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O. ACKERMANN
LIGHTNING ARRESTER

2,476,791

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2 Sheets-Sheet 1

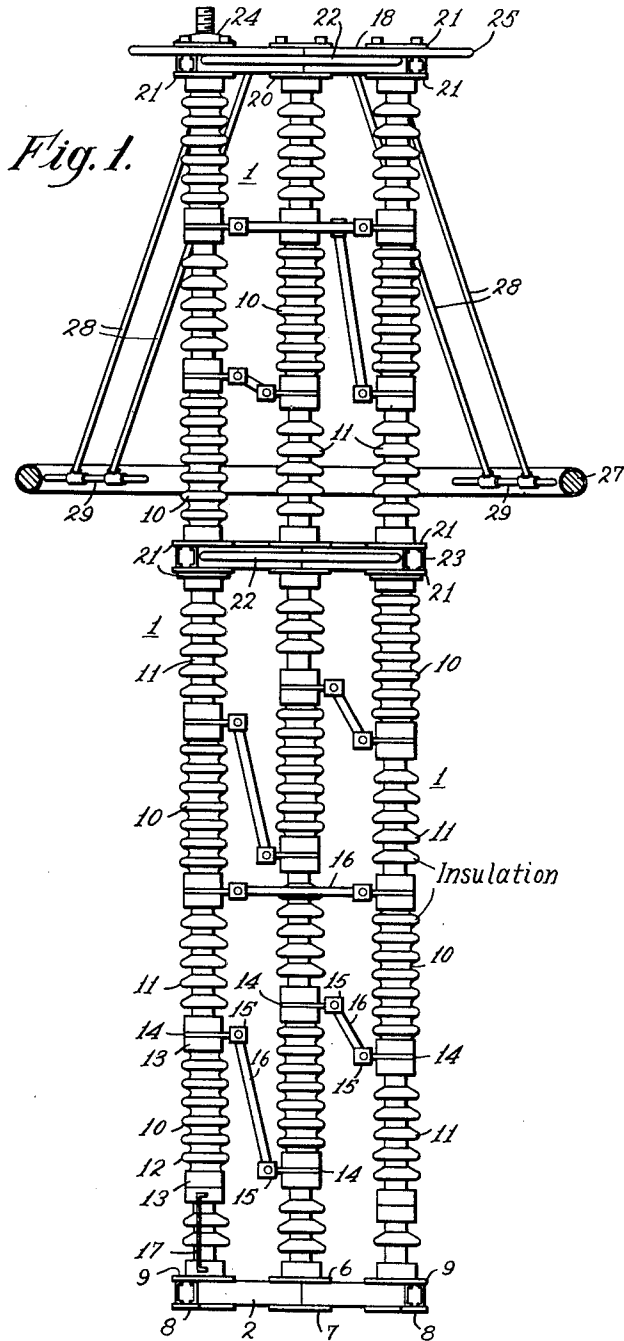


Fig. 1.

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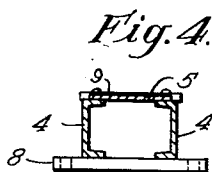
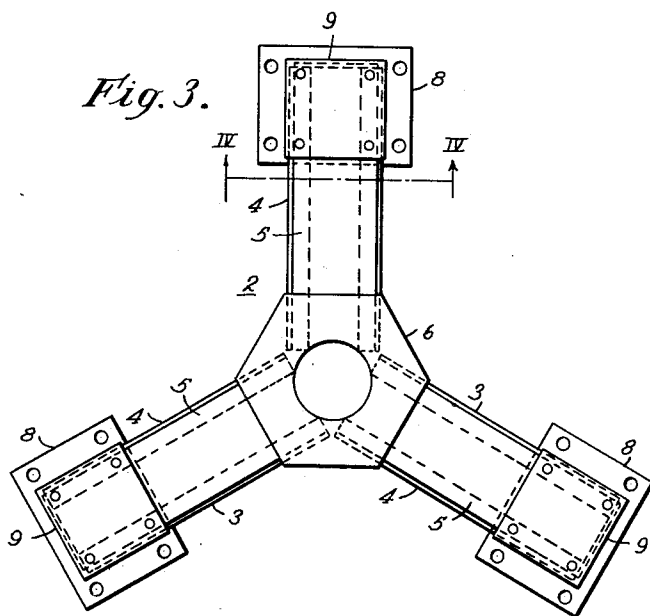
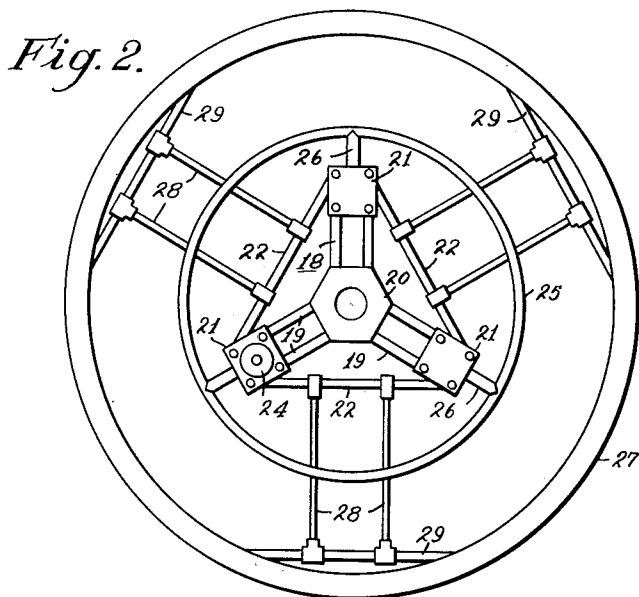
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LIGHTNING ARRESTER

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9 Claims. (Cl. 175-30)

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The present invention relates to lightning arresters, and more particularly to high-voltage station-type lightning arresters.

Station-type lightning arresters are usually of the so-called unit construction. That is, the arrester is built up of a number of individual lightning arrester units of the valve type, each unit consisting of a suitable number of spark gaps and resistance or valve blocks, enclosed in a porcelain housing with metal end caps. The complete arrester is made up of a sufficient number of these units to obtain the desired voltage rating, the units being assembled in a vertical column, with the metal end caps of adjacent units bolted together for electrical and mechanical connection. This conventional construction results in a vertical column of great height as compared to its diameter, especially in the higher voltage ratings. For this reason, lightning arresters of this type are not self-supporting, if the height of the column exceeds a certain maximum, and for high-voltage lightning arresters it has been necessary to brace the column to some adjacent fixed support, such as part of a substation structure. This bracing is undesirable, because of its additional cost and complication, and lightning arresters are sometimes designed to be suspended from overhead structures, to avoid the necessity of bracing, although suspension mounting also has certain disadvantages. In spite of the disadvantages, however, it has heretofore been necessary to utilize either bracing or suspension mounting for high-voltage station-type lightning arresters, since the tall columns of small diameter were not self-supporting.

The principal object of the present invention is to provide a self-supporting high-voltage lightning arrester.

A more specific object of the invention is to provide a high-voltage lightning arrester consisting of a suitable number of series-connected individual lightning arrester units arranged in a plurality of vertical columns, which can be braced to each other so as to make the structure self-supporting, and in which the lightning arrester units are arranged and connected so that the voltage difference between adjacent columns at any point during a discharge, is not unduly great, and excessive clearance distances are not required.

Other objects and advantages of the invention will be apparent from the following detailed description, taken in connection with the accompanying drawing, in which:

Figure 1 is a view in elevation of a high-voltage lightning arrester embodying the invention,

Fig. 2 is a top plan view of the lightning arrester of Fig. 1,

Fig. 3 is a plan view of the base of the arrester, and

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Fig. 4 is a sectional view on the line IV-IV of Fig. 3.

The drawings show a preferred embodiment of the invention in a high-voltage station-type lightning arrester. This arrester comprises three vertical columns 1 of lightning arrester units, equally spaced from each other, and supported on a base 2. In the particular arrester shown in the drawings for the purpose of illustration, there are three of the vertical columns 1, but it is to be understood that more than three columns may be utilized if necessary.

The base 2, which is shown in detail in Figs. 3 and 4, is fabricated from structural steel members, and since three columns of arrester units are utilized in the illustrated embodiment of the invention, the base has three arms 3 radiating from the center and equally spaced apart. Each of the arms 3 of the base 2 is built up of two channel members 4 welded to a top plate 5, and the three arms are joined at the center by means of a top plate 6 and bottom plate 7, to which the channels 4 and covers 5 are welded. A base plate 8 is welded to the bottom of each of the arms 3 at the outer end, for supporting the arrester on a suitable foundation, and a mounting pad 9 is welded to the top of each arm 3 at the outer end to support one of the columns 1. It will be apparent that this construction provides a strong and rigid base for the arrester, and the arms 3 are made long enough to space the columns 1 far enough apart to prevent any danger of flashover between them when a voltage surge is discharged.

Each of the vertical columns 1 consists of a plurality of lightning arrester units 10, and a plurality of insulators 11. The lightning arrester units 10 may be of any suitable or usual construction, and each unit includes a number of spark gaps and a number of valve blocks, or resistor elements, enclosed in a porcelain housing 12 with metal end caps 13. A suitable construction for the arrester units 10 is shown, for example, in a patent to L. R. Ludwig et al. No. 2,135,085, issued November 1, 1938, and assigned to Westinghouse Electric Corporation. The insulators 11 may be any type of porcelain insulators suitable for outdoor use, and the lightning arrester units 10 and insulators 11 alternate in each column, so that each lightning arrester unit is separated by an insulator from the adjacent arrester units in the same column.

The metal end caps 13 of the arrester units 10 are bolted, or otherwise mechanically secured, to the ends of the adjoining insulators 11, and metal plates 14 are clamped between the end caps 13 of each of the arrester units and the adjoining insulators, so as to be in electrical contact with the end caps of the lightning arrester units. Each of the metal plates 14 has an extending lug or connector element 15 welded or otherwise se-

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cured to it, and the lightning arrester units are electrically connected to each other by means of sections of steel pipe 16, or other suitable, mechanically rigid conductors, extending between the connector elements 15. It will be observed in Fig. 1 that each arrester unit is connected to arrester units in other columns, and that all the arrester units 10 are connected in series in this manner. Thus, the lowermost arrester unit 10 in one of the columns 1 is connected to the grounded steel base 2 by means of a jumper 17, and the upper end of this arrester unit is connected to the lower end of an arrester unit in another column. The upper end of this latter arrester unit is connected to the lower end of a third arrester unit in the third column, and the upper end of this third unit is connected to the next uppermost arrester unit in the first column, and so on to the top of the assembly, a sufficient total number of lightning arrester units 10 being provided to give the desired voltage rating.

Since this construction is intended primarily for lightning arresters of very high-voltage rating, the vertical columns 1 are very tall, as compared to their diameter, and the individual columns are not self-supporting. The complete arrester is made self-supporting, however, by bracing the three columns to each other. For this purpose, a top brace 18 is provided at the top of the arrester. The top brace 18 is of generally similar construction to the base 2, and consists of three arms, each made up of a pair of steel channels 19. The channels 19 are welded to center plates 20 at their inner ends, and to steel plates 21 at their outer ends. The arms of the top brace 18 are connected at their outer ends by steel tubes 22 welded to the outer ends of the channels 19, in order to further strengthen the brace. The top ends of the three columns 1 are bolted, or otherwise secured, to the lower plates 21 at the outer ends of the arms of the top brace 18, so that the three columns are rigidly braced to each other at the top.

In very high-voltage lightning arresters of relatively great height, it is also usually desirable to brace the columns 1 to each other between the top and bottom, and for this purpose an intermediate brace 23 may be provided. The intermediate brace 23 is preferably identical in construction to the top brace 18, and the adjacent arrester units 10 and insulators 11 are bolted, or otherwise secured, to the plates 21 of the intermediate brace 23, thus also utilizing the intermediate brace for electrical connection between the lightning arrester units 10 which immediately adjoin it. It will be seen that in this way rigid bracing between the three columns is provided, so that the complete structure is self-supporting. As previously mentioned, the uppermost arrester unit 10 is directly connected to the steel top brace 18, and a terminal stud 24 is bolted to the top brace 18 for connection of the arrester to a transmission line conductor, or other device to be protected. The base 2 is, of course, grounded.

Since the lightning arrester is quite high, and is normally subjected to a high voltage, it is usually desirable to control the distribution of voltage stress along the lightning arrester, and for this purpose one or more grading rings may be provided. For very high-voltage arresters, such as that shown in the drawing, two grading rings are preferably utilized. The upper ring 25 is supported from the top brace 18 by means of

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radial supports 26 welded to the outer ends of the arms of the top brace, so that the grading ring 25 is electrically connected to the upper terminal of the arrester, and is supported substantially in the horizontal plane of the top brace 18. The lower grading ring 27 is also supported from the top brace 18 by means of pairs of supports 28, which may be pieces of steel pipe, and which are secured to the bracing members 22. At their lower ends the supports 28 are secured to short steel members 29 which are welded to the grading ring 27. Thus, the two grading rings 25 and 27 are securely supported in position from the top brace 18, and are electrically connected to the line terminal 24 of the arrester by the supporting members.

It should now be apparent that a high-voltage lightning arrester of unit construction has been provided which is self-supporting, and which requires no bracing to supports external to the arrester, thus avoiding the disadvantages and extra cost of such bracing. This is accomplished by disposing the individual arrester units in a plurality of vertical columns, which are braced to each other, any suitable number of columns being utilized, although at least three columns are necessary to make the complete arrester self-supporting. The electrical connections between the individual arrester units are arranged so that the voltage difference between corresponding points in any two columns during a discharge is not unduly great, as would be the case if two or more complete columns of arrester units of the conventional arrangement were connected in series. For this reason, it is not necessary to provide unduly large clearance distances between the three columns and the space occupied by the arrester is kept within reasonable limits. Since adjacent arrester units in each column are not directly connected to each other, there is a voltage difference between adjacent units when a surge is discharged, but the danger of flashover is prevented by the insulators which space adjacent arrester units apart. Since the arrester units are disposed in a plurality of columns, the overall height of the complete arrester is substantially reduced, as compared with the height of a conventional arrester of equivalent voltage rating. Thus, in the embodiment shown in the drawing, the height is only about 70% of the height of a conventional lightning arrester of the same voltage rating.

A particular embodiment of the invention has been shown and described for the purpose of illustration, but it will be apparent that various modifications may be made within the scope of the invention. Thus, more than three columns may be utilized if desired, and one or both of the grading rings might be omitted if not needed. It is to be understood, therefore, that the invention is not limited to the particular details of construction shown, but in its broadest aspects it includes all equivalent embodiments and modifications which come within the scope of the appended claims.

I claim as my invention:

1. A self-supporting high-voltage lightning arrester comprising a base, a plurality of vertical columns of lightning arrester units supported on said base, each of said columns consisting of a plurality of lightning arrester units and a plurality of insulators, said insulators alternating with the lightning arrester units to space the arrester units a substantial distance apart, means for electrically connecting each lightning arrester

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unit to a lightning arrester unit in another column to connect all the arrester units together in a series circuit extending from column to column, and bracing means between the columns.

2. A self-supporting high-voltage lightning arrester comprising a base, a plurality of vertical columns of lightning arrester units supported on said base, each of said columns consisting of a plurality of lightning arrester units and a plurality of insulators, said insulators alternating with the lightning arrester units to space the arrester units a substantial distance apart, means for electrically connecting each lightning arrester unit to a lightning arrester unit in another column to connect all the arrester units together in a series circuit extending from column to column, and a top bracing member secured to the upper ends of all the columns.

3. A self-supporting high-voltage lightning arrester comprising a base, a plurality of vertical columns of lightning arrester units supported on said base, each of said columns consisting of a plurality of lightning arrester units and a plurality of insulators, said insulators alternating with the lightning arrester units to space the arrester units a substantial distance apart, means for electrically connecting each lightning arrester unit to a lightning arrester unit in another column to connect all the arrester units together in a series circuit extending from column to column, a top bracing member secured to the upper ends of all the columns, and intermediate bracing means secured to all the columns between the top bracing member and the base.

4. A self-supporting high-voltage lightning arrester comprising a base, a plurality of vertical columns of lightning arrester units supported on said base, each of said columns consisting of a plurality of lightning arrester units and a plurality of insulators, said insulators alternating with the lightning arrester units to space them apart, means for electrically connecting the lowermost arrester unit in one of said columns to the base, means for electrically connecting all of said arrester units in series, each arrester unit being connected to an arrester unit in another column, a top bracing member secured to the upper ends of all the columns, and means for connecting the topmost arrester unit in one of the columns to said top bracing member.

5. A self-supporting high-voltage lightning arrester comprising a base, a plurality of vertical columns of lightning arrester units supported on said base, each of said columns consisting of a plurality of lightning arrester units and a plurality of insulators, said insulators alternating with the lightning arrester units to space them apart, means for electrically connecting the lowermost arrester unit in one of said columns to the base, means for electrically connecting all of said arrester units in series, each arrester unit being connected to an arrester unit in another column, a top bracing member secured to the upper ends of all the columns, means for connecting the topmost arrester unit in one of the columns to said top bracing member, and intermediate bracing means secured to all the columns between the top bracing member and the base.

6. A self-supporting high-voltage lightning ar-

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rester comprising a base, a plurality of vertical columns of lightning arrester units supported on said base, each of said columns consisting of a plurality of lightning arrester units and a plurality of insulators, said insulators alternating with the lightning arrester units to space the arrester units a substantial distance apart, means for electrically connecting each lightning arrester unit to a lightning arrester unit in another column to connect all the arrester units together in a series circuit extending from column to column, a top bracing member secured to the upper ends of all the columns, and means supported on said top bracing member for controlling the voltage distribution along the columns.

7. A self-supporting high-voltage lightning arrester comprising a base, a plurality of vertical columns of lightning arrester units supported on said base, each of said columns consisting of a plurality of lightning arrester units and a plurality of insulators, said insulators alternating with the lightning arrester units to space them apart, means for electrically connecting each lightning arrester unit to a lightning arrester unit in another column to connect all the arrester units together in series, a top bracing member secured to the upper ends of all the columns, and at least one grading ring supported by said top bracing member and encircling all the columns.

8. A self-supporting high-voltage lightning arrester comprising a base, three vertical columns of lightning arrester units supported on said base, each of said columns consisting of a plurality of lightning arrester units and a plurality of insulators, the insulators alternating with the arrester units to space the arrester units a substantial distance apart, bracing means for bracing the columns to each other, and means for electrically connecting each arrester unit to arrester units in other columns so that all the arrester units are connected in a series circuit which extends from column to column in rotation.

9. A self-supporting high-voltage lightning arrester comprising a base, three vertical columns of lightning arrester units supported on said base, each of said columns consisting of a plurality of lightning arrester units and a plurality of insulators, the insulators alternating with the arrester units to space the arrester units a substantial distance apart, a bracing member secured to the tops of said columns to brace them to each other, and means for electrically connecting each arrester unit to arrester units in other columns so that all the arrester units are connected in a series circuit which extends from column to column in rotation.

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