

[54] **LIGHTNING ARRESTERS AND SURGE DIVERTERS**

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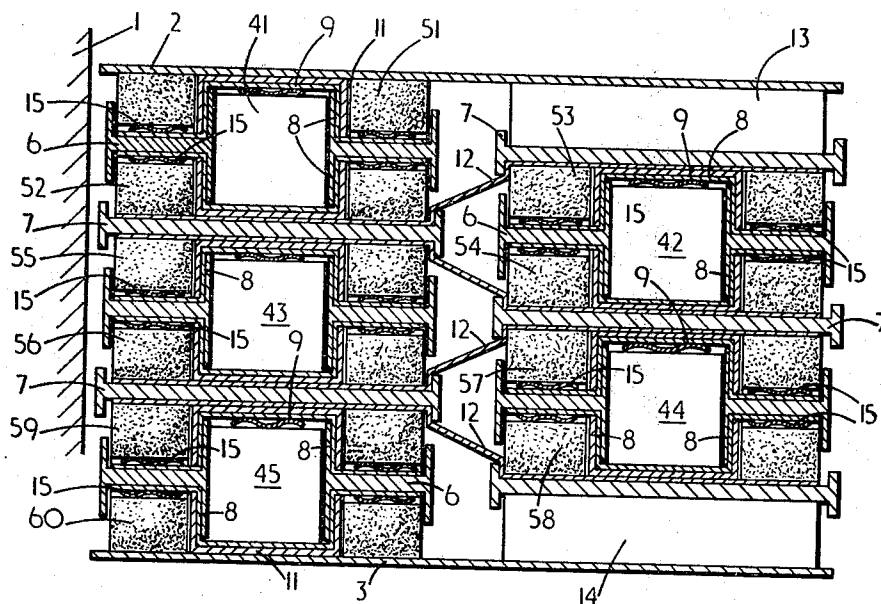
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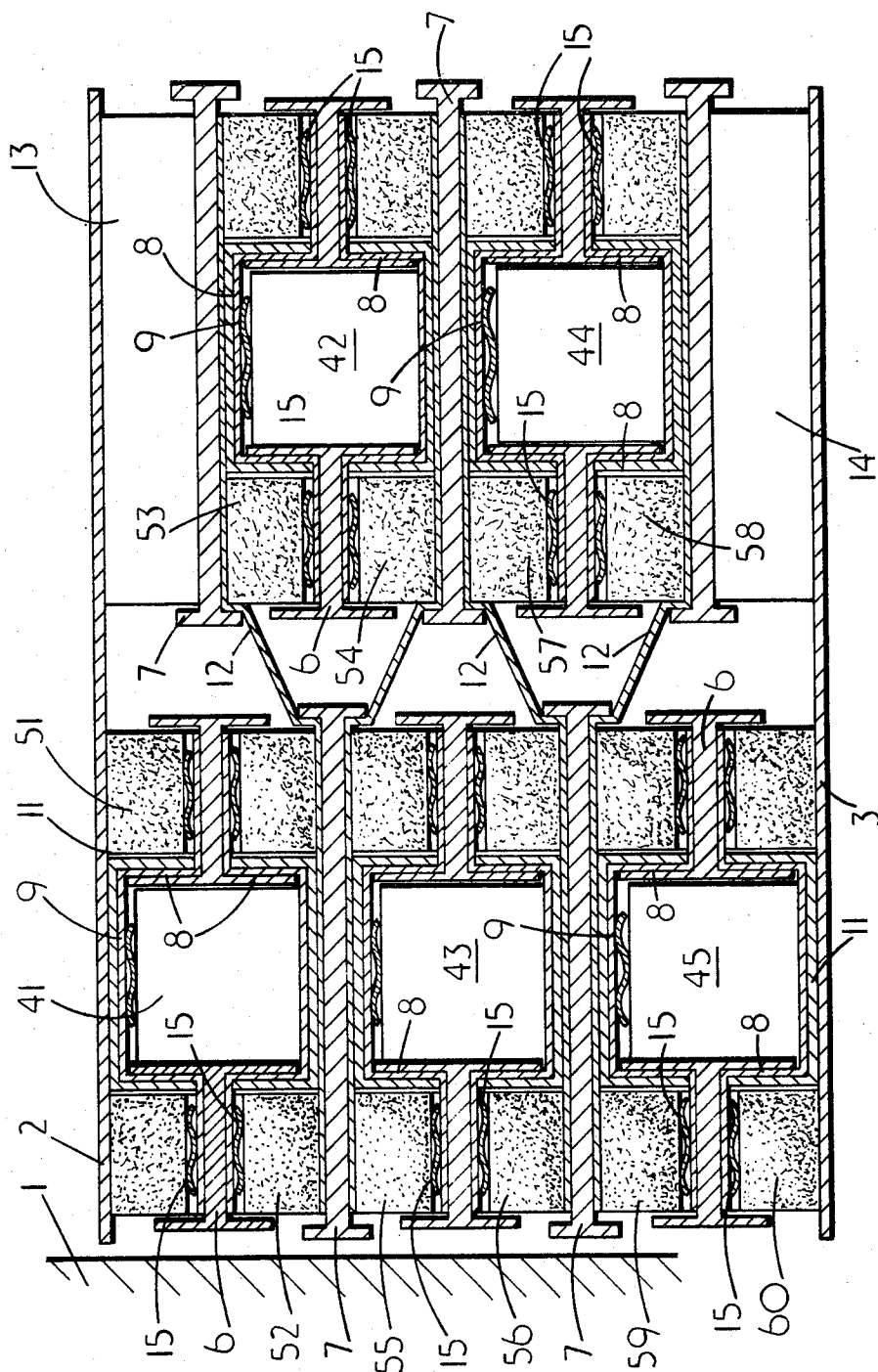
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ABSTRACT

Lightning arresters and surge diverters comprising a casing housing a plurality of series connected components arranged in two or more stacks, each component including non-linear resistors arranged around a spark gap unit and each component in any one of the stacks being electrically connected directly to a component in the other or one of the other stacks.

4 Claims, 1 Drawing Figure





LIGHTNING ARRESTERS AND SURGE DIVERTERS

The present invention relates to improvements in lightning arresters and surge diverters, and is particularly concerned with high or extra high voltage devices and with the arrangement of the operating components within the outer casings of such devices.

While the invention is of general application to all types and ratings of lightning arresters it is particularly useful for extra high voltage systems above say 400 kV.

Surge diverters or lightning arresters for high voltage applications commonly incorporate a number of components including spark gaps and non-linear resistor blocks all arranged in series electrically and physically. The total number of components must be increased with the voltage rating. The gaps spark over in the event of an overvoltage on the protected line higher than a predetermined value and normally for extra-high voltage diverters the spark gaps are of the active type in that the arc, when carrying power follow current from the protected line, is elongated by magnetic means to provide an appropriately regulated termination of the flow of power current with a current limiting action. The components are supported within a casing of insulating material normally having outwardly directed ribs or sheds to increase the external surface length from terminal to terminal.

Normally the spark gaps and the non-linear resistor blocks are assembled in the form of a stack of components supported within the insulated casing, and this arrangement has been widely adopted in the past. However for voltage ratings above 200 kV. the total length of the casing required to accommodate the many internal components becomes inconveniently great and the very long casings required, which are generally made of porcelain or other ceramic materials, tend to be mechanically weak due to the high aspect ratio. Such casings may, particularly for higher voltages, require to be braced at the top of the assembly but this necessarily involves an expensive construction because of the high voltages involved.

Various attempts have been made to reduce the height of the stack of components required for extra high voltage surge diverters. One method of ensuring greater compactness is to use the so-called Folded Pole design in which the space within the outer casing accommodates two or more columns or stacks of gaps and resistors, which columns are interconnected in such a way that the current path through the diverter starts at the top of one column and is then transferred in staggered fashion by diagonal connections to another column and so on in succession to the bottom of one column. This arrangement involves the use of a shorter casing of larger diameter than is required for a single stack construction and provides a better aspect ratio, but again becomes expensive and unsatisfactory when required for line voltages exceeding 500 kV. Another method of reducing the overall height has been developed by the present applicants for their range of extra high voltage station diverters in which the non-linear resistors are in the form of rings surrounding the spark gaps, rather than cylindrical blocks arranged in line with them. With the improved construction suitable interconnections are provided so that the current path passes through the annular resistor elements in turn and then through suitable re-entrantly arranged

connector elements to the spark gap units, then from each unit to the next set of resistor blocks and so on. This arrangement again provides some economy in the length of the casing but the total stack length for ratings at and beyond 400 kV. is still greater than desirable.

The result of these considerations is that known lightning arresters designed for 400 kV. and above call for casings which are expensive to produce and lead to consequential difficulties in that the assembled height may be substantially greater than the height of the associated equipment and consequently connections to the lightning arrestor require the provision of expensive additional insulators. Further, in extra high voltage installations the height required to accommodate such an arrester will often determine the overall height of the sub-station.

It has now been found that a further reduction in the overall height of lightning arresters intended for high voltage operation at voltages above 500 kV., for example up to 765 kV. and with appropriate design even up to 1,000 kV. and more, may be obtained by combining the folded pole construction with an arrangement in which the non-linear resistor elements are positioned around the spark gaps.

According to the present invention there is provided a high voltage device comprising a casing housing a plurality of series connected components arranged in two or more stacks, each component including non-linear resistors arranged around a spark gap unit and each component in any one of the stacks being electrically connected directly to a component in the other or one of the other stacks.

The substantial reduction in height that can be obtained in accordance with the invention does not involve any very substantial increase in the outside diameter of the casing and permits casings to be designed for extra high voltage applications which have a relatively moderate aspect ratio and are thus mechanically strong, do not require any bracing and do not unduly increase the height of the sub-station structures involved. Thus lightning arresters designed according to the present invention become economically practical in that the casings are not unduly expensive and the construction does not require any great expense in the provision of auxiliary components nor in the construction of sub-station structures of excessive height overall.

An embodiment of the present invention will now be described by way of example with reference to the drawing accompanying the specification in which part of the internal assembly of a lightning arrester or surge diverter incorporating the features of the present invention is illustrated.

The accompanying drawing shows an outer casing 1 which is formed of porcelain, glass or any other suitable insulating material and has outwardly directed ribs or sheds and terminal end caps at each end in accordance with normal practice. The end caps include, apart from the usual electrical connecting means, sealing covers to permit the space within the casing to be evacuated and provided with a gas filling, for example of nitrogen, and at least one of said sealing covers may be provided with a pressure relief diaphragm.

The outer casing houses a number of components, a simplified version of which is shown on the drawing, the components being fitted between top and bottom contact plates 2 and 3. The components are shown in two parallel stacks or columns, and it is to be under-

stood that practical constructions may embody many more components in each stack than that shown on the drawing, and more than two such columns may be provided.

The construction shown embodies a series of spark gap units 41 to 45 which are interconnected in a manner to be described so that fault currents follow a zig-zag path between the top and bottom contact plates 2 and 3. Each spark gap unit embodies at least one arc chamber surrounding spark gap electrodes and having a sinuous closed periphery, and ferrite or other suitable magnets, not shown, are incorporated to ensure quenching of the arc in conjunction with the arc chamber housing the electrodes. Each spark gap unit is enclosed within a bore located centrally within a ceramic insulator plate 6 which may if desired be formed in two sections. The insulator plates 6 embody peripheral channels to receive annular non-linear resistor rings 51 to 60. Insulating discs 7 are provided between adjacent gap units, and it will be noted that the insulator plates 6 and the insulating discs 7 are provided with flanged outer edges which assist in locating the components within the casing 1.

The resistor rings 51 to 60 are disposed in the channels formed on the two faces of the insulator plates 6 and make contact with respective metal pressings 8 having a cupped portion surrounding the central up-standing flange surrounding the gap unit 41 to 45 and a flat annular portion seating against the base of the channel. This arrangement provides electrical continuity between the resistor rings and the gap unit, one end of the gap unit being provided with a contact spring 9. The cup-shaped parts of the metal pressings 8 are surrounded by a cup-shaped insulating member 11. The insulating discs 7 are provided with metal plates on the two surfaces and interconnection between such plates is effected by means of connecting strips 12 to provide a path from the components of one column to the components of the other column or columns which are staggered one in relation to the other by means of blocks or stands 13 and 14 of insulating material which rest on the top and bottom contact plates 2 and 3 as indicated on the drawings.

A plurality of spaced apart contact springs 15 are provided between each of the resistor rings 51 to 60 and the respective adjacent metal pressing 8 to ensure that electrical contact is established therebetween. Each of the contact springs 15 comprises a strip of resilient conductive material arranged radially with respect to the rings. Each strip has two arcuate outer portions so that when compressed between two surfaces one of the surfaces contacts the central regions of the two arcuate outer portions and the other surface contacts the ends and a central portion of the strip.

Although the contact springs 15 are shown arranged between the resistor rings 51 to 60 and the adjacent metal pressings 8, alternative arrangements are possible so long as each resistor ring is associated with at least one spring. For example, the contact springs 15 may be arranged between the resistor rings 51 to 60

and the insulating discs 7 and top and bottom contact plates 2 and 3.

The weight of the stacks of components is taken by the insulating members 11 and insulator plates 6 and 7. The current path from the top plate 2 through the components passes via the resistor ring 51; the contact spring 15 and the respective metal pressing 8 to the contact spring 9 of the spark gap unit 41, then to the next following cup-shaped pressing 8, then through the next following contact spring 15 and resistor ring 52 to the conductor plate on the insulating disc 7, then through the uppermost connecting strip 12, then through the resistor ring 53 to the cup-shaped pressing 8 pertaining to the gap unit 42 and so on successively in zig-zag manner until the bottom contact plate 3 is reached.

The path through the components is of course the path which becomes effective under spark-over conditions on the line to which the arrester or diverter is connected; there is of course no path through the components at the rated voltage apart from any small flow of current there may be through grading resistors, capacitors or the like provided within the casing 1 to ensure correct distribution of the voltage stresses across all the spark gaps so that uniform voltages are maintained across said gaps in service.

What is claimed is:

1. A high voltage device comprising a casing housing, a plurality of series connected components arranged in two or more stacks, each component in anyone of the stacks being electrically connected directly to a component in the other or one of the other stacks, said components each comprising a central annular ceramic plate, an annular non-linear resistor located on each side of the central plate, a spark gap unit located in the aperture defined by the central plate, two contact plates, one arranged on each side of the central plate so as to cover its surface and the aperture therein, and a cup-shaped insulation member arranged over the central portion of the contact plate on each side of the central plate, the components being separated by circular ceramic plates so that the weight of the whole assembly is taken by the cup-shaped insulation members and the central plates.

2. A device according to claim 1, wherein there extend from both sides of the inner and outer edges of said central annular ceramic plates cylindrical flanges, one said non-linear resistor being located between the flanges on each side of the plate, and said gap unit being located in the cylindrical cavity defined by the inner flanges.

3. A device according to claim 1, comprising a gap contact spring located between one end of each spark gap unit and the adjacent contact plate.

4. A device according to claim 1, wherein said circular ceramic plates have peripheral flanges, and each side of each ceramic plate supports a respective metal contact disc which is electrically connected to the metal contact disc of a component in another stack.

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