

S. MOMOTA.

HIGH POTENTIAL INSULATOR.
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1,266,516.

Patented May 14, 1918.

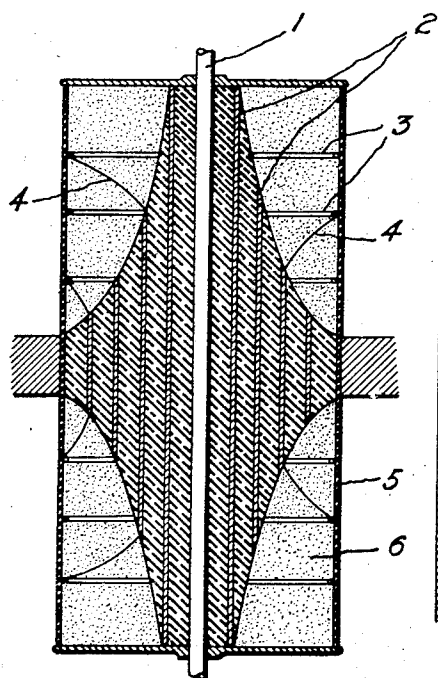


FIG. 1.

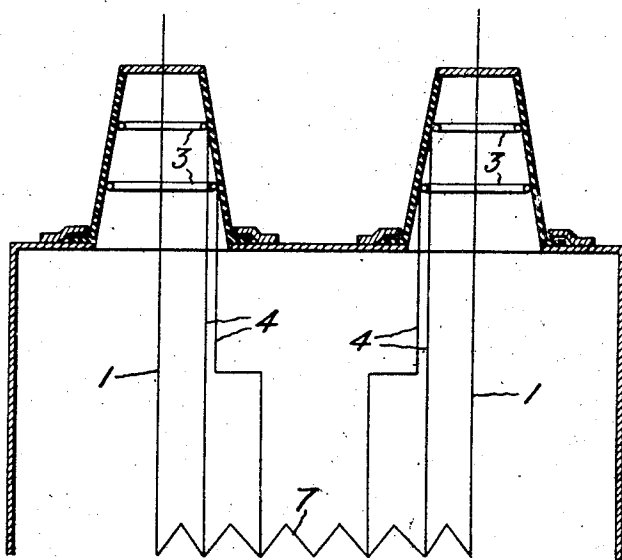


FIG. 2.

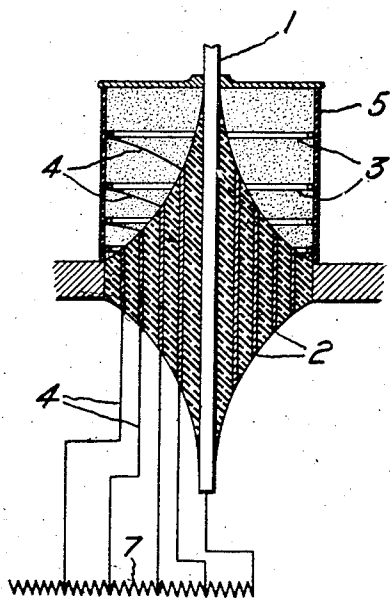


FIG. 3.

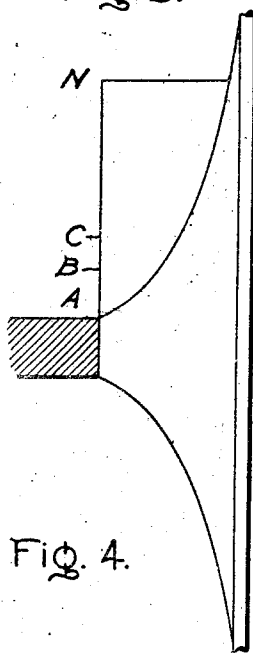


FIG. 4.

Inventor:
Sadaji Momota,
by *Albert S. Davis*
His Attorney.

UNITED STATES PATENT OFFICE.

SADAJI MOMOTA, OF TOKYO, JAPAN, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

HIGH-POTENTIAL INSULATOR.

1,266,516.

Specification of Letters Patent.

Patented May 14, 1918.

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To all whom it may concern:

Be it known that I, SADAJI MOMOTA, a subject of the Emperor of Japan, residing at Tokyo, Japan, have invented certain new and useful Improvements in High-Potential Insulators, of which the following is a specification.

This invention relates to means for preventing creeping or surface discharge by so distributing the electric pressure sustained by an insulator surrounding a high voltage conductor that it will be limited at each and every point on the surface of the insulating mass to a predetermined value. One object of this invention is to prevent the heretofore unavoidable insulating surface destruction by distributing the intensity of the electrostatic field in a desired manner.

The invention may be applied to conductor leads or bushings of the condenser type or of the oil filled type or any other type suitable for insulating high potentials, in order to increase the surface insulation thereof.

The invention is illustrated in the accompanying drawing, in which: Figure 1 is a vertical sectional view of an insulator or bushing of the condenser type with my invention applied thereto; Fig. 2 is a similar view of insulating tubes which surround the leads of an oil filled electrical apparatus and embodying my invention; Fig. 3 is similar to Fig. 1, with the condenser cylinders connected through resistances or a transformer winding; and Fig. 4 shows something of the natural distribution of the electric pressure on ordinary insulators which do not employ this invention.

Considering for a moment the electric pressure upon the insulating covering of a high voltage conductor to which this invention is not applied, we find a condition something like that indicated in Fig. 4; that is, the portion at A sustains the greatest difference of electrical potential per unit length and this difference of potential per unit length gradually decreases toward the point N; in other words, the potential is somewhat concentrated on the portion A and tends to cause the surface insulation to break down first at that portion, then on to points B, C, and so on in order, until the creeping discharge in time perhaps flashes over the whole insulator. In other words, because of

the non-uniformity in the distribution of the electric pressure, the insulating power of the insulator is considerably less than it might be. The present invention contemplates fixing the potential of certain points on the surface of the bushings at values other than they would naturally assume, and particularly aims at obviating the defect of non-uniform distribution of potential by distributing the electric pressure on the insulating shell according to a predetermined ratio between the differences of potential and the unit lengths of the insulator; in other words, it aims to distribute the electrostatic field in a desired manner instead of leaving it free to concentrate potential in a less efficient manner.

In Fig. 1 is shown an insulator of the condenser type for insulating a conductor 1, the insulator being provided with concentric metallic tubes 2; something like predetermined differences of potential exist between each two adjacent metallic tubes, as is well known. The outer surfaces of this condenser tube insulating bushing are covered by shells 5 of some suitable insulating material, as porcelain, and the spaces between these shells 5 and the body portion of the insulator carrying the metallic tubes 2 are filled with oil or other insulating material 6 to prevent corona effects, etc. Rings 3 of conducting material are connected to the different metallic tubes 2 by the conductors 4 and thereby fixed at something like predetermined potentials. These rings 3 are disposed one above another adjacent the bushing surface and surrounding the conductor 1 as illustrated. The rings are inclosed by the insulating material of the bushing and are spaced such distances apart along the bushing surfaces that the total potential on the surface of the insulating shell, as from the point A to the point N (Fig. 4), is so distributed that each unit of length of the insulator (so far as is desirable under the conditions of the particular case) is subjected to approximately a predetermined desired difference of potential between its ends. This is accomplished, of course, by impressing on each ring a potential of a desired value and a different value than the natural potential of the surface of the bushing adjacent that respective ring. For example, if the tubes 2 are so arranged that equal dif-

ferences of potential occur between adjacent tubes, and the number of rings 3 at one end of the bushing is equal to the number of tubes 2, the rings 3 adjacent the surface of that end of the bushing may be spaced substantially equal distances apart. The electric pressure will then be more equally distributed along the surface of that end of the bushing than were the rings omitted. Of course, the invention may be applied to either or both ends of any bushing. Obviously the members 3 are not limited in shape to the ring shapes shown, as will be understood to those skilled in this art.

The present invention is not limited to deriving the potential for any ring 3 (or other substituted member) from the bushing itself, as in the case of Fig. 1, but this potential may be derived from any other suitable source. Furthermore, the invention may be applied to other types of bushings than the condenser type, as previously indicated, and the number of members 3 used in any case will be such a number as may be desirable or necessary for that particular case. Thus in Fig. 2 the invention is shown applied to a form of oil filled bushing. The two rings 3 in each bushing in Fig. 2 derive potentials through conductors 4 connected at suitable points of different potentials on the member 7, the member 7 being connected to and carrying current between the conductors 1. The member 7 may be a resistance connected between the conductors 1 or an electrical winding supplied from or supplying the leads 1. As before, the distribution of potential on the shell of the bushing may be limited as desired by employing a suitable number of rings 3 impressed with suitable potentials.

In the construction of Fig. 3 the distribution of potential both within and on the surface of the insulating shell is limited by the member 7, a resistance or a winding between the conductors 1. The metallic cylinders 2 and their respectively connected rings 3 are separately connected to suitable points on the member 7 by means of the conductors 4.

Altogether the present invention is subject to more or less modification.

The present invention, it thus appears, greatly increases the insulating power of the surface of the insulation; at the same time, where the condenser type of bushing is employed, the electric potential on each of the condenser elements 2 and members 3 may be exactly determined in spite of the differences which are unavoidable in the manufacture of the apparatus and in spite of differences in electrostatic capacity, and independently of the conducting areas.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. The combination with a conductor and an insulating bushing surrounding the same,

of a ring of conducting material adjacent the surface of said bushing and surrounding said conductor, a source of potential of a different value than the natural potential of the surface of said bushing adjacent said ring, and a conductor connecting said ring and said source of potential.

2. The combination with a conductor and an insulating bushing surrounding the same, of a ring of conducting material inclosed by the insulating material of said bushing adjacent the surface thereof and surrounding said conductor, a source of potential of a different value than the natural potential of the surface of said bushing adjacent said ring, and a conductor connecting said ring and said source of potential.

3. The combination with a conductor and an insulating bushing of the condenser type surrounding the same, said bushing being provided with the usual condenser plates and being provided with insulating material beyond the ends of said plates forming an external surface of said bushing, of a ring of conducting material adjacent said surface of said bushing and surrounding the conductor, and a conductor connecting said ring to a condenser plate of a different potential than the natural potential of said surface adjacent said ring.

4. The combination with a conductor and an insulating bushing surrounding the same, of a ring of conducting material adjacent the surface of said bushing and surrounding the conductor, a conducting plate of a greater capacity than said ring, said conducting plate being embedded in said bushing and so located with reference to said conductor as to have impressed upon it a potential of a different value than the natural potential of the surface of said bushing adjacent said ring, and a conductor connecting said ring and said plate.

5. The combination with a conductor and an insulating bushing surrounding the same, of a ring of conducting material adjacent the surface of said bushing and surrounding the conductor, a second conductor connected to and carrying current in connection with the first mentioned conductor, and another conductor connecting said ring to a point on said second conductor of a different potential than the natural potential of the surface of the bushing adjacent said ring.

6. The combination with a conductor and an insulating bushing surrounding the same, of conducting material concentrated adjacent a portion of the surface of said bushing, a conducting plate of greater capacity than said conducting material, said conducting plate being embedded in said bushing and so located with reference to said conductor as to have impressed upon it a potential of a different value than the natural potential of the surface of said bushing adjacent said

conducting material, and a conductor connecting said conducting plate and said conducting material.

7. The combination with a conductor and an insulating bushing surrounding the same, of a plurality of rings of conducting material spaced apart along and adjacent the surface of said bushing and surrounding said conductor, a source of potentials of different values than the natural potentials of the portions of the surface of said bushing adjacent said rings, and conductors connecting said rings and said source to impress on each of said rings a potential differing from the potential of each of the other rings and differing from the natural potential of the surface of the bushing adjacent the respective ring.

8. The combination with a conductor and an insulating bushing surrounding the same, of a plurality of rings of conducting material spaced apart along and inclosed by the insulating material of said bushing adjacent the surface thereof and surrounding said conductor, a source of potentials of different values than the natural potentials of the portions of the surface of said bushing adjacent said rings, and conductors connecting said rings and said source to impress on each of said rings a potential differing from the potential of each of the other rings and differing from the natural potential of the surface of the bushing adjacent the respective ring.

9. The combination with a conductor and an insulating bushing surrounding the same, of a plurality of rings of conducting material spaced apart along and adjacent the surface of said bushing and surrounding said conductor, a source of potentials of different values than the natural potentials of the portions of the surface of said bushing adjacent said rings, and conductors connecting said rings and said source to impress on said rings such potentials that the difference of potential between each two rings is approximately proportional to the distance between the same.

10. The combination with a conductor and an insulating bushing of the condenser type surrounding the same, said bushing being provided with the usual condenser cylinders and being provided with insulating material beyond the ends of said cylinders form-

ing an external surface of said bushing, of means for reducing creepage along said surface by limiting the distribution of electric pressure, which means consists of a plurality of rings around and adjacent said surface of the bushing and conductors separately connecting said rings to said condenser cylinders.

11. The combination with a conductor and a bushing surrounding the same, of means for reducing the creepage along the surface of said bushing by limiting the distribution of electric pressure, which means consists of a plurality of metallic pieces arranged adjacent the surface of said bushing, a source of predetermined electric pressures, and conductors connecting said metallic pieces and said source.

12. The combination with a conductor and an insulating bushing of the condenser type surrounding the same, said bushing being provided with the usual condenser cylinders and being provided with insulating material beyond the ends of said cylinders forming an external surface of said bushing, of means for reducing creepage along said surface by limiting the distribution of electric pressure, which means consists of a plurality of rings around and adjacent said surface of the bushing, a source of predetermined electric pressures, and conductors separately connecting said rings to said condenser cylinders and said condenser cylinders separately to said source.

13. The combination with a conductor and an insulating bushing of the condenser type surrounding the same, said bushing being provided with the usual condenser cylinders and being provided with insulating material beyond the ends of said cylinders forming an external surface of said bushing, of means for reducing creepage along said surface by limiting the distribution of electric pressure, which means consists of a plurality of rings around and adjacent said surface of the bushing, a second conductor connected to and carrying current in connection with the first mentioned conductor, and other conductors separately connecting said rings and condenser cylinders to different points on said second conductor.

In witness whereof, I have hereunto set my hand this 8th day of May, 1916.

SADAJI MOMOTA.