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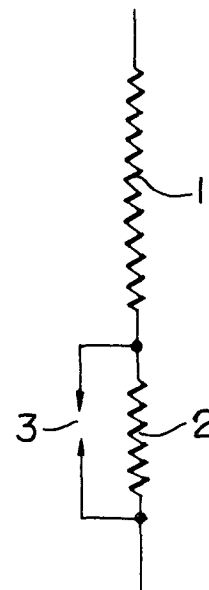
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㉒ **Lightning arrester device.**

㉒ A lightning arrester device comprises a spark gap device (3) connected in parallel to a part of serial connection of non-linear resistors (1,2) whereby a limiting voltage characteristic as level of protection can be reduced to impart long life of the lightning arrester.



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EA-2799

SPECIFICATION

TITLE OF THE INVENTION:

LIGHTNING ARRESTER DEVICE

BACKGROUND OF THE INVENTION:

The present invention relates to a lightning arrester device for power transmission system which is used for protecting a power transmission line, especially a lightning arrester device utilizing non-linear resistors.

It has been proposed to provide a lightning arrester for power transmission system which has no serial gap and which is a non-dynamic current type one utilizing excellent non-linear resistive characteristic of a lightning arrester element prepared by sintering a composition comprising a main component of zinc oxide at 1200 to 1300°C in United States Patent No. 3,806,765.

Such lightning arrester has no serial gap and the lightning arrester element is formed only by the non-linear resistor whereby a response to lightning voltage application can be performed without any discharge delay. On the contrary, the system voltage (AC or DC system voltage) is continuously applied to the non-linear resistor.

When a level of protection of the lightning arrester (limiting voltage characteristic) is reduced, a current passing in the normal state is increased to shorten the life of the lightning arrester. Therefore, the level of protection could disadvantageously not be reduced below a specific value.

SUMMARY OF THE INVENTION:

It is an object of the present invention to overcome the above-mentioned disadvantage.

It is another object of the present invention to provide a lightning arrester device which has a level of protection lower than the minimum level of protection attained by the conventional lightning arrester, even though the structure is simple.

BRIEF DESCRIPTION OF THE DRAWINGS:

Figure 1 is an equivalent circuit diagram of the lightning arrester device of the present invention;

Figure 2 is a schematic view of the structure of the lightning arrester device of the present invention;

Figure 3 is a limiting voltage-current characteristic diagram for illustrating the operation of the lightning arrester of the present invention;

Figure 4 is a sectional view of one embodiment of a spark gap device used in the present invention ; and

Figure 5 is a partially sectional view of one embodiment of an insulator including lightning arrester which supports a power transmission cable according to the present invention.

In the drawings, the same references designate identical or corresponding parts.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Figure 1 shows an equivalent circuit diagram of the lightning arrester device of the present invention and Figure 2 shows a schematic view of the structure thereof. As shown in the drawings, the lightning arrester device of the present invention comprises a serial connection of a first non-linear resistor (1) and a second non-linear resistor (2) which are respectively prepared by sintering a composition of a main component of zinc oxide at high temperature and which have excellent non-linear resistive characteristics and a spark gap device (3) connected in parallel to the second non-linear resistor (2). The first non-linear resistor (1) has a structure of piled up disc elements and the second non-linear resistor (2) has a cylindrical structure as shown in Figure 4. The spark gap device (3) is formed by cup shaped metal plates which are disposed inside of the cylindrical non-linear resistor (2). That is, the flanges of the metal plates of the discharge gap device (3) is held by the non-linear resistor (2).

The operation of the lightning arrester device of the present invention will be illustrated referring to the limiting voltage current characteristic diagram.

In the embodiment of Figure 1, the limiting voltage-current characteristic curves in the case of no connection of the spark gap device (3) are given by Figure 3 (A), (B), wherein the lightning voltage (corresponding to level of protection) to nominal spark current i_2 is given by v_3 . On the contrary, in the device of the present invention, when the terminal voltage of the second non-linear resistor (2) reaches to a predetermined value, the spark is formed in the spark gap of the spark gap device (3) to form a short-circuit whereby the level of protection can be reduced to v_2 in Figure 3.

In Figure 3, the characteristic curves (C), (D) show characteristics of the non-linear resistor (1).

The spark gap device (3) is set to create a spark when the current i_1 in the region of $v_2 \geq v_1$ is passed whereby the limiting voltage characteristic of the embodiment of Figure 1 is given as the full lines (A), (D) in Figure 3, to give the level of protection to v_2 .

The spark in the spark gap device (3) is stopped by diminishing the lightning voltage which releases the spark gap device (3).

In accordance with the structure of the embodiment of the present invention, the limiting voltage characteristic of Figure 3(A) is given in the condition applying the normal voltage to ground v_0 to the lightning arrester whereby the above-mentioned low level of protection v_2 can be given without increasing the current passing in the normal state. The spark gap device is disposed inside of the cylindrical non-linear resistor whereby an additional space for the spark gap device is not required advantageously.

As shown in Figure 5, the long trunk insulator (6) is formed in a hollow shape and the lightning arrester of the disc type first non-linear resistor (11) and the cylindrical second non-linear resistor (12) having a same outer diameter are held in the hollow insulator whereby the lightning arrester device which can be used as supporting insulator for power transmission line can be obtained.

In said structure, a diameter of the hollow part of the long trunk insulator (6) is preferably minimized from the economical viewpoint.

In the lightning arrester device of the present invention, the spark gap device is disposed inside the second non-linear resistor whereby the diameter of the hollow part of the insulator can be minimized.

In the embodiment of Figure 5, the reference numeral (7) designates a flange ; (8) designates a metal cover which is disposed at each end of the insulator (6) to form each terminal which is electrically connected to either of the non-linear resistor (11) or (12) ; (9) designates the O-ring for air-tightening ; (10) designates a cement for bonding the insulator (6) to the flange (7) in one body.

In accordance with the embodiment of the present invention, the lightning arrester device has a simple structure and imparts low level of protection without shortening the life of the lightning arrester.

When the level of protection is the same, the number of non-linear resistors to the normal voltage can be increased whereby the duty of each non-linear resistor of the lightning arrester device in the normal operation can be reduced to prolong the life of the lightning arrester.

In the structure, the spark gap device is disposed in the non-linear resistor, whereby a size of a container (usually an insulator) can be small when the lightning arrester elements are held in the container. The advantages of the present invention are remarkable in practical use,

WHAT IS CLAIMED IS:

1) A lightning arrester device with a serial connection of a first non-linear resistor and a second non-linear resistor characterized by a spark gap device (3) connected in parallel to at least one (2;12) of said non-linear resistors (1,2; 11,12).

2) A lightning arrester device according to claim 1, characterized in that the non-linear resistor (1,2;11,12) is made of a sintered product comprising a main component of zinc oxide sintered at high temperature.

3) A lightning arrester device according to one of claims 1 or 2, characterized in that the second non-linear resistor (2;12) is in a cylindrical form and said spark gap device (3) is disposed inside the cylindrical non-linear resistor (2).

4) A lightning arrester device according to one of claims 1 to 3, characterized in that the first non-linear resistor (1;11) has a disc form and the second non-linear resistor (2;12) has a cylindrical form with the same outer diameter.

5) A lightning arrester device according to one of claims 1 to 4, characterized in that the first and second non-linear

resistors (1,2;11,12) and said spark gap device (3) are held in an insulator (6).

6) A lightning arrester device according to claim 5, characterized in that each one terminal (8) connected to the non-linear resistor (1,2;11,12) is disposed at each end of said insulator (6).

FIG. 2

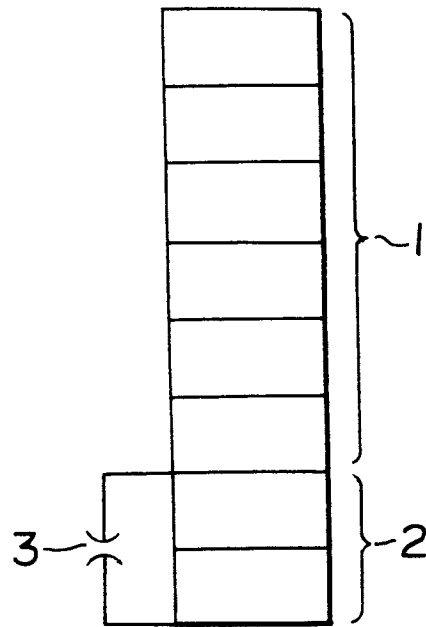


FIG. 1

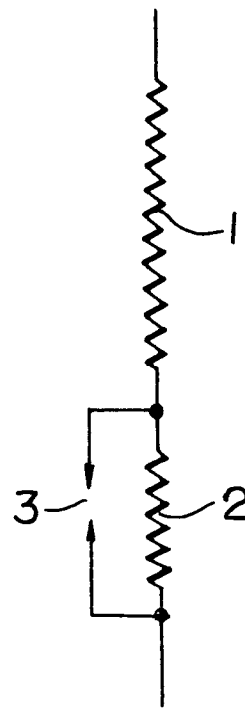


FIG. 3

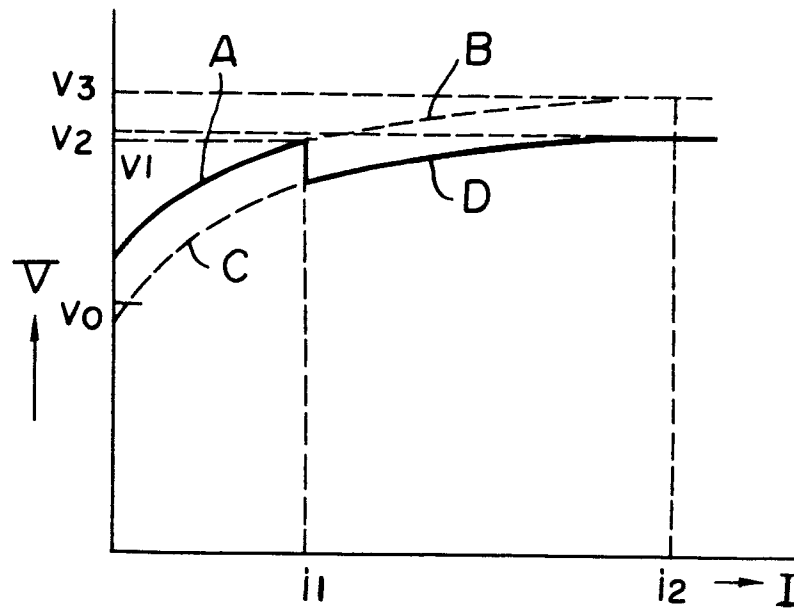


FIG. 4

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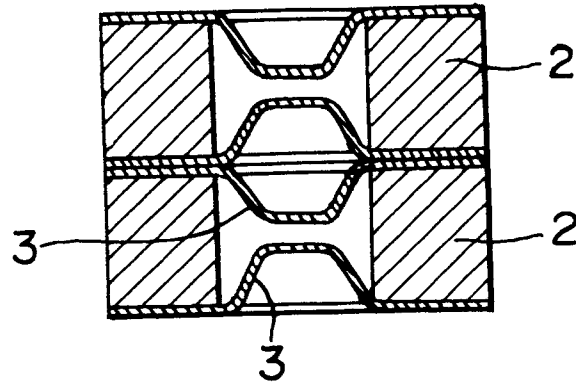
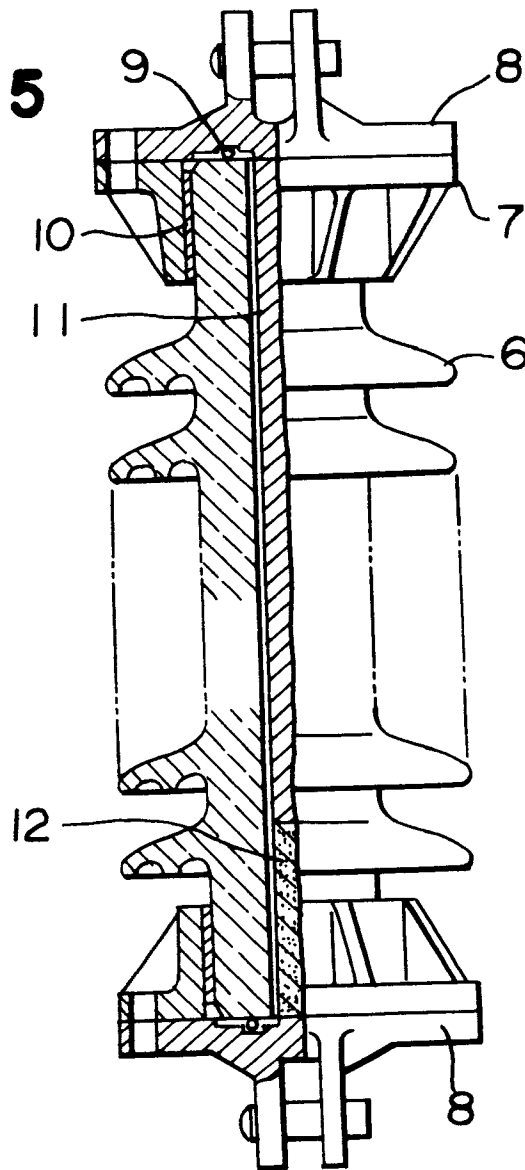


FIG. 5





DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	DE - A - 2 647 233 (GENERAL ELEC- TRIC CIE) * Page 14, lines 1-31; figure 1 *	1,2,4- 6	H 01 T 1/16 H 01 C 7/12
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	DE - B - 1 098 592 (LICENTIA) * Column 1, lines 6-32; fi- gure 1 *	3,4	

			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
			H 01 T 1/16 H 01 C 7/12 H 01 T 3/00 1/00 5/00 5/02 H 01 C 7/10
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family, corresponding document
X	The present search report has been drawn up for all claims		
Place of search	Date of completion of the search		Examiner
The Hague	14-06-1979		BIJN