No. 876,773. PATENTED JAN. 14, 1908.

F. COSSOR.

MERCURIAL THERMOSTATIC CIRCUIT CLOSER.

APPLICATION FILED AUG. 15, 1907.

Fig. 1.

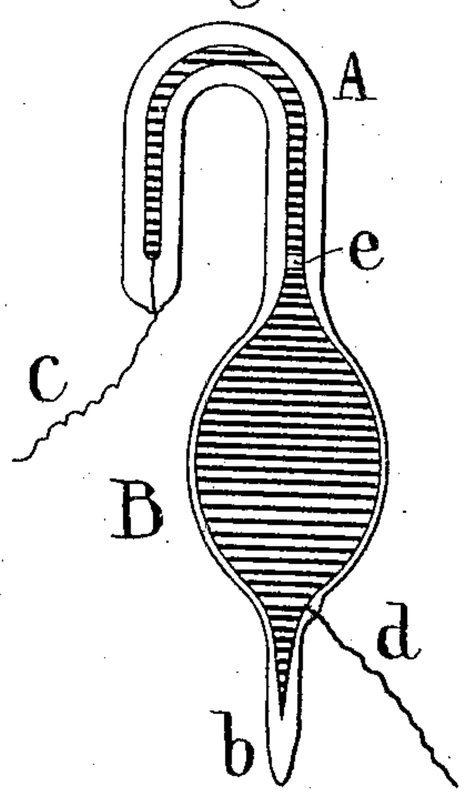


Fig. 2.

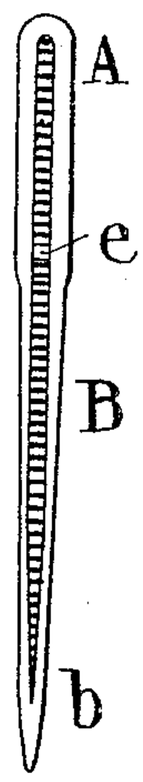
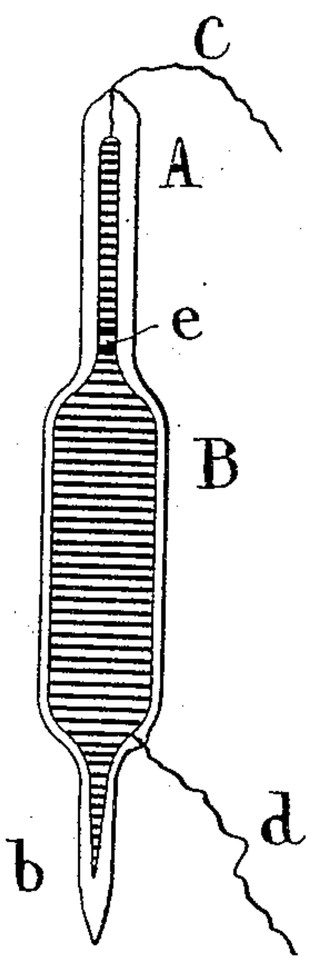


Fig. 3.



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MERCURIAL THERMOSTATIC CIRCUIT-CLOSER.

No. 876,773. Specification of Letters Patent. Patented Jan. 14, 1908.

Application filed August 15, 1907. Serial No. 388,597.

To all whom it may concern:

Be it known that I, FRANK COSSOR, a subject of the King of Great Britain, and resident of 12 Clerkenwell Green, London E. C., England, scientific-instrument maker, have invented certain new and useful Improvements in Mercurial Thermostatic Circuit-Closers, of which the following is a specification.

In mercurial thermostatic circuit-closers as usually constructed, one of the platinum terminals is (or both may be) normally exposed and consequently liable to oxidation or corrosion, and in any case the same mercurial surface (which in general is comparatively large) remains constantly exposed so that the deleterious effects of oxidation or corrosion (instead of being annulled, as would happen if a fresh surface were exposed after each closure of the circuit) are allowed to accumulate. Moreover rupture of the mercurial column in handling or transit is liable to render the appliance useless.

It is the object of the present invention to overcome these defects either partially or wholly, and to this end the circuit-closer is constituted by a body of mercury having an exposed surface or surfaces of very small area, the mercury being contained in a chamber of such form that after each closure of the circuit a fresh mercurial surface may become exposed.

According to one form of my invention the circuit-closer is constituted by a closed glass tube having a fine or capillary bore terminating at one end in a bulb and having platinum leading-in wires sealed into it at two points, viz., one at the closed extremity of the capillary bore and the other at or near the opposite extremity of the bulb, both the bulb and the capillary bore being completely filled with mercury except for the presence of a small space, which being occupied by a bubble of rarefied air at ordinary temperatures separates the mercury column or thread into two parts and constitutes the break in the circuit. Upon the temperature rising to a critical point the mercury, by expanding, condenses this air to such an extent that the two portions of the mercury coalesce, or approximate sufficiently closely to allow the current to pass.

In the accompanying drawings Figures 1 and 2 illustrate one form of the circuit-breaker of my invention viewed in two directions at right angles to one another. Fig. 3 shows a slightly modified form.

A is the capillary tube.

B is the bulb which is drawn out to a point at *b*; *c* and *d* are the platinum leading-in wires.

The bulb B and capillary tube A are completely filled with mercury except for the presence of the small air-space *e* which is normally occupied by rarefied air introduced in the following manner. The bulb and capillary are first filled with warm mercury (the tube being open at *b*) whereupon a minute bubble of air is allowed to enter. By thereafter allowing the mercury to cool and contract, the air-bubble is drawn into the bulb together with more mercury. By agitating the tube the air-bubble is then caused to take up the position *e*. The tube and its contents are then warmed to the "critical" temperature, *i. e.* the temperature at which the instrument is to close the circuit, whereby some of the mercury is expelled from the tube, and the latter is then sealed up at *b*. The mercury by subsequent cooling, undergoes slight contraction within the bulb, thus causing the air-bubble to expand and become somewhat rarefied. The bubble is caused (by agitating the tube, should this be necessary) to take up the position *e* at the junction of the bulb and the capillary and thus form the "break" in the circuit. With this construction, whenever a coalescence of the mercury column has occurred (whether from the apparatus having been accidentally set in action or from a test having been applied to it, the subsequent rupture of the column which takes place upon the mercury cooling down again to the normal temperature, will occur at a point different from that at which the division originally existed, and consequently fresh surfaces of mercury will be exposed and the effects of any oxidation which may have taken place will be nullified. The shifting of the air-gap is apparently due to the thermal action of the spark which is formed when the "break" occurs and which volatilizes some of the mercury.

It is obvious that in the event of a continuous rise in temperature, the glass tube must eventually burst. Hence where the appliance is used as a fire alarm the warning might cease prematurely. It has however been found that the elasticity of the glass suffices to delay the fracture until a

temperature has been reached considerably higher than that at which closure of the circuit takes place. Consequently, by providing a series of such circuit closers, connected in parallel and respectively adapted to permit the closure of the circuit at progressively increasing temperatures, a continuous closure of the circuit may be insured, notwithstanding the destruction of successive tubes as the temperature rises. By using a bulb of flattened form as in Figs. 1 and 2 however, the necessity for employing a plurality of circuit closers may be overcome, since the bulb is capable of expanding for a considerable time after the temperature has passed the point at which coalescence has taken place.

For the efficient working of the circuit-closer it is desirable that the air gap should not become displaced so as to occupy the extremity of the stem and be adjacent to the platinum terminal since in this case the breaking of the circuit would be accompanied by considerable arcing across the gap between the platinum and the mercury, which would be highly detrimental to the instrument. By providing the instrument with a curved stem as shown in Fig. 1, this result may be obviated, for if the tube be set up in a vertical position the air-gap may shift to the highest point of the stem but will never pass round the curve and descend towards the platinum terminal. For some purposes it may however be found preferable to employ a circuit-closer having a straight stem as shown in Fig. 3.

In another form of the circuit closer the bulb is round (spheroidal, or cylindrical) instead of flattened as in the form above described. For use with heavy currents the cylindrical or spherical form is preferable for the following reasons. In using these circuit-closers, it will be found that after an instrument has been set in action a certain number of times, the "critical" temperature has fallen considerably below its original value. It is supposed that this is due to the burning up by the passage of the spark, of the oxygen of the air contained in the air-gap, with the result that a diminished resistance is offered to the expansion of the mercury. Where a flat bulb possessing considerable elasticity is employed, there will be a marked change in the "critical" temperature from this cause, owing to the differential action of the pressure (resulting from the expansion of the mercury) on the glass and on the imprisoned air. But in the case of a round bulb (which for this purpose may be regarded as non-elastic), since the mercury must obviously occupy the same volume at a given temperature, the diminution of the air-pressure resulting from oxidation will have no influence on the mercury in coalescing at a particular temperature, and therefore the original critical temperature will remain constant. This is of course on the assumption that the glass is absolutely non-elastic. Hence where the circuit-closer is to be used for heavy currents capable of producing considerable oxidation in the air-gap it is preferable to employ a non-elastic or round-bulb instrument. Such elasticity as the latter kind do in fact possess is called into action at higher pressures *i. e.* after the closure of the circuit has taken place, and thereby fulfils the requirement of delaying the fracture of the tube for a short period after the alarm has been set in operation.

Claims:

1. In a circuit closer, the combination of a tubular member of insulating material, a column of mercury disposed within said tubular member and provided with a break filled with rarefied air, and electrical connections for different portions of said column located upon opposite sides of said break.

2. In a thermostatic circuit closer, the combination of a glass receptacle provided with a hollow bulb and with a tubular stem communicating therewith, said bulb and said stem both containing mercury, a portion of which is arranged to form a column, said column being broken and having a minute portion of rarefied air intermediate of its ends thus separated, and electrical connections for portions of said column located upon opposite sides of said portion of air.

3. In a thermostatic circuit breaker, the combination of a receptacle, electrical connections for different portions of said receptacle, and two distinct bodies of mercury disposed within said receptacle, each body of mercury communicating electrically with one of said electrical connections, said bodies of mercury being separated by a minute portion of rarefied air and otherwise completely filling said receptacle.

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Witnesses:
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