(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 October 2009 (22.10.2009)

PCT

(10) International Publication Number
WO 2009/127934 A2

(51) International Patent Classification:
H01F 27/40 (2006.01) *H01H 31/12* (2006.01)

(21) International Application Number:
PCT/IB2009/005222

(22) International Filing Date:
9 April 2009 (09.04.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2008/03463 18 April 2008 (18.04.2008) ZA

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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(54) Title: TRANSFORMER HOUSING, TRANSFORMER BUSHING AND SURGE ARRESTOR

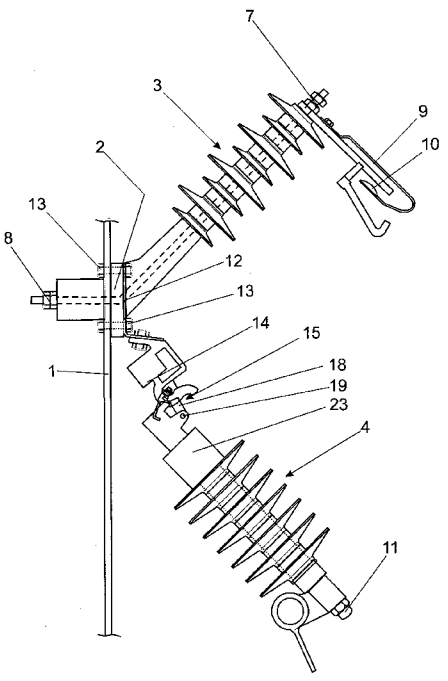


Figure 3

(57) Abstract: A transformer bushing (3) and cooperating surge arrestor are provided wherein an insulating body (6, 44) has a foot (2) for securing the bushing to a transformer housing (1) and an input conductor (5, 35, 43) passing generally axially through at least a major part of the length of the insulating body. The input conductor terminates in an internal output terminal (8) at its operatively inner end and is electrically connected, in its operative condition, to an external input terminal (7, 34, 46) at or towards the operatively outer end of the transformer bushing remote from the foot. The external input terminal has a laterally extending conductor (9) electrically connected to it and having at its end region remote from the bushing a releasable terminal assembly (10) for cooperation with a cooperant releasable contact (11) at one end of a surge arrestor (4, 32). The foot of the insulating body is preferably adapted to be mounted in a generally vertical plane with the insulating body extending upwardly at an incline in the operative position and has an electrically conductive bracket (12). The bracket has attached thereto an electrically conductive terminal assembly (14) for operative association with a contact (15) at the grounded end of a surge arrestor such that, when the surge arrestor fails, it drops out of the operative position to a hanging inoperative position.

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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

TRANSFORMER HOUSING, TRANSFORMER BUSHING AND SURGE ARRESTOR

FIELD OF THE INVENTION

This invention relates to a transformer housing assembly, a transformer bushing, and a surge arrestor for use in association therewith on the line (input) side to a transformer within the housing.

BACKGROUND TO THE INVENTION

It is common practice to install a surge arrestor in parallel with the insulated input conductor passing through a transformer bushing in order to dissipate surges to ground that would otherwise damage a transformer, typically by causing a breakdown in the insulating properties of the usual insulating oil in the relevant transformer housing.

Typically, and as illustrated in Figure 1 of the accompanying drawings, a surge arrestor (a) is installed in parallel with a transformer bushing (b) that is carried by the transformer housing (c). The surge arrestor is generally mounted by way of a mounting flange (d) of electrically insulating material that is secured to a special mounting bracket (e) in turn secured to the transformer housing. The input terminal (f) of the surge arrestor is connected by means of a conductor to the input terminal (g) of the transformer bushing and the ground terminal (h) is connected to the grounded transformer housing by way of an earth conductor (i) with an expulsion device (j) being interposed between the ground terminal and earth conductor.

Commonly, the surge arrestor is of the metal oxide, in particular zinc oxide, varistor type that can become faulty if it is subjected to an excessive severity of surge or number of surges in which instance the normally high resistance

of the arrestor to normal voltages becomes diminished and the input terminal of the surge arrestor may become effectively grounded. The purpose of the expulsion device is to disconnect the surge arrestor under such conditions.

The surge arrestor then needs to be replaced and that may only be done during a periodic maintenance check that is frequently only conducted once a year. In the intervening period the transformer would therefore be susceptible to damage that may be caused by surges, for example those occasioned by lightning strikes, that would otherwise be taken care of by the surge arrestor. Also, replacement of such a surge arrestor typically requires the network to be isolated during replacement with the accompanying inconvenience to all affected consumers.

It is to be noted that in order to minimise the effects of impedance, a surge arrestor is generally installed as close as possible to the transformer bushing.

OBJECT OF THE INVENTION

It is an object of this invention to provide a transformer housing assembly, a transformer bushing and a surge arrestor that, in use, provides at least some advantage over the prior art situation described above.

It is another object of the invention to provide, as may be required, a transformer housing assembly, a transformer bushing and a surge arrestor that in use provide a visible indication that the surge arrestor is non-functional or that the electrical circuit to the transformer has become open.

SUMMARY OF THE INVENTION

In accordance with one aspect of this invention there is provided a transformer bushing comprising an insulating body having a foot for securing the bushing to a transformer housing, an input conductor passing generally

axially through at least a major part of the length of the insulating body and terminating in an internal output terminal at its operatively inner end, the input conductor being electrically connected, in its operative condition, to an external input terminal at or towards the operatively outer end of the transformer bushing remote from the foot, the transformer bushing being characterized in that the external input terminal has a laterally extending conductor electrically connected to it and having at its end region remote from the bushing a releasable terminal assembly for cooperation with a cooperant releasable contact at one end of a surge arrestor.

Further features of this aspect of the invention provide for the releasable terminal assembly to include an electrically conductive resilient leaf in which instance the releasable terminal assembly includes a recess for receiving a domed contact surface provided on an input contact at one end of a surge arrestor; for the foot of the insulating body to be adapted to be mounted in a generally vertical plane with the insulating body extending upwardly at an incline in the operative position; for the foot of the insulating body to have an electrically conductive bracket associated therewith wherein the bracket has attached thereto an electrically conductive terminal assembly for operative association with a contact at the grounded end of a surge arrestor such that the bracket and electrically conductive terminal assembly are operatively grounded to an associated transformer housing by means of electrically conductive fasteners such as bolts securing same to the transformer housing; and for the electrically conductive terminal assembly associated with the bracket to include a bifurcated cradle for releasably receiving, in use, a relatively rotatable articulated contact assembly associated with the grounded end of a surge arrestor.

In some variations of the invention the input conductor extends through the insulating body from the internal output terminal to the external input terminal. In other variations the input conductor as interrupted along its length and provided with a pair of laterally offset intermediate terminals that are

interconnected by a bridging conductor associated with an installed surge arrestor.

In accordance with a second aspect of the invention there is provided a transformer bushing assembly comprising a transformer bushing as defined above in which the foot of the insulating body has an electrically conductive bracket associated with it for mounting on the outside of the foot wherein the electrically conductive bracket is configured to support one end of a surge arrestor by way of a contact assembly associated in use with the grounded end of the surge arrestor with the opposite end of the surge arrestor having the releasable contact assembly in cooperating relationship with the releasable terminal assembly carried by the bushing.

In accordance with a third aspect of the invention there is provided a transformer housing fitted with a transformer bushing as defined above with the foot of the bushing insulator being secured to the transformer housing by means of electrically conductive fasteners that also secure an electrically conductive bracket on the outside of the foot with the electrically conductive bracket being configured to support one end of a surge arrestor by way of a contact assembly associated with the grounded end of the surge arrestor.

In accordance with a fourth aspect of the invention there is provided a surge arrestor of generally elongate construction with a variable resistance core surrounded by an optionally finned insulator, the surge arrestor having an input contact at one end and a ground contact at the other end, the surge arrestor being characterised in that the input contact is configured as a releasable contact for cooperation with a cooperant terminal assembly and the ground contact includes an articulated contact assembly having retaining means for holding the articulated contact in an operatively generally rigid configuration in which the input terminal and ground terminal are in cooperating relationship with cooperant terminals, and an inoperative configuration in which the articulated contact is free to collapse and the input

contact is operatively free to disengage itself from a cooperant terminal assembly.

Further features of the fourth aspect of the invention provide for the surge arrestor to be of the type in which the variable resistance core is constituted by a series of metal oxide, in particular zinc oxide, varistor units; for the retaining means to be associated with release means adapted to be activated when the resistance of the variable resistance core diminishes to a predetermined extent; and for the release means to be either a standard expulsion device or a suitable fuse wire.

In some variations of the fourth aspect of the invention a bridging conductor offset laterally from the variable resistance core extends at least partway along the length of the insulator and is connected to the input contact at one end and a series input terminal at its other end. In one instance the bridging conductor extends along substantially the entire length of the insulator and is arranged to be in series with a dropout fuse typically carried by the surge arrestor. In another instance the bridging conductor extends only a short distance from the input contact and terminates at a laterally offset position in an intermediate contact such that the relevant circuit is opened when the surge arrestor drops out of its operative position.

In order that the above and other features of the invention may be more fully understood, embodiments of the various aspects of the invention will now be described with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:-

Figure 1 is a schematic side elevation of a prior art transformer, bushing and surge arrestor assembly;

Figure 2 is a schematic partly sectioned side elevation of an assembly embodying various aspects of the invention defined above in the operative condition;

Figure 3 is a view similar to Figure 2 on a somewhat reduced scale and illustrating the assembly in the inoperative condition following on a failure of the surge arrestor;

Figure 4 is a view similar to Figure 2 but of one embodiment of the invention that includes a circuit isolating arrangement in this instance in the form of a fuse connected in parallel with a surge arrestor;

Figure 5 illustrates the embodiment of Figure 4 on a somewhat reduced scale with the parallel fuse dropped out;

Figure 6 illustrates the embodiment of Figure 4 on a somewhat reduced scale with the surge arrestor and fuse dropped out together; and,

Figure 7 is a view similar to Figure 2 but of a second embodiment of the invention that includes a circuit isolating arrangement in this instance in which the electrical supply to the input conductor in the insulating body of the bushing is by way of a short bridging conductor in the surge arrestor.

DETAILED DESCRIPTION WITH REFERENCE TO THE DRAWINGS

In the embodiment of the invention illustrated in Figures 2 and 3 of the accompanying drawings, a transformer housing (1) has secured thereto a foot (2) of a transformer bushing (3) that has electrically connected in parallel with it, a surge arrestor (4).

The transformer bushing has an insulated input conductor (5) passing axially through an insulating body (6) and having an external input terminal (7) at its operatively outer end and an internal output terminal (8) at its operatively inner end. The external input terminal has one end of a laterally extending electrically conductive resilient leaf (9) connected to it, the resilient leaf having at its end region remote from the bushing a releasable contact in the form of a recess (10) for receiving a domed contact surface on a nut (11) that forms the input contact to the surge arrestor. Conveniently the outer end of the input conductor is screw threaded and the resilient leaf is simply clamped in position by means of a nut on that screw threaded end.

Reverting to the attachment of the foot of the bushing to the housing, the foot of the insulating body is adapted to be mounted in a generally vertical plane, as illustrated, with the insulating body extending upwardly at an incline in the operative position. This arrangement ensures that, as will be appreciated from what follows, the surge arrestor will fall out of its operative position effectively.

An electrically conductive bracket (12) is secured on the outside of the foot by means of the same electrically conductive bolts (13) that are used to secure the foot to the housing. In this manner the bracket becomes effectively grounded to the transformer housing by way of the bolts and the housing itself is effectively grounded in the normal course of events.

The bracket is electrically connected to, and supports, an electrically conductive contact assembly in the form of a bifurcated cradle (14) for releasably receiving, in use, an articulated contact assembly (15) associated with the grounded end of the surge arrestor.

Turning now more particularly to the surge arrestor, it is of substantially conventional elongate construction having a variable resistance core (16) the exact nature of which is immaterial to the invention but that, in this

embodiment, is typically a plurality of zinc oxide varistor units surrounded by a finned insulator (17). As indicated above, the input terminal to the surge arrestor is in the form of a domed nut (11) and the ground terminal is in the form of the articulated contact assembly (15).

The articulated contact assembly in this embodiment of the invention is rotatable relative to the bifurcated cradle (14) very much in the manner of well-known dropout types of fuse. The articulated contact assembly has two conditions, namely; an operatively generally rigid configuration (illustrated in Figure 2) and an inoperative configuration (illustrated in Figure 3). In the operative configuration the articulated contact assembly is prevented from moving and, in particular, from collapsing, and serves to hold the input terminal and ground terminal in cooperating relationship with cooperant terminals of the bushing. In the inoperative configuration (illustrated in Figure 3) the articulated contact assembly is free to move in articulated manner and, in particular, to collapse, and the input terminal of the surge arrestor is thus free to disengage itself from the cooperant leaf terminal.

The articulated contact assembly is held in the operative position by retaining means that includes a pivotally mounted link (18) supported by the cradle and pivotally attached to the grounded end of the surge arrestor by a pivot (19) spaced upwards of the lower end of the surge arrestor.

A catch (20) maintains the link in an extended orientation in which it is roughly parallel to the length of the surge arrestor, in use, the catch being movable in unison with a spring loaded flap (21) that imposes a tension on a retaining wire (22) that is held in tension by release means (23) associated with the surge arrestor.

The arrangement is such that with the articulated link in its operative condition the surge arrestor may be rotated about the now rigid articulated

link such that the domed contact surface snaps into position in the recess of the conductive resilient leaf to assume the operative position.

The resultant arrangement is one that is well-known as applied to fuses wherein, consequent on activation of the release means and the resultant rotation of the flap to disengage the catch, as illustrated in Figure 3, the articulated link is allowed to collapse which results in the collapse of the effective length of the surge arrestor. The result is that the surge arrestor drops out of the transformer bushing and hangs downwards on the articulated contact assembly, as illustrated in Figure 3.

The release means could be a conventional expulsion device that is activated when excessive current flows through the surge arrestor for an excessive length of time corresponding to failure of the surge arrestor. It is also envisaged that the release means could, in the alternative, be a simple fuse type of release means that is activated by excessive current flowing through the surge arrestor for an excessive length of time.

It will be understood that, in use, the assembly described above provides all the advantages of the prior art arrangement described in the preamble hereto and, in addition, provides a visible indication that a surge arrestor has failed in consequence of its dropping out of the transformer bushing. In addition, because of the arrangement, it is possible to replace a surge arrestor whilst the transformer is live and therefore no inconvenience is occasioned to consumers. Also, because of the proximity of the surge arrestor to the transformer bushing, any problems associated with impedence of the connections is minimised in so far as is possible.

Of course, it may be unacceptable or at least undesirable that the power supply to the transformer continues whilst the surge arrestor is no longer functional. In instances in which it is preferred to isolate the transformer pending replacement of the surge arrestor, either of the embodiments of the

invention illustrated in Figures 4 to 6 or Figure 7 may be employed in which a a bridging conductor that is associated with an installed surge arrestor forms at least a part of the circuit from the external input terminal to the input conductor of the insulating body of the bushing.

In the instance of the embodiment of the invention illustrated in Figures 4 to 6 of the accompanying drawings, a bridging conductor (30) is offset laterally from the variable resistance core (31) so as to extend along substantially the entire length of the insulator of the surge arrestor (32) within the insulation thereof.

This bridging conductor is arranged to be in series with a dropout fuse (33) carried by the surge arrestor such that the external input terminal (34) to the bushing, that is in this instance insulated from the input conductor (35) of the bushing by an insulator (36), is connected directly to the input end of the dropout fuse. The circuit is therefore from the external input terminal (34) through the dropout fuse (33), through the bridging conductor (30) and thence to both the input contact of the surge arrestor (32) and the input conductor (35) of the bushing.

In use, should the input to the external input terminal (34) become subjected to variations that would cause the dropout fuse to blow, the dropout fuse will simply drop out of the operative position so as to hang from the surge arrestor in a position such as is illustrated in Figure 5. If, on the other hand, the surge arrestor itself fails, or is subjected to excessive surges, the entire surge arrestor will drop out of the operative position in a manner described with reference to Figures 2 and 3 above so that it assumes the general position illustrated in Figure 6 in which it, together with the dropout fuse, hangs from the bushing. The operation of the surge arrestor dropping out of the operative position will take place exactly as described with reference to Figures 2 and 3 above.

In the embodiment of the invention illustrated in Figure 7, the bridging conductor (40) extends only a short distance from the outer input contact (41) of the surge arrestor and terminates at a laterally offset position in an intermediate terminal (42). The input conductor (43) of the bushing, in this instance, terminates short of the outer end of the insulating body (44) and also terminates at a laterally offset intermediate terminal (45) that operatively mates with the intermediate terminal (42) connected to the bridging conductor (40).

In such an instance the circuit from the outer input terminal (46) passes through the releasable contact (47) attached thereto and the domed contact surface on the input contact (41) of the surge arrestor to the bridging conductor (40) and thence by way of the intermediate terminals (42) and (45) to the input conductor (43) of the bushing and thence to the transformer. It will be understood that, with this arrangement, the relevant input circuit to the input conductor of the transformer bushing is opened when the surge arrestor drops out of its operative position in the manner described above and the transformer becomes electrically isolated pending replacement of the relevant surge arrestor.

In both of the latter instances, it will be appreciated that the identity of a transformer that has become electrically isolated can be easily observed visually and the offending component can be replaced promptly so that power can be restored to the consumers reliant on that transformer.

It will therefore be noted that use of any of the arrangements described above will result in appreciable reduction of labour and accompanying costs.

It will be understood that numerous variations may be made to the embodiments of the invention described above without departing from scope hereof.

CLAIMS:-

1. A transformer bushing (3) comprising an insulating body (6, 44) having a foot (2) for securing the bushing to a transformer housing (1), an input conductor (5, 35, 43) passing generally axially through at least a major part of the length of the insulating body and terminating in an internal output terminal (8) at its operatively inner end, the input conductor being electrically connected, in its operative condition, to an external input terminal (7, 34, 46) at or towards the operatively outer end of the transformer bushing remote from the foot, the transformer bushing being characterized in that the external input terminal has a laterally extending conductor (9) electrically connected to it and having at its end region remote from the bushing a releasable terminal assembly (10) for cooperation with a cooperant releasable contact (11) at one end of a surge arrestor (4, 32).

2. A transformer bushing as claimed in claim 1 in which the releasable terminal assembly to include an electrically conductive resilient leaf in which instance the releasable terminal assembly includes a recess for receiving a domed contact surface provided on an input contact at one end of a surge arrestor.

3. A transformer bushing as claimed in either one of claims 1 or 2 in which the foot of the insulating body is adapted to be mounted in a generally vertical plane with the insulating body extending upwardly at an incline in the operative position.

4. A transformer bushing as claimed in any one of the preceding claims in which the foot of the insulating body has an electrically conductive bracket (12) associated therewith wherein the bracket has attached thereto an electrically conductive terminal assembly (14) for operative association with a contact (15) at the grounded end of a surge arrestor such that the bracket and electrically conductive terminal assembly are operatively grounded to an

associated transformer housing by means of electrically conductive fasteners (13) securing same to the transformer housing.

5. A transformer bushing as claimed in any one of the preceding claims in which the electrically conductive terminal assembly associated with the bracket includes a bifurcated cradle for releasably receiving, in use, a relatively rotatable articulated contact assembly associated with the grounded end of a surge arrestor.

6. A transformer bushing as claimed in any one of the preceding claims in which the input conductor extends through the insulating body from the internal output terminal to the external input terminal.

7. A transformer bushing as claimed in any one claims 1 to 5 in which the input conductor as interrupted along its length and provided with a laterally offset intermediate terminal (45) for cooperation with an intermediate terminal (42) connected to a bridging conductor (40) associated with an installed surge arrestor.

8.A transformer bushing assembly comprising a transformer bushing as claimed in any one of the preceding claims in which the foot of the insulating body has an electrically conductive bracket (12) associated with it for mounting on the outside of the foot wherein the electrically conductive bracket is configured to support one end of a surge arrestor by way of a contact assembly associated in use with the grounded end of the surge arrestor with the opposite end of the surge arrestor having the releasable contact assembly in cooperating relationship with the releasable terminal assembly carried by the bushing.

9. A transformer housing fitted with a transformer bushing as claimed in any one of the preceding claims in which the foot of the bushing insulator is secured to the transformer housing by means of electrically conductive

fasteners that also secure an electrically conductive bracket on the outside of the foot with the electrically conductive bracket being configured to support one end of a surge arrestor by way of a contact assembly associated with the grounded end of the surge arrestor.

10. A surge arrestor (4, 33) of generally elongate construction with a variable resistance core (16, 31) surrounded by an optionally finned insulator (17), the surge arrestor having an input contact (11) at one end and a ground contact (15) at the other end, the surge arrestor being characterised in that the input contact is configured as a releasable contact for cooperation with a cooperant terminal assembly and the ground contact includes an articulated contact assembly having retaining means (20, 21, 22, 23) for holding the articulated contact in an operatively generally rigid configuration in which the input terminal and ground terminal are in cooperating relationship with cooperant terminals, and an inoperative configuration in which the articulated contact is free to collapse and the input contact is operatively free to disengage itself from a cooperant terminal assembly.

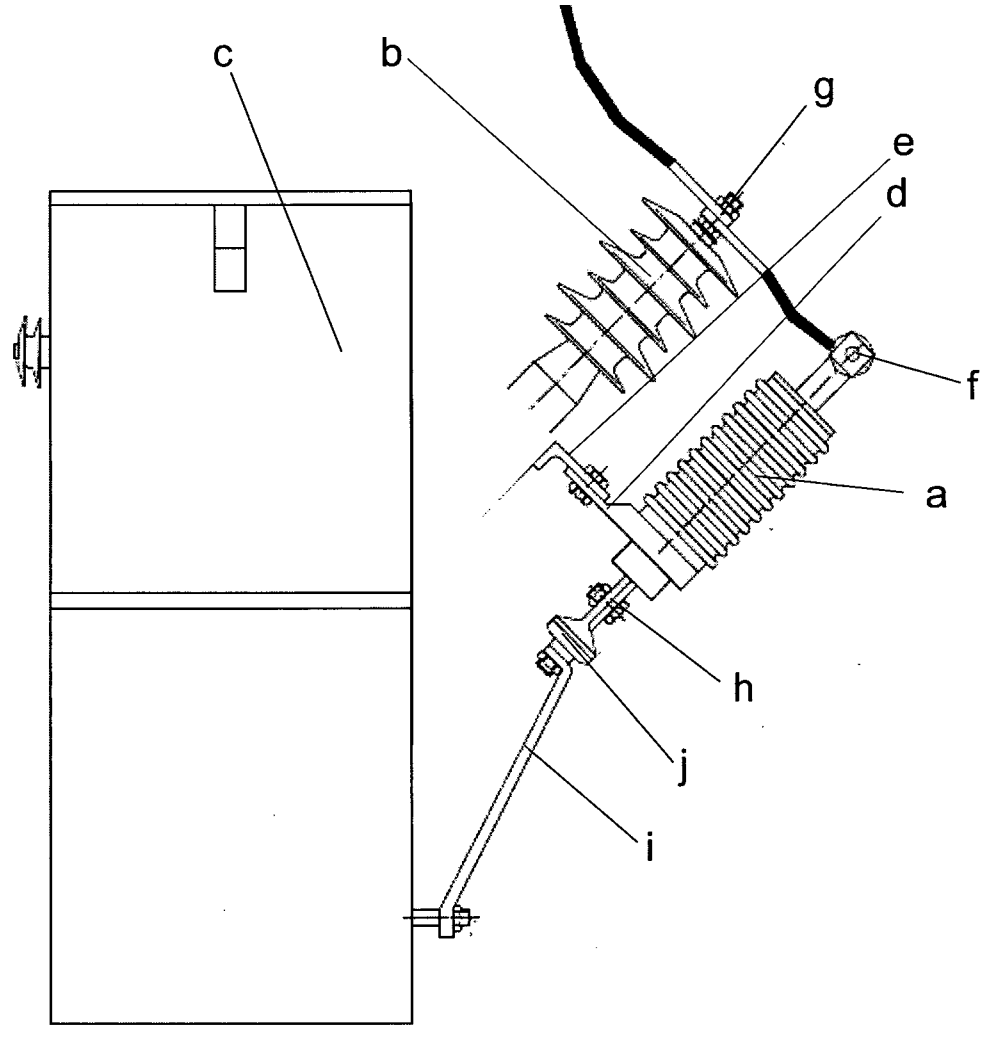
11. A surge arrestor as claimed in claim 10 in which the surge arrestor in which the articulated contact includes release means selected from a standard expulsion device and a suitable fuse wire.

12. A surge arrestor as claimed in either one of claims 10 or 11 in which a bridging conductor (30, 40) is included offset laterally from the variable resistance core two extend at least partway along the length of the insulator and is connected to the input contact at one end.

13. A surge arrestor as claimed in claim 12 in which the bridging conductor (30) extends along substantially the entire length of the insulator and is arranged to be in series with a dropout fuse (32) carried by the surge arrestor.

14. A surge arrestor as claimed in claim 12 in which the bridging conductor (40) extends only a short distance from the input contact and terminates at a laterally offset position in an intermediate contact (42) such that the relevant circuit is opened when the surge arrestor drops out of its operative position.

15. A transformer bushing as claimed in any one of claims 1 to 8 in combination with a cooperate surge arrestor as claimed in any one of claims 10 to 14.



PRIOR ART

Figure 1

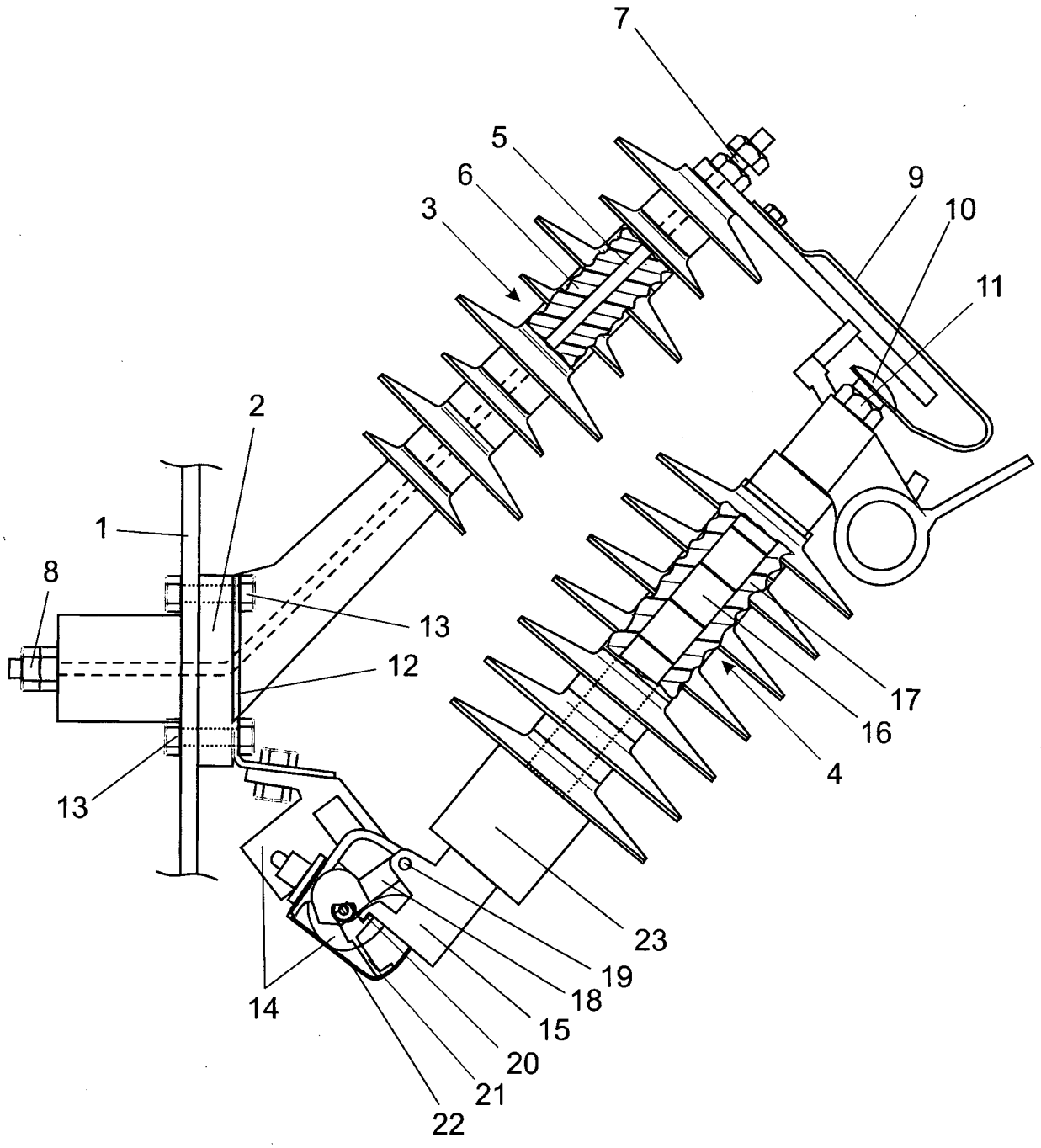


Figure 2

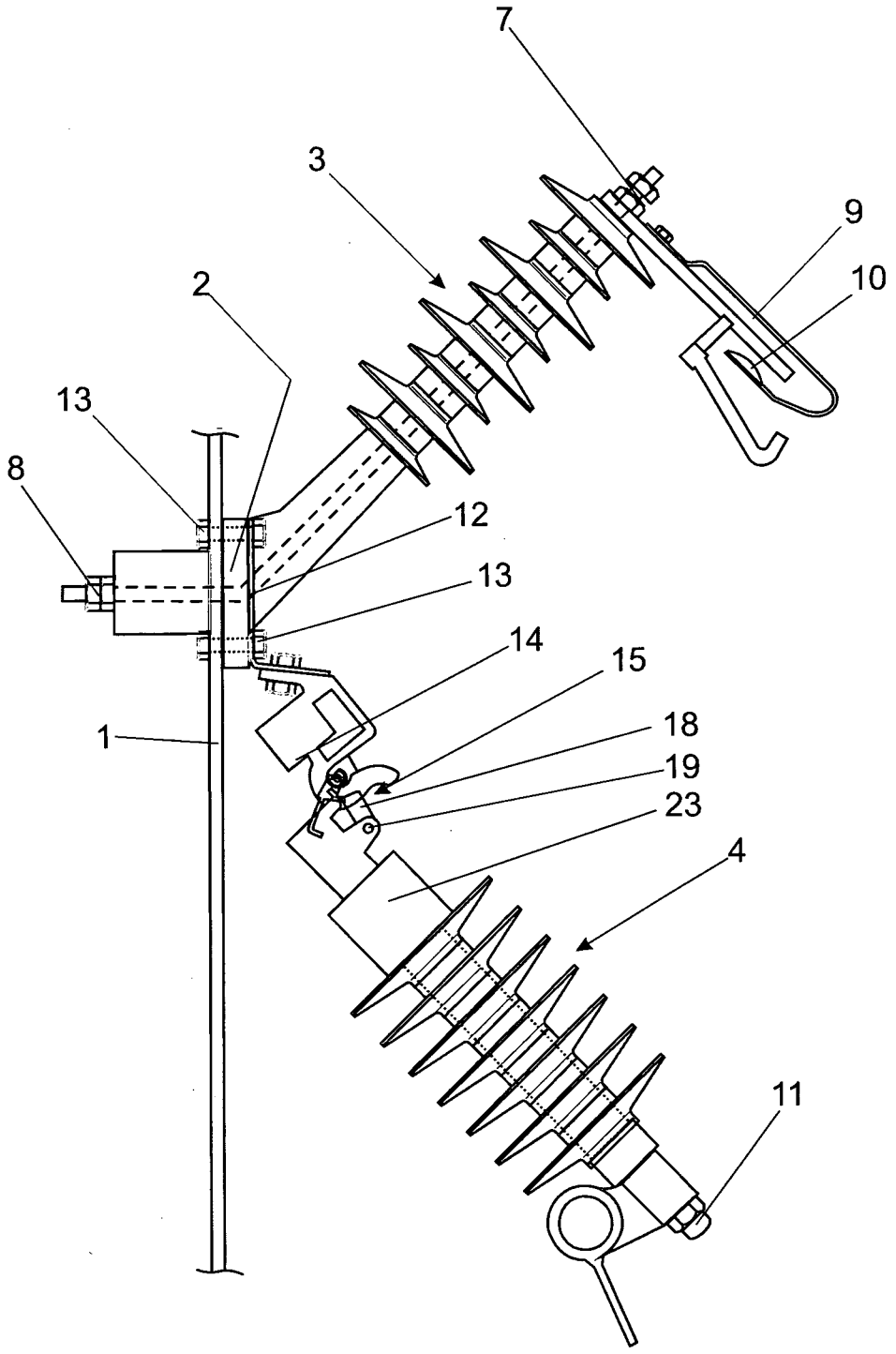


Figure 3

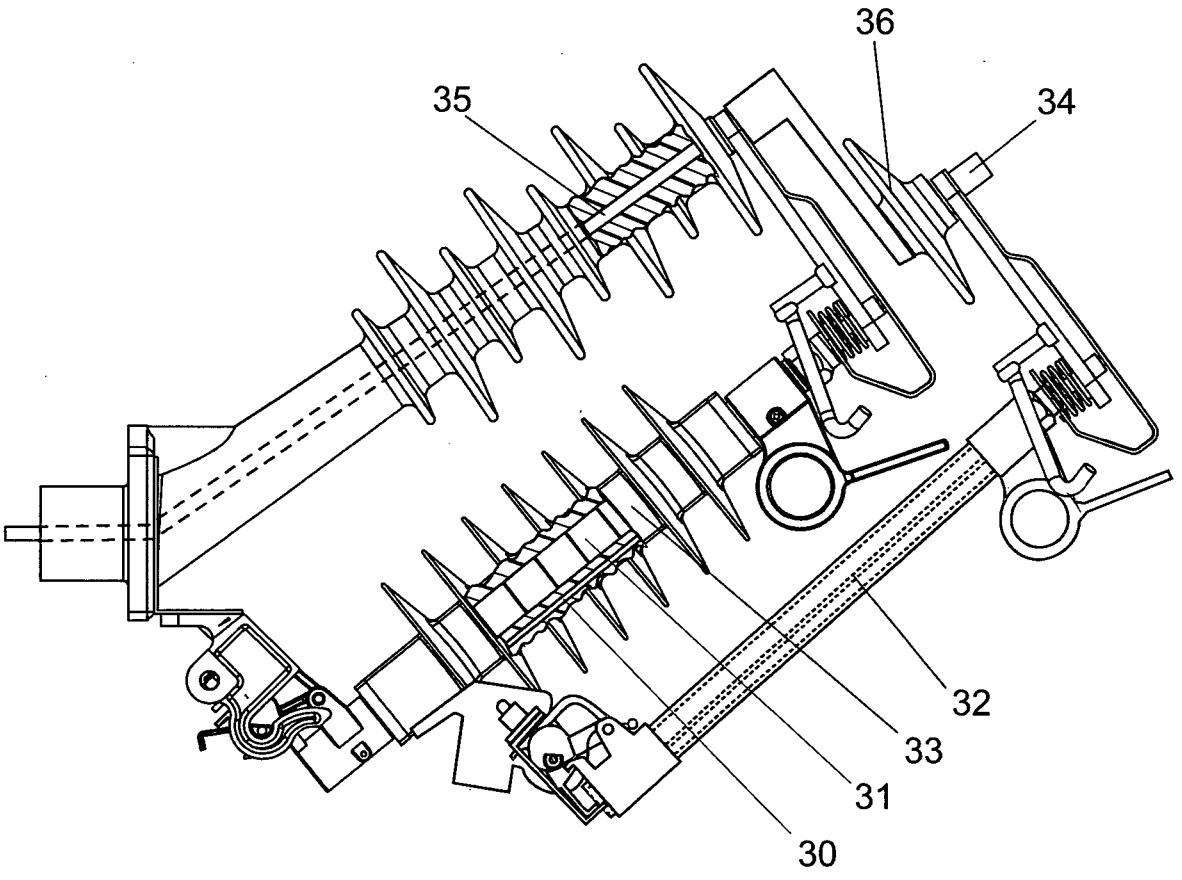


Figure 4

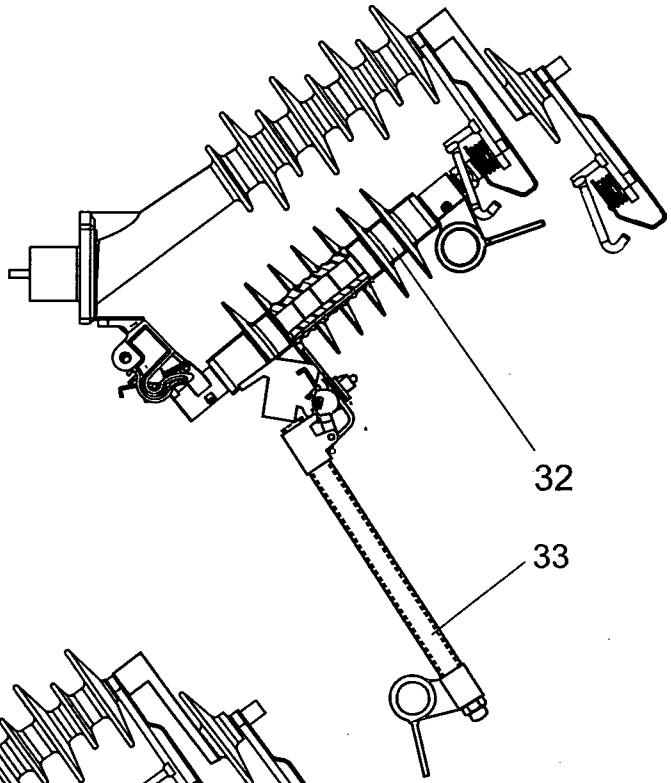


Figure 5

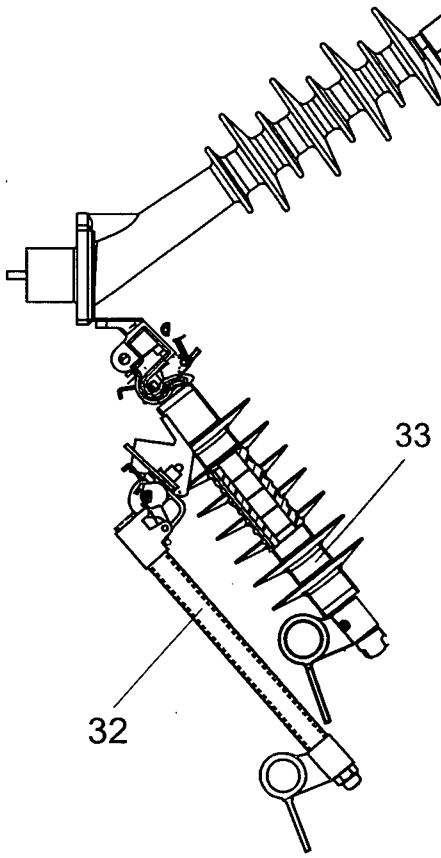


Figure 6

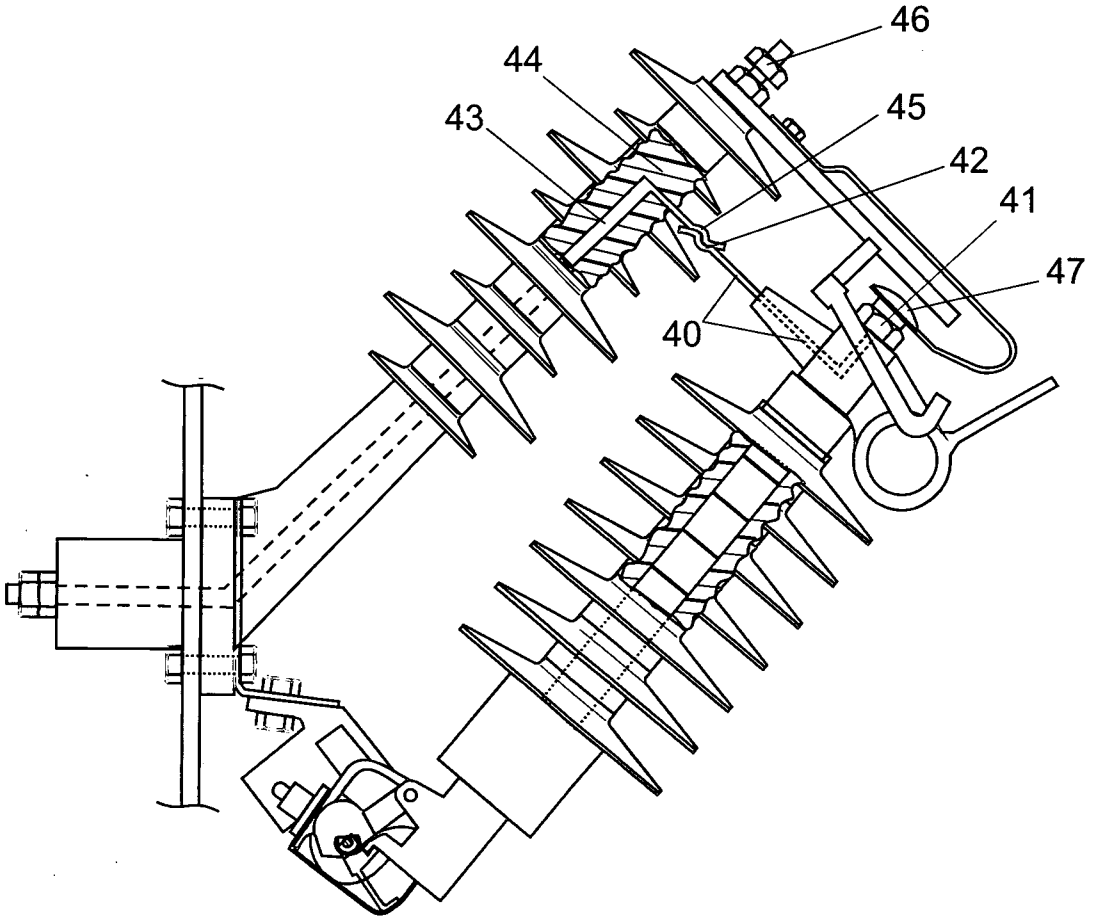


Figure 7