June 7, 1949. S. R. SMITH, JR 2,472,625

ELECTRIC CIRCUIT BREAKER

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Fig. 2.

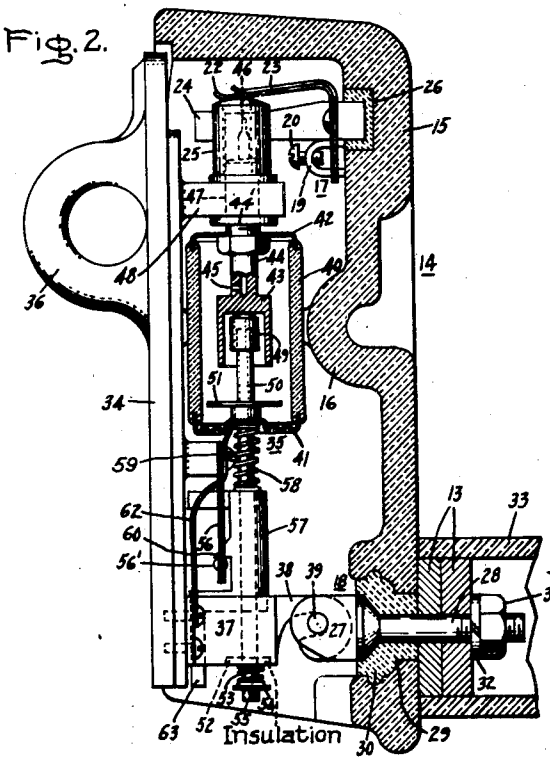


Fig. 3.

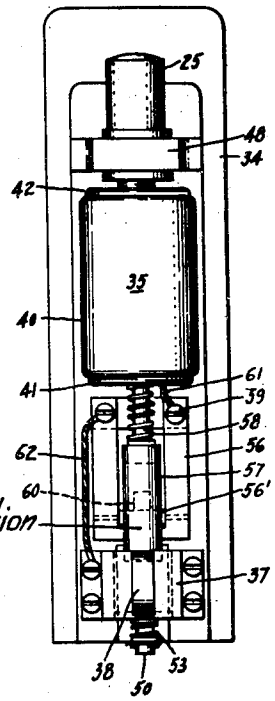


Fig. 4.

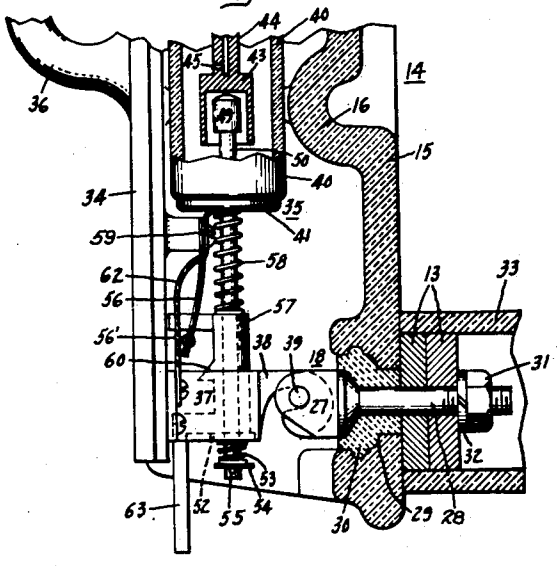
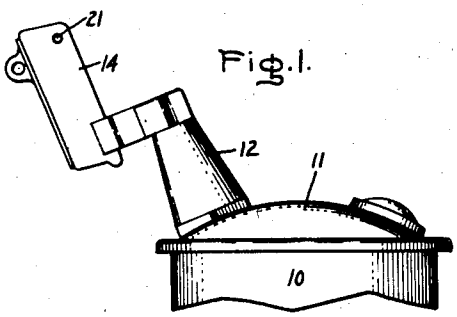


Fig. 1.



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Fig. 5.

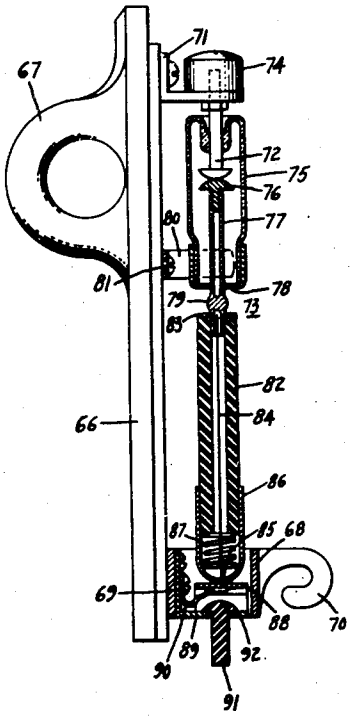


Fig. 6.

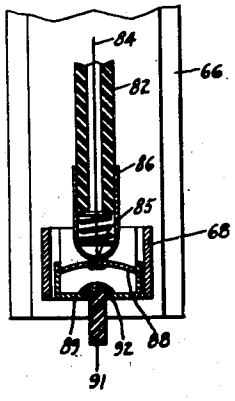
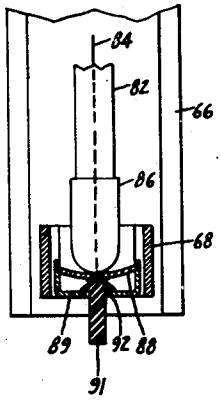


Fig. 7.



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UNITED STATES PATENT OFFICE

2,472,625

ELECTRIC CIRCUIT BREAKER

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Application May 23, 1944, Serial No. 536,872

3 Claims. (Cl. 200—113)

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My invention relates to electric circuit breakers and more particularly to such circuit breakers which are adapted for use in place of the conventional fuse cutout devices. Specifically, my invention is an improvement on my prior copending application Serial No. 334,629, filed May 11, 1940, and assigned to the same assignee as the present application and which has resulted in Patent No. 2,424,126, issued July 15, 1947.

Fuse cutout devices have been used to a large extent in the protection of high tension electric circuits. Devices of this kind in general comprise replaceable fusible means mounted within a suitable holder and they are usually located in close proximity to the high tension conductors as a consequence of which they are relatively inaccessible for inspection and maintenance. Difficulties have been encountered in providing fuse cutouts having an electric fuse convenient for installation and inspection and at the same time capable of being removable and replaceable. In any event, an abnormal electrical condition occurring on a circuit protected by a fuse cutout will destroy the fuse and hence require replacement thereof. Although recent experimentation and research have reduced the cost of the replaceable elements, nevertheless such cost is still appreciable and it would be desirable to provide a fuseless cutout which would automatically interrupt the circuit under abnormal electrical conditions and yet wherein it is unnecessary to replace any elements after the protective operation of such cutouts, as is necessary with the fuse cutouts of the prior art.

It is an object of my invention, therefore, to provide a new and improved circuit breaker adapted to replace the fuse cutouts of the prior art.

It is another object of my invention to provide a new and improved fuseless cutout which is simple and compact, economical in construction, which gives an immediate and reliable indication of the actuation and condition thereof, and which may be used in connection with prior art housings for fuse cutouts.

It is another object of my invention to provide a fuseless cutout of the vacuum type which may be used in place of the fuse cutouts of the prior art.

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

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For a better understanding of my invention, reference may be had to the accompanying drawings in which Fig. 1 is a view of the upper portion of an electrical device with which my invention is associated; Fig. 2 is an enlarged sectional view of a fuseless cutout of my invention in the closed circuit position; Fig. 3 is a view looking at the inside of the door or cover of the housing of the fuseless cutout of my invention; Fig. 4 is a partial view similar to Fig. 2 illustrating the fuseless cutout in the open circuit position; Fig. 5 is a sectional view similar to Fig. 1 with the housing removed, of a modification of my invention, and Figs. 6 and 7 are partial views of the modification illustrated in Fig. 5 showing different operating conditions thereof.

Although my invention is adapted for use wherever fuse cutouts of the prior art have been used, either supported from a pole, cross-arm, or the like, I have chosen to illustrate my invention as supported on the insulating bushing of an electrical apparatus such as a transformer or the like.

Referring now to Fig. 1, the transformer 10 is illustrated as being provided with a cover 11 upon which is mounted a high voltage bushing 12 having a terminal with a suitable extension 13 (see Figs. 2 and 4) at the upper end thereof. Mechanically supported from the terminal extension 13 is an electric circuit interrupting device 14 embodying my invention.

Electric circuit interrupting device 14 preferably comprises a housing 15 which may be substantially identical with the housing disclosed in Hermann Patent 2,163,398, granted June 20, 1939, and assigned to the same assignee as the present application. Housing 15 is preferably formed of porcelain or other suitable insulating material and is provided with an integrally formed electric creepage and gas barrier 16 disposed between stationary contact assemblies 17 and 18 supported in spaced relationship in housing 15.

The contact assembly 17 includes a line terminal 19 adapted to have a line conductor or lead fastened thereto by means of a suitable clamping screw 20. This line conductor or lead,

not shown, may enter the housing or casing 15 through an opening 21 (see Fig. 1) which opening is in alignment with terminal 19. Contact assembly 17 further includes a contact finger 22 backed up by means of a spring strip 23 which serves to press the contact finger 22 downwardly. In addition, contact assembly 17 includes a terminal clip 24 which is arranged to receive the flanged terminal cap 25 of my improved circuit interrupter which is similar to the terminal caps of the fuse holders of the prior art. The terminal clip 24, the spring strip 23, the contact finger 22 and the line terminal 19 are united to form the unitary contact assembly 17 which is suitably cemented into a recess 26 in the upper rear wall within housing 15.

The lower terminal assembly 18 really comprises a hinge bracket 27 which serves as the lower terminal contact of the circuit interrupter and forms an integral part of the electrically conductive bolt 28 which extends outwardly through an opening 29 in the rear wall of casing or housing 15 and which is fixedly anchored in the opening 29 by means of suitable cement indicated at 30. The outer end of this bolt 28 is threaded for the reception of a clamping nut 31 and a lock washer 32 so that cutout housing 15 may be mechanically supported from terminal extension 13 of transformer 10. With this arrangement the hinge bracket 28 which serves as a lower contact of the circuit interrupter of my invention, is electrically connected to the transformer terminal extension 13. Preferably the live exposed portions of terminal extension 13 and conductive bolt 28 are covered by a suitable insulating shield 33 which may be similar to that disclosed and claimed in Patent No. 2,409,042, issued October 8, 1946, to Benjamin R. Hermann, and assigned to the same assignee as the present application.

It should be understood that as far as my invention is concerned, housing 15 might also be constructed in accordance with the housing disclosed in United States Letters Patent 2,081,813, granted May 5, 1937, upon an application of Benjamin R. Hermann and assigned to the same assignee as the present application.

The open side at the front of housing 15 is closed by means of a door, or cover 34 preferably constructed of insulating material and having generally the same shape and design as the doors or covers of enclosed fuse cutouts of the prior art, whereby this door and the apparatus associated therewith may replace the doors or covers of the prior art constructions or at least be interchangeable therewith. This door 34 supports on one face an electric circuit interrupter generally indicated at 35 and described in greater detail hereinafter. On the other face of the door or cover 34 there is formed an eyelet handle 36 which may either be grasped manually or engaged by a suitable switch stick (not shown). The circuit breaker or interrupter 35 when in the closed position completes the electrical circuit between contact or terminal assemblies 17 and 18, respectively.

Suitably bolted to the lower inside face of door 34 is a U-shaped member 37 having a hook-shaped extension 38 for engaging the hinge pin 39 supported by hinge bracket 27. With this arrangement door or cover 34 which, as will be described, supports circuit interrupter 35, is adapted to be pivotally supported by hinge bracket 27 in such a manner that the door or cover 34 may be pivotally moved to either its open or closed position and furthermore bodily

removed from casing or housing 15 whereupon the contact assemblies 17 and 18 are completely isolated from one another.

Door mounted circuit interrupter 35 preferably comprises a suitable evacuated container 40 which is illustrated as of cylindrical form and formed of insulating material such as glass, or the like. The lower end of glass housing 40 is preferably closed by a flexible diaphragm 41 fastened to housing 40 by means of a suitable seal. The upper end of housing 40 is closed by a metal cover 42 also suitably connected so that glass casing or housing 40 may be evacuated to a high degree of vacuum. Fixedly mounted within the upper end of evacuated housing 40 is a cup-shaped stationary contact 43. This contact has a hollow rod-like extension 44 which extends out of evacuated housing 40. A passageway 45 within extension 44 connects the interior of housing 40 with the exterior so that the housing may be evacuated to a high degree after which the end of extension 44 is sealed off exteriorly of housing or casing 40 as is indicated at 46.

In order to support the circuit interrupter 35 from door or cover 34 rod-like extension 44 extends through an opening 47 in a projection 48 mounted on the inside face of cover 34. Any suitable means for rigidly fastening rod-like extension 44 to projection 48 may be provided. As illustrated in Fig. 2, rod-like extension 44 is threaded so that flanged cap 25, which is internally threaded, and nut 44' may be suitably fastened thereto. Flanged cap 25 is removed so that the rod-like extension 44 may be inserted through opening 47 in projection 48, and projection 48 can then be clamped between nut 44' and flanged cap 25. Cap 25 connected to rod-like extension 44 forms the upper contact of the circuit breaker which is adapted to be electrically engaged by contact finger 22 when the cover 34 is in the closed position shown.

Cooperating with stationary cup-shaped contact 43 is movable contact 49 supported on a rod 50 which extends through flexible diaphragm 41 but in sealed relationship therewith. It will be understood by those skilled in the art that only a very small movement which may be of the order of $\frac{1}{32}$ inch separation between contacts 43 and 49 is required to interrupt high currents in a high vacuum. This relatively small movement is permitted by flexible diaphragm 41. A suitable disk 51 is mounted on rod 50 within vacuum housing 40 to prevent the arc products from impinging against the flexible diaphragm. The reciprocal movement of rod 50 and contact 49 is guided by a member 52 supported by U-shaped member 37 or, if desired, formed integrally therewith. Member 52 is preferably formed of insulating material or at least the opening therein through which rod 50 reciprocates, is bushed with insulating material.

With the arrangement described thus far, it is obvious that atmospheric pressure will bias contacts 49 and 43 into engagement. I provide a spring 53 which is compressed between member 52 and a washer 54 held on rod 50 by pin 55 which provides a sufficient force to overcome atmospheric pressure and bias contacts 43 and 49 to the open position shown in Fig. 4.

In order to hold or latch the contacts 43 and 49 in the closed position shown in Fig. 2, I provide a latching means which comprises a current responsive means comprising U-shaped bimetallic element 56 best shown in Fig. 3, a member 57

preferably formed of molded insulation and slidable on rod 50, and a suitable spring means 58. Spring means 58 is slidable on rod 50 with one end engageable with flexible diaphragm 41, while the other end is engageable with the upper portion of latching member 57. The U-shaped bimetallic element 56 is suitably fastened, as indicated at 59, to door or cover 34. A sort of roller element 56' on bimetallic element 56 is adapted to engage a projection 60 on slidable member 57 when it is moved to its uppermost position indicated in Fig. 2. In this position spring 58 is compressed so that diaphragm 41 is moved upwardly to hold contacts 43 and 49 in the closed position. One leg of the U-shaped bimetallic element 56 is electrically connected to rod 50 by means of a conductor 61, while the other leg of the U-shaped bimetallic element 56 is electrically connected by conductor 62 to U-shaped member 37. U-shaped bimetallic element 56 is very similar to the arrangement disclosed and claimed in U. S. Letters Patent 2,273,764, Salter, assigned to the same assignee as the present application.

With the above arrangement of U-shaped bimetallic element 56 the current flowing through circuit interrupter 35 must flow through bimetallic element 56. Excess currents will cause it to deflect to the position shown in Fig. 4 whereupon roller 56' becomes disengaged from projection 60 and spring 53 then causes relative separation of contacts 43 and 49 to the position indicated in Fig. 4 with the consequent interruption of the current flowing between terminal assemblies 17 and 18.

In order to indicate the operating condition of circuit interrupter 35, slidable member 57 is provided with an extension 63 which may be suitably colored in a conspicuous manner. When the circuit interrupter is in the closed position shown in Figs. 2 and 3 the indicator 63 is moved completely within housing 15 and is not visible. However, upon operation of the current responsive latching means including bimetallic element 56, slidable member 57, and indicator 63 move downwardly to the position shown in Fig. 4, with the indicator 63 clearly visible. It will be observed that the movement of slidable element 57 is many times greater than that of rod 50 and this movement is limited by the engagement of slidable member 57 with member 52, as shown in Fig. 4. The indicator 63 also provides a handle for resetting the circuit interrupter 35. As soon as bimetallic element 56 has cooled sufficiently following a circuit interruption the circuit interrupter may be reclosed by merely pushing upwardly on indicator 63 until roller 56' again engages projection 60. Preferably such reclosing operation is performed while the door 34 and associated circuit interrupter 35 are removed from housing 15. When the contacts 43 and 49 are reclosed the door or cover may be replaced and moved to the closed position in the same manner as the doors or covers of the enclosed fuse cutouts of the prior art. With my arrangement, however, no replacement of a burned out fusible element is required.

The operation of the fuseless cutout of my invention will be obvious from the detailed description included above and, as will be obvious from this description, the present invention provides pronounced advantages over fuse cutouts of the prior art in that it is unnecessary to replace any parts before the circuit may again be completed after circuit interruption, it being merely necessary for the lineman to reclose the circuit interrupter in the manner described above. Also an indication of the condition of the fuseless cutout is at all times evident to the lineman.

Some times it is desirable in enclosed cutout devices to open the door or cover following a circuit interruption to provide an isolating gap between the terminal assemblies within the housing. This may readily be accomplished with my invention in a manner similar to that disclosed in my copending application, Serial No. 459,791, filed September 26, 1942, now Patent 2,357,853, and assigned to the same assignee as the present application.

Although I have disclosed the current or thermal-responsive means of my invention as a bimetallic element 56, it will be obvious that other current or thermal-responsive means might equally well be employed, such for example as are disclosed in the copending application of George F. Lincks, Serial No. 522,584, filed February 16, 1944, and assigned to the same assignee as the present application or in Figs. 5, 6 and 7 of the drawings of the present application. Also in accordance with the above mentioned Lincks application, my fuseless cutout may be of the automatic reclosing type if desired.

In Figs. 5, 6 and 7 of the drawings, I have disclosed a modification of the vacuum type fuseless cutout of my invention. Since the housing for the fuseless cutout shown in Figs. 5, 6 and 7 would be substantially identical with the housing of Fig. 2, it has been omitted for the sake of simplicity in the drawings. As in the fuseless cutout of Fig. 2, a door or cover 66 is provided, having a manually engageable handle 67. A U-shaped hinge support 68 is fastened to the lower inside face of door 66 by means of screws 69. This U-shaped hinge support is provided with a hook-shaped portion 70 similar to the hook-shaped portion 38 of Fig. 1 which is engageable with the hinge pin 39. A suitable support 71 is bolted to the inside face of door 66 near the upper end thereof for supporting in any suitable manner the stationary contact 72 of the circuit interrupter 73 mounted on door 66. A terminal cap 74 electrically connected to stationary contact 72 is provided so as to be engageable by the contact finger 22 and spring clip 24 of upper contact assembly 17.

Stationary contact 72 extends into an evacuated envelope 75 preferably constructed of suitable insulating material, such as glass or the like. A suitable seal between stationary contact 72 and evacuated envelope 75 is provided. Movably mounted in evacuated envelope 75 is movable contact 76 which is attached to a tubular switch arm 77. This switch arm 77 extends through and preferably is brazed or otherwise suitably sealed to a diaphragm 78 which is suitably sealed to the lower end of evacuated envelope 75. When the vacuum switch comprising envelope 75 and contacts 72 and 76 is assembled, it is evacuated to a high degree of vacuum through tubular switch arm 77 after which the tubular switch arm is flattened and sealed exteriorly of the casing or envelope 75 as indicated at 79. The lower end of evacuated envelope 75 is additionally supported from door 66 by means of a spring clip 80 suitably fastened to door 66 as indicated at 81 in Fig. 5.

In order to bias relatively separable contacts 72 and 76 to the open position, I provide a tube of insulating material 82 which is disposed so that the end of switch arm 77 extends into the upper end of the bore in tube 82. A suitable washer 83 on the upper end of tube 82 engages with the enlarged flattened portion 79 of switch