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Thiel et al.

[11] 3,783,342
[45] Jan. 1, 1974

[54] INDICATING FUSE HAVING IMPROVED DEIONIZING MUFFLER CONSTRUCTION

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[73] Assignee: **Westinghouse Electric Corporation,** Pittsburgh, Pa.

[22] Filed: **Mar. 3, 1972**

[21] Appl. No.: **231,563**

[52] **U.S. Cl.** **317/103,** 337/144, 337/178, 337/280, 337/282, 337/292
[51] **Int. Cl.** **H01h 85/38**
[58] **Field of Search** .... 337/280, 279, 173, 337/161, 162, 159, 176, 159, 292, 169, 170, 177, 178, 144; 317/103, 116, 12, 40 A

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Assistant Examiner—D. A. Tone
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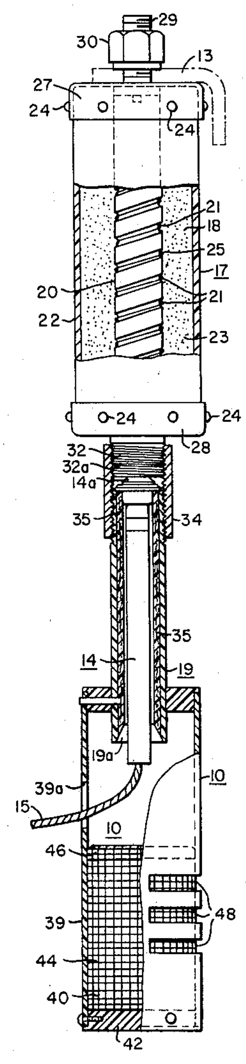
[57] **ABSTRACT**

An improved indicating-type fuse structure is provided having an improved deionization muffler provided therefor to prevent ionized gas and metallic particles from the fusing link from being ejected into areas of high-electrical stress to minimize the possibility of flashover, and consequent damage to the equipment. The deionizing and condensing muffler has one end closed by an end-plug, and is provided with one or more lateral vents to relieve the gas pressure. In addition, the improved muffler has a lateral opening to accommodate the fuse link cable.

11 Claims, 16 Drawing Figures



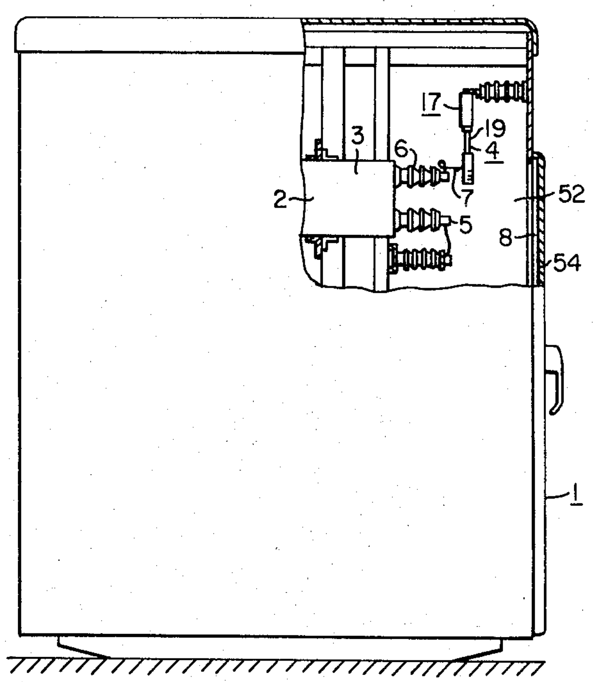


FIG. 1

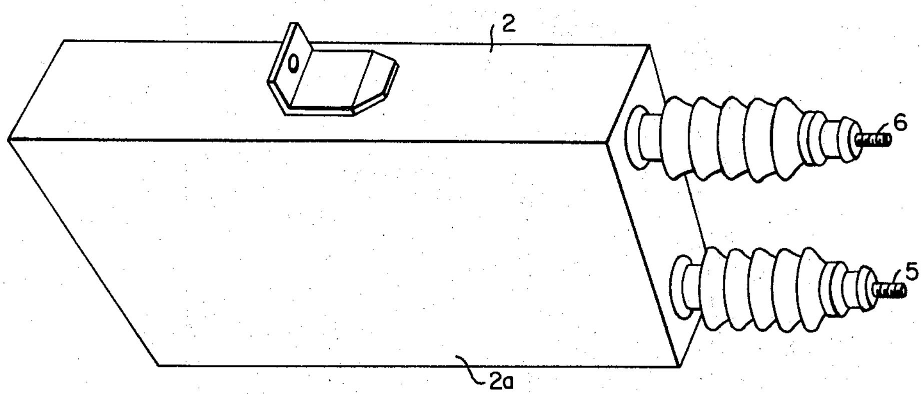


FIG. 3

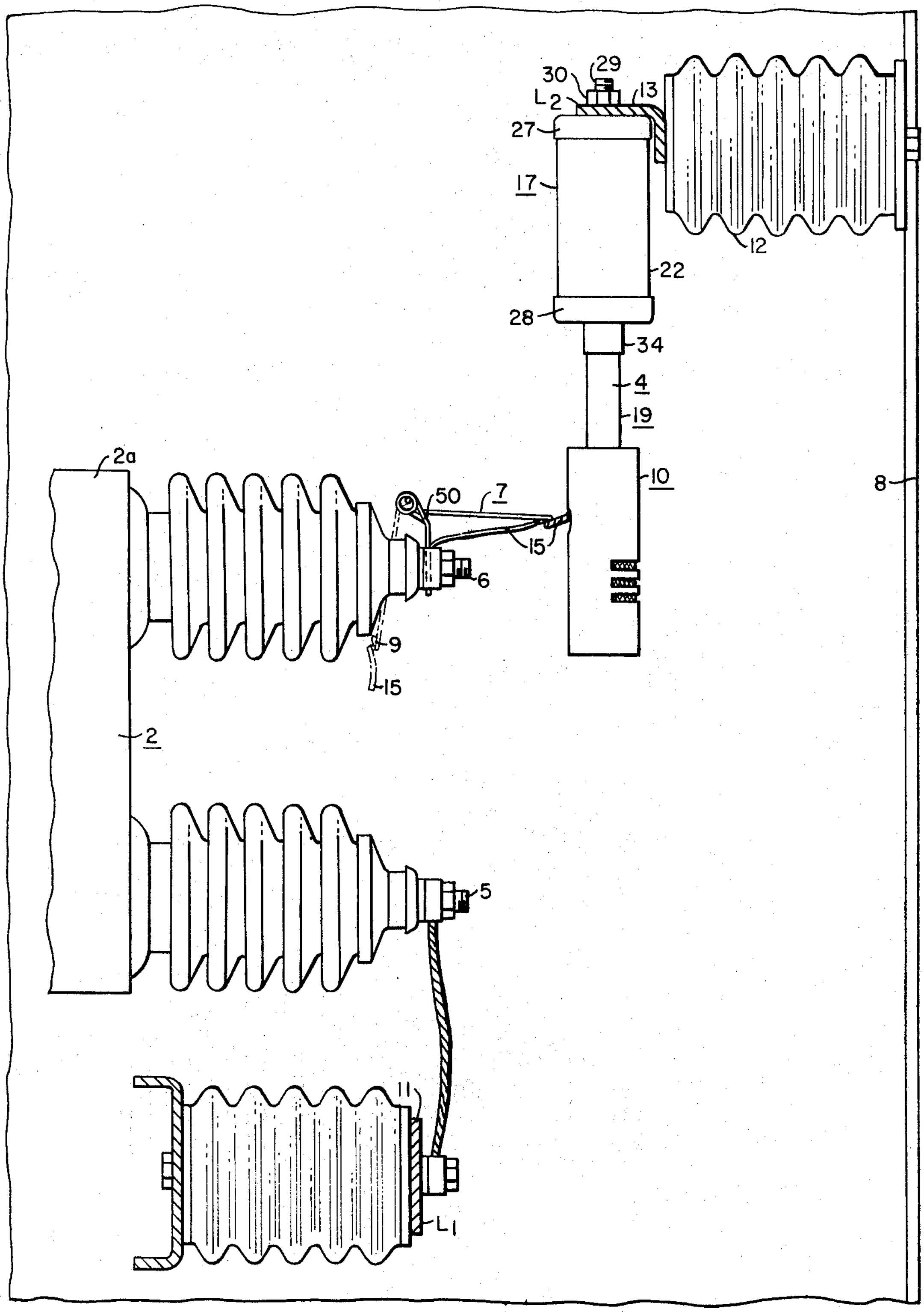


FIG.2

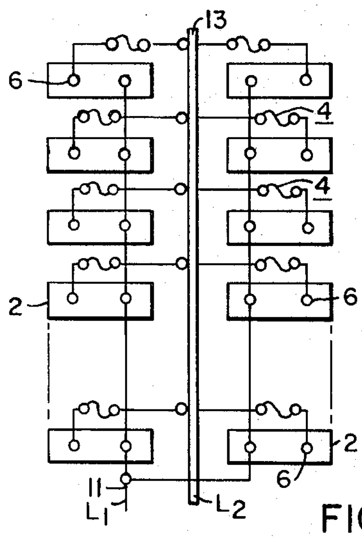


FIG.4

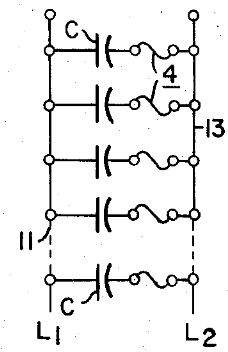
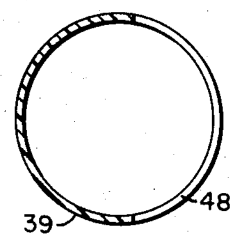


FIG.5

FIG.10



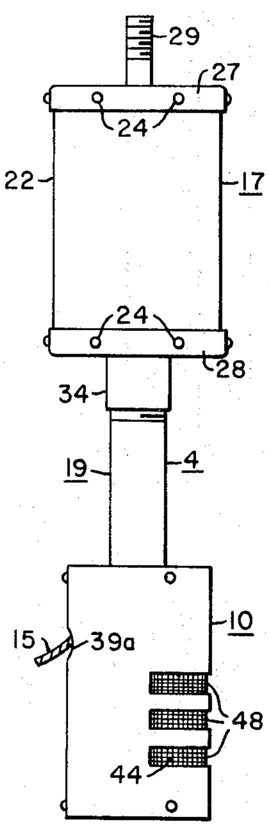


FIG.6

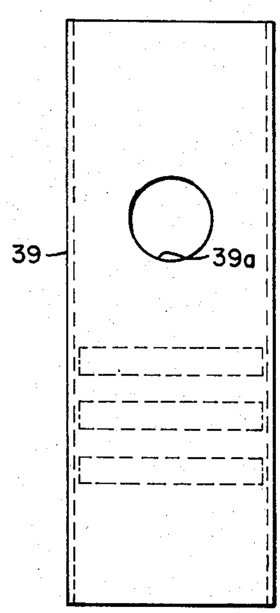


FIG.11

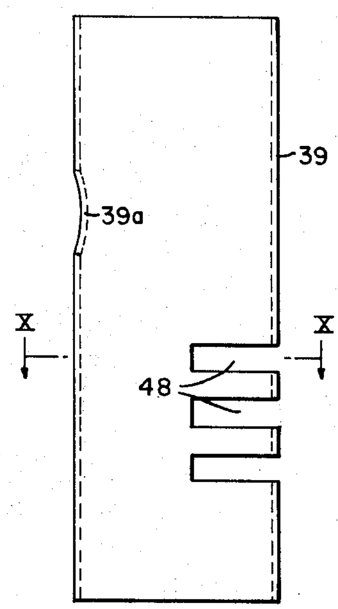


FIG.9

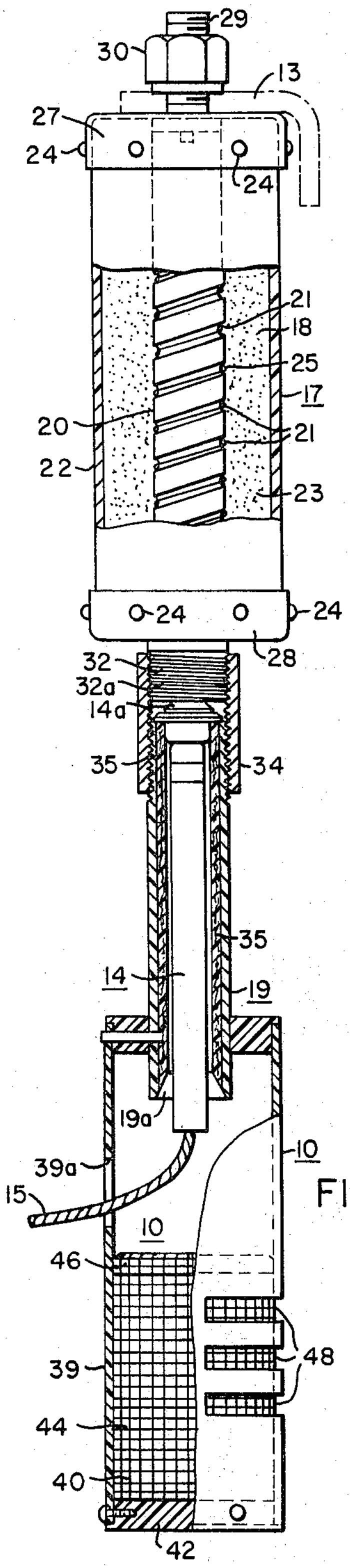


FIG. 7

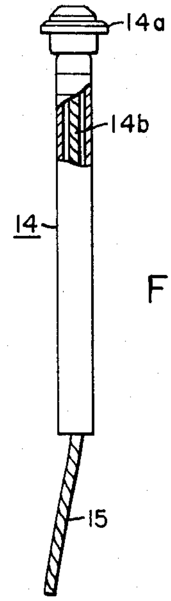


FIG. 16

FIG. 13

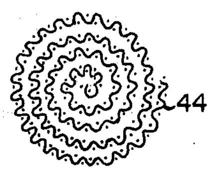
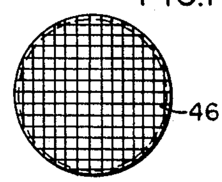


FIG. 14



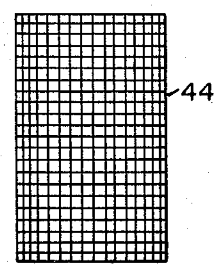


FIG. 12

FIG. 15

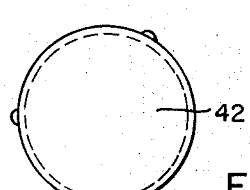


FIG. 8

INDICATING FUSE HAVING IMPROVED DEIONIZING MUFFLER CONSTRUCTION

CROSS-REFERENCES TO RELATES APPLICATIONS

United States patent application filed Aug. 26, 1970, Ser. No. 67,175, by Frank L. Cameron, entitled "Composite Sectionalized Protective Indicating-Type Fuse," and assigned to the assignee of the instant application, illustrates a dual composite sectionalized fuse having a high-current interrupting section and a low-current interrupting section, the latter accommodating a fuse-link cable, which is placed under tension by suitable tensioning means. During relatively low overload currents, the low-current interrupting section only fuses, and the tensioning means withdraws the fuse-link cable to an indicating position. In this eventuality, the high-current interrupting section does not fuse, and may be utilized for subsequent operations of the structure, merely a replacement of the low-current section only being required. Preferably, the high-current section of the aforesaid Cameron patent application is a current-limiting fuse, and the low-current interrupting section is an expulsion-type fuse having an expulsion bore associated therewith, through which the fuse-link cable extends.

Another patent application, pertinent to the present invention, is United States patent application filed Aug. 26, 1970, Ser. No. 67,183 by James N. Santilli, entitled "Indicating Sectional Composite Fuse Constraction," and assigned to the assignee of the instant application. This latter patent application concerns the utilization of a standard-type fuse-link cable in the low-current section for convenience, and utilizing the benefits of standardization of standard-type fuse-links, and preferably in the latter-mentioned Santilli application, again a current-limiting fuse is employed for the high-current section. As before, only the low-current section fuses during relatively low-overload fault currents, the high-current section remaining intact, and capable of further use. In general, the Santilli application relates to commercialized features of the aforesaid Cameron case.

BACKGROUND OF THE INVENTION

Although the improved fuse construction of the present invention may be utilized in a wide variety of applications, the fuse construction has particular applicability to the protection of individual capacitor units. As well known by those skilled in the art, the primary purpose of fusing individual capacitor units is to remove a faulted capacitor unit from service before the capacitor case ruptures and damages adjacent units. The removal of the faulted capacitor unit must take place before the main protective device can operate and interrupt service to the remaining capacitor units, which are unaffected. Another purpose is to protect the unaffected capacitor units from the high-transient current associated with the failure of a capacitor unit in the same capacitor bank.

Capacitor equipment usually consists of a number of individual capacitor units connected in parallel to make up the total capacity required for a given installation. In most installations, the complete equipment is protected by a circuit-breaker, or power fuses. The current rating is determined by the normal current rating of the equipment, plus an ample margin, to allow for increased current due to operation above rated voltage,

manufacturing tolerances, presence of harmonics and transient currents during switching operations.

Usually, individual capacitor units are liberally designed to withstand the requirements of normal service; nevertheless, a capacitor unit may fail if operated under abnormal conditions. Should this occur, no protection can be expected from the circuit-breaker or power fuses, because of the high ratio of total bank current to the small current, that can be drawn by a faulty capacitor unit. As a result, individual capacitor unit fuses are recommended for use on all power capacitor installations to provide maximum protection, preserve continuity of service, and to provide identification of a faulted capacitor unit.

For indoor capacitor equipment applications, the present practice is to fuse individual capacitors with a current limiting indicating fuse. A problem with the present practice is ionized gas and metallic particles from the fusing link being emitted during operation of the fuse, especially during a low-current interruption. These containments are usually ejected into areas of high electrical stress, and could cause flashovers and subsequent damage to the equipment.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a new-type current-limiting fuse with a gas-condensing muffler, or deionizer in conjunction with the low-current sectional element of the fuse structure. In addition, according to the present invention, the fuse has an indicating and disconnecting feature, when installed with a special biasing means, such as a special spring-tension flipper.

Accordingly, it is a general object of the present invention to provide an improved fuse structure for protecting electrical equipment.

Another more specific object of the present invention is to provide an improved fuse structure for protecting enclosed units, such as, for example, capacitor units disposed within a grounded metallic housing for indoor use, for example.

Another object of the present invention is the provision of an improved gas-condensing muffler, or deionizer construction for a fuse.

Another object of the present invention is the provision of an improved dual-type sectionalized composite fuse structure having a high-current interrupting unit and also in series therewith a low-current interrupting unit, with the low-current interrupting unit being of the expulsion-type and having cooperating therewith an improved muffler and deionizer device.

Still another object of the present invention is the provision of an improved muffler, or condensing chamber for a fuse structure in which one end of the aforesaid muffler, or condensing chamber is closed to prevent the bullet-type ejection of metallic contaminants and ionized gas particles occurring during a fusing operation, which could possibly cause flashover within an associated grounded metallic housing.

Further objects and advantages will readily become apparent upon reading the following specification, taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an end elevational view, partially in section, of an enclosed protected capacitor bank installation, indicating internal stacking of capacitor units with individual protective fuse elements closely situated to the cabinet wall;

FIG. 2 is a considerably enlarged side-elevational view of the improved fuse structure of the invention illustrated in its unfused intact condition;

FIG. 3 illustrates, in perspective, a typical capacitor unit utilized in the conventional capacitor bank of FIG. 1;

FIG. 4 illustrates, in vertical plan, the electrical diagram of a fuse connection to the central bus;

FIG. 5 illustrates diagrammatically the electrical components involved between the bank terminals;

FIG. 6 illustrates the improved dual sectionalized fuse structure of the present invention;

FIG. 7 is an enlarged size elevational view, paetially in vertical section, of the low-current interrupting section in cooperation with its condensing muffler;

FIG. 8 is an end view of the muffler element of FIG. 7;

FIGS. 9–11 illustrate, in detail, the muffler casing;

FIGS. 12 and 13 respectively, illustrate side-elevational and end views of the helically-wound mesh metallic screening utilized in the muffler;

FIGS. 14 and 15 are, repsectively, end and side-elevational views of the mesh and shield utilized in the improved muffler structure of the present invention; and,

FIG. 16 illustrates a conventional-type fuse-link with its flexible fuse cable, which may be readily replaced within the expulsion-type low-current fuse-holder of FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Although the improved fuse construction of the present invention may be utilized in a wide variety of applications, merely for the purpose of describing the present invention, and not by way of limitation, the fuse construction is illustrated as applied to an individual capacitor unit. As well known by those skilled in the art, the primary purpose of fusing individual capacitor units is to remove a faulted capacitor from service before the capacitor causes ruptures and damages adjacent units. The removal of the faulted capacitor unit must take place before the main protective device can operate, and interrupt service to the remaining capacitor units, which are unaffected. Another purpose is to protect the unaffected capacitor units from the high transient current associated with the failure of a capacitor unit in the same capacitor bank.

Capacitor equipment usually consists of a number of individual capacitor units connected in parallel to make up the total capacity required for a given installation. In most installations, the complete equipment is protected by a circuit breaker, or power fuses. The current rating is determined by the normal current rating of the equipment, plus an ample margin to allow for increased current due to operation above rated voltage, manufacturing tolerances, presence of harmonics, and transient currents during switching operations.

Usually, individual capacitor units are liberally designed to withstand the requirements of normal service; nevertheless, a capacitor unit may fail if operated under abnormal conditions. Should this occur, no protection can be expected from the circuit breaker, or power fuses, because of the high ratio of total bank current to the small current that can be drawn by a faulty capacitor unit. As a result, individual capacitor unit fuses are recommended for use on all power capacitor installations to provide for maximum protection, preserve continuity of service, and to provide indentification of a faulted capacitor unit.

Referring to FIG. 1 of the drawings, it will be observed that a capacitor bank compartment 1 encloses a plurality of stacked capacitor units 2 in a plurality of banks 3. Individual capacitor fuses 4 are secured to one of the terminals 6 of the capacitor units 2 for protection against fault conditions. It will be observed that the indicating assembly 7 of the capacitor fuse 4 is situated relatively closely to the wall 8 of the compartment 1. As a result, there is the danger of flashover conditions occurring between the capacitor fuse 4 and the grounded compartment wall 8 if the fuse is not properly constructed.

In previous individual capacitor fuses, operation of the fuse element was indicated by the position of a coiled flipper spring attached to a flexible cable at the lower end of the fuse assembly. Such a flipper indicating spring, at the time of fuse operation, moves several inches, carrying with it a portion of the flexible fuse cable. When the capacitor, to which the fuse is connected, is mounted inside a cubicle, or compartment (as is usually the case), special care must be exercised to allow sufficient electrical clearance between the lower end of the fuse, the indicator parts, and the sides, or walls of the cubicle compartment 1. This often requires extra space inside the cubicle, which is undesirable. In addition, previous individual-type capacitor fuses were suitable only for bus mounting, there being no means of attachment of the lower end of the fuse assembly to the terminal bushing of the capacitor unit.

The improved indicating fuse construction 4 of the present invention comprises generally the important addition of a condenser chamber 10. Electrical connection is preferably made to the terminal stud 6, of the capacitor unit 2. The fuse 4 may be mounted directly onto a post bushing 12 and bus 13 by means of a simple flat mounting strap. Moreover, the fuse 4 may also be mounted upon a capacitor bus for other installations. The utilization of a condensing chamber 10 permits the fuse 4 to be used more closely adjacent other live parts, because the expelled gases, generated during fuse operation, are cooled and deionized by the condenser chamber 10.

The electrical connections are more readily apparent from an inspection of FIGS. 4 and 5 of the drawings. FIG. 3 illustrates a typical two-terminal capacitor unit 2, with terminal bushings 5, 6, and the dotted lines 9 in FIG. 2 illustrate the position of the fuse 4 indicating a blown condition, with the fuse pigtail 15 hanging downwardly, and the capacitor unit 2 completely isolated and disconnected from the central energized bus 13, as well as indicating for ease of maintenance.

The protective fusible device 4, in accordance with the present invention, as illustrated more clearly in FIGS. 2 and 6 comprises a dual-sectional fuse construction having a first current-limiting high-current section 17 and a second low-current expulsion unit 19, the latter accommodating standard fuse links 14 (FIG. 16). Generally, the internal construction of the high-current current-limiting section 17 is described in U.S. Pat. No. 3,259,719 issued July 5, 1966 to R. T. Innis and George A. Rusnak, and assigned to the assignee of the instant application. As shown, the high-current section

17 utilizes an interrupter rod **20** composed of steatite, or other suitable insulating material, and having one or more spiral grooves **21** extending the length thereof. The space or volume **18** (FIG. 7) inside the tube **22**, between the wall of the tube **22** and the interrupter rod **20**, is filled with a suitable material **23**, such, for example, as white sand. The helical grooves **21** may contain main fuse wires **25**, composed of silver, for example, or other conducting material, which run the length of the grooves **21**. It will be understood that the main fuse wires **25** may be a single wire, or several strands of wire twisted together, depending upon the desired current-carrying capacity of the fuse device **4**.

As shown, the casing **22** has secured to its upper and lower ends, as by staking pins **24**, a pair of conducting caps or ferrules **27, 28**, the upper cap **27** having a clamping stud portion **29**, which extends through the bus **13**, and is secured thereto by a mounting nut **30**.

The lower cap, or ferrule **28** of the high-current current-limiting section **17** contains a mounting-stud portion **32**, which is threaded externally, as at **32a**, and accommodates a mounting sleeve **34**, which is secured, as by a threaded connection **35**, to the insulating expulsion-tube, or fuse-holder **19**, which may be fibre-lined, as at **36**, as shown. The low-current expulsion-tube **19** utilizes a standard-type fuse-link **14**, having a button head **14*a***, which is replaceable. As shown in FIG. **7**, the flexible fuse-link cable **15** extends through the open lower end **19*a*** of the expulsion fuse-tube **19**, and it is electrically connected to the capacitor terminal **6**, as shown in FIG. **2**.

There is a need for insuring that an operated, or blown fuse **4** gives a positive observable indication, when a piece of electrical equipment has partially, or completely failed. For instance, if a capacitor-unit **2** has partially, or completely failed, the fuse **4** should operate to protect against gas generation internally inside the capacitor casing **2*a***, which could otherwise rupture the capacitor case **2*a***. The fuse **4** should also disconnect, and indicate a blown condition of the fuse, so that the failed unit **2** will be completely disconnected from the circuit **L1, L2**, and a maintenance man can readily observe and locate the failed capacitor unit **2**, and thereby provide for replacement scheduling.

FIG. **7** shows the basic construction of an inexpensive current-limiting indicating fuse **4**, with a replaceable low-current standard-type fuse-link element **14**. The advantage of using this separate high-and-low current fuse construction **4** is that the low-current element **19** accommodates a standard fuse-link **14**, which is replaceable, if this element **14** is damaged due to a partially-failed unit **2**, parallel-unit failure, bus flashover, or shipping damage. The fuse construction **4** of the present invention also has a very good disconnecting and observable indicating feature, since the low-current element **19** has the fuse-link cable **15** ejected through the open end **19*a*** of the fuse-tube **19**, either on high- or low- current operation.

It will be obvious that during heavy fault current interruption, the high-current interrupting section **17** provides a current-limiting feature, which restricts the current flow to a safe magnitude, as the fuse **4** is isolating the faulted unit. During this same high-current interruption, as will be obvious, the low-current section **19** will also fuse, and eject the fuse-link cable **15** out of the open end **19*a*** of the expulsion-tube section **19**. Thus, during such high-current interruption, which occurs at high speed, the danger of case rupture **2*a*** and damage to adjacent units **2** is eliminated.

Under fault conditions, the fusible elements **25** inside the high-current unit **17** melt and/or vaporize, and the fused metal, within the current-limiting section **17**, condenses in the sand **23** surrounding the assembly **20**. The ensuing arc is confined in the spiral grooves **21** in the interrupter bar **20** by the sand **23**. This restriction of the arc produces a high arc voltage, which opposes the system voltage, and limits the fault current to a safe value. The energy generated in the current-limiting section **17** is absorbed by the quartz sand **23**.

During low-current operation, the fusible section **14*b***, constituting a part of the replaceable fuse-link **14**, fuses, and the gases, which are generated within the fibre-lined expulsion tube **19**, eject the fuse-link cable **15** out of the open end **19*a*** of the expulsion-tube **19** to an indicating position **9**, as shown more clearly in FIG. **2** of the drawings. The high-current section **17** is not affected during such low-current operation.

It is to be observed that should the low-current section **19** become damaged, or otherwise unsuitable for use, the entire low-current unit **19** may be readily unscrewed from the mounting stud **32** of the high-current unit **17**, and an entire new low-current unit **19** may be utilized. During normal operation, however, only the universal cable-type fuse-link **14** will need to be replaced, as well known by those skilled in the art. Thus, the improved fusible protective device **4** of the present invention utilizes a standard replaceable fuse-link **14** during normal operation.

For a particular application, by way of example, the individual capacitor units **2** each had a 150 kvar. rating, the voltage of the line was 20 K.V., and the normal operating current of the individual capacitor unit **2** was 7.5 amperes. With regard to the fusible device **4**, there were **3** smooth silver wires **25**, each of 0.02 inches diameter, laid together side-by-side in a single groove **21** formed on the interrupter rod **20** of the high-current unit **17**. The fuse-link rating of the low-current unit **19** was **12** amperes.

CONDENSING MUFFLER

Referring to FIGS. **6** and **7**, it will be noted that there is provided an improved condensing muffler construction, generally designated by the reference number **10**, and comprising an insulating casing **39** more clearly illustrated in FIGS. **9–11** of the drawings. It will be observed that the end **40** (FIG. **7**) of the muffler **10** is closed, as by an insulating end plate **42** (FIG. **7**), and mesh screening **44** (FIG. **12**), rolled up helically, is disposed within the muffler casing **39** to condense the exhaust gases, which are ejected through the open end **19*a*** of the low-current expulsion tube **19**. A mesh end shield **46** is positioned over the end of the rolled-up mesh screening **44**, and FIGS. **14** and **15** more clearly illustrate the mesh end shield **46**.

The muffler casing **39** has an opening **39*a*** provided laterally thereoutof to accommodate the fuse-link cable **15**, as shown in FIG. **6**. Additionally, the muffler **10** has a plurality of side vent openings, designated by the reference number **48**, which accommodate the exhausting of the gas products laterally out of the muffler casing **39**.

Upon fuse operation, the flipper **50** (FIG. **2**), which maintains the fuse-link cable **15** in tension prior to fuse operation, will move in a clockwise direction to its indicating position, as illustrated by the dotted lines **9** in FIG. **2.**

MUFFLER FUSE APPLICATION

A typical arrangement would have the characteristics as set forth below:

A three-phase capacitor installation may have ten **150** kvar. capacitors per phase in a three-phase grounded wye installation. Each capacitor **2** may operate at 7,200 rms. with a nominal load current of about 21 amperes rms.

A suddenly shorted, or failed capacitor **2** will draw possibly 50,000 amps at 20,000 hz. The high-current section **17** of the fuse would operate quickly, in say hundreds of microseconds. The low current/muffler assembly **19** would have melted and indicated the fuse operation. In this type of operation the 60 hz. line current is negligibly affected.

Another type of operation might happen under a progressive or high-impedance fault, where the fuse passes 200 or 300 amps. for say a second, with the low-current assembly producing gases to clear the fault. The condenser assembly **10** deionizes the gases and ejects them to low voltage stress areas **52** (FIG. **1**) inside the cabinet. The high-current section **17** has not even sensed this low-fault current.

The fuse **4** of the present invention is designed such that any operation of the fuse **4** will always produce an operation in the low-current section **19** of the fuse **4.** Typically the low-current element **19** senses a high current flowing due to a fault situation, heats rapidly, producing gas from the small diameter tube **19,** and this hot ionized gas is forced through the deionizer section **10** which cools these gases and deionizes them. The deionized gas is expelled through the venting slots **48** and is directed toward the doors **54** of the cabinet housing **1,** which is an area of a relatively low electric field. During this operation, the expended pigtail **15** is pulled out the opposite side (through a circular hole **39***a*) of the muffler **10** with a spring flipper **50,** that resembles a mouse trap. This introduces an open-air gap which eliminates or removes the bus voltage on the fuse **4.** This eliminates the possibility of tracking over the fuse **19** which could cause a flashover.

The previous discussion applies to all operated fuses since a low current operation is common to all fuse operations. In the event of a very high fault current, the high current **17** will actually clear the fault while the low current operation provides indication of a fuse operation. The high current section **17** is capable of clearing very high fault currents even at the maximum expected system overvoltage on the line.

From the foregoing description, it will be apparent that there has been provided an improved fuse structure **4,** particularly adapted for capacitor unit protection, in which both a high-current section **17** and a low-current section **19** are utilized, together with an improved muffler construction **10** to prevent the bullet-like ejection of metallic particles out of the fuse structure **4,** which could cause flashover. By the particular muffler construction **10** utilized, this ejection has been held to a minimum.

Although there has been illustrated and described a particular structure, it is to be clearly understood that the same was merely for the purpose of illustration, and that changes and modifications may be readily made therein by those skilled in the art, without departing from the spirit and scope of the invention.

We claim:

1. The combination in an outdoor metal-enclosed capacitor installation including, in combination, one or more capacitor units and a housing door, the two terminals of said capacitor unit extending generally transversely of said door, means for protecting the capacitor unit including an expulsion-type fusible device having a muffler associated therein, the muffler having vents extending in the direction of the door, said muffler also having a hold accommodating the fuse-link cable of the expulsion fuse, said accommodating hole being disposed diametrically on the opposite side of the muffler casing from the vents, and spring-means supported by one of the capacitor terminals for exerting tension on the fuse-link cable.

2. The combination according to claim **1,** wherein a plurality of capacitor units are in stacked array, each of said capacitor units having a fusible device for the protection thereof, said fusible device including a current-limiting section and an electrically-series expulsion-fuse section, the expulsion-fuse section for each capacitor unit having a muffler, each muffler having vents directed toward the door, and each muffler having a hole for accommodating the fuse-link cable extending diametrically on the opposite side from the muffler vents.

3. In combination, electrical apparatus having a terminal bushing associated therewith, a fusible device for electrically protecting said apparatus including an expulsion-type fuse having a fuse-link disposed within the expulsion-bore therein and the associated fuse-link cable extending out of the open end of the expulsion-bore, spring-means supported by said terminal bushing for applying spring tension to the fuse-link cable, a muffler disposed adjacent the open end of the expulsion-type fuse to receive the fuse-products during fuse rupture, an opening in the side of the muffler through which the fuse-link cable extends, and one or more vents disposed on the other side of the muffler and directing exhaust gases away from said terminal bushing.

4. The combination according to claim **3,** wherein a current-limiting fuse is electrically arranged in series relation with said expulsion-type fuse to assist in fault-current interruption.

5. The combination according to claim **3,** wherein the muffler has provided therein metallic mesh screening to cool the exhausting arc gases.

6. The combination according to claim **3,** wherein a standard-type fuse-link is utilized which may be readily replaced following fusing of the second relatively low-current expulsion section, whereby changeable minimum-melt fuse characteristics are possible.

7. The combination according to claim **3,** wherein a rotatable spring-flipper is supported adjacent the end of said terminal bushing and exerts spring-tension upon the fuse-link cable.

8. The combination in an outdoor metal-enclosed electrical installation including, in combination, one or more pieces of electrical equipment and a housing door, the two terminals of each electrical equipment extending generally transversely of said door, means for protecting the electrical equipment including an expulsion-type fusible device having a muffler associated therewith, said muffler having one or more vents extending in the direction of the door, said muffler also having a hole accommodating the fuse-link cable of the expulsion fuse, said accommodating hole being disposed diametrically on the opposite side of the muffler-casing from the vents and in the direction toward the two terminals of the electrical equipment.

9. The combination according to claim **8,** wherein the outdoor metal-enclosed installation includes a plurality of capacitor-units each of which has a pair of terminal bushings associated with each unit and extending generally transversely of said door, and additionally one of the two terminal bushings has a spring-means associated therewith to exert tension on the fuse-link cable extending through said accommodating hole provided in the side of the muffler casing.

10. The combination in an outdoor metal-enclosed capacitor installation including, in combination, a plurality of capacitor-units disposed within a metallic housing having a metallic housing door, one or more bus-bars extending horizontally along the front of the installation, the plurality of capacitor-units having their two terminal bushings extending generally horizontally and transversely of the metallic door, a fusible device for protecting each capacitor-unit, one end of such fusible device being fixedly secured to a horizontally-extending bus-bar, said fusible device including an expulsion-type fuse having a fuse-link disposed within the expulsion bore thereof and the associated fuse-link cable extending out of the open end of the expulsion bore, a muffler disposed adjacent the open end of the expulsion-type fuse to receive the exhausting fuse-products during fuse rupture, said muffler having one or more vents in the side-wall of the muffler-casing directed at the metallic door, and the accommodating hole in the side of the muffler-casing for the end of the fuse-link cable being directed inwardly toward the capacitor-units, whereby exhausted arc products will be directed away from the live electrical equipment.

11. The combination according to claim **10,** wherein a series high-current current-limiting fuse section is arranged in series relation with the expulsion-type relatively low-current fuse-section.

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