

Sept. 25, 1945.

H. E. STRANG ET AL
CIRCUIT-INTERRUPTING DEVICE

2,385,658

Filed March 20, 1942

Fig. 2.

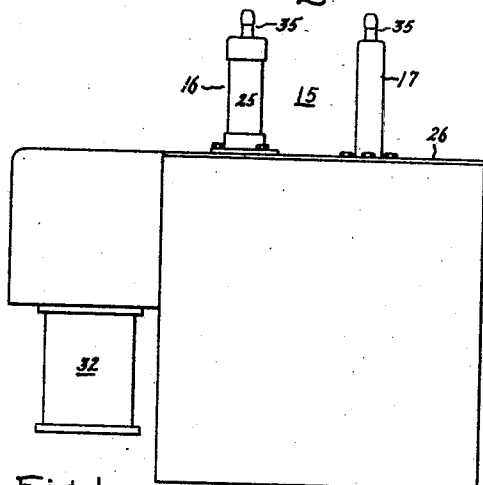


Fig. 3.

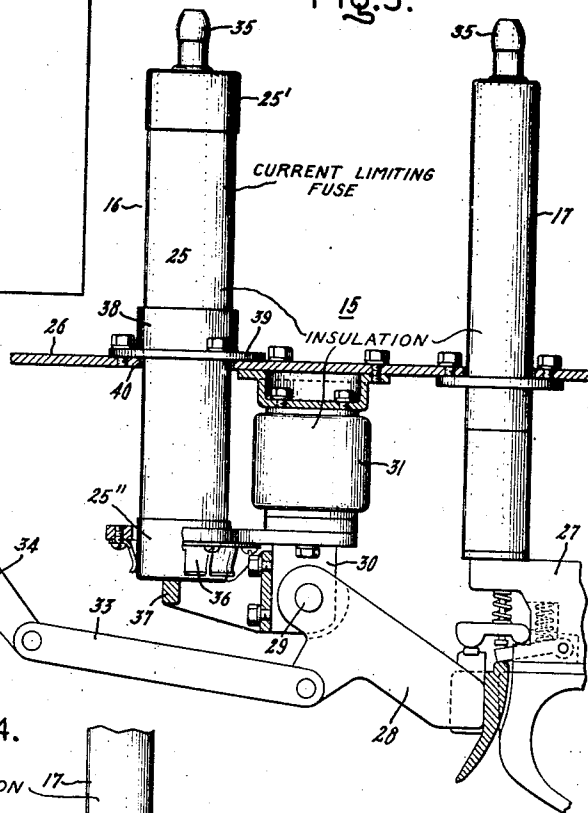


Fig. 1.

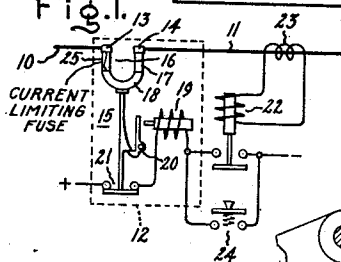
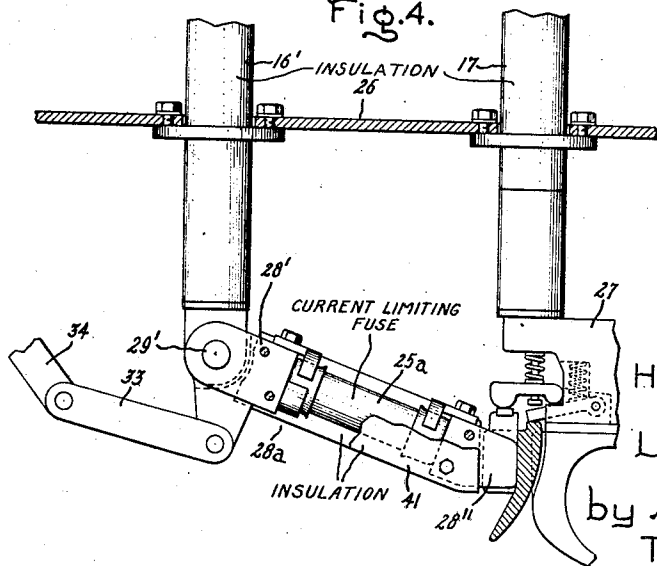


Fig. 4.



Inventors:
Harold E. Strang,
George M. Reed,
Leonard J. Linde,

by *Harry E. Smith*
Their Attorney.

UNITED STATES PATENT OFFICE

2,385,658

CIRCUIT-INTERRUPTING DEVICE

Harold E. Strang, Ardmore, George M. Reed, Upper Darby, and Leonard J. Linde, Drexel Hill, Pa., assignors to General Electric Company, a corporation of New York

Application March 20, 1942, Serial No. 435,464

7 Claims. (Cl. 200—114)

Our invention relates to circuit-interrupting devices and more particularly to a circuit interrupter which includes as a part of its physical structure a second circuit-interrupting device preferably of the type including a fusible element.

In the copending application of Alan G. Darling, Serial No. 428,739, filed January 29, 1942, now Patent No. 2,358,215, issued September 12, 1944, and assigned to the same assignee as the present application, there is disclosed and claimed a switching device or circuit interrupter including a current-limiting fuse connected in series therewith, which serially arranged combination produces certain very desirable results in connection with the protection of an associated device or system. Recently, there has been a great demand for the standardization of switchgear which has been accomplished by the use of so-called "metal-clad switchgear." It would be desirable to provide the advantages of the series arrangement of circuit breaker and current-limiting fuse which would fit in with the standardized switchgear without requiring additional space together with a greatly increased cost.

Accordingly, it is an object of our invention to provide a new and improved circuit-interrupting device in which a circuit interrupter of any standard type includes as a part of its physical structure a second circuit-interrupting device electrically in series with the first-mentioned circuit interrupter.

It is another object of our invention to provide a circuit-interrupting device including a circuit breaker having as a part of its physical structure a current-limiting fuse serially connected with the circuit-breaker contacts for interrupting fault currents above the range of operation of the first-mentioned circuit interrupter.

Further objects and advantages of our invention will become apparent as the following description proceeds and the features of novelty which characterize our invention will be pointed out with particularity in the claims annexed to and forming a part of this application.

For a better understanding of our invention, reference may be had to the accompanying drawing in which Fig. 1 is a schematic diagram of a power system employing a circuit-interrupting device embodying our invention, Fig. 2 discloses a side elevational view of a well-known type of standard air circuit breaker embodying our invention constructed for use with metal-clad switchgear of the vertical lift type, Fig. 3 is an enlarged sectional view of a portion of Fig. 2, and Fig. 4 is a view similar to Fig. 3 illustrating a modification of our invention.

It will be understood that our invention is applicable to any circuit-interrupting devices and, when applied to a circuit breaker, is applicable to any of the well-known types, such as

oil circuit breakers, air-blast circuit breakers, and the like. It is, however, particularly applicable to switchgear which comprises a stationary housing into which electric power circuits are connected, which power circuits are controlled by a cooperating electric circuit breaker mounted on a removable unit which may be of the vertical lift or the horizontal drawout type. Movement of the unit including the circuit breaker into and out of the stationary housing connects the circuit-interrupting device with the associated power circuit through primary disconnecting devices which usually comprise stationary portions in the housing and cooperating conductor studs on the circuit breaker.

Referring now to Fig. 1, we have illustrated a single-line diagram of a power bus 10 and a feeder circuit 11 which terminate in a stationary metal housing generally indicated at 12 and the ends of which are connected to the stationary portions 13 and 14 respectively of so-called "primary disconnecting devices." The connection between bus 10 and feeder circuit 11 is controlled by means of any well-known type of circuit interrupter unit generally indicated at 15, which is constructed for movement into and out of stationary housing 12. Circuit breaker 15 comprises schematically illustrated conductor studs 16 and 17 including cooperating portions for respectively engaging with the stationary portions 13 and 14 of the primary disconnecting devices.

Circuit breaker unit 15 is schematically illustrated as comprising a circuit breaker of the latched closed type including a movable conducting member 18 for completing a circuit between the lower ends of conductor studs 16 and 17. A suitable trip coil 19 for releasing latch 20 is provided and trip coil 19 is connected in a suitable control circuit through "a" switch 21 which is closed when the circuit breaker is closed and open when the circuit breaker is open. Opening of circuit breaker 15 is obtained automatically through the operation of an over-current relay schematically indicated at 22, which controls the energization of trip coil 19. Relay 22 is energized from a suitable current transformer 23 connected in feeder circuit 11. Manual opening of circuit breaker 15 is obtained by operation of opening switch 24 connected in series with trip coil 19. The operation of circuit breaker unit 15 for controlling the flow of power between bus 10 and feeder circuit 11 will be obvious to those skilled in the art. In order to interrupt the flow of current between bus 10 and feeder circuit 11 when the current flowing is above that which can safely be interrupted by circuit breaker 15, we connect in series with the relatively movable contacts of circuit breaker 15 a current-limiting fuse 25 which forms a part of the physical structure of circuit breaker 15. In Fig. 1, the current-limiting fuse or circuit-

interrupting device 25 is indicated as comprising the circuit-breaker stud 16 but it will be apparent from the following description that it could equally well comprise some other part of the circuit breaker, such as the movable contact portion or the like. By combining the two circuit-interrupting devices in this manner, they really form a single device which has all the advantages of the protective arrangement disclosed in the above-mentioned copending application of Alan G. Darling together with compactness, low first cost, and, furthermore, is readily adaptable to the present standardized forms of switchgear which are so much in demand.

Although we have disclosed a current-limiting fuse 25 as comprising the stud 16 of circuit breaker 15, it should be understood that it might equally well comprise the stud 17 instead, in the event that circuit 11 were a supply circuit rather than a feeder circuit since it might be desirable to have the current-limiting fuse on the so-called "hot side" of the circuit breaker unit. Also two fuses, one in each stud might be provided. It will also be understood by those skilled in the art that, although circuit breaker unit 15 has been indicated as controlling only a single-phase circuit, it could equally well control a polyphase circuit, such as the standard three-phase circuit, in which case, three studs 16 and three studs 17 would be provided and, depending upon whether circuit 11 were a feeder circuit or a supply circuit, one or more sets of these conductor studs would actually be current-limiting fuses serving as the studs of the circuit breaker.

Although we have specifically referred to fuse 25 as a current-limiting fuse which is preferably of the form and construction shown in United States Letters Patent 2,188,816 Rankin, assigned to the same assignee as the present application, it might in certain cases be desirable that some other type of circuit-interrupting device, whether of the fusible type or not, be employed in accordance with the present invention, particularly where advantageous results such as those disclosed in the copending Darling application referred to above are obtained.

Referring now to Figs. 2 and 3, we have disclosed our invention as specifically applicable to a well-known form of air circuit breaker such as is disclosed and claimed in the copending application of Eugene W. Boehne, Serial No. 349,220, now Patent 2,293,452, filed August 1, 1940, and assigned to the same assignee as the present application. Since in Fig. 1, we schematically illustrate our invention as applied to any type of circuit breaker, the corresponding parts of Figs. 2 and 3 showing specific applications of our invention will be, in so far as possible, designated by the same reference numerals as in Fig. 1.

The air circuit breaker unit of Figs. 2 and 3 generally indicated at 15 is in a form that is particularly adaptable for central stations and substations wherein the unit can be bodily disconnected with respect to the stationary circuits comprising the stationary portions 13 and 14 of the primary disconnecting contacts (not shown) by a simple plugging operation. In the case of Figs. 2 and 3, the circuit breaker unit 15 is illustrated as of the well-known vertical lift type, wherein disconnection of the primary disconnecting contacts is effected merely by bodily lowering of the circuit-breaker unit 15. As was pointed out in connection with Fig. 1, the circuit-breaker unit 15 would be housed in a grounded metal enclosure or cubicle, not shown in Fig. 2, similar

to 12 schematically indicated in Fig. 1. More specifically, the circuit breaker unit of Figs. 2 and 3 comprises a main supporting frame 26 for the movable contact structure which comprises a fixed or stationary contact 27 and a relatively movable contact 28 pivotally mounted at 29 to a conducting member 30. Conducting member 30 is supported from supporting frame 26 by means of an insulating member 31. Relative movement of movable contact 28 is obtained through the operation of any suitable actuating mechanism, such as 32 (Fig. 2), carried by the supporting frame 26 which may be of the solenoid type, for example. The actuating mechanism 32 is interconnected in any suitable manner with movable contact 28, as for example, by link 33 and crank 34. The particular construction of contacts 27 and 28 forms no part of the present invention but is disclosed and claimed in the copending application of Leonard J. Linde, Serial No. 435,463, now Patent 2,335,068, filed March 20, 1942, and assigned to the same assignee as the present application.

The stationary contact 27 is electrically connected to the lower end of conductor stud 17 while the conducting member 30 pivotally supporting moving contact 28 is electrically connected to the lower end of conducting stud 16, which not only serves as a conducting stud but actually comprises a current-limiting fuse of the type disclosed in the above-mentioned Rankin patent with the upper ferrule 25' of the fuse being modified slightly to accommodate the member 35 which serves as the plug-type disconnect contact for the circuit-breaker unit 15 and which is identical with the member 35 associated with conductor stud 17. Electrical connection between the lower end of current-limiting fuse 25 and conducting member 30 may be accomplished in any suitable manner, such, for example, as an annular spring-type contact member 36 for making electrical contact with the lower ferrule 25' of current-limiting fuse 25. A suitable support 37 either integral with member 30 or bolted thereto as shown in Fig. 3 may be provided to limit the downward movement of current-limiting fuse 25 to determine the vertical position thereof.

In order properly to position current-limiting fuse 25 satisfactorily to act as conductor stud 16, we provide an annular supporting collar 38 which may be suitably connected or attached to the body or casing of current-limiting fuse 25 intermediate the ends thereof as by cementing or the like. Collar 38 is provided with a horizontal flange 39 which is adapted to close completely the opening 40 in supporting frame 26 which accommodates the stud 16 comprising current-limiting fuse 25 and, furthermore, flange 39 may be bolted or otherwise suitably attached to supporting frame 26 properly to align current-limiting fuse 25, whereby cooperation with the stationary portions of the primary disconnecting devices may be satisfactorily obtained.

As has been mentioned above, the current-limiting fuse 25 might comprise conductor stud 17 instead of conductor stud 16 as illustrated, whereby the circuit-interrupting device would be satisfactory for use in controlling the interconnection of a feeder circuit or supply circuit and a bus circuit.

Although thus far, we have disclosed our invention in which the current-limiting fuse comprises the conductor stud of a circuit breaker, it should be understood that it might equally well comprise some other physical part of the circuit

interrupter and, in Fig. 4 where the corresponding parts thereof are designated by the same reference numerals as in Fig. 3, we have illustrated an air circuit breaker in which the current-limiting fuse 25a comprises the pivotally mounted relatively movable contact 28a. In this case, conductor stud 16' may be substantially identical with conductor stud 17 and movable contact 28a may be pivotally mounted at 29' to the lower end of conductor stud 16'. Current-limiting fuse 25a may be supported in any suitable manner so as to comprise movable or pivoted blade 28a. As illustrated in Fig. 4, a conducting member 28' is pivoted at 29' to the lower end of conductor stud 16'. Member 28' is connected to the contacting portion 28'' of movable blade 28a as by suitable insulating supports 41 and the electrical connection between members 28' and 28'' is completed through current-limiting fuse 25a, as is clearly indicated in Fig. 4.

From the above discussion, it will be obvious that we have provided a circuit-interrupting device which includes as a physical part thereof a second circuit-interrupting device serially arranged therewith in so far as the electrical circuit is concerned. The main circuit-interrupting device operates as a conventional circuit breaker but, in the event of fault currents greater than those which the circuit breaker can satisfactorily interrupt, the second circuit interrupter becomes effective to interrupt the current. By this arrangement, a very compact structure is provided having all of the advantages of a serially arranged current-limiting fuse and circuit-interrupting device.

While we have disclosed certain specific embodiments of our invention, it should be understood that our invention is not limited to the specific details and arrangement thereof herein illustrated and we intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

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

1. In an electric circuit interrupter, a pair of relatively movable contacts adapted to be connected in an associated power circuit, motive means for producing relative separation of said contacts to interrupt the current flowing in said associated circuit, and a fuse of the current-limiting type wholly replacing a part of the physical structure of said circuit interrupter serially arranged with said relatively movable contacts to interrupt the current flowing in said associated circuit in the event of a fault current above the value capable of being satisfactorily interrupted by said circuit interrupter.

2. In an electric circuit interrupter, a pair of relatively movable contacts for making and breaking an electric circuit through said circuit interrupter, a pair of insulated conductors each connected to one of said relatively movable contacts and each constructed so as to form a stud for connection with an associated electric circuit, one of said studs comprising a current-limiting fuse so as to provide means for interrupting fault currents above the value capable of being safely interrupted by the relatively movable contacts of said circuit interrupter.

3. In an electric circuit breaker, a pair of relatively movable contacts for making and breaking an electric circuit through which said circuit breaker means for initiating relative separation of said contacts in response to the current flowing in an associated electric circuit, and a fuse

of the current-limiting type wholly replacing a part of the physical structure of said circuit breaker serially arranged with said relatively movable contacts to interrupt the current flowing in said associated circuit in the event of a fault current on said circuit above the value capable of being satisfactorily interrupted by said circuit interrupter.

4. In an electric circuit breaker, a stationary contact, a movable contact, and means for initiating opening movement of said movable contact in response to the current flowing in an associated electric circuit, said movable contact comprising a fuse of the current-limiting type serially arranged with the circuit including said stationary and movable contacts of said circuit breaker to interrupt the current flowing in said associated circuit in the event of a fault current on said circuit above the value capable of being satisfactorily interrupted by said circuit interrupter.

5. In an electric circuit interrupter, a pair of relatively movable contacts for controlling the current flowing in an associated electric circuit, a conductor stud having one end connected to one of said relatively movable contacts and the other end adapted to be connected with said associated electric circuit, a second conductor stud comprising a current-limiting fuse having one end thereof connected to the other of said relatively movable contacts while the other end thereof is adapted to be connected with said associated electric circuit, said current-limiting fuse providing means for interrupting fault currents above the value capable of being safely interrupted by the relatively movable contacts of said circuit interrupter, and means permitting removal and replacement of said conductor stud comprising said current-limiting fuse.

6. In combination with electric switchgear, a stationary housing and a removable unit including a circuit breaker mounted thereon, a pair of conductor studs on said removable unit, each including a portion of the primary disconnecting device, the other portion of the primary disconnecting device being associated with said stationary housing, a pair of relatively movable contacts each of which is connected to the end of one of said conductor studs, said relatively movable contacts being capable of interrupting the current flowing in an associated electric circuit, at least one of said conductor studs comprising a current-limiting fuse for interrupting fault currents on said associated circuit above the value capable of being safely interrupted by the relatively movable contacts of said circuit breaker, and means permitting ready removal and replacement of said conductor stud comprising said current-limiting fuse.

7. In an electric circuit interrupter, a pair of relatively movable contacts for making and breaking an electric circuit through said circuit interrupter, and a pair of insulated conductors each connected to one of said relatively movable contacts and each constructed so as to form a stud for connection with an associated electric circuit, one of said studs comprising a high speed fuse so as to provide means for interrupting fault currents above the value capable of being safely interrupted by the relatively movable contacts of said circuit interrupter.

HAROLD E. STRANG.
GEORGE M. REED.
LEONARD J. LINDE.