Feb. 7, 1967 C. H. FLURSCHEIM ET AL 3,303,309

SERIES CONNECTED SWITCHES OF DIFFERENT TYPES

Filed May 11, 1964

4 Sheets-Sheet 1

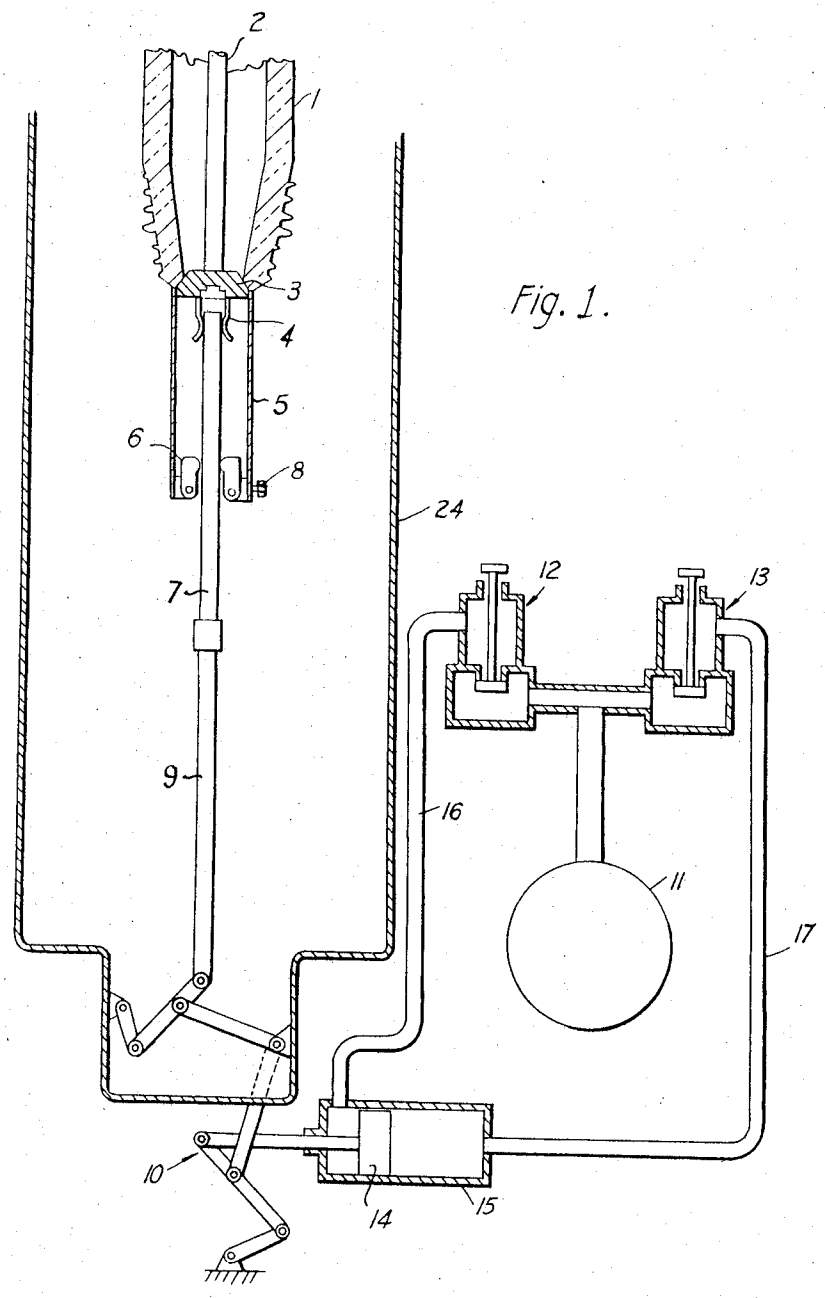

Fig. 1.

SERIES CONNECTED SWITCHES OF DIFFERENT TYPES

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Fig. 2.

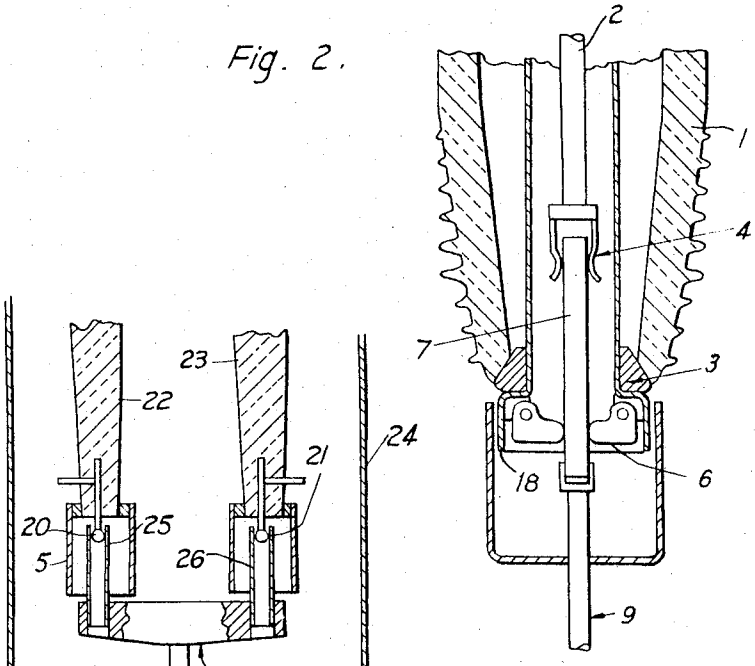
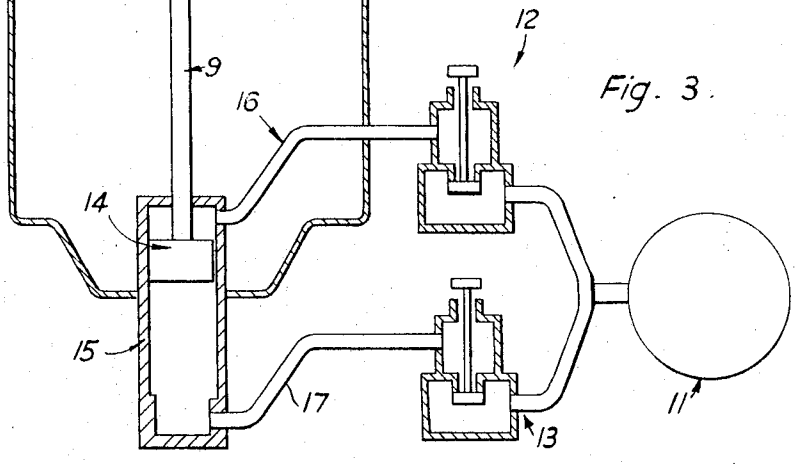


Fig. 3.



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SERIES CONNECTED SWITCHES OF DIFFERENT TYPES

Filed May 11, 1964

4 Sheets-Sheet 3

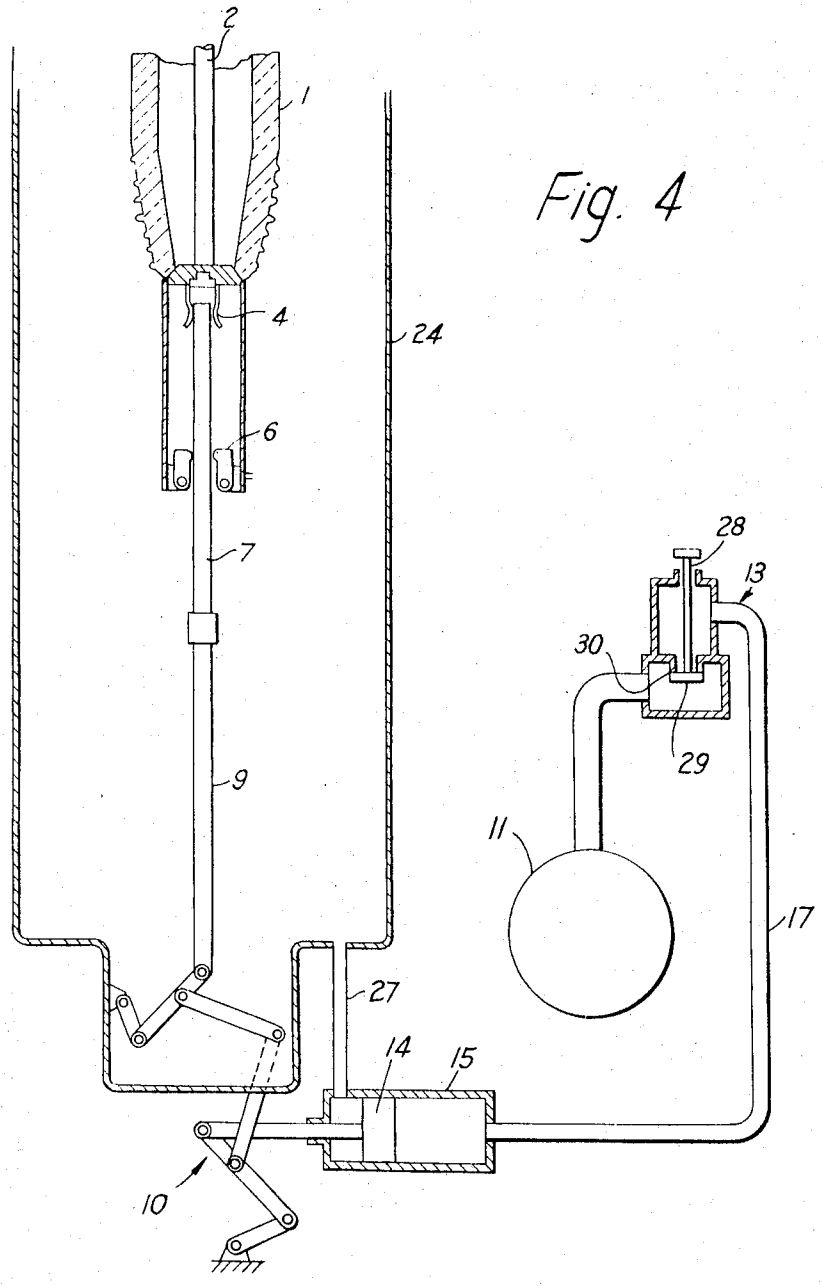

Fig. 4

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SERIES CONNECTED SWITCHES OF DIFFERENT TYPES
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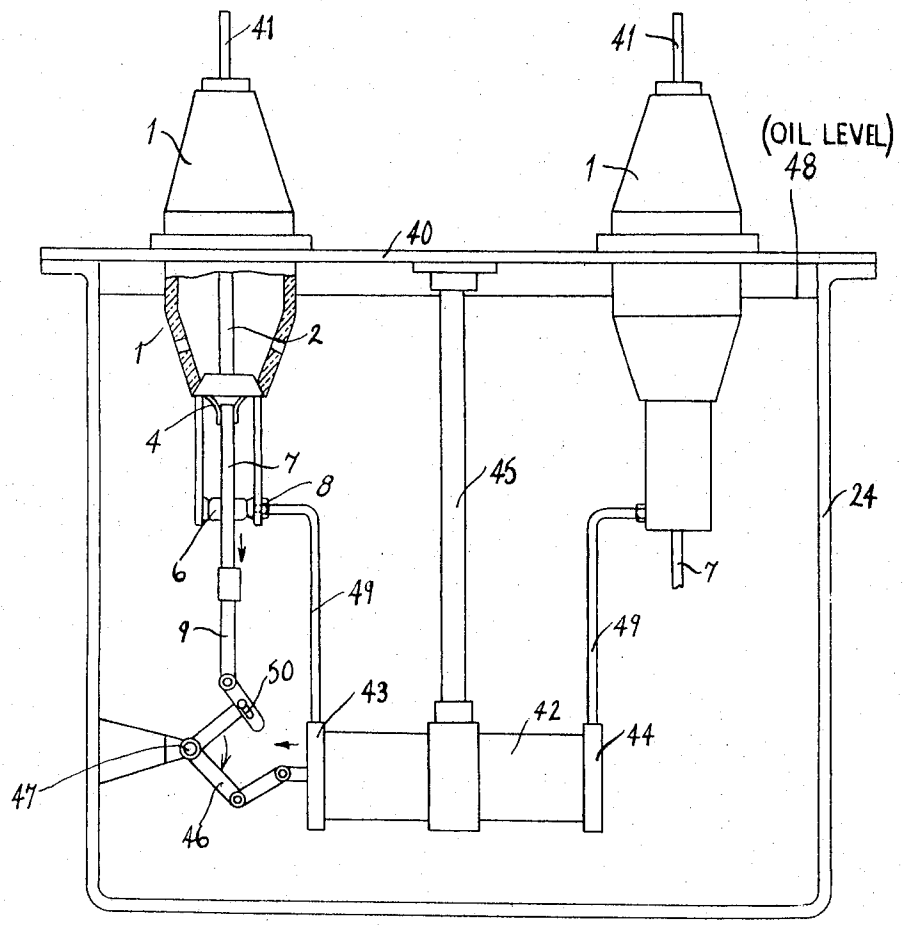

Fig. 5.

United States Patent Office

3,303,309

Patented Feb. 7, 1967

3,303,309

SERIES CONNECTED SWITCHES OF DIFFERENT TYPES

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Filed May 11, 1964, Ser. No. 366,325
Claims priority, application Great Britain, May 14, 1963, 19,111/63
1 Claim. (Cl. 200—144)

This invention relates to electric isolators, with contacts designed to open and close under no-load conditions, connected in series with circuit breaker contacts which are constructed to interrupt and reconnect power current flow. It aims at an improvement which allows savings, particularly in space, while ensuring increased safety under high voltage conditions.

Accordingly the invention resides in an electric switching arrangement comprising an isolator switch and at least one vacuum switch unit connected in series with each other and controlled by a common mechanism, a sealed container enclosing the said switch and unit, also an insulating fluid which is different from air.

A hollow bushing may be mounted on the container to insulate a terminal extending therethrough and then the isolator is advantageously situated adjacent to or in the hollow of the bushing.

Usually the container is filled with an insulating fluid, such as oil, or an insulating gas, then this insulant also surrounds the isolator contacts and improves the flash-over value of the isolator.

Automatic operation of the isolator can readily be provided for, and the invention is particularly advantageous where the circuit breaker contacts are provided by vacuum switches, as more specifically described herein and in our copending patent application No. 366,324, filed May 11, 1964.

More details will become apparent and the invention will be better understood from the following description referring to the accompanying drawings, in which:

FIG. 1 shows an embodiment of the invention having an isolator mounted on the end of a terminal bushing in a circuit breaker tank,

FIG. 2 shows another embodiment where the isolator is partly contained in the hollow of a bushing,

FIGS. 3, 4 show modifications of the arrangement of FIG. 1, and

FIG. 5 shows diagrammatically the pairs of isolator and circuit breaker contacts enclosed in a common container.

In the various figures similar reference characters indicate similar parts.

FIG. 1 shows a hollow bushing **1** which serves for insulating a terminal conductor **2** extending through the top wall (not shown) of a tank **24** which encloses circuit breaker contacts (not shown). The movable contact of the isolator comprises a rod **7** of conducting material, which can be longitudinally reciprocated by a rod **9** of insulating material. Two stationary contacts are provided, the lower one comprising contact pieces **6** spring biased against the rod **7**, and the other comprising a tulip contact **4** mounted on an adapter piece **3** which is conductively joined to the lower end of the terminal conductor **2**, and is fastened to the lower end of the bushing **1**. The lower contacts **6** are held by a shroud **5** of insulating material which is supported by the bushing **1**. A terminal screw **8** is provided for connecting the isolator contact **6** to circuit breaker contacts in the tank **24**, the latter being preferably formed by vacuum switches,

as described in the specification of our abovementioned patent application.

Lowering and raising the movable rod contact **7** for opening and closing the isolator, is effected preferably with the aid of hydraulic or pneumatic means.

To this end, the rod of a piston **14** is connected through lever linkage means **10** to the actuating rod **9** coupled to rod **7**. One end of a cylinder **15** in which piston **14** works, communicates through a pipe **16** and valve **12** with a pressure reservoir **11**, while the other end of the cylinder **15** communicates through a pipe **17** and valve **13** with the reservoir. When valve **12** opens, piston **14** moves to the right and causes opening of the isolator, the conducting rod **7** being withdrawn from the tulip contact **4** while still engaging the contacts **6**. When valve **12** is closed the isolator remains in its open position. When valve **13** opens pressure fluid is supplied to the right-hand of piston **14** to reclose the isolator. Valve **12** may be controlled in dependence upon a mechanism which is trippable to open a circuit breaker before the isolator contacts are separated from one another.

According to FIG. 2, the tulip contact **4** is situated in the hollow of insulating bushing **1**, the contact pieces **6** being now pivoted to an adaptor **3** which is secured to the lower end of bushing **1**. A shroud **18** of insulating material supported by the bushing extends below the isolator contacts **6**.

FIG. 3 shows a double break isolator whose movable contact comprises a bridge or cross bar **19** at the upper end of a rod **9** of electrically insulating material. Stationary contacts **20, 21** of rounded shape and horizontally spaced from each other, are supported through insulators **22, 23** by the top of a tank **24** which is oil or gas filled and contains circuit breaker contacts constituted for instance by vacuum switches, as described in the specification our abovementioned patent application. Tubular contact pieces **25, 26** mounted on the cross bar **19** are arranged to engage the contacts **20, 21** when rod **9** is raised. Cylinder **15** now extends through the bottom of the tank and is coaxial with the rod **9**. The upper end of the cylinder communicates through a pipe **16** and an "opening" valve **12**, and the lower end of cylinder **15** communicates through a pipe **17** and a "closing" valve **13** with the pressure supply reservoir **11**. As the two contacts **25, 26** move simultaneously a double break is provided. An operation similar to that described with reference to FIG. 1 is achieved, while the interlinking lever arrangement **10** is omitted.

Where vacuum switches are arranged to be operated by pressure transmitted through an insulating fluid filling the tank, pressure which causes opening of the isolator can also be derived from said insulating fluid, as shown in FIG. 4, in which parts previously described in conjunction with the other embodiments are similarly referenced. A cylinder **15** in which the isolator operating piston **14** is reciprocable, has now its left-hand end communicating with the tank **24** through a channel **27**. The actuating rod **9** is interconnected with the rod of piston **14** through a lever linkage as shown in FIG. 1. Pressure applied to the contents of tank **24** is transmitted through channel **27** to the left-hand face of piston **14** and causes opening of the isolator. When the pressure is released, the circuit breaker contacts, specifically the vacuum switches, reclose, as described in the beforementioned specification, but the isolator remains open. The right-hand end of the cylinder **15** communicates through a "closing" valve **13** with pressure supply tank **11**. When valve **13** is opened piston **14** moves to the left and recloses the isolator. During the opening operation when piston **14** moves to the right, pressure medium at the right-hand end of cylinder **15** can escape through pipe **17** and a

port 28 of valve 13 which opens as the valve member 29 engages its seat 30 to interrupt the communication between pressure reservoir 11 and pipe 17.

Referring to FIG. 5 a container or tank 24 enclosing the isolator contacts and circuit breaker contacts has a cover 40. Bushings 1 extending through the cover 40 insulate conductors 2 which lead to external terminals 41. The lower ends of the bushings support stationary isolator contacts 4, 6 as in the FIG. 1 embodiment. A vacuum switch unit 42, preferably comprising two or more vacum switches connected in series, has end contacts 43, 44 conductively connected through conductors 49 to the lower isolator ocntacts 6. The vacuum switch unit 42 may be suspended from the cover 40 by an insulating post 45. A lever linkage 46 is provided to operate both the vacuum switch units and the isolators. While rod 9 is shown only for the left-hand isolator it will be understood that the rod 7 shown at the right-hand bushing 1 will be coupled through a rod 9 to the linkage 46 so that isolator contacts at both bushings are operated simultaneously. In the present arrangement clockwise rotation of an actuating shaft 47 causes first interruption by the circuit breaker contacts of the unit 42 and thereafter, because of the lost motion provided by the pin and slot connection at 50, separation between the isolator contacts 4, 7. The level of an insulating liquid is indicated at 48 so that the unit 42 and the isolator contacts 4, 6 are immersed in the liquid.

Modifications are possible without departing from the invention. While a single-phase arrangement has been shown the invention is applicable to polyphase systems. The cross bar carrying two movable contacts to provide for a double break isolator, as shown in FIG. 3, could be actuated through a lever linkage, as shown in FIG. 1, and the "opening" end of cylinder 15 of FIGS. 1 and 3 could communicate directly with the fluid in tank 24 to be operated by pressure increase in the tank, the opening of the isolator being delayed in relation to the opening of the circuit breaker contacts, such as by allowing for some initial movement before the isolator contacts disengage.

If desired a means can be provided to indicate outside the tank, or isolator enclosure, whether the isolator contacts are open or closed. Stress grading cylinders of conducting material can be arranged in the hollow terminal.

Circuit breaker or isolator contact operating means, or any other detail, shown in one of the figures can be used with any constructional detail shown in one of the other figures.

What we claim is:

An electric switch gear for high voltage power circuits comprising an outer container, a pair of insulating bushings extending into said container, a terminal in each bushing extending into the container, a vacuum circuit breaker within said container, a fluid insulant surrounding said vacuum circuit breaker and within the space of said outer container, first and second isolator circuit breakers within said outer container with one contact of each of said isolator breakers electrically connected to a respective terminal, said isolator breakers and vacuum switch being in series with each other and the vacuum switch being electrically positioned between the two isolator breakers and a common operating mechanism which opens the vacuum switch prior to opening of the isolator breakers and closes the vacuum switch after closing the isolator breakers.

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