

Oct. 13, 1970

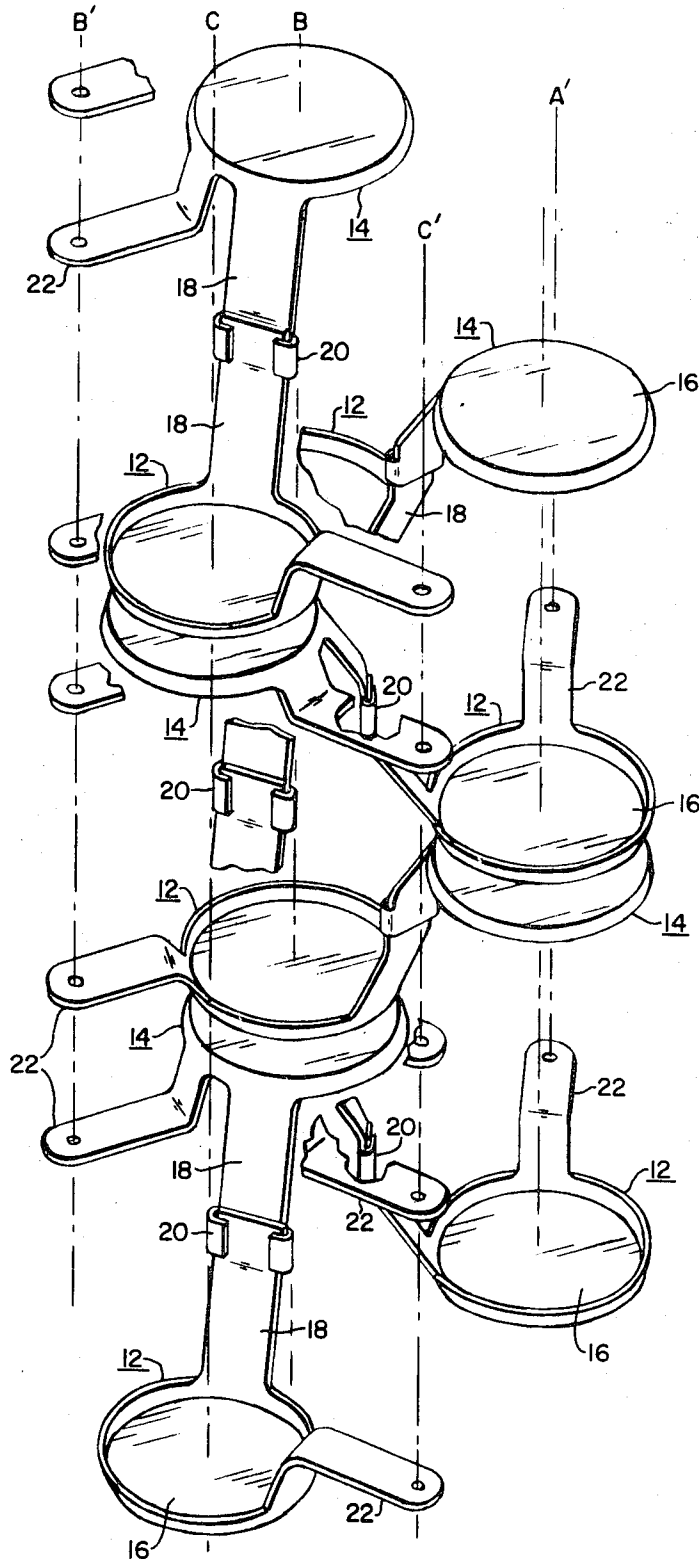
R. E. KENNON

3,534,221

LIGHTNING ARRESTER CONFIGURATION

Filed April 16, 1969

2 Sheets-Sheet 1



INVENTOR
Richard E. Kennon
BY *7. R. 26*
ATTORNEY

Oct. 13, 1970

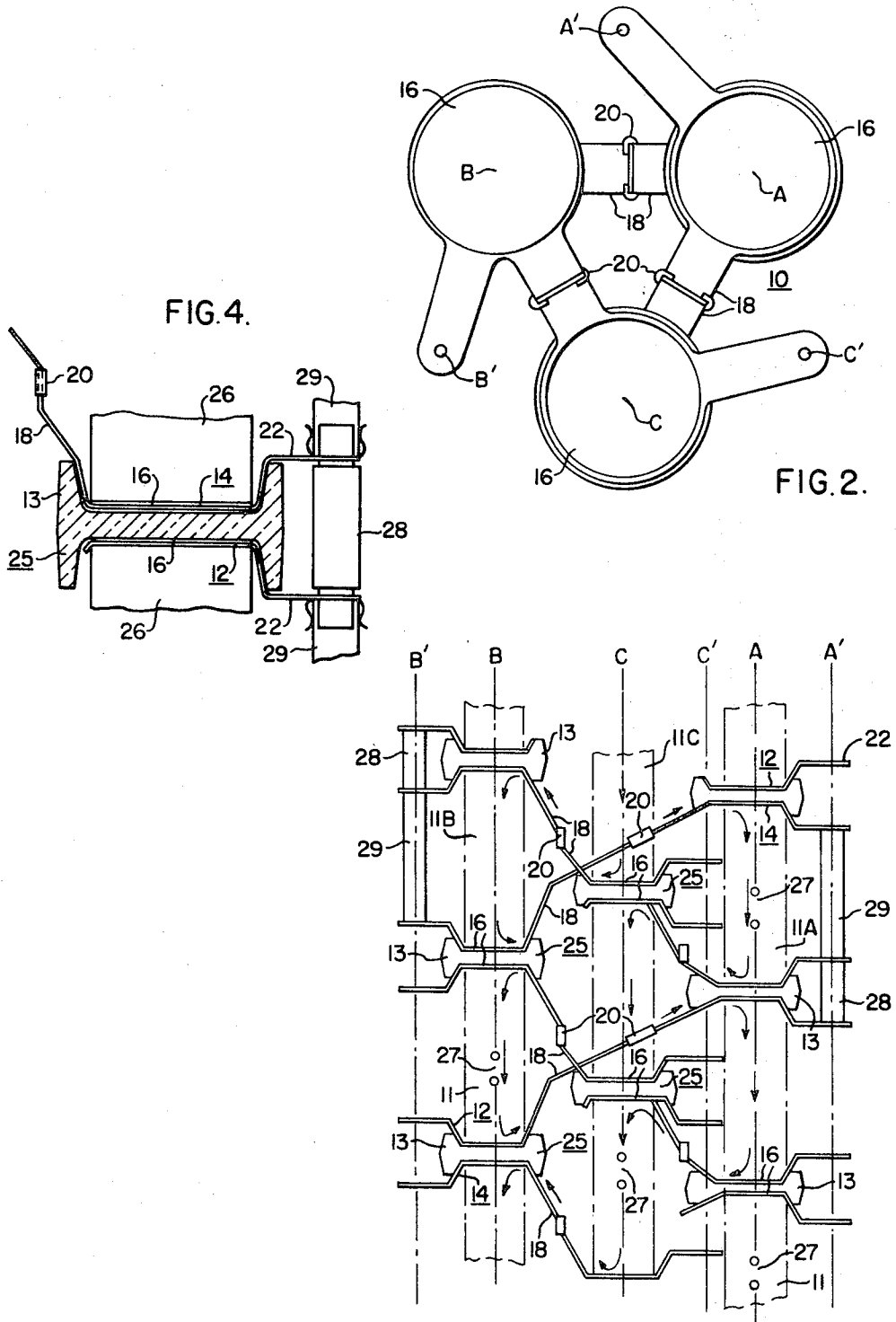
R. E. KENNON

3,534,221

LIGHTNING ARRESTER CONFIGURATION

Filed April 16, 1969

2 Sheets-Sheet 2



1

3,534,221

LIGHTNING ARRESTER CONFIGURATION

Richard E. Kennon, Bloomington, Ind., assignor to Westinghouse Electric Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

Filed Apr. 16, 1969, Ser. No. 816,485

Int. Cl. H01j 7/44

U.S. Cl. 315—36

6 Claims

ABSTRACT OF THE DISCLOSURE

Voltage grading and cascading arrangement for a lightning arrester employing at least three equally spaced vertical columns of arrester components including spark gap devices, the arrangement including insulating trays strategically located in each column between the components, and means connecting each tray in each column alternately across two adjacent, serially connected spark gap devices in two adjacent columns, the trays providing voltage grading and cascading capacitances in each column, and the connecting means electrically connecting the arrester components in electrical series.

BACKGROUND OF THE INVENTION

The present invention relates generally to lightning arresters, and particularly to an arrester configuration in which insulating trays provide strategically located capacitances in columns of arrester components.

In application Ser. No. 679,315 (W. E. 39,078) filed Oct. 31, 1967 by John E. Harder and assigned to the present assignee, there is disclosed a voltage grading and cascading circuit arrangement which permits the use of a single accurately controlled or critical spark gap to initiate the sparkover of a complete arrester. The circuit comprises at least two groups of serially connected capacitors with each capacitor in each group alternately connected across two adjacent, serially connected main spark gap devices. Voltage cascading occurs when the controlling gap sparks over, the voltage across this gap being instantly transferred to the adjacent main gap in parallel with one of the grading capacitors. This results in an instant increase in the voltage across the adjacent gap thereby enhancing its ability to spark over. When it does spark over the parallel capacitor discharges thereby instantly transferring its voltage to the remaining unfired gaps and associated capacitors which, in turn, increases the firing capabilities of the unfired gaps. This operation continues, and occurs rapidly, until all gaps are fired.

BRIEF SUMMARY OF THE INVENTION

The present invention is a mechanical configuration and structure using the above, briefly described voltage cascading circuit of the Harder application in a manner in which the principle capacitances form a structural part of the configuration. More particularly, the invention includes at least three columns of valve-type resistance blocks and spark gap devices, the resistance blocks and gap devices being supported and separated by insulating trays with metal connectors seated in the insulating trays. The metal connectors are interconnected among the columns and between the trays in a manner to connect the blocks and gap devices in electrical series and to alternately connect the trays across two electrically adjacent spark gap devices. The trays, with their inherent capacitances, thus appear in the circuit at the precise locations required to effect the voltage grading and cascading function while simultaneously forming a part of the arrester structure. Further, by locating the inherent capacitance of the trays in the manner briefly described thus far, the inherent capacitance is prevented from the appearing elsewhere in the

2

arrester columns and circuit in an unwanted fashion which could upset voltage balance and prevent the very desirable cascading effect.

THE DRAWINGS

The invention, including its objectives and advantages, will become more apparent from reading the following detailed description in connection with the accompanying drawings in which:

FIG. 1 is a perspective view of connecting structures for interconnecting grading capacitances with arrester components in accordance with the principles of the present invention;

FIG. 2 is a top plan view of the structure shown in FIG. 1;

FIG. 3 is a schematic representation showing the paths for current flow in the structure of FIG. 1; and

FIG. 4 is a side elevation view (in partial section) of a capacitance tray employed in structure of FIGS. 1 and 2.

PREFERRED EMBODIMENT

Specifically, FIG. 1 shows structure 10 for connecting arrester component groups 11 (FIG. 3) disposed in three equally spaced apart column structures in electrical series, and for simultaneously interconnecting voltage grading capacitances trays 13 (FIG. 4), forming a part of the column structures, between said columns in a manner to alternately connect each tray across two electrically adjacent component groups (including spark gap devices) as disclosed in the above mentioned Harder application.

For purposes of clarity of illustration, the arrester components 11 and the trays 13 are not shown in FIGS. 1 and 2, and are only representatively shown in FIG. 3. The components, however, would be stacked in three separate and equally spaced apart columns along vertical axes designated A, B and C, in the figures, the use of separate columns per se being a well known expedient in the arrester art to obtain high voltage ratings for arrester units without having excessively tall columnar structures that are difficult and costly to support. In plan view, the columns form an equilateral triangular configuration as seen in FIG. 2.

Means for interconnecting vertical columns of components with grading capacitors are known in the arrester art. The difficulty arises, however, and the present disclosure solves the difficulty, in combining the teachings and advantages of the above mentioned Harder disclosure with those of the three column arrester unit. More particularly, what is needed is a compact inexpensive structure which will connect the arrester component devices in the three columns in electrical series to obtain the desired high voltage rating, and, to connect each grading capacitance alternately across each two electrical adjacent component devices to obtain the voltage cascading effect described in the Harder application and briefly described above. The structures shown in FIGS. 1 to 4 meet these needs.

Thus, in FIG. 1, the structure 10 comprises a plurality of electrically conductive connectors, generally designated 12 and 14, each connector comprising a plate portion 16 (shown in the form of a shallow pan) having an integral strap portion 18 extending outwardly therefrom and at an obtuse angle with the plane of the plate portion. The connectors 12 and 14 are identical to each other except for the ends of the integral strap portions 18. The strap end of the connector 12 has a flat, rectangular configuration while the strap end of the connector 14 is provided with inwardly folded wing portions 20 adapted to receive and crimp the flat end of the connector 12 as shown in FIG. 1. In this manner, the plate portions 16 of each connector are electrically interconnected.

The connectors 12 and 14 are shown further provided with a second integral strap or arm portion 22 extending

outwardly from the plate 16 in a plane substantially parallel therewith. The angular relationship of the strap 18 and the arm 22 in the plane of the plate is acute for the plate 14 and obtuse for the plate 12 such that when the straps 18 are disposed towards each other for mutual connection, the arms 22 extend outwardly from the triangular configuration of connectors when so connected as shown in FIG. 2. The purpose of the arms is to secure grading resistors and auxiliary capacitor components in a manner presently to be explained.

Between the plate portions 16 of the connectors 12 and 14 are disposed the insulating annular trays 13 (FIG. 4) in the manner shown somewhat schematically in FIG. 3. The trays are made from an insulating material having a dielectric constant, which, when disposed between two adjacent plates 16 in the manner shown in FIGS. 3 and 4 form voltage grading capacitances 25 strategically located in the three columns in the manner explained hereinafter.

Each tray 13 has two opposite sides or faces in which are provided center recesses adapted to receive and seat the connectors 12 and 14 as shown in FIG. 4, the plate portions 16 of the connectors forming electrodes and terminals for the capacitances 25.

Each recess in each tray 13 is further adapted to receive and seat the end of a stack or group of the arrester components 11 as shown in FIG. 4, the ends of each component group being disposed in electrical contact with the plate portions 16 of the connectors 12 and 14. Each component group includes well known non-linear resistance blocks (not shown) and main spark gap devices 27 only representatively shown in FIG. 3.

When the trays 13 and the components groups or devices 11 are properly located between the plate portions 16 of the connectors 12 and 14, the trays and component devices form the three vertical columns along axes A, B and C.

Across each capacitance 25 may be connected an auxiliary capacitor 28 suitably supported and electrically connected between the two integral arms 22 of the connectors 12 and 14. In this manner, the capacitor 28 is connected in parallel with the tray 13 to provide additional grading capacitance if needed. In a similar manner, grading resistors 29 can be provided, each resistor being connected between the arms 22 located at the ends of each component device 11 as shown diagrammatically in FIG. 3. When the auxiliary capacitors 28 and the resistors 29 are properly secured between the ends of the arms 22, the capacitors and resistors form three vertical columns along axes A', B' and C' in substantial parallel alignment with the axes A, B and C.

The three columns of arrester components and three of resistors 29 and capacitors 28, as thus far described, are supported and commonly connected between top and bottom terminal plates (not shown) to form an arrester unit and circuit for electrical connection between a line and ground to provide overvoltage and surge current protection for the line and for electrical apparatus connected thereto. When the unit is called upon to discharge a surge of current to ground, current flows serially through the arrester component devices 11 by virtue of the structure 10, i.e., the connectors 12 and 14. In FIG. 3, a portion of such a unit is shown in schematic form, the path of current flow therethrough being indicated by appropriate arrows.

Thus, in operation, when the columns of the arrester components discharge a current surge to ground, current flows through each of the arrester component devices 11, the flow starting with the first such device in the circuit, i.e., the one device (not shown) connected directly to the above mentioned top terminal plate. For purposes of explanation, this one device may be the uppermost one (labelled 11C) on the center axis C in FIG. 3. As indicated by the downwardly pointing arrow in the device 11C, current flows therethrough to associated plate 16

of the tray capacitor 25 located at the bottom of said device. The current is then conducted upwardly and to the left along integral strap 18 and crimp 20 to the plate 16 in the column of axis B, the plate being in electrical and physical contact with the top end of another component device labelled 11B.

Again, the current is conducted downwardly through the device 11B (in column B) until the current reaches the plate engaging the lower end of said device. Again, an associated integral strap 18 conducts the current upwardly (and this time to the right) to a capacitor plate 16 in column A, and current is conducted downwardly through another component device (labelled 11A) in said column in electrical contact with said plate. From said plate, current is again directed upwardly and to the left via integral straps 18 to a plate 16 and the next component device 11 in column C in line and immediately below 11C.

The current conducting process described above continues down the columns in the manner described until it enters ground through an associated ground terminal (not shown). As can be seen, the structure 10 serially connects all of the arrester component devices 11 in the three columns A, B and C to provide the desired high voltage rating without necessitating the use of tall columns of arrester components.

The structure 10, however, serves another highly important function, namely, that of connecting the capacitances 25 alternately across two electrically adjacent arrester component devices 11 to provide the highly desirable voltage grading and cascading effect of the above mentioned Harder application. By referring again to FIG. 3, it is seen that each insulating tray 13 with two associated plates 16 are electrically connected across two of the serially adjacent component devices 11 by the integral straps 18 secured together by the crimping folds 20. For example, the middle tray 13 in column B is connected across the upper component device 11A in column A and the middle component device 11 in column C by a set of integral interconnecting straps 18, the two devices being electrically serially connected together by another set of integral straps extending between the top of device 11 in column C and the bottom of the device 11A in column A.

Thus, the structure 10 not only performs the two highly important functions described above, but performs them in a compact and economical manner. The connectors 12 and 14 require a minimum of space in and between the columns, the connectors are identical to each other (except for the end portions of 12 and 14 and the angle differences between 18 and 22) thereby requiring a minimum of different parts, and the connectors are relatively simple structures requiring minimum effort and cost to manufacture.

In addition to the above advantages, the configuration of the connecting structure 10, with its deliberate locating of the inherent capacitance of the trays 11 in the columns of arrester components, prevents the inherent capacitance of the trays 13 from appearing elsewhere in the columns in an unwanted fashion, i.e., in a manner that could upset voltage balance in the columns so as to prevent the voltage cascading effect.

It should now be apparent from the foregoing description that a new and highly useful arrester configuration has been disclosed which provides series connection for columns of arrester components while simultaneously locating and connecting component supporting insulating trays in a manner to provide voltage grading and cascading for the configuration.

Though the invention has been described with a certain degree of particularity, changes may be made therein without departing from the spirit and scope thereof.

What is claimed is:

1. A lightning arrester comprising a plurality of arrester component devices electrically connected in series and physically disposed in at least three vertical columns, said component devices including spark gap devices and non-

5

linear resistance blocks, individual insulating trays interposed in each of said columns at spaced locations, conductive plate means disposed on each side of each tray in contact therewith and in electrical contact with the adjacent arrester component, and means for electrically connecting each of the plate means to a plate means in a different column in a manner to connect all the arrester component devices in series.

2. A lightning arrester as defined in claim 1 in which said connecting means are strap members integral with the plates and extending from each plate in position to engage a strap member of a plate in another column.

3. A lightning arrester as defined in claim 2 in which the trays and plates are generally circular and the plates are substantially coextensive with the arrester components.

4. A lightning arrester comprising a plurality of arrester component devices electrically connected in series and physically disposed in at least three vertical columns, said component devices including spark gap devices and non-linear resistance blocks, individual insulating trays interposed in each of said columns in spaced locations, conductive plate means disposed on each side of each tray in contact therewith and in electrical contact with the adjacent arrester component, voltage grading impedance elements including capacitors and resistors disposed adjacent said columns of arrester components, means for electrically connecting each of the plate means to a plate means in a different column in a manner to connect all the arrester component devices in series, and means for connecting the plate means to said impedance elements

6

to connect the impedance elements across the arrester components.

5. A lightning arrester as defined in claim 4 in which each plate means has a first integral connector strap extending therefrom in position to engage a connector strap of a plate means in another column and a second integral connector strap extending therefrom in position to engage an impedance element.

6. A lightning arrester as defined in claim 5 in which said first connector strap of each plate extends therefrom at an obtuse angle to the plane of the plate to extend toward another column, and said second connector strap extends in a plane substantially parallel to the plane of the plate, said impedance elements being received between the second connector straps of successive plates in the same column.

References Cited

UNITED STATES PATENTS

2,611,108	9/1952	Rydbeck	315—36
2,862,153	11/1958	Nilsson	317—99
3,069,589	12/1962	Cunningham	315—36
3,144,583	8/1964	Sorrow et al.	315—36
3,366,831	1/1968	Lapple	315—36
3,412,273	11/1968	Kennon et al.	313—1

JOHN HUCKERT, Primary Examiner

R. F. POLISSACK, Assistant Examiner

U.S. Cl. X.R.

313—325; 315—35