

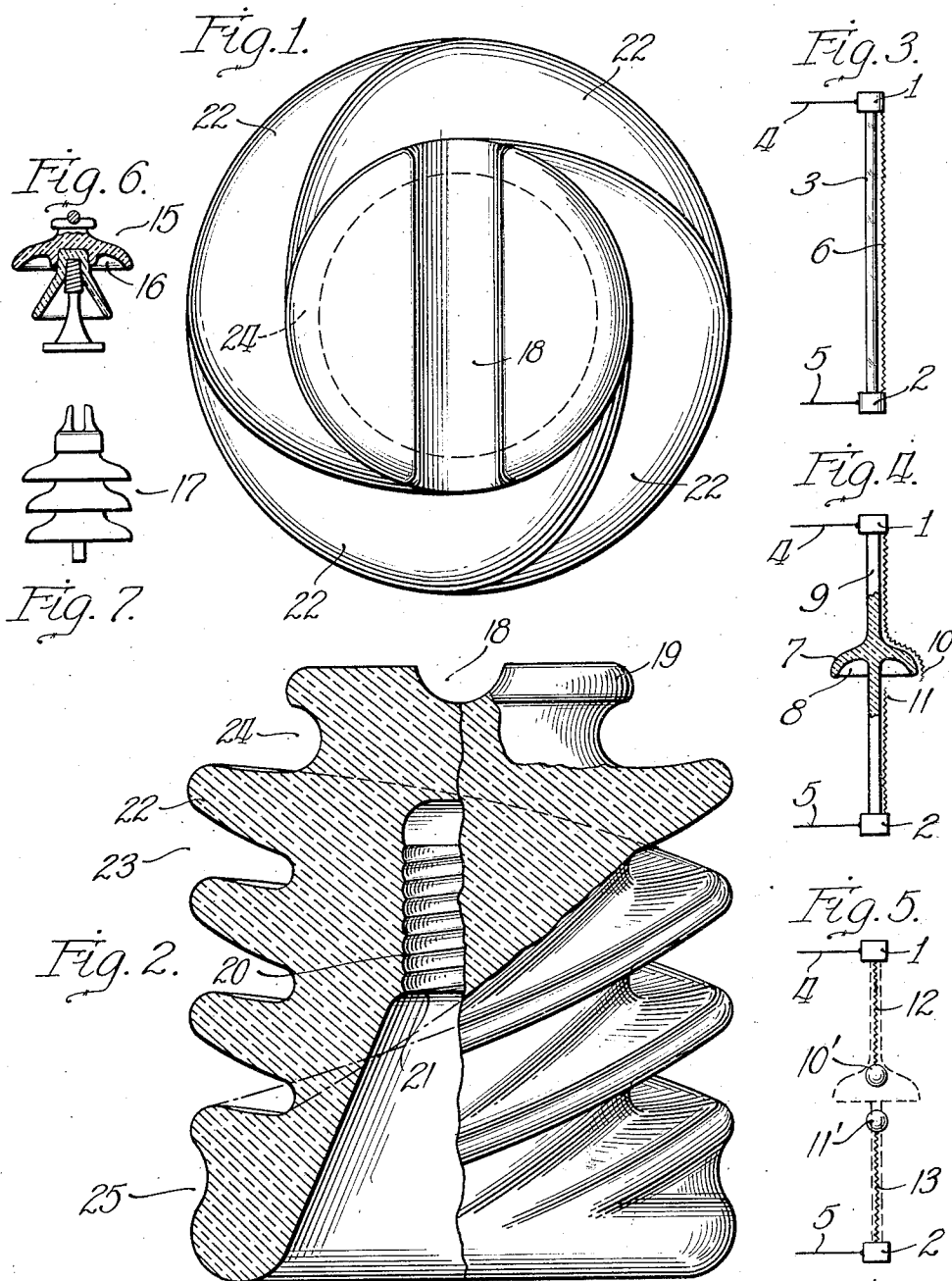
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INSULATOR

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UNITED STATES PATENT OFFICE

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INSULATOR

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My invention relates to insulators and while it is applicable generally, it is particularly useful in connection with outdoor service.

5 The teaching of 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 such as bushings for terminals of transformers, circuit
10 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, I do not con-
15 fine the invention to any one form of insulator but intend the appended claims to cover the invention broadly.

The problem of an outdoor insulator as
20 heretofore known is difficult and has grown increasingly so with increases in voltage. The outdoor insulator employed for supporting high tension conductors as heretofore constructed when subjected to atmospheric
25 conditions accumulates a coating of dust, soot, and the like, which lowers its creepage resistance value. It has been customary to provide petticoats which are adapted to serve as rain sheds, keeping a portion of the surface
30 dry. This is particularly true in connection with pin type insulators, such as are disposed vertically for supporting high tension conductors. The petticoat type of construction of the prior art has presented a number of
35 objections:

1. The petticoat type of insulator necessarily presents a varying cross-section in its own body.

2. The surfaces which are protected from
40 rain accumulate dirt and never become washed.

3. The electrical stresses on a wet insulator are concentrated at the worst possible place, namely, at the point of smallest cross-section, and they result in the formation of spark
45 discharges which tend to injure the insulator and particularly are likely to induce complete flashovers.

From time to time, the importance of an
50 insulator having a uniform cross-sectional

area from the live part to the grounded supporting structure, or between parts of different phase or potential, has been impressed upon me by the observation of insulators under operating conditions. I have observed
55 that a dry, clean insulator begins to show signs of flashover first in the restricted areas. I have observed also that an insulator when wet, and having dry spots, shows small arcs over dry spots without indications of arcs
60 over the wet surfaces; and I have observed that these dry spots occur in the restricted areas on the insulator. It appears that the arcs increase in length as the insulator dries either by the heat of the arc or the action of
65 the elements and this occasionally causes arc-over of the entire insulator. I have observed also that this arcing at the dry spots causes heating and deterioration of the insulator. In running tests on insulators for
70 corona formation I have caused the insulator to be placed in a dark room and observed from a small window in the side of the room. As the voltage impressed on the insulator is raised corona forms around the tie wire.
75 Then it forms in the restricted area under the top shell. It appeared to me to be logical that as the voltage was raised the corona under the top shell would spread until it met the corona formed around the tie wire and
80 then cause a flashover to take place.

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 only by wetting
85 the rest of the insulator. This causes a greater voltage drop across these restricted areas. The exposed surfaces being wet and conductive would compel the dry, dirty surfaces to have much higher voltage gradient
90 over these surfaces than normally, this being equivalent to raising the voltage over the entire insulator. It then occurred to me that an insulator with spiral flanges would
95 tend to eliminate the above trouble by providing a uniform cross-sectional area and I conceived that by properly shaping the flanges the insulator would be self cleaning.

Certain important advantages flow from this form of insulator, namely,

1. The insulator is very strong mechanically.

2. By turning the outer edge of the flanges upwardly and disposing them spirally or helically, rain coming from any one direction will follow around the insulator and wash the other surfaces.

3. Due to the helical or spiral design and the upward turn of the flanges it is easy to clean the insulator by hand.

4. When arc-over occurs on this spiral insulator, the heat of the arc will cause a current of air to pass upwardly over the surface of the insulator and the spiral shape of the insulator will cause the current there to rotate, carrying the arc around the insulator and preventing concentration at any one point, saving the insulator from destruction and exerting a quenching effect upon the arc.

Now in order to acquaint those skilled in the art with the manner of constructing and operating a device embodying my invention I shall describe in connection with the accompanying drawing a specific embodiment of the same.

In the drawing:

Figure 1 is a plan view of an insulator embodying my invention;

Figure 2 is a side elevational view of the same with parts broken away;

Figures 3, 4 and 5 are diagrams to explain the action of the insulator;

Figure 6 is a vertical section through a conventional form of insulator; and

Figure 7 is a side elevational view of a suspension type of insulator.

Referring to Figure 3, assume that the terminals 1 and 2 are metallic terminals between which there is connected a straight insulating rod or body 3 and that a potential is put upon these terminals as by means of the line wires 4 and 5. An insulator is a highly resistant conductive body. Therefore, a certain current will flow therethrough, depending upon the impressed voltage. In commercial forms of insulators the ratio of

resistance to voltage impressed thereupon is so high that we speak of an insulator as a non-conductor. In reality it is merely a very poor conductor, so poor, when properly designed, that the flow of current is negligible. However, there are conditions under which the conductivity of an insulator is very important.

Assume that the rod 3 is made of glazed porcelain, or the like, and that it is then subjected to wetting on the surface. The wetting of the surface provides a film of moisture which is conductive to a greater degree than the body of the porcelain. I have represented this by dotted line resistance 6 which will thereupon conduct a flow of current until

it is evaporated either by the action of the atmosphere or by heating and driving off of the moisture by the current flow or other means.

If, however, the rod shown in Figure 3 be provided with a petticoat, as shown at 7 in Figure 4, and the insulator exposed to the rain a film of moisture will form on the exposed parts leaving the parts under the petticoat, as indicated at 8, relatively dry. The result will be that the film of moisture which is represented by the dotted line 9 is not continuous but extends to the lip of the flange petticoat 7 as indicated at 10 from above, and to a point adjacent the overhang of the petticoat as indicated at 11 from below.

Now the effect of this interrupted film of moisture is to bring the potentials of the conductors 4 and 5 to the terminals of the films, namely, to the points 10 and 11 so that the full voltage is impressed upon the short space between said points 10 and 11 and also is impressed upon the porcelain between these two points.

That is to say, the stress upon the air between the points 10 and 11 is now the full voltage, and likewise the stress through the porcelain from the point 10 to the point 11 is full voltage. It can be seen at once that the air gap is too small, if the proper air gap is represented by the distance between the line wires 4 and 5. Also, it can be seen that the stress through the porcelain is now too high since the resistance of the parts of the porcelain shunted by the film of moisture is a very large percent of the total length of the bar 9. The result is that there will be a breakdown and a discharge just as if the terminals 10' and 11', shown in Figure 5, were connected to the line terminals 1 and 2 through the high resistances 12 and 13. It is to be observed that the films of moisture when no current is flowing are like good conductors so far as transmitting potential is concerned. They act also somewhat like condenser plates in that they have a certain amount of capacity and the result is a snapping discharge will begin at the margin of the petticoat of the insulator at 10, as shown in Figure 4, through the advance edge of the moisture as indicated at 11 in Figure 4. Obviously, the part of the rod protected by the petticoat is subjected to excessive potential. Now if the film of moisture were continuous, as shown in Figure 3, a discharge of current flow would occur but it would be quiet and would not arc, being in that respect like a very high resistance wire or other conductor.

Now with the foregoing explanation conventional types of insulators, such as shown in Figures 6 and 7, at once show the difficulties under which they are required to operate.

Referring to Figure 6, I have shown a con-

ventional type of petticoat insulator 15 which it will be seen has a relatively narrow waist 16 which when the insulator is wetted is subjected to excessive electrostatic stress. This wetting of the surface of the insulator is equivalent to raising the voltage upon certain parts of the insulator with the result that the insulator is immediately overloaded in the most constricted parts.

Such an insulator as shown in Figure 6 when supported by a clamp or base attached to the lower petticoat instead of being mounted on a pin is subject to particularly severe stressing.

In Figure 7 I have shown a conventional form of suspension insulator which is provided with a plurality of narrow waists under the margins of the petticoats. This insulator 17, like the one shown in Figure 6, is subjected to the deposit of dust, soot, and the like, at places where moisture does not succeed in washing off the same with the result that the tendency to form corona is increased. This is true whether the insulator be held in vertical or horizontal position.

Figure 1 shows in plan view an insulator of my invention which comprises, in this instance, a porcelain body having the wire receiving groove or saddle 18 across the head 19. As shown in Figure 2, a threaded socket or pocket 20 is provided for the reception either by threading or by cementing of a supporting pin. The insulator is preferably made of a single solid piece and it will be observed that from the point where the threads begin, as indicated at 21 at the constricted part of the pocket 20 to the end of the said pocket 20 the cross-section is substantially uniform. The thickness of insulation between the bottom of the pocket 20 and the saddle 18 is sufficient to withstand the electrostatic stress of the line voltage and this, obviously, may be varied without any departure from the invention. It is not essential that the insulator be made of the pin type; 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 usually the stresses on the solid insulation between the permanent metallic parts which gives trouble; it is the exposed surface.

The body of the insulator has a series of spiral or helical flanges 22 in this case four which are formed like multiple screw threads. The flanges which take the place of petticoats are preferably dished upwardly so that any water trapped or caught on the upper surface will be conducted downwardly in a helical path to the bottom of the insulator and there discharged at the bottom. Water engaging the edges or bottom surfaces of the flanges will run down into the channel below and dripping between flanges is thereby positively prevented. The flanges are coarse enough, that is thick and wide enough, to

be relatively strong against breakage and they are spaced far enough apart that there is no danger of any solid body of water which may strike the insulator bridging the space between flanges. A drop of water striking the surface of the insulator will naturally tend to gravitate straight downwardly, but it will be intercepted by the first channel under it and instead of being led straight down the surface of the insulator will be conducted off circumferentially and downward, that is, in a generally helical pass.

The grooves 23 between flanges are open at both top and bottom and preferably the helical flanges are so arranged that the running out of the groove at the bottom is out of register with the overrunning of the groove at the top, although this is optional. In reverse manner it may be said that the beginning of a flange such as 22 at the top overlaps the trailing off of the same flange or another flange at the bottom. The groove 24 under the head 18 may be employed for a tie wire or clamp as is the present practice. Likewise, at the base of the insulator a groove 25 may be provided for gripping the base of the insulator with a clamp or the like. The number of flanges may be anything desired within limits. It is to be observed, however, that the flanges are to be of such a coarse pitch helically that the incline will be swift enough to cause water which is precipitated on to the flanges to run downwardly with sufficient velocity to have a cleaning effect upon the surface. That is to say, if water is precipitated upon the surface of the insulator, the pitch of the helical flanges is preferably so steep as to cause relatively rapid flow of the water to occur in the channels which are thus formed and thereby tend to carry dust, soot, and the like, which may be precipitated on the insulator downwardly and discharge the same at the ends of the flanges at the bottom.

Another feature of the construction of the insulator of my invention is the steepness of the under surface of the flanges, which is great enough that any water gravitating down these surfaces will flow with sufficient velocity to wash these surfaces clear of deposited dust, etc. The steepness of the under surfaces is greater than that of the top surfaces and hence the bottom surfaces can clean themselves with less water than the top surfaces.

While I have shown this insulator as made of porcelain, it is to be understood that it might be made of glass with equal facility or of any preferred insulating material which is suitable for the service.

This form of construction gives substantially a uniform section throughout the major part of the insulator and this may be strictly true in the case of a bushing having a uniform outside and uniform inside

diameter which is contemplated within my invention. It is also to be observed that while the body which I have shown is substantially cylindrical, the same may be frusto-conical or of larger diameter at one end than the other, or the body of the porcelain may be in general any surface of revolution with flanges of uniform or of varying section formed upon the surface thereof.

The insulator of my invention may readily be formed by cutting as in forming a screw thread. It, therefore, lends itself to a novel process of manufacture. It is preferably made of a single unitary piece although this is not essential.

In use the insulator may be mounted in any position, that is, either vertical or horizontal or at an angle between them 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 dished or upturned flanges and conducted around to the other side. It is not strictly necessary that the flanges be dished upwardly to secure certain of the benefits of my invention but when they are so dished upwardly moisture precipitated on one side will be conducted around the insulator and thereby wash the opposite side which would otherwise be left dry.

By this scheme the electrostatic stresses are distributed over the surface of the insulator rather than concentrated upon one side. A continuous leakage path is thereby provided and since there is a tendency to provide spiral paths moisture will tend to remain in the spiral paths and the edges of the flanges will dry off first, leaving the spiral paths to form conducting films providing continuous leakage paths until they are dried off.

If a discharge over the surface should occur, it will be seen that the heating of the air thereby reacting against the spiral flanges will tend to move the arc and rotate it about the surface of the insulator. This gives a tendency to prevent concentration of the heat and to chill and quench the arc.

The depth of the flanges may be widely varied and their thickness may, likewise, be varied, but the design I have shown gives 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 present great strength against fracture even as against the discharge of missiles or bullets against the same. The well known and snapping discharge over high tension insulators subjected to the precipitation of moisture which is particularly objectionable to circuits and radio channels of communicating systems is avoided by my invention.

It is known that the skirts on insulators

of the conventional type decrease wind velocity and allow dirt to be deposited particularly under the petticoats on the more restricted sections. In the insulator of my invention the subsequent precipitation of moisture cleans the entire surface of the insulator and assists in maintaining its optimum condition.

The insulator may be made in a great variety of forms or shapes without departing from 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. There is nothing to prevent its being made unitary for long bushings since the cross-section throughout is substantially uniform consisting then of a tubular body having helical flanges.

I claim:

1. As an article of manufacture, an insulator having coiled flanges upon its surface, said flanges being dished upwardly to provide water conducting channels and being spaced apart to prevent bridging by atmospheric moisture.

2. As an article of manufacture, an insulator comprising a body of porcelain having a helical flange, said flange being tilted upwardly throughout its length to form a water collecting and conveying channel.

3. As an article of manufacture, an insulator comprising a body of porcelain having a helical flange, said flange being tilted upwardly throughout its length to form a water collecting and conveying channel, said channel being steep enough to wash deposited solids downwardly by the flow of liquid in the channel.

4. As an article of manufacture, an insulator having coiled flanges each extending uninterruptedly from top to bottom of the insulator, said flanges projecting from the surface of the insulator, said flanges being dished upwardly to define water trapping and conducting channels for both washing the exposed surface of the insulator and for preventing dripping.

5. As an article of manufacture, an insulator comprising a substantially circular elongated body with a longitudinal axis, helically disposed flanges each extending substantially from end to end of the body, said flanges being inclined upwardly throughout their length to provide on the upper surfaces water conducting channels and to provide on their lower surfaces water collecting surfaces.

6. In an outdoor insulator, an integral helically disposed rib having its base thicker than its edge and being inclined upwardly, the upper surface forming a helical channel for intercepting the flow of moisture vertically and diverting it helically.

7. In an outdoor insulator an integral helically disposed rib having its base thicker

- than its edge and being inclined upwardly, the upper surface being inclined upwardly and extending helically to form a helical channel for intercepting the flow of moisture
- 5 vertically and diverting it helically, the lower surface of the rib being inclined upwardly, more sharply than the upper surface, and merging with the body of the insulator, said lower surface conducting and collecting
- 10 liquid into the groove of the convolution below it.
8. As an article of manufacture, an insulator consisting of a body of insulation comprising a circular head member with a peripheral tie wire receiving groove and a transverse saddle groove, there being a pin receiving recess which is formed in the lower end of the body and there being coiled flanges
- 15 extending out from the sides of the body, said flanges having a pitch steep enough to cause water to travel by gravity along the surfaces of said flanges fast enough to wash away impurities deposited thereupon from the atmosphere, said flanges having their
- 20 outer margins tilted upwardly, to define between the outer margins and the body of the insulator water-conducting channels preventing drip from one flange to the flange below.
9. An outdoor insulator having upwardly
- 25 flared petticoats, said petticoats being disposed helically.
10. An outdoor insulator having upwardly flared petticoats, both top and bottom sides of which are exposed to wetting by rain, said petticoats being dished for collecting
- 30 water toward the center of the insulator and being open to discharge the water so collected, said openings being angularly displaced with respect to one another.
11. An outdoor insulator having a vertical
- 35 axis and having a plurality of upwardly and outwardly flared flanges both top and bottom surfaces of which flanges are exposed to wetting by rain, the inclined top and bottom surfaces being washed by rain water running
- 40 downwardly and inwardly towards the axis of the insulator, the water running down the bottom inclined surface of one flange being collected upon the top surface of the flange
- 45 below, said flanges having discharge outlets for the water collected upon their top surfaces, the outlets of said flanges being angularly disposed relative to each other about the vertical axis.
12. An outdoor insulator having a petti-
- 50 coat, all parts of which are directed upwardly and outwardly so that top and bottom surfaces are exposed to rain, said petticoat having an outlet for discharging the water
- 55 which is collected upon the top surface of the same, and there being a second petticoat like the first named petticoat but having its outlet angularly displaced from the first petticoat outlet.
13. An outdoor insulator having a petti-
- 60 coat, all parts of which are directed upwardly and outwardly so that the top and bottom surfaces are exposed to rain, said petticoat having an outlet for discharging the water which is collected upon the top
- 65 surface of the same, and there being a second petticoat like the first named petticoat but having its outlet angularly displaced from the first petticoat being located below the first named petticoat for receiving the rain water that strikes the bottom surface of the first named petticoat.
- In witness whereof I hereunto subscribe my name this 14th day of March, A. D. 1929.
- CHARLES L. STROUP.

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