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COMBINED FUSE AND SWITCH OPERATOR ASSEMBLY

Filed April 12, 1967

Fig. 1.

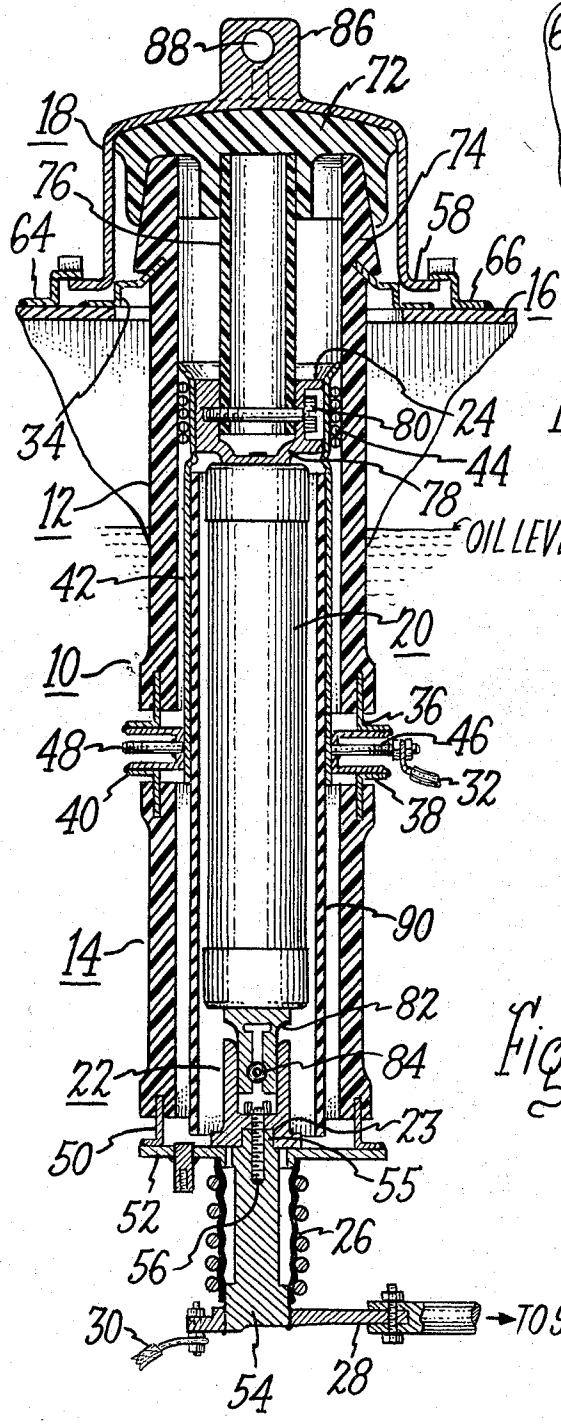


Fig. 2.

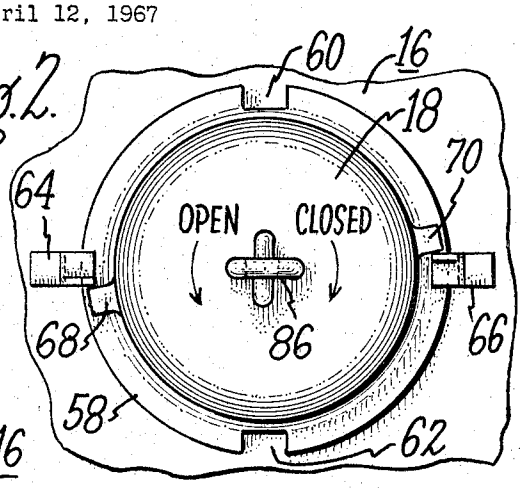


Fig. 3.

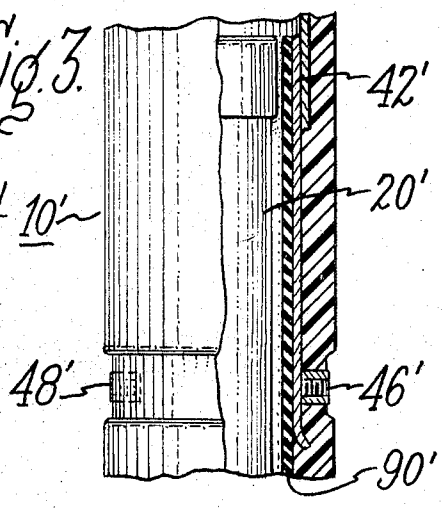
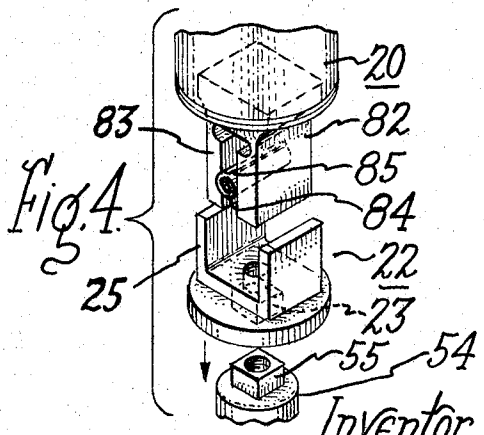


Fig. 4.



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COMBINED FUSE AND SWITCH OPERATOR ASSEMBLY

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ABSTRACT OF THE DISCLOSURE

A combined fuse and switch assembly especially useful in electrical apparatus, such as submersible distribution transformers. The apparatus is provided with a fuse holder mounted in the interior of the apparatus. The fuse holder has a lower rotatable fuse contact which is hermetically sealed and connected to a switch mounted in the interior of the apparatus. The rotatable fuse contact operates the switch. A second fuse contact is provided in the fuse holder. A removable cover has the fuse secured thereto such that when the cover is placed on the top of the fuse holder, outside of the apparatus, such as a transformer, the fuse is inserted into the holder contacting both fuse contacts. Rotation of the fuse cover, to lock and seal the cover on the outside of the fuse holder, closes the internal switch. To remove the fuse, the cover must first be rotated to unlock the cover which opens the internal switch.

Background of invention

This invention relates to electrical apparatus such as distribution transformers and more particularly to a combined fuse and switch operator assembly for use in such electrical apparatus.

There is presently a well defined, growing trend in the electrical distribution field from overhead, open wire electrical distribution to underground, buried wire distribution. With this growing trend many utilities are evolving new operating procedures to develop safe, efficient operating practices for underground servicing. At the same time, the equipment manufacturers are attempting to build distribution equipment which may be used with these new operating procedures. Many types of distribution apparatus are now provided with removable fuses which may be readily removed from the outside of the apparatus and there may be replaced, in the event of faults which may occur within the electrical apparatus. With these types of removable fuses, many of the utilities require that a switch be provided in series with the removable fuse such that the switch may first be opened prior to the removal of the fuse. In many instances, in following these numerous operating procedures of utilities, the fuse is removed prior to operating or performing a service function on the electrical apparatus since the removal of the fuse provides a positive, visually verifiable, opening of the circuit to the electrical apparatus.

Many of these fuses are not considered as current interrupting devices in the manner of a switch, since they are not designed to be removed while the electrical current is applied to such fuses. In order to provide safe operating procedures for the removal of fuses, it is considered desirable to provide with such fuses, a switch operating device such that the switch in series with the fuse must be opened prior to the removal of the fuse. In those instances where switches are provided in series with the fuse, but are not required to be operated prior to removal of the fuse, it is of course, possible for a lineman or other service man working on the electrical apparatus to forget to open the switch prior to the removal of the

fuse. In such instances, as is well known in the art, the electrical arc built up in the removal of the fuse may be sufficient to actually blow the fuse out of the transformer or to cause a line to ground fault, which may injure the operator and also damage the equipment. Therefore it is considered desirable to provide a switch in series with the fuse, which switch must be opened prior to the removal of the fuse.

It is therefore one object of this invention to provide a combined fuse and switch operator assembly such that the fuse cannot be removed or inserted while the switch is in its closed or energized position.

A further object of the invention is to provide a sealed, removable fuse, where a fuse cover carries the fuse and causes opening of a series switch when the fuse cover is being unlocked prior to removal of the fuse.

Summary of invention

Briefly, in one form, the combined fuse and switch operator of this invention comprises a fuse holder mounted in an electrical apparatus. A rotatable fuse contact is provided sealed in the holder and connected to operate a switch internally of the apparatus. A fuse cover is also provided with the fuse secured thereto. When the fuse is inserted in the holder, the lower portion of the fuse fits into the rotating contact. As the fuse cover is turned to lock the cover and fuse in place in the electrical apparatus, the rotatable fuse contact is rotated to close the switch. When the fuse cover is rotated to unlock the cover for removal of the fuse, the rotatable fuse contact moves the switch to its open or deenergized position, before the fuse can be removed.

The invention which is sought to be protected will be particularly pointed out and distinctly claimed in the claims appended hereto. However, it is believed that this invention, and the manner in which its various objects and advantages are obtained, as well as other objects and advantages thereof, will be better understood from the following detailed description of a preferred embodiment thereof, particularly when considered in the light of the accompanying drawing.

Brief description of drawing

FIGURE 1 is a length-wise sectional view of a combined fuse and switch operator according to one embodiment of this invention;

FIGURE 2 is a top view of the fuse cover shown in section in FIGURE 1;

FIGURE 3 is a partial view, partially in section showing another form of fuse holder according to this invention; and

FIGURE 4 is a perspective view of a preferred form of rotatable fuse contact according to this invention.

Description of preferred embodiment

This invention relates to a combined fuse and switch operating device in which the fuse is provided wtih a contact which connects with a rotatable fuse contact in a fuse holder. The rotatable fuse contact is, in turn, directly connected to a switch operator which, on rotation, will either open or close a series switch. The preferred embodiment set forth herein discloses the present specific construction believed most suitable for obtaining the various objects and advantages of this invention. Obviously, many changes may be made in various constructional details without departing from the scope of the invention herein defined.

Referring now to the drawing in which like numerals are used to indicate like parts throughout and referring particularly to FIGURE 1, there is shown one form of a combined fuse and switch operator assembly according

to this invention. As is shown in FIGURE 1, a fuse holder **10** shown as two parts, **12** and **14** of electrical insulating material such as porcelain or the like, is secured to a wall member **16** which may be, for example, the cover of an electrical apparatus, such as a submersible transformer. A cover member **18** is provided which seals in a water tight manner to fuse holder **10**. The cover **18** carries a fuse **20** which makes electrical connection with fuse contacts **22** and **24**, which are mounted in the fuse holder **10**. Fuse contact **22** is rotatably mounted in the bottom of fuse holder **10** and is hermetically sealed from the interior of the transformer by an hermetic seal **26** which may be, for example, an hermetic seal as described and claimed in application Ser. No. 623,451, filed Mar. 15, 1967, for Hermetic Seal for Rotating Shaft, by the inventor herein, and which is assigned to the same assignee as this invention and now abandoned. A switch operator or handle **28** is provided and fixed to the lower part of contact **22** as shown. The operator handle **28** rotates with the contact **22** to open or close a switch (not shown) which is within the transformer or electrical apparatus and in electrical series with fuse **20**. Leads **30** and **32** are provided on the fuse holder **10**, the lead **30** going to the switch (not shown) through which the apparatus is energized and the lead **32** leading to a bushing (not shown) which provides the electrical energy to the apparatus, for example, a submersible distribution transformer.

Referring specifically to the constructional details shown, the upper part **12** of fuse holder **10** is molded of electrical insulating material such as, for example, a porcelain material and is provided with a circular flange, such as **34**, which is molded or cast in place into the upper part of member **12**, as shown. Flange **34** may be attached to wall member **16** of the electrical apparatus in any desired manner, the present preferred manner being to weld flange **34** directly to the wall **16** of the electrical apparatus. A pair of metal inserts such as, for example, L-shaped flanges **36** and **38** are also molded or cast in place into the upper portion **12** and the lower portion **14**, respectively. These metal inserts **36** and **38** are in turn welded to a U-shaped metal member **40**, which forms a portion of the electrical contact of the fuse holder **10**. As can be seen from FIGURE 1 of the drawing, the metal insert **40** is connected, preferably by brazing, to a metal sleeve **42** which extends from metal insert **40** to the top of fuse holder **10**, in the manner shown. As will be understood, the metal sleeve **42** is provided at its upper portion with a spring **44** to maintain pressure on the electrical contact **24** as is shown. Lead **32** which, as explained, goes to the bushing (not shown) of the electrical apparatus, is connected to a stud **46** which is mounted on the metal insert **40** in the manner shown. A second stud **48** may also be provided, if desired, for an additional connection of the electrical lead to the interior of the transformer.

The lower portion **14** of bushing **10** is provided with an L-shaped metal flange **50** which is molded or cast in place in the lower end of the porcelain part **14**. Flange **50** in turn is welded to a lower plate member **52** which forms the bottom of the fuse holder **10**. The rotatable contact **22** is rotatably mounted in the lower plate member **52** and, as mentioned, is provided with the hermetical sealing member **26**, as shown. In the example shown in FIGURE 1 of the drawing, metal contact **22** is bolted to rotatable shaft **54** by means of a bolt member **56**. Obviously, the rotatable shaft **54** and the fuse contact **22** may be made of one piece if desired. However, it has been found that, for purposes of assembly, it is better to make it in two parts as shown.

A rotatable cover member **18** is provided which has a flange member **58** as is best seen in FIGURE 2 of the drawing. As is shown in FIGURE 2, flange member **58** is provided with cutout portions **60** and **62** which mate with the turned lugs **64** and **66**, which are mounted on the cover or wall member **16** of the electrical apparatus. The flange **58** of cover **18** is also provided with stops **68** and **70** which, as can be seen in FIGURE 2 of the drawing, will rotate to contact lugs **64** and **66** to prevent further movement of the cover member **18**. As will be understood, the cover member **18** is placed on the fuse holder **10** with cutouts **60**, **62** fitting down over the lugs **64**, **66**. The cover is then rotated in a clockwise direction, as indicated by the "closed" arrow shown in FIGURE 2, until the stops **68** and **70** contact lugs **64** and **66**, in the manner shown in FIGURE 2. As will be understood, this will lock the fuse member **20** within fuse holder **10** and prevent any accidental removal thereof. The lugs **64** and **66** extend high enough above cover **16** so that the fuse cannot be partially inserted to close the switch, but must be fully inserted so that flange **58** is held down by the lugs.

As is best shown in FIGURE 1 of the drawing the interior of cover **18** is provided with the insulating material **72** which is flared to cooperate with the conical shaped top **74** of the upper member **12** to fuse holder **10**. The internal dimensions of insulation **72** in cover member **18** is smaller than the outer dimension of top **74** of fuse holder **10**. This provides a pressure-tight fit, requiring insulation **72**, which is preferably an elastomeric material to be stretched over top **74** of fuse holder **10**. This provides a water-proof seal to the fuse holder **10** and also provides very high dielectric strength to the seal. It has been found that the dielectric strength is related directly to the stretch of insulation **72**. It is believed that this is due to imperfections in the mating surfaces between insulation **72** and top **74** of fuse holder **10**. The stretching of insulation **72** apparently brings these mating surfaces into closer contact, with fewer voids. As will be understood, as the cover **18** is placed over the conical top **74** of bushing **10**, the insulation **72** will stretch and tighten on the top portion **74** of portion **12** to seal the bushing holder from any possibility of water entering through the cover member **18**. It also provides an electrical seal capable of withstanding insulation test voltages.

Also connected to insulation **72** is an insulating tube **76** which in turn is connected to the upper fuse contact **78** of fuse member **20**. In the embodiment shown, fuse contact **78** is bolted to the insulating tube **76** by means of bolt **80**. As will be understood, the upper contact **78** of fuse **20** may be pinned or brazed or otherwise firmly fixed to fuse **20**. The lower contact of fuse **20** is indicated at **82** and, as shown, is a split contact having a spiral spring **84** therein and fits within the sides of the contact **22** of fuse holder **10**. As will be understood, contact **82** is also pinned or brazed or otherwise firmly connected to fuse **20**. The spiral spring **84** aids in providing a firm electrical contact between fuse contact **82** on fuse **20** and the fuse contact **22** in fuse holder **10**. As will be understood from the foregoing, rotation of fuse cover **18** to lock it in place, or to unlock it, will in turn rotate fuse **20** through tube **76**, bolt **80** and contact **78** which will, in turn, rotate contact **82** which will rotate the contact **22** to thereby rotate switch operator **28** to either open or close the internal switch (not shown) of the electrical apparatus.

As is shown, particularly in FIGURE 1, the cover **18** is provided with a raised lug **86** which has an opening **88** therein for reception of a hook stick or the like. Thus, as will be understood, an operator such as a lineman may place a hook stick (not shown) into opening **88** and thereby insert fuse **20** into fuse holder **10** and in locking such fuse within the fuse holder, close the switch through operator **28**. In a similar manner, the lineman using a hook stick in the opening **88** of lug **86**, may unlock the fuse cover **18** by rotating it in a counterclockwise direction, as indicated by the arrow labeled "open" in FIGURE 2, to thereby open or deenergize the switch. After cover **18** is unlocked, which opens the switch, fuse **20** may be removed from fuse holder **10**.

Fuse holder **10** is also provided with an insulating sleeve or tube **90** which surrounds fuse **20**. This insulating

sleeve 90 is placed between fuse 20 and metal sleeve 42, as shown in FIGURE 1. The insulating sleeve 90 extends from the top of fuse 20 to the bottom of fuse holder 10. As can be seen, this construction allows the placing of contact 46 and lead 32 below the oil level of the electrical apparatus. It is desirable to have this below the oil level to provide adequate insulation from contact 46 to the wall member 16. If only air were used as insulation it would be necessary to substantially increase the length of fuse holder 10 below wall member 16. Also the insulating sleeve 90 provides adequate insulation to prevent any arcing from the lower end of fuse 20 to the lower end of metal sleeve 42, after the fuse has interrupted the circuit.

FIGURE 3 shows a modification of the fuse holder in which the fuse holder is made of an electrically insulating material such as, for example, a molded epoxy resin. In this type of one piece fuse holder, indicated at 10', a metal insert such as 46' and 48' may be molded directly into the fuse holder and make contact with the metallic sleeve member 42' which will form one of the contacts for the fuse 20' as is shown in FIGURE 3. Insulating sleeve 90' is also provided, as shown. In this manner, as will be understood, the fuse holder may be made of a single piece of insulating material rather than the two piece porcelain holder as is shown in FIGURE 1 of the drawing. As will be clear to those skilled in the art, the fuse contacts for the fuse 20' will operate in the same manner as previously discussed, for opening and closing a switch (not shown) prior to the removal or after the insertion of the fuse 20'.

FIGURE 4 shows the present preferred construction of the lower fuse contact 82 and the rotatable fuse contact 22. As can be seen from FIGURE 4, rotatable fuse contact 22 has a square opening 23 which accepts the square shank 55 of rotating member 54. Contact 22 includes a U-shaped contact portion 25, as shown. Preferably both 22 and 54 are brass castings. Contact 82 also includes a U-shaped portion 83 which fits into U-shaped member 25. A spiral metal spring member 84 fits in opening 85 in portion 83 to provide constant outward pressure on the arms of the U-shaped portion 83. As will be understood, spring 84 will allow portion 83 to be inserted into U-shaped contact members 25, providing firm electrical contact between members 22 and 82, and providing the rigidity necessary to operate the switch, without requiring excessive push-in or pull-out forces between contacts 22 and 82. Of course, the mating U-shaped portions allow the fuse 20 to rotate contact 22, when the fuse 20 is rotated with cover member 18.

While there has been shown and described the present preferred embodiment of this invention, it will of course be understood by those skilled in the art that various changes may be made. For example, the removable fuse with hermetic fuse holder may be used without the rotating contact, if desired. As will be apparent, these changes may be made without departing from the spirit and scope of the invention, particularly as the invention is defined in the appended claims.

What is claimed as new and which it is desired to be secured by Letters Patent of the United States is:

1. A combined fuse and switch operator comprising:
(a) a fuse holder mounted in a wall portion of an electrical apparatus,
  (1) said fuse holder having a metal flange molded therein, said flange rigidly attached to the wall portion of the electrical apparatus,
(b) an electrical contact at the bottom of said fuse holder,
  (1) said electrical contact being rotatably mounted and being hermetically sealed from the interior of said apparatus,
(c) a switch operator, said switch operator mounted on said rotatable contact outside said fuse holder, and rotatable with said rotatable contact,
(d) a fuse mounted within said fuse holder, said fuse having one contact making electrical and mechanical connection with said contact in said fuse holder,
(e) a fuse cover, said fuse cover being rigidly attached to said fuse,
  (1) said fuse cover fitting on said fuse holder in one position and being rotated to a second position for locking said cover on said holder, rotation of said cover causing said fuse contact to rotate said rotatable contact to thereby rotate said switch operator.

2. A combined fuse and switch operator comprising:
(a) a fuse holder mounted in a wall portion of an electrical apparatus,
(b) a first electrical contact in the bottom of said fuse holder,
  (1) said electrical contact being rotatably mounted in the bottom of said fuse holder,
  (2) said rotatable contact being hermetically sealed from the interior of said apparatus,
(c) a switch operator, said switch operator mounted on said rotatable contact outside said fuse holder, and rotatable with said rotatable contact,
(d) a second electrical contact in a portion of said fuse holder remote from said first electrical contact,
(e) a cover member for said fuse holder,
(f) a fuse member, said fuse member rigidly connected to said cover member,
  (1) said fuse member having a pair of electrical contacts making electrical connection with said first and second electrical contacts,
  (2) one of said pair of contacts making a mechanical connection with said first contact,
(g) locking means on said wall portion of the electrical apparatus,
  (1) said locking means receiving said cover member in one position,
  (2) said cover member rotatable to a second position to lock with said locking means, rotatation of said cover member from said one position to said second position rotating said rotatable contact to thereby rotate said switch operator.

3. A combined fuse and switch operator as claimed in claim 2 in which said fuse cover is provided with an internal elastomeric insulation, said elastomeric stretching over the top of said fuse holder to provide a water tight fit and an electrically insulating seal therewith.

4. A combined fuse and switch operator as claimed in claim 2 in which said rotatable contact is provided with a U-shaped portion to receive said one of said fuse contacts, said one fuse contact being a U-shaped member having a spiral spring therein to force said one contact into firm electrical connection with said rotatable contact.

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