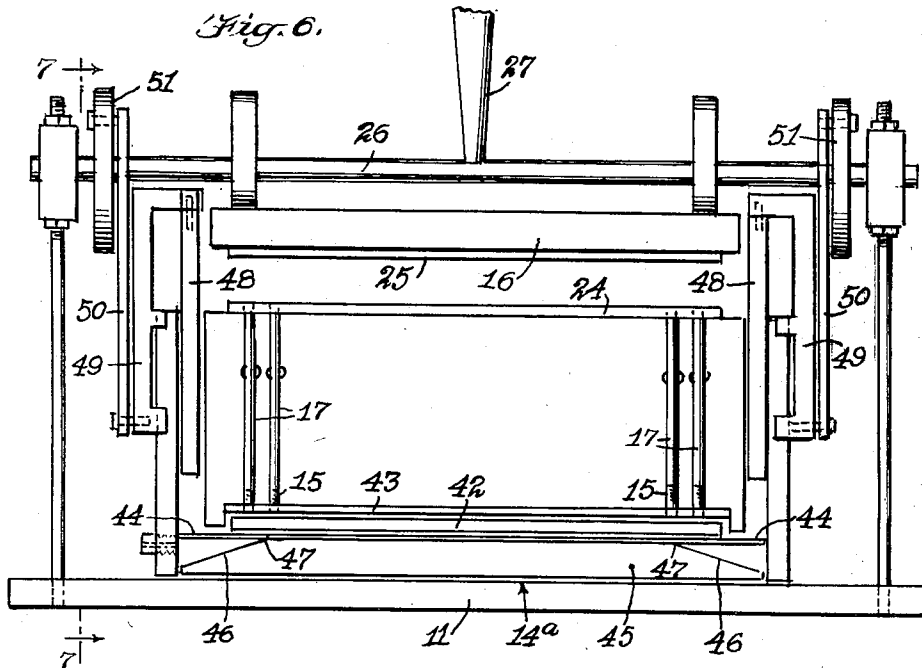
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MULTIPLE FLUID SWITCH DEVICE

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MULTIPLE FLUID SWITCH DEVICE

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18 Claims. (Cl. 200—46)

This invention relates to selector switches, or switches which are selectively operable according to predetermined plans or patterns, and more particularly to switches of this type which utilize a conducting fluid, such as mercury.

An object of the invention is to provide an improved selector or multiple switch device employing a conducting fluid, wherein any of various desired patterns or plans of closed or open circuits may be quickly and easily produced without danger or likelihood of loss of the fluid.

Another object of the invention is to provide an improved switch device as above set forth, which is extremely simple in its construction and easily operated.

A still further object of the invention is to provide a novel and improved fluid switch device of the above type, wherein the closed and open circuits which have been established may be maintained for any desired length of time.

In accomplishing the above objects I provide a novel, fluid switch structure comprising a vessel containing a conducting fluid such as mercury, means providing a plurality of unsealed channels extending from and connecting with said vessel, and electrical contact means in said channels, arranged to be contacted by the mercury when the latter is caused to travel into and occupy portions of the channels. In conjunction with this structure, I provide means including a pattern member such as a perforated card of cardboard or other material, said pattern member being operable to selectively seal or unseal, according to a predetermined plan, the uppermost portions of the channels which are remote from the mercury-filled vessel and which are beyond the contact means. I also provide means for causing the mercury to travel into and occupy any unsealed channel or channels, thereby to engage the contact means and establish a circuit therewith.

By means of this structure, any of a large number of different combinations of circuits may be closed or opened, according to the patterns established on the pattern member. When the closed circuits have been established, I provide a means for sealing the portions of the channels which communicate with the mercury-filled vessel, as by the use of a rubber pad or the like, and as a consequence of such sealing the mercury is maintained at the level determined by the pattern card, thereby maintaining closed or open the desired electrical circuits. The mercury is caused to travel only a predetermined extent in the channels, and at no time does it leave the unsealed ends of the channels; therefore there is obviated any possibility of leakage or loss of mercury at all times.

A feature of the present invention resides in the provision of an improved, multiple-contact, selectively-operable switch as above characterized, which is extremely compact and relatively small in size, so that a large number of circuits may be controlled in a small space.

Another feature of the invention resides in the provision of an electric switch of the multiple selector, mer-

cury-conduction type, which is fast-acting and reliable in its operation.

A still further object of the invention is to provide a multiple-contact mercury switch in accordance with the above, which has relatively few and simple components, is easy to service, and economical to fabricate and manufacture.

Other features and advantages will hereinafter appear.

In the accompanying drawings:

Figure 1 is a side elevational view of a multiple switch device made in accordance with the invention.

Fig. 2 is a front elevational view of the switch device shown in Fig. 1.

Fig. 3 is a plan view of a master pattern card for use with the multiple switch device of Figs. 1 and 2.

Fig. 4 is a front elevational view of a switch device illustrating a modification of the invention.

Fig. 5 is a fragmentary side elevational view of the switch device of Fig. 4.

Fig. 6 is a front elevational view of a switch device in accordance with the invention, incorporating means for maintaining contacts or closed circuits which have been established.

Fig. 7 is a side elevational view of the switch device of Fig. 6.

Referring to Figs. 1 and 2, the improved multiple, fluid switch shown therein comprises a frame 10 having a base 11 provided with uprights 12 which support cross bars 13. Carried by the base 11 is a relatively large, flat, low vessel 14 containing a conductive fluid 15 such as mercury. Above the vessel 14 a block 16 is provided, having a large number of juxtaposed, upright channels 17 which are preferably arranged in both rows and columns. The vessel 14 and the block 16 may be advantageously formed of a single piece of material such as plastic or the like, in which event the channels 17 would be formed by inserts in the mold if the block were cast or molded, and the space 18 constituting the interior of the vessel 14 formed either by inserts or suitable machine operations. The above structure may also be fabricated by cementing or otherwise attaching to the block 16 a lower plate spaced from the bottom of the block, such plate constituting the bottom wall of the vessel 14.

In accordance with the invention, in the channel 17 electrical contact means are provided, spaced a substantial distance above the vessel 14, and such contact means may have the form of pairs of electrical contacts 19 disposed in the channels and arranged to be engaged by the mercury 15 when the latter is forced up to the level of the contact means. The pairs of electrical contacts may be connected to electrical circuits in any desired and suitable manner.

As will be hereinafter fully set forth, the pairs of contacts 19 will be selectively engaged and bridged by the mercury 15 in the vessel 14 in accordance with a predetermined plan or action set forth on a perforated master card adapted to be disposed on the top surface of the channel block 16 and held in intimate contact therewith.

Cooperable with the block 16 and mounted above it is a pressure plate 20 carried by bearings 21 through which a shaft 22 passes, the latter being supported in the cross bars 13. A helical extension spring 23 normally maintains the pressure plate 20 in the raised position shown in Figs. 1 and 2.

The opposed surfaces of the channel block 16 and the pressure plate 20 are provided with rubber coatings or sealing sheets 24 and 25 respectively, said coatings or sheets having perforations corresponding to or in registration with the upper openings of the channels 17. The undersurface of the pressure plate 20 is provided with

grooves 20a opening to the atmosphere and communicating with the perforations of the rubber coating or sheet 25.

For the purpose of shifting the pressure plate downward against the top surface of the block 16, a rocker shaft 26 is provided, having a handle 27 by which it may be turned. The shaft 26 is journaled in the cross bars 13, and carries cams 28 having flat surfaces or reliefs 29 engageable with the pressure plate 20. By this organization, referring to Fig. 1, initial clockwise movement of the handle 27 in the direction of the arrow will cause the pressure plate 20 to be forced downward against the channel block 16, and continued clockwise movement of the handle will maintain the pressure plate 20 in its downward position.

In accordance with the present invention I provide means for applying pressure to the mercury 15 in response to turning of the rocker shaft 26, for the purpose of causing the mercury to rise in the channels 17. This means comprises a flexible tube 30 having a connection at 31 to the vessel 14, the free end of the tube 30 being carried in a collar 32 pivotally mounted on a crank arm 33 which is carried by one end of the rocker shaft 26. The mercury 15 in the vessel 14 will occupy the tube 30, preferably to a level indicated at 34, and this level will therefore also be established in the channels 17. From the positions of Figs. 1 and 2, when the handle 10 is moved clockwise the pressure plate 20 will first be brought to the channel block 16 with but little movement of the flexible tube 30. As the rotation of the handle 10 is continued, the pressure plate 20 will be maintained in its lowered position, and the crank 33 will raise the free end of the flexible tube 30, thereby raising the level of the mercury in the lower bend of the tube and causing the mercury to rise in the channels 17 sufficiently to engage and bridge the pairs of contacts 19.

By the present invention I provide, in conjunction with the channel block 16 and pressure plate 20, master perforated pattern cards such as the card 35 shown in Fig. 3, adapted to be disposed between the top surface of the channel block 16 and the pressure plate 20 and to be held in intimate contact with said top surface by the pressure plate. The pattern cards 35 have perforations 36 disposed according to a predetermined pattern, said perforations being adapted to register with certain of the channels 17 of the channel block 16. When a card 35 is properly positioned on the top surface of the channel block 16 and the pressure plate 20 brought down to tightly hold the card in engagement with the channel block, the perforations 36 of the card will enable certain of the channels 17 to communicate with the grooves 20a in the lower face of the pressure plate 20. Accordingly these channels will be open to the atmosphere, and when pressure is applied to the mercury 15 it will enable the mercury to ascend the channels 17 and engage the pairs of contacts 19. The remaining channels 17 will be sealed by the imperforate portions of the card 35, and accordingly the mercury 15 will not be able to rise in these sealed channels. Therefore the circuits connected with the contacts 19 of the sealed channels 17 will remain open, whereas the circuits connected with the contact 19 of the unsealed channels will be closed. By arranging the perforations 36 of the card 35 in different patterns, any of a very large number of different combinations of closed and open circuits may be produced, and various cards may be employed to produce various combinations.

When the card 35 is made of cardboard, heavy paper, or other semi-porous material, a certain amount of leakage results during use of the card which causes an imperfect seal of the channel 17, and therefore the circuits which are established will be maintained only for a short period of time. This may be obviated by making the cards 35 of a non-porous material such as flexible plastic, metal or the like, and in such event the circuit

pattern may be maintained over an appreciably long period of time.

A modification of the invention is shown in Figs. 4 and 5. In this figure portions of the switch device which are similar to those already described above have been given identical characters. In Figs. 4 and 5 the means for applying pressure to the mercury is different from that of Figs. 1 and 2. Instead of the flexible tube 30 of Figs. 1 and 2 there is shown in Figs. 4 and 5 a bellows 40 connected by channels 41 to the mercury containing vessel 14. The bellows 40 has a valve seat 42 closed by a valve pin 43 normally held in open position by a helical compression spring 44. The valve pin 43 is actuated by a lever 45 pivoted on the frame 10 of the switch, said lever being in turn depressed by means of a cam 46 on the rocker shaft 26 of the switch device. When the lever 45 is depressed it will first close the valve 42, 43 and thereafter depress the bellows 40 to cause the desired controlled rise of mercury in the channels 17. When the lever 45 is raised, the bellows 40 will expand with the valve 42, 43 open, and the mercury 15 will again resume its normal low position, opening all of the circuits.

Another embodiment of the invention is shown in Figs. 6 and 7. Portions of the switch shown in these figures which are similar to those described above have been given identical characters. In Figs. 6 and 7 I provide a means by which the mercury is maintained in circuit-closing position regardless of the action of the master pattern card 35. This means comprises a rigid sealing plate 47 disposed in the mercury-containing vessel 14a, said plate being engageable with a rubber facing or strip 43 carried on the upper surface of the vessel 14a where the channels 17 communicate with the vessel. When the plate 42 is raised and held tightly against the rubber strip 43 it will prevent passage of mercury from the vessel 14a to the channels 17 and vice versa. It is understood that the rubber strip 43 is perforated to register with the channels 17.

Automatic actuation of the sealing plate 42 is accomplished by means of leaf springs 44 disposed below the plate 42 and resting on the lower wall 45 of the vessel 14a, said lower wall having relieved portions 46 providing fulcrum edges 47 cooperable with the leaf springs 44.

The ends of the leaf springs 44 are engageable by plungers 48 which are connected to slides 49 in turn actuated by connecting rods 50 driven by cranks 51 on the rocker shaft 26. When the plungers 48 are brought downward they will engage the ends of the leaf springs 44 and flex the springs so as to raise the rigid plate 42 and securely hold the latter tightly against the rubber facing 43 on the upper surface of the mercury-containing vessel 14a. Thus any movement of the mercury 15 in the channel 17 will be prevented. It will be understood that initial turning of the rocker shaft 26, as in the previous illustrations, clamps the master pattern card 35 against the top of the channel block 16, the thereafter continued movement of the rocker shaft 26 will cause the plungers 48 to actuate the springs 44 so as to raise the sealing plate 42.

The switching device of the present invention, as above set forth, is seen to be extremely simple in construction, having relatively few parts of simple structure, to be reliable and foolproof in operation, and economical to fabricate and manufacture. The application of pressure to the mercury and to the mercury containing vessel may be closely controlled, thereby to eliminate any possibility of mercury being forced out of the open ends of the channels which contain the electrical contacts. The various parts are readily accessible for servicing, if necessary.

Variations and modifications may be made within the scope of the claims, and portions of the improvements may be used without others.

I claim:

1. A fluid switch device comprising a vessel containing mercury; means providing a plurality of unsealed chan-

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nels extending from and connecting with said vessel; electrical contact means in said channels, arranged to be contacted by the mercury when the latter is caused to travel into and occupy portions of the channels; means including a pattern member, operable to selectively seal or unseal according to a predetermined plan portions of the channels remote from the vessel and beyond said contact means; and means including a fluid line connected to said vessel for causing the mercury to travel at will into and occupy any unsealed channel or channels and engage the said contact means, thereby to establish a circuit therewith.

2. The invention as defined in claim 1 in which there is releasable means for maining stationary the mercury which engages the said contact means.

3. A fluid switch device comprising a vessel containing mercury; means providing a plurality of unsealed channels extending from and connecting with said vessel; electrical contact means in said channels, arranged to be contacted by the mercury when the latter is caused to travel into and occupy portions of the channels; means including a pattern member, operable to selectively seal or unseal, according to a predetermined plan, portions of the channels remote from the vessel and beyond said contact means; means for causing the mercury to travel at will into and occupy any unsealed channel or channels and engage the said contact means, thereby to establish a circuit therewith; releasable means for maintaining stationary the mercury which engages the said contact means, including means for sealing the channels at the points where they join the said vessel.

4. The invention as defined in claim 3, in which the vessel has a flat perforated wall from which the channels extend, and in which the means for sealing the channels to maintain the mercury stationary includes a member engageable with said wall to cover and seal the perforations thereof.

5. The invention as defined in claim 4, in which the member engageable with the perforated wall of the vessel comprises a resilient rubber pad.

6. A fluid switch device comprising a vessel containing mercury; means providing a plurality of unsealed channels extending from and connecting with said vessel; electrical contact means in said channels, arranged to be contacted by the mercury when the latter is caused to travel into and occupy portions of the channels; means including a pattern member, operable to selectively seal or unseal, according to a predetermined plan, portions of the channels remote from the vessel and beyond said contact means; means for causing the mercury to travel at will into and occupy any unsealed channel or channels and engage the said contact means, thereby to establish a circuit therewith; releasable means for maintaining stationary the mercury which engages the said contact means, said releasable means being interconnected with the means for causing travel of the mercury, so as to be operative after the latter-mentioned means.

7. The invention as defined in claim 2 in which the means for maintaining the mercury stationary is interconnected with the means for selectively sealing the channels, so as to be operative after the latter means.

8. The invention as defined in claim 1 in which the means for causing the mercury to travel into the channels includes means for applying pressure to the mercury in the said vessel.

9. The invention as defined in claim 8 in which the means for applying pressure includes a bellows connected to the means for sealing the channels.

10. A fluid switch device comprising a vessel containing mercury; means providing a plurality of unsealed channels extending from and connecting with said vessel; electrical contact means in said channels, arranged to be contacted by the mercury when the latter is caused to travel into and occupy portions of the channels; means including a pattern member, operable to selectively seal

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or unseal, according to a predetermined plan, portions of the channels remote from the vessel and beyond said contact means; means for causing the mercury to travel at will into and occupy any unsealed channel or channels and engage the said contact means, thereby to establish a circuit therewith, said means for causing the mercury to travel into the channels including means for applying pressure to the mercury in said vessel, said pressure-applying means including a bellows connected to the means for sealing the channels, said bellows having a vent opening, and said connection between the bellows and means for sealing the channels including a valve adapted to close said opening when the connection is operative to actuate the bellows.

11. A fluid switch device comprising a vessel containing mercury; means providing a plurality of unsealed channels extending from and connecting with said vessel; electrical contact means in said channels, arranged to be contacted by the mercury when the latter is caused to travel into and occupy portions of the channels; means including a pattern member, operable to selectively seal or unseal, according to a predetermined plan, portions of the channels remote from the vessel and beyond said contact means; means for causing the mercury to travel at will into and occupy any unsealed channel or channels and engage the said contact means, thereby to establish a circuit therewith; a shaft having a cam operating the means for selectively sealing the channels; and a driving connection between the shaft and the means for causing the mercury to travel.

12. The invention as defined in claim 11 in which the driving connection between the shaft and the means causing the mercury to travel includes a cam providing lost motion.

13. A fluid switch device comprising a vessel containing mercury; means providing a plurality of unsealed channels extending from and connecting with said vessel; electrical contact means in said channels, arranged to be contacted by the mercury when the latter is caused to travel into and occupy portions of the channels; means including a pattern member, operable to selectively seal or unseal, according to a predetermined plan, portions of the channels remote from the vessel and beyond said contact means; means for causing the mercury to travel at will into and occupy any unsealed channel or channels and engage the said contact means, thereby to establish a circuit therewith; a shaft having a cam, operating the means for selectively sealing the channels; and a lost motion driving connection between the shaft and the means for maintaining the mercury stationary.

14. The invention as defined in claim 1 in which the contact means comprises pairs of closely-spaced contacts disposed in the channels, said pairs of contacts being bridged by the mercury when engaged thereby.

15. A fluid switch device comprising a vessel containing mercury; means providing a plurality of unsealed channels extending from and connecting with said vessel; electrical contact means in said channels, arranged to be contacted by the mercury when the latter is caused to travel into and occupy portions of the channels; means including a pattern member, operable to selectively seal or unseal, according to a predetermined plan, portions of the channels remote from the vessel and beyond said contact means; means for causing the mercury to travel at will into and occupy any unsealed channel or channels and engage the said contact means, thereby to establish a circuit therewith, said means for selectively sealing the channels and means for causing the mercury to travel into the channels being interconnected for related operation.

16. The invention as defined in claim 1 in which the channel-providing means provides a plurality of rows and plurality of columns of channels disposed in a regular, rectangular pattern.

17. A fluid switch device comprising a vessel containing mercury; means providing a plurality of unsealed

channels extending upward from and connecting with said vessel; electrical contact means in said channels, disposed above the normal level of said mercury and arranged to be contacted thereby when the mercury is made to rise in the channels; means including a pattern member, operable to selectively seal or unseal according to a predetermined plan upper portions of the channels above the said contact means; and means including a fluid line connected to said vessel for causing the mercury to rise at will in any unsealed channel or channels and engage the said contact means, thereby to establish a circuit therewith.

18. A fluid switch device comprising a vessel containing mercury; means providing a plurality of unsealed channels extending upward from and connecting with said vessel; electrical contact means in said channels, disposed above the normal level of said mercury and arranged to

be contacted thereby when the mercury is made to rise in the channels; means including a pattern member, operable to selectively seal or unseal, according to a predetermined plan, upper portions of the channels above the said contact means; in means for causing the mercury to rise at will in any unsealed channel or channels and engage the said contact means, thereby to establish a circuit therewith; a flexible tube containing mercury, connected to said vessel, said means for causing the mercury to rise including means raising the said flexible tube.

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