Dec. 22, 1953 R. H. AMUNDSON 2,663,825

COMBINATION FUSE CUTOUT AND SWITCH

Filed May 12, 1951 3 Sheets-Sheet 1

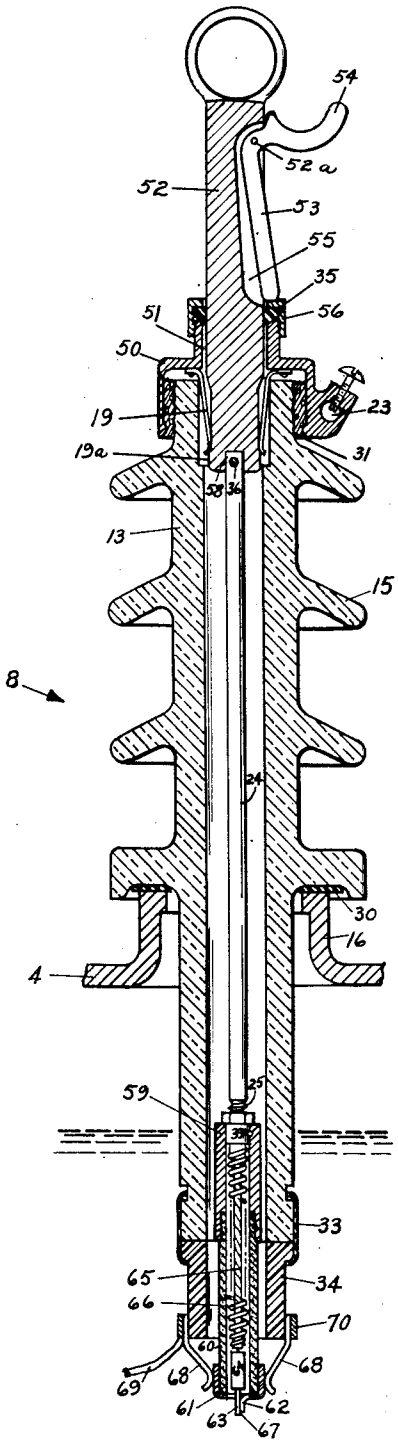


Fig. 1

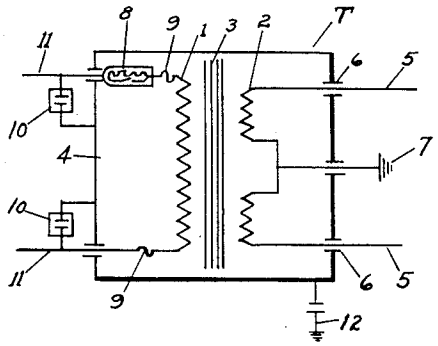


Fig. 2

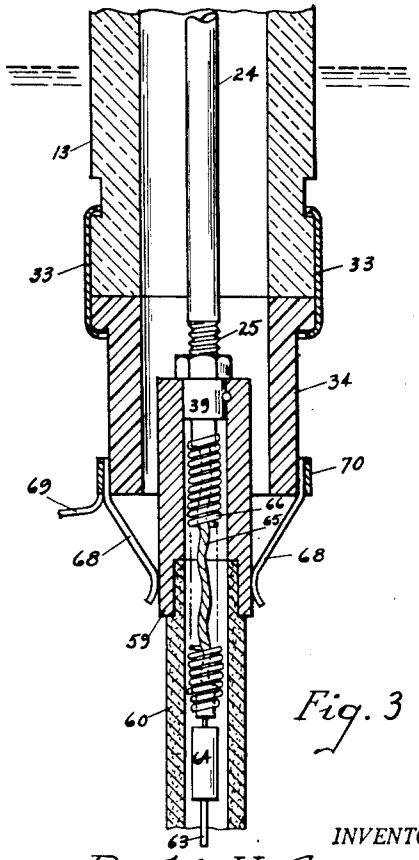


Fig. 3

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COMBINATION FUSE CUTOUT AND SWITCH

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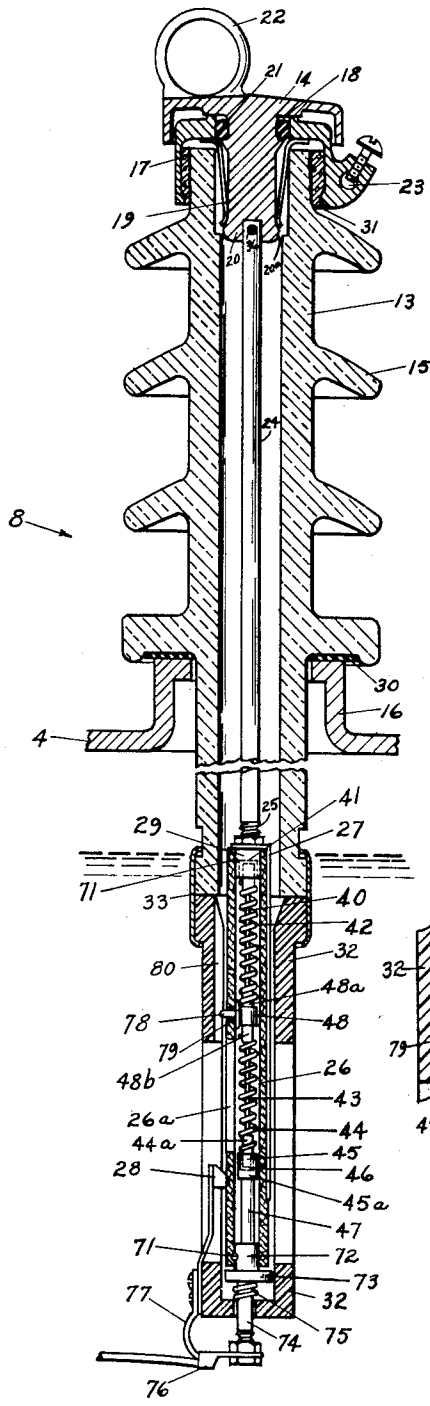


Fig. 4

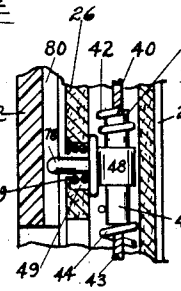


Fig. 11

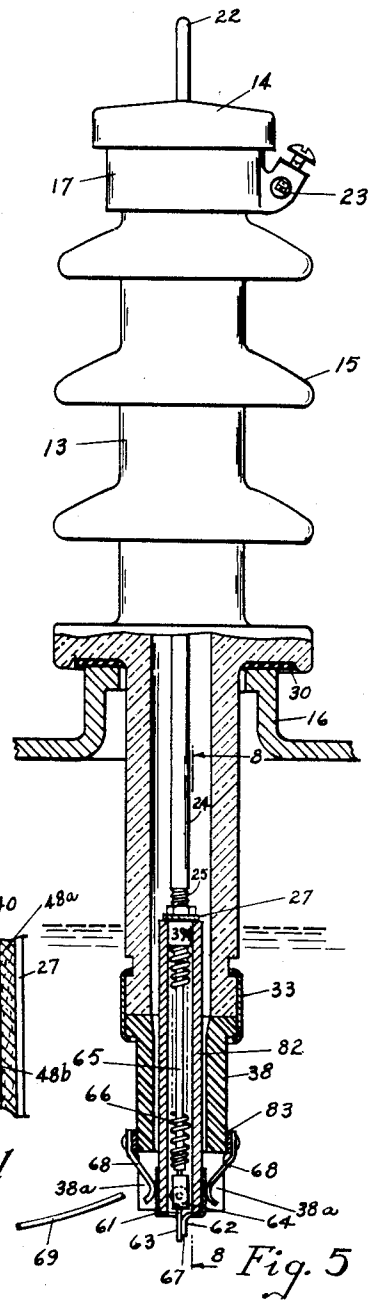


Fig. 5

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COMBINATION FUSE CUTOUT AND SWITCH

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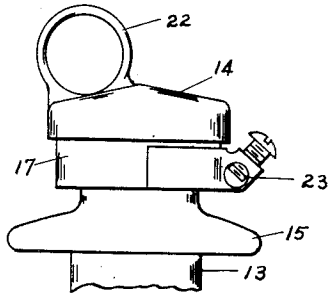


Fig. 6

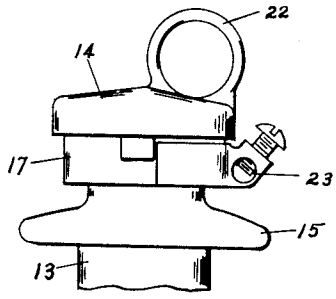


Fig. 7

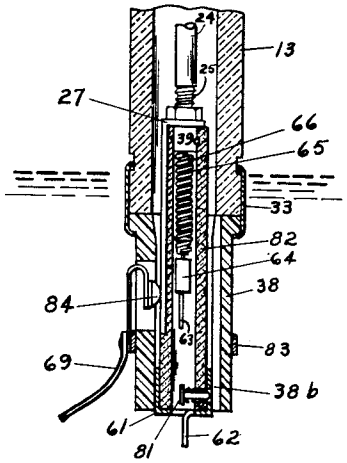


Fig. 8

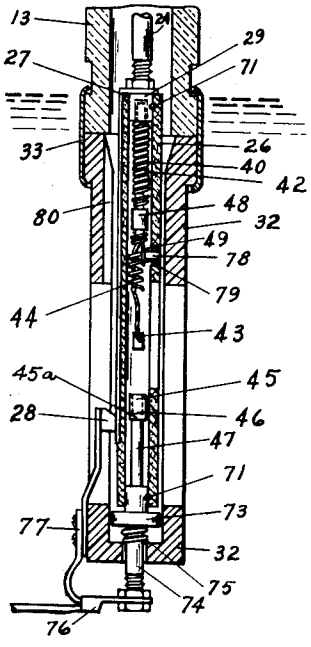


Fig. 10

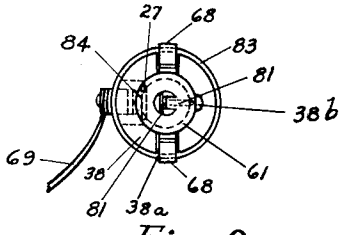


Fig. 9

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UNITED STATES PATENT OFFICE

2,663,825

COMBINATION FUSE CUTOUT AND SWITCH

Roald H. Amundson, Milwaukee, Wis., assignor to McGraw Electric Company, Milwaukee, Wis., a corporation of Delaware

Application May 12, 1951, Serial No. 226,077

17 Claims. (Cl. 317—15)

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My invention relates to a combination fuse cutout and a switch for controlling an electric circuit.

It is an object of this invention to provide for a bayonet type combination fuse cutout and circuit closer in an electrical distribution system, a fuse which in one part will react to a low steady overload and in the other part will react to a current of greater magnitude over a shorter period of time, and which bayonet can be rotated to close the circuit only after rupture of the fuse.

Also an object of my invention is to provide in a primary transformer bushing a combined dual purpose fuse and circuit closer means whereby on rupture of the fuse under either of two abnormal conditions in an electric circuit, the circuit may be closed by manual operation of the circuit closer.

Another object of my invention is to provide in a primary transformer bushing a dual purpose fuse and circuit closer consisting of a flexible link which is fusible in its first part when the temperature of the oil or other substance in which it is immersed reaches a value indicating sustained overload and is fusible in the second part by a load of dangerous over-current but which is insufficient in duration to raise the temperature of the dielectric medium in which it is immersed to a value that would fuse the first part, and including means exteriorly of the bushing for manually operating the circuit closer to close the circuit after the fuse has ruptured.

A further object of this invention is to provide in a primary transformer bushing a bayonet type combination fuse and recloser, the fuse having dual characteristics operable under either of two abnormal circuit conditions and the recloser being manually operable to reclose the circuit upon rupture of the fuse under either of the abnormal conditions.

Still another object is to provide a bayonet type fuse and circuit closer which has two circuit closing positions, one of which disposes the fuse in circuit closing position, and the other of which disposes the circuit closer in circuit closing position, said latter position being manually selectable only after rupture of the fuse.

Further, it is an object to provide in a transformer including a casing and a fluid insulating material therein, a tubular transformer bushing extending from the exterior of the casing and into the fluid therein and a bayonet insertable in the bushing and comprising a fuse element fusible by excess currents and by fluid temperatures exceeding a given value, the bayonet including a circuit recloser operable to reclose the circuit after interruption by the fuse element.

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Other objects will appear from time to time in the course of the specification and claims.

The dual characteristic fuse and circuit closer disclosed herein is in its broader concept the invention of William D. Kyle, Jr., whose application Serial No. 222,849, filed April 25, 1951, is copending herewith and is assigned to the same assignee of the present application.

Referring to the drawings:

Fig. 1 is a sectional view taken longitudinally on the axis of an embodiment of this invention.

Fig. 2 is a diagrammatic view of an electrical transformer and a combined fuse and circuit closer embodied therein.

Fig. 3 is an enlarged fragmentary view in section of the lower part of Fig. 1 showing the fuse blown and the bayonet rod moved axially into position to close the circuit.

Fig. 4 is a fragmentary view in section taken longitudinally on the axis of another embodiment of this invention.

Fig. 5 is a view partly in section taken longitudinally on the axis of a third embodiment of this invention.

Fig. 6 is a fragmentary view in elevation showing the bayonet operating handle in circuit closing position through the fuse.

Fig. 7 is a fragmentary view in elevation showing the bayonet operating handle in circuit closing position after rupture of the fuse.

Fig. 8 is a fragmentary sectional view taken relatively on the line 8—8 of Fig. 5 but showing the fuse ruptured, the detent out of locking position, and the switch rotated to circuit closing position.

Fig. 9 is a bottom view of the lower end of the bayonet relative to Fig. 8 as it appears before the fuse has blown.

Fig. 10 is a fragmentary sectional view of the lower part of the bayonet shown in Fig. 4 as it appears when the fuse is ruptured and the switch is rotated to circuit closing position.

Fig. 11 is an enlarged fragmentary sectional view of that portion of the embodiment shown in Fig. 4 which is intermediate the end of the fuse section.

Like parts are indicated by like reference numerals in all the various views.

As indicated in Fig. 2 the distribution transformer consists of a primary winding 1, a secondary winding 2, and a transformer core 3. The secondary winding 2 is grounded at 7 and is connected to service lines 5 which terminate

at secondary bushings 6. A combined fuse and switch embodying my invention is shown diagrammatically at 8 with a protector fuse 9 in series and located between it and the winding 1. Outside the casing 4 is a lightning arrester or expulsion gap 10, located between each primary lead 11 and the casing 4. A tank discharge gap is shown at 12.

Fig. 1 shows in detail one embodiment of the combined fuse and switch shown diagrammatically at 8 in Fig. 2. The insulating bushing 13 is preferably made of porcelain and is provided with skirts 15 on the upper section and a tubular insulating sleeve or extension 34 at its lower end. A metal sleeve 33 fits over adjacent annular shoulders on the bushing 13 and the sleeve 34 and is spun over the shoulders at its ends to hold the bushing and extension together.

The transformer bushing 13 is mounted in an opening in the annular boss 16 on the transformer casing 4 and sealed in position by means not shown, with the sealing means 30 making the connection air tight. At the upper end of the porcelain bushing 13 is a terminal or ferrule 50 shaped on one side so as to provide means for attaching the primary lead at 23. A cement 31 is injected between the ferrule 50 and the bushing 13 to securely fasten them together. The ferrule 50 has a reduced tubular end providing an opening 51 substantially co-axial with the bore in the bushing 13. The handle 52 extends through the opening 51 and is normally held against movement downwardly relative to Fig. 1 by a latch 53 which is pivoted at 52*a* on the handle and normally engaged at its lower end with a collar 56. By pulling on an arm 54 of the latch 53, the latch will move into the channel 55 in the handle 52. The collar 56 is threaded on the cap 50 and as indicated forms a rest for the lower end of the latch 53. A gasket 35 forms an air tight seal between the collar 56, the ferrule 50, and the handle 52. On the under side of the ferrule 50 and adjacent its opening 51, a plurality of contact fingers 19 are secured thereto and extend downwardly and inwardly so as to contact the metal handle 52. As may be seen the lower end of the handle is provided with an annular shoulder 19*a* which cooperates with the fingers 19 to releasably latch the handle against upper movement. A conductor rod 24 is attached to the lower end of the handle at 58 by some pinning means 36 or other suitable means. At the lower end of conductor rod 24 is the dual characteristic fuse and switch.

This dual characteristic fuse and switch comprises a sleeve 59 of some conducting material such as brass in its upper portion secured to bushing nut 39 which is threaded on the threaded end 25 of the rod 24. As may be seen in Figs. 1 and 3, the sleeve 59 has a fibre sleeve 60 secured to and extending from the lower end. The inner diameter of the sleeves is the same but the outer diameter of sleeve 59 is slightly greater than that of sleeve 60.

At the lower end of the fibre sleeve 60 is secured a contact ferrule 61 having a terminal lug 62. Resilient contact fingers 68 attached by means of an encircling terminal ring 70 to the insulating bushing 34 engage the ferrule 61. The transformer terminal wire 69 is secured to the ring 70. Extending from and secured to the bushing nut 39 is a flexible conductor cable 65 which is secured at its lower end to a resistor 64 having a terminal tongue 63 secured by a solder 67 or other metal of low melting temperature characteristics, to the terminal lug 62. A coil spring 66 is secured at one end to the bushing nut 39 and at the other end to the resistor 64 and is maintained in tension and thereby stresses the connection between the tongue 63 and the lug 62. Although I have suggested that the solder 67 be characterized by a low melting temperature, it will be understood that higher temperatures may be desirable and, therefore, the choice of materials for connecting the tongue 63 and the lug 62 rest with the designer and the results desired.

If the temperature of the oil or other medium in the transformer casing reaches a given temperature sufficient to melt the solder 67 as it will with an overload of long duration, the spring 66 will separate the tongue 63 and the lug 62, and collapse the cable 65 and draw the resistor 64 upwards in the sleeve 60 thus producing a gap and interrupting the circuit. If the temperature of the resistor 64 is raised sufficiently by a sudden surge of current sufficient to damage transformer insulation if continued but which might not be of sufficient duration to warm the transformer oil, the heat will be transmitted through the tongue 63 to the solder 67. When the solder is softened sufficiently to allow the spring 66 to separate the tongue 63 and the lug 62 and collapse the flexible cable 65, the resistor 64 will be drawn upward in the sleeve 60, thereby producing a gap and interrupting the circuit.

When the circuit has been interrupted under either of the conditions noted, it may be reclosed by pulling the hook-like latch releasing arm or handle 54 down so that the latch 53 will be moved from the collar 56 and into the space 55. The conductor handle 52 is then freely movable downward into the bushing 13 until the conductor sleeve 59 makes contact with the resilient contact fingers 68 as shown in Fig. 3. This reestablishes the circuit through the handle 52, rod 24, sleeve 59, resilient fingers 68 and the lead off line 69.

In Fig. 4 I show a second embodiment of my invention. At the top of the bushing 13 I show a substantially flat topped cover or closure 14 having a centrally located conductor hub 20 projecting into the bushing. A terminal ferrule 17 having a terminal clamp 23 is secured to the bushing by means of a cementitious material 31 and has a central opening 18 co-axial with the bore of the bushing and receiving the hub 20. A gasket 21 seals the opening 18 and the closure 14 is provided with an operating eye 22 integral therewith.

The lower end of the bushing 13 is provided with an insulating sleeve 32. A metal sleeve 33 fits over adjacent annular shoulders on the bushing 13 and the sleeve 32 and is spun over the shoulders at its ends to hold the bushing 13 and sleeve 32 together. The manner of mounting the bushing in the container 4 is similar to that illustrated in Fig. 1.

On the under side of the ferrule 17 adjacent its opening 18 a plurality of contact fingers 19 are secured thereto and extend downwardly and inwardly so as to contact the conductor hub 20. As may be seen the lower end of this conductor hub 20 is provided with an annular shoulder 20*a* which cooperates with the fingers 19 to prevent upward movement of the bayonet.

To the conductor hub 20 is attached a conductor rod 24 by some pinning means 36. At the lower end of the conductor rod 24 is a threaded portion 25 which is connected with the dual

characteristic fuse and switch hereafter described. This combination fuse and switch is surrounded by a fibre sleeve 26 having a radially disposed venting slot 26a. A conductor strap 27 preferably made of copper extends across the top and down one side of the fibre sleeve 26 and is secured to the upper end of the sleeve by means of the bushing nut 29. This conductor strap 27 is out of contact as a conductor when in the position shown in Fig. 4.

The bushing nut 29 encased within the upper section of the fibre sleeve 26 to which it is fastened by a key means 71 is in direct contact with the conductor rod 24 and strap 27. Inserted into the bore 41 of the bushing nut 29 and secured therein by means of a low melting solder is a flexible link 40 of the dual characteristic fuse, the low melting solder joint being responsive to the temperature of the cooling medium in the transformer casing. A coil spring 42 surrounds the flexible link 40 and maintains tension thereby in the link as long as the link 40 remains joined at 41. The lower ends of the link 40 and the spring 42 are anchored to a spacer 48. This spacer 48 is of sufficient diameter to loosely fill the bore within the fibre sleeve 26 and is provided with a vertical extension 48a to which the link 40 and spring 42 are secured.

The second flexible link 43 of the dual characteristic fuse and the surrounding coil spring 44 are secured at their upper ends to the extension 48b on the spacer 48. The lower ends of the link 43 and spring 44 are attached to a rod 44a which extends into the bore 45 in the resistor terminal 45a. Solder 46 in the bore 45 secures the rod 44a to the resistor terminal 45a which is a unit part of resistor element 47. The lower end of the resistor 47 is provided with a terminal contact or plug 72 secured in the lower end of the sleeve 26 by means of pin 71. When the fuse and switch assembly is in assembled relationship as shown in Fig. 4, the springs 42 and 44 are under tension and jointly stress the soldered joints 41 and 46. When current in excess of a predetermined value passes through the resistor 47 heat generated in the resistor will be conducted to the solder joint 46 and soften it sufficiently to permit the springs 42 and 44 to withdraw the rod 44a and introduce a gap in the circuit of sufficient length to cause the current to be broken.

Below the metal plug 72 and contacting it is a contact plate 73 which serves as a guide and has a terminal rod 74 which extends to the exterior of the lower end of the sleeve 32. Between the plate 73 and the lower enclosure of the insulating extension 32 is a coil spring 75 surrounding the terminal rod 74 and urging the plate 73 in firm contact with the plug 72. A lead 76 is connected with the terminal rod 74 and with the auxiliary flexible connection 77 electrically joined with the contact member 28. After the fuse has blown at either 41 or 46, the circuit can be closed by rotating the handle 22 which switches the position of the conductor strap 27 from that shown in Fig. 4 to that shown in Fig. 10 so as to reclose the circuit through the contact piece 28.

Adjacent the spacer 48 is an opening 49 in the fibre fuse tube 26, of sufficient diameter to hold a detent 78 with its surrounding spring 79. Fig. 11 is an enlarged view of this. The head of the detent 78 is held tightly against the spacer 48 by the spring 79, and the other end of the detent extends into the slot 80 of the insulating sleeve 32. When the detent extends into the slot 80, the bayonet is locked against rotation in the bushing 13. The detent will remain in this position until either of the joints 41 or 46 collapses and interrupts the circuit. The detent is then moved out of the slot 80 and into the bore of the fibre sleeve 26. This frees the bayonet for rotation in the bushing by means of the handle and cover.

Fig. 10 illustrates what happens when the solder connecting the lower link 43 of Fig. 4 to the metal contact piece 45a melts at 46. The springs 44 and 42 recoil upwardly, the flexible cables 40 and 43 and the spacer 48 move upwardly with the springs and the spring held detent 78 moves out of its locking position inwardly in the bore of the fibre sleeve 26. The movement inward of the detent 78 allows the handle 22 with its integral closure member 14 and associated elements to be rotated in the bushing so that the conductor strap 27 will engage the contact member 28 and thus direct the current from conductor rod 24, through the conductor strap 27 to the contact piece 28, and conductor 77 to the lower terminal 76.

A third embodiment of this invention is shown in Figs. 5 and 8, the two views are taken at 90° from each other, in Fig. 8 the fuse has ruptured and the conductor strap rotated 180° to close the circuit. This embodiment is substantially the same as Fig. 4 in the upper part of its construction and in the rotation of the circuit maker and breaker. In the Fig. 5 structure an insulating sleeve 38 having diametrically disposed slots 38a is secured to the bushing 13 by means of a sleeve 33. A bushing nut 39 extends into the upper part of fibre sleeve 82 and is in threaded engagement with conductor rod 24. The lower end of fibre sleeve 82 is provided with a contact ferrule 61 having a terminal lug 62.

Resilient contact fingers 68 attached by means of an encircling terminal ring 83 to the insulating sleeve 38 extend into the slots 38a and engage the ferrule 61. As indicated in Fig. 8 the transformer terminal wire 69 is secured to the ring 83. Extending from and secured to the bushing nut 39 is a flexible cable 65 which is secured at its lower end to a resistor 64 having a terminal tongue 63 secured by a solder 67 or other metal of low melting temperature characteristics, to the terminal lug 62. A coil spring 66 is secured at one end to the bushing nut 39 and at the other end to the resistor 64 and is maintained in tension and thereby stresses the connection between the tongue 63 and the lug 62.

If the temperature of the oil or other medium in the transformer casing reaches a given temperature sufficient to melt the solder 67 as it will with an overload of long duration, the spring 66 will separate the tongue 63 and the lug 62, and collapse the cable 65 and draw the resistor 64 into the sleeve 82 thus producing a gap and interrupting the circuit. If the temperature of the resistor 64 is raised sufficiently by a current of a magnitude sufficient to damage transformer insulation if continued but which might not be of sufficient duration to warm the transformer oil, the heat will be transmitted through the tongue 63 to the solder 67. When the solder is softened sufficiently to allow the spring 66 to separate the tongue 63 and the lug 62 and collapse the flexible cable 65, the resistor 64 will be drawn into the sleeve 60, thereby producing a gap and interrupting the circuit.

Referring to Fig. 8, when the spring 66 recoils

in the fibre sleeve 82 carrying with it the flexible coil 65 and the resistor 64', the detent 81 held by spring means moves into the core of the sleeve 82 out of the locking slot 38b in the insulating sleeve 38. The movement of the detent out of locking position allows the bayonet to be rotated so that the conductor strap 27 makes contact with contact piece 34 to close the circuit subsequent to rupture of the fuse.

Since the resilient contact fingers 68 are at right angles to the conductor strap 27, contact point 34 and the lead off line 69 they do not appear together in the same section view. The resilient contact fingers 68 appear in Fig. 5 and the conductor strap 27 and contact point 34 along with the lower terminal or lead off line 69 appear in Fig. 8. Fig. 9 shows their relative position from the bottom.

When the fuse section in either of the modified forms of my combination fuse cutout and switch has been ruptured, the bayonet type closer may be withdrawn from the bushing and the fuse section replaced by disconnecting it from the threaded end 25 on the rod 24 and connecting a new unit thereto. During the interval that the fuse is being replaced, the transformer will be de-energized but such operation may be carried on without disturbing the conductor connections on the bushing.

The use and operation of my invention are as follows:

The three embodiments of my invention are based on the same principle of using a bayonet type fuse and switch in a primary transformer bushing and utilizing a dual characteristic fuse link which will respond to two kinds of abnormal circuit conditions and which when the fuse blows from either of these abnormal circuit conditions the bayonet type fuse rod can be adjusted manually to close the circuit. If there is a long overload on the line it will warm the transformer oil to a sufficient degree to melt the solder which holds the flexible coil in closed circuit. Or if there should be a current of great magnitude on the line that may be of insufficient duration to warm the transformer oil but be sufficiently great to damage the transformer insulation, this current will create heat in the resistor which heat will be transmitted to the solder joint and melt it. When this solder connection melts the electrical circuit is broken. The forms shown in Figs. 1 and 5 have one solder joint that responds to two kinds of abnormalities, and the form shown in Fig. 4 has two solder connections, one responding to one kind of abnormality and the other responding to another kind of abnormality.

In all three types the circuit can be closed manually by either rotating the handle or by releasing a latch and dropping the handle. In this manner it can be seen that the electric service along the lines can be readily renewed.

To replace a blown fuse it is necessary to lift the bayonet type closer from the transformer primary bushing using a hot-line stick. The old ruptured link is then removed from threaded end 25 of rod 24 and a new link screwed thereon. The bayonet is then reinserted into the transformer bushing effecting reclosing of the transformer primary input circuit.

I claim:

1. In an electrical apparatus including a casing and a dielectric fluid therein, the combination with a tubular terminal bushing projecting from the exterior to the interior of said casing, said bushing including a line terminal on the exposed end of said bushing and a transformer lead terminal on the concealed end of said bushing, of a bayonet type circuit closer projecting into said bushing and having a contact at one end engaging with said line terminal and a contact at the other end engaging with said transformer lead terminal, said closer including a conductive assembly electrically connecting said contacts and comprising a dual characteristic fuse section immersed in said fluid and a resistor in series with and heat transfer relation to said section, said section characterized by its selective response to ambient temperatures of said fluid in excess of a predetermined value or to temperatures of said resistor in excess of a predetermined value.

2. In an electrical apparatus including a casing and a dielectric fluid therein, the combination with a tubular bushing extending from the exterior to the interior of said casing and having a terminal at each end of said bushing, of a bayonet type closer projecting into said bushing and including a fuse normally electrically connecting said terminals and a switch normally in open circuit position, said fuse comprising a fusible section immersed in said fluid and a resistor in series with and heat exchange relation to said section, said closer being manually movable in said bushing after rupture of the fusible section to electrically connect said terminals through said switch.

3. In an electrical apparatus including a casing and a dielectric fluid therein, the combination with a tubular bushing extending from the exterior to the interior of said casing and having a terminal at each end of said bushing, of a bayonet type circuit closer projecting into said bushing and including a fuse electrically connecting said terminals, said fuse comprising two relatively spaced fusible sections in series relation and immersed in said fluid, spring means interposed between said sections and maintaining a stress thereon tending to rupture said sections, and a resistor in series with said sections and including a heat conducting portion engaging one of said sections, the other of said sections being responsive to ambient temperatures of said fluid in excess of a predetermined value.

4. In an electrical apparatus including a casing and a dielectric fluid therein, the combination with a tubular bushing extending from the exterior to the interior of said casing and having a terminal at each end of said bushing, of a bayonet type circuit closer projecting into said bushing and including a fuse electrically connecting said terminals, said fuse comprising two relatively spaced fusible sections in series relation and immersed in said fluid, spring means interposed between said sections and maintaining a stress thereon tending to rupture said sections, and a resistor in series with said sections and including a heat conducting portion engaging one of said sections, the other of said sections being responsive to ambient temperatures of said fluid in excess of a predetermined value, said closer also including a switch normally in open circuit position and movable through the agency of said closer to closed circuit position electrically connecting said terminals after rupture of said fuse.

5. In an electrical apparatus including a casing and a dielectric fluid therein, the combination with a tubular bushing extending from the exterior to the interior of said casing, of a bayonet type circuit closer projecting into said bush-

ing and comprising a fuse and a switch, said closer having a first and a second position in said bushing, and releasable latching means normally interposed between said closer and bushing and retaining said closer in said first position closing a circuit through said fuse, said closer being movable to said second position closing said circuit through said switch upon release of said latching means.

6. In a electrical apparatus including a casing and a dielectric fluid therein, the combination with a tubular bushing extending from the exterior to the interior of said casing, of a bayonet type circuit closer projecting into said bushing and comprising a fuse and a switch, said closer having a first and a second position in said bushing, and a latch normally interposed between said closer and bushing and latching said closer to said bushing in said first position closing a circuit through said fuse, said latch biased to release said closer and normally held in latching position by said fuse, said latch being released only upon rupture of the fuse and said closer thereafter movable to said second position closing said circuit through said switch.

7. The combination with an elongated tubular housing having a terminal at each end, said housing having a longitudinal slot interiorly at one end, of a bayonet type circuit closer insertable in said housing for electrically connecting said terminals, said closer including a fuse normally electrically connecting said terminals and comprising an insulating tube, spaced fusible sections in said tube, a flexible cable connecting said fusible sections and having an intermediate enlarged portion, a detent carried by and projecting through the wall of said tube and into said slot in radial relationship to said enlarged portion of said cable, said detent biased out of said slot and said enlarged portion normally holding said detent in said slot, a pair of coil springs encompassing said cable and each disposed on a side of said enlarged portion opposite that of the other, one of said springs under tension between said enlarged portion and one of said fusible sections, the other of said springs under tension between said enlarged portion the other of said fusible sections, said enlarged portion movable alternatively to either side of said detent upon rupture of either fuse section, and a switch carried by said closer in normal open circuit relation to said terminals and closable only upon rupture of said fuse, said closer rotatable in said housing to electrically connect said terminals through said switch subsequent to release of said detent, one of said fusible sections responsive to predetermined ambient temperatures and the other of said fusible sections responsive to predetermined transient electric currents.

8. The combination with an elongated tubular housing having a terminal at each end, said housing having a longitudinal slot interiorly at one end, of a bayonet type circuit closer insertable in said housing for electrically connecting said terminals, said closer including a fuse normally electrically connecting said terminals and comprising an insulating tube, spaced fusible sections in said tube, a flexible cable connecting said fusible sections and having an intermediate enlarged portion, a detent carried by and projecting through the wall of said tube and into said slot in radial relationship to said enlarged portion of said cable, said detent biased out of said slot and said enlarged portion normally holding said detent in said slot, a pair of coil springs encompassing said cable and each disposed on a side of said enlarged portion opposite that of the other, one of said springs under tension between said enlarged portion and one of said fusible sections, the other of said springs under tension between said enlarged portion the other of said fusible sections, said enlarged portion movable alternatively to either side of said detent upon rupture of either fuse section, a resistor in series with said fusible sections and having heat transfer means engaging said one of said sections, and a switch carried by said closer in normal open circuit relation to said terminals and closable only upon rupture of said fuse, said closer rotatable in said housing to electrically connect said terminals through said switch subsequent to release of said detent, said one of said fusible sections responsive to predetermined temperatures of said resistor incident to transient electric currents and the said other of said fusible sections responsive to predetermined ambient temperatures incident to continuing overload electric currents.

9. In a protective device for an electrical apparatus including a casing and a cooling medium therein, the combination with a tubular bushing having a line terminal at one end and an apparatus terminal at the other end, of a circuit closer movably mounted in said bushing and including a dual characteristic fuse and resistor in series relation to each other electrically connecting said terminals, said fuse embodying a section fusible in response to predetermined ambient temperatures of said cooling medium and a second section fusible in response to a predetermined rise in the temperature of said resistor in excess of said predetermined ambient temperatures, and a conductor carried by said circuit closer in open circuit relation to said terminals when said fuse and resistor are in closed circuit relation to said terminals, said closer being movable in said bushing to place said conductor in closed circuit relation to said terminals after rupture of said fuse.

10. In a protective device for an electrical apparatus including a casing, the combination with a tubular bushing having a line terminal at one end and an apparatus terminal at the other end, of a circuit closer insertable in said bushing adjacent said line terminal and including a dual characteristic fuse and resistor in series relation normally electrically connecting said terminals, and a conductor carried by said closer in open circuit relation to said terminals when said fuse is normally in circuit closing relation to said terminals, said closer rotatable in said bushing upon rupture of said fuse to reclose the circuit through said conductor, said dual characteristic fuse being selectively responsive to ambient temperatures in said casing incident to the duration of a predetermined continuous overload currents in said apparatus or to temperatures in said resistor incident to predetermined current values of shorter duration than and in excess of said overload currents.

11. A tubular bushing for an electrical apparatus casing, said bushing including a line terminal at one end and an apparatus terminal at the other end in combination with a circuit closer telescopically movable and rotatable in the bushing adjacent the line terminal, said closer including a dual characteristic fuse carried thereby and electrically engaged at one end with said line terminal and at the other end with said apparatus terminal, said fuse being selectively responsive to predetermined ambient temperatures and to pre-

determined abnormal surge currents, and a switch member carried by said closer in electrical connection with said line terminal and normally out of electrical connection with said apparatus terminal, said bushing having a portion provided with a slot extending longitudinally interiorly thereof, a detent carried by said closer and normally held by the fuse in said slot and locking the closer against rotation until said fuse link ruptures, said detent biased to move out of locking position and release the closer for manual rotation, whereby the switch member carried by said closer is moved into electrical contact with said apparatus terminal.

12. A tubular bushing for an electrical apparatus casing said bushing including a line terminal at one end and an apparatus terminal at the other end, in combination with a circuit closer movable in the bushing relative to said terminals, said closer including a dual characteristic fuse electrically engaged at one end with said line terminal and at the other end with said apparatus terminal, said fuse carried by said closer and characterized by its selective response to predetermined ambient temperatures and to predetermined abnormal surge current, and a switch member carried by said closer in electrical connection with said line terminal and normally out of electrical connection with said apparatus terminal, a detent normally held by the fuse in a locking position interposed between said closer and bushing and biased to move out of locking position upon subsequent rupture of the fuse to release said closer for movement to electrically engage said member and apparatus terminal.

13. A terminal bushing for a transformer casing said bushing including a line terminal at one end and a transformer terminal at the other end, in combination with an electrical closer insertable in said bushing adjacent said line terminal and including a dual characteristic fuse carried thereby and normally closing the circuit between said terminals, said fuse comprising two relatively spaced fusible sections one of which is characterized by its response to predetermined ambient temperatures resultant to continuing overload currents in the transformer and the other of which is responsive to predetermined transient currents in the transformer, a flexible conductor cable electrically connecting said fusible sections in series, a coil spring surrounding said cable and subjecting said fuse sections to tension, and a switch member carried by said closer in electrical connection with one of said terminals and normally in open circuit relation to the other of said terminals, said closer movable in said bushing to electrically connect said member and said other of said terminals subsequent to rupture of one of said fusible sections.

14. A tubular insulating housing having a first terminal at one end and a second terminal at the other end, in combination with a circuit closer inserted in said housing adjacent said first terminal and including a fuse carried thereby and normally electrically connecting said terminals, said fuse characterized by its selective response to predetermined ambient temperatures incident to continued overload currents of a value insufficient to rupture said fuse or to predetermined transient electric current's of predetermined values in excess of said overload current values, spring means carried by said closer holding said fuse tensioned, a switch member carried by said closer normally in electrical connection with one of said terminals only, and detent means normally interposed between said housing and closer to hold said fuse in circuit closing position and said switch member in open circuit position, said detent means held in its interposed position by said fuse and bias therefrom for movement upon rupture of the fuse, said closer being movable in said housing to electrically connect said terminals through said switch member subsequent to rupture of said fuse.

15. A circuit interrupter comprising a dual characteristic fuse having a first fusible section and a second fusible section in series therewith, and a resistor in series with said sections and including a heat transmitting portion connected to said second fusible sections, said first fuse section characterized by its response to ambient temperatures of predetermined values and said second fuse section responsive to predetermined temperatures of said resistor.

16. A circuit interrupter comprising an insulating support having relatively spaced terminals, in combination with a circuit closer movably spanning said terminals, said closer embodying a fusible section and a resistor in series with each other and normally electrically connecting said terminals, said fusible section characterized by its selective response to ambient temperatures in excess of pre-determined values or to resistor temperatures in excess of predetermined values, and a switch member carried by said closer and normally in open circuit relation to said terminals, said closer upon rupture of said fusible section being movable to reclose an electric circuit by electrically connecting said terminals through said switch member.

17. In a circuit interrupter and recloser, the combination with a bushing having a pair of spaced terminals and interiorly a slot projecting longitudinally thereof, of a bayonet type circuit closer projecting into the bushing and including a fusible section, a resistor connected in series with said section by means of a heat conductive means, and a switch, said closer having a first and a second position and rotatable therebetween in said bushing, said fusible section and resistor electrically connecting said terminals when said closer is in said first position and said switch electrically connecting said terminals when said closer is in said second postion, said fusible section selectively responsive to temperatures in excess of a predetermined value incident to ambient temperatures or resistor temperatures, and a detent carried by said closer and normally latching said closer in said first position and held by said fusible section in said slot, said detent biased to move out of said slot upon rupture of said fuse section, whereby upon rupture of said fusible section said closer is rotatable to said second position to electrically connect said terminals through said switch.

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