April 5, 1932. O. A. ROSS 1,852,539

ELECTRIC CIRCUIT BREAKER

Original Filed Oct. 28, 1925

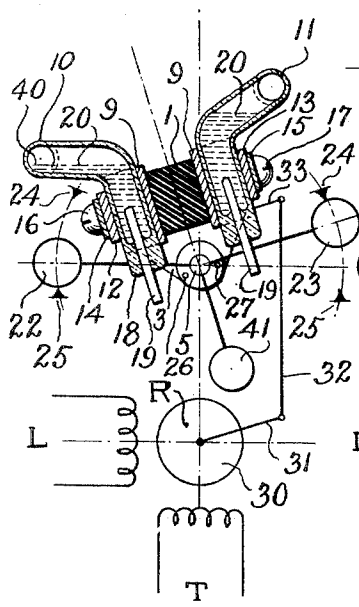

Fig. 1

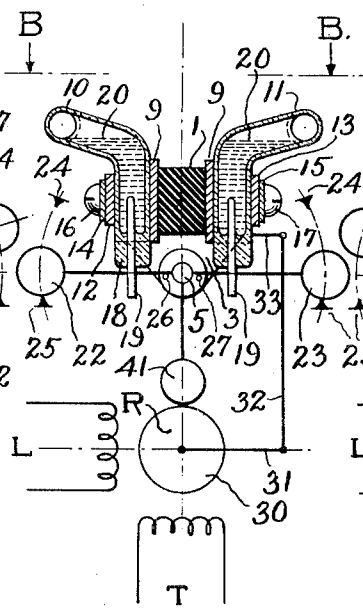

Fig. 2.

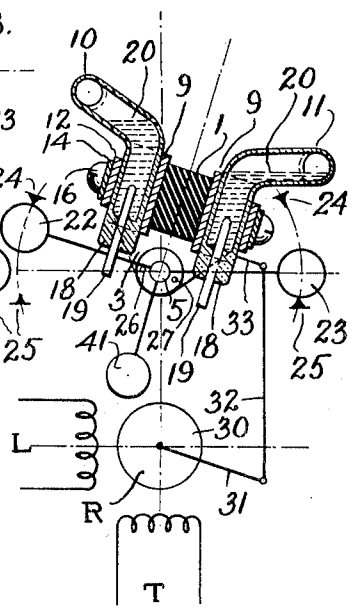

Fig. 3.

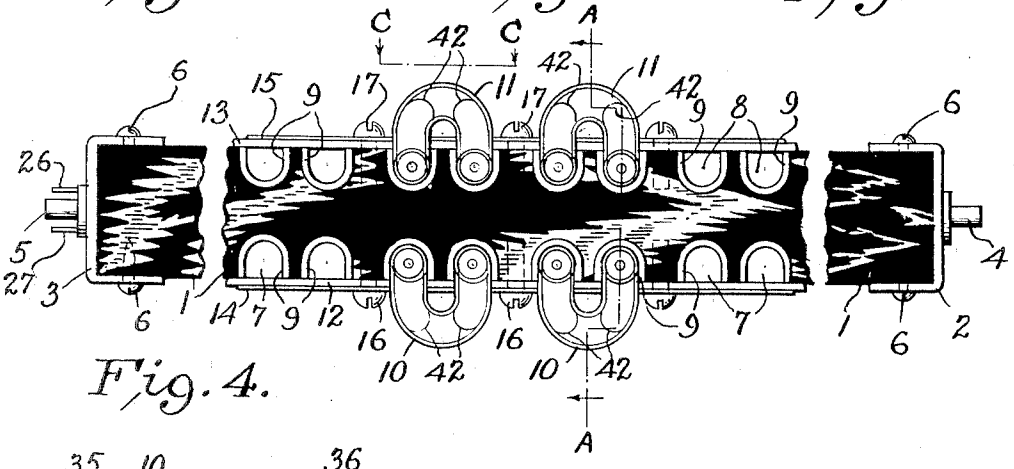

Fig. 4.

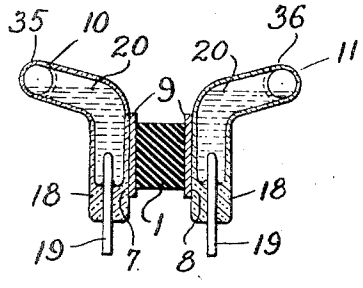

Fig. 5.

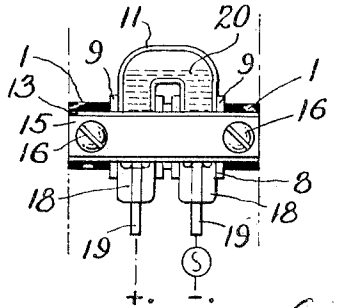

Fig. 6.

INVENTOR

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Patented Apr. 5, 1932 1,852,539

UNITED STATES PATENT OFFICE

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ELECTRIC CIRCUIT BREAKER

Application filed October 28, 1925, Serial No. 65,399. Renewed November 13, 1929.

This invention relates to electric circuit breakers and more particularly to that class of circuit breakers, which when operated manually, or mechanically will open and close an electric circuit. Such devices are more commonly known as "contacting" devices and will be hereinafter termed as such.

One object of my invention is to furnish a contacting device of negligible resistance, such that such negligible resistance will be maintained throughout substantially the entire life of said contacting device.

Another object is to furnish a contacting device which requires a minimum of mechanical energy to either open or close an electric circuit through said contact, or to hold it in the closed or open position. Most contacting devices require spring pressure for maintaining the closed position, whether front or back contact, said spring pressure becoming ineffective the moment the contacts separate and remaining so during a further movement to establish the airgap. In devices employed in signalling practice and known as relays, the irregular torque curve developed by the practice as hereinbefore described, makes it difficult to construct counterweighting means having substantially the same counter-torque curve whereby a high percentage of drop-away of the relay may be obtained. In my improved contacting device the torque curve is substantially a sine curve, or portion thereof, thereby making it readily possible to produce a similar counter-torque by employing a counter-weight attached to a pivoted arm.

Another object is to produce a contacting device which, for a given factor of safety, namely, ratio of torque produced by mechanical friction, to the torque produced by the mechanical or electrical energy supplied to the instrument of which the contacts form a part, will require a small amount of energy for its operation. In signalling practice where devices, as for example track relays, remain in the closed contact position substantially all the time, energy is being constantly consumed, and, obviously the smaller the amount of energy required the lower will be the maintainance cost. Most contacting devices, in addition to the energy required for closing the air-gap, require further energy to overcome spring pressure, or weights, employed to secure good contact. As my improved contacting device does not require such springs or weights, the counter-weighting in my improved device is only that required by what may be considered as a requisite factor of safety over the mechanical friction of the instrument of which the contacting device forms a part. Such a factor of safety, to the inventor's knowledge has not, as yet, been established by the Railway Signal Association.

Another object is to furnish a contacting device, in which, any arc formed in opening an electric circuit will be produced in a hermetically closed space thereby permitting the use of my improved device in zones of dangerous gases, fluids, and explosive dusts.

Another object is to furnish a contacting device wherein the circuit there-through is opened by the parting, or dividing, of a pool of electric conducting fluid into two pools, the break, or gap, occurring in said fluid only. Devices heretofore employing an electric conducting fluid for circuit control, have opened the circuit by causing said fluid to flow away from an electrode, or conductor hermetically sealed into the container holding said fluid. The electro-chemical action between said conductor and fluid as the circuit is opened, seriously affects the contact whereby it soon fails to function. My improved device obviates this destructive action by opening the circuit in the manner hereintofore named and by keeping the electrodes, or conductors, completely covered by said liquid at all times, said electrodes, or conductors serving only to conduct the current to or from said fluid.

Another object is to furnish a liquid metal circuit breaker wherein the body of metal contained therein is comparatively large as compared to the gas space required for the making and breaking of the circuit.

Another object is to furnish novel apparatus for the supporting of liquid metal circuit breakers whereby the inertia imparted to the liquid metal as the apparatus acts to move the circuit breakers from one position

to the other will effect a more rapid or quicker make and break of the circuit.

Another object is to furnish a novel means of supporting liquid metal circuit breakers whereby the containers for the liquid, usually made of glass, are less liable to breakage during the operation thereof.

Another object is to furnish a novel form of supporting means for liquid metal circuit breakers whereby the circuit breaking portion of the breaker may be moved extensively for more rapid separation of the liquid metal while the electrode portion is moved through a comparatively small distance and at a comparatively slower rate of movement.

Another object is to furnish novel supporting means for liquid metal circuit breakers whereby the circuit breaker portion of the breaker may be readily viewed for inspection and operation.

Another object is to furnish a novel form of operating support for liquid metal circuit breakers whereby a comparatively large number of breakers may be placed in a comparatively small space, certain of the breakers having differing functions of circuit control than other breakers upon a predetermined movement of the operating support.

Other objects and advantages will appear as the description of the invention progresses and the novel features of the invention will be pointed out in the appended claims.

This invention consists in the novel construction and arrangement of parts hereinafter described, delineated in the accompanying drawings, and particularly pointed out in that portion of the instrument wherein patentable novelty is claimed for certain and peculiar features of the device, it being understood that, within the scope of what hereinafter thus is claimed, divers changes in the form, proportions, size and minor details of the structure may be made without departing from the spirit of the invention, or sacrificing any of its details.

In describing the invention in detail, reference is had to the accompanying drawings, wherein I have illustrated one embodiment of the invention, and wherein like characters of reference designate corresponding parts throughout the several views, and in which:—

Figure 1 is a sectional view of a preferred form of my invention taken on line A—A, of Fig. 4, showing what is generally termed the front contact in a closed position. Fig. 2 is a similar view with contacts in their neutral position, both contacts having their circuits opened. Fig. 3 is a similar view showing the back contact closed. Fig. 4 is a top elevational view of contacts mounted on a bar, or support and is taken on line B—B, of Fig. 2. Fig. 5 is a view similar to Fig. 2, but in which both contacts are in the closed position, and is known as a "make before break" contact. Fig. 6 is a side elevational view of a contact mounted on a bar, or support, and is taken on line C—C, of Fig. 4.

Referring to Fig. 1, carrier or contact bar, or support 1, of insulating material, as for example bakelite, has trunnion brackets 2 and 3, carrying trunnions 4 and 5, secured to bar 1, by pins 6. Contact bar 1, is also supplied with recesses as 7 and 8, lined with a pliable material, as for example, felt, or leather pads 9—9, against which bear contacts, as 10 and 11, held in position by pliable strips 12, and 13, backed up by hard material strips 14 and 15, secured in place by screws 16 and 17.

Contacts 10 and 11, each comprises a U shaped transparent container, or tube, 18, the extremities of which are angularly disposed to the bent portion, said container being preferably made from what is known as "thermo glass" and said extremities containing hermetically sealed in conductors 19 and 20, having a coefficient of expansion equal to that of the material of said container. Said conductors form means to complete an electric circuit from the exterior to the interior of said container. Before sealing said container an electric conducting fluid, as for example mercury, is introduced into each extremity or leg, whereafter it is exhausted of its air and preferably filled with an inert gas, whereafter the container is sealed. The quantity of electric conducting fluid supplied to each extremity of container 18, will be hereinafter more fully disclosed.

For purposes of illustrating the operation of my improved contacting device, the trunnion 5, is assumed to have one end of counterweights 22 and 23, shown diagrammatically, pivotally mounted thereon, the weighted ends of which are free to rotate through an arc limited by the stops 24 and 25, pins 26 and 27 attached to bar 1, serving to elevate said counter-weights.

The movement of contacts, as 10 and 11, to effect opening or closing of an electric circuit may be accomplished a number of ways, and, for purposes of illustration, an actuating device known as a relay is shown, said relay having a rotor 30, operating a lever 31, connected to one end of a link 32, the other end of which is pivotally connected to lever 33 attached to contact bar 1. Said relay is shown to have a local winding L, and track winding T, and such a relay is described more fully in my Patent No. 1,795,144 dated March 3, 1931.

In Fig. 5, contacts 35 and 36 are similar to contacts 10 and 11, but contain a greater amount of electric conducting fluid whereby both contacts remain closed in the neutral position, as shown.

The operation of my improved contacting device is as follows:—Contacts 10 and 11 are of a type preferably employed in signalling relays and Figs. 1, 2, and 3, show the three positions in what is known as three-position relays, namely, front, neutral and back.

In Fig. 1, the rotor 30, has been actuated to close front contact 10 thereby raising counter-weight 23 to strike stop 24. As this action takes place, the fluid which has been divided into two pools in contact 11, is still further separated into substantially two equal pools making a large air gap between said pools. While this is occurring the lowering of contact 10 causes the fluid in its extremities to unite in the U shaped bend thereby closing the circuit therethrough, in other words closing the front contact.

With rotor 30 de-energized, it returns to neutral position as shown in Fig. 2, counter-weights 22 and 23, resting on stops 25—25. In this position both circuits through contacts 10 and 11 are opened unless the device is equipped with contacts as 35 and 36, in which case both will have their circuits closed. This position is known as the de-energized, or neutral position, and the fluid in each of contacts 10 and 11, is divided into two pools.

In Fig. 3, the relative instantaneous polarity of currents energizing the windings controlling rotor 30 has been reversed causing lever 31 to oscillate contact bar 1 to the position shown, this being known as the back contact position. Contact 11 has now closed its circuit therethrough in the manner heretofore described and contact 10 has opened its circuit.

If it is desired to operate contacts 10 and 11, or 35 and 36, as two position, namely front and back, the contact bar 1 is oscillated from the position shown in Fig. 1 to that shown in Fig. 3, without stopping in the neutral position. For such operation only one counter-weight, as 23, is employed and said counter-weight is rigidly fixed to bar 1 and moves in an arc substantially twice as great as when employed for three position work, stop 25 being lowered to permit said counter-weight to operate the same distance below the center line representing a horizontal plane, as it moves above said line.

It will be noted from the foregoing description that the counterweights 22 and 23 operate through the maximum torque producing portion of a sine curve, the minimum torque being at the full contact positions whether two or three position. By this arrangement, a reduction of energy in rotor 30 sufficient to permit counter-weight 22 and 23 to begin a downward movement will cause said counter-weight to continue its movement to the extreme bottom position on stop 25 without stopping, in this manner insuring a full open contact, or in other words open circuit. This continued downward movement is caused by the constantly increasing torque of the counter-weight. With poor shunting, track relays now in general use will hang just as the contacts open causing fusing and burning of said contacts. This is due to the fact that the springs on the contact fingers form part of the returning torque and after this partial torque has been spent the contacts are just ready to open and the counter-weight torque is not sufficient to further open the contacts against the torque produced by the rotor of the relay. The advantage of the continually downward movement in my improvement is therefore obvious.

Counter-weight 41 serves to counter-balance the weight of the various parts above the axis on which bar 1, rotates, and therefore the only energy required from rotor 30 in addition to that for overcoming the mechanical friction of the various bearings, will be that required to raise counter-weights 22 and 23.

The movement of the fluid in contacts 10 and 11, has a further tendency to assist the increasing torque of counter-weights 22 and 23, as they move downwardly. The ratio of the relative torques produced is substantially high and therefore does not substantially affect the sine curve produced by the movement of said counter-weights.

In Fig. 4, the contacting edges 42—42 of the fluid 20, indicate the opening, or gap of the circuit in the neutral position. The gap in contact 10 will be further opened as movement of bar 1 closes the circuit through contact 11 by bringing edges 42—42 together and uniting the two pools of fluid contained therein.

What I claim is:—

1. As a circuit controller, a substantially inverted U shaped hollow body having the loop of the U bent at an angle less than a right angle to the legs; two electrodes, one in each leg and a mass of mercury in said body, sufficient to form electrical connection between said electrodes when said body is in one position, but insufficient when the body is in another position and means for moving said body from one position to the other position, substantially as described.

2. As a circuit controller, a substantially inverted U shaped hollow body of insulating material having the loop of the U bent at an angle to the legs; two electrodes, one in each leg and a mass of mercury in said body sufficient to form electrical connection between said electrodes when said body is in one position, but insufficient when said body is in another position, and means for moving said body from one position to the other position, substantially as described.

3. As a circuit controller, an inverted U-shaped hollow body of substantially uniform cross section having the loop of the U bent

to make a slight angle to the horizontal, two electrodes, one in each leg, and a mass of mercury in said body sufficient to form electrical connection between said electrodes when the body has its legs slightly inclined to the vertical, but insufficient to form such electrical connection when the legs are substantially vertical, and means for moving said body from one position to the other.

4. Circuit closing apparatus comprising, in combination, substantially inverted U-shaped containers having a divisible body of liquid metal contained therein in continual contact with electrodes supported by the extensions thereof, a longitudinal supporting member, means for supporting a row of the containers on one side of the member and another row on the other side thereof whereby the curved portions of the containers are positioned above the member for more ready inspection thereof, and means for pivotally supporting the member for longitudinal oscillation thereof whereby pivotal movement in one direction will effect division of the liquid body in one row of containers and a juncture of the bodies in the other row, and pivotal movement of the member in the other direction will effect juncture of the first named bodies and a division of the second named bodies.

Signed at New York city, in the county of New York, and State of New York, this 27th day of October, A. D. 1925.

OSCAR A. ROSS.