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POLYPHASE FUSE CONSTRUCTION

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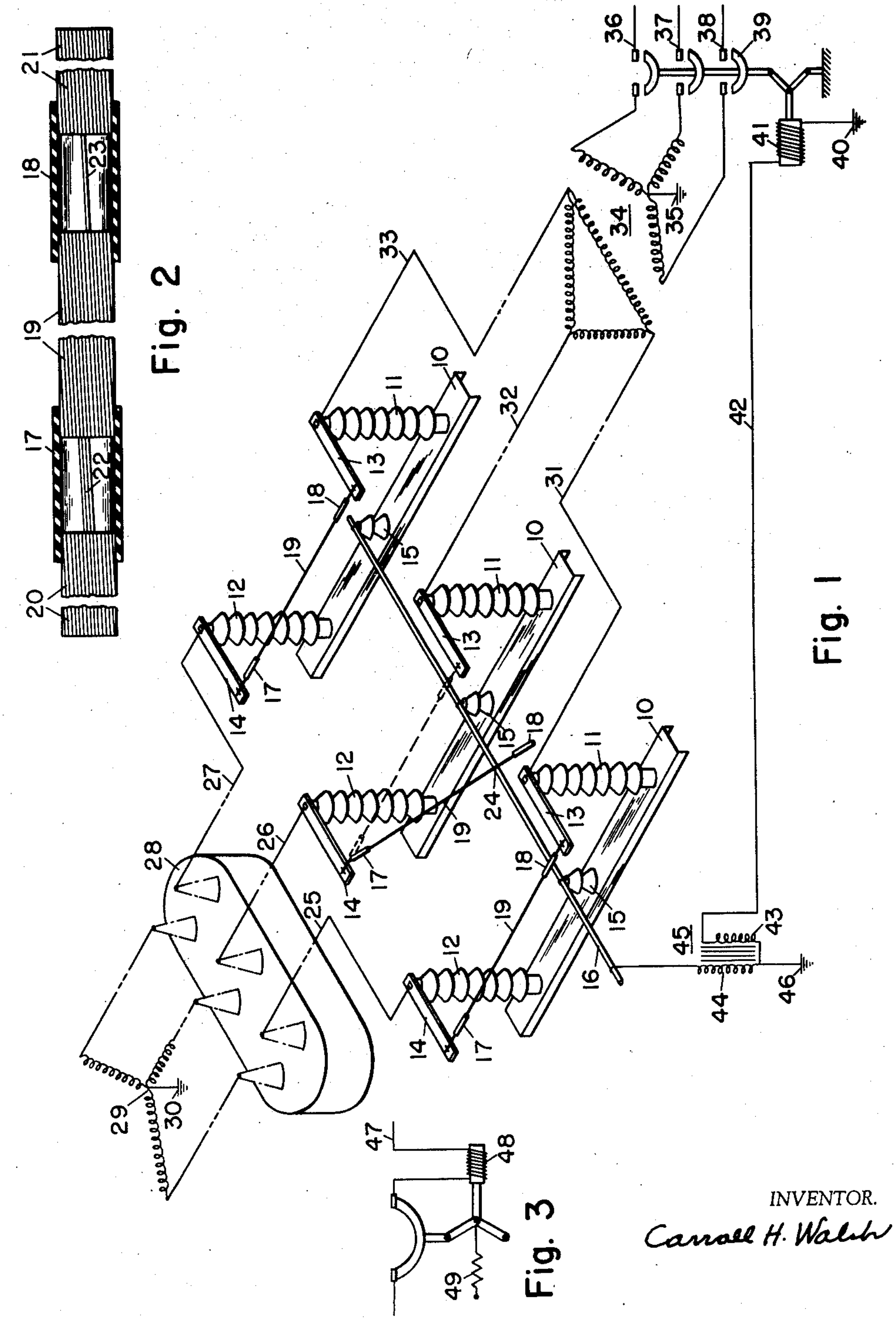


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# POLYPHASE FUSE CONSTRUCTION

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This invention relates generally to fuses for use with high voltage electric circuits, and specifically to a fuse construction suitable for the protection of a high voltage polyphase power transformer and its connected load apparatus.

Commercial self-clearing high voltage fuses suitable for application to alternating current circuit voltages exceeding 138 kv. are unavailable, and it has been necessary to employ some other arrangement for the protection of polyphase high voltage transformers, not only to insure against damage due to overcurrent but also to prevent the application of a single voltage to customers' polyphase equipment in the event of a blown fuse in series with any conductor of the circuit.

Some arrangements in common use are (1) a motor-driven air break switch which opens in response to excess current in the circuit, and which has the undesirable incidence of a long arc drawn between the arcing horns of the switch, this long arc being likely to be blown from one phase to another and so faulting the circuit; (2) a motor-operated switch arranged to ground one or more phases of the circuit in response to an overcurrent in one conductor, which switch can only be opened while the circuit is deenergized; and (3) an automatic reclosing high voltage circuit breaker, which is by far the superior design, but which has the disadvantage of being quite expensive.

The principal object of the present invention is to provide a fuse construction for use in an arrangement for protecting a polyphase high voltage transformer from damage due to excess current and concurrently disconnecting the low voltage load circuit normally supplied by the transformer when any one of the high voltage fuses operates, thus protecting connected polyphase motors from damage resulting from single phase operation. Other objects will be obvious, or pointed out hereinafter.

Fig. 1 illustrates the invention as applied to a polyphase circuit, certain components of the circuit being shown diagrammatically.

Fig. 2 is a fragmentary view of the fuse link embodied in the construction, shown partly in section.

Fig. 3 diagrammatically shows a reclosing circuit breaker desirable for use in the circuit to which the invention is applied.

Referring first to Fig. 1 of the drawing, three metal bases **10** are disposed in laterally spaced relationship, each base having mounted near one end the source terminal insulator **12** and at the other end the load terminal insulator **11**, each of the insulators extending upwardly from the bases in spaced relationship and having dimensions suitable for the voltage of the associated circuit in accordance with common practice. A load terminal member **13** and a source terminal member **14** are respectively rigidly fastened to the load terminal insulator **11** and the source terminal insulator **14**, these members being formed of conducting material and extending outwardly from the insulators in the same direction and in substantially parallel relationship.

Under normal operating conditions, the polyphase circuit through the device is completed through a fuse link exemplified by Fig. 2 of the drawing. The terminal portions **20** and **21** of the fuse link are respectively secured to the outer ends of the load and source terminal members **13** and **14**, and the latter members are electrically connected through the source fusible element **22**, the intermediate fuse link portion **19**, and the load fusible element **23**. The fusible elements **22** and **23** are preferably housed within the tubular insulators **17** and **18** for weather protection. These tubular insulators are assembled in slip-fit engagement with the ends of the intermediate portion **19** so that the latter is releasable for downward movement upon the fusing of either or both of the fusible elements. It may be noted that the source fusible element **22** is in series with the load fusible element **23**, and therefore both fusible elements normally carry the same current. As indicated in the drawing, the load fusible element is of such dimensions that its fusing current is substantially less than that of the source fusible element.

Near the midpoints of each of the bases **10** are mounted the insulators **15**, which extend upwardly therefrom for a relatively short distance in comparison with the length of the terminal insulators **11** and **12**, and which support, in insulated relationship with respect to the bases **10** and the terminal members **13** and **14**, the transversely extending conducting member **16**. This conducting member **16** is common to all phases of the construction, in that it is arranged to traverse the paths of movement of all of the releasable intermediate fuse link portions **19**.

Fig. 1 illustrates the application of the invention to a polyphase circuit, certain portions of the circuit being shown in diagram. A high voltage source, represented by a Y-connected winding **29** having the neutral point grounded as indicated by the numeral **30**, is connected through a reclosing circuit breaker **28** and the line conductors **25**, **26** and **27** to the source terminal members **14** of each pole of the fuse structure. Fig. 3 diagrammatically illustrates one pole of the circuit breaker **28**, here shown as a normally closed breaker, the spring **49** acting to normally maintain the breaker in the closed position whenever the current from a source conductor **47** through the opening and overload **48** is below a predetermined magnitude.

From the load side of the invention, the high voltage load conductors **31**, **32** and **33** extend from the load terminal members of each phase of the fuse structure to connect the polyphase delta connected high voltage winding of the load transformer **34**. The low voltage winding of the transformer **34** is shown as a polyphase Y-connected arrangement, having the neutral point grounded as indicated at the numeral **35**, and the low voltage load conductors **36**, **37** and **38** are normally connected to the low voltage winding through the low voltage circuit breaker **39**, the latter having a closed position and an open position.

The low voltage circuit breaker **39** is provided with a trip coil **41**, one end of which is connected to the ground indicated by the numeral **40**, and the other end of which is connected through the conductor **42** to the secondary winding **43** of the current transformer **45**. The primary winding **44** of the latter transformer is interposed between the common fuse ground indicated at **46** and the common insulated conducting member **16**.

Fig. 1 illustrates the device immediately after the load fusible element **18** of the middle pole of the structure has fused in response to excess current. The fusing of this element has released the intermediate fuse link portion **19**, which in falling has contacted the common insulated conducting member **16** at the point indicated by the numeral **24**. In response to this condition, a line-to-ground fault current is initiated which passes serially from the source 29 through the high voltage circuit breaker 28, the high voltage conductor 26, the source fusible element 17, the intermediate fuse link portion 19, the common insulated conducting member 16, the primary winding 44 of the current transformer 45, the common ground 46, and thence through the ground back to the source transformer winding. Responsive to the fault current through the primary of the current transformer 45, a proportional current is induced in the secondary winding 43, this current passing to ground 40 through the conductor 42 and the trip coil 41 of the breaker 39, tripping this breaker to the open position.

Following or concurrently with the proceeding just described, the source fusible element 22 fuses, releasing the other end of the intermediate fuse link portion 19, drawing an arc from the free end of the source terminal member 14. This arc continues until the source circuit breaker 28 opens to extinguish it, and immediately following arc extinguishment, the breaker 28 recloses to re-establish service to any customers which may be supplied from taps connected between the breaker 28 and the point of installation of the fuse structure.

An important feature of the invention is the isolated arrangement of the common insulated conducting member 16, which enables the tripping of the load-side breaker and avoidance of single phase circuit operation regardless of which fuse is blown. It is essential for proper operation that the load fusible element always operate regardless of the magnitude of the circuit fault current, because fusing initially of the source fusible element results in the interposition between line and ground of the windings of the load transformer, and the impedance of these windings may limit the current through the tripping circuit below the value required to trip the load circuit breaker. Under certain fault conditions, both fusible elements may fuse at the same time, but such an occurrence is without adverse effect upon the intended operation of the device.

The foregoing description is intended to be illustrative rather than limiting, reference being made to the appended claims to ascertain the scope of the invention.

I claim:

1. A polyphase high voltage fuse construction for use between a grounded polyphase source and a polyphase load; comprising at least three laterally spaced fuse assemblies each including insulating means supporting a source fuse terminal and a load fuse terminal, a fuse link fastened at its respective ends to said source and load terminals and electrically connnecting said terminals, said fuse link embodying a load fusible element disposed adjacent said load terminal and a source fusible element disposed adjacent said source terminal, and an intermediate conducting portion joining the fusible elements and swingably movable in response to the fusing of either of said fusible elements and completely releasable in response to the fusing of both of said fusible elements, a conducting member, and insulating means supporting said conducting member in the paths of movement of all of said intermediate fuse link portions.

2. A polyphase high voltage fuse construction for use between a grounded polyphase source and a polyphase load; comprising at least three laterally spaced fuse assemblies each including insulating means supporting a source fuse link terminal and a load fuse link terminal, a fuse link fastened at its respective ends to said source and load terminals and electrically connecting said terminals, said fuse link embodying a load fusible element disposed adjacent said load terminal and a source fusible element disposed adjacent said source terminal, and an intermediate conducting portion joining said fusible elements and swingably movable in response to the fusing of said load fusible element and completely releasable in response to the fusing of both of said fusible elements, and insulating means supporting a conducting member, said conducting member being positioned to traverse the paths of movement of all of said intermediate fuse links portions.



3. A polyphase high voltage fuse construction for use between a grounded polyphase source and a polyphase load; comprising at least three laterally spaced fuse assemblies each including insulating means supporting a source fuse link terminal and a load fuse link terminal, a fuse link fastened at its respective ends to said source and load terminals and electrically connecting said terminals, said fuse link embodying a load fusible element disposed adjacent said load terminal and a source fusible element disposed adjacent said source terminal, and an intermediate conducting portion joining said fusible elements, said intermediate portion being arranged for movement in response to the fusing of said source fusible element and for complete separation from said fusible elements when both of said elements are fused, and insulating means supporting a conducting member, said conducting member being positioned to traverse the paths of movement of all of said intermediate fuse link portions.

4. A polyphase high voltage fuse construction for use between a grounded polyphase source and a polyphase load; comprising at least three laterally spaced fuse assemblies each including insulating means supporting a source fuse link terminal and a load fuse link terminal, a fuse link fastened at its respective ends to said source and load terminals and electrically connecting said terminals, said fuse link embodying a load fusible element disposed adjacent said load terminal and a source fusible element disposed adjacent said source terminal, and an intermediate conducting portion connecting said fusible elements in series, said portion being releasable from its respective ends in response to the fusing of both of said fusible elements, a transversely extending conducting member, and insulating means supporting said conducting member in the paths of movement of all of said intermediate fuse link portions.

5. A polyphase high voltage fuse construction for use between a grounded polyphase source and a polyphase load; comprising at least three laterally spaced fuse assemblies each including insulating means supporting a source fuse link terminal and a load fuse link terminal, a fuse link fastened at its respective ends to said source and load terminals and electrically connecting said terminals, said fuse link embodying a load fusible element disposed adjacent said load terminal and a source fusible element disposed adjacent said source terminal, and an intermediate conducting portion disposed between the fusible elements and arranged for downwardly swingable movement in response to the fusing of one of said fusible elements and for complete release at its respective ends when both fusible elements are fused, a conducting member extending laterally through the paths of movement of all of said intermediate fuse link portions, and insulating means rigidly supporting said conducting member along a line extending transversely across and below said intermediate fuse link portions.

6. A polyphase high voltage fuse construction for use between a grounded source and a polyphase load; comprising three laterally spaced fuse assemblies each including a metal base, a conducting member extending transversely across the metal bases, insulators mounted between the ends of each of said bases and supporting said conducting member in vertical spaced relationship therewith, longitudinally spaced insulators mounted on each of said bases at the respective ends thereof and extending upwardly therefrom, source and load terminals mounted respectively on said spaced insulators, and a fuse link extending between said terminals and over said conducting member in vertical spaced relationship therewith, said fuse link including a load fusible element located adjacent said load terminal and a serially related

source fusible element located adjacent said source terminal, said load fusible element being adapted to fuse upon passage of a predetermined current therethrough and to release one end of said fuse link for movement to engagement with said conducting member, and said source fusible element being adapted to remain unfused upon passage of said predetermined current therethrough and to fuse upon passage of a current through said conducting member which is greater than said predetermined load current, and concurrently release the other end of said fuse link.




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