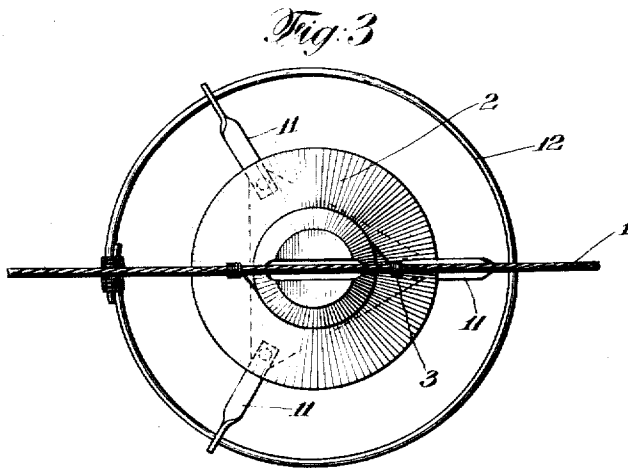
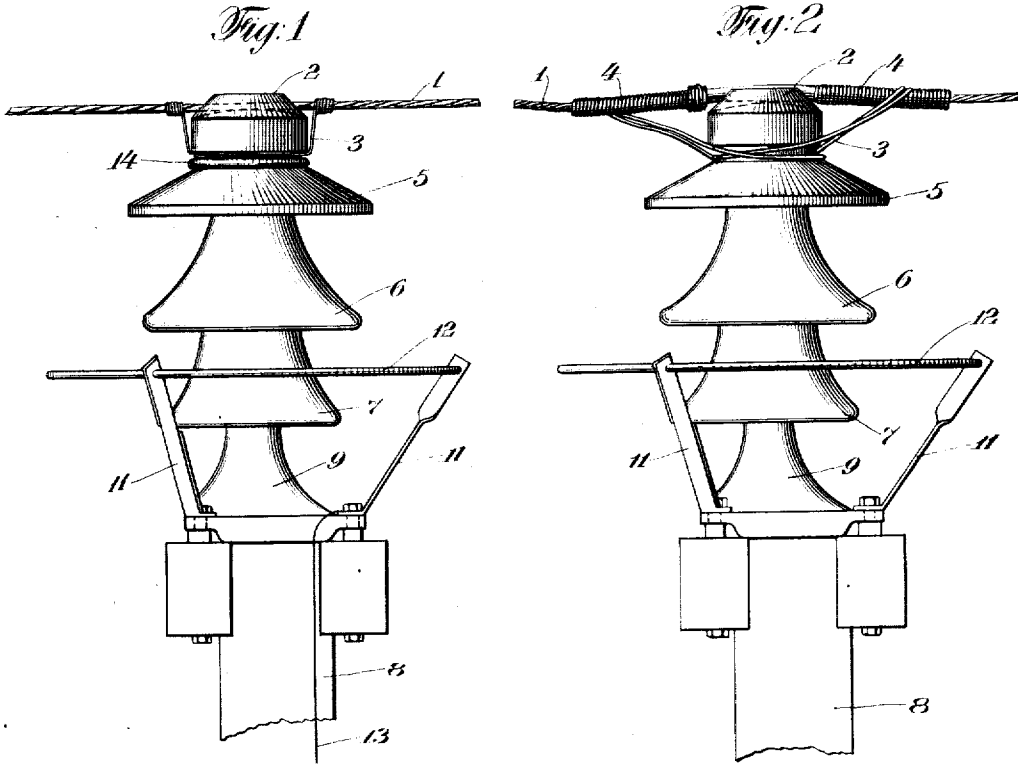


INSULATOR PROTECTING APPARATUS.
APPLICATION FILED JAN. 25, 1909.

954,329.

Patented Apr. 5, 1910.

2 SHEETS--SHEET 1.



Witnesses:
Germans.
John A. Temple

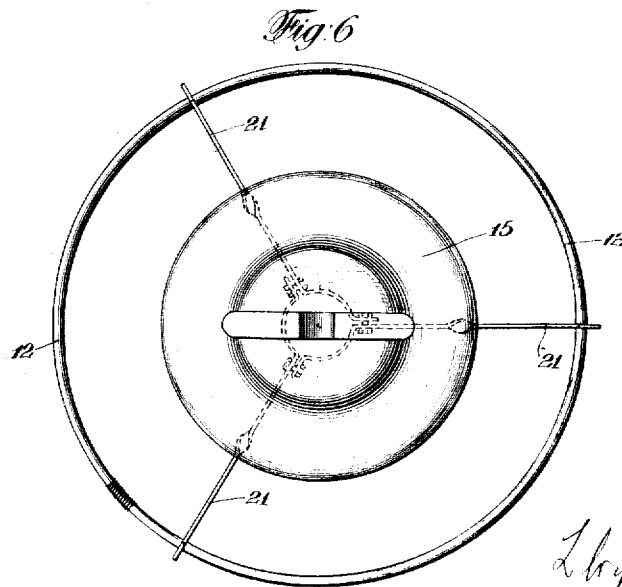
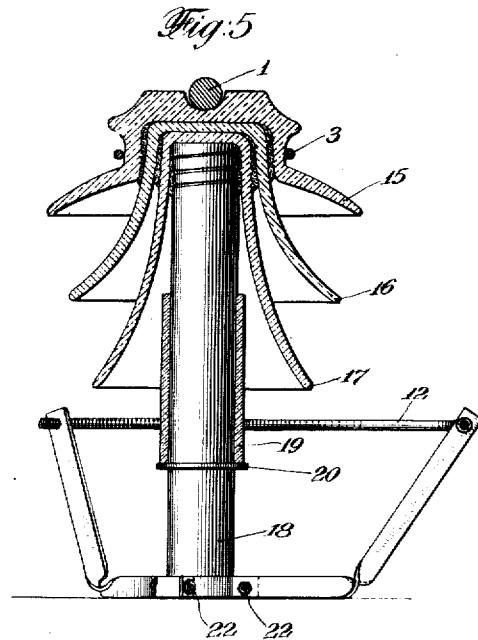
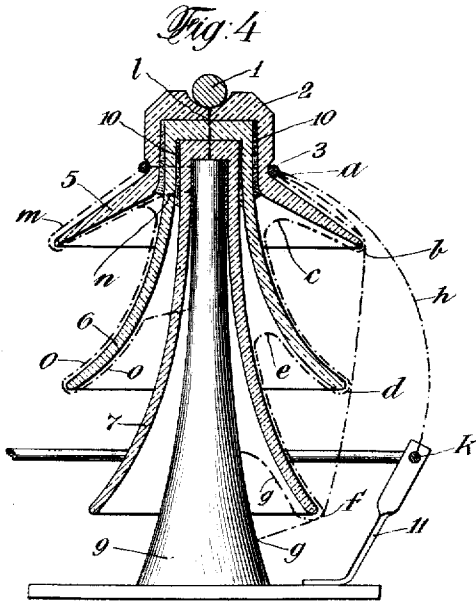
Lloyd C. Nicholson
Inventor
By His Attorney, Keegan & Keegan

L. C. NICHOLSON.
INSULATOR PROTECTING APPARATUS.
APPLICATION FILED JAN. 25, 1909.

954,329.

Patented Apr. 5, 1910.

2 SHEETS—SHEET 2.



Witnesses:
John O. Green & Co.

Lloyd C. Nicholson
Inventor
By *Wm. Attorney Keegan & Keegan*

UNITED STATES PATENT OFFICE.

LLOYD C. NICHOLSON, OF BUFFALO, NEW YORK.

INSULATOR-PROTECTING APPARATUS.

954,329.

Specification of Letters Patent.

Patented Apr. 5, 1910.

Application filed January 25, 1909. Serial No. 473,980.

To all whom it may concern:

Be it known that I, LLOYD C. NICHOLSON, a citizen of the United States, and a resident of Buffalo, county of Erie, State of New York, have invented certain new and useful Improvements in Insulator-Protecting Apparatus, of which the following is a specification.

My invention relates to improvements in protecting apparatus for insulators and is more especially designed to prevent injury to high potential insulators due to punctures and the arcs of the power current which follow flash-overs.

In ordinary high potential electric systems when the voltage on the line conductor rises abnormally due to lightning or other causes a flash-over current is apt to take place over the surface of the insulator to the pin beneath it and thence to the earth. If this discharge current is of sufficient value to overcome the dielectric strength of the medium and break it down an arc will follow, which arc is due to the power current or voltage of the line. That is, the actual discharge due to the high voltage of the lightning is of very short duration but the heavy discharge which follows is due to the flow of the power current which follows the flash-over when the dielectric strength of the air has been broken down. The insulators used in such high potential electric systems are usually of glass or porcelain, which materials are very refractory and easily injured by heat. Therefore, when such power arcs occur over the skirts of the insulator the heat is apt to injure or wholly destroy it. To prevent such destruction I place an electrode connected with the earth so that when a flash-over and power arc occur thereon the whole arc is diverted away from the insulator to the electrode so that it will not injure the insulator. In such high potential insulators there is also liability of the insulator puncturing directly from the tie-wire to the pin carrying the insulator, or else only one or two of the skirts of the insulator may be punctured, the discharge taking place over the surface of the remaining skirts.

It is another object of my invention to prevent or eliminate such punctures and to do this without increasing the flash-over liability of the insulator.

Further objects, features and advantages

will more clearly appear from the detailed description given below taken in connection with the accompanying drawings which form a part of this application.

In the drawings, Figure 1 is a vertical view of an insulator with protecting apparatus embodying one form of my invention. Fig. 2 is a similar view showing a modification in which a protecting covering is applied to the main line conductor. Fig. 3 is a plan view of the insulator and apparatus shown in Fig. 1. Fig. 4 is a vertical section of the insulator and apparatus shown in Fig. 1. Fig. 5 is a vertical section of a modified form of insulator with protecting apparatus embodying one form of my invention. Fig. 6 is a plan view of the insulator and apparatus shown in Fig. 5.

Referring to Figs. 1, 2, 3 and 4, 1 represents a main line high potential conductor secured to the insulator 2 by means of a tie-wire 3 passing around the neck of the insulator. In Fig. 2 the tie-wire 3 is shown wound about the main line wire 1 for a considerable space on each side of the insulator, thus forming a metallic covering 4 for the conductor 1, giving body thereto to prevent the main line conductor from burning apart when a heavy discharge takes place therefrom at the insulator. This last feature, however, is not necessary to the attainment of the principal objects of my invention.

The insulator 2 in the present instance is made up of three skirts 5, 6 and 7 and is secured to a pole or other base 8 by means of an iron pin 9. The various skirts 5, 6 and 7 may be secured together and to the pin 9 by means of Portland cement 10. Bolted to the base of the iron pin 9 are metallic members 11 projecting upwardly and outwardly and carrying at their outer ends a guard ring 12. The guard ring 12 is below or on the same side of the horizontal plane of the conductor 1 as the insulator 2 and extends in the form of a circle, about the insulator 2, at a height between the skirts 6 and 7 and is somewhat larger in diameter than any of the skirts, so that it is spaced therefrom and from the insulator 2. The conducting member or pin 9 is thereby electrically connected with the guard ring 12 by means of the metallic members 11 and the whole is connected with the ground or earth by means of a conductor 13.

Referring more especially to Fig. 4 the

operation of the guard ring 12 is as follows. When an abnormal voltage exists upon the main line conductor 1 the same voltage exists upon the tie-wire 3. This tends to increase the leakage current over the surface of the insulator and if the voltage becomes large enough the dielectric strength of the intervening medium will be broken down and a heavy discharge will take place along the lines *a, b, c, d, e, f* and *g* to the pin 9 and to earth. This heavy discharge which follows, however, is due to the power current which will now flow from the conductor to the ground over the path which has been broken down because of the initially high voltage to which it has been subjected. The discharge immediately forms into an arc which takes the path *a-b, b-d, d-f*, and *f-g*. This arc passing directly over the skirts of the insulator and flaring in all directions causes heating of the insulator and thereby often injures or wholly destroys the same. However, when the guard ring 12 is present the arc immediately shifts to the shorter path along the dotted line *a, h, k*, to it. The arc reaches the point *k* because in flaring about it comes into contact with the ring 12 after which time it no longer goes to the pin 9 because the path to the ring 12 is shorter and more favorable. The arc is thereby diverted from the insulator 2 and its skirts so that it produces no injurious effect thereupon and is prevented from doing damage thereto.

In order that the presence of the guard ring 12 may not cut down the resistance offered by the insulator or increase the flash-over liability thereof the initial resistance along the path *a, h, k*, is greater than the initial resistance over the surface of the insulator along the path *a, b, c, d, e, f* and *g* to the pin 9. By the term initial resistance I intend to comprehend the tendency of the air gaps to resist the discharge of current and not break down as well the tendency of the conductors to resist the passage of current. The guard ring or electrode 12 is thus so situated that the initial resistance through the air or surrounding medium between it and the conductor or tie-wire 3 is so great that the initial discharge will not pass directly thereto along the path *a, h, k*; but will take place over the surface of the insulator to the pin 9 and thence to earth. However, immediately the arc has been formed it takes the path *a, b, d, f, g*, and then because of its flaring in various directions, it shifts to the point *k* at the guard ring 12 so that the arc is drawn away from the skirts of the insulators and thus prevented from doing damage thereto.

In insulators constructed as shown in the figures it is a necessary condition that the electrostatic capacity of a shell or part be less than that of the shell or part into which

it fits. This is true because the active dielectric area of the inner shell is smaller than the active area of the outer shell into which it engages. This condition causes more voltage to act upon the inner shell per unit thickness, than upon the outer shell or shells when two or more shells are assembled as shown. For this reason when an abnormally high potential exists on an insulator the inner part will have to resist more voltage per unit thickness than any of the other parts. Thus, when a high voltage acts the inner part is more liable to puncture than the others. Also, if the inner part punctures the other parts may puncture also because of the ineffectiveness of the inner part when punctured.

In Fig. 4 I have represented by line 1 the path of a puncture when taking place directly through all of the parts of the insulator. However, if the dielectric strength of the skirt 5 is great enough and its electrostatic capacity is large enough the discharge will take place over its surface along the dotted line *m*, but may puncture skirts 6 and 7 along the dotted line *n* on account of the lower electrostatic capacity of these parts. In a like manner if skirts 5 and 6 have sufficient dielectric strength and sufficient electrostatic capacity the discharge will take place along the dotted line *m o* and will puncture skirt 7 on account of its relatively low electrostatic capacity. Since the electrostatic capacity of the inner skirt 7 is necessarily less, on account of the size of its top, than that of 6, and the capacity of 6 is for the same reason less than 5, it is evident that skirt 7 is more liable to puncture than skirt 6 and that skirt 6 is more liable to puncture than skirt 5. Hence it is apparent that if the skirt 7 can be prevented from puncturing the puncture of the other skirts is likewise prevented. The puncture of skirt 7 is prevented by means of the electrode or guard ring 12 being placed at a position such that the dielectric strength of the surrounding medium will be broken down between the points *d* and *k*, before the surrounding medium will be broken down between *d* and the pin 9 along the path *d, e, f, g*. This result is accomplished therefore by causing the ring 12 to slightly lower the flash-over value of the insulator below the point *d*.

An additional advantage arising is that when a discharge occurs from *d* to *k* it must come over the surface of the part of the insulator above *d* along the path *a, b, c, d*. The resistance of this path will tend to prevent a flash-over of the insulator by power current. Such resistance would not be effective if the entire insulator were relieved by an initial discharge from cable 1 or tie-wire 3 directly to an electrode placed for this purpose. It is of course desirable to prevent insulators from flashing over by

power arcs since such action interferes with the continuous operation of the electrical machinery and I attain this advantage and at the same time prevent the various skirts from puncturing in the efficient manner above described.

In order that the heavy discharge taking place from the tie-wire 3 may not burn the same apart because of its taking place at approximately a single point I prefer to place around the neck of the insulator, in contact with the tie-wire 3, a conducting ring or band 14. However, if the tie-wire is sufficient to withstand the discharge the conductor or ring 14 may be omitted.

Referring to Figs. 5 and 6 I show a modified form of insulator much shorter than that of Figs. 1, 2 and 4. The insulator of Fig. 5 is provided with three skirts 15, 16 and 17 secured to the metallic conducting pin 18 in the usual manner. In such short insulators in order that the electrode or guard ring 12 may not cut down the flash-over value of the insulator it may be found desirable to place the same at a lower level than that of the lowest skirt 17 of the insulator. In order that the operation of preventing flash-over arcs from injuring the insulator may take place as above described I provide a porcelain tube 19 surrounding pin 18 and resting upon a flange 20 thereupon. This causes the arc due to a flash-over immediately it has once started to shift to the electrode or guard ring 12 rather than keep to the longer path to the metallic pin 18. In the arrangement shown in Figs. 5 and 6 the guard ring or electrode 12 is secured directly to the pin 18 by means of metallic braces 21 secured to the pin 18 by means of bolts 22. In some arrangements it may not be necessary to use the porcelain tube 19, since, although the ring 12 is placed below the lowest skirt of the insulator yet the arc will readily shift to the guard ring because of its flaring qualities.

Although I have described my improved arrangements in great detail I do not desire to be limited to such details but

Having fully and clearly explained my invention what I claim as new and desire to secure by Letters Patent is:

1. In an arrangement of the class described, an electrical conductor, an insulator therefor and an electrode on the same side of the horizontal plane of the conductor as the insulator and so arranged that the resistance from the conductor through the surrounding medium directly to the electrode is greater than the resistance from the conductor to earth when the discharge occurs over the surface of the insulator.

2. In an arrangement of the class described, an electrical conductor, an insulator therefor and an electrode in proximity to the insulator and connected with the earth and

so arranged that the initial resistance offered to a discharge between the conductor and earth is greater when the path of the discharge is directly through the surrounding medium than when it is over the surface of the insulator.

3. In an arrangement of the class described, an electrical conductor, an insulator therefor and an electrode connected with the earth, arranged on the same side of the horizontal plane of the conductor as the insulator and so adjusted that the initial resistance offered to a discharge from the conductor through the surrounding medium directly to the electrode is greater than the "flash-over" resistance of the insulator.

4. In an arrangement of the class described, an electrical conductor, an insulator therefor and an electrode connected with the ground and placed on the same side of the horizontal plane of the conductor as the insulator and lying outside of the insulator parts and arranged to divert the arc away from the insulator parts when a flash-over and arc occur thereon.

5. In an arrangement of the class described, a conductor, an insulator therefor, and means for diverting the arc from the insulator when a flash-over and arc occur thereon.

6. In an arrangement of the class described, a power conductor, an insulator therefor, and an electrode arranged to divert the power arc from the insulator when a flash-over occurs over the surface of the insulator.

7. In an arrangement of the class described, a conductor, an insulator therefor, and an electrode connected with the ground and arranged to divert the arc away from the insulator when a flash-over occurs thereon.

8. In an arrangement of the class described, a conductor, an insulator therefor, and an electrode connected with the ground and spaced around the insulator in a position to divert the arc thereto away from the insulator when a flash-over and arc occur on the insulator.

9. In an arrangement of the class described, a conductor, an insulator therefor, and an electrode placed at one side of the insulator and below the top thereof for attracting the arc thereto away from the insulator when a flash-over and power arc occur thereon.

10. In an arrangement of the class described, a conductor, an insulator therefor, and an electrode for diverting the arc thereto, away from the insulator, when a flash-over and arc occur thereon, said electrode being so arranged that the resistance through the surrounding medium directly to the electrode is greater than the resistance from the conductor to earth when the dis-

charge occurs over the surface of the insulator.

11. In an arrangement of the class described, a conductor, an insulator therefor, and a metallic electrode outside of the insulator parts and connected with the earth, for diverting the arc away from the insulator when a flash-over and arc occur thereon, said electrode being so arranged that the initial resistance offered a discharge between the conductor and the earth is greater when the path of discharge is directly through the surrounding medium to the electrode than when it is over the surface of the insulator.

12. In an arrangement of the class described, a conductor, an insulator therefor, a metallic pin for the insulator and an electrode connected with the pin and with earth for diverting the arc away from the insulator when a flash-over and arc occur over the surface of the insulator.

13. In an arrangement of the class, described, a conductor, an insulator therefor, a conducting member extending beneath the insulator, and an electrode electrically connected therewith and with earth for diverting the arc away from the insulator when a flash-over arc occurs on the surface, said electrode being placed on the same side of the conductor as the insulator and outside thereof.

14. In an arrangement of the class described, a conductor, an insulator therefor having a plurality of skirts, and an electrode electrically connected with earth for diverting the arc away from said skirts when a flash-over and arc occur over the surface of the insulator.

15. In an arrangement of the class described, a conductor, an insulator therefor having a plurality of skirts, and an electrode electrically connected with earth for diverting the arc away from said skirts when a flash-over and arc occur over the insulator, said electrode being placed outside of said skirts and below said conductor.

16. In an arrangement of the class described, a conductor, an insulator therefor, and an electrode arranged to divert the arc from the insulator when a flash-over and arc occurs over the insulator, said electrode being in the form of a metallic ring extending substantially around the insulator.

17. In an arrangement of the class described, a conductor, an insulator therefor, and an electrode electrically connected with earth for diverting the arc away from the insulator when a flash-over and arc occur on the surface thereof, said electrode being in the form of a conducting ring extending substantially around the insulator below the top thereof and spaced therefrom.

18. In an arrangement of the class described, a conductor, an insulator therefor having a plurality of skirts, and an electrode

electrically connected with earth for diverting the arc away from said skirts when a flash-over and arc occurs on the insulator, said electrode being in the form of a conducting ring extending substantially around the insulator between its top and bottom and spaced therefrom.

19. In an arrangement of the class described, a conductor, an insulator therefor having two skirts, the lower of said skirts having less electrostatic capacity than the one above it, and an electrode arranged so that the initial resistance from the upper skirt to the electrode directly through the surrounding medium is less than the initial resistance to said electrode when the path is over the surface of said lower skirt and the initial resistance from the conductor to said electrode is greater than either of the above mentioned resistances.

20. In an arrangement of the class described, a conductor, an insulator therefor having two skirts, the lower of said skirts having less electrostatic capacity than the one above it, and an electrode arranged on the same side of the conductor as the skirts and so that the initial resistance from the upper skirt to the electrode directly through the surrounding medium is less than the initial resistance of the path over the surface of said lower skirt to earth, for preventing the lower skirt from being punctured from abnormally high voltages.

21. In an arrangement of the class described, a conductor, an insulator therefor having two skirts, the lower of said skirts having less electrostatic capacity than the one above it, and an electrode connected with earth and arranged so that the initial resistance from the upper skirt to the electrode directly through the surrounding medium is less than the initial resistance to earth when the path is over the surface of said lower skirt, said electrode being situated outside of the insulator and between said skirts.

22. In an arrangement of the class described, a conductor, an insulator therefor having two skirts, the lower of said skirts having less capacity than the one above it, and an electrode arranged to divert arcs away from the skirts and also arranged so that the initial resistance from the upper skirt to the electrode directly through the surrounding medium is less than the initial resistance to earth when the path is over the surface of said lower skirt, said electrode being connected with the earth and in the form of a conducting ring extending around the insulator and spaced therefrom.

23. In an arrangement of the class described, a conductor, an insulator therefor having a plurality of skirts, one of said skirts being arranged to have less electrostatic capacity than the others, and an elec-

trode arranged so that a discharge to it will pass over one skirt without passing over another to prevent said skirt of low capacity puncturing from abnormally high voltages, said electrode being connected to earth and situated outside of said skirts below the top of the insulator.

24. In an arrangement of the class described, a conductor, an insulator therefor having a plurality of skirts, one of said skirts having the smallest capacity, and an electrode so situated that a discharge to it from the conductor will take place over one of said skirts and will take place to it before puncturing said skirt of smallest capacity.

25. In combination, a conductor, an insulator therefor having a plurality of skirts, a conducting pin for the insulator, a guard ring extending around the insulator outside thereof, and means for electrically connecting said ring to said pin and to earth.

26. In combination, a conductor, an insulator therefor having a plurality of skirts, a pin for the insulator, a guard ring extending around the insulator outside thereof and between the two lowermost of said skirts and conducting members for connecting said ring to earth.

27. In an arrangement of the class described, a conductor, an insulator therefor, an electrode electrically connected therewith and with earth for diverting the arc away from the insulator when a flash-over and arc occur on the surface thereof and a metallic covering on the conductor near the insulator to prevent the conductor from

burning apart when such a flash-over takes place.

28. In an arrangement of the class described, a main line conductor, an insulator therefor, a tie-wire for securing the conductor to the insulator, an electrode for diverting the arc away from the insulator when a flash-over and arc occur over the surface thereof and a conducting ring about the neck of the insulator adjacent the tie-wire for preventing injury to the tie-wire.

29. The combination of a conductor, an insulator therefor having a plurality of skirts, an electrode outside of said skirts and arranged so that a discharge to it from the conductor will take place over one of said skirts without passing over another of said skirts.

30. The combination of a conductor, an insulator therefor having a plurality of skirts, one of said skirts being arranged to have less electrostatic capacity than another, and the electrode arranged so that the discharge to it from the conductor will pass over the surfaces of the skirt having the larger electrostatic capacity without passing over the surfaces of the skirt having the lesser electrostatic capacity to prevent said last mentioned skirt from puncturing from abnormal high voltages.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

LLOYD C. NICHOLSON.

Witnesses:

F. C. AVERILL,
C. M. SEALY.