April 19, 1932. J. A. DIENNER 1,854,459

INSULATOR

Filed Feb. 24, 1930

Fig. 1.

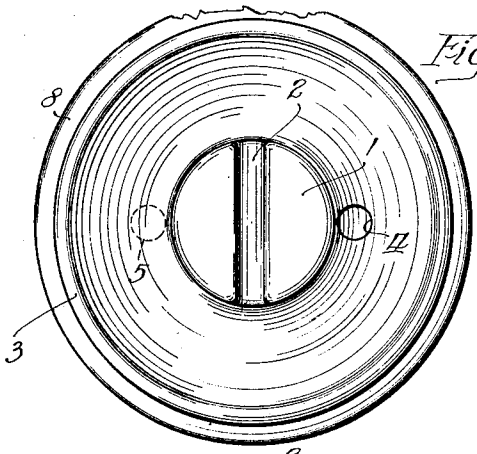


Fig. 5.

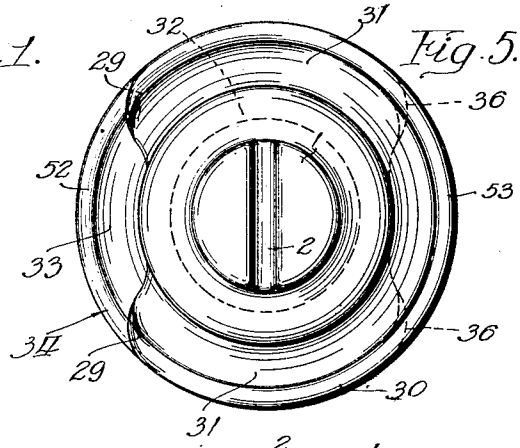


Fig. 2

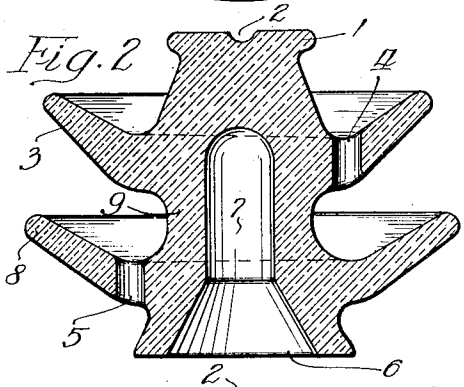


Fig. 6.

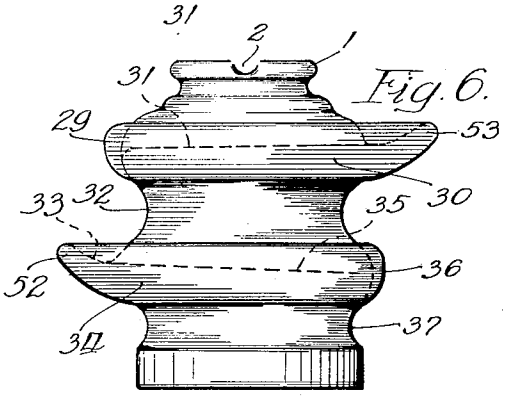


Fig. 3.

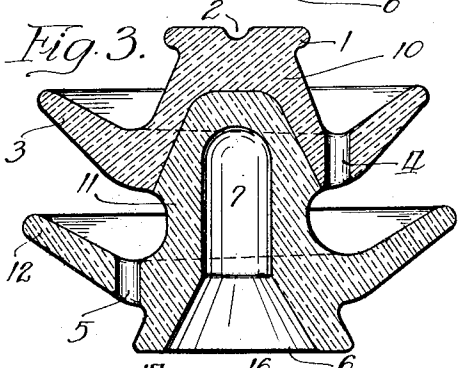


Fig. 7

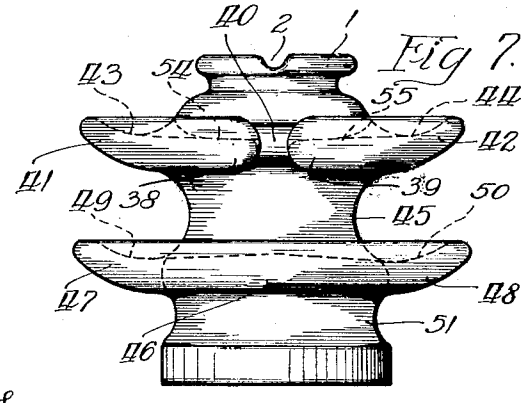
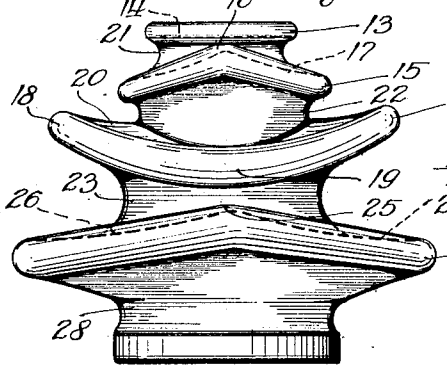


Fig. 4



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UNITED STATES PATENT OFFICE

JOHN A. DIENNER, OF EVANSTON, ILLINOIS

INSULATOR

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This invention relates, generally speaking, to insulators for receiving and for securely supporting current conductors for the transmission of electric energy, and is specifically concerned with a novel type of insulator which is particularly useful in connection with outdoor service and which incorporates numerous novel features not exhibited by insulators disclosed prior to my invention.

A number of difficult problems which have not yet found satisfactory solution arise in connection with the outdoor insulators. Such insulator employed for supporting high-tension conductors, as constructed in the past, when subjected to atmospheric conditions, accumulates a coating of dust, soot and the like, which decreases its creepage resistance value and contributes to the formation of arcs over the surface of the insulator, as will be explained presently.

It has been customary to provide downwardly extending petticoats which are adapted to serve as rain-sheds, keeping portions of the insulator surface dry. This is particularly shown in connection with pin type insulators, such as are disposed vertically for supporting high-tension conductors.

The petticoat type of construction as exhibited by the prior art has occasioned a number of objections. It presents, necessarily, a varying cross-section in its own body. The surfaces which are protected from rain, due to the downwardly extending petticoats, accumulate dirt and never become washed, and the electrical stresses on a wet insulator of this type are concentrated at the worst possible places, namely, at the points of smallest cross-section, and result in the formation of spark discharges which tend to injure the insulator and are particularly likely to induce complete flashovers.

When such insulator is observed under operating conditions it may be seen that signs of flashover begin to show first on the restricted areas. When such insulator is subjected to rain, dry areas will form in the restricted sections intermediate of the wet areas and small arcs will show over the dry areas without indication of arcs over the wet surfaces. It appears that the arcs increase in length as the insulator dries, either by the heat of the arc or by the action of the elements, and this occasionally causes arcs over the entire insulator. This arcing at the dry spots, which are covered with a deposit of dirt and dust particles, causes heating and deterioration of the insulator.

In running tests on insulators for corona formations it may be observed that corona forms around the tie-wire as the voltage impressed upon the insulator is raised. Then it forms in the restricted area under the top shell. It appears logical that, as the voltage is raised, the corona under the top shell will spread until it meets the corona formed around the tie-wire, thus causing a complete flashover. The high voltage can be induced on these restricted areas either by raising the voltage on the entire insulator or by raising the voltage on the restricted areas by wetting the rest of the insulator and thus producing dry spots at the restricted areas.

This causes a great voltage drop across the restricted areas. The exposed wet surfaces are conductive and compel the dry, dirty surfaces to have much higher voltage gradient over those surfaces than normally, which is equivalent to increasing the voltage over the entire insulator.

The problems intimated above may now be expressed in saying that the conventional type of insulator, having downwardly extending petticoats, induces the formation of layers of dust, soot and dirt at the restricted areas, changing the surface resistance of these areas, thus contributing to the formation of arcs and complete flashovers as described, to the detriment and possibly acute injury of the insulator. It will be understood that the difficulties increase with increased voltage carried by the conductor supported by such insulators.

It is the principal object of my invention to provide an insulator which is mechanically strong and has a novel structure which inhibits and prevents the formation of layers or films of dust, soot or dirt at any part of the insulator surface, and specifically, to provide an insulator having inverted or upwardly extending flanges or petticoats, or symmetri-

cally curved flanges, which catch rain-water, together with communicating openings or other provision for conducting the rain-water downwardly, thus utilizing the rain-water for washing and cleaning the entire surface of the insulator.

The formation of arcs and flashovers due to sections covered with layers of dust particles is thereby prevented and the safety of service is increased by better serviceability and reliability of the insulator.

The various objects underlying my invention may be briefly stated as follows:

One object of the invention resides in providing a novel, rugged insulator of great mechanical strength, which is easy to manufacture and reliable in operation, and having means disposed on its surface for receiving water precipitated on the insulator and for conducting said water radially and axially along the surface in cascade steps to wash and to clean said surface.

Another object is to provide concentric, upwardly extending petticoats or flanges for catching water precipitated on the insulator to prevent dripping between the sections of the insulator, the diameter of the flanges varying axially to the insulator and increasing from top to bottom of the insulator.

A third object is concerned with provision of longitudinally extending communicating openings for causing the water collected in the upwardly flaring petticoats or flanges to flow downwardly in cascade steps near the insulator body.

A further object has to do with a modification of a self-draining and self-washing insulator having peripherally extending laterally curved flanges of varying diameters to permit downward flow of rain-water from the top flange to the bottom flange, the flanges being disposed in an angle of 90° to each other and radially of the insulator body.

Another object is concerned with a modified structure of such insulator having a plurality of laterally extending concentric tray flanges integral with the insulator body and disposed in axially spaced relation on the insulating body on opposite sides thereof, each flange having a circular channel or groove axially displaced to the insulator for conducting water downwardly to wash the insulator surface.

Still another object relates to the provision of a further modification of such insulator in which pairs of oppositely disposed tray flanges are provided in axially spaced relation and disposed in a radial angle of 90° to each other on the insulator, but each pair in a definite axial plane, there being a plurality of such pairs of tray flanges arranged in a plurality of axial planes of the insulator.

Other objects which are not specifically mentioned above will appear clear as the description progresses.

My invention is applicable to various forms of insulating bodies, such as post type insulators, pin type insulators, suspension insulators, strain insulators, all manner of insulating bushings for terminals of transformers, circuit breakers, potheads, or the like, floor, wall, and ceiling bushings, bus supports and, in fact, for all purposes where a conductor is to be supported in insulated relation or guarded against leakage, and therefore, it is not my intention to confine the invention to any one specific form of insulator. However, for purposes of description, I have chosen specific structural embodiments of my invention as shown in the accompanying single sheet of drawings which I will presently explain in detail.

Referring now to the drawings, I have shown therein several embodiments of my invention in different views to illustrate the possibilities of the inventive ideas underlying my invention.

Figure 1 illustrates a top view of an insulator having upwardly flaring concentric flanges, the diameters of which vary axially to the insulator body, and provided with communicating openings for draining rain water from the top to the bottom of the insulator;

Figure 2 illustrates a cross-sectional side view of the insulator shown in Figure 1;

Figure 3 shows a longitudinal cross-section of an insulator as shown in Figures 1 and 2 in which the top shell is separately attached to the insulator body by cementing;

Figure 4 shows a side view of a modified type of insulator having a plurality of peripherally extending flanges which are curved to form displacements axial to the insulator, the flanges also increasing in diameter downwardly of the insulator body;

Figure 5 illustrates the top view of an insulator having tray flanges disposed in axially spaced relation relative to the insulator body and arranged on opposite sides of the insulator body. Each flange is provided with a radial groove or channel which has a displacement axially to the insulator to conduct the rainwater properly;

Figure 6 shows a side elevation of the insulator shown in Figure 5; and

Figure 7 illustrates an insulator having a plurality of pairs of tray flanges arranged in different axial levels of the insulator body in spaced relation to each other and having radially arranged spaces between the flanges of each pair in each level for conducting rainwater from the top flange downwardly over the other flanges to the bottom of the insulator. The pairs of flanges in the various levels are disposed in an angle of 90° relative to each other.

Like parts are designated by like reference numerals in all figures to simplify explanation.

Referring now particularly to Figures 1

and 2, I have shown in these figures an insulator which may be cast or molded of suitable material in a single solid piece. The body 9 of the insulator is provided with a socket or pocket which is wider at the bottom 6 than at the constricted part 7 for the reception of a supporting pin which may be attached by cementing. A wire receiving groove or saddle 2 is provided across the head 1. The thickness of insulation between the bottom of the pocket 7 and the saddle 2 is sufficient to withstand the electro-static stress of the line voltage and may, obviously, be varied without any departure from the invention. It is not essential that the insulator be made of the pin type as shown in these figures; it may be made of the post type or it may be made in the form of a bushing with an axial opening therethrough. It is not the stresses on the solid insulation between the permanent metallic parts which usually gives trouble; it is the exposed surfaces.

The body 9 of the insulator is, in this case, provided with a plurality of concentric circular flanges 3 and 8 located on the insulator body 9 in axially spaced relation to each other, and shaped to provide laterally progressive displacements of their surfaces, the diameter of these flanges varying progressively axially to the insulator body. In other words, the flanges 3 and 8 provided on different levels of the insulator body are turned upwardly, and their diameter increases progressively from the top to the bottom of the insulator. There are communicating openings or drain holes 4 and 5 provided in the flanges 3 and 8, respectively, which are disposed at an angle of 180° to conduct rainwater from the top flange to the bottom flange. The laterally curved surfaces of the flanges are also inclined toward the communicating openings 4 and 5, respectively, or, in other words, they are displaced axially toward these openings to prevent formation of moisture pockets in these flanges. The contours of the holes 4 and 5 are smooth with the lower edges rounded to conduct the water smoothly. It is, of course, understood that there may be more such flanges provided on an insulator body than I have shown, without introducing a novelty over the teaching of my invention.

The insulator shown in Figure 3 distinguishes over the one just explained in the provision of a separate top member or shell 10 which carries the top flange 3 and the head 1 provided with the usual groove or saddle 2 for receiving the tie wire. This top shell may be attached to the insulator body 11 by cementing to form a unitary structure.

The operation of the insulator will be readily understood from the remarks made previously. Rainwater precipitated on the insulator will collect in the top flange 3 and will be conducted radially along the inclined surface and through the opening 4 to the lower flange (in Figures 1 and 2) or to the flange 12 (in Figure 3), where it collects again and is conducted radially along the surface of the flange and through the opening 5 to the next flange (if there are more flanges provided than I have shown in the figures) and finally to the bottom of the insulator where it is discharged. The upper flange or shell does not act strictly as a shed for the adjoining lower flange due to the fact that the diameter of the flanges increases progressively from top to bottom. Therefore, rainwater will be caught by each flange or shell individually.

The insulator is thus self-washing and self-draining and the former function is naturally expedited by the progressively increasing diameter of the flanges from top to bottom of the insulator. Thus, soot or dirt particles which may be deposited on the insulator will be washed away very effectively, the insulator will be clean and will at all times have the surface resistance given by the material and unaltered by local or atmospheric conditions. Spark or arc discharges over the surface of the insulator, due to changed surface resistance caused by the deposits of dirt or dust particles, will be inhibited and detriment to the insulator from this cause is, therefore, eliminated.

In Figure 4 I have shown a modified adaption of the inventive ideas disclosed in this specification as applied to an insulator serving similar purposes as the one disclosed in connection with previously described figures.

The insulator shown in Figure 4 is again provided with a plurality of peripherally extending flanges 15, 18 and 27 which are disposed in definite axial levels on the insulator body and which have diameters which vary progressively axially of the insulator. Each of these flanges conforms to a symmetric curve radially and axially of the insulator body and this curve is disposed and proportioned in such a manner as to provide surfaces for these flanges which are progressively displaced axially of the insulator with a lateral curvature of each surface sloping towards the insulator body. Each flange is also displaced radially in an angle of 90° relative to the adjoining flange.

The axially spaced location and the progressively varying diameters of the flanges 15, 18 and 27 are readily apparent from the drawings. It will also be seen that each of the flanges conforms to a curve which provides displacements of the flange surface axially of the insulator body. Point 16 of the top flange 15 is raised axially of the insulator body 22; points 18 of the center flange are axially displaced relative to the portion 19; and point 25 of the bottom flange is again displaced axially of the insulator body in a similar manner as point 16 in case

of the top flange. The surface of each flange is also curved laterally to slope toward the insulator body as is plainly indicated in the drawing by numerals 17, 20 and 26, designating these sloping surfaces of the various flanges. The radial displacement of each flange by 90° relative to the adjoining flange positions the raised points or portions of a flange beneath the lowered portions of the flange above or, in other words, (with the insulator viewed in a vertical position as shown in the drawings) the ascending portions of a curved flange, such as the center flange 18 are positioned below the descending portions of the curved flange located above flange 18 while the ascending portions 25 of the bottom flange 27 are positioned below the descending portions 19 of the center flange.

Water will therefore collect on each flange due to the progressively varying diameters of the flanges, and will be conducted toward the center due to the lateral curvature of each flange. It will flow then radially down the descending surfaces of each flange and from there axially smoothly along a portion of the insulator body (as is plainly seen at 22 of Figure 4) onto the flange beneath from where it is conducted in the same manner onto the next lower flange toward the bottom of the insulator, effectively washing and cleaning the same to remove deposits of dust, soot and dirt from its surface.

A further modification is illustrated in Figures 5 and 6 of the drawings which I shall explain next.

The insulator body 32 is provided with the usual head 1 having a groove or channel 2 across its top for receiving the wire. A plurality of concentric tray flanges 30 and 34 are located in spaced axial relation on the insulator body, each having a conducting channel 31 and 35, respectively, which is disposed radially within the upwardly projecting peripheral flanges in progressive axial displacements relative to the insulator body as is indicated by the slope designated by reference numerals 33 and 35 in connection with the radial groove of the bottom flange in Figure 6. The mouth of each flange, designated by numerals 52 and 53, respectively, extends circularly around the flange and terminates in the rear portions 29 and 36, respectively, which curve smoothly toward the insulator body. The groove or channel 31 and 35, respectively, of the two tray flanges flares laterally toward the edge and slopes toward the rear portions of each flange, providing a gradual progressive axial displacement of the flange surface relative to the insulator body for conducting water smoothly and evenly radially within each flange and axially away from each flange along the intermediate portion of the insulator body.

The water, therefore, will collect in each tray flange due to the mouth of each flange located opposite the rear curve of the adjoining flange, and washing the surface of each flange, the water will flow toward the rear and then proceed to flow down the insulator body onto the flange located beneath, where the play is repeated, until the water reaches the bottom of the insulator where it is discharged.

In this case, as in the cases discussed previously, the water washes the entire insulator thoroughly and effectively, removes all deposits of dust and dirt from the flanges and from the insulator body, leaving the surfaces clean and thus solving a problem which has not yet received such satisfactory solution in any invention prior to my disclosure. It is, of course, apparent that all remnants of water are drained off due to the sloping circular channels or grooves in the surfaces of the tray flanges as described.

Figure 7 shows still another embodiment of the invention. The insulator body 45 is in this case provided with pairs of tray flanges disposed in spaced axial relation on the insulator body, the members of each pair of flanges being spaced radially from each other and each flange being provided with a groove or channel for conducting water laterally on the flange surface toward the insulator body and circularly around the insulator body toward the spaces provided between the flanges of each pair. These pairs of flanges are radially displaced on the insulator body in an angle of 90° relative to each other so that the space separating the flanges of one pair is located above the mouth of a flange in the adjoining level.

This is illustrated particularly in the embodiment shown in Figure 7, wherein numeral 45 designates the insulator body which is provided with a pair of tray flanges 38 and 39 at the top and another pair of flanges at the bottom. Due to the radial displacement of the flanges on the insulator body, only one flange of the bottom pair is visible in Figure 7 and designated there by reference numeral 46. It is located beneath the space 40 which separates the top flanges radially on the insulator body. These pairs of flanges are concentric, and, as in previously explained embodiments, they are of progressively varying radius, that is, their radii increase progressively from top to bottom of the insulator. The outer edge of each flange flares upwardly providing a smooth lateral curve for each flange surface which slopes toward the insulator body, as is clearly indicated by reference numerals 43—44 and 49—50. These laterally curved surfaces of the flanges slope axially to the insulator as they approach the space separating the flanges of each pair in order to conduct water smoothly along the insulator body intermediate of the pairs of flanges and onto the flange positioned beneath the separating space.

It will be seen from the above description of the various embodiments of my invention that I have disclosed a novel insulator of an advantageous structure not shown by any insulator known prior to my invention. The problem of maintaining a uniform surface resistance of an insulator is solved by my invention as water precipitating onto the flanges of any of the structures which I have disclosed will run downwardly of the insulator with a cleaning effect to its surface thus removing elements which might contribute toward altering the surface resistance. The flow of water will carry dust, soot and the like, which may be deposited on the flanges or on any part of the insulator downwardly and discharge the same at the bottom.

While I have described the insulator as made of suitable insulating material, it is to be understood that this material may be glass or porcelain or any preferred material which is suitable for the purpose. It is also to be observed that while the shape of the insulator as shown in the several embodiments is substantially cylindrical, the same may be frusto-conical or of larger diameter at one end than at the other end, or the body of the insulator may be, in general, any surface of revolution with flanges of uniform or of varying sections formed upon the surface thereof. The insulator is preferably made of a single uniform piece although this is not essential.

In use, the insulator may be mounted in any position, either vertical or at an angle and the advantages of my invention may be secured to a great degree in any position. Rain coming from one side of the insulator will be caught by the flaring flanges and will be conducted around to the other side. It is not strictly necessary that the flanges be shaped exactly as shown in the drawings, to secure certain of the advantages of my invention, but when they are so proportioned and shaped, flaring upwardly as shown, moisture precipitated at one side will be conducted around the insulator and thereby wash the opposite side which would, otherwise, be left dry.

An insulator of the structure according to my invention provides for distributing the electrostatic stresses over the entire surface rather than concentrating the same upon one side of the insulator. A continuous leakage path is provided and since there is a tendency to conduct the moisture near the core of the insulator body in an unbroken path, the moisture will tend to remain in this path and the edges of the flanges will dry off first, leaving the path near the insulator body to form a conductive film providing continuous leakage paths until the film is dried off.

The width of the flanges may be widely varied and their thickness may, likewise, be varied, but the designs which I have shown give a form easily shaped and fired. It is desirable to have the flanges sufficiently thick to be rugged for the practical requirements of handling, and if the flanges are made relatively short and thick they will present great strength against fracture even as against the discharge of missiles or bullets against the same. The insulator may be made in a great variety of forms or shapes without departing from the spirit of my invention. Where relatively great lengths are required, as in transformer bushings and the like, it may be made up in a series of sections.

Other modifications in addition to those which I have shown and described may suggest themselves in the light of the teachings of my invention, and I, therefore, want to have it understood that I do not intend to limit myself in the application of the invention exactly to the structures shown in the drawings and explained in the foregoing, but only to the scope and meaning of the claim which follows.

I claim:

An insulator for supporting a current conductor, comprising an upright body of insulation of sufficient dieletric strength to sustain the electrostatic stress to which it is subjected by the supported conductor, and a plurality of flanges increasing the creepage distance between the ends of the body, said flanges lying at different levels and having top and bottom surfaces inclined upwardly and outwardly so as to be washed by rain gravitating upon the same, each flange being provided with a drain point lying radially within the confines of the flange below it for discharging water collected upon its upper surface, the drain points of adjacent flanges being angularly spaced about the body to maintain a long creepage distance between the ends of the body.

In witness whereof, I hereunto subscribe my name this 21st day of Feb., 1930.

JOHN A. DIENNER.