Aug. 14, 1945. A. ESTIENNE 2,382,703

CIRCUIT BREAKER

Filed Sept. 30, 1942

Fig. 5

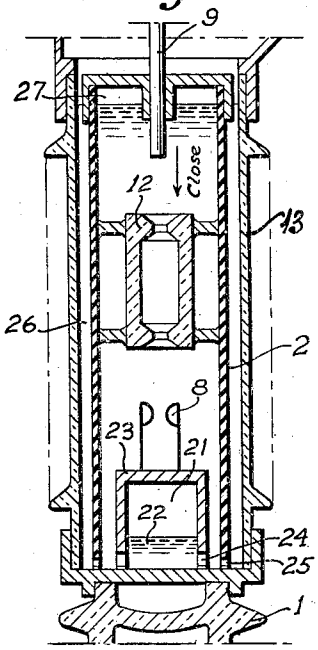


Fig. 1

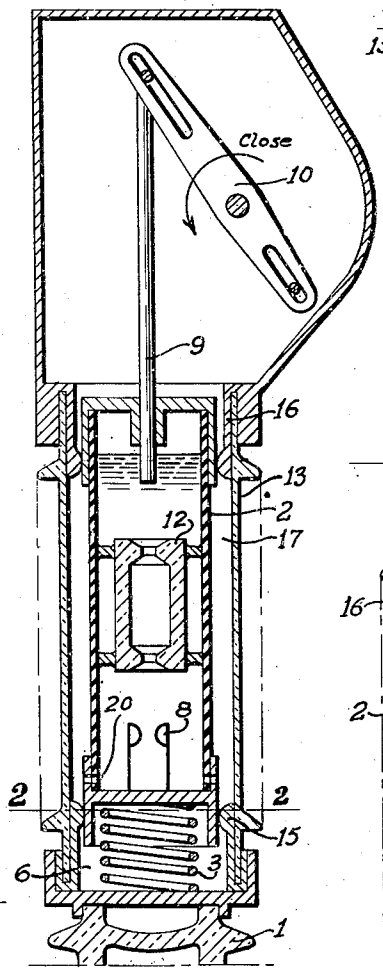


Fig. 2

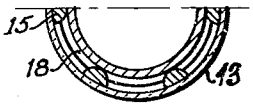


Fig. 6

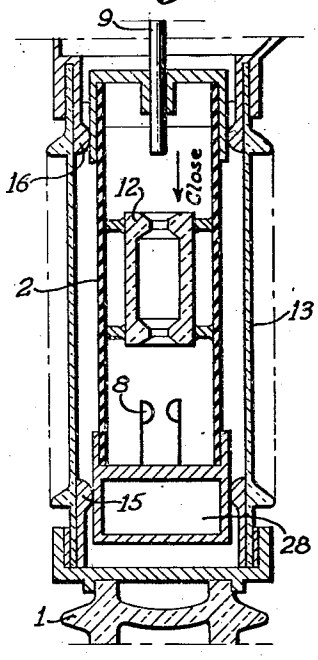


Fig. 3

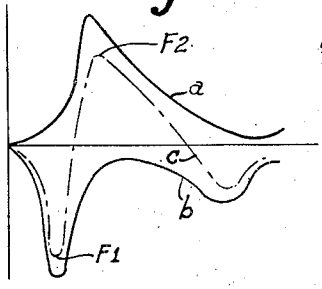
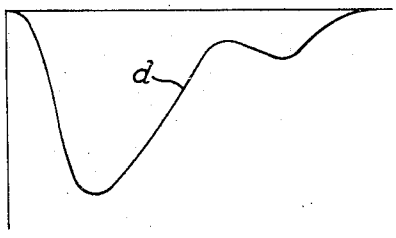


Fig. 4



Inventor
AIMÉ ESTIENNE

By A. Holcombe
Attorney

Patented Aug. 14, 1945 2,382,703

UNITED STATES PATENT OFFICE

2,382,703

CIRCUIT BREAKER

Aimé Estienne, Lyons, France; vested in the Alien Property Custodian

Application September 30, 1942, Serial No. 460,231
In France June 18, 1941

11 Claims. (Cl. 200—150)

In circuit-breakers in which the contacts are separated in a liquid such as oil for instance, the extinguishing arc causes the formation of vapors which provoke the displacement of an important mass of said liquid. The motion of this mass, called "oil piston" in the extinguishing chamber, produces considerable stresses which are transmitted to the securing and supporting elements of the extinguishing chamber. In circuit-breakers with a small oil volume, these stresses are most prejudicial because of the fact that the most detrimental stress occurs generally in an upward direction, and in the apparatuses of the type in question for outside mounting the extinguishing chamber is usually supported by ceramic insulators having a low rupturing strength when stressed.

One object of the present invention is to reduce the stresses which the supporting insulators of circuit-breakers of small oil-volume are subjected to. Its aim is a circuit-breaker of this type chiefly characterized by devices which allow part of the liquid mass contained in the extinguishing chamber to move towards the insulators supporting the chamber when the breaking of the circuit occurs and before said mass escapes from said chamber under the action of gases formed by the extinction of the arc.

According to a preferred form of the invention, this motion or displacement of a part of the liquid mass takes place in opposition to the antagonist stress exerted upon said extinguishing chamber by either a mechanical or other suitable means.

The invention and its aims and objects will be readily understood from the following description, taken in connection with the accompanying drawing of embodiments of the invention herein given for illustrative purposes.

In the drawing;

Fig. 1 shows a longitudinal section of an electric circuit-breaker embodying one illustrative form of the present invention, the extinguishing chamber of which is movable relatively to its insulating support;

Fig. 2 is a cross-section on line 2—2 of Fig. 1;

Fig. 3 is a graph of the general form taken by the stresses caused by the displacement of the "oil piston";

Fig. 4 is a graph of the general motion imparted to the extinguishing chamber;

Fig. 5 is a longitudinal section of another illustrative embodiment of the invention, and

Fig. 6 is a longitudinal section of a further illustrative embodiment of the invention.

Referring to Fig. 1 a supporting insulator supports a porcelain cylinder 13 inside which is mounted an extinguishing chamber preferably of Bakelite. The latter is filled with oil and contains an extinguishing pot 12 fixed in chamber 2 and traversed by the movable contact of the arc-drawing means in the arc-drawing operation. This chamber is supported by a spring 3 resting on the insulator 1 and the strength of which has been so chosen that it balances the weight of said chamber 2 and allows the latter, when it undergoes internal pressures produced by the rupturing arc, to move a few centimeters coaxially of the insulator 1 and the external cylinder 13. Guiding means is provided in order to guide said displacement, said means herein illustratively comprising guiding bosses 15 and 16 spaced circularly inside cylinder 13 adjacent its top and bottom. The space between cylinder 13 and chamber 2 is filled with oil and ports 20 of very small diameter provided in the lower part of the wall of chamber 2 balance the oil level in chamber 2 and in the external cylinder 13 without any quick pressure waves produced by the electric arc being transmitted to the said cylinder.

The arc-drawing means comprises a fixed contact 8 at the bottom of the extinguishing chamber 2 under the extinguishing chamber 12, and a movable circuit breaker contact consisting of a rod 9 driven by a two armed lever 10. The circuit breaker contacts are shown in open circuit position; in order to close the circuit, lever 10 is turned in the direction of the arrow by any suitable, conventional mechanism (not shown).

On breaking the circuit, the arc formed between contacts 8 and 9 vaporizes a part of the oil in the extinguishing chamber 2, and stresses caused by the displacement of the "oil piston" generally takes the form represented by the curves of Fig. 3. These stresses, shown in ordinates, are given with respect to the time, represented in abscissae. The stresses exerted on the upper end surface of the extinguishing chamber are represented by curve *a*, those exerted upon the lower end surface, by curve *b*. Their difference, corresponding to resultant stresses applied to the extinguishing chamber, is represented by curve *c*.

On breaking the circuit, chamber 2, under the action of stress F_1, undergoes at first a downward displacement, compressing spring 3; the stress transmitted to insulator 1 corresponds only to the spring compressing stress.

On account of the inertia of the mass of oil set in motion, when the displacement has covered a few centimeters, the applied strain changes direction, first breaks the downward motion of the chamber, then stops it, and after the second peak F_2 (Fig. 3), is reached, restores its state of equilibrium, after a few oscillations, all as shown by the curve in Fig. 4, which represents the motion of the extinguishing chamber with respect to the time represented in abscissae. The inertia of the extinguishing chamber is thus used to damp the rapid variations of stresses produced by the "oil piston."

Fig. 5 represents another illustrative embodi-

ment of the invention, in which the elasticity of the air layer 21, contained in air chamber 23 at the lower part of extinguishing chamber 2 has a similar action to that of spring 3 in the embodiment represented in Fig. 1. The oil at 22 in the lower part of the air chamber 23 communicates with the oil contained in the extinguishing chamber 2 through ports 24 having a relatively large section, much superior to that of the equilibrium apertures 25. This arrangement has the advantage of maintaining the extinguishing chamber in a fixed position, but the stress transmitted to the supporting insulator 1 is somewhat greater. One can reduce this stress to a minimum by providing air volumes in the upper part of said extinguishing chamber at 27, and in the lower part at 21, said air volumes being in inverse ratio to the distance from the ends of the extinguishing arc to the nearest oil level.

Fig. 6 shows another embodiment which makes it possible to reduce to a minimum the stress transmitted to the supporting insulator 1, to maintain the optima conditions of extinction and to do away with spring 3. In this embodiment the extinguishing chamber is provided at its lower portion with an airtight float 28 which raises said chamber slightly above the oil level. One could as well place said float at the upper part of the chamber or around it. Said chamber may be guided in its movement in any suitable manner, for example as in the embodiment of Fig. 1; but this embodiment of Fig. 6 requires two independent oil levels, one for the external cylinder 13 and the other for the extinguishing chamber 2.

In all of the above-mentioned embodiments of the invention the driving elements of the movable contact are mounted on the upper part of the supporting insulator 1. The stroke of the movable contact-rod 9 being predetermined, and the lower contact being connected to the extinguishing chamber, which moves downwardly in the embodiments represented in Figs. 1 and 6, these two embodiments have the advantage of increasing slightly the relative speed of the breaking of the circuit.

I am aware that the present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and I therefore desire the present embodiments of the invention to be considered in all respects as illustrative and not restrictive, reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. In an electric circuit breaker, the combination of an exterior cylinder; an arc-extinguishing chamber within said cylinder, closed at both ends and having its lateral walls spaced from those of said cylinder, said cylinder and said arc-extinguishing chamber containing oil; arc-drawing means comprising a fixed contact mounted in said arc-extinguishing chamber and a cooperating movable contact having a sliding fit in an end wall of said arc-extinguishing chamber; suitable ports in the wall of said arc-extinguishing chamber, for equalizing the oil levels in said cylinder and in said arc-extinguishing chamber, thus to avoid transmission of pressure waves to said cylinder upon rupture of the arc; means at one end of said arc-extinguishing chamber, yieldingly to support said chamber in the oil in said cylinder, for movement axially of the latter upon rupture of the arc.

2. In an electric circuit breaker, the combination of an exterior cylinder; an insulator support for said cylinder; an arc-extinguishing chamber within said cylinder, closed at both ends and having its lateral walls spaced from those of said cylinder, said cylinder and said arc-extinguishing chamber containing oil; arc-drawing means comprising a fixed contact mounted in said arc-extinguishing chamber and a cooperating movable contact having a sliding fit in the top end wall of said arc-extinguishing chamber; suitable ports in the wall of said arc-extinguishing chamber, for equalizing the oil levels in said cylinder and in said arc-extinguishing chamber, thus to avoid transmission of pressure waves to said cylinder upon rupture of the arc; and means between the bottom of said arc-extinguishing chamber and said insulator support yieldingly to support said chamber in the oil in said cylinder for movement axially of the latter and thus to reduce the stresses exerted upon said insulator support upon rupture of the arc.

3. In an electric circuit breaker the combination of an exterior cylinder; an arc-extinguishing chamber within said cylinder closed at both ends and having its lateral walls spaced from those of said cylinder, said cylinder and said arc-extinguishing chamber containing oil; arc-drawing means comprising a fixed contact mounted in said arc-extinguishing chamber and a cooperating movable contact having a sliding fit in an end wall of said arc-extinguishing chamber; suitable ports in the wall of said arc-extinguishing chamber, for equalizing the oil levels in said cylinder and in said arc-extinguishing chamber thus to avoid transmission of pressure waves to said cylinder upon rupture of the arc; an air chamber mounted in said arc-extinguishing chamber, said air chamber having relatively large ports communicating with the interior of said arc-extinguishing chamber, said air chamber containing oil and an air cushion above the surface of the latter, whereby yieldingly to support the oil column in said arc-extinguishing chamber and thus to reduce the stresses exerted upon the structure upon rupture of the arc.

4. In an electric circuit breaker the combination of an exterior cylinder; an arc-extinguishing chamber within said cylinder closed at both ends and having its lateral walls spaced from those of said cylinder, said cylinder and said arc-extinguishing chamber containing oil; arc-drawing means comprising a fixed contact mounted in said arc-extinguishing chamber and a cooperating movable contact having a sliding fit in an end wall of said arc-extinguishing chamber; suitable ports in the wall of said arc-extinguishing chamber, for equalizing the oil levels in said cylinder and in said arc-extinguishing chamber, thus to avoid transmission of pressure waves to said cylinder upon rupture of the arc; an air chamber mounted in said arc-extinguishing chamber, said air chamber having relatively large ports communicating with the interior of said arc-extinguishing chamber, said air chamber containing oil and an air cushion above the surface of the latter; and an air space above the oil column in said arc-extinguishing chamber whereby yieldingly to support the oil column in said arc-extinguishing chamber and thus to re-

duce the stresses exerted upon the structure upon rupture of the arc.

5. In an electric circuit breaker, the combination of an exterior cylinder; an arc-extinguishing chamber within said cylinder closed at both ends and having its lateral walls spaced from those of said cylinder, said cylinder and said arc-extinguishing chamber containing oil; arc-drawing means comprising a fixed contact mounted in said arc-extinguishing chamber and a cooperating movable contact having a sliding fit in an end wall of said arc-extinguishing chamber; a sealed air chamber acting as a float for supporting said arc-extinguishing chamber in the oil in said cylinder, whereby said arc-extinguishing chamber is adapted to move axially of said cylinder, thus to reduce the stresses exerted upon the structure upon rupture of the arc.

6. In an electric circuit breaker, the combination of an exterior cylinder; an arc-extinguishing chamber within said cylinder, closed at both ends and having its lateral walls spaced from those of said cylinder, said cylinder and said arc-extinguishing chamber containing oil; arc-drawing means comprising a fixed contact mounted in said arc-extinguishing chamber and a cooperating movable contact having a sliding fit in an end wall of said arc-extinguishing chamber; an arc-extinguishing pot mounted in said arc-extinguishing chamber and traversed by said movable contact in the arc-drawing operation; suitable ports in the wall of said arc-extinguishing chamber, for equalizing the oil levels in said cylinder and in said arc-extinguishing chamber, thus to avoid transmission of pressure waves to said cylinder upon rupture of the arc; means at one end of said arc-extinguishing chamber yieldingly to support said chamber in the oil in said cylinder, for movement axially of the latter and thus to reduce the stresses exerted upon the structure upon rupture of the arc.

7. In an electric circuit breaker, the combination of an exterior cylinder; an insulator support for said cylinder; an arc-extinguishing chamber within said cylinder, closed at both ends and having lateral walls spaced from those of said cylinder, said cylinder and said arc-extinguishing chamber containing oil; arc-drawing means comprising a fixed contact mounted in said arc-extinguishing chamber and a cooperating movable contact having a sliding fit in the top end wall of said arc-extinguishing chamber; an arc-extinguishing pot mounted in said chamber and traversed by said movable contact in the arc-drawing operation; suitable ports in the wall of said arc-extinguishing chamber, for equalizing the oil levels in said cylinder and in said arc-extinguishing chamber, thus to avoid transmission of pressure waves to said cylinder upon rupture of the arc; and means between the bottom of said arc-extinguishing chamber and said insulator support yieldingly to support said chamber in the oil in said cylinder for movement axially of the latter and thus to reduce the stresses exerted upon said insulator support upon rupture of the arc.

8. In an electric circuit breaker the combination of an exterior cylinder; an arc-extinguishing chamber within said cylinder, closed at both ends and having its lateral walls spaced from those of said cylinder, said cylinder having said arc-extinguishing chamber containing oil; arc-drawing means comprising a fixed contact mounted in said arc-extinguishing chamber and a cooperating movable contact having a sliding fit in an end wall of said arc-extinguishing chamber; an arc-extinguishing pot mounted in said chamber and traversed by said movable contact in the arc-drawing operation; suitable ports in the wall of said arc-extinguishing chamber, for equalizing the oil levels in said cylinder and in said arc-extinguishing chamber, thus to avoid transmission of pressure waves to said cylinder upon rupture of the arc; an air chamber mounted in said arc-extinguishing chamber, said air chamber having relatively large ports communicating with the interior of said arc-extinguishing chamber, said air chamber containing oil and an air cushion above the surface of the latter whereby yieldingly to support the oil column in said arc-extinguishing chamber and thus to reduce the stresses exerted upon the structure upon rupture of the arc.

9. In an electric circuit breaker the combination of an exterior cylinder; an arc-extinguishing chamber within said cylinder closed at both ends and having its lateral walls spaced from those of said cylinder, said cylinder and said arc-extinguishing chamber containing oil; arc-drawing means comprising a fixed contact mounted in said arc-extinguishing chamber and a cooperating movable contact having a sliding fit in an end wall of said arc-extinguishing chamber; an arc-extinguishing pot mounted in said chamber and traversed by said movable contact in the arc-drawing operation; suitable ports in the wall of said arc-extinguishing chamber, for equalizing the oil levels in said cylinder and in said arc-extinguishing chamber, thus to avoid transmission of pressure waves to said cylinder upon rupture of the arc; an air chamber mounted in said arc-extinguishing chamber, said air chamber having relatively large ports communicating with the interior of said arc-extinguishing chamber, said air chamber containing oil and an air cushion above the surface of the latter; and an air space above the oil column in said arc-extinguishing chamber; whereby yieldingly to support the oil column in said arc-extinguishing chamber and thus to reduce the stresses exerted upon the structure upon rupture of the arc.

10. In an electric circuit breaker a substantially closed container forming an arc-extinguishing chamber, a pair of separable contacts enclosed in said chamber, said chamber containing arc-extinguishing liquid in which said contacts are immersed, one of said contacts being fixed in said chamber and the other contact being slidably mounted in said chamber through an aperture formed in the wall of said chamber, a second container surrounding the first mentioned container and having portions spaced therefrom, the space between said first and second containers being partly filled with a liquid, said first and second containers having communication with each other whereby the pressure waves generated in the liquid within the first container upon rupture of the arc are absorbed by the resultant change in the level of the liquid in said second container so that no dangerous stresses are exerted on the structure of said circuit breaker upon rupture of the arc.

11. In a circuit breaker according to claim 10, means permitting relative movement of said first and second containers, resulting from sudden changes in the pressure of the liquid within the containers produced by rupture of the arc, and means yieldably resisting such relative movement.

AIMÉ ESTIENNE.