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Russell et al.

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[54] **FUSE HOLDER ASSEMBLY**

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[73] Assignee: **Kuhlman Corporation**, Troy, Mich.

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[52] **U.S. Cl.** ..... **317/15**; 317/14 H; 337/202; 337/257

[51] **Int. Cl.²** **H02H 7/04**

[58] **Field of Search**..... 317/15, 14 R, 14 C, 14 H, 317/40 A; 337/144, 145, 162, 186, 193, 202, 207, 208, 229, 231, 412, 414

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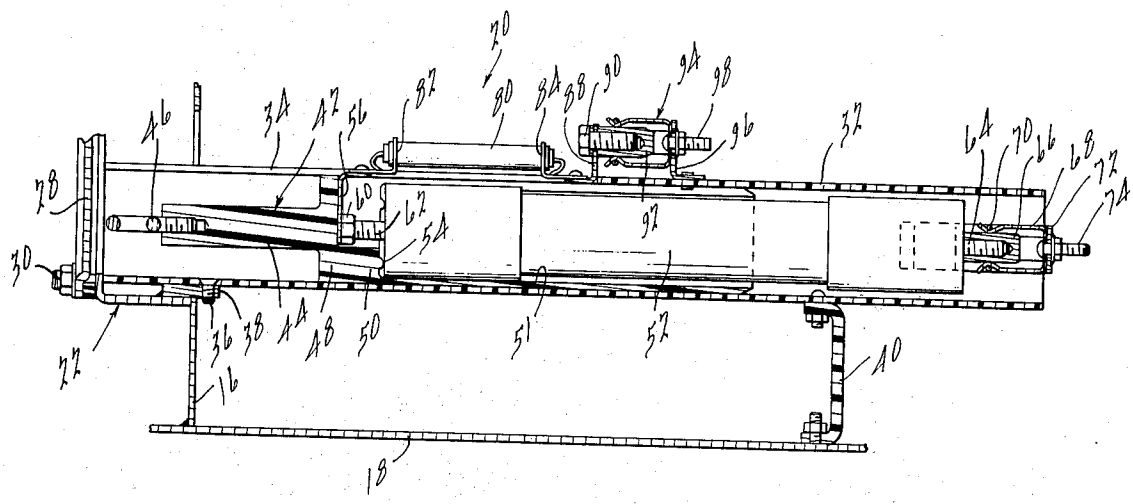
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[57] **ABSTRACT**

A fuse holder assembly which is particularly adapted to be utilized in conjunction with the protection system for the primary side of an oil-filled transformer assembly, wherein the fuse holder is mounted on a plate, the plate being supported on the face of the transformer casing. The fuse holder extends from the plate through an aperture in the transformer housing to support the fusing elements below the level of the cooling liquid within the transformer housing. The fusing elements are a current limiting fuse and a weaklink fuse which are mechanically supported by the fuseholder and which can both be withdrawn from the transformer casing with the fuseholder, to permit inspection and replacement.

7 Claims, 4 Drawing Figures



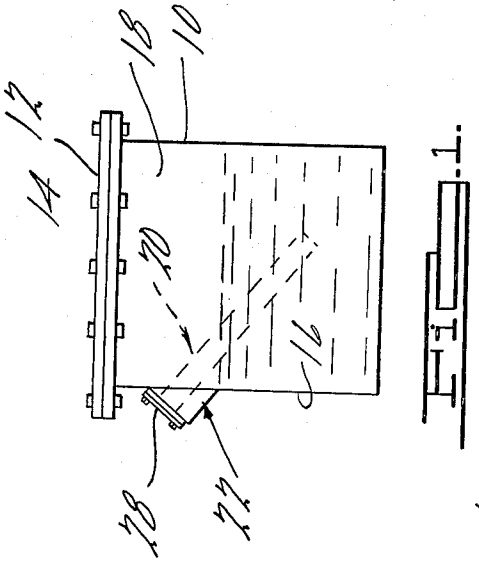


Fig. 1.

Fig. 2

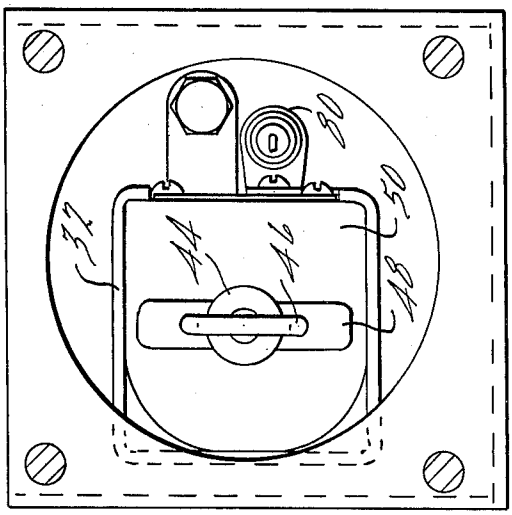


Fig. 4.

Fig. 2.

FUSE HOLDER ASSEMBLY

CROSS REFERENCE

This invention is related to those of U.S. Pat. No. 3,699,490 granted Oct. 17, 1972, and of U.S. Pat. No. 3,701,926 granted Oct. 31, 1972, and is further related to those in the United States patent application of Arthur C. Westrom, Ser. No. 459,171, entitled "Fuse Holder Assembly" and the United States patent application of Arthur C. Westrom, John L. Fisher and Peter Mayer, Ser. No. 459,172, entitled "Fuse Holder Assembly" both filed Apr. 18, 1974.

BRIEF SUMMARY OF THE INVENTION

This invention relates to an improved mechanism for electrically fusing liquid cooled electrical induction equipment such as power and distribution transfomers. The invention is of particular usefulness in protecting pole type, pad mounted and underground oil-filled distribution transformers. For protection under a broad range of fault conditions, the combination of an oil immersible current limiting fuse and on oil immersible weaklink fuse, of commercially available types, is supported internally of the transformer housing and immersed in liquid coolant within that housing, and in the preferred use, the fuses are serially connected with the primary windings of the transformer. Since the weaklink fuse responds to oil temperature, it reacts to secondary loads and faults, and as a result the oil-immersed combination can provide secondary fault control, high-energy internal fault control, high current internal fault control, overload control, tank temperature control, and oil temperature control.

The fuse combination is mounted on a fuse holder member which controls its immersed position relative to the other components of the transformer. The fuse holder and fuse combination can be withdrawn through a normally covered access opening in the transformer housing for field inspection and replacement of one or both of the fuses.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of a transformer assembly illustrating the use of the fuse holder assembly embodying the principles of the present invention;

FIG. 2 is an elevational view of the fuse holder assembly used in the transformer of FIG. 1;

FIG. 3 is a sectional view taken substantially along the line 3—3 of FIG. 2; with the view being tilted on the sheet; and

FIG. 4 is an end view taken in the direction of the labeled arrow in FIG. 2.

DESCRIPTION

The transformer of FIG. 1 includes a housing including a casing **10** closed by a cover **12** bolted or otherwise secured thereon. The transformer, which is conventional, includes internal components including primary and secondary windings (not shown) immersed in a suitable dielectric coolant such as oil **14.** The casing **10** is assumed to be approximately square in cross section, having a front wall or plate **16** and side walls **18.** A fuse holder assembly **20** is majorly immersed in the coolant **14** and projects into a throat assembly **22** formed on the exterior of the wall **16** of the casing **10.** Throat assembly **22** comprises a weldment welded or otherwise secured to the front plate **16** to form a liquid-tight

throat or cavity surrounding an opening **24** (FIG. **2**) in the wall **16.** Throat assembly **22** is itself open on its outer face, as at **26,** with that opening being selectively closable by a gasketed cover plate **28** which may be secured to the throat assembly **22** by means such as a stud and nut assembly **30.** If the dielectric liquid level is above that of the bottom portion of the opening **24,** it should be lower than the opening **26.**

A fuse holder tube or support and guide member **32** is disposed within the casing **10** and projects through opening **24** to a position proximate opening **26.** Tube **32** which is of insulative material such as glass fiber reinforced epoxy. It can be formed of other insulative materials and may be molded, extruded or otherwise formed. In the illustrated arrangement, tube **32** is generally square in cross section, tubular, and open at both ends. In one face, tube **32** is provided with an elongated slotted opening **34** extending from its outermost end to a point **33** essentially midway of its length for a purpose to be noted.

Tube **32** is rigidly supported with respect to the transformer casing. In the illustrated embodiment of the invention, this is accomplished by providing both forward and aft supports. The forward support includes a screw **36** (FIG. **3**) threaded through the wall of tube **32** into a support lug **38** which is welded or otherwise secured to the front plate **16,** to the throat assembly **22,** or to both. The aft support comprises a support bracket **40,** which may be of glass fiber reinforced epoxy or otherwise, and which is bolted or otherwise secured both to the side wall **18** and to the fuse holder tube **32.** Tube **32** constitutes a support and guide member to support the withdrawable elements essentially over the entirety of their path of withdrawal and insertion movements as well as in their fully inserted positions.

A fuse holder or fuse attachment device is removably disposed within the tube **32.** Fuse holder **42,** which may be molded or otherwise formed of plastic or other dielectric material, includes a neck portion **44** the end of which threadedly accepts a pull-out eye **46.** At its lower (rightward) end, neck **44** terminates in a flanged shoulder portion **48.** The body portion **50** of the fuse holder extends rightwardly from the shoulder **48** and is hollow from the shoulder **48** rearwardly, to accept a current limiting fuse **52.** At its innermost or forward end, the cavity **51** within body **50** is provided with integral position defining stops **54** (FIG. **3**) for locating the end of fuse **52** at its point of maximum insertion.

A metallic end bracket **56,** of folded T-shape, has a cross-arm portion which is secured to the fuse holder **42** such as by screws **58** (FIG. **2**) which threadedly engage body portion **50.** The apertures in end bracket **56,** which are engaged by screws **58** are preferably elongated to permit adjustment during assembly.

End bracket **56** is further provided with a depending leg portion to which a nut **60** (FIG. **3**) is welded or otherwise secured. Nut **60** threadedly accepts the threaded stud **62** which is formed on commercially available forms of current limiting fuses **52.** When a fuse **52** is replaced, the new fuse is simply inserted into the cavity within body **50** of the fuse holder **42** (from the right) until stud **62** engages nut **60,** and is then rotated, by hand, to thread stud **62** into nut **60,** the right-hand end of the current limiting fuse **52** projecting from the fuse holder **42** to facilitate that assembly.

The lower or right-hand end of the current limiting fuse **52** is provided with the customary terminal stud **64**

upon which is threaded a metallic male contact **66.** Contact **66** engages a tulip contact finger assembly **68,** the projecting fingers of which are compelled into a good electrical engagement with contact **66** by means of a garter spring **70.**

Spring assembly **68** is secured to an end bracket **72** by means of a machine screw **74** which also serves as the line side connector. End bracket **72** (FIGS. **2** and **3**) is provided with projecting side arms **76** which embrace and are riveted or otherwise secured to the tube **32.** It will be observed that the end bracket **72** does not fully close the lower end of tube **32** or impede the effective flow of coolant thereinto.

A leaf spring assembly, comprising a plurality of leaf springs **78,** is secured to the lower end of tube **32** in a position to engage and guide the lower or leading end of the current limiting fuse **52.**

A weaklink fuse **80** is provided with integral angled support brackets **82** and **84.** Support bracket **82** is screwed or otherwise detachably connected to end bracket **56** and that end of weaklink fuse **80** is electrically connected to bracket **56,** and hence to stud **62,** and hence to one end of the current limiting fuse **52.**

Weaklink fuse support bracket **84** (FIG. **2**) is screwed or otherwise detachably connected to a plate **86** which is in turn screwed or otherwise attached to the body portion **50** of the fuse holder **42.** Plate **86** is provided with an upstanding leg **88** (FIG. **3**) to constitute a contact. Leg **88** is apertured to accept a screw **90** threadedly engaging a male contact member **92.** Male contact member **92** engages a tulip spring contact assembly **94** similar to that previously described, and that contact assembly is in turn fastened to a support bracket **96** by means of a screw and nut assembly **98** which also serves as the load side connection. Bracket **96** is riveted or otherwise secured to the fuse holder tube **32.**

As a result of the noted connections, power connected to the line side connection **74** by means of a suitable conductor is conducted through current limiting fuse **52,** stud **62,** bracket **56,** weaklink fuse **80,** bracket **84,** bracket **88,** male contact **92,** contact assembly **94,** load side connecting stud **98** and, through a suitable conductor, to the primary winding of the transformer.

Current limiting fuse **52** and weaklink fuse **80** may be of any suitable, appropriately rated, commercially available types such as those manufactured by Kearney-National, Inc. In general, current limiting fuses perform well on high current faults but under some circumstances can tend to perform less satisfactorily in the low current region, tending to overheat, with extended-duration low-current fault conditions, to the possible point of blowing up. The weaklink fuses, on the other hand, are less satisfactory on high fault currents, perform well under low-current fault conditions. Accordingly, a coordinated series combination of the two can provide highly improved full-range fault protection. In the present utilization, the weaklink fuse senses, or may sense, oil temperature.

To inspect or replace either of the fuses, the cover plate **28** is removed by unscrewing nuts **30.** The pull-out eye may then be engaged with a hotstick (shotgun stick or hookstick) and a force exerted to translate the fuse assembly outwardly along its longitudinal axis. The male contact **92** will thereupon be disengaged from the contact assembly **94** and the male contact **66** will be disengaged from the contact assembly **68,** and the entire assembly translated out of the housing. It will be observed that the slot **34** in the tube **32** permits the weaklink fuse **80,** with its brackets **82** and **84** and with its male contact element **92,** to be freely moved out of the tube and through the openings **24** and **26** (FIG. **2**). The current limiting fuse may be replaced, if necessary, in the manner above noted, with the addition of transferring the male contact **66** to the replacement fuse. The weaklink fuse **80** may be replaced, if necessary, by unscrewing its brackets **82** and **84** and replacing it with a replacement fuse.

The fuse assembly including the fuse holder **42** with the fuses in place, is then reinserted through the opening **26** into the fuse holder tube **32** and shoved downwardly into the illustrated seated position, the engagement between the portion **50** of the fuse holder (FIG. **4**) and the inner wall of the tube **32** insuring proper orientation of the parts. In view of the magnitude of the currents which are carried, forcible engagement should be made between the male contacts **92** and **66** and their respective contact assemblies **94** and **68.** However, if the requisite seating is not achieved during such reinsertion, provision is made, in the preferred arrangement, for insuring an adequate degree of seating. This is accomplished by establishing the dimensions such that upon the replacement of cover plate **28,** and the tightening of nuts **30,** the engagement between that cover plate and an improperly extending pull out eye **46** will exert a force on the assembly to drive the male contacts **92** and **96** into proper electrical engagement with their respective contact assemblies.

What is claimed is:

1. In a transformer assembly having a housing having a line terminal, a winding assembly supported in the housing and having a primary winding terminal, and a cooling liquid within the housing for cooling the winding, the combination of means defining a separate fuse assembly accepting opening in said housing above the level of the cooling liquid spaced from the line terminal, means removably attachable to said housing for closing said opening, a fuse holder member, first securing means on said fuse holder for detachably securing thereon a current limiting fuse, second securing means for removably supporting a separate weaklink fuse on the combination of said fuse holder member and the current limiting fuse, said first and second securing means permitting separate replacement of the current limiting fuse and of the weaklink fuse, support and guide means rigidly supported in said housing in a fixed position and adjacent said opening, said fuse holder member and said support and guide means supporting the current limiting and the weaklink fuses below the level of and immersed in the cooling liquid, means for detachably electrically interconnecting the current limiting and the weaklink fuses, means for permitting the withdrawal of said fuse holder member including the current limiting and weaklink fuses from the housing through the opening therein, and means including said support and guide means for guiding said fuse holder member including the separate current limiting and weaklink fuses during the withdrawal, reinsertion and use thereof, said means for permitting the withdrawal of said fuse holder member comprising an eye on said fuse holder engageable by a hotstick only after said means for closing said opening has been removed.

2. The combination of claim 1 further including connector means for connecting the current limiting fuse to one of the transformer terminals, and connector means for connecting the weaklink fuse to the other one of the transformer terminals, and in which both of said connector means are quick detachable connector means for automatically effecting detachment when said fuse holder member is withdrawn from said support and guide means.

3. The combination of claim 2 further including means for insuring re-engagement of said quick detachable connector means upon the replacing of said fuse holder member in said support and guide means.

4. The combination of claim 3 in which said means for insuring re-engagement includes said eye and said means for closing said opening.

5. In a transformer assembly having a housing having a line terminal, a winding assembly supported in the housing and having a primary winding terminal, and a cooling liquid within the housing for cooling the winding, the combination of means defining a separate fuse assembly accepting opening in said housing above the level of the cooling liquid spaced from the line terminal, means removably attachable to said housing for closing said opening, a fuse holder member, first securing means on said fuse holder for detachably securing thereon a currect limiting fuse, second securing means for removably supporting a separate weaklink fuse on the combination of said fuse holder member and the current limiting fuse, said first and second securing means permitting separate replacement of the current limiting fuse and of the weaklink fuse, support and guide means rigidly supported in said housing in a fixed position, said fuse holder member and said support and guide means supporting the current limiting and the weaklink fuses below the level of and immersed in the cooling liquid, means for detachably electrically interconnecting the current limiting and the weaklink fuses, means for permitting the withdrawal of said fuse holder member including the separate current limiting and weaklink fuses from the housing through the opening therein, and means including said support and guide means for guiding said fuse holder member including the current limiting and weaklink fuses during the withdrawal, reinsertion and use thereof, said support and guide means comprising a rigid tubular insulative member supported by the housing, and said fuse holder being insertable in said tubular member.

6. The combination of claim 5 in which said fuse holder has a tubular portion for sheathing a portion of the current limiting fuse and contact means within said tubular portion for removably securing one of the fuses within said tubular portion.

7. In a transformer assembly having a housing having a line terminal, a winding assembly supported in the housing and having a primary winding terminal, and a cooling liquid within the housing for cooling the winding, the combination of means defining a separate fuse assembly accepting opening in said housing above the level of the cooling liquid spaced from the line terminal, means removably attachable to said housing for closing said opening, a current limiting fuse, a fuse holder member, first securing means on said fuse holder for detachably securing thereon said current limiting fuse, a weaklink fuse, second securing means for removably supporting said separate weaklink fuse on the combination of said fuse holder member and said current limiting fuse, said first and second securing means permitting separate replacement of said current limiting fuse and of said weaklink fuse, support and guide means rigidly supported in said housing in a fixed position, said fuse holder member and said support and guide means supporting said current limiting and said weaklink fuses below the level of and immersed in the cooling liquid, means for detachably electrically interconnecting said current limiting and said weaklink fuses, means for permitting the withdrawal of said fuse holder member including said separate current limiting and weaklink fuses from the housing through the opening therein, and means including said support and guide means for guiding said fuse holder member including said current limiting and weaklink fuses during the withdrawal, reinsertion and use thereof, said support and guide means comprising a rigid tubular insulative member supported by the housing, and said fuse holder being insertable in said tubular member.

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