June 14, 1938. H. W. CLOTHIER 2,120,731

ELECTRIC CIRCUIT BREAKER

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FIG. 1.

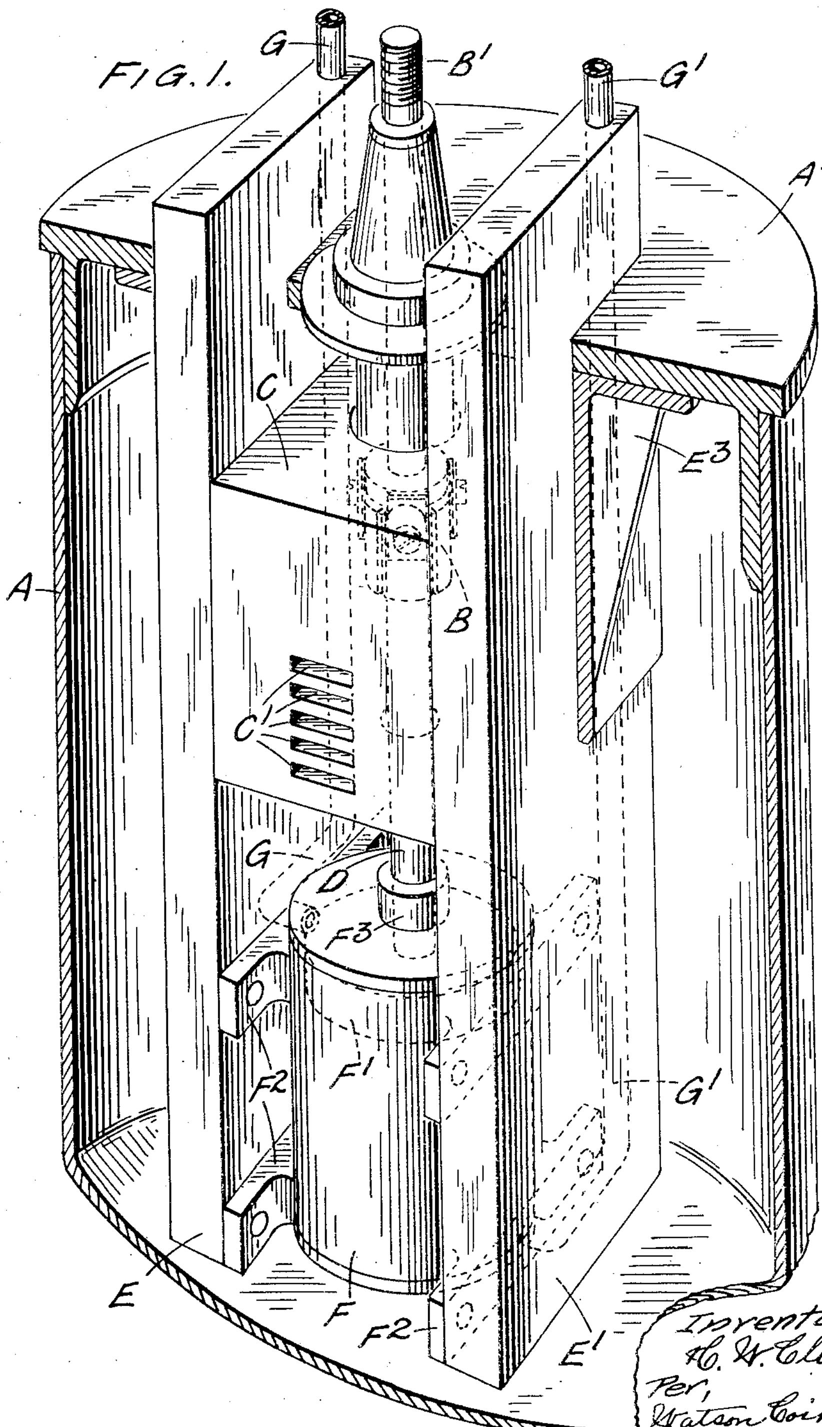

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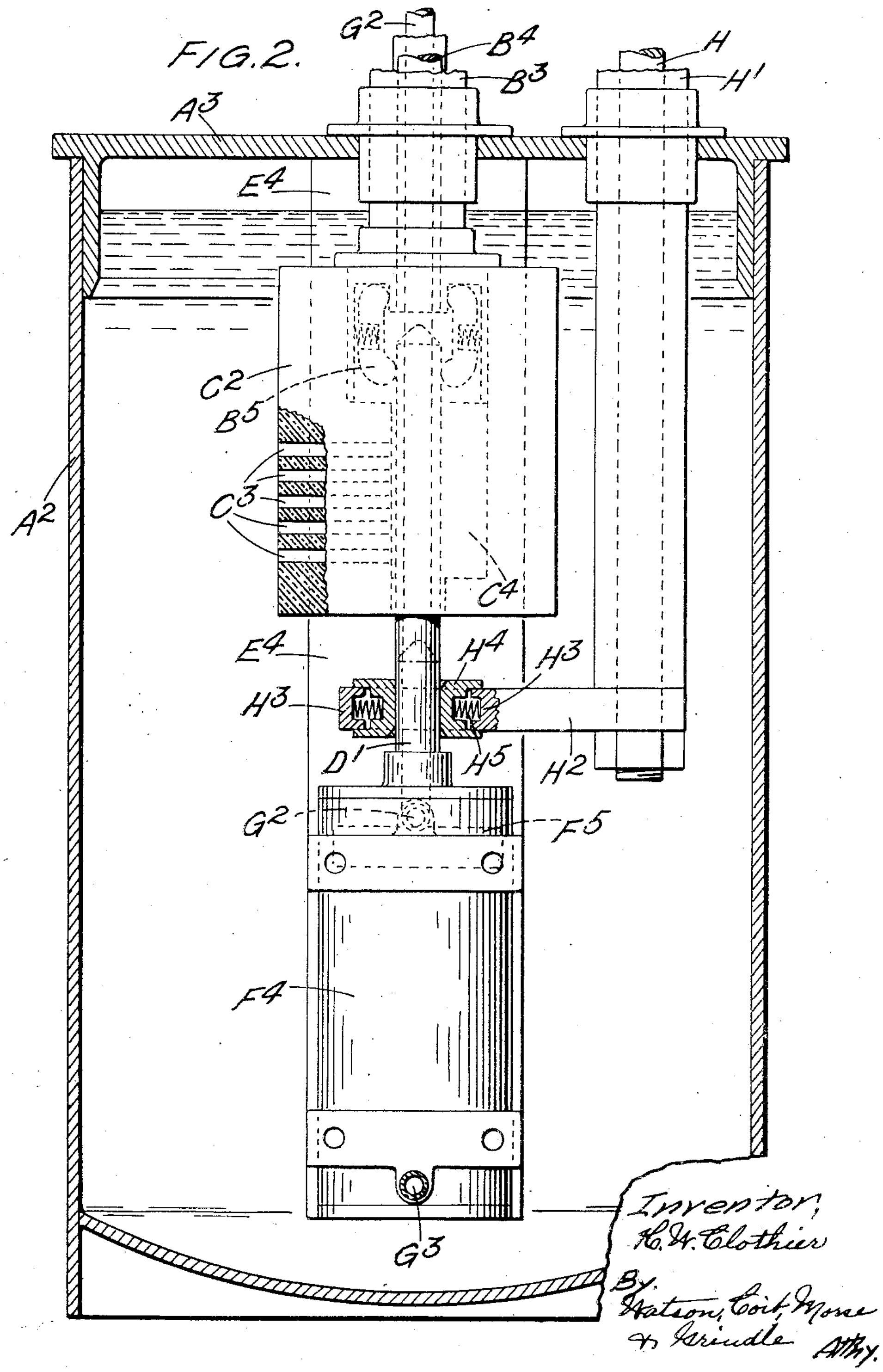
FIG. 2.



UNITED STATES PATENT OFFICE

2,120,731

ELECTRIC CIRCUIT BREAKER

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12 Claims. (Cl. 200—150)

This invention relates to liquid-insulated A. C. electric circuit-breakers, more especially intended for use on high voltage circuits. In order to increase the speed of operation, it is known to provide such a circuit-breaker with an arc control device comprising an enclosure through which the moving contact is drawn and in which a relatively high pressure is produced by the arc so that the compressed insulating liquid, vapour and/or gas within the enclosure constitutes a deionizing fluid or blast which forces the ionized arc gases through vents or outlets in the enclosure which are laterally disposed with respect to the arc path.

The present invention has for its object to provide an improved construction of circuit-breaker having an arc control device of this kind, wherein still higher speed of operation can be obtained with due economy in material and space occupied and with ready accessibility of all working parts.

In the circuit-breaker according to this invention the moving contact is actuated by a fluid-pressure operated device disposed within the circuit-breaker tank adjacent to the end of the arc control device. With this arrangement the moving contact can be mounted directly on or formed integral with the piston or other moving member of the actuating device, thus providing for a minimum inertia of moving parts and thereby enabling a very high speed of operation to be obtained.

The electrical connection from the moving contact to the external circuit may include a portion of the conduit or conduits conveying the operating fluid to the fluid-pressure operated device, or the relatively moving members of such device which are in sliding engagement with one another, or both. Alternatively the operating fluid may be supplied to the fluid-pressure operated device through a conduit or conduits of insulating material within the circuit-breaker tank. The electrical connection from the moving contact to the external circuit (which may comprise one or more conductors and/or a portion of the conduit or conduits) is preferably disposed adjacent to the enclosure of the arc control device on the side thereof remote from the lateral vents, the arrangement being such that the flow of current through this connection tends to move the arc towards or into the throats of the vents.

The following is a description by way of example of two convenient constructions of circuit-breaker according to this invention with reference to the accompanying drawings, in which

Figure 1 is a somewhat diagrammatic perspective view of one construction, the tank being partly broken away, and

Figure 2 is a side elevation partly in section of another construction.

The circuit-breaker shown in Figure 1 is of the single-phase single-break type, the circuit-breaker contacts being immersed in oil in a metal tank A closed at the top in the usual manner by a cover plate A^1 from which the contact structure is suspended. Inspection of the contacts is carried out by lowering the tank from the cover plate or by raising the cover plate and contacts from the tank.

The fixed contact B of the circuit-breaker (indicated in dotted lines) is mounted within the upper end of an arc control device C comprising a structure of insulating material surrounding an enclosure (not shown) from one side of which a number of vertically aligned vents C^1 extend to the outside of the structure. The fixed contact B is connected to the external circuit by a conductor B^1 passing through a lead-in bushing B^2 carried more or less centrally by the cover plate A^1. The lower end of the arc control device C is closed except for an orifice within which is loosely mounted a throat washer (not shown) through which passes a vertical rod or bar D constituting the moving contact. The construction of the arc control device may vary but is preferably in one or other of the forms described in British patent specification Nos. 435,250 and 435,308, in the names of the present applicants and others.

Two vertical slabs of insulating material E and E^1 extending through the cover A^1 of the tank are supported by brackets E^2 and E^3 fixed to the underside of the cover A^1 so that they extend downwardly past the arc-control device C, one on either side thereof. The plates E, E^1 carry between them and beneath the arc control device C a vertical closed metal cylinder F within which can slide a piston F^1 directly mounted on the lower end of the moving contact rod D. The cylinder F is connected to the plates by lugs F^2. The plates E, E^1 may also serve to support the arc control device C although, if desired, this may be directly supported by the bushing insulator B^2 through which passes the conductor B^1 leading to the fixed contact.

To the upper and lower ends of the cylinder F are respectively connected two metal pipes G and G^1 which pass upwardly through bores in the two plates E and E^1 and project through the upper ends of these plates.

The pipes G and G^1 serve to convey operating fluid to the cylinder F to cause movement of the piston F^1 therein and thus movement of the moving contact D into and out of engagement of the fixed contact B within the arc control device. The operating fluid may consist of air or other gas or of a liquid, such for example as oil.

In addition to conveying operating fluid to the cylinder F, the pipes G and G^1 are electrically connected in parallel to the external circuit so as to constitute part of the connection between this circuit and the moving contact D. The engaging surfaces of the piston F^1 and cylinder F and of the moving contact D and a gland F^3 at the top of the cylinder are utilized as sliding contacts for conveying the current from the pipes G and G^1 to the moving contact D. If desired, however, in addition to or instead of this arrangement, some other connection (such as a flexible lead or leads, or a fixed sleeve in sliding engagement with the part of the moving contact D between the lower end of the arc control device C and the top of the cylinder F) may be provided between the moving contact D and the pipes G and G^1. The bores in the plates EE^1 containing the pipes GG^1 are, as shown, preferably so disposed in relation to the arc control device that any electro-dynamic action which may be exerted on the arc within the enclosure of the device C by the current flowing through the pipes, will tend to move the arc towards or into the throats of the lateral vents C^1, that is, the pipes GG^1 are preferably disposed in bores near to those edges of the plates EE^1 on the side of the arc control device C remote from the lateral vents C^1. Conduits of insulating material (not shown) are employed between the upper ends of the pipes GG^1 and the mechanism controlling the supply of operating fluid in order to isolate such mechanism from the electrical circuit.

Operation of the fluid supply control mechanism will effect pneumatically or hydraulically the opening and closing movements of the circuit-breaker, and since the moving parts, which consist merely of the piston F^1 and the relatively short rod or bar D constituting the moving contact, can be light in weight, a very high speed of operation can readily be obtained, thus rendering the arc control device C highly efficient in effecting extinction of the arc within a very few cycles of the alternating current. The arrangement is also compact and economical to manufacture.

The construction shown in Figure 2 differs from that shown in Figure 1 mainly in that the fluid pressure system is independent of the electrical circuits and the conductors which are respectively connected to the fixed and moving contacts at opposite ends of the arc control device, are arranged to form a current loop or partial loop for producing a magnetic field for deflecting the arc towards or into the throats of the lateral vents.

As in the construction shown in Figure 1, the arc control device C^2 is supported from the cover plate A^3 of a tank A^2 either by a bushing insulator B^3 for the conductor B^4 connected to the fixed contact B^5 or by side plates E^4 (only one of which is shown) which extend downwardly from the cover plate A^3 and serve to support the cylinder F^4 of the pneumatic or hydraulic actuating device for the moving contact rod D^1. The arc control device C^2 is provided with vertically aligned lateral vents C^3 extending from the enclosure C^4 to the outside of the structure.

In this construction the connection to the moving contact D^1 is made by a conductor H passing through a lead-in bushing H^1 carried by the tank cover plate A^3 this conductor being so disposed that it extends downwardly into the tank in close proximity to the arc control device C^2 and on the side thereof remote from the lateral vents C^3. The lower end of the conductor H carries a cross-bar H^2 having at its end a sleeve or ring H^3 surrounding the moving contact rod D^1 in the space between the lower end of the arc control device C^2 and the upper end of the cylinder F^4. The ring H^3 carries a number of contact segments H^4 which are pressed into engagement with the surface of the contact rod D^1 by springs H^5. Owing to the arrangement of the conductor H relatively to the axis of the moving contact and the line of vertically aligned vents, the electro-dynamic action of the current flowing through the conductor H will tend to move the arc in the enclosure C^4 towards or into the throats of the vents.

As in the first arrangement, the moving contact D^1 is directly connected to the piston F^5 of the fluid-pressure actuating device, but the pipes G^2 and G^3 within the tank conveying operating fluid to the cylinder F^4 are in this instance of insulating material and may be in the form of bores through the insulating side plates E^4. This arrangement avoids the necessity for providing insulated conduits leading from the upper ends of the pipes to the fluid supply control mechanism.

It will be appreciated that the above arrangements have been described by way of example only and may be modified in various ways within the scope of the invention. Thus for instance the above arrangements employ a vertically moving piston and contact with the fluid-pressure device beneath the arc control device, but these parts may be otherwise disposed, as for example by using horizontal movements. Again the arrangements may be applied to multi-phase circuit-breakers with the devices in the several phases all mounted in the same tank. The insulating supporting structures for the fluid pressure device or devices may be used as the supports for the arc control device or devices and may in some instances constitute parts of the insulating walls thereof.

What I claim as my invention and desire to secure by Letters Patent is:—

1. A liquid-insulated alternating current electric circuit-breaker comprising, in combination, a tank, a cover therefor, insulating liquid within the tank, cooperating fixed and moving contacts within the tank, an arc control device having an enclosure through which the moving contact is drawn during opening of the circuit-breaker and in which a relatively high pressure is produced by the arc so as to expel the arc gases through lateral vents in the enclosure, an actuating device for the moving contact operated by fluid pressure and mounted within the tank near an end of the arc control device, and a metal conduit passing through the cover of the tank and insulated therefrom for conveying pressure fluid to the actuating device and making electrical connection to the moving contact.

2. A liquid-insulated alternating current electric circuit-breaker comprising, in combination, a tank, insulating liquid within the tank, cooperating fixed and moving contacts within the tank,

an arc control device associated with the contacts, an actuating device for the moving contact operated by fluid pressure and mounted within the tank near an end of the arc control device, and a metal conduit for conveying pressure fluid to the actuating device and making electrical connection to the moving contact, the disposition of the metal conduit relatively to the arc control device being such that the electrodynamic action due to the electric current flowing therethrough, tends to move the arc towards the lateral vents.

3. A liquid-insulated alternating current electric circuit-breaker comprising, in combination, a tank, a removable cover therefor, insulating liquid within the tank, cooperating fixed and moving contacts within the tank, an arc control device having an enclosure through which the moving contact is drawn during opening of the circuit-breaker and in which a relatively high pressure is produced by the arc so as to expel the arc gases through lateral vents in the enclosure, an actuating device for the moving contact operated by fluid pressure and mounted within the tank near an end of the arc control device, means for supporting the actuating device and the arc control device from the cover of the tank, a conduit of insulating material passing through the cover for conveying pressure fluid to the actuating device, and an electrical connection passing through the cover and insulated therefrom and in sliding engagement with the moving contact.

4. A liquid-insuluated alternating current electric circuit-breaker as claimed in claim 3, in which the electrical connection to the moving contact is disposed on the side of the arc control device remote from the lateral vents.

5. A liquid-insulated alternating current electric circuit-breaker comprising, in combination, a tank, insulating liquid within the tank, cooperating fixed and moving contacts within the tank, an arc control device having an enclosure through which the moving contact is drawn during opening of the circuit-breaker and in which a relatively high pressure is produced by the arc so as to expel the arc gases through lateral vents in the enclosure, an actuating device for the moving contact operated by fluid pressure and mounted within the tank near an end of the arc control device, and electrical connections to the fixed and moving contacts arranged to form a current loop for producing a magnetic field for deflecting the arc towards the lateral vents in the enclosure.

6. A liquid-insulated alternating current electric circuit-breaker comprising, in combination, a tank, a cover therefor, insulating liquid within the tank, an arc control device within the tank having an enclosure, a fixed contact at the upper end of the enclosure, a cooperating moving contact which passes through an opening in the lower end of the enclosure, at least one plate of insulating material supported from the tank cover so as to extend downwardly into the tank, and an actuating device for the moving contact operated by fluid pressure and mounted on the said plate so that it is directly below the lower end of the arc control device.

7. A liquid-insulated alternating current electric circuit-breaker comprising, in combination, a tank, a cover therefor, insulating liquid within the tank, an arc control device within the tank having an enclosure, a fixed contact at the upper end of the enclosure, a cooperating moving contact which passes through an opening in the lower end of the enclosure and is drawn through the enclosure during opening of the circuit-breaker so that the arc produces within the enclosure a relatively high pressure which expels the ionized arc gases through vents in the enclosure laterally disposed with respect to the arc path, at least one plate of insulating material supported from the tank cover so as to extend downwardly into the tank, an actuating device for the moving contact operated by fluid pressure and mounted on the said plate so that it is directly below the lower end of the arc control device, and means for supplying pressure fluid to the actuating device comprising a bore in at least one plate supporting the said device.

8. A liquid-insulated alternating current electric circuit-breaker comprising, in combination, a tank, a cover therefor, insulating liquid within the tank, an arc control device within the tank having an enclosure, a fixed contact at the upper end of the enclosure, a cooperating moving contact which passes through an opening in the lower end of the enclosure and is drawn through the enclosure during opening of the circuit-breaker so that the arc produces within the enclosure a relatively high pressure which expels the ionized arc gases through vents in the enclosure laterally disposed with respect to the arc path, two plates of insulating material supported from the tank cover so as to extend downwardly one on each side of the arc control device, an actuating device for the moving contact operated by fluid pressure and mounted on the said plates so that it is directly below the lower end of the arc control device, and metal conduits for supplying pressure fluid to the actuating device disposed in bores in the plates supporting the said device.

9. A liquid-insulated alternating current electric circuit-breaker as claimed in claim 8 in which the metal conduits act as electrical connections to the moving contact and are so disposed relatively to the arc control device that the electro-dynamic action due to the electric current flowing therethrough tends to move the arc towards the lateral vents.

10. A liquid-insulated alternating current electric circuit-breaker comprising, in combination, a tank, insulating liquid within the tank, an arc control device within the tank having an enclosure, a fixed contact at one end of the enclosure, a cooperating moving contact which passes through an opening at the other end of the enclosure and is drawn through the enclosure during opening of the circuit-breaker so that the arc produces within the enclosure a relatively high pressure which expels the ionized arc gases through vents in the enclosure laterally disposed with respect to the arc path, a cylinder mounted within the tank near that end of the arc control device having the opening for the moving contact, a piston within the cylinder, a connection between the piston and the moving contact, and metal conduits for supplying pressure fluid to the cylinder and making electrical connection to the moving contact.

11. A liquid-insulated alternating current electric circuit-breaker comprising, in combination, a tank, a cover therefor, insulating liquid within the tank, an arc control device within the tank having an enclosure, a fixed contact at the upper end of the enclosure, a cooperating moving contact which passes through an opening at the lower end of the enclosure, at least one plate of insulating material supported from the tank

cover so as to extend downwardly into the tank, a cylinder mounted on the said plate so that it is directly below the lower end of the arc control device, a piston within the cylinder, means for connecting the moving contact to the piston, and means for supplying pressure fluid to the cylinder for operating the piston.

12. A liquid-insulated alternating current electric circuit-breaker as claimed in claim 11, in which pressure fluid is supplied to the cylinder through a bore in the plate supporting the cylinder and an electrical connection in sliding engagement with the moving contact is disposed on the side of the arc control device remote from the lateral vents.

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