June 6, 1939. H. A. TRIPLETT ET AL 2,160,926

CIRCUIT INTERRUPTER HOUSING

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Fig. 1.

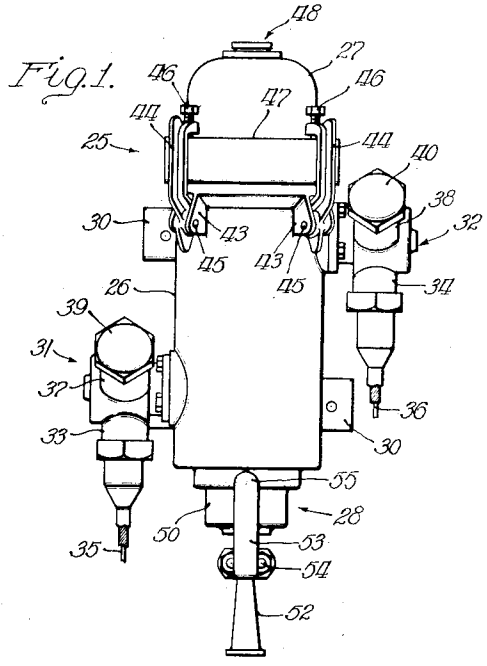


Fig. 2.

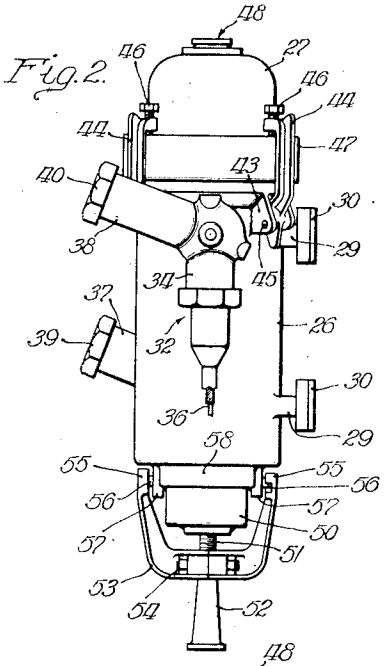


Fig. 3.

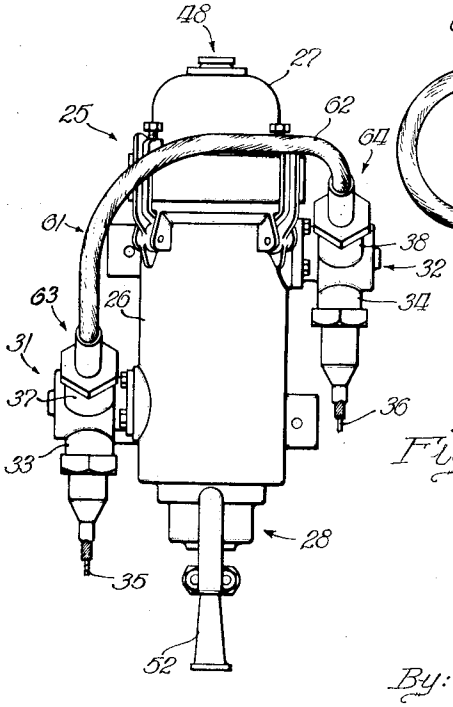
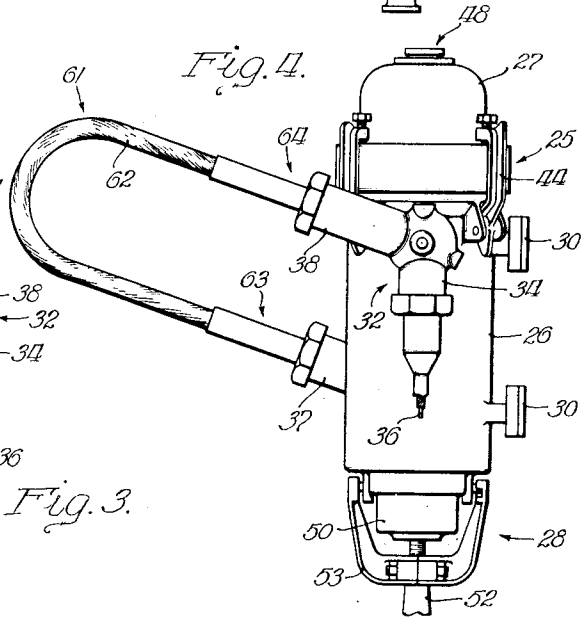


Fig. 4.



Inventors:
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By: Pierce, Scheffler & Parker

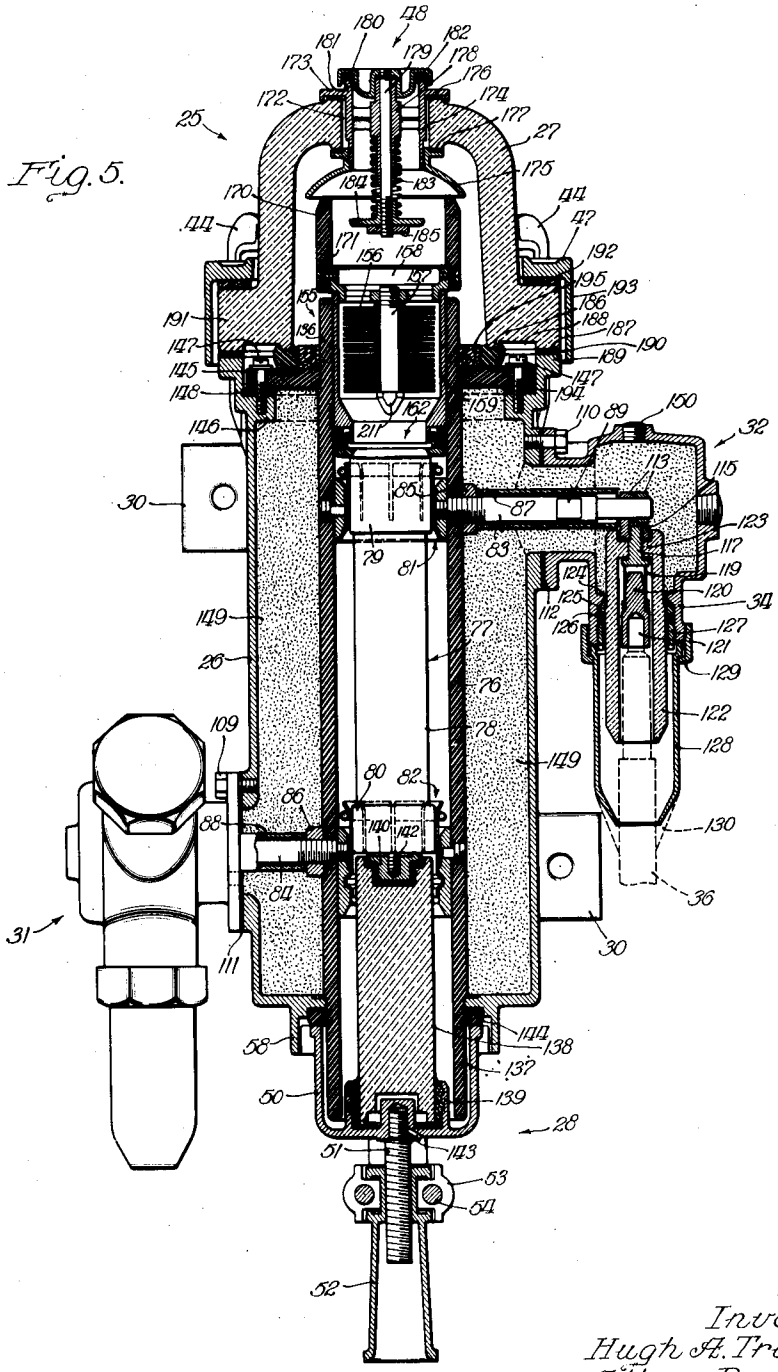
Attys.

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CIRCUIT INTERRUPTER HOUSING

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Fig. 5.



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CIRCUIT INTERRUPTER HOUSING

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Fig. 6.

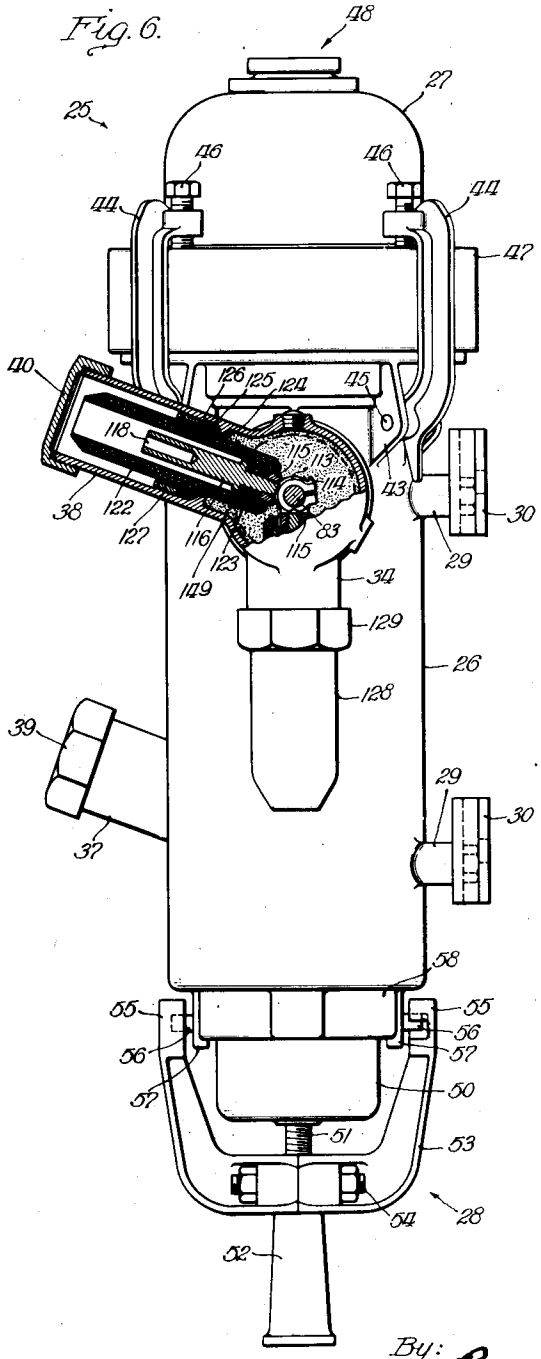


Fig. 7.

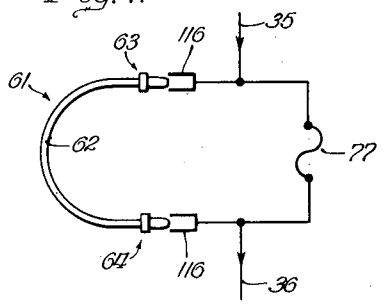
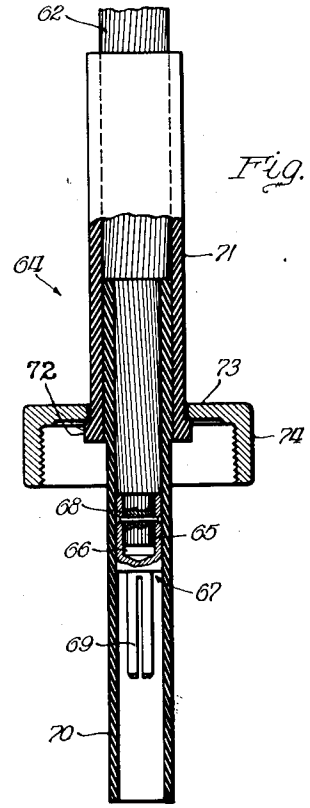


Fig. 8.



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June 6, 1939. H. A. TRIPLETT ET AL 2,160,926

CIRCUIT INTERRUPTER HOUSING

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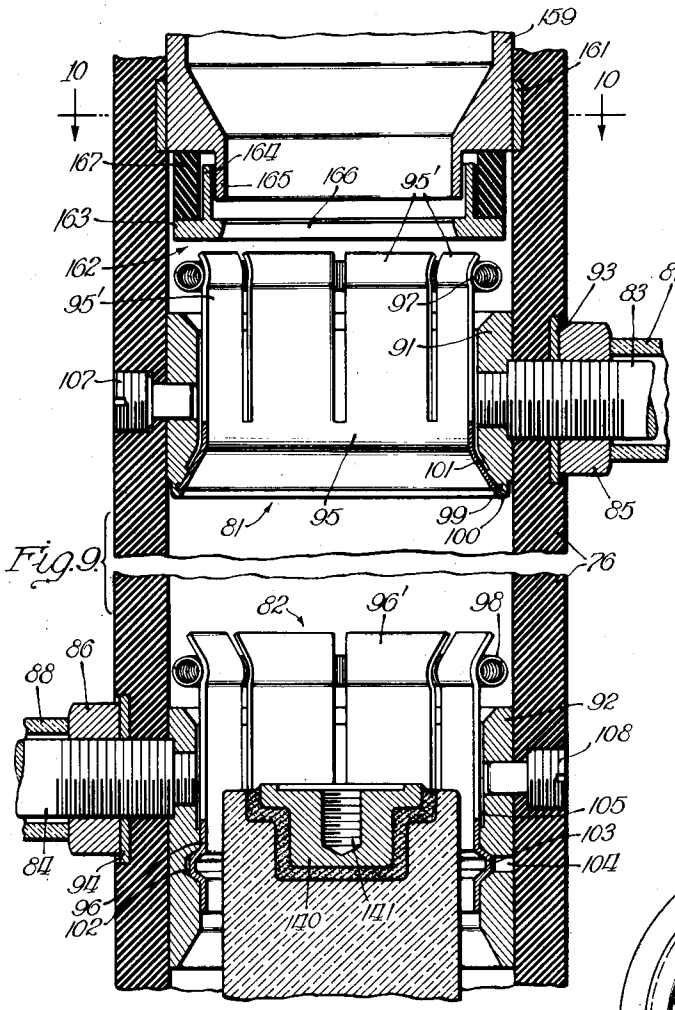


Fig. 9.

Fig. 11.

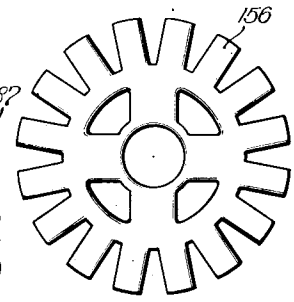


Fig. 12.

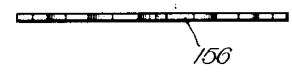


Fig. 13.

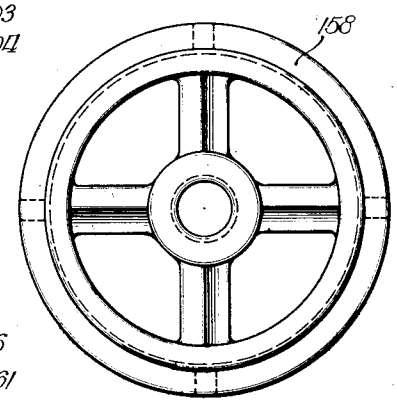
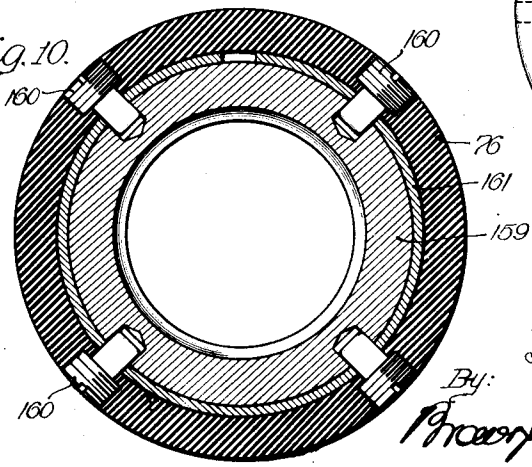


Fig. 10.



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CIRCUIT INTERRUPTER HOUSING

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Fig. 14.

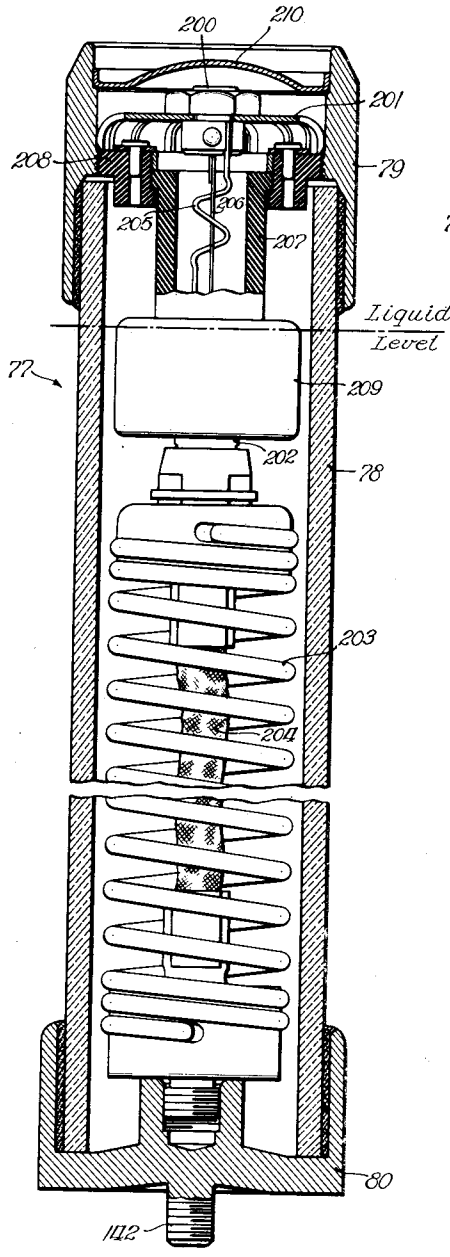
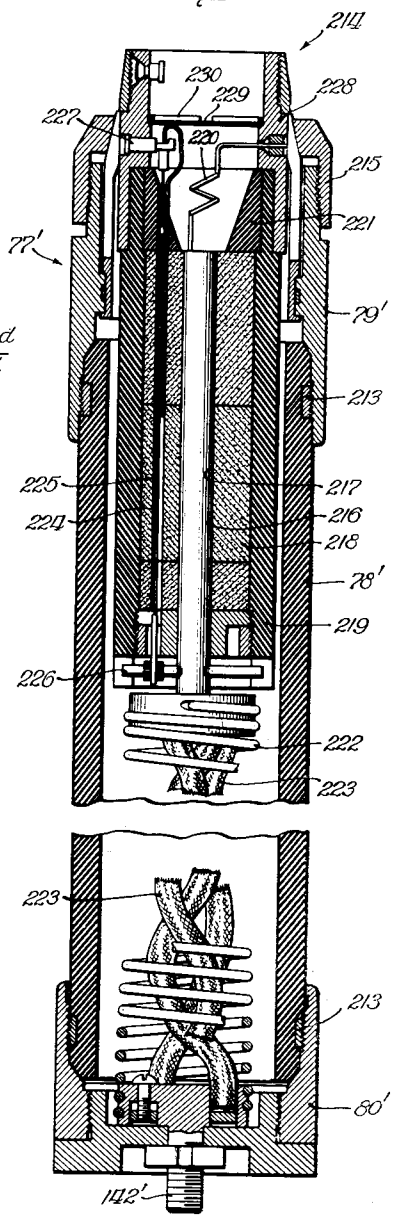


Fig. 15.



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June 6, 1939. H. A. TRIPLETT ET AL 2,160,926

CIRCUIT INTERRUPTER HOUSING

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Fig. 16.

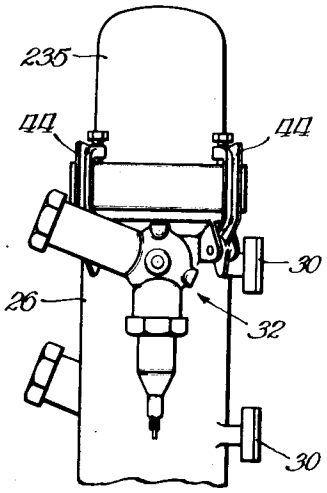


Fig. 18.

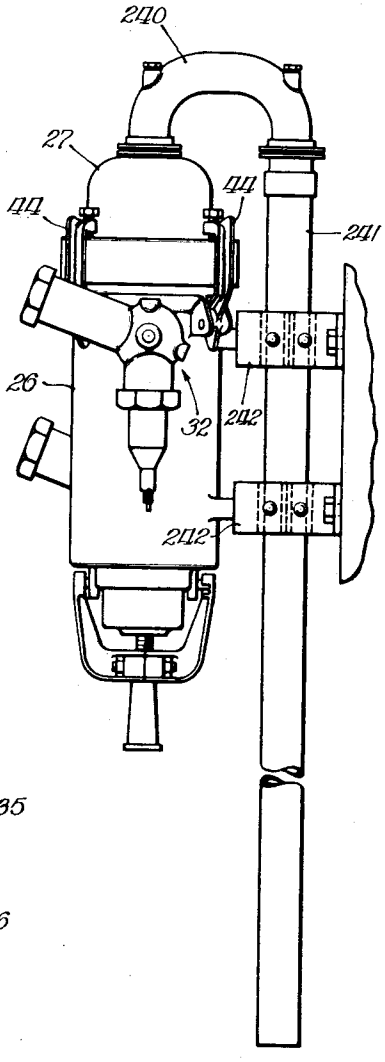
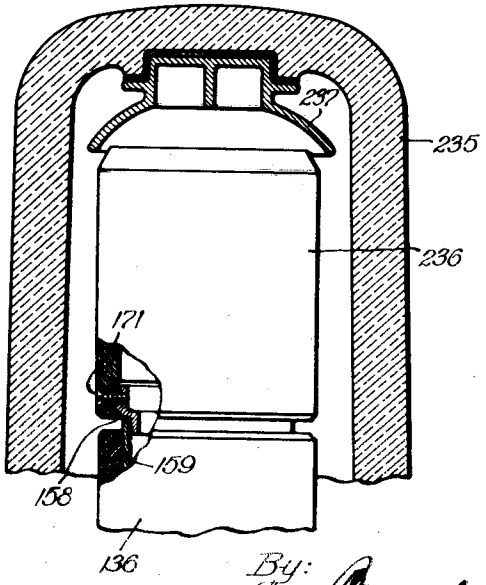


Fig. 17.



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June 6, 1939. H. A. TRIPLETT ET AL 2,160,926

CIRCUIT INTERRUPTER HOUSING

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Fig. 19.

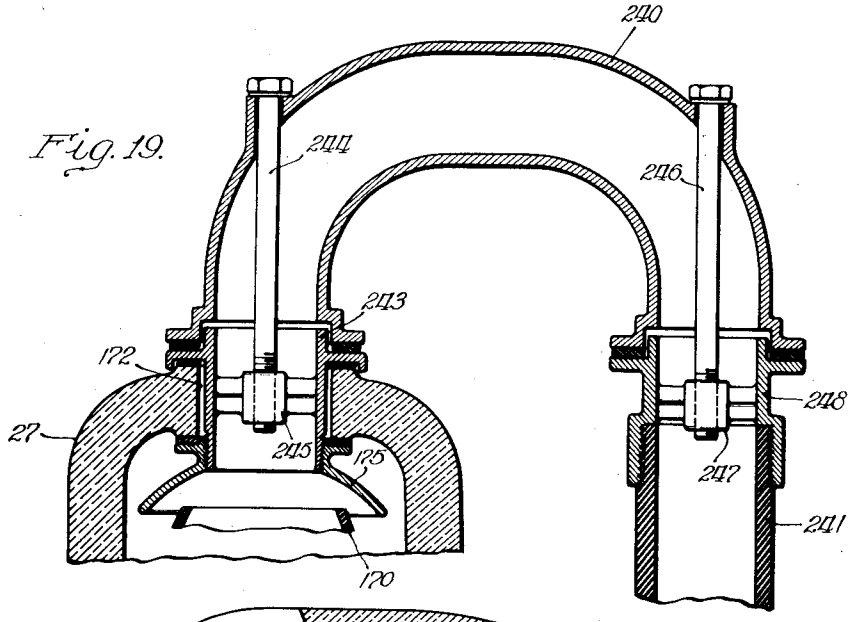
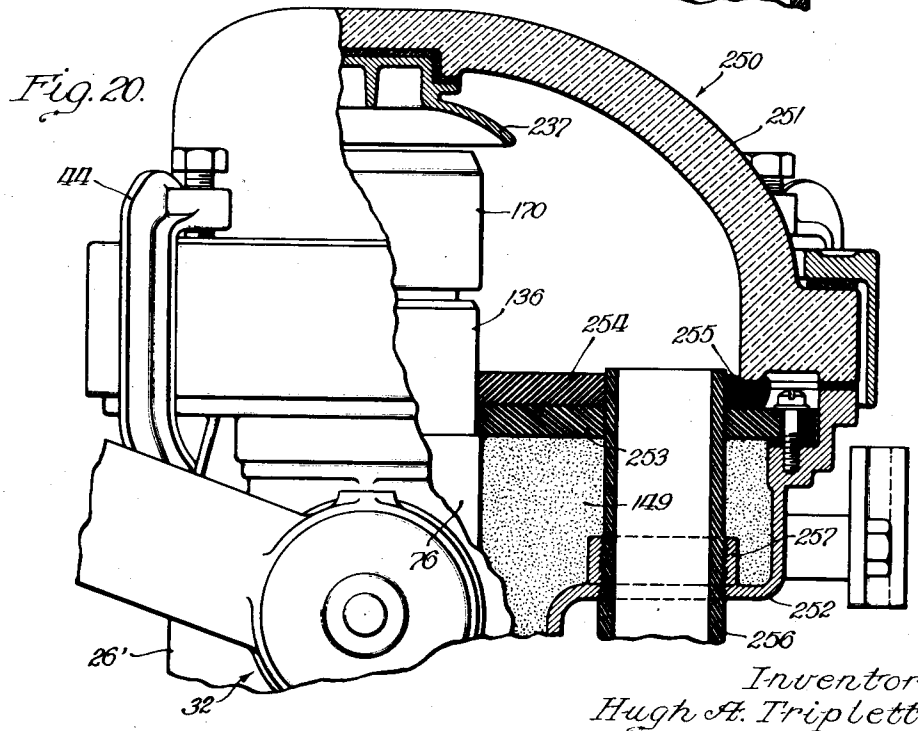


Fig. 20.



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CIRCUIT INTERRUPTER HOUSING

Filed April 30, 1937 8 Sheets-Sheet 8

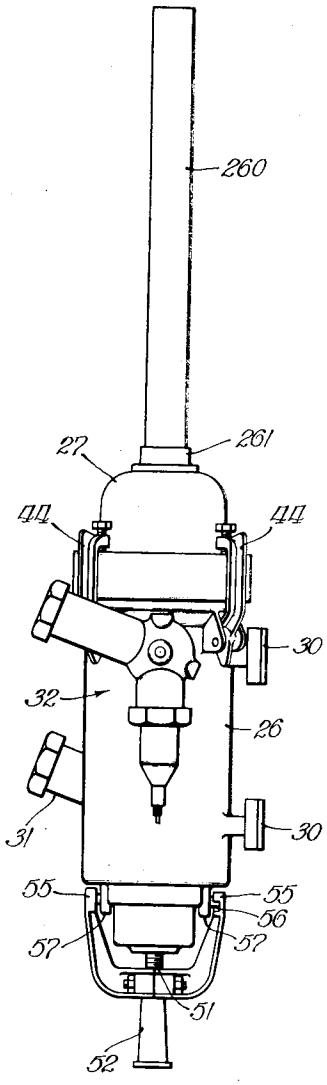


Fig. 21.

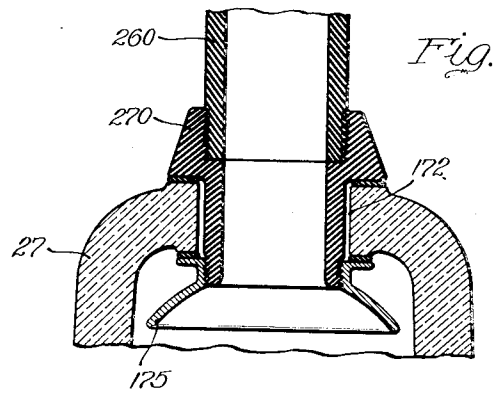


Fig. 23.

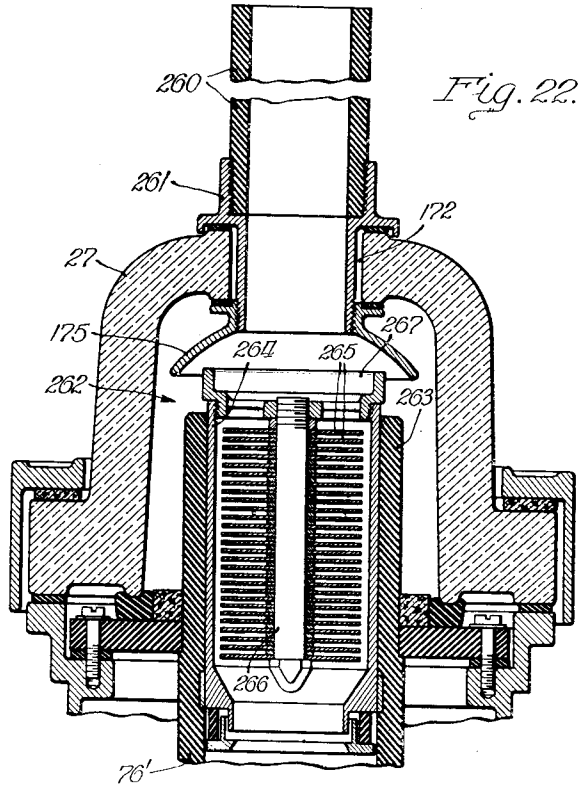


Fig. 22.

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UNITED STATES PATENT OFFICE

2,160,926

CIRCUIT INTERRUPTER HOUSING

Hugh A. Triplett, Wilmette, and Allan Ramsey, Evanston, Ill., assignors to Schweitzer & Conrad, Inc., Chicago, Ill., a corporation of Delaware

Application April 30, 1937, Serial No. 139,852

75 Claims. (Cl. 200—120)

Our invention relates, generally, to electric circuit interrupters and it has particular relation to housings for circuit interrupters of the blast action arc extinguishing type.

With the widespread development of underground cable systems for the distribution of electric power at high voltage, such as 4000 to 5000 volts, there has been a demand for circuit interrupters, such as fuse cutouts, for protecting them against short circuits and overloads. Since the cables are run underground and the cutouts must be likewise installed for operation underground, for practical reasons, certain problems have arisen, the solution of which has not been free from difficulty.

One of the problems has been the development of a circuit interrupter that will open the circuit automatically, either under various overload conditions or under short circuit conditions with a minimum of disturbance. This situation has been met through the use of circuit interrupters of the blast action arc extinguishing type, such as disclosed in the pending application of Conrad, Serial No. 470,416, filed July 24, 1930, now Patent No. 2,091,430, and in the application of Triplett, one of the joint inventors of the invention disclosed herein, Serial No. 85,700, filed June 17, 1936, both of which applications are assigned to the assignee of this application. In these circuit interrupters the arc caused by melting of the fusible means is subjected to a blast action by an arc extinguishing medium which is created by the heat of the arc. Interrupters of this type are now constructed in different forms, the particular embodiments mentioned being for illustrative purposes only.

Another problem that has been encountered has been the provision of a suitable housing for a circuit interrupter intended for operation under these circumstances. The solution of this problem has been made difficult because of the requirement that the circuit interrupter be mounted under-ground where it may be subjected to damp conditions or, in many cases, partly or totally submerged. The matter has been further complicated when circuit interrupters of the blast action arc extinguishing type are employed because of the rapid evolution of large quantities of gas from the arc extinguishing media that are employed in deionizing and putting out the arc. The circuit interrupter must be so housed that its operating characteristics will be unaffected by its being mounted in a damp location or even submerged and yet it must be adapted to take care in one way or another of the large quantities of gas that are evolved on operation of the device.

Another requirement is that the circuit interrupter be readily replaceable as a unit, either for testing purposes or for renewing it once it has operated. This means that special precautions must be taken, first to adequately insulate the parts that are employed for effecting the replacement, and second to maintain the water tight integrity of the housing once the circuit interrupter has been replaced.

It is to the construction of such a housing in a manner tnat the products of the arc will be properly disposed of and its water tight integrity be maintained that our invention, as disclosed herein, is particularly directed.

The object of our invention, generally stated, is to provide a housing for a circuit interrupter of the blast action arc extinguishing type that will be simple in construction and which may be readily and economically manufactured and installed.

An important object of our invention is to provide for housing a high voltage circuit interrupter of the blast action arc extinguishing type in such manner that it may be installed in damp locations or even submerged.

An object of our invention is to provide for venting a housing in which a circuit interrupter of the blast action arc extinguishing type is mounted to dispose of the products of the arc that are evolved when the interrupter operates.

Another important object of our invention is to provide for automatically venting a fluid tight housing containing a circuit interrupter of the blast action arc extinguishing type on operation thereof.

A further object of our invention is to provide for shunting a circuit interrupter mounted in a fluid tight casing.

Still another object of our invention is to provide for removably mounting a circuit interrupter of the blast action arc extinguishing type in a fluid tight metal casing or tank which is adapted to be grounded.

Another important object of our invention is to seal an expansion chamber formed of insulating material, such as glazed porcelain, to a housing supporting a circuit interrupter of the blast action arc extinguishing type in such manner that ingress of moisture from outside of the housing is prevented and egress of the products of the arc is also prevented.

An ancillary object of our invention is to pro-

vide an improved terminal construction for a fluid tight housing to permit connection to a high voltage circuit interrupter mounted therein.

Still another object of our invention is to provide for removably mounting a circuit interrupter, such as a fuse of the blast action arc extinguishing type, inside of an insulating sleeve with its terminals in contact engagement with terminals inside of the sleeve and to provide for external connection thereto.

Another object of our invention is to provide for automatically adjusting the connection between a replaceable circuit interrupter of the blast action arc extinguishing type and a condenser adapted to receive and cool the products of the arc that are formed on operation of the circuit interrupter.

Another important object of our invention is to provide a fluid tight non-ventable housing for a circuit interrupter of the blast action arc extinguishing type.

Another object of our invention is to provide improved construction for venting the interior of a housing for circuit interrupters of the blast action arc extinguishing type that are arranged to be mounted in locations where they may be subjected to damp conditions or may be partly or entirely submerged.

Other objects of our invention will, in part, be obvious and in part appear hereinafter.

Accordingly, our invention is disclosed in the embodiments hereof shown in the accompanying drawings and it comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the constructions hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of our invention reference may be had to the following detailed description, taken in connection with the accompanying drawings, in which:

Figure 1 is a view, in front elevation, of a circuit interrupter housing constructed in accordance with our invention;

Figure 2 is a view, in side elevation, of the circuit interrupter housing shown in Figure 1;

Figure 3 is a view, similar to Figure 1, showing how the terminals of the circuit interrupter housing may be shunted;

Figure 4 is a view, in side elevation, of the circuit interrupter housing and shunt connection shown in Figure 3;

Figure 5 is a longitudinal sectional view, on an enlarged scale, of the circuit interrupter housing shown in Figures 1 through 4, a circuit interrupter of the blast action arc extinguishing type being shown in operative position therein;

Figure 6 is a view, in side elevation, of the housing shown in Figure 5, certain parts being shown in section in order to illustrate more clearly the terminal housing construction;

Figure 7 illustrates diagrammatically the circuit connections that are employed in practicing our invention;

Figure 8 is a longitudinal sectional view, showing the preferred construction of the plug terminal for the shunt conductor;

Figure 9 is an enlarged fragmentary longitudinal sectional view of the fuse housing shown in Figure 5, the various parts being shown in the positions that they occupy when the circuit interrupter is in position, but with the circuit interrupter omitted in order to more clearly illustrate the relationship of the various parts;

Figure 10 is a detail sectional view taken along the line 10—10 of Figure 9;

Figure 11 is a view, in top plan, of one of the condenser plates;

Figure 12 is a view, in side elevation, of the condenser plate shown in Figure 11;

Figure 13 is a view, in top plan, of the condenser holder;

Figure 14 is a view, partly in side elevation and partly in section, showing a circuit interrupter of the liquid arc extinguishing type, such as disclosed in the copending application of Conrad, Serial No. 470,416; referred to hereinbefore, which may be employed in the housing shown in certain of the preceding figures;

Figure 15 is a view, partly in side elevation and partly in section showing a circuit interrupter of the solid material arc extinguishing type, such as shown in the copending application of Triplett, Serial No. 85,700, referred to hereinbefore, which may also be employed in the housings shown in the preceding figures;

Figure 16 is a fragmentary view, in side elevation, of a circuit interrupter housing with which a non-ventable insulated expansion chamber is employed;

Figure 17 is a fragmentary view at an enlarged scale partly in side elevation and partly in section, showing the construction of the expansion chamber and its associated parts that may be employed in the construction shown in Figure 16;

Figure 18 is a view, in side elevation, of a circuit interrupter housing of the type herein described that is arranged to be vented downwardly;

Figure 19 is a sectional view, at an enlarged scale, of a portion of the expansion chamber as shown in Figure 18 and the connections thereto for venting it downwardly;

Figure 20 is a view, partly in side elevation and partly in section, showing a modified form of expansion chamber and connections thereto for venting it downwardly;

Figure 21 is a view, in side elevation, of a housing for a circuit interrupter of the type herein described that is arranged for venting upwardly;

Figure 22 is a sectional view, at an enlarged scale, of the expansion chamber and associated parts, shown in Figure 21; and

Figure 23 is a fragmentary sectional view of a modified form of mounting for the vent pipe shown in Figure 22.

Referring now particularly to Figures 1 and 2 of the drawings, it will be observed that the reference character **25** designates, generally, a housing for a circuit interrupter of the blast action arc extinguishing type that is constructed in accordance with the present invention. The housing **25** includes a casing or tank **26**, a dome or expansion chamber **27** and a handle assembly, shown generally at **28**, for removably mounting the circuit interrupter therein. As will hereinafter appear, different types of circuit interrupter may be employed in the housing **25**. It will also be presently apparent that this housing is particularly adapted for mounting underground where damp conditions may prevail or where the system may be partly or entirely submerged.

The tank **26** is preferably formed of cast iron and it has integrally formed therewith bosses **29** on the rear side to which apertured brackets **30** may be bolted, or otherwise secured, for mounting

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the housing 25 in operative position, such as on the wall of a vault or manhole. Ordinarily, the tank 26 will be grounded to reduce operating hazards but there may be some cases where grounding is not desired.

In order to provide for external connection to the circuit interrupter that is mounted inside of the housing 25, left and right hand terminal housings 31 and 32 are provided and secured to opposite sides of the metal tank 26, as illustrated. The terminal housings 31 and 32 are preferably formed of cast iron and each is provided with a conductor receiving sleeve 33 and 34, respectively, integrally formed therewith, for receiving line conductors 35 and 36. It will be understood that the line conductors 35 and 36 are provided with suitable insulating coverings and that they will ordinarily be provided with outside sheaths of metal, such as lead, and that they may be suitably connected into the housings 31 and 32 in a manner that will presently be set forth.

In certain instances it is desirable to shunt the circuit interrupter inside of the housing 25 so that it may be removed for inspection or otherwise while still maintaining power flow between the conductors 35 and 36. For this purpose the terminal housings 31 and 32 are provided with additional sleeves 37 and 38 that are cast integrally therewith and angularly spaced from the sleeves 33 and 34 as illustrated. Normally these sleeves 37 and 38 will not be in use and threaded covers 39 and 40 are provided for closing the open ends thereof.

While the expansion chamber 27 is shown and described herein as being preferably formed of glazed poreclain, it will be apparent that it could be formed partly or wholly of metal. A metal expansion chamber is shown in Patent 2,091,423 to Triplett which issued August 31, 1937, on an application filed October 28, 1932. Another type of metal expansion chamber is shown in Patent 2,091,424 to Triplett, issued August 31, 1937, on an application filed May 13, 1933. Both of these patents are assigned to the assignee of this application, were copending with the same, and are referred to in more detail hereinafter. Thus, whether the expansion chamber 27 is formed entirely of insulating material or is formed of metal and suitably insulated, an insulated expansion chamber is provided for receiving the products of the arc that is formed on blowing of the fusible element of the circuit interrupter.

For the purpose of holding the expansion chamber 27, which is preferably formed of glazed porcelain, onto the upper end of the metal tank 26, the latter is provided with four pairs of ears 43 that are cast integrally therewith for receiving C-shaped clamps 44 on suitable pins 45 therebetween. Cap screws 46 are threaded in the upper ends of the C-shaped clamps 44 for holding a clamp ring 47, having an inverted L-shaped section in position. It will be understood that, when the cap screws 46 are unscrewed, the clamps 44 may be rotated about the pins 45 and out of the way of the clamp ring 47 so that it may be readily lifted off of the expansion chamber 27 to permit its removal.

In order to automatically vent the interior of the housing 25 to the atmosphere on operation of the circuit interrupter of the blast action arc extinguishing type mounted therein, a valve, shown generally at 48, is provided in the expansion chamber 27. The details of construction of the valve 48 will be set forth hereinafter. While it is desirable in many instances to employ the valve 48 for venting the housing 25, it will be understood that the valve 48 may be omitted in certain constructions with the expansion chamber 27 either completely closed to the atmosphere and and non-ventable or with it vented to the atmosphere with a suitable vent pipe extending either above or below the housing 25 as the case may be.

The handle assembly 28 for removably mounting the circuit interrupter inside of the housing 25 comprises a handle shell 50, composed preferably of cast iron, that is adjustably held in position by a stud 51 having a left hand thread which is secured therein, as will hereinafter appear, and which cooperates with a correspondingly threaded handle 52. The handle 52 is rotatably mounted in a two part bail 53, the two parts of which are held together by bolts 54. The ends 55 of the parts of the bail 53 are provided with oppositely facing hook-shaped portions that interfit with pins 56 carried by and extending outwardly from bosses 57 that are integrally formed with a depending flange 58 from the metal tank 26. When the handle 52 is rotated in a counterclockwise direction, as viewed from underneath the housing 25 to release the handle shell 50 and to withdraw the circuit interrupter carried thereby from contact clips in the housing, the hook-shaped ends 55 of the bail 53 are also released from the pins 56 and the bail then may be rotated in a clockwise direction, as viewed from underneath the housing 25, to permit removal of the handle assembly 28 and the circuit interrupter carried thereby. Further, description of the withdrawal of the circuit interrupter from the contact clips will be set forth hereinafter.

The conductors 35 and 36 may be directly interconnected and the circuit interrupter in the housing 25 shunted by the shunt connector, as shown generally at 61 in Figures 3 and 4 of the drawings. The shunt connector 61 comprises an insulated flexible cable 62 having terminal assemblies 63 and 64 at its ends. In order to connect the shunt connector 61 the covers 39 and 40 are removed from the sleeves 37 and 38 to expose socket terminals, the construction of which will be described hereinafter.

In Figure 8 of the drawings the details of construction of one of the terminal assemblies 64 are shown. As there shown the strands 65 of the cable 62 are inserted in a socket 66 of a plug contact member, shown generally at 67. The strands 65 are soldered into the socket 66 and a pin 68 is then inserted, as shown, for further securing the strands 65 in position. A plurality of spring fingers 69 is integrally formed with the plug contact member 67, as by providing saw cuts at right angles to each other in the plug end to provide spring contact engagement with a suitable plug. A portion of the insulation of the flexible cable 62 is removed to permit the positioning thereon of a sleeve 70 formed of a suitable insulating material, such as "Bakelite". Another sleeve 71, formed of like material, is telescoped over the sleeve 70 and over the insulation of the flexible cable 62. The sleeve 71 is provided with a radial flange 72 for interfitting with an inwardly extending radial flange 73 of a clamp nut 74. It will be understood that the clamp nut 74 may be threaded onto the sleeve 38, for example, on the same threads from which the cover 40 is removed.

The details of the internal construction of the housing 25 are illustrated more clearly in Figure 5 of the drawings to which reference will now be

had. As shown, the tank 26 has mounted therein and coaxially therewith a sleeve or insulator 76 which is adapted to receive a circuit interrupter of the blast action arc extinguishing type, shown generally at 77. The circuit interrupter 77 may be of the types shown in Figures 14 and 15 of the drawings or it may be of any other suitable type. The circuit interrupter 77 includes a housing or sleeve 78 having terminal furrules 79 and 80 at its ends. The ferrules 79 and 80 are arranged to have contact engagement with upper and lower contact clip assemblies, shown generally at 81 and 82, respectively. External connection to the contact clips 81 and 82 is provided by connector studs 83 and 84 which extend, as shown, radially outwardly through the opposite sides of the sleeve or insulator 76. Lock nuts 85 and 86 are provided on the threaded inner ends of the connector studs 83 and 84 for holding them in position. Sleeves 87 and 88, formed of suitable insulating material such as glass, porcelain, or "Bakelite", surround the connector studs 83 and 84 intermediate their ends for insuring insulation thereof from the metal tank 26 and the terminal housings 31 and 32. Each of the connector studs 83 and 84 may be provided with slabbed off portions, such as shown at 89 on the stud 83, on opposite sides to permit the use of a wrench in assembling these studs.

The details of construction of the upper and lower contact clips 81 and 82 and the assembly thereof in the sleeve or insulator 76 are shown more clearly in Figure 9 of the drawings. Each of the contact clips 81 and 82 includes a contact ring 91 and 92. These rings 91 and 92 are of such external diameter that they snugly fit in the inner bore of the sleeve or insulator 76. The inner ends of the connector studs 83 and 84 are positioned in suitably threaded apertures, as shown. When the lock nuts 85 and 86 are tightened on the washers 93 and 94, the contact rings 91 and 92 are securely held in position. Secured to each of the contact rings 91 and 92 is a contact clip shell 95 and 96, respectively. Each of the contact clip shells 95 and 96 has integrally formed therewith a plurality of spring fingers 95' and 96' which are suitably curved to have contact engagement with the ferrules 79 and 80 of the circuit interrupter 77, shown in Figure 5 of the drawings. It may not be desirable to depend solely upon the spring fingers of the contact clip shells 95 and 96 for the entire contact pressure with the ferrules 79 and 80. Accordingly, garter springs 97 and 98, in the form of coil tension springs, are provided around the outwardly curved upper ends of the contact fingers 95' and 96' to insure suitable contact pressure.

With a view to providing contact engagement between contact clip shell 95 and the contact ring 91, to support the former securely on the latter, and to provide a maximum degree of flexibility for the contact fingers 95' and 96', the shell 95 is provided with an outwardly radially extending flange 99 at its lower end and a depending flange 100 from the contact ring 91 is rolled over the flange 99, as shown. After the rolling operation has been completed the shell 95 is sweated to the contact ring 91. It will be observed that the internal surface of the contact ring 91 is so formed that a space 101 is left between it and the fingers of the contact clip shell 95. This construction affords a high degree of flexibility for the contact fingers 95' so that they will be freely movable into contact engagement with the upper ferrule 79 of the circuit interrupter 77.

The contact clip shell 96 is secured to the contact ring 92 by the provision therein of a circumferential groove 102 into which a portion 103 of the skirt of the contact clip shell 96 is rolled. An aperture 104 extends through the contact ring 92 and into the groove 102. As shown a slight space is left between the portion 103 and the bottom of the groove 102 for receiving molten solder through the aperture 104 to sweat the contact clip shell 96 securely to the contact ring 92. Flexibility of the contact fingers 96' is insured by the provision of the space 105 between them and the upper portion of the contact ring 92.

Since the clip shells 95 and 96 are secured to or adjacent the lower edges of the contact rings 91 and 92 and the contact fingers 95' and 96' extend through and slightly beyond them, a relatively long free length of contact finger is available within a relatively small overall length of contact clip. This is important when it is recalled that space is at a premium within the housing 25.

The contact rings 91 and 92 are further secured inside of the sleeve or insulator 76 by dog point set screws 107 and 108. As shown these set screws 107 and 108 are positioned in suitably threaded apertures in the wall of the sleeve or insulator 76 and the dog points thereof extend into suitable apertures in the contact rings 91 and 92. Since the contact rings 91 and 92 fit snugly inside of the sleeve or insulator 76 the two point suspension thereof is all that is required to hold them in proper relation while the circuit interrupter 77 is being inserted or removed.

As shown in Figure 5 of the drawings, the terminal housings 31 and 32 are secured to opposite sides of the metal tank 26 by cap screws 109 and 110, suitable gaskets 111 and 112 being interposed therebetween to provide a fluid tight joint. Since the terminal construction inside of each of the housings 31 and 32 is the same, a detailed description of one of them will suffice. For this purpose reference may be had to Figures 5 and 6 of the drawings.

As shown in these figures of the drawings, the outer end of the connector stud 83 is somewhat reduced in diameter for receiving a pair of contact clamps 113. These contact clamps 113 are provided with split apertured portions for positioning on the outer end of the connector stud where they may be secured in the desired position by screws 114, only one of which is shown in Figure 6. Each of the contact clamps 113 is provided with a threaded boss 115 for receiving terminal sockets 116 and 117. As shown in Figure 6, the terminal socket 116 is provided with a longitudinal aperture 118 for receiving the spring contact fingers 69 of the shunt connector contact member 64, as shown in Figure 8 of the drawings. The socket member 117, Figure 5, is provided with a plurality of spring fingers 119 for contact engagement with a terminal plug 120 that is arranged to receive the strands 121 of the line conductor 36.

It is essential that the electrical connections inside of the sleeves 34 and 38 of the terminal housing 32 be fully insulated so that there will be no liability of grounding the circuit to the housing. An insulating material, such as porcelain, is well adapted to provide the desired insulation but it has heretofore not been considered practical to use this material for insulating the electrical connections in the housing 32. The chief difficulty that has been encountered is the provision of suitable means for mounting porce-

lain insulators inside of the terminal housing 32 in fluid tight relation and in such manner that they will not be cracked or broken during assembly or after the device is placed in service. These difficulties have been overcome by the provision of the porcelain bushings or insulators 122 each of which is provided with an inwardly extending flange 123 for mounting it on the respective socket members 116 and 117. It will be observed that these socket members are provided with suitable flanges for interfitting with the inwardly extending flanges 123, together with suitable gaskets between the flanges and the threaded bosses 115 into which the socket members 116 and 117 are threaded. For making the fluid tight connection with the terminal housing 32 each of the sleeves 34 and 38 is provided with an inwardly extending flange 124 that is beveled on the outer face as shown. The inner ends of the bushings 122 are slightly reduced in diameter as compared to the outer ends and are spaced slightly from the inner peripheries of the flanges 124. A rubber gasket 125 is disposed around the shoulder formed between the intermediate ends of the bushing 122 and abutting the beveled face of the flange 124. A gland 126, in the form of a metal ring having its inner face beveled as shown, is next disposed in engagement with the outer edge of the rubber gasket 125. The inner diameter of the gland 126 is such that it is spaced from the periphery of the bushing 122. A packing nut 127 is threaded inside of each of the sleeves 34 and 38 and, on being tightened, forces the gland 126 into engagement with the rubber gasket 125 which is deformed thereby into engagement with the bushing 122 and between the beveled faces of the flange 124 and the gland 126. The internal diameter of the packing nut 127 is such that its inner periphery is spaced slightly from the outer surface of the bushing 122. In this manner a resilient support for the bushing 122 is provided in each of the sleeves 34 and 38 and they do not come into direct engagement with any portion of the terminal housing 32. This construction provides a fluid tight mounting of the bushings 122 and at the same time cracking or breakage thereof during assembly or service is avoided.

When the shunt connector 61 is used, it will be understood that the sleeve 70 is inserted into the bushing 122 that surrounds the socket member 116 and that, when the spring contact fingers 69 are inserted in the longitudinal aperture 118, the sleeve 70 surrounds the socket member 116.

In Figure 7 of the drawings, the circuit connections that are employed are illustrated. As there shown, the line conductors 35 and 36 are interconnected by the circuit interrupter 77. This is shown in the form of a fuse wire. The line conductors 35 and 36 are also connected to the socket members 116 in the terminal housings 31 and 32 for receiving the terminals 63 and 64 of the shunt connector 61.

As shown in Figures 5 and 6 of the drawings, the bushing 122 in the sleeve 34 is surrounded at its lower end by a terminal bell 128 which may be secured by a clamp nut 129 to the threaded lower end of this sleeve. The lead covering of the line conductor 36 may be sealed to the lower end of the terminal bell 128 as by a wiped joint 130. It will be understood that, when the clamp nut 129 is unscrewed, the line conductor 36 may be disconnected by withdrawing it from the terminal housing 32. Since the terminal plug 120 is secured as by soldering to the strands 121, it will be withdrawn from the contact fingers 119 of the socket member 117, thereby opening the circuit at this point. This plug-in type of connection is desirable for the purpose of permitting the replacement of the housing 25 without disturbing the wiped joint 130 at the lower end of the terminal bell 128.

The sleeve or insulator 76, shown in Figure 5 of the drawings, is preferably formed of asphalt impregnated fiber and is of such length that it extends well beyond the ends of the circuit interrupter 77. Moreover, it is of such length that it extends beyond the upper and lower ends of the metal tank 26 in order to provide adequate insulation for the circuit interrupter 77 therefrom. It will be observed that the upper and lower ends 136 and 137 of the sleeve or insulator 76 are slightly reduced in external diameter from the intermediate portion. The lower end 137 fits snugly in an aperture at the lower end of the metal tank 26 and extends, as illustrated, into the handle shell 50.

In order to support the circuit interrupter 77 and to provide for removably mounting it within the sleeve or insulator 76, an insulating pillar 138, preferably formed of porcelain, is carried by the handle shell 50 within a suitable cup-shaped receptacle 139 to which it may be secured as by cement or otherwise. At its upper end the pillar 138 is provided with a metal boss 140, that may be cemented therein, and it is provided with a threaded aperture 141, Figure 9, for receiving a threaded stud 142 that depends from the lower ferrule 80. This construction is provided so that the circuit interrupter 77 may be withdrawn from the contact clips 81 and 82 when the bail 53, Figure 6, is disconnected and the handle assembly 28 is moved downwardly relative to the housing 25. It will be noted that the threaded stud 51, forming a part of the handle assembly 28, is further secured in the handle shell 50 by a pin 143, Figure 5, that is driven into a suitably drilled aperture.

Since the housing 25 is intended for positioning under ground where it may be subjected to damp conditions or may be partly or totally submerged, it is essential that a fluid-tight connection be provided between the handle shell 50 and the lower end of the metal tank 26. For this purpose a soft rubber gasket 144 is provided inside of the depending flange 58, around the lower end 137 of the sleeve or insulator 76 and in alinement with the outer rim of the handle shell 50. As shown in Figure 5 of the drawings, a suitable circumferential groove inside of the flange 58 is provided for receiving the soft rubber gasket 144 and confining it when the handle shell 50 is moved into fluid-tight engagement therewith by rotation of the handle 52 on the left hand threaded stud 51. It will be noted that this construction provides a fluid-tight connection at the lower end of the tank 26 and yet readily permits the removal of the handle shell 50 when it is desired to replace or inspect the circuit interrupter 77.

In addition to compressing the gasket 144, rotation of the handle 52 on the stud 51 forces the circuit interrupter 77 into and out of engagement with the contact clips 81 and 82. This action is important since a relatively large force is required to insert the ferrules 79 and 80 into and remove them from contact engagement with the contact fingers 95' and 96'. This force may be more than could be directly applied by the lineman.

The reduced upper end portion 136 of the

sleeve or insulator 76 projects through a close fitting hole in a tank seal plate 145 that is formed of a suitable insulating material, such as "Bakelite". The tank seal plate 145 is secured to an integrally formed inwardly extending flange 146 of the metal tank 26 by means of screws 147. A tank seal gasket 148 preferably in the form of a soft rubber ring, is disposed between the under side of the tank seal plate 145 and the upper surface of the flange 146.

With a view to further insulating the electrical connections inside of the housing 25 from the metal tank 26 and to securely hold the sleeve or insulator 76 in position, the tank 26 is filled with a filling of insulating compound 149. The compound 149 is sold under the name of "Mineralac", its principal ingredient being refined asphalt to which has been added relatively small amounts of rosin and other materials to secure the desired fusion temperature and plasticity. It will be understood that any other suitable insulating compound having the necessary insulating and plastic characteristics may be employed without departing from the scope of our invention.

The compound 149 is heated and poured into the metal tank 26 after the sleeve or insulator 76, the terminal connections thereto, and the terminal housings 31 and 32 have been assembled in the relations shown in Figure 5 of the drawings. For purposes of assembly the tank seal plate 145 is placed in position. Before the compound 149 is poured into the tank 26 the tank seal plate 145 is removed and replaced by a metal spider having a number of large holes through which the molten insulating compound 149 may be readily poured. A plug 150 in the upper portion of each of the terminal housings 31 and 32 is removed in order to permit the compound 149 to completely fill these housings. As soon as the level of the compound 149 in the tank 26 reaches the openings from which the plugs 150 are removed, they are replaced and the filling process is continued until the tank 26 is completely filled. The compound is then permitted to cool and, on solidification, it shrinks away from the spider that is substituted for the tank seal plate 145. This shrinkage is compensated for by adding more molten compound until it reaches a level corresponding to the top of the tank seal gasket 148. The metal spider is then removed and a small amount of molten compound is poured on top of the solidified compound. While it is still molten, the tank seal plate 145 is replaced and the screws 147 are tightened to secure it in position, a tight seal being formed at the outer and inner edges of the tank seal plate 145.

When the circuit interrupter 77 of the blast action arc extinguishing type is employed, it is desirable to provide for cooling and condensing the products of the arc that are formed when the device is called upon to operate. For this purpose a condenser, shown generally at 155, Figure 5, is provided. The theory of operation of the condenser 155 in connection with a circuit interrupter of the blast action arc extinguishing type is fully described in the copending application of Triplett, Serial No. 639,939, filed October 28, 1932, now Patent No. 2,091,423, and the copending application of Triplett, Serial No. 670,884, filed May 13, 1933, now Patent No. 2,091,424, both of which patents are assigned to the assignee of this application. It will be sufficient for the purposes of this application to point out that the condenser 155 is located in the upper end of the sleeve or insulator 76 in such position as to receive the products formed by the arc for extinguishing the same by the blast action of the arc extinguishing material which is created by the heat of the arc. The condenser 155 comprises a plurality of condenser plates 156, Figures 11 and 12, which may be formed of copper and which may be mounted on a condenser stem 157 and secured thereto in spaced apart relation. As shown in Figure 11, each condenser plate 156 is provided at its periphery with a plurality of radially extending fingers on which the products of the arc impinge. In assembling the condenser 155 the condenser plates 156 are mounted on the stem 157 in alinement and then successive plates are given a slight radial twist so that spiral, rather than longitudinal, grooves will be provided through which the products of the arc may flow. This spiral arrangement of the grooves between the fingers exposes a greater portion of the area of each of the fingers to the products of the arc and thereby increases the cooling and condensing action thereof.

The condenser stem 157 is threaded into a suitably tapped aperture in a spider-like condenser holder 158, Figure 13, that is provided with external threads for interfitting with corresponding internal threads in the upper end of a condenser housing 159. The condenser housing 159 is cylindrical in shape and fits closely within the upper end of the sleeve or insulator 76.

Since the condenser 155 will be subjected to considerable outward pressure when the circuit interrupter 77 is called upon to operate under heavy overload or short circuit conditions, it is desirable that it be securely fastened in position. For this purpose four dog point set screws 160 are provided in suitably shaped and threaded apertures in the wall of the sleeve or insulator 76 and they extend through a split bearing ring 161, Figures 9 and 10, into suitable drilled apertures in the lower end of the condenser housing 159. It will be observed that the bearing ring 161 is snapped into a suitably shaped groove on the inner surface of the sleeve or insulator 76 so that the upward thrust applied to the condenser 155 is substantially uniformly distributed along the wall thereof.

A comparatively tight fitting connection should be provided between the upper end of the circuit interrupter 77 and the lower end of the condenser housing 159 so that all of the products of the arc will flow into the condenser 155. Since these products of the arc are of a conducting nature it is highly undesirable that they flow into the sleeve or insulator 76 where they might provide a conducting path between the terminal clips 81 and 82 resulting in a flashover therebetween. Since the condenser 155 is mounted inside of the sleeve or insulator 76 and the circuit interrupter 77 is placed in operative position from the opposite end, it is desirable that some means be provided for automatically interconnecting the upper end of the circuit interrupter 77 and the lower end of the condenser 155. Moreover, this connection should be such that slight differences in position of the circuit interrupter 77 in the sleeve or insulator 76 will not affect its proper functioning.

By means of the telescopic connection, shown generally at 162, Figure 5, these conditions are met. The details of construction of this connection are shown more clearly in Figure 9 of the drawings. As there shown this connection includes a bumper ring 163 that has integrally formed therewith an annular flange 164 that is

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arranged to slide over an annular flange 165 which depends from the lower end of the condenser housing 159. The bumper ring 163 has its inner periphery 166 curved in such manner as to receive the beveled upper end of the ferrule 79 of the circuit interrupter 77. When the circuit interrupter 77 is removed, the bumper ring 163 slides downwardly until it rests upon the upper ends of the fingers forming a part of the contact clip shell 95. Interposed between a radial flange of the bumper ring 163 and the underside of the condenser housing 159 is a resilient member 167 in the form of a rubber ring or rubber bumper which not only is adapted to absorb the shock received by the bumper ring when the circuit interrupter 77 is inserted in position but also it serves to bias the bumper ring 163 into contact engagement with the upper end of the ferrule 79. Since the rubber bumper 167 is compressible to various degrees, the necessary tight connection with the upper end of the ferrule 79 is provided even though the circuit interrupter 77 is not always positioned in exactly the same place in the sleeve or insulator 76 or is not always provided wth the same spacing between the ferrules 79 and 80.

The products of the arc from the condenser 155 are directed to the upper end of the dome or expansion chamber 27 by an exhaust tube 170, made of "Bakelite" or other suitable insulating material, that may be secured as by screws 171 to the condenser holder 158, Figure 5. In the event that the pressure generated within the expansion chamber 27 on operation of the circuit interrupter 77 is sufficiently great, the valve 48 will be opened to vent it to the atmosphere. As shown, the valve 48 is positioned in a valve aperture 172 in the expansion chamber 27 that is alined with the exhaust tube 170 and the condenser 155. The upper and lower surfaces of the expansion chamber 27 adjacent the valve aperture 172 are ground in such manner that these surfaces will lie in parallel planes. These surfaces are provided for receiving a valve seat member 173, the body portion 174 of which extends downwardly through the valve aperture 172, and a gas baffle 175 that is threaded on the lower end of this body portion. A gasket 176, formed preferably of a putty-like gasket material, is spread onto the upper surface of the expansion chamber for receiving the valve seat member 173 while a suitable gasket 177, such as a copper faced asbestos gasket, is provided between the under surface and the gas baffle 175. It will be understood that the gas baffle 175 is screwed tightly onto the body portion 174 of the valve seat member 173. It will be noted that the gas baffle 175 extends to a position slightly outside of the exhaust tube 170 so that all of the products of the arc impinge directly thereon or flow directly through the body portion 174 of the valve 48. The valve seat member 173 is provided with an integrally formed valve guide 178 within which a valve stem 179 is slidably mounted. At its upper end the valve stem 179 has threaded thereon a valve member 180, the outer periphery of which is provided with a groove opening downwardly for interfitting with a rim 181 formed integrally with and extending upwardly from the valve seat member 173. A rubber gasket 182 is positioned, as illustrated, in this groove and it engages the upper surface of the rim 181 in fluid-tight relation when the valve 48 is closed. A coil compression spring 183, surrounding the valve stem 179 and reacting between the valve guide 178 and a gas baffle 184, threaded on the lower end of the valve stem 179, serves to bias the valve 48 to the closed position. A nut 185 is provided for locking the gas baffle 184 in position. The gas baffle 184 is provided for initiating the opening of the valve 48 by the blast resulting from the flow of the products of the arc before sufficient pressure is generated within the expansion chamber 27 to compress the spring 183 and lift the valve member 180 off of the valve seat member 173. This initiation of the opening movement of the valve 48 is desirable in order to quickly vent the expansion chamber 27. The gas pressure within the expansion chamber 27 may, under certain interrupting conditions, such as heavy overloads or short circuits, increase with extreme rapidity with the result that the expansion chamber 27 may be subjected to excessive stresses before the valve 48 has had an opportunity to open.

As set forth hereinbefore it is highly desirable that the expansion chamber 27 be sealed to the metal tank 26 in such manner that the ingress of moisture from the outside is prevented as well as the egress of the products of the arc from the interior of the expansion chamber. Special precautions are taken in forming these seals so that these conditions will be met.

It will be observed that the porcelain expansion chamber 27 is provided on its under surface with inner and outer depending lips 186 and 187 thereby forming a downwardly opening annular groove 188 therebetween. These lips are formed when the expansion chamber 27 is cast and the glazed surface covers them. With a view to providing for hermetically sealing these lips 186 and 187 and, since the glazed surface on these lips is usually somewhat irregular, a sufficient portion is removed therefrom by suitable grinding operation so that the desired plane surfaces will be had. The grinding operation is carried out in such manner that the lower surface of each of the lips 186 and 187 is in a plane and these planes are preferably coplanar. A rim 189 formed integrally with the metal tank 26 at its upper end has its upper surface machined in a plane that is parallel to the plane of the lower surface of the lip 187. A gasket 190, preferably formed of relatively hard rubber gasket material, is interposed between the lip 187 and the rim 189. This material is used with two purposes in mind, first to provide a gasket of sufficient strength to resist the stress applied by the C-shaped clamps 44 and second to prevent the ingress of moisture from outside of the housing 25. Any other suitable material may be employed but we have found that rubber is particularly well suited for this application. Between the clamp ring 47 and the upper surface of the integrally formed radially extending flange 191 of the porcelain expansion chamber 27 is a gasket 192, preferably formed of cork, for the purpose of preventing the clamp ring 47 from coming into direct contact with the porcelain. The skirt 193, forming a part of the clamp ring 47, extends downwardly a sufficient distance to surround the joint between the lip 187 and the rim 189.

Egress of the products of the arc inside of the expansion chamber 27 is prevented by a gasket 194, preferably formed of soft rubber, and interposed between the undersurface of the inner lip 186 and the upper surface of the tank seal plate 145. A material such as soft rubber is employed in order to provide for intimate engagement with

the ground undersurface of the lip. A packing retainer 195, preferably in the form of a ring of cork, is provided around the upper end 136 of the sleeve or insulator 76 and between it and the inner surface of the gasket 194 to insure that it will be held in position. If the soft rubber gasket 194 were not provided, it is possible that an arc might be formed to the screws 147 by the products of the arc, which are conducting, coming into contact with them. Since these screws are threaded into the metal tank 26, which is grounded, a flashover to ground might take place. This is prevented by the provision of the gasket 194. The gasket 194 is made of relatively soft rubber in order to insure that, in addition to making a fluid-tight joint between the expansion chamber 27 and the tank seal plate, it will yield enough to allow a tight joint to be made with the relatively hard rubber gasket 190 between the outer lip 187 of the dome 27 and the rim 189 of the tank 26. If both gaskets 190 and 194 were composed of material having the same mechanical characteristics, it would be difficult, if not impossible, to keep both joints fluid-tight.

In Figure 14 of the drawings the construction of the circuit interrupter 77 is shown in greater detail. Since the construction and operation of the circuit interrupter 77 are fully described in the copending application of Conrad, Serial No. 470,416, a detailed description thereof will not be set forth herein except as is necessary to describe the present invention and the particular adaptations of the circuit interrupter 77 for use in the housing 25 described hereinbefore.

As set forth, the circuit interrupter 77 includes a sleeve or housing 78 and this is preferably formed of glass. Ferrules 79 and 80 are secured to the ends of the glass sleeve 78 by any suitable means such as by cementing them in position. The lower ferrule 80 is provided with a threaded stud 142 and it may be screwed into the tapped hole 141 in the boss 140, Figures 5 and 9, that is carried by the pillar 138. This threaded connection permits the withdrawal of the circuit interrupter 77 by grasping the handle 52 and, since the pillar 138 is composed of porcelain, there is little chance of accidental contact with a live part of the circuit.

The circuit interrupter 77 is of the liquid arc extinguishing type and it is provided with a normally stationary terminal 200, carried by a terminal support spider 201, and a relatively movable terminal 202 that is arranged to be retracted by a tension coil spring 203. One end of the spring 203 is connected to the terminal 202 while the other end is suitably connected to the lower ferrule 80, as illustrated. A flexible shunt conductor 204 interconnects the terminal 202 and the ferrule 80 to provide a low resistance current path therebetween. The terminals 200 and 202 are interconnected by a fusible element 205, preferably composed of silver, and a strain element 206, preferably composed of a nickel-chromium alloy, which relieves the fusible element 205 of any tension stress that might be otherwise applied by the spring 203. The elements 205 and 206 are positioned inside of an arcing tube 207, preferably composed of insulating material such as "Bakelite", that is supported by a mounting washer, also preferably formed of insulating material such as "Bakelite", that is threaded, as illustrated, into the upper ferrule 79. The sleeve 78 is filled with liquid arc extinguishing material to the level indicated by the broken line and it is forced to flow into the arcing tube 207 on melting of the fusible and strain elements 205 and 206 by a liquid director 209 that is carried by the movable terminal 202. A releasable vent cap 210 is sealed into the upper end of the ferrule 79 to hermetically seal the device.

On operation of the circuit interrupter 77 under heavy overload or short circuit conditions, the vent cap 210 will be blown out of the upper end of the ferrule 79 and it will strike the conical point 211, Figure 5, of the condenser stem 157 where it is deformed and thus falls back into the upper ferrule 79. In this position the vent cap 210 does not interfere, as a practical matter, with the flow of the products of the arc into the condenser 155 and removal thereof is insured when the circuit interrupter 77 is removed.

In Figure 15 of the drawings a circuit interrupter 77' of the solid arc extinguishing material type is illustrated. This circuit interrupter 77' may be employed in the housing 25 in place of the circuit interrupter 77 of the liquid arc extinguishing type. The details of construction and operation of the circuit interrupter 77' are fully set forth in the copending application of Triplett, Serial No. 85,700, and, therefore, no further description will be set forth herein other than appears to be necessary to disclose the present invention.

The circuit interrupter 77' includes a tubular sleeve 78' which may be formed of glass or, as shown, of an insulating material such as "Bakelite". When such material is employed snap rings 213 are provided in suitable grooves adjacent the ends. These rings are externally threaded for receiving internal threads of the ferrules 79' and 80', as illustrated. If the sleeve 78' were formed of glass, the ferrules 79' and 80' would be suitably constructed to permit their being secured in position by cement.

The circuit interrupter 77' is provided with a renewable cartridge 214 that may be secured in position by a clamp nut 215 to the upper end of the ferrule 79'. The cartridge 214 includes a movable rod-like terminal 216 that is positioned in a main bore 217 of a body of arc extinguishing material 218 which may comprise magnesium hydroxide or boric acid or any other like material which will evolve in a vapor in the presence of an arc that will assist in extinguishing the arc with a minimum of disturbance. The body of arc extinguishing material 218 may either be a single solid body or it may be made up of several sections, as illustrated. A cartridge tube 219, formed of a suitable insulating material, such as "Bakelite", surrounds the body of arc extinguishing material 218. A fusible element 220, preferably in the form of a silver wire is provided for interconnecting the rod-like terminal 216 with the ferrule 79'. The fusible element 220 is positioned in an arcing chamber that is formed, in part, by a ring 221 of insulating material that is flared outwardly as shown.

The rod-like terminal 216 is arranged to be retracted by a coil tension spring 222 that is interconnected between it and the lower ferrule 80'. Flexible conductors 223 serve to form a low resistance current path between the terminal 216 and the lower ferrule 80'.

With a view to preventing the application of any tension stress to the silver fusible element 220, a strain element 224 is provided and is positioned in an auxiliary bore 225 of small diameter in the body of arc extinguishing material 218. As illustrated, the strain element 224 is

interconnected between a pin 226 extending through the lower end of the rod-like terminal 216 and a strain wire pin 227 that is carried by and extends inwardly from a cartridge ferrule 228. When the fusible element 220 and the strain element 24 blow, portions thereof are expelled through the central opening in the cartridge ferrule 228. This opening is normally closed by a readily expellable disc or plate 29 of suitable insulating material, such as mica, and it is held in position by a retaining ring 230.

When the current flows through the circuit interrupter 77' it is sufficient to melt the fusible element 220, the current flow is then transferred to the strain element 224 and it melts. The strain element is constructed, as described in the copending application of Triplett, Serial No. 85,700, in such manner that it will melt at its upper end, thereby releasing the tension spring 222 for retracting the rod-like terminal 216 in the main bore 217. For low current interruption the arc is drawn and extinguished in the auxiliary bore 225 by the evolution of vapor from the inner wall thereof. The continued movement of the rod-like terminal 216 prevents the arc from restriking.

During short circuit interrupting conditions the current transfers from the fusible element 220 to the strain element 224 in this same manner. However, under this operating condition, the entire section of the strain element 224 may fuse and the arc may be reestablished in the main bore 217 before any appreciable movement of the rod-like terminal 216 takes place. But in this case the larger bore is adapted to extinguish the arc.

The vapor that is evolved from either of the bores 217 or 225 by the heat of the arcs drawn therein will flow upwardly through the central opening in the cartridge ferrule 28, carrying with it the thin disc 229. These products of the arc are, in the case that a material such as boric acid is employed for the arc extinguishing material 218, composed principally of water vapor which may be readily condensed. Advantage is taken of this characteristic in the construction of a circuit interrupter housing to be presently described.

In Figures 16 and 17 of the drawings a circuit interrupter housing construction is disclosed in which advantage is taken of the fact that the products of the arc from a circuit interrupter of the solid arc extinguishing material type may be readily condensed, thereby not requiring that they be vented to the atmosphere, as is generally the case when a circuit interrupter of the liquid arc extinguishing type is employed. As shown, the metal tank 26 is employed and its interior construction is as shown in Fig. 5 of the drawings and described hereinbefore. However, an expansion chamber 235 is provided which is somewhat larger than the expansion chamber 27. The expansion chamber 235 is preferably formed of porcelain and it is non-ventable. It may be secured to the tank 26 in fluid-tight relation by the clamps 44 in the manner described hereinbefore.

As shown more clearly in Figure 17 the condenser support 158, that is threaded into the upper end of the condenser housing 159 in the upper end 136 of the sleeve that houses the circuit interrupter, is provided with an exhaust tube 236 that is somewhat longer than the exhaust tube 170, of Figure 5. The products of the arc, after they have passed through the condenser, are directed by the exhaust tube 236 against a gas baffle 237 which may be cemented to the upper end of the expansion chamber 235 as shown.

In some cases it may be desirable to provide for directly venting the expansion chamber 27 rather than to provide the valve 48 for automatically venting it or for constructing it so that it will be non-ventable as is the case with the expansion chamber 235. For this construction it is desirable that the venting arrangement be such that the interior of the housing will not be filled with water in the event that the housing is submerged.

A construction satisfying these requirements is shown in Figures 18 and 19 of the drawings. As there shown the valve 48 has been omitted from the porcelain expansion chamber 27 and in its stead an inverted U-shaped metal tube 240 has been substituted. The tube 240 is connected to a pipe 241 that is formed of suitable insulating material, such as asphalt impregnated fiber, and it extends downwardly through brackets 242, as illustrated, which may also be employed to support the tank 26. The insulated pipe 242 extends below the tank 226 to such a distance that a water seal will be formed therein when the tank 26 is partly or wholly submerged.

The details of construction are shown more clearly in Figure 19. A sleeve 243 extends through the aperture 172 in the expansion chamber 27 and the gas baffle 175 is threaded onto its lower end. Suitable gaskets are provided, as shown, to make the connection fluid-tight. A bolt 244 extends through the pipe 240 and is threaded at its lower end into a spider 245 extending from the sleeve 243. At its other end the pipe 240 is provided with a bolt 246 that is threaded into a spider 247 of a connecting member 248. The upper end of the insulated pipe 241 may be threaded into the connecting member 248.

While the insulated pipe 241 has been shown as being mounted in the brackets 242 that support the tank 26, it will be understood that it may be mounted independent of these brackets. It should be borne in mind, however, that the pipe 241 should be so located that water will not get into the expansion chamber 27 when the housing is partly or wholly submerged.

Instead of employing the construction shown in Figures 18 and 19 of the drawings for venting the expansion chamber, the construction shown in Figure 20 may be employed. As there shown, a porcelain expansion chamber 250 is provided having an offset portion 251 for registering with a corresponding offset portion 252 of a metal tank 26'. Except for the offset portion 252, the metal tank 26' and the interior construction thereof are as shown in Figure 5 of the drawings. The tank 26' is filled with a suitable insulating compound 149, as previously described, and a tank seal plate 253, of appropriate shape, is provided over it. A retaining plate 254 is provided above the tank seal plate 253 for holding the soft rubber gasket 255 in position. The details for sealing the expansion chamber 250 are essentially as described hereinbefore in connection with the description of the manner in which the expansion chamber 27 is sealed to the tank 26 and will not be repeated.

The expansion chamber 250 may be vented by a vent pipe 256 that extends through an internally threaded flange 257 in the offset portion 252 of the tank 26' and up into the expansion chamber 250 through the plates 253 and 254. The vent pipe 256 is preferably formed of insulating ma-

terial such as asphalt impregnated fiber. At least its upper end should be formed of such material until a point well below the offset portion 252 is reached in order to prevent arcing over to ground.

Instead of venting the expansion chamber 27 downwardly, as shown in Figure 18 of the drawings, it may be vented upwardly as shown in Figures 21 and 22 of the drawings. For this purpose a vent pipe 260 is threaded into a suitable sleeve fitting 261 in the aperture 172 of the expansion chamber 27 and it extends upwardly for a distance that will be well above the level of any water in which the housing may be submerged. For this construction a somewhat larger condenser 262 may be employed for cooling and condensing the products of the arc. The condenser 262 will be mounted in the upper end 263 of the sleeve or insulator 76' in the manner described hereinbefore for the condenser 155, shown in Figure 5 of the drawings. The condenser 262 is provided with a somewhat longer condenser housing 264 for mounting therein the condenser plates 265 on the condenser stem 266. As shown the condenser stem 266 is carried by a condenser support member 267 that may be similar in construction to that of the condenser holder 156, Figure 13.

In the event that the circuit interrupter mounted in the housings, constructed as shown in Figures 18 and 21, should be called upon to operate when submerged, it is possible that a flashover to ground might occur since the U-shaped tube 240 and the sleeve fitting 261 are formed of metal. This action might occur since these members would thus be in contact with the water outside and with the conducting products of the arc on the inside. Possibility of such a condition arising may be obviated in the use of the construction shown in Figure 23 of the drawings.

As there illustrated, the vent pipe 260 is threaded into the upper end of a sleeve 270 onto the lower end of which the gas baffle 175 is threaded. The sleeve 270 is formed of a suitable insulating material, such as a molded insulating material. In this manner the conducting products of the arc do not come into contact with any metal parts that may be submerged when the interrupter opens the circuit under such a condition.

Since certain further changes may be made in the foregoing constructions and different embodiments of the invention may be made without departing from the scope thereof, it is intended that all matter set forth in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim as our invention:

1. A fluid-tight housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank, means removably mounting the circuit interrupter therein in insulated spaced relation, an insulated expanson chamber for receiving the products of the arc resulting from the blast action, and means providing fluid-tight connections between said metal tank and said mounting means and between said metal tank and said expansion chamber.

2. In a fluid-tight housing for a circuit interrupter of the blast action arc extinguishing type, in combination, means removably mounting the circuit interrupter in the housing, and an expansion chamber formed of insulating material carried externally by said housing in such position as to receive the products of the arc resulting from the blast action.

3. A unitary housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for receiving the interrupter, means at one end of said tank for removably mounting the circuit interrupter therein, and an insulated expansion chamber mounted at the other end of said tank for receiving the products of the arc resulting from the blast action.

4. A unitary housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for receiving the interrupter, means at one end of said tank for removably mounting the circuit interrupter therein, an insulated expansion chamber mounted at the other end of said tank for receiving the products of the arc resulting from the blast action, and clamp means removably holding said expansion chamber on said other end of said tank.

5. A unitary housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for receiving the interrupter, means at one end of said tank for removably mounting the circuit interrupter therein, an insulated expansion chamber mounted at the other end of said tank for receiving the products of the arc resulting from the blast action, and valve means operable as a result of said blast action to vent said expansion chamber to the surrounding atmosphere.

6. In combination, a metal housing for receiving a circuit interrupter of the blast action arc extinguishing type, means for removably mounting the circuit interrupter in said housing, terminal means extending exteriorly of said housing to permit connection of the circuit interrupter in an electric circuit, and connector means arranged and adapted to cooperate with said terminal means for bridging the same and shunting the circuit interrupter.

7. In combination, a metal housing for receiving a circuit interrupter of the blast action arc extinguishing type, means for removably mounting the circuit interrupter in said housing, a pair of terminal assemblies carried by said housing and each connected to a terminal of the circuit interrupter, and a pair of connector means forming a part of each terminal assembly and disposed externally of said housing, one of each of said connector means being adapted for connection to a circuit conductor and the other being adapted for connection to a conductor for shunting the circuit interrupter.

8. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter, insulating means carried by said tank for receiving the circuit interrupter and surrounding the same, and an insulated expansion chamber carried externally by said tank in such position as to receive the products of the arc resulting from the blast action.

9. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank arranged and adapted to receive the circuit interrupter, an expansion chamber formed of insulating material and carried by said tank in such position as to receive the products of the arc resulting from the blast action, and means providing a sealed connection between said expansion chamber and said tank.

10. A housing for a circuit interrupter of the

blast action arc extinguishing type comprising, in combination, a metal tank arranged and adapted to receive the circuit interrupter, an expansion chamber formed of insulating material and carried by said tank in such position as to receive the products of the arc resulting from the blast action, sealing means between said expansion chamber and said tank to prevent the ingress of moisture, and additional sealing means between said expansion chamber and said tank to prevent the egress of said products of the arc.

11. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank arranged and adapted to receive the circuit interrupter, an expansion chamber formed of porcelain and carried by said tank in such position as to receive the products of the arc resulting from the blast action, means for clamping said expansion chamber onto said tank, outside gasket means between said chamber and said tank to prevent the ingress of moisture, and inside gasket means between said chamber and said tank to prevent the egress of said products of the arc.

12. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank arranged and adapted to receive the circuit interrupter, an expansion chamber formed of percelain and carried by said tank in such position as to receive the products of the arc resulting from the blast action, a flange integrally formed with and extending outwardly from said porcelain expansion chamber, an annular clamp ring surrounding said expansion chamber with its faces parallel to said flange, a plurality of C-shaped clamp members cooperating with said tank and said clamp ring for holding said expansion chamber in position, sealing means between said flange and said tank to prevent the ingress of moisture, and additional sealing means between said expansion chamber and said tank to prevent the egress of said products of the arc.

13. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank arranged and adapted to receive the circuit interrupter, an expansion chamber formed of porcelain and carried by said tank in such position as to receive the products of the arc resulting from the blast action, the face of said porcelain expansion chamber abutting said tank having an annular groove therein, means for clamping said porcelain expansion chamber onto said tank, an outside gasket between the outer lip of said groove and said tank adapted to resist the stress set up by said clamping means and to prevent the ingress of moisture, and an inside gasket between the inner lip of said groove and said tank adapted to have intimate engagement with said inner lip to prevent the egress of said products of the arc.

14. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank arranged and adapted to receive the circuit interrupter, an expansion chamber formed of porcelain and carried by said tank in such position as to receive the products of the arc resulting from the blast action, the face of said porcelain expansion chamber abutting said tank having an annular groove therein and the outside and inside lips of said groove having toned surfaces, means for clamping said porcelain expansion chamber onto said tank, a relatively hard rubber gasket between the toned surface of said outer lip and said tank for resisting the stress set up by said clamping means and to prevent the ingress of moisture, and a relatively soft rubber gasket between the toned surface of said inner lip and said tank to prevent the egress of said products of the arc.

15. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank arranged and adapted to removably receive the circuit interrupter, an insulated expansion chamber carried by said tank in such position as to receive the products of the arc resulting from the blast action, and valve means carried by said expansion chamber and operable on the generation of a predetermined pressure therein to vent the same to the surrounding atmosphere.

16. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank arranged and adapted to removably receive the circuit interrupter, an expansion chamber formed of insulating material and hermetically sealed to said tank in such position as to receive the products of the arc resulting from the blast action, and valve means carried by said chamber in line with the flow of said products of the arc and operable on the generation of a predetermined pressure therein to vent the same to the surrounding atmosphere.

17. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank arranged and adapted to removably receive the circuit interrupter, an expansion chamber formed of insulating material and hermetically sealed to said tank in such position as to receive the products of the arc resulting from the blast action, valve means carried by said chamber in line with the flow of said products of the arc and operable on the generation of a predetermined pressure therein to vent the same to the surrounding atmosphere, and baffle means carried by said valve means and disposed directly in the path of said products of the arc for initiating the opening of said valve means.

18. A housing for a generally cylindrically shaped circuit interrupter unit of the blast action arc extinguishing type comprising, in combination, a metal tank, and a tubular insulator inside of and secured to said tank in a substantially vertical position for receiving the circuit interrupter unit.

19. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a cylindrical metal tank, and an insulating sleeve disposed coaxially with said tank inside thereof and secured thereto for receiving the circuit interrupter, said sleeve being of such length that its ends project beyond the ends of said tank.

20. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a cylindrical metal tank, a tubular insulator inside of and secured to said tank for receiving the circuit interrupter, and a pair of terminal assemblies carried by said tubular insulator in spaced apart relation and extending externally of said tank to permit connection to the circuit interrupter.

21. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a cylindrical metal tank, an insulating sleeve disposed coaxially with said tank inside thereof and secured thereto for receiving the circuit interrupter, said sleeve being of such length that its ends project beyond the ends of said tank, a pair of terminals carried by said insulating sleeve in spaced apart relation for elec-

trical connection to the circuit interrupter, and connecting means individual to each of said terminals and extending externally of said tank to permit external connection to the circuit interrupter.

22. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a cylindrical metal tank, a tubular insulator inside of and secured to said tank for receiving the circuit interrupter, and a filling of solidified insulating compound inside of said tank around said tubular insulator.

23. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a cylindrical metal tank, an insulating sleeve disposed coaxially with said tank inside thereof and secured thereto for receiving the circuit interrupter, said sleeve being of such length that its ends project beyond the ends of said tank, and a filling of solidified insulating compound inside of said tank and around said insulating sleeve.

24. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a cylindrical metal tank, a tubular insulator inside of and secured to said tank for receiving the circuit interrupter, a filling of insulating compound inside of said tank around said tubular insulator, and a pair of terminal assemblies carried by said tubular insulator in spaced apart relation and extending through said filling of insulating compound and said tank to permit external connection to the circuit interrupter.

25. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a cylindrical metal tank, an insulating sleeve disposed coaxially with said tank inside thereof and secured thereto for receiving the circuit interrupter, said sleeve being of such length that its ends project beyond the ends of said tank, a filling of solidified insulating compound inside of said tank and around said insulating sleeve, a pair of terminals disposed inside of said insulating sleeve in spaced apart relation for electrical connection to the circuit interrupter, and connecting means individual to each of said terminals and extending through said insulating sleeve, said filling of insulating compound and said tank to permit external connection to the circuit interrupter.

26. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a cylindrical metal tank, an insulated dome sealed to one end of said tank for receiving the products of the arc, a tubular insulator inside of and secured to said tank for receiving the circuit interrupter, and mounting means disposed to be sealed to the other end of said tank for removably mounting the circuit interrupter in said insulator.

27. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a cylindrical metal tank, an insulated dome sealed to one end of said tank for receiving the products of the arc, a tubular insulator inside of and secured to said tank for receiving the circuit interrupter, and mounting means disposed to be sealed to the other end of said tank for removably mounting the circuit interrupter in said insulator, said insulator being of such length that its ends project beyond the ends of said tank and into said dome at one end and into said mounting means at the other end.

28. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a cylindrical metal tank, an insulated dome sealed to one end of said tank for receiving the products of the arc, a tubular insulator inside of and secured to said tank for receiving the circuit interrupter, mounting means disposed to be sealed to the other end of said tank for removably mounting the circuit interrupter in said insulator, said insulator being of such length that its ends project beyond the ends of said tank and into said dome at one end and into said mounting means at the other, and a filling of solidified insulating compound inside of said tank and around said insulator.

29. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a cylindrical metal tank, an insulated dome sealed to one end of said tank for receiving the products of the arc, a tubular insulator inside of and secured to said tank for receiving the circuit interrupter, mounting means disposed to be sealed to the other end of said tank for removably mounting the circuit interrupter in said insulator, said insulator being of such length that its ends project beyond the ends of said tank and into said dome at one end and into said mounting means at the other, a filling of solidified insulating compound inside of said tank and around said insulator, and a pair of terminal assemblies carried by said tubular insulator in spaced apart relation and extending through said filling of insulating compound and said tank to permit external connection to the circuit interrupter.

30. A housing for an elongated circuit interrupter of the blast action arc extinguishing type having external terminals comprising, in combination, a tank, an expansion chamber sealed to one end of said tank for receiving the products of the arc, an insulating sleeve mounted in said tank for receiving the circuit interrupter, a pair of terminal assemblies carried by said sleeve in spaced apart relation and extending externally of said tank, and mounting means disposed to be sealed to the other end of said tank for removably mounting the circuit interrupter in said sleeve with its terminals in contact engagement with said terminal assemblies.

31. A housing for an elongated circuit interrupter of the blast action arc extinguishing type having external terminals comprising, in combination, a tank, an expansion chamber sealed to one end of said tank for receiving the products of the arc, an insulating sleeve mounted in said tank for receiving the circuit interrupter, a pair of terminal assemblies carried by said sleeve in spaced apart relation and extending externally of said tank, a support shell, means for sealing said support shell to the other end of said tank, and a pillar of insulation carried by said support shell and adapted to removably mount the circuit interrupter in said sleeve with its terminals in contact engagement with said terminal assemblies.

32. In a housing for a circuit interrupter of the blast action arc extinguishing type having a vent cap adapted to be blown off, in combination, means removably mounting the circuit interrupter in the housing, an insulated expansion chamber carried by said housing in such position as to receive the products of the arc resulting from the blast action, a condenser assembly carried by said housing between said circuit interrupter and said expansion chamber for cooling and condensing the products of the arc, and means disposed in the path of the vent cap and

adapted to deform the same on operation of said circuit interrupter for insuring removal of said vent cap on withdrawal of said circuit interrupter.

33. In a fluid tight housing for a circuit interrupter of the blast action arc extinguishing type, in combination, means removably mounting the circuit interrupter in the housing, an insulated expansion chamber carried by said housing in such position as to receive the products of the arc resulting from the blast action, and a removable condenser assembly carried by said housing between said circuit interrupter and said expansion chamber for cooling and condensing the products of the arc.

34. A housing for an elongated circuit interrupter of the blast action arc extinguishing type having external terminals comprising, in combination, a tank, an expansion chamber sealed to one end of said tank for receiving the products of the arc, an insulating sleeve mounted in said tank for receiving the circuit interrupter, a condenser assembly mounted in said sleeve between said expansion chamber and the circuit interrupter for cooling and condensing the products of the arc, a pair of terminal assemblies carried by said sleeve in spaced apart relation and extending externally of said tank, and mounting means disposed to be sealed to the other end of said tank for removably mounting the circuit interrupter in said sleeve with its terminals in contact engagement with said terminal assemblies.

35. A housing for an elongated circuit interrupter of the blast action arc extinguishing type having external terminals comprising, in combination, a tank, an expansion chamber sealed to one end of said tank for receiving the products of the arc, an insulating sleeve mounted in said tank for receiving the circuit interrupter, a filling of insulating compound inside of said tank and around said insulating sleeve, a pair of terminal assemblies carried by said sleeve in spaced apart relation and extending through said filling of insulating compound and externally of said tank, and mounting means arranged and adapted to be removably sealed to the other end of said tank for removably mounting the circuit interrupter in said sleeve with its terminals in contact engagement with said terminal assemblies.

36. A housing for a cylindrically shaped circuit interrupter of the blast action arc extinguishing type having terminals at its ends comprising, in combination, a cylindrical metal tank, an expansion chamber formed of insulating material at one end of said tank for receiving the products of the arc, means hermetically sealing said expansion chamber to said tank in such manner as to prevent ingress of moisture and egress of the products of the arc, an insulating sleeve coaxially mounted in said tank and extending beyond its ends for receiving the circuit interrupter, a filling of insulating compound inside of said tank and around said insulating sleeve, a pair of terminals disposed inside of said sleeve in spaced apart relation, a connector individual to each of said pair of terminals and extending through said insulating sleeve, said filling of insulating compound and said tank to permit external connection thereto, and mounting means disposed to be hermetically sealed to the other end of said tank for removably mounting the circuit interrupter in said sleeve with its terminals in contact engagement with said terminals in said sleeve.

37. A housing for a cylindrically shaped circuit interrupter of the blast action arc extinguishing type having terminals at its ends comprising, in combination, a cylindrical metal tank, an expansion chamber formed of insulating material at one end of said tank for receiving the products of the arc, means hermetically sealing said expansion chamber to said tank in such manner as to prevent ingress of moisture and egress of the products of the arc, an insulating sleeve coaxially mounted in said tank and extending beyond its ends for receiving the circuit interrupter, a plurality of condenser plates mounted in spaced apart relation in and by said sleeve between said expansion chamber and the circuit interrupter for cooling and condensing the products of the arc, a filling of insulating compound inside of said tank and around said insulating sleeve, a pair of terminals disposed inside of said sleeve in spaced apart relation, a connector individual to each of said pair of terminals and extending through said insulating sleeve, said filling of insulating compound and said tank to permit external connection thereto, and mounting means disposed to be hermetically sealed to the other end of said tank for removably mounting the circuit interrupter in said sleeve with its terminals in contact engagement with said terminals in said sleeve.

38. A housing for a cylindrically shaped circuit interrupter of the blast action arc extinguishing type having terminals at its ends comprising, in combination, a cylindrical metal tank, an expansion chamber formed of insulating material at one end of said tank for receiving the products of the arc, means hermetically sealing said expansion chamber to said tank in such manner as to prevent ingress of moisture and egress of the products of the arc, an insulating sleeve coaxially mounted in said tank and extending beyond its ends for receiving the circuit interrupter, a filling of insulating compound inside of said tank and around said insulating sleeve, a pair of terminals disposed inside of said sleeve in spaced apart relation, a connector individual to each of said pair of terminals and extending through said insulating sleeve, said filling of insulating compound and said tank to permit external connection thereto, a support shell, means for removably hermetically sealing said support shell to the other end of said tank, and a porcelain pillar carried by said support shell and arranged for detachably mounting the circuit interrupter thereon and for positioning the same in said sleeve with its terminals in contact engagement with said pair of terminals therein.

39. The combination, with a metal tank adapted to removably receive in fluid-tight relation a circuit interrupter, of a metal terminal housing disposed to be mounted on said metal tank, plug and socket connector means in said terminal housing for interconnecting a metal sheathed insulated line conductor and a terminal of the circuit interrupter, a porcelain bushing secured in fluid-tight relation to said terminal housing and surrounding said plug and socket connector means, a filling of solidified insulating compound in said terminal housing and around a portion of said bushing, and a terminal bell disposed to have a wiped connection to the metal sheath of said line conductor and to be secured to said terminal housing.

40. The combination, with a metal tank adapted to removably receive a circuit interrupter in fluid tight relation, of a metal terminal housing disposed to be mounted on said metal tank, a connector stud connected to one terminal of the cir-

cuit interrupter and extending through said metal tank into said terminal housing, a sleeve of insulation surrounding said connector stud, socket means connected to said connector stud, a bushing composed of ceramic material surrounding said socket means and extending out of said terminal housing, a filling of solidified insulating compound in said tank and terminal housing and surrounding said sleeve of insulation and a portion of said bushing, plug means disposed to be connected to a line conductor having a metal sheath and to be received in said socket means, and a terminal bell disposed to have a wiped connection to said metal sheath and to be secured to said terminal housing.

41. The combination, with a metal tank adapted to removably receive a circuit interrupter in fluid-tight relation, of a metal terminal housing disposed to be mounted on said metal tank, a connector stud connected to one terminal of the circuit interrupter and extending through said metal tank into said terminal housing, an insulating sleeve surrounding said connector stud, socket means connected to said connector stud, a porcelain bushing surrounding said socket means and extending out of said terminal housing, packing means securing said porcelain bushing in fluid-tight relation with said terminal housing, a filling of insulating compound in said tank and terminal housing and surrounding said insulating sleeve and a portion of said bushing, plug means for connection to a line conductor having a metal sheath and adapted to be received by said socket means, a terminal bell arranged to have a wiped connection with said metal sheath, and means securing said terminal bell in fluid-tight relation to said terminal housing.

42. The combination, with a metal tank adapted to removably receive in fluid-tight relation a circuit interrupter, of a metal terminal housing disposed to be mounted on said metal tank, a pair of tubular sleeves extending from said terminal housing, a connector stud connected at one end to one terminal of the circuit interrupter and extending through said metal tank into said terminal housing, a pair of socket members connected to the other end of said connector stud in alignment with said tubular sleeves, a bushing composed of ceramic material surrounding each of said socket members and extending through the sleeve individual thereto, and a filling of insulating compound in said tank and terminal housing and surrounding a portion of each bushing.

43. The combination, with a metal tank adapted to removably receive in fluid-tight relation a circuit interrupter, of a metal terminal housing disposed to be mounted on said metal tank, a pair of tubular sleeves integrally formed with said terminal housing, an inwardly extending flange in each of said sleeves, a connector stud connected at one end to one terminal of the circuit interrupter and extending through said metal tank into said terminal housing, a pair of socket members connected to the other end of said connector stud in alignment with said tubular sleeves, a porcelain bushing surrounding each of said socket members and extending through the sleeve individual thereto, each bushing having a reduced portion for interfitting with the flange in its sleeve, packing means in each sleeve cooperating with the flange therein for securing said bushings in fluid-tight relation in said terminal housing, and a filling of insulating compound in said tank and terminal housing and surrounding a portion of each porcelain bushing.

44. In a housing for an elongated circuit interrupter having a pair of spaced apart terminals, in combination, an insulating sleeve for receiving the circuit interrupter, said sleeve being of such length that each end extends a substantial distance beyond the ends of the circuit interrupter, a pair of spring stressed terminals carried inside of said sleeve for contact engagement with the terminals of the circuit interrupter, and connector means extending through said sleeve and connected to said terminals to permit external connection to the circuit interrupter.

45. A contact assembly for positioning inside of a cylindrical sleeve to permit connection to a cylindrical terminal of an electrical device disposed therein comprising, in combination, a relatively wide annular base member, and a plurality of individually flexible spring stressed contact fingers anchored at one end of said base member and extending longitudinally through and spaced radially inwardly from the same for contact engagement with said cylindrical terminal adjacent the other end of said base member.

46. A contact assembly for contact engagement with a cylindrical terminal comprising, in combination, an annular base member having a relatively thin flange depending therefrom, an annular contact shell including a plurality of flexible spring stressed fingers extending through said base member, and a radial flange extending outwardly from said contact shell toward said depending flange, said depending flange being deformed onto said radial flange for anchoring said contact shell to said base member.

47. In a housing for receiving an elongated circuit interrupter unit of the blast action arc extinguishing type, in combination, an insulating sleeve for removably mounting the circuit interrupter unit, means carried by said sleeve for cooling and condensing the products of the arc, and means for detachably holding the circuit interrupter unit in said sleeve in operative relation to said cooling and condensing means.

48. In a housing for an elongated circuit interrupter of the blast action arc extinguishing type having spaced apart terminals, in combination, an insulating sleeve for receiving the circuit interrupter, means carried by said sleeve for cooling and condensing the products of the arc, a pair of contact clips disposed in spaced apart relation inside of said sleeve, and means for holding the circuit interrupter in said sleeve in operative relation to said cooling and condensing means with its terminals in contact engagement with said contact clips.

49. In a housing for a circuit interrupter of the blast action arc extinguishing type having a pair of spaced apart terminals, in combination, an insulating sleeve adapted to receive the circuit interrupter from one end, terminals in said sleeve for contact engagement with said terminals of the circuit interrupter, a condenser assembly removably insertable into said sleeve from its other end for cooling and condensing the products of the arc, and sealing means between said circuit interrupter and said condenser assembly arranged and adapted to prevent said products of the arc from coming into contact with said terminals.

50. In a housing for a circuit interrupter of the blast action arc extinguishing type having a pair of spaced apart terminals, in combination, an insulating sleeve adapted to receive the circuit in-

terrupter from one end, terminals in said sleeve for contact engagement with said terminals of the circuit interrupter, a condenser assembly removably insertable into said sleeve from its other end for cooling and condensing the products of the arc, sealing means between said circuit interrupter and said condenser assembly arranged and adapted to prevent said products of the arc from coming into contact with said terminals, an insulated expansion chamber carried by the housing for receiving said products of the arc from said condenser assembly, and sealing means between said expansion chamber and said housing providing a fluid-tight connection therebetween.

51. In a housing for a circuit interrupter of the blast action arc extinguishing type having a pair of spaced apart terminals, in combination, an insulating sleeve adapted to receive the circuit interrupter from one end, terminals in said sleeve for contact engagement with said terminals of the circuit interrupter, an insulated expansion chamber carried by the housing for receiving the products of the arc, and sealing means between said expansion chamber and said housing providing a fluid-tight connection therebetween.

52. A unitary housing for a circuit interrupter of the blast action arc extinguishing type having a pair of spaced apart terminals comprising, in combination, a metal tank adapted to be grounded, a pair of contact assemblies mounted in insulated spaced relation in said tank, means for removably mounting the circuit interrupter in said tank with its terminals in contact engagement with said pair of contact assemblies, and an expansion chamber carried by and insulated from said tank for receiving the product of the arc.

53. A support for a circuit interrupter of the blast action arc extinguishing type having a pair of spaced apart terminals comprising, in combination, a fluid-tight housing, a pair of spring stressed contact assemblies mounted in spaced apart relation in said housing, means for removably mounting the circuit interrupter in said housing with its terminals in contact engagement with said contact assemblies, and mechanical advantage means cooperating with said mounting means for moving said circuit interrupter toward and away from said spring stressed contact assemblies.

54. A support for a circuit interrupter of the blast action arc extinguishing type having a pair of spaced apart terminals comprising, in combination, a fluid-tight housing, a pair of spring stressed contact assemblies mounted in spaced apart relation in said housing, means for removably mounting the circuit interrupter in said housing with its terminals in contact engagement with said contact assemblies, sealing means between said mounting means and said housing, and mechanical advantage means cooperating with said mounting means for moving said circuit interrupter toward and away from said spring stressed contact assemblies and simultaneously therewith said sealing means into and out of fluid-tight relation.

55. In a housing for a circuit interrupter of the blast action arc extinguishing type, in combination, an insulating sleeve for receiving the circuit interrupter, a condenser rigidly mounted in said sleeve for receiving and cooling the products of the arc, slip joint connecting means between the circuit interrupter and said condenser, and means holding the circuit interrupter in said sleeve in operative relation to said condenser.

56. In a housing for a circuit interrupter of the blast action arc extinguishing type, in combination, an insulating sleeve for receiving the circuit interrupter, a condenser rigidly mounted in said sleeve for receiving and cooling the products of the arc, slip joint connecting means between the circuit interrupter and said condenser, resilient means cooperating with said slip joint means for biasing the same into engagement with the circuit interrupter, and means holding the circuit interrupter in said sleeve against the biasing force of said resilient means.

57. In a housing for a circuit interrupter of the blast action arc extinguishing type having a pair of spaced apart terminals, in combination, an insulating sleeve for receiving the circuit interrupter, a condenser rigidly mounted in said sleeve for receiving and cooling the products of the arc, a pair of contact clips disposed in spaced apart relation inside of said sleeve, telescoping connecting means between the circuit interrupter and said condenser, and means holding the circuit interrupter in said sleeve in operative relation to said condenser with its terminals in contact engagement with said contact clips.

58. In a housing for a circuit interrupter of the blast action arc extinguishing type having a pair of spaced apart terminals, in combination, an insulating sleeve for receiving the circuit interrupter, a condenser rigidly mounted in said sleeve for receiving and cooling the products of the arc, a pair of contact clips disposed in spaced apart relation inside of said sleeve, telescoping connecting means between the circuit interrupter and said condenser, rubber bumper means interposed between said condenser and said telescoping means, and means holding the circuit interrupter in said sleeve in operative relation to said condenser with said rubber bumper means compressed and with its terminals in contact engagement with said contact clips.

59. The combination, with a circuit interrupter of the blast action arc extinguishing type, of a condenser arranged and adapted to receive and cool the products of the arc, telescopic connecting means between the circuit interrupter and said condenser, and resilient means biasing said telescopic connecting means into operative relation with the circuit interrupter.

60. The combination, with a circuit interrupter of the blast action arc extinguishing type, of a condenser arranged and adapted to receive and cool the products of the arc, means for rigidly supporting said condenser, means for removably mounting the circuit interrupter in operating relation to said condenser, telescopic connecting means for interconnecting the circuit interrupter and said condenser, and resilient means biasing said telescopic means into operative relation with the circuit interrupter.

61. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter, means for removably mounting the circuit interrupter in said tank in insulated relation, and a non-ventable expansion chamber formed of insulating material and hermetically sealed to said tank in such position as to confine the products of the arc.

62. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter, means for removably mounting the circuit interrupter in said tank in insulated relation, a condenser mounted in said tank in insulated relation for receiving and cooling the

products of the arc, an exhaust tube secured to said condenser for directing the flow of the products of the arc therefrom, a non-ventable porcelain expansion chamber hermetically sealed to said tank in such position as to confine the products of the arc that have traversed said condenser, and baffle means disposed in the path of the products of the arc from said exhaust tube for causing them to flow in said expansion chamber in a predetermined manner.

63. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter, insulating means in said tank for receiving the circuit interrupter, mounting means disposed to be sealed to one end of said tank for removably mounting the circuit interrupter in said insulating means, a condenser mounted in said tank in insulated relation for receiving and cooling the products of the arc, and a non-ventable expansion chamber formed of insulating material and hermetically sealed to the other end of said tank in such position as to confine the products of the arc that have traversed said condenser.

64. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter, insulating means in said tank for receiving the circuit interrupter, mounting means disposed to be sealed to one end of said tank for removably mounting the circuit interrupter in said insulating means, a condenser mounted in said tank in insulated relation for receiving and cooling the products of the arc, an exhaust tube secured to said condenser for directing the flow of the products of the arc therefrom, a non-ventable porcelain expansion chamber hermetically sealed to the other end of said tank in such position as to confine the products of the arc that have traversed said condenser, and a metal baffle secured to said expansion chamber in such position as to direct the flow of the products of the arc away from the portion thereof adjacent the end of said exhaust tube.

65. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter, means for removably mounting the circuit interrupter in said tank in insulated relation, an insulated expansion chamber sealed to said tank for receiving the products of the arc, and a vent pipe formed of insulating material and connected to said expansion chamber for venting the same to the atmosphere.

66. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter adapted for mounting in a vertical position, means for removably mounting the circuit interrupter in said tank in insulated relation and in such position that it vents upwardly on operation, an insulated expansion chamber sealed to the upper end of said tank for receiving the products of the arc, and a vent pipe formed of insulating material and connected to said expansion chamber for venting the same to the atmosphere.

67. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter adapted for mounting in a vertical position, means for removably mounting the circuit interrupter in said tank in insulated relation and in such position that it vents upwardly on operation, an insulated expansion chamber sealed to the upper end of said tank for receiving the products of the arc, a vent pipe formed of insulating material for venting said expansion chamber to the atmosphere, and a fitting formed of insulating material interconnecting said vent pipe and said expansion chamber whereby there is no likelihood of said products of the arc coming in contact with ground when the housing is submerged.

68. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter adapted for mounting in a vertical position, means for removably mounting the circuit interrupter in said tank in insulated relation and in such position that it vents upwardly on operation, a condenser mounted at the upper end of said tank in insulated relation for receiving and cooling the products of the arc, an expansion chamber formed of insulating material and sealed to the upper end of said tank for receiving the products of the arc from said condenser, and a vent pipe connected in fluid-tight relation to said expansion chamber, said vent pipe being formed of insulating material and extending downwardly to such position below said tank that a water seal is provided therein when the tank is submerged.

69. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter adapted for mounting in a vertical position, means for removably mounting the circuit interrupter in said tank in insulated relation and in such position that it vents upwardly on operation, a condenser mounted at the upper end of said tank in insulated relation for receiving and cooling the products of the arc, an expansion chamber formed of insulating material and sealed to the upper end of said tank for receiving the products of the arc from said condenser, a vent pipe formed of insulating material and disposed in a vertical position adjacent said tank, and an inverted U-shaped metal tubular member interconnecting said expansion chamber and said vent pipe in fluid-tight relation, said vent pipe extending downwardly to such position below said tank that a water seal is provided therein when the tank is submerged.

70. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter adapted for mounting in a vertical position, the upper end of said tank having an offset portion, means for removably mounting the circuit interrupter in said tank in insulated relation and in such position that it vents upwardly on operation, an insulated expansion chamber sealed to the upper end of said tank for receiving the products of the arc, said expansion chamber having an offset portion corresponding to said offset portion of said tank, and a vent pipe extending through said offset portion of said tank and into said offset portion of said expansion chamber for venting the same to the atmosphere.

71. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter adapted for mounting in a vertical position, the upper end of said tank having an offset portion, means for removably mounting the circuit interrupter in said tank in insulated

relation and in such position that it vents upwardly on operation, a condenser mounted at the upper end of said tank in insulated relation for receiving and cooling the products of the arc, an expansion chamber formed of insulating material and sealed to the upper end of said tank for receiving the products of the arc from said condenser, said expansion chamber having an offset portion corresponding to said offset portion of said tank, and a vent pipe formed of insulating material and extending downwardly from said offset portion of said expansion chamber through said offset portion of said tank for venting said expansion chamber to the atmosphere.

72. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter adapted for mounting in a vertical position, means for removably mounting the circuit interrupter in said tank in insulated relation and in such position that it vents upwardly on operation, an insulated expansion chamber sealed to the upper end of said tank for receiving the products of the arc, said expansion chamber having an offset portion, and a vent pipe extending downwardly from said offset portion of said expansion chamber for venting the same to the atmosphere.

73. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter adapted for mounting in a vertical position, means for removably mounting the circuit interrupter in said tank in insulated relation and in such position that it vents upwardly on operation, an insulated expansion chamber sealed to the upper end of said tank for receiving the products of the arc, and a vent pipe formed of insulating material and extending upwardly a substantial distance from said expansion chamber for venting the same to the atmosphere.

74. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter adapted for mounting in a vertical position, means for removably mounting the circuit interrupter in said tank in insulated relation and in such position that it vents upwardly on operation, an insulated expansion chamber sealed to the upper end of said tank for receiving the products of the arc, a vent pipe formed of insulating material and extending upwardly a substantial distance from said expansion chamber for venting the same to the atmosphere, and a fitting formed of insulating material interconnecting said vent pipe and said expansion chamber whereby there is no likelihood of said products of the arc coming in contact with ground when the housing is submerged.

75. A housing for a circuit interrupter of the blast action arc extinguishing type comprising, in combination, a metal tank for the circuit interrupter adapted for mounting in a vertical position, means for removably mounting the circuit interrupter in said tank in insulated relation and in such position that it vents upwardly on operation, a condenser mounted at the upper end of said tank in insulated relation for receiving and cooling the products of the arc, an expansion chamber formed of insulating material and sealed to the upper end of said tank for receiving the products of the arc from said condenser, said condenser extending a substantial distance into said expansion chamber, apertured baffle means disposed adjacent the discharge end of said condenser and carried by said expansion chamber for directing the flow of the products of the arc outwardly from said condenser, and a vent pipe formed of insulating material and extending upwardly a substantial distance from said apertured baffle means for venting said expansion chamber to the atmosphere.

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