Dec. 1, 1942. W. H. GERISCH 2,303,834

LIQUID CONTACT CIRCUIT CLOSER

Filed Sept. 13, 1941

Fig. 1.

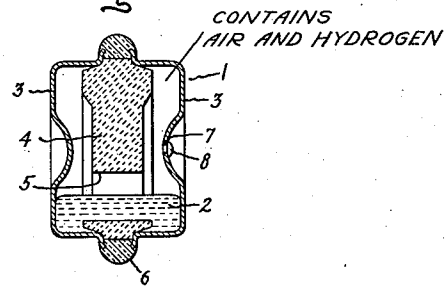
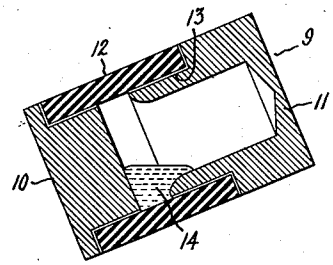


Fig. 2.



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LIQUID CONTACT CIRCUIT CLOSER

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7 Claims. (Cl. 200—152)

The present invention relates to circuit closers of the type having an envelope which contains a small quantity of mercury arranged to complete and interrupt a circuit between the terminals of the circuit closer.

It is a primary object of the invention to provide improved circuit closers of the type specified above and more particularly to increase to the safe current carrying capacity of such circuit closers. In this connection, I have discovered that high temperature arcs heretofore incident to the operation of mercury-containing circuit closers and the attendant destructive effects of such arcs can be minimized by the introduction into the circuit closer of a conditioning medium which contains hydrogen and oxygen, both in substantial proportions.

For an explanation of the invention and for a consideration of what I believe to be novel, attention is directed to the accompanying description and the claims appended thereto.

In the accompanying drawing;

Fig. 1 is a sectional elevation of a liquid contact circuit closer (switch) embodying my invention; and

Fig. 2 is a sectional elevation of another type of liquid contact circuit closer also embodying the invention.

The circuit closer illustrated in Fig. 1 of the drawing has an envelope 1 containing a limited quantity of mercury 2. The major portion of the envelope comprises opposed straight-drawn cup-shaped metal terminals 3 juxtaposed to form an enclosed space between them. Between the terminals is a diaphragm or barrier 4 of insulating material having an opening 5 therein through which the mercury flows in order to complete a circuit between the terminals 3, 3. When the said circuit closer is in the position illustrated, the circuit between the terminals is complete. The members 3, 3 are hermetically joined by means of a thin ring 6 of glass or other thermoplastic material sealed directly thereto in such a way as to be also in continuous contact with the outer periphery of the diaphragm 4.

When the circuit closer is rotated about the axis of symmetry of the terminals a few degrees from the position illustrated, the opening 5 is raised clear of the mercury, and the circuit between the terminals is broken by separation of the mercury within the opening as it flows from each end thereof. In this position, the diaphragm separates the mercury into two pools. When the circuit closer is returned to the position illustrated, the circuit between the terminals is completed by the joining of mercury flowing into the opening 5 from each end thereof.

Heretofore, in the commercial production of circuit closers of this type, the switch has been first evacuated and then a charge of hydrogen has been introduced therein of one or more atmospheres, serving as the arc-suppressing medium in the operation of the switch in opening and closing a circuit therethrough.

I have now discovered that in the manufacture of these switches if the step of evacuating the air therefrom is omitted and in addition to the air normally present in the switch there is added thereto hydrogen ranging in pressure from about a few pounds to an atmosphere or even much higher pressures, the arc-suppressing effect of the gaseous filling is materially enhanced and the improvement is so great as to double the current which may be interrupted by a given form of switch without excessive erosion of the barrier. Such hydrogen may be introduced into the circuit closer during the manufacturing process through an opening 7, provided in the metal member 3. This opening 7 is thereafter sealed, preferably by fusion-welding a closure member 8 therein, for example, in accordance with the procedure described and claimed in John H. Payne Patent 2,141,932, issued December 27, 1938.

Results generally similar to those described above as being attributable to the use of mixtures of air and hydrogen in barrier type switches are also obtainable in switches of other types, such, for example, as the pellet or cartridge type of mercury switch shown at 9 in Fig. 2. This comprises metal terminals 10 and 11 of iron or nickel plated iron or chrome-iron spaced apart by a tubular insulating sleeve 12 of fibre or glass press-fitted to the metal terminals with a thin layer of adhesive resin 13 interposed between the metal and the insulating sleeve to insure a gas-tight seal at the respective end junctures thereof. A globule of mercury 14 provided within the switch serves to connect and disconnect the terminals 10 and 11 as the switch is moved into its open and closed positions.

While a complete explanation of the advantageous results obtained by the use of a mixture of hydrogen and air as a switch filling is not yet available, there is enough evidence at hand to show that these results are attributable at least in part to the effect of the oxygen content of the air in conditioning the contact surfaces of the parts within the interior of the switch. For example, it is found that when a mercury switch which contains admixed hydrogen and air is op-

erated several times an observable oxide film appears on the surface of the mercury. This film has the apparent effect of increasing the ability of the mercury to perform its circuit-closing and circuit-interrupting functions. Moreover, it appears that the metal surfaces within the switch are affected in such a way, presumably by slight oxidation, as to decrease the likelihood of a destructive arc being established to these surfaces during the operation of the switch. In this connection it has been repeatedly observed that a switch which has been filled with air and hydrogen produces, during the closing operation, an arc which is very much less intense than that obtained with hydrogen alone. The improvement in this respect and the attendant decrease in the destructive effects obtained during the arcing period are so great as to more than double the circuit-interrupting capacity of a switch of given size.

A significant phenomenon which has been observed during the operation of a switch filled with air in combination with hydrogen consists in the variation of the heating effect which occurs during the initial period of use. During the first few operations on high load the switch tends to become quite warm, indicating an intense arcing condition. However, after operation has been continued for a short time this effect disappears and the switch runs at a lower temperature, a condition which appears to endure indefinitely as long as the switch is used in a normal way. If the switch is materially disturbed, as by taking it from its socket and shaking the switch structure, renewed operation will result in temporary heating, this condition again disappearing, however, with a further continuance of use.

It is believed that the foregoing observations show that a certain amount of time is required for the formation of the oxide film referred to above as being produced on the surface of the mercury. Once this film is produced, however, it appears to exist indefinitely and to exert a helpful influence on the operation of the switch.

Instead of producing the desired filling merely by adding hydrogen to the normal air content of the switch, switches may alternatively be charged from a tank containing a mixture of air and hydrogen. As a still further alternative, the hydrogen normally used for switch fillings may be qualified by an addition of pure oxygen (i. e. instead of air). In either of these last two cases the switches can be flushed a few times by the gaseous mixture and then sealed off at the pressure found desirable.

Still further, oxygen may be introduced into the switch interior in other than a gaseous form. For example, one may incorporate in the switch an oxide which is adapted to be decomposed without harmful by-products when the switch is initially operated to produce an arc between the contacting metallic components. In this connection one may employ, for example, mercuric or mercurous oxides or suitable oxides of nitrogen (e. g. nitrous oxide).

While the invention has been described by reference to two types of switch, it is obviously not limited thereto and I aim in the appended claims to cover all such equivalent applications as come within the true spirit and scope of the foregoing disclosure.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A mercury-containing switch comprising metallic electrodes cooperating with the mercury to complete a circuit through the switch and conditioned by a gaseous filling within the switch comprising atmospheric air qualified by the addition thereto of free hydrogen at a pressure of from one to several atmospheres.

2. A mercury-containing switch comprising metallic electrodes cooperating with the mercury to complete a circuit through the switch and conditioned by inclusion within the switch of a gaseous filling which comprises free oxygen at relatively low pressure and free hydrogen at relatively much higher pressure.

3. A mercury-containing switch comprising metallic electrodes cooperating with the mercury to complete a circuit through the switch and conditioned by a gaseous filling including free oxygen at substantially the pressure at which it exists in atmospheric air and free hydrogen at relatively much higher pressure.

4. The method of preparing a mercury switch which includes assembling the switch parts under such conditions as to leave the switch filled with air, introducing hydrogen into the switch in addition to the air, and thereafter sealing the switch.

5. The method of preparing a mercury switch which includes assembling the switch parts under such conditions as to permit the retention within the switch enclosure of air at atmospheric pressure, and thereafter introducing hydrogen at a pressure of at least several pounds per square inch.

6. A mercury switch comprising metallic elements adapted to serve concurrently as wall parts for the switch and as contact members cooperating with the mercury for establishing a circuit through the switch, said switch containing a gaseous filling at a pressure above atmospheric pressure and comprising free hydrogen and free oxygen, both gases being present in substantial amounts.

7. A mercury switch comprising metallic elements adapted to serve concurrently as wall parts for the switch and as contact members cooperating with the mercury for establishing a circuit through the switch, said switch being conditioned by a gaseous filling at a pressure above atmospheric pressure comprising free hydrogen and free oxygen, the hydrogen preponderating over the oxygen in said filling.

WALTER H. GERISCH.