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VACUUM CIRCUIT BREAKER

Original Filed April 6, 1923

Fig. 1

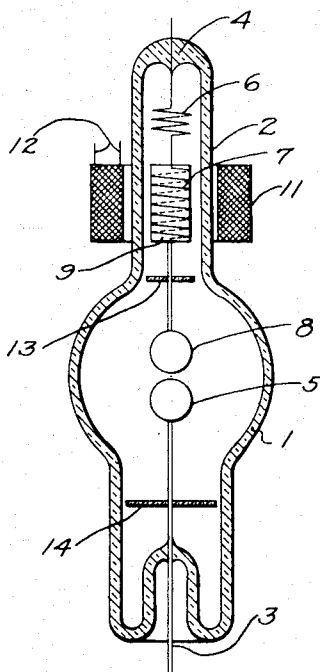
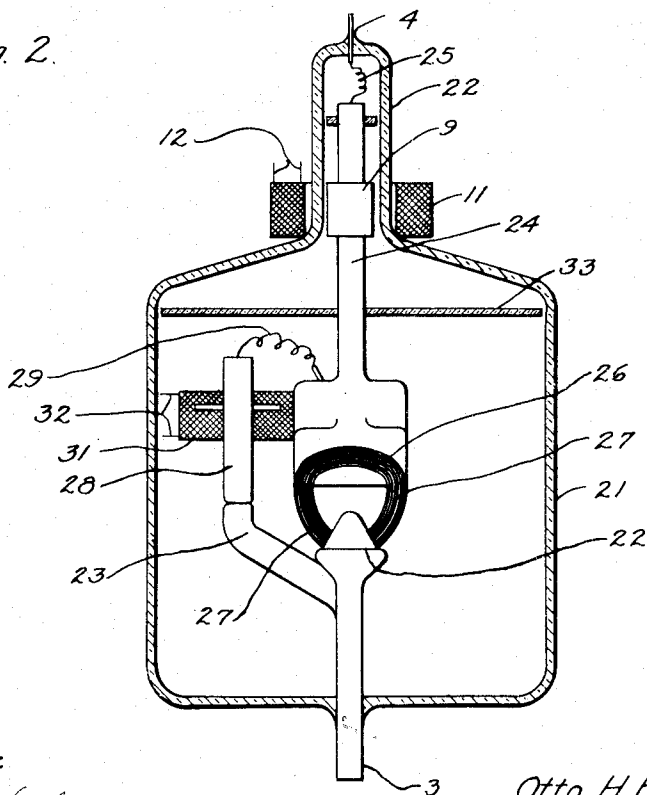


Fig. 2



WITNESSES:

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VACUUM CIRCUIT BREAKER

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My invention relates to circuit interrupters and more particularly to circuit interrupters in which relatively movable contact members are separated in a highly rarefied atmosphere.

One object of my invention is to provide a circuit interrupter having relatively movable contact members to be separated in a highly rarefied atmosphere.

Another object of my invention is to provide a circuit interrupter having relatively movable contact members contained in a sealed receptacle.

A further object of my invention is to provide a circuit interrupter by means of which an electrical circuit may be interrupted in a highly rarefied atmosphere.

It is also an object of my invention to provide a circuit interrupter the relatively movable parts of which are mounted within a sealed receptacle and having means mounted externally of the receptacle for creating relative movement between the parts.

It is a well-known fact that an arc is supported by an ionized atmosphere between terminals. This atmosphere may consist of elemental gases, such as hydrogen, oxygen, nitrogen, etc., together with certain metallic vapors, such as copper, tungsten, calcium, etc., which may be volatilized from the metal contact members. I propose to rarefy the atmosphere surrounding the contact members to approximately a perfect vacuum, or to a pressure of less than one one-hundredth of a millimeter of mercury, for the purpose of requiring a large voltage gradient to either ionize the remaining gases or to cause electrons to flow from the switch terminals. I have determined that in a high vacuum an electromotive force of the order of one million volts is required to cause an electron flow from contact members spaced one centimeter apart. No transfer of current can take place between the separated contact members in a highly rarified atmosphere until an ionized path or an electron stream has been created.

In the accompanying drawing:

Figure 1 is a sectional view of a circuit interrupter embodying my invention, and

Fig. 2 is a sectional view of another form of circuit interrupter embodying my invention.

In the several figures of the drawing similar reference numerals indicate like parts.

In the preferred form of my invention, as is shown in Fig. 1, a receptacle 1 preferably in the form of a sealed glass tube, is provided with an extension 2. The contents of receptacle 1 are reduced to a highly rarefied atmosphere approximating a perfect vacuum.

Electrical terminals 3 and 4 are sealed in the walls of the receptacle 1. Electrical terminal 3 supports a stationary contact member 5. The terminal 4 is connected to a pair of resilient members 6 and 7 which, in turn, support a movable contact member 8. The resilient member 7 surrounds and supports a magnetizable member 9.

Mounted exteriorly of the extension 2 is a solenoid 11 which is energized in any suitable manner by an electric circuit 12. The receptacle 1 is provided with baffle plates 13 and 14 which may be composed of suitable gas absorbing material, such as calcium, phosphorus or magnesium in order that any metallic gases which may be generated within the receptacle 1 are reduced and the rarefied atmosphere thereby maintained. The plates 13 and 14 also function to prevent any condensed terminal vapors from short-circuiting the electrodes. The contact members 5 and 8 may also be composed of suitable gas-removing material.

In the operation of the preferred form of my circuit interrupter, which is shown in the open position in Fig. 1, the contact members 5 and 8 are brought into electrical contact, whereupon electrical current traverses the terminal 4, resilient members 6 and 7, contact members 8 and 5 and terminal 4.

In order to interrupt the circuit, the solenoid 11 is energized through its terminals 12, thereby attracting the magnetizable member 9 upwardly. The movable contact member 8 is simultaneously separated from the stationary contact member 5. By reason of the highly rarefied atmosphere within the receptacle 1, such arc as may be drawn between the contact members 5 and 8 cannot

long endure because of the absence of an ionized gas path.

In the event that certain occluded gases are released during the circuit interrupting movement, such gases are removed upon coming in contact with the plates 13 and 14. By reason of the relatively small arc generated in the receptacle 1, the total arc energy developed during the interruption of a circuit is materially reduced as compared with the interruption of currents of equal amperage and voltage in an open circuit interrupter, where an ionized path is readily built up.

In the form of my invention shown in Fig. 2, a receptacle 21, having a tubular extension 22, of reduced diameter, is provided with terminal members 3 and 4, a solenoid 11 having terminals 12, similar to those shown in Fig. 1. The receptacle 21 has a relatively large diameter which is uniform for an appreciable proportion of its length.

The terminal 3 carries a stationary contact member 22 of conical shape and an associated arcing tip 23. The terminal 4 is attached to an elongated conductor 24 by a flexible conductor 25. The conductor 24 terminates in a contact member 26, which is preferably composed of a plurality of brushes 27 adapted to engage the conical contact member 22 during the closed position of the circuit interrupter. Movable arcing tip 28 is connected by a conductor 29 to a main contact member 26. A magnetic coil 31 surrounds and supports the arcing tip 28 and is connected to any suitable controlling means (not shown) by terminals 32. Conductor 24 is provided with a magnetizable member 9 that constitutes a core member for solenoid 11. A gas absorbing plate 33 is provided which corresponds to the plates 13 and 14 shown in Fig. 1.

In the operation of the circuit interrupter shown in Fig. 2, the solenoid 11 is energized through its terminals 12 thereby causing the magnetizable member 9 to be drawn upwardly to separate the contact member 22 and the brushes 27. Virtually no arcing occurs between the main contact members because of the parallel circuit through the arcing tips 23 and 28. Current then traverses the arcing tip 28. The latter is moved upwardly after a suitable interval by reason of the magnetic attraction of the coil 31, thereby separating from the arcing tip 23. Such arc energy as is developed in this form of my invention occurs between the arcing tips 23 and 28. The operation of this form of my invention is otherwise the same as that shown and described in connection with Fig. 1.

It will thus be seen that I have provided a circuit interrupter in which the high dielectric properties of a rarefied atmosphere are employed for the purpose of controlling arc rupture and eliminating undesirable arc gases. By reason of the very high potential

gradient developed by circuit interrupter acts as an electric valve.

Certain materials, notably calcium, phosphorus and magnesium, have the property of improving the vacuum in vessels exhausted to low pressures, when they are vaporized and permitted to recondense. This may be due to a process of adsorption. Such substances are known in the art as "getters" and I intend that term in the claims to cover any substances having the above-described properties.

While I have shown and described my invention in its preferred form, it is apparent that modifications may be made in the arrangement of the mechanism for controlling the positions of the circuit interrupters without departing from the spirit of my invention. I desire, therefore, to be limited only to the scope of the appended claims.

I claim as my invention:

1. A circuit interrupter comprising a vacuum-tight container and a pair of separable contact members comprising one of the materials calcium, magnesium.

2. A circuit interrupter comprising a vacuum-tight container and a pair of separable contact members therein, and barriers in said container comprising one of the materials calcium, magnesium, phosphorus.

In testimony whereof, I have hereunto subscribed my name this 4th day of April 1923.

OTTO H. ESCHHOLZ.