

[54] **ELECTRICAL LOAD-BREAK APPARATUS**
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 [73] Assignee: **Westinghouse Electric Corporation, Pittsburgh, Pa.**
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3,236,984 2/1966 Lindell..... 200/149 R
 3,586,802 6/1971 Nichols et al. 200/144 C
 3,628,092 12/1971 Keto..... 317/15 R

Primary Examiner—Robert S. Macon
Attorney, Agent, or Firm—J. R. Hanway

[52] **U.S. Cl.**..... **200/144 C, 200/149 A, 337/186 R, 337/207 R, 317/15 R**
 [51] **Int. Cl.**..... **H01h 9/30, H01h 33/00**
 [58] **Field of Search**..... **200/144 C, 149 R, 149 A, 200/151 R; 337/186 R, 207 R; 317/15 R**

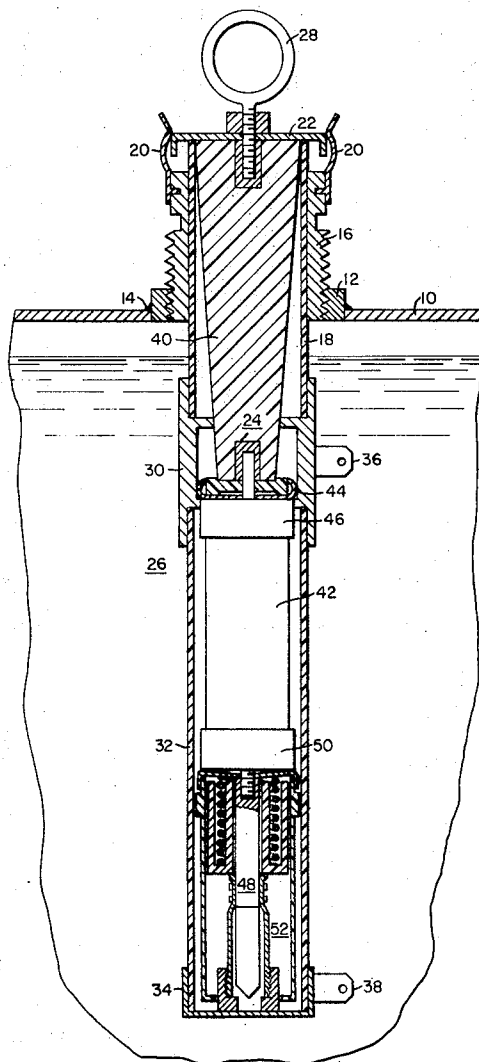
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[57] **ABSTRACT**

An electrical power disconnect device having an arc-quenching sleeve which extinguishes generated arcs. The sleeve is positioned around a conductor probe which is inserted into a contact structure to provide a current path. The probe is withdrawn from the contact structure to interrupt the current path and disconnect the load. During probe withdrawal, the sleeve slides along the probe and blocks the path of an arc between the probe and the contact structure. The arc-quenching sleeve is constructed on an insulating material which exhibits arc-extinguishing properties.

10 Claims, 5 Drawing Figures



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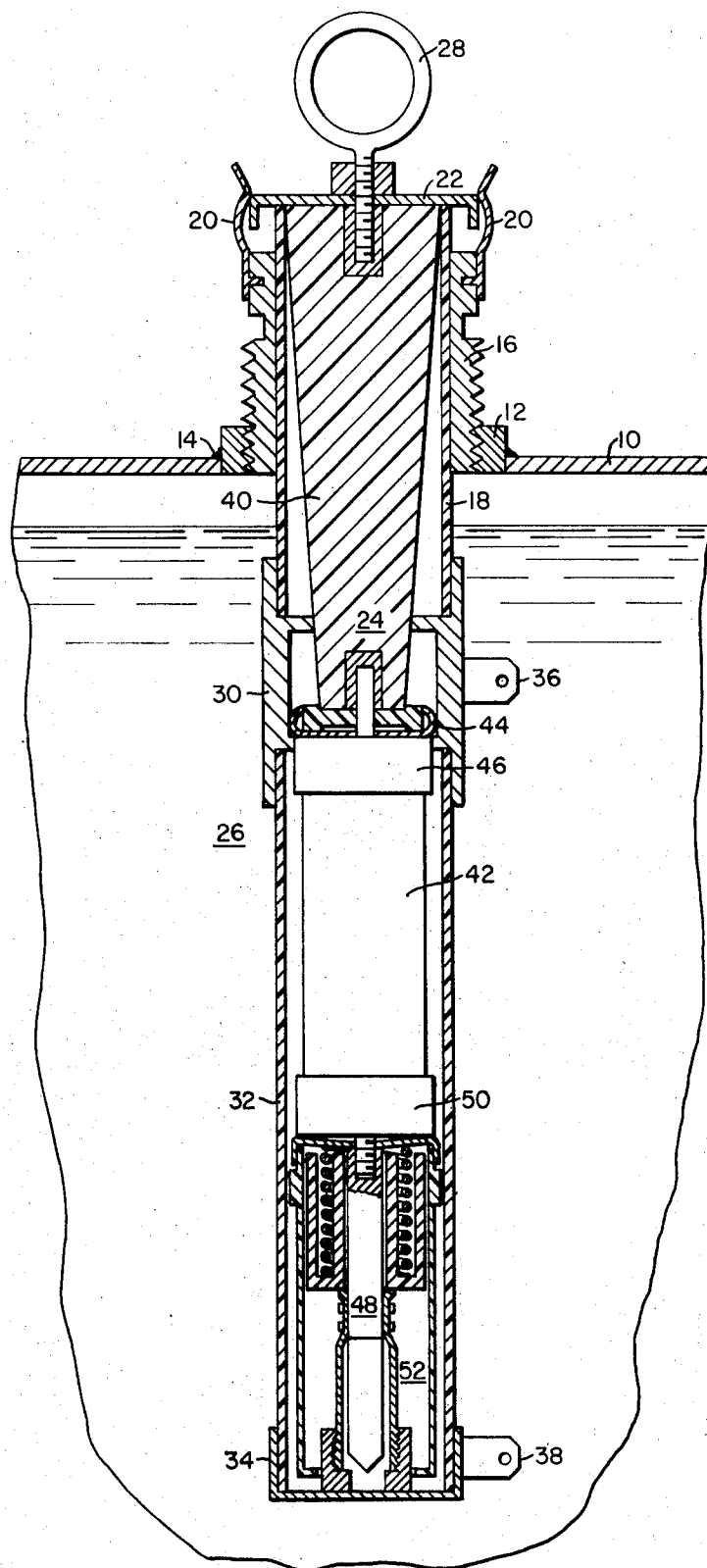
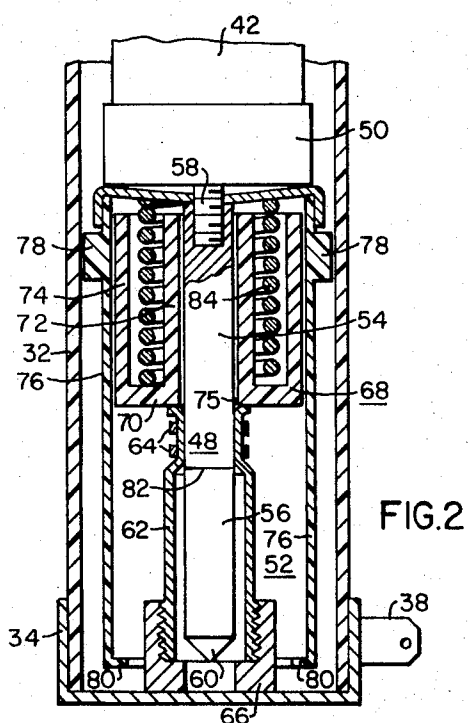
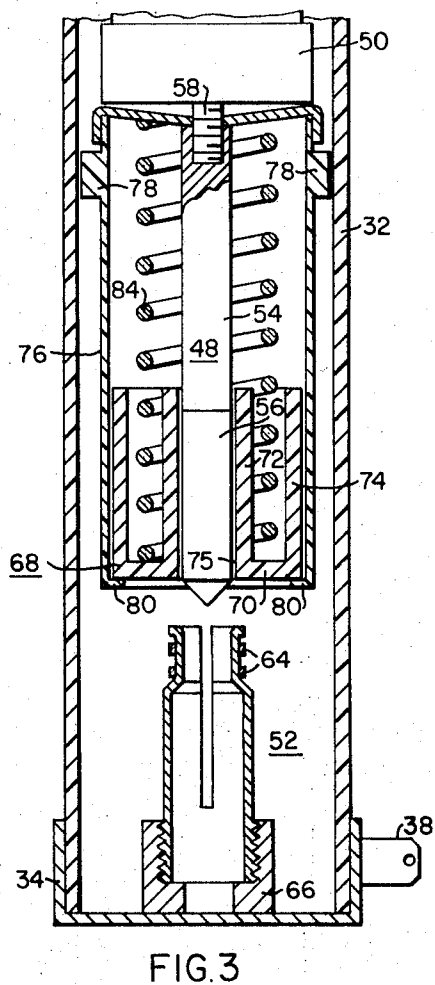
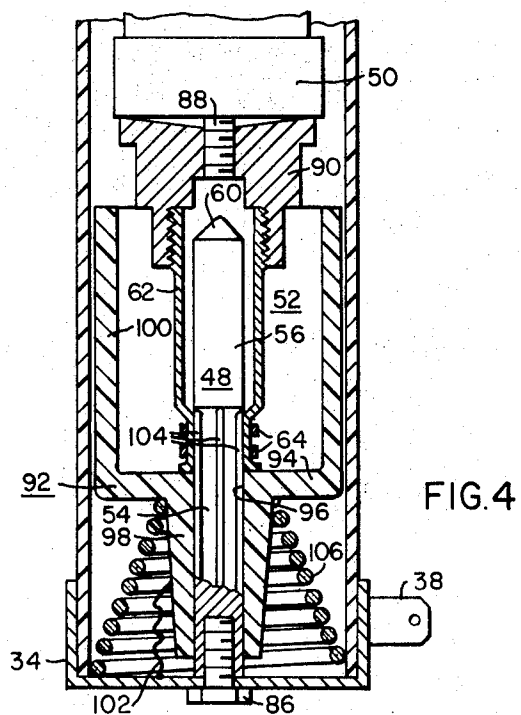


FIG. 1



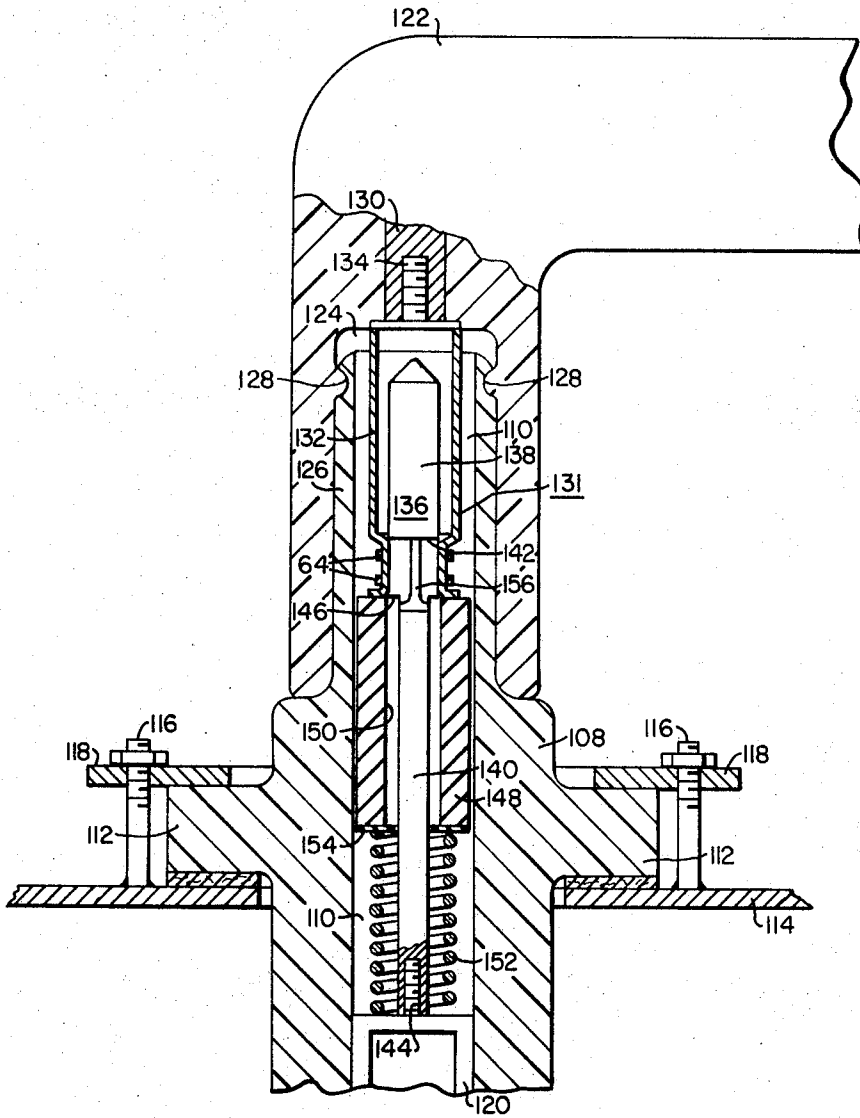


FIG. 5

ELECTRICAL LOAD-BREAK APPARATUS**BACKGROUND OF THE INVENTION****1. Field of the Invention**

This invention relates, in general, to electrical load-break apparatus and, more specifically, to electrical load-break apparatus having arc-quenching means.

2. Description of the Prior Art

Electrical load-break devices are used in various applications to disconnect electrical power from energized apparatus such as power transformers. Although load-break devices are capable of interrupting electrical current having a large magnitude, desirable load-break devices must also disconnect the electrical apparatus when power is not being transferred through the load-break device, that is under no-load conditions. It is also desirable in many applications that the load-break device contain means for limiting the amount of current which may flow therethrough. Generally, current limiting is accomplished by a current limiting fuse which is part of the load-break device.

Several types of load-break devices are presently being used. One type of load-break device is described in U.S. Pat. No. 3,628,092, which is assigned to the same assignee as this invention. The load-break device described therein is suitable for use with 95 KV BIL circuits. Another type of load-break device is described in U.S. Pat. No. 3,732,517, which is also assigned to the same assignee as this invention. The arc snuffing arrangements described therein permit the use of the load-break device with 125 KV BIL circuits.

It is desirable, and it is an object of this invention, to provide an electrical load-break device which will operate satisfactorily at high power levels with a minimum of components. It is also desirable, and it is another object of this invention, to provide an electrical load-break device containing a current limiting fuse and arc-quenching means.

SUMMARY OF THE INVENTION

There is disclosed herein new and useful load-break devices which are capable of satisfactorily operating with circuits having a rating greater than 125 KV BIL. The current path provided by the load-break device travels through a probe and a probe receiver which includes a contact structure. An arc-quenching sleeve is disposed around the probe with resilient means positioned to slide the arc-quenching sleeve along the probe when the probe is withdrawn from the contact structure to disconnect or break the load. The probe includes a conducting portion and an insulating portion. The conducting portion exists from the contact structure before the insulating portion during a load-break sequence. As the conducting portion exits from the contact structure, the arc-quenching sleeve slides along the probe and blocks the path of any arc which strikes between the conducting portion and the contact structure. The arc-quenching sleeve is constructed on an insulating material which exhibits arc-extinguishing properties.

BRIEF DESCRIPTION OF THE DRAWINGS

Further advantages and uses of this invention will become more apparent when considered in view of the following detailed description and drawings, in which:

FIG. 1 is an elevational view, partially in section, of a load-break device constructed according to an embodiment of this invention;

FIG. 2 is a partial elevational view illustrating the lower portion of the load-break device shown in FIG. 1;

FIG. 3 is a partial elevational view of the load-break device shown in FIG. 2 in the disengaged position;

FIG. 4 is a partial elevational view of a load-break device constructed according to another embodiment of this invention; and

FIG. 5 is a partial elevational view of an elbow-type load-break device constructed according to the teachings of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Throughout the following description, similar reference characters refer to similar members in all figures of the drawings.

Referring now to the drawings, and FIG. 1 in particular, there is shown a load-break device constructed according to this invention. The load-break device is mounted on an electrical apparatus enclosure 10, such as a power or distribution transformer casing. A mounting coupling 12 is attached to the enclosure 10 by a suitable method, such as by the weld bead 14. A threaded adapter 16 is attached to the upper portion of the load-break device casing 18 and is threadably engaged with the mounting coupling 12. Retainer springs 20 lock the top cap 22 of the removable fuse assembly 24 into position when the fuse assembly 24 is fully inserted into the fuse casing 26 of the load-break device. The eye bolt 28 is secured to the removable fuse assembly 24 and provides means for pulling the fuse assembly 24 from the fuse casing 26.

The fuse casing 26 includes the upper fuse casing portion 18, the upper casing contact 30, the lower fuse casing portion 32, and the lower casing contact 34. Terminal lugs 36 and 38 are attached to the upper and lower casing contacts 30 and 34, respectively, for providing means for connecting the load-break device to its associated electrical circuits. Although other materials may be used, the upper fuse casing portion 18 and the lower fuse casing portion 32 are normally constructed of an insulating material. The upper casing contact 30 and the lower casing contact 34 are normally constructed of a conducting material suitably attached to the insulating casing portions 18 and 32.

The removable fuse assembly 24 includes an insulated shaft member 40 which is mechanically connected to the upper end of the current limiting fuse 42. The sliding contact 44 electrically connects the upper end 46 of the current limiting fuse 42 to the upper casing contact 30 when the removable fuse assembly 24 is locked in the position illustrated in FIG. 1, which is the load-make position. A probe 48 is attached to the lower end 50 of the current limiting fuse 42. The probe 48 and the probe receiver 52 complete the electrical path between the circuit terminal lugs 36 and 38. For example, current entering lug 36 travels through the upper casing contact 30, the sliding contact 44, the upper current limiting fuse end 46, the fusible element which is not illustrated, the lower current limiting fuse end 50, the probe 48, the probe receiver 52, the lower casing contact 34, the circuit terminal lug 38, and then to the electrical circuit associated therewith.

A more detailed view of the lower portion of the load-break device is shown in FIG. 2. The probe 48 includes an upper portion 54 which is constructed of an electrically conducting material and attached to the lower end 50 of the fuse 42 by the stud 58. The probe 48 also includes a lower portion 56 which is constructed of a suitable electrically insulating material and which is attached to the end 82 of the probe portion 54. A suitable insulating material for the probe portion 56 would be methyl methacrylate with a 20 percent glass filler. The probe 48 is longitudinally shaped, that is having a length dimension substantially greater than its width or depth dimensions. Although other tubular shapes may be used, the probe 48 is normally cylindrically shaped with the lower end 60 of the probe portion 56 tapered to facilitate insertion into the probe receiver 52.

The probe receiver 52 includes a finger contact structure 62 which has springs 64 positioned thereon to maintain contact pressure between the finger contact structure 62 and the conducting probe portion 54. The finger contact structure 62 is threadably engaged with the boss projection 66 from the lower casing terminal 34. The finger contact structure 62 has dimensions which allow the probe 48 to readily engage with the finger contact structure 62 when the fuse assembly 24 is inserted into the fuse casing 26.

An arc-quenching sleeve 68 is positioned around the probe 48. The arc-quenching sleeve 68 is constructed of a suitable insulating material such as methyl methacrylate with a 20 percent glass filler. The arc-quenching sleeve 68 includes a base portion 70 and tubular side portions 72 and 74 which extend from the base portion 70. An opening 75 in the base portion 70 permits the penetration of the probe through the arc-quenching sleeve 68 and allows the arc-quenching sleeve 68 to slide along the probe 48. The outer tubular guide member 76 is attached to the lower fuse end 50 and is constructed of an insulating material. The projections 78 on the guide member 76 keep the probe 48 aligned with the probe receiver 52 when the removable fuse assembly 24 is being inserted into the fuse casing 26. The guide member 76 also includes the projections 80 which limit or stop the sliding movement of the arc-quenching sleeve 68 along the probe 48. The guide member 76 defines the space in which the arc-quenching sleeve 68 slides and, along with the side portions 72 and 74, guide the arc-quenching sleeve 68 through the space defined by the guide member 76 and the probe 48.

When the removable fuse assembly 24 is withdrawn from the fuse casing 26, the probe receiver 52 and the probe 48 become disengaged. While being disengaged under load, an arc usually strikes between the conducting portion 54 of the probe 48 and the contact structure 62. The arc strikes as the end 82 of the conducting portion 54 leaves the top of the contact structure 62. As the probe 48 is disengaged from the probe receiver 52, the arc-quenching sleeve slides along the probe 48 and remains seated substantially on the top of the contact structure 62 due to the force from the spring 84. Thus, the insulated portion 56 of the probe 48 is drawn through the arc-quenching sleeve 68. Therefore, in order for the arc to persist, it must traverse a path between the insulated portion 56 and the arc-quenching sleeve 68. The dimensions of the probe 48 and the arc-quenching sleeve 68 are selected to provide a relatively

tight fit between the arc-quenching sleeve 68 and the probe 48. However, the fit is sufficiently loose to permit satisfactory sliding of the arc-quenching sleeve 68 along the probe 48. In addition to the blocking of the arc path furnished by the arc-quenching sleeve 68, the material of the sleeve 68 contains arc-extinguishing properties which also aid in quenching the arc.

FIG. 3 illustrates the load-break device in the disengaged position. When the probe 48 is completely disengaged from the probe receiver 52, the arc-quenching sleeve 68 is positioned substantially between the conducting portion 54 of the probe 48 and the contact structure 62. Therefore, the path therebetween is effectively blocked, thus any arcing is quenched. In addition, gases generated by an arc before it is quenched by the sliding sleeve 68 are confined to the region containing the spring 84 and thus help slide the sleeve 68 to quench the arc. Therefore, as the intensity of the arc increases, the slide producing force acting on the arc-quenching sleeve 68 is increased. The projections 80 from the guide member 76 limit the movement of the arc-quenching sleeve 68 and prevent ejection of the arc-quenching sleeve 68 from the removable fuse assembly 24 when withdrawn from the fuse casing 26. Although shown in FIGS. 1, 2 and 3 with the probe 48 attached to the fuse 42, it is within the contemplation of this invention that the probe 48, the arc-quenching sleeve 68, and the probe receiver 52 may be interchanged, that is, the probe receiver would be attached to the fuse 42, and the probe 48 with the arc-quenching sleeve 68 therearound would be attached to the lower casing contact 34.

FIG. 4 illustrates another embodiment of this invention. In this embodiment, the probe 48 is attached to the lower casing contact 34 by the stud 86. The probe receiver 52 is attached to the lower fuse end 50 by the stud 88 and by the support member 90. The finger contact 62 and the probe 48 are dimensioned similarly to the same components in FIGS. 1, 2 and 3, and are also constructed of materials as herebefore described. The arc-quenching sleeve 92 is constructed of an electrically insulating material such as methyl methacrylate with a 20 percent glass filler. The arc-quenching sleeve 92 includes a base portion 94 with an opening 96 therein through which the probe 48 extends. Tubular side portions 98 and 100 extend axially from the base portion 94 and aid in guiding the arc-quenching sleeve 92 along the probe 48. The strap 102 is attached to the arc-quenching sleeve 92 and to the lower casing contact 34 to limit the distance the arc-quenching sleeve 92 can slide along the probe 48. When the probe 48 and the probe receiver 52 are completely disengaged, the base portion 94 of the arc-quenching sleeve 92 is positioned substantially even with the tapered end 60 of the insulated probe portion 56. In this position, the tubular side portion 98 blocks the arc path between the contact structure 62 and the conducting portion 54, thus the arc is quenched.

Bypass grooves 104 on the outside of the conducting portion 54 of the probe 48 allow arc generated gases to flow into the region occupied by the spring 106 to aid the sliding force provided by the spring 106. The spring 106 is shown in FIG. 4 in a compressed state. It is also within the contemplation of this invention that, in all of the embodiments disclosed herein, the insulated probe portion, such as the probe portion 56, may be con-

structed of a member having an insulating layer or coating disposed thereon.

The invention disclosed herein may also be used with elbow-type cable connectors which are used in applications where connector space is limited, such as in underground power distribution systems. FIG. 5 illustrates an elbow-type connector having a body member 108 with a tubular opening 110 therein. The flange 112 protrudes from the body member 108 and is attached to the apparatus casing 114 by the bolts 116 and by the ring 118. The body member 108 is constructed of an insulating material such as an epoxy resin. An electrical terminal 120 is positioned at the lower end of the tubular opening 110 and provides an electrical connection point for connecting the lower end of the body member 108 to the associated electrical circuit.

The removable connector assembly 122 contains a tubular opening 124 therein which is dimensioned to fit over the upper portion 126 of the body member 108. The body of the removable connector assembly 122 is constructed of an elastomeric material. The detent 128 locks the removable connector assembly 122 to the body member 108 when the connector is engaged to provide a current path.

A cable connecting member 130 is contained within the body of the removable connector assembly 122 and provides means for electrically connecting a conducting cable to the probe receiver 131. The finger contact structure 132 is attached to the cable connecting member 130 by the stud 134. The probe 136 includes an insulating portion 138 and a conducting portion 140 which are joined together at the junction 142. The conducting portion 140 is attached to the terminal 120 by the stud 144 and has a smaller diameter below the shoulder 146 than above the shoulder 146.

A tubular arc-quenching sleeve 148 having a tubular opening 150 therethrough is positioned around the probe 136. The arc-quenching sleeve 148 is constructed of a suitable insulating material, preferably of a material which exhibits arc-extinguishing properties. The opening 150 is dimensioned to slide closely over the part of the conducting portion 140 which is located above the shoulder 146 and over the insulating portion 138. Resilient means, such as the compressed spring 152, moves the arc-quenching sleeve 148 along the probe 136 when the connector assembly 122 is being removed. The ring 154 limits the movement of the arc-quenching sleeve 148 by stopping the upward movement of the arc-quenching sleeve 148 when the ring 154 contacts the shoulder 146.

Operation of the arc-quenching sleeve 148 is similar to the operation described herein concerning the other embodiments of this invention. Briefly, as the connector assembly 122 is removed, the probe 136 disengages from the probe receiver 131. While disengaging, the arc-quenching sleeve 148 slides across the junction 142 and blocks the path of any arc occurring between the conducting portion 140 and the finger contact structure 132. The inside wall of the tubular opening 110 provides guidance for the arc-quenching sleeve 148 when it is below the shoulder 146. Grooves, such as the groove 156, exist on the surface of the conducting portion 140 to allow generated gases to flow into the region containing the spring 152. An added advantage of this embodiment is that the conducting portion 140 is not exposed when the connector assembly 122 is re-

moved. Thus, accidental contact with a potential on the conducting portion 140 is substantially eliminated.

By using the embodiments of this invention as disclosed herein, the rating of load-break connectors and fuse assemblies may be increased economically. Since numerous changes may be made in the above described apparatus and different embodiments of the invention may be made without departing from the spirit thereof, it is intended that all of the matter contained in the foregoing description, or shown in the accompanying drawings, shall be interpreted as illustrative rather than limiting.

I claim as my invention:

1. Electrical load-break apparatus comprising longitudinal probe means having first and second ends, probe receiver means which is engagable with said longitudinal probe means, an arc-quenching sleeve having an opening therein through which said probe means extends, resilient means which moves said arc-quenching sleeve along said probe means when said probe means and said probe receiver means are being disengaged, means for confining any arc generated gases which travel through the opening in said arc-quenching sleeve, said confinement of gases aiding the resilient means in the movement of said arc-quenching sleeve, and limit means which limits the distance said arc-quenching sleeve moves along said probe means when said probe means and said probe receiver means are being disengaged.

2. The electrical load-break apparatus of claim 1 wherein the longitudinal probe means comprises first and second portions, said first portion being constructed of an electrically conducting material and forming the first end of the probe means, said second portion being constructed of an electrically insulating material and forming the second end of the probe means.

3. The electrical load-break apparatus of claim 2 wherein the first and second portions of the longitudinal probe means are attached to each other with the second portion of the probe means positioned to penetrate the probe receiver means before the first portion of the probe means when the probe means and the probe receiver means are being engaged.

4. The electrical load-break apparatus of claim 2 wherein the arc-quenching sleeve is positioned, when the probe means and the probe receiver means are disengaged, at a location which is substantially between the first portion of the probe means and the probe receiver means.

5. The electrical load-break apparatus of claim 2 wherein the first portion of the longitudinal probe means contains bypass means which allows gases formed during arcing to flow through the opening in the arc-quenching sleeve and into the region occupied by the resilient means.

6. The electrical load-break apparatus of claim 1 wherein the resilient means provides a force acting on the arc-quenching sleeve, said force acting in a direction which is oriented toward the second end of the probe means.

7. The electrical load-break apparatus of claim 1 including guide means which guides the arc-quenching sleeve along the probe means.

8. Electrical load-break apparatus comprising a tubular casing having first and second ends, said first casing end having terminal means thereon, said second casing

end having an opening thereat, a removable fuse assembly insertable through the opening at said second casing end, probe receiver means including contact means electrically connected to the first casing end, said fuse assembly comprising a shaft member, a fuse member having first and second ends, said first fuse end being attached to said shaft member and to contact means, probe means comprising a longitudinal electrically conducting member having first and second ends, a longitudinal electrically insulating member having first and second ends, the first ends of said conducting and insulating members being attached to each other, the second end of said conducting member being connected to the second end of said fuse member, said conducting and insulating members being dimensioned to permit penetration into the contact means of said probe receiver, an arc-quenching sleeve having a base portion with an opening therein and side portions extending therefrom, said probe means extending through the opening in said arc-quenching sleeve, resilient means providing a force on the base portion of said arc-quenching sleeve which acts in a direction away from the second fuse end, means for confining any arc generated gases which travel through the opening in said arc-quenching sleeve, said confinement of gases aiding the force provided by said resilient means, and limit means which stops the movement of said arc-quenching sleeve along the probe means.

9. Electrical load-break apparatus comprising a tubular casing having first and second ends, said first casing end having terminal means thereon, said second casing end having an opening thereat, a removable fuse assembly insertable through the opening at said second casing end, said fuse assembly comprising a shaft member, a fuse member having first and second ends, probe receiver means including contact means electrically connected to the second end of said fuse member, probe means comprising a longitudinal electrically conducting member having first and second ends, a longitudinal electrically insulating member having first and second ends, the first ends of said conducting and insulating members being attached to each other, said second end of said conducting member being connected to said terminal means at the first casing end, said conducting and insulating members being dimensioned to

permit penetration into the contact means of said probe receiver, an arc-quenching sleeve having a base portion with an opening therein and a tubular side portion extending axially from said base portion, said probe means extending through the opening in said arc-quenching sleeve, resilient means providing a force on the base portion of said arc-quenching sleeve which acts in a direction away from said terminal means at the first casing end, means for confining any arc generated gases which travel through the opening in said arc-quenching sleeve, said confinement of gases aiding the force provided by said resilient means, and limit means which limits the movement of said arc-quenching sleeve along the probe means.

10. Electrical load-break apparatus comprising a body member having first and second ends and mounting means thereon, said first body member end having terminal means thereat, said second body member end having an opening thereat, a removable connector assembly comprising cable connector means, probe receiver means including contact means electrically connected to said cable connector means, said probe receiver means being insertable through the opening at said second body member end, probe means comprising a longitudinal electrically conducting member having first and second ends, a longitudinal electrically insulating member having first and second ends, the first ends of said conducting and insulating members being attached to each other, the second end of said conducting member being connected to said terminal means at the first body member end, said conducting and insulating members being dimensioned to permit penetration into the contact means of said probe receiver means, a tubular arc-quenching sleeve having an opening therein, said probe means extending through the opening in said arc-quenching sleeve, resilient means providing a force on said arc-quenching sleeve which acts in a direction away from said terminal means at the first body member end, means for confining any arc generated gases which travel through the opening in said arc-quenching sleeve, said confinement of gases aiding the force provided by said resilient means, and limit means which limits the movement of said arc-quenching sleeve along the probe means.

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