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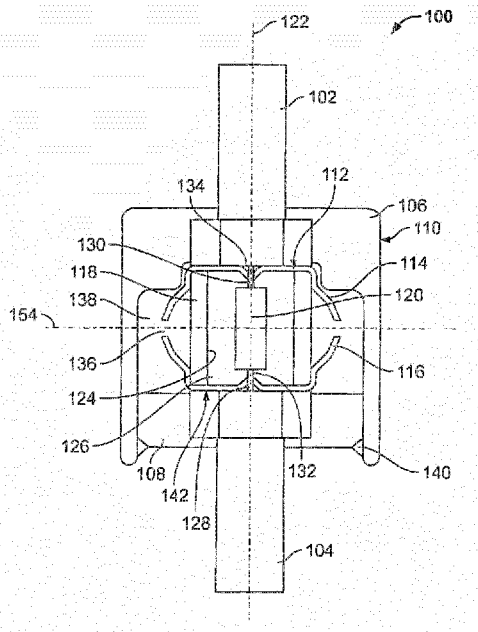

FIG. 1

(57) Abstract: The present invention generally relates to a disconnector arrangement for surge arresters that are used in protecting electrical equipment against overvoltage. The present invention further relates to a method of fabricating such a disconnector arrangement. The disconnector arrangement comprises a first terminal (102), and a second terminal (104), said first and second terminals (102, 104) being arranged along a longitudinal axis (122) of the disconnector arrangement (100), an electrically insulating enclosure (110) comprising a main body (106) and a cover element (108), the enclosure (110) forming an arc chamber (138) between said first and second terminals (102, 104), a resistor (120) interconnecting said first and second terminals (102, 104), said resistor (120) being arranged in a central region of the disconnector arrangement (100), wherein the arc chamber (138) is ring-shaped and surrounds the resistor (120), a first arc electrode (114), and a second arc electrode (116). The first and second arc electrodes (114, 116) are distanced apart from each other to form an arc gap (136) that is arranged to radially encompass said resistor (120). An explosive material (126) can be thermally activated to detonate when a temperature at the resistor (120) exceeds a threshold value, said explosive material (126) being arranged around the resistor (120) and in a radial direction inside the arc gap (136).

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DISCONNECTOR ARRANGEMENT AND FABRICATION METHOD

The present invention generally relates to power transmission and distribution systems and to protection of electrical equipment against overvoltage. In particular, this invention relates to a disconnector arrangement for surge arresters that are used in protecting electrical equipment against overvoltage. The present invention further relates to a method of fabricating such a disconnector arrangement.

Lighting or surge arresters are typically connected to power lines to carry electrical surge currents to ground, and thus, prevent damage to lines and equipment connected to the arresters. Arresters offer high resistance to normal voltage across power lines, but offer very low resistance to surge current produced by sudden high voltage conditions caused for example by lightning strikes, switching surge currents, or temporary over voltages. After the surge, the voltage will drop in the arrester should normally return to a higher resistance state. However, upon arrester malfunction or failure, the same resistance state is not resumed, and the arrester continues to provide an electrical path from the power line to ground. Ultimately, the line will fail due to a short circuit condition, and the arrester will require replacement.

To avoid line failure, disconnector arrangements are known in the art. Disconnector arrangements are commonly used in conjunction with arresters to separate a malfunctioning arrester from the circuit, provide a visual indication of arrester failure and to allow the line to be successfully re-energized or reclosed following the arrester failure and thus minimize the interruption in power supply. Conventional disconnectors have an explosive charge to destroy the circuit path and physically separate the electrical terminals. For instance, an oxidizing agent such as $KClO_3$ can be used that causes, following the overheating and degradation of a resistive wire, an internal explosion within the disconnector. By the explosion the disconnector is triggered to operate and break the ground path if the surge arrester has failed in service.

Some known disconnectors use a 0.22 blank cartridge which detonates and causes the internal explosion. Most commercial disconnectors employ a resistor in parallel with a spark gap in their design and in particular often use a through hole resistor in combination with a spark gap and a 0.22 blank cartridge.

From Indian patent application IN3263MU2013 A, a disconnector arrangement is known which is based on a resistive wire wound onto a plastic tube (also referred to as bobbin). The resistive wire is covered

with a room temperature vulcanization (RTV) material, usually a silicone rubber. A spark gap is located within the center of the tube and $KClO_3$ is arranged in a chamber surrounding the resistor tube. Fig. 4 shows this known disconnecting device 200.

During normal, non-fault operation of the surge arrester, little or no current passes through the disconnecting device 200. When subjected to overvoltage conditions, the surge arrester experiences one or more high current pulses which pass through the disconnecting device 200 to the electrical ground. The disconnecting device 200 comprises a first portion 204 and a second portion 206, the first portion 204 coupled to the surge arrester 104 through a first terminal 208 and the second portion 206 coupled to an electrical ground through a second terminal 210.

The second portion 206 may be physically coupled to the first portion 204 using an adhesive such as epoxy. The first portion 204 and the second portion 206 are formed of an insulating material. The line lead connecting the first terminal 208 to the surge arrester 104 is insert molded onto the first portion 204.

The disconnecting device 200 further comprises a bobbin 212 extending between the first terminal 208 and the second terminal 210 and a resistive element 214 wound around the cylindrical shaped bobbin 212. The resistive element 214 is configured for carrying a fault current generated within the surge arrester in an event of an actual arrester failure or a potential arrester failure. The bobbin 212 is made of an insulating material such as a thermoplastic or a thermoset plastic and the resistive element 214 may be formed using ferrous chromium aluminum alloy.

The first terminal 208 is structured so as to receive a stud from the surge arrester. An externally screw threaded stud that is provided at the lower terminal of the surge arrester 104 is received within an internally screw threaded first terminal 208. Further, at least a portion of the first terminal 208 may be molded to the inner wall of the first portion 204 of the disconnecting device 200. The disconnecting device 200 further comprises an arc pin 216 coupled to the first terminal 208.The arc pin 216 is configured for transmitting the transient over voltage from the surge arrester 104 to the ground.

As the first terminal 208 extends towards the second portion 206, the first terminal 208 is separated by the first portion 204 through the bobbin 212. The shape of the first terminal 208 is tapered towards the second portion 206 so as to give rise to an air gap between the first terminal 208 and the bobbin 212. This air gap is essential in building up appropriate clearance for arriving at a measured spark gap 217.

During normal operation of the surge arrester, the arc pin 216 is configured to divert the overvoltage to the electrical ground. As illustrated in Fig. 4, space within the first portion 204 between arc pin 216 and

the bobbin 212 provides the spark gap 217 through which high current impulses travel to the electrical ground. Within the disconnecting device 200, the high current pulses travel through the arc pin 216 and spark gap 217 for connection to the second terminal 210 and subsequently to the electrical ground. The arc pin 216 and the first terminal 208 are formed of a conductive material such as a metal or a metal alloy. The second portion 206 is formed of an insulating material.

Still referring to Fig. 4, the known disconnecting device 200 further comprises a resistive element 214 spirally would around the non-conductive bobbin 212.The resistive element 214 is configured for carrying a fault current generated within the surge arrester. A chemical agent 218 is disposed between the first portion 204 and the non-conductive bobbin 212, such that the chemical agent 218 is in direct contact with the resistive element 214. The chemical agent 218 comprises an oxidizing agent such as potassium chlorate. In the event of a sustained over voltage and/or failure of the surge arrester, a fault current will flow through the disconnecting device 200. In the process, the resistive element 214 heats up the chemical agent 218 initializing a chemical reaction. The chemical reaction thus activated generates a mechanical force that expels the second portion 206 from the first portion 204. This action electrically disconnects the surge arrester from the ground and also provides a visual indication of the need for surge arrester replacement.

When the surge arrester is normally functioning while withstanding transient over voltage, impedance of the resistive element 214 is so graded that the fault current does not flow through the resistive element 214 and therefore the transient voltage is applied across the spark gap 217 making the impulses flow through the spark gap 217 to the ground. However, if the surge arrester fails to withstand the transient voltage, arcs may be generated over a sufficiently longer duration to activate a chemical reaction causing the mechanical separation of the portions 204 and 206 from one another. This action electrically disconnects the surge arrester from the electrical ground and provides a visual indication of the need for surge arrester replacement.

Further, the disconnecting device 200 operates in a similar fashion when experiencing alternating current (AC) for a time period longer than a predetermined duration. A continuous flow of alternating current heats up the resistive element 214 that upon reaching a threshold temperature induces a reaction in the chemical agent 218 that surrounds the resistive element 214. The pressure generated due to chemical reaction propels the second portion 206 to separate from first portion 204 thereby severing the current path.

However, conventional disconnector arrangements comprise usually a relatively large number of intricate, specialized parts which are relatively expensive to manufacture and assemble. Moreover,

known disconnectors often have the disadvantage that they have an unsatisfactory reproducibility of their operational characteristics due to variations of their dimensions and tolerances.

There is a need to provide an improved more reliable disconnector arrangement, which furthermore can easily be adapted to changing requirements and allows economic fabrication and testing.

This object is solved by the subject matter of the independent claims. Advantageous embodiments of the present invention are the subject matter of the dependent claims.

The present invention is based on the idea that by providing an external arc gap (also referred to as air gap or spark gap) which encompasses the resistor, the disconnector arrangement can be fabricated much more easily and with a significantly improved accuracy. Furthermore, the testing of whether the required tolerances are met can be achieved much more easily because the arc electrodes and the arc gap there between stay visible until the final mounting steps.

In particular, a disconnector arrangement according to the present invention comprises a first terminal, and a second terminal, said first and second terminals being arranged along a longitudinal axis of the disconnector arrangement. An electrically insulating enclosure comprises a main body and a cover element, the enclosure forming an arc chamber between said first and second terminals. A resistor interconnects said first and second terminal, said resistor being arranged in a central region of the disconnector arrangement, wherein the arc-chamber is ring-shaped and surrounds the resistor.

The connector arrangement comprises a first arc electrode and a second arc electrode, wherein the first and second arc electrodes are distanced apart from each other to form an arc gap that is arranged to radially encompass said resistor is provided. An explosive material that can be thermally activated to detonate when a temperature at the resistor exceeds a threshold value, said explosive being arranged around the resistor and in a radial direction inside the arc gap.

This design according to the present invention differs from the conventional design explained with reference to Fig. 4 in that it allows using a standard off-the-shelf through-hole resistor instead of a handmade resistor wound onto a nylon tube. Moreover, the number of specialized components required can be reduced and therefore the costs are decreased. Providing an external arc gap allows the quality check to be performed on the actual gap dimensions before performing the final assembly. This is not possible with designs where the gap is embedded within a tube or is only formed when the disconnector is finally sealed and assembled. Advantageously, the external gap according to the present invention provides a greater surface area for the arc flashover and therefore has the advantage of a longer operational life time and a higher robustness in service. Furthermore, higher resistance values

can be chosen which in turn allow a greater tolerance in the external gap, the rendering the disconnector arrangement more reliable.

According to an advantageous embodiment, the resistor comprises a through-hole resistor. such a through-hole resistor is a commercially available electronic component which is produced at low cost and with small parameter variation. Furthermore, different resistance values can easily be implemented without changes in the mechanical setup.

According to a further advantageous embodiment of the present invention, the resistor and said explosive material are arranged within an electrically insulating protective sheath that is surrounded by said first and second arc electrodes. Thereby the explosive material is protected during normal operation on the one hand, and, on the other hand, is in direct and reliable thermal contact with the resistor in order to be actuated reliably if needed.

In order to avoid cartridges that use hazardous chemicals which may be subject to statutory regulation, the disconnector arrangement according to the present invention employs potassium chlorate powder as the explosive material. Manganese (IV) oxide may also be added to the potassium chlorate powder to act as a catalyst for the thermal decomposition of potassium chlorate. However, it is clear for a person skilled in the art that any other chemical agent which generates pressure upon being heated up by the resistor may also be used.

The electrical connection between the resistor and the arc electrodes may be established by means of a solder connection. This is a simple and reliable method of electrically connecting these parts. However, of course also press-fit connection, plug connection, or any other suitable contacting means may also be employed.

Advantageously, the main body of the enclosure has a rotationally symmetric shape with respect to the longitudinal axis, wherein said resistor extends along the longitudinal axis. such a design allows a particularly easy and economic fabrication of the enclosure and the complete disconnector arrangement. For the same reason, the first and second arc electrodes may have a rotationally symmetric shape with respect to said longitudinal axis. In this case, the air gap may be formed as a circular ring radially surrounding said longitudinal axis. Such a circular gap has the advantage that it provides a larger surface area for the arc flash over. Consequently, the disconnector arrangement is longer-lasting and more robust in service. Of course, also a non-rotationally symmetric shape can be used for the main body and the arc electrodes.

Advantageously, the first and second arc electrodes have an identical geometry and are arranged to be symmetrical to each other with respect to a plane that extends across to the longitudinal axis. Hence, only one set of tools for producing the arc electrodes has to be provided. This results in a further reduction of costs.

According to a further advantageous embodiment of the present invention, the cover element is inserted into an opening of the main body and fixed by means of a press fit. This facilitates the assembly while still ensuring a reliable breaking of the electrical connection in case the explosive is activated. Other assembly and sealing techniques may of course also be employed, such as gluing, ultrasonic welding, and the like.

In order to ensure a long-term reliable and stable functioning of the disconnector arrangement during faultless operation, the disconnector arrangement further comprises sealing means that seal an interface between the main body and the cover element against the intrusion of humidity and dust. The sealing means may for instance be a thermosetting adhesive such as an epoxy, acrylic, or polyurethane adhesive.

The present invention further relates to a method of fabricating a disconnector arrangement. According to the present invention, the method comprises the following steps:

attaching a first terminal to a main body of an electrically insulating enclosure,

attaching a second terminal to a cover element of the electrically insulating enclosure, the cover element being a part separate from the main body,

assembling a first arc electrode with a resistor, so that the first arc electrode partly surrounds the resistor and is electrically connected to a first end of the resistor,

mounting an electrically insulating protective sheath inside the first arc electrode and around said resistor, so that a cavity is formed around the resistor and inside the protective sheath,

arranging an explosive material that can be thermally activated to detonate when a temperature at the resistor exceeds a threshold value, said explosive being arranged inside the cavity,

attaching a second arc electrode, so that the second arc electrode partly surrounds the resistor and is electrically connected to a second end of the resistor, an arc gap being formed that radially encompasses said resistor,

inserting the assembly comprising the arc electrodes, the protective sheath, the explosive material, and the resistor into the main body, and attaching the cover element, so that a first electrical connection is established between the first terminal, the first end of the resistor, and the first arc electrode, and a second electrical connection is established between the second terminal, the second end of the resistor, and the second arc electrode.

By first fabricating an active component comprising the arc electrodes, the protective sheath, the explosive material, and the resistor, the air gap can be inspected before the complete disconnector arrangement is assembled. Thus, quality control is facilitated.

In order to provide a secure and stable electrical connection, the first and second ends of the resistor are soldered to the first and second arc electrodes, respectively. Advantageously, the first arc electrode is push fitted over one end of the protective sheath, and a through-hole resistor is connected to the arc electrodes using lead-free solder. An inner chamber of the protective sheath is then filled with potassium chlorate so as to surround the resistor. Next, the second arc electrode is pushed onto the other end of the protective sheath, at the same time allowing the resistor lead wire to pass through a center hole in the arc electrode. This wire can also be soldered to the second arc electrode.

Advantageously, the first and second arc electrodes are formed as identical pressed metal parts.

As already mentioned above, the fabrication method advantageously further comprises the step of sealing an interface between the main body and the cover element against the intrusion of humidity and dust.

The accompanying drawings are incorporated into the specification and form a part of the specification to illustrate several embodiments of the present invention. These drawings, together with the description, serve to explain the principles of the invention. The drawings are merely for the purpose of illustrating the preferred and alternative examples of how the invention can be made and used, and are not to be construed as limiting the invention to only the illustrated and described embodiments.

Furthermore, several aspects of the embodiments may form—individually or in different combinations—solutions according to the present invention. Further features and advantages will be become apparent from the following more particular description of the various embodiments of the invention as illustrated in the accompanying drawings, in which like references refer to like elements, and wherein:

FIG. 1 is a schematic sectional view of a disconnector arrangement according to the present invention;

FIG. 2 is a schematic electrical diagram illustrating the disconnector arrangement in a first application environment;

FIG. 3 is a schematic electrical diagram illustrating the disconnector arrangement in a second application environment;

FIG. 4 is a schematic sectional view of a conventional disconnector arrangement.

The invention will now be explained in more detail with reference to the Figures. Referring first to Figure 1, a disconnecting arrangement 100 according to the present invention is shown. the disconnector arrangement 100 comprises a first terminal 102 and a second terminal 104. Via the first and second terminals 102, 104, respectively, the disconnector arrangement 100 can be connected to the electric line which has to be interrupted by means of the disconnector arrangement 100 (see Figures 2 and 3 as described below). in the shown embodiment, the first and second terminals 102, 104 are formed by steel bolts, for instance M12 bolts. This has the advantage that economic, commercially available components can be used which are compatible with many surge arrestors and connectors.

The first terminal 102 is embedded in an electrically insulating main body 106. The second terminal 104 is held within a cover element 108 which preferably is also fabricated from an electrically insulating plastic material. The main body and the cover element together form an electrically insulating enclosure 110 for an active component 112. According to the present invention, the active component 112 comprises a first arc electrode 114 and a second arc electrode 116. The arc electrodes 114, 116 are attached to an electrically insulating protective sheath 118.

According to the present invention, a linear resistive element for example formed by a through-hole resistor 120 is arranged in the center of the active component 112. Alternatively a non-linear resistor can be arranged in the center of the active component 112. However, the resistive element 120 does not necessarily have to be formed by a through-hole resistor. It can also be formed by other suitable resistors that heat up if an excessive current flows through them. The important aspect of the present invention is that the resistive element 120 is located in the center of the disconnector arrangement 100. According to the shown embodiment the resistor 120 extends along a longitudinal axis 122 of the disconnector arrangement 100.

The protective sheath 118 forms an explosive compartment 124 which is filled with a thermally activatable chemical compound 126. The thermally activatable chemical compound (also referred to as chemical agent) may for instance comprise an oxidant such as potassium chlorate ($KClO_3$).

The first and second arc electrodes 114, 116 are essentially cup-shaped and have an opening 128 for inserting a first lead 130 and second lead 132 of the resistor 120, respectively. Solder connections 134 electrically connect the first lead of the resistor 122 the first arc electrode 114, and the second lead 130 of the resistor 122 the second arc electrode 116. However, also a press-fit connection may be sufficient.

According to the present invention a ring shaped arc gap 136 is formed between the first arc electrodes 114 and a second arc electrode 116. Before being mounted inside the enclosure 110, the active component 112 can be tested regarding the dimensions and quality of the arc gap 136 because the arc gap is arranged externally to the compartment 124 enclosing the chemical agent 126 and the resistor 120. In the finally mounted state, the active component 112 is arranged inside an internal cavity inside the main body 106 of the enclosure 110 which forms an arc chamber 138. Usually, the arc chamber 138 is simply filled with air. However, it is clear for a person skilled in the art that also other gases, or liquids, or powders may be filled into the arc chamber 138.

The arc chamber is closed by the cover element 108. Advantageously, the cover element 108 is a flat part that is pressed fitted into the opening provided at the main body 106. For sealing the arc chamber 138 and the active component 112 from the intrusion of humility or dust, a sealant 140 is provided at the interface between the main body 106 and the cover element 108.

As shown in Fig. 1, the first and second arc electrodes 114, 116 are in electrical contact with the first terminal 102 and the second terminal 104. For establishing this electrical contact, each of the first and second arc electrodes 114, 116 has an essentially planar contact region 142.

In the embodiment shown in Fig. 1, the disconnector arrangement 100 is rotationally symmetric with respect to the longitudinal middle axis 122. In other words, all parts of the disconnector arrangement 100 have circular cross-sections under 90° to the middle axis 122. However, if necessary also a square cross-section or any other suitable outline can be chosen for any or all of the parts of the disconnector arrangement 100.

Fig. 2 shows an arrangement where the disconnector arrangement 100 is connected in series with an arrester 144, forming an arrester assembly 146. The arrester assembly 146 may for instance be connected between a power line 148 and ground 150. During normal non-fault operation of the arrester, little or no current passes through the arrester assembly 146 due to the high resistance of the

arrester. When subjected to lightning or surge currents, the arrester 144 experiences high pulse currents which travel through the arrester 144 and the disconnector arrangement 100 to ground. Within the disconnector arrangement 100 as shown in Fig. 1, the current will arc over the arc gap 136 from the first terminal 114 to the second terminal 116.

When the arrester 144 is properly functioning, the gaps spark over for high current lightning or switching currents. For such short sparkovers, insufficient energy is generated to activate or detonate the chemical agent 126. However, if the lightning arrester fails due to an internal fault or inability to withstand the surge current, a longer duration power frequency current flows over the resistor 120 and thermally activates the chemical agent 126. This causes an explosion that separates the main body 106 with the first terminal 102 and the cover element 108 with the second terminal 104 mechanically from one another. This action electrically disconnects the arrester 144 and provides a visual indication of the need for arrester replacement and allows the power line to be re-energized or reclosed successfully following the arrester fault and thus minimizes the power interruption to customers.

This principle may also be used for protecting electrical equipment 152 by connecting the arrester assembly 146 in parallel to the electrical equipment 152 between the power line 148 and ground 150.

In the following, the fabrication of the disconnector arrangement 100 will be explained with reference to Fig. 1.

First, the first and second arc electrodes 114, 116 are fabricated as pressed metal parts for instance from brass, stainless steel, zinc plated steel, aluminum or other metallic materials. Advantageously, both arc electrodes 114, 116 have identical shape.

Furthermore, the protective sheath 118 is fabricated as a short tube from an electrically insulating material, such as polyamide or any other suitable insulating material. One of the arc electrodes is pushed fitted onto one end of the protective sheath 118 and the through-hole resistor 120 is connected to the arc electrodes using e. g. lead-free solder. The internal chamber of the tube 118 is filled with $KClO_3$ or any other suitable chemical agent which surrounds the resistor 120.

Next, the second arc electrode 116 is pushed fitted over the other side of the tube while at the same time allowing the resistor lead wire 134 or 132 to pass through the center hole 128 of the arc electrode. This resistor wire can also be soldered to the arc electrodes. These parts form an active component 112 having an external spark gap formed by the arc electrodes, wherein the parallel resistor 120 is embedded within the tube 118 and surrounded by the $KClO_3$ powder 126.

The active component 112 can be analyzed as to the quality of the arc gap 136 between the two arc electrodes 114, 116. The spark gap distance may for instance be 1.2 mm nominally. Moreover, once a particular distance has been reached for the arc gap 136, the further process steps will not influence this distance anymore. It should be noted that the active component 112 is not only rotationally symmetric with respect to the longitudinal axis 122, but also mirror symmetric with respect to a plane 154 defined by the middle of the spark gap 136.

After the optional step of performing a quality check, the active component 112 is inserted into the main body 106 in a direction along the longitudinal axis 122. The planar contact region 142 is in abutting contact with the screw head of the bolt forming the first terminal 102.

In a next step, the cover element 108 with the bolt forming the second terminal 104 is inserted into the internal chamber of the main body 106. Thereby an electrical connection is established between the contact region 142 and the screw head of the bolt forming the second terminal 104.

As a final step, alternately a sealant 140 may be applied at the interface between the main body 106 and the cover element 108. For instance, a thermosetting adhesive such as an epoxy, acrylic, or polyurethane adhesive may be applied.

In summary, the design according to the present invention differs from existing designs as for instance shown in Fig. 4 in that it uses a standard off-the-shelf through-hole resistor (preferably a carbon film resistor, or a metal oxide or metal film resistor) instead of a handmade resistor wound onto a plastic tube. According to the present invention, the resistor is inside a polyamide (or alternative insulating material) tube sealed on either end with two pressed metal components (brass or stainless steel). One pressed metal component is push fitted onto one end of the nylon tube and the through-hole resistor is connected to it using lead-free solder. The internal chamber of the tube is filled with $KClO_3$ which surrounds the resistor. The second pressed component is pushed onto the upper side of the tube while at the same time allowing the resistor lead wire to pass through the center hole in the pressed component. This wire can also be soldered to the pressed component. The active component of the disconnector arrangement is thus assembled with an external spark gap formed by the pressed components and the parallel resistor is embedded within the tube and surrounded by the $KClO_3$.

Some of the existing designs are less robust as the spark gap distance (nominally 1.2 mm) cannot be easily checked following assembly and variable clamp forces applied by the clamp jig can cause the spark gap distance to be compressed either to 0 mm or a fraction of a millimeter, potentially causing variations in performance or non-operation of the disconnect devices during type tests and when in service.

Furthermore, a higher resistor value can be easily selected from the available off-the-shelf components and wattages of 1 W and 2 W are readily available and provide sufficient robustness for surge arrester temporary overvoltage (TOV) withstand test requirements. The higher resistor value allows larger spark gap values to be selected and these are less susceptible to variation in gap distances during assembly and manufacturing.

Consequently, the present invention offers the advantage of a lower cost as it can utilize a low cost through-hole resistor, standard M12 bolts and minimizes the number of specialized components required. The principle is close to the current technology as shown in Fig. 4, but the external gap allows a quality check to be performed on the actual gap dimensions which is not possible on designs where the gap is embedded within a tube or only formed when the disconnect is sealed and assembled. Furthermore, the external gap provides greater surface area for arc flashover and thus is longer lasting and more robust in service. Finally, the disconnector arrangement according to the present invention is more reliable than existing concepts because the higher resistance allows greater tolerances in the external arc gap.

REFERENCE NUMERALS

Reference Numeral	Description
100	Disconnector arrangement
102	First terminal
104	Second terminal
106	Main body
108	Cover element
110	Enclosure
112	Active component
114	First arc electrode
116	Second arc electrode
118	Protective sheath
120	Through-hole resistor
122	Longitudinal axis
124	Compartment
126	Thermally activatable compound, chemical agent
128	Opening in arc electrode
130	First lead of resistor
132	Second lead of resistor
134	Solder connection
136	Arc gap
138	Internal cavity, arc chamber
140	Sealant
142	Contact region
144	Arrester

146	Arrester assembly
148	Power line
150	Ground
152	Electrical equipment
154	Plane of symmetry
200	Disconnecting device
204	First portion
206	Second portion
208	First terminal
210	Second terminal
212	Bobbin
214	Resistive element
216	Arc pin
217	Spark gap
218	Chemical agent

CLAIMS

1. Disconnector arrangement comprising:

a first terminal (102), and a second terminal (104), said first and second terminals (102, 104) being arranged along a longitudinal axis (122) of the disconnector arrangement (100),

an electrically insulating enclosure (110) comprising a main body (106) and a cover element (108), the enclosure (110) forming an arc chamber (138) between said first and second terminals (102, 104),

a resistor (120) interconnecting said first and second terminals (102, 104), said resistor (120) being arranged in a central region of the disconnector arrangement (100), wherein the arc chamber (138) is ring-shaped and surrounds the resistor (120),

a first arc electrode (114),

a second arc electrode (116),

wherein the first and second arc electrodes (114, 116) are distanced apart from each other to form an arc gap (136) that is arranged to radially encompass said resistor (120),

an explosive material (126) that can be thermally activated to detonate when a temperature at the resistor (120) exceeds a threshold value, said explosive material (126) being arranged around the resistor (120) and in a radial direction inside the arc gap (136).

2. Disconnector arrangement according to claim 1, wherein said resistor (120) is a linear or a non-linear resistor.

3. Disconnector arrangement according to claims 1 or 2, wherein the resistor (120) and said explosive material (126) are arranged within an electrically insulating protective sheath (118) that is surrounded by said first and second arc electrodes (114, 116).

4. Disconnector arrangement according to one of the preceding claims, wherein said explosive material (126) comprises potassium chlorate.

5. Disconnector arrangement according to one of the preceding claims, wherein said resistor (120) is electrically connected with said arc electrodes (114, 116) by means of a solder connection (134).

6. Disconnector arrangement according to one of the preceding claims, wherein the main body (106) of said enclosure (110) has a rotationally symmetric shape with respect to the longitudinal axis (122), and wherein said resistor (120) extends along the longitudinal axis (122).

7. Disconnector arrangement according to one of the preceding claims, wherein said first and second arc electrodes (114, 116) have a rotationally or non-rotationally symmetric shape with respect to said longitudinal axis (122).

8. Disconnector arrangement according to claim 7, wherein the air gap (136) is formed as a circular ring radially surrounding said longitudinal axis (122).

9. Disconnector arrangement according to one of the preceding claims, wherein said first and second arc electrodes (114, 116) have an identical geometry and are arranged to be symmetrical to each other with respect to a plane (154) that extends across to said longitudinal axis (122).

10. Disconnector arrangement according to one of the preceding claims, wherein said cover element (108) is inserted into an opening of the main body (106) and fixed by means of a press fit, gluing, and/or ultrasonic welding.

11. Disconnector arrangement according to claim 10, further comprising sealing means (140) that seal an interface between the main body (106) and the cover element (108) against the intrusion of humidity and dust.

12. Method of fabricating a disconnector arrangement, said method comprising the following steps:

attaching a first terminal (102) to a main body (106) of an electrically insulating enclosure (110),

attaching a second terminal (104) to a cover element (108) of the electrically insulating enclosure (110), the cover element (108) being a part separate from the main body (106),

assembling a first arc electrode (114) with a resistor (120), so that the first arc electrode (114) partly surrounds the resistor (120) and is electrically connected to a first end (130) of the resistor (120),

mounting an electrically insulating protective sheath (118) inside the first arc electrode (114) and around said resistor (120), so that a cavity (124) is formed around the resistor (120) and inside the protective sheath (118),

arranging an explosive material (126) that can be thermally activated to detonate when a temperature at the resistor (120) exceeds a threshold value, said explosive being arranged inside the cavity (124),

attaching a second arc electrode (116), so that the second arc electrode (116) partly surrounds the resistor (120) and is electrically connected to a second end (132) of the resistor (120), an arc gap (136) being formed that radially encompasses said resistor (120),

inserting the assembly (112) comprising the arc electrodes (114, 116), the protective sheath (118), the explosive material (126), and the resistor (120) into the main body (106), and

attaching the cover element (108), so that a first electrical connection is established between the first terminal (102), the first end of the resistor (130), and the first arc electrode (114), and a second electrical connection is established between the second terminal (104), the second end of the resistor (132), and the second arc electrode (116).

13. Method according to claim 12, wherein the first and second ends (130, 132) of the resistor (120) are soldered to the first and second arc electrodes (114, 116), respectively.

14. Method according to claims 12 or 13, wherein the first and second arc electrodes (114, 116) are formed as identical pressed metal parts.

15. Method according to one of the claims 12 to 14, further comprising the step of sealing an interface between the main body (106) and the cover element (108) against the intrusion of humidity and dust.

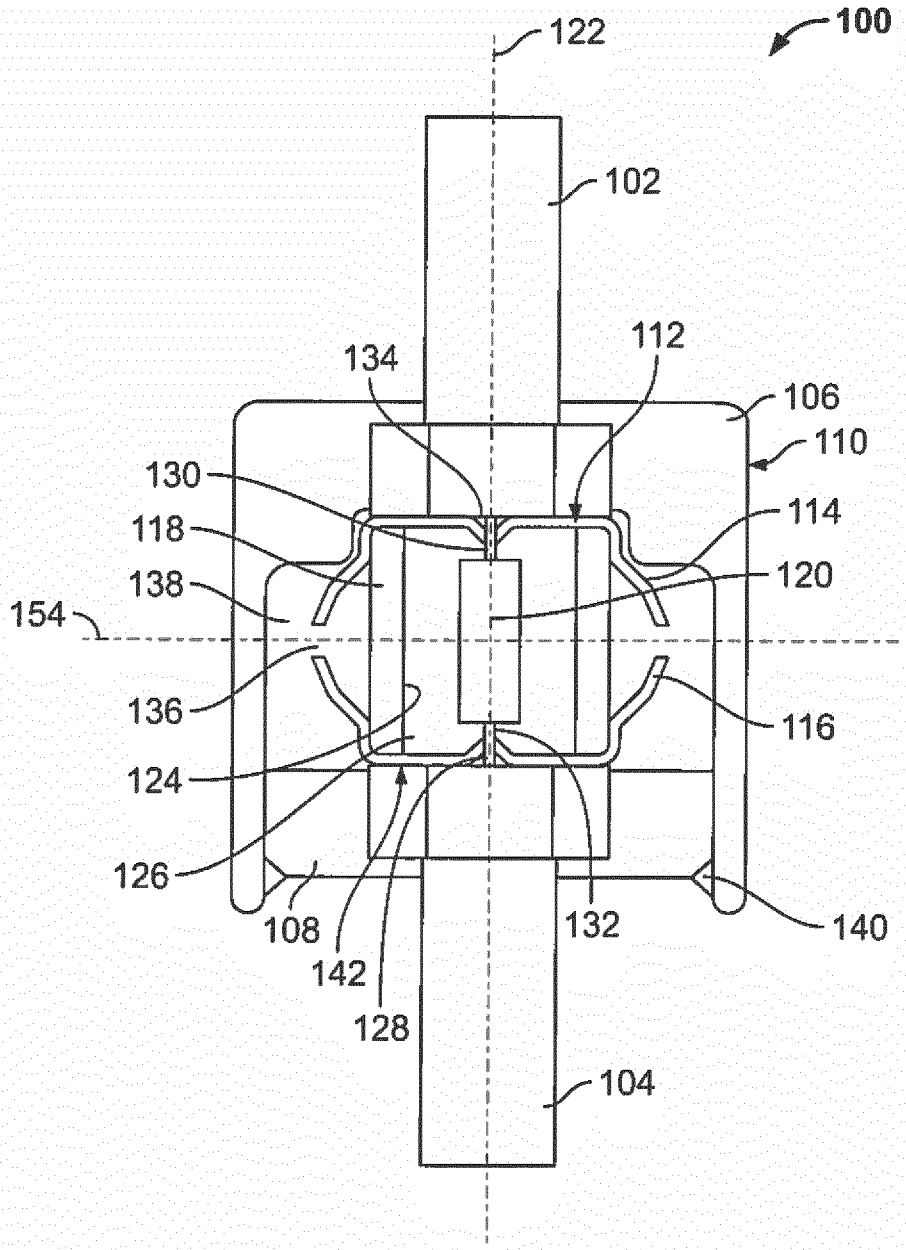
122
100
102
112
134
106
110
130
114
118
120
138
154
136
116
124
126
108
132
140
142
128
104

FIG. 1

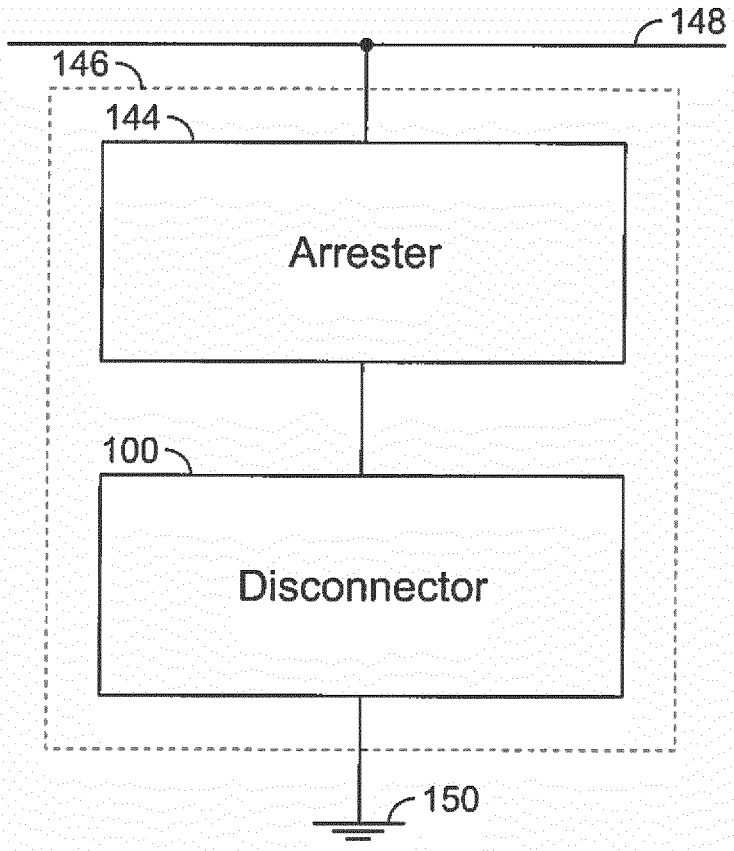
148
146
144
Arrester
100
Disconnector
150

FIG. 2

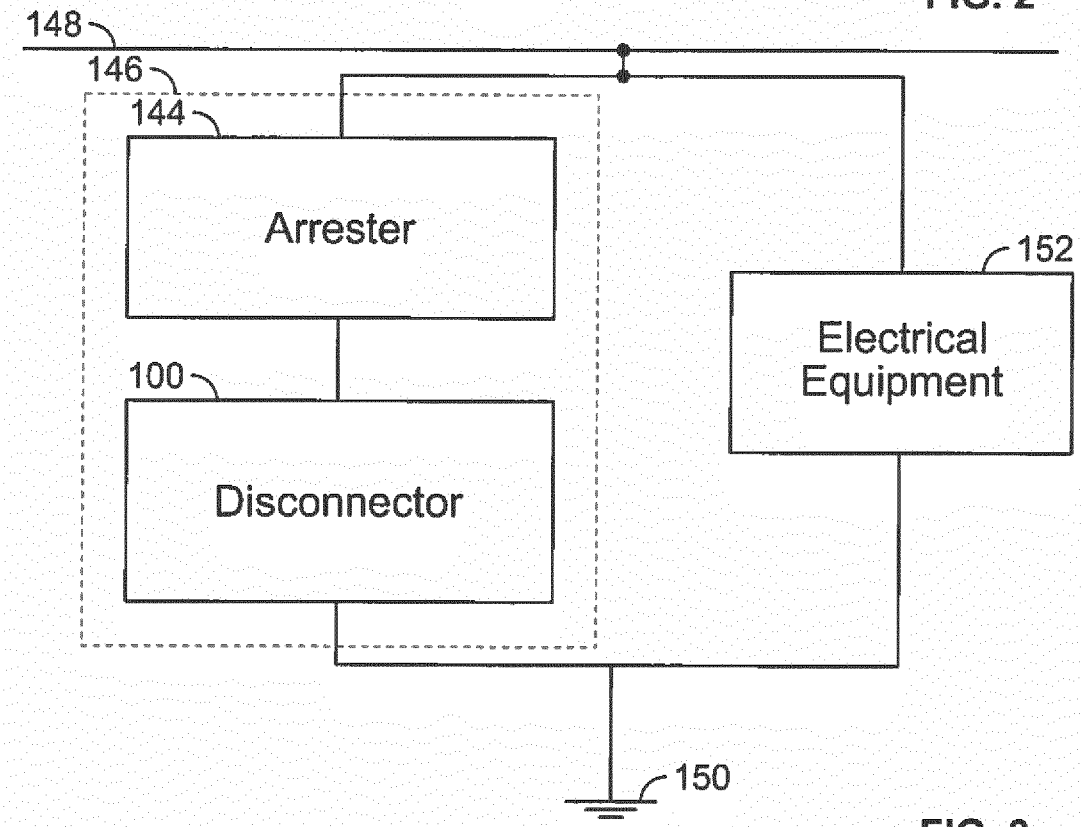
148
146
144
Arrester
100
Disconnector
152
Electrical Equipment
150

FIG. 3

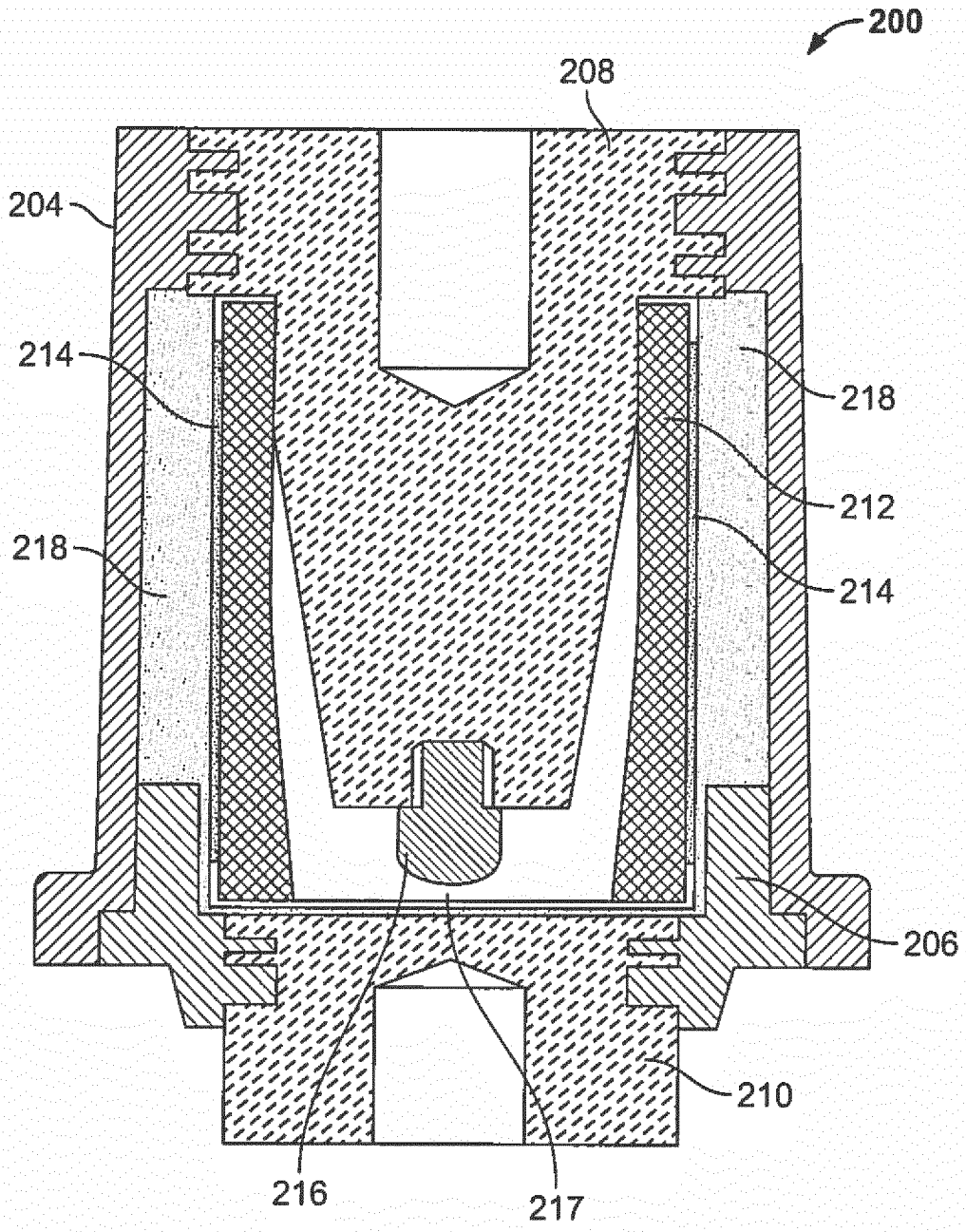

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/055304

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01T1/14 H01T4/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01T H01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3 668 458 A (IRIE KOUHEI ET AL) 6 June 1972 (1972-06-06) column 1, line 67 - column 2, line 66; figures 1-3	1-15
Y	DE 10 2014 015612 A1 (PHOENIX CONTACT GMBH & CO [DE]) 28 April 2016 (2016-04-28) paragraph [0041] - paragraph [0044]; figures 1-3	1-15
A	US 2 989 608 A (CLIFFORD HICKS BRUCE) 20 June 1961 (1961-06-20) column 3, line 62 - column 4, line 25; figure 2	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 May 2018	28/05/2018

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2018/055304

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		DE 102014015612 A1	28-04-2016
US 2989608 A	20-06-1961	NONE	