July 24, 1934. A. O. AUSTIN 1,967,654

INSULATOR

Filed Dec. 26, 1931

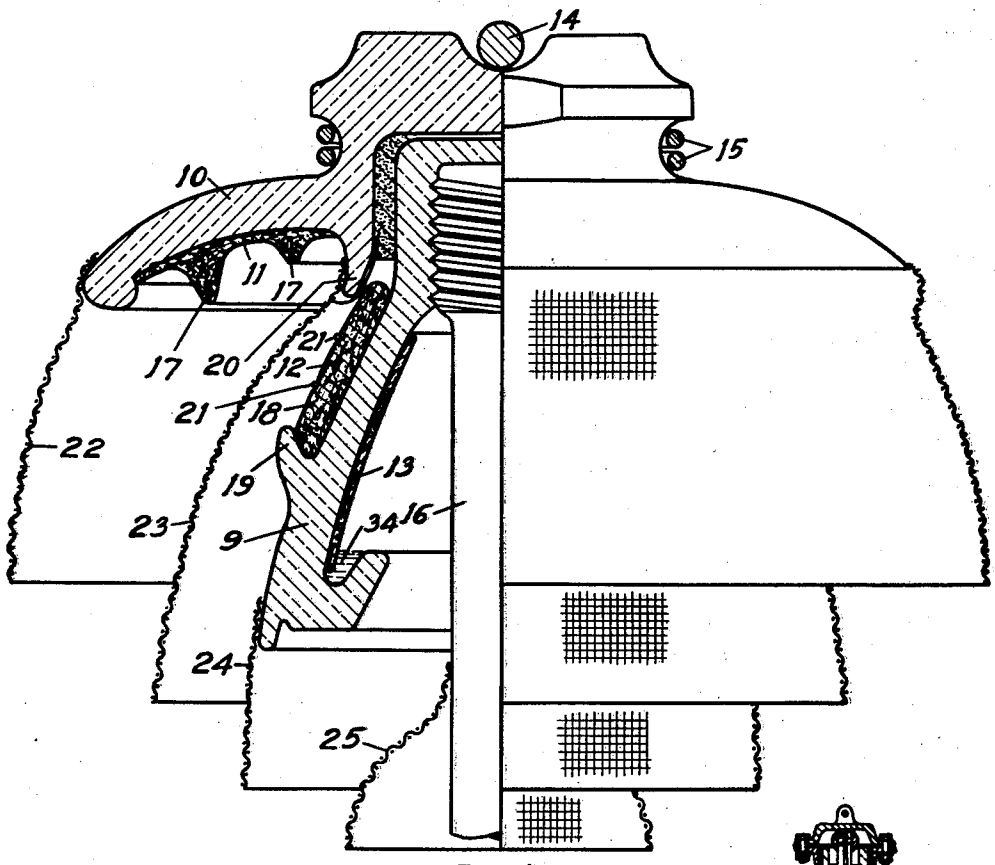


Fig. 1

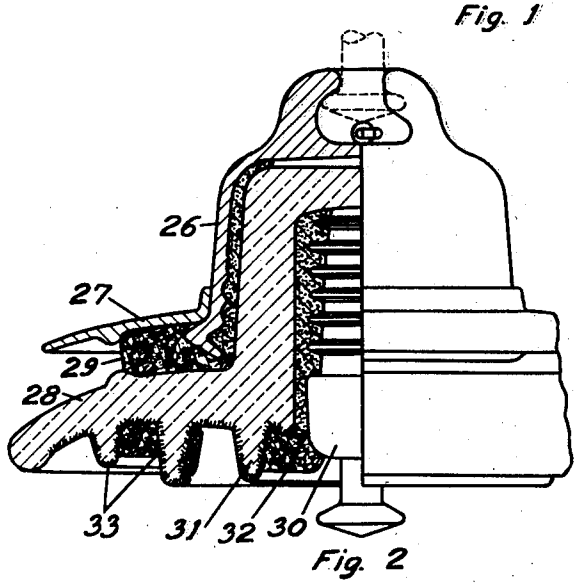


Fig. 2

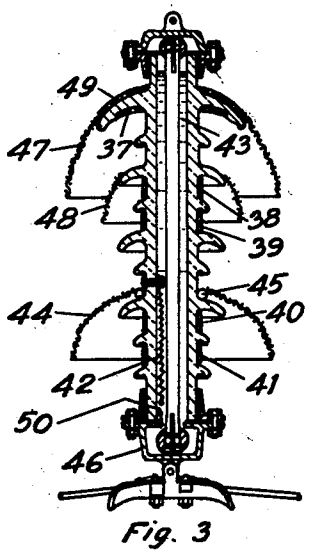


Fig. 3

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Patented July 24, 1934 1,967,654

UNITED STATES PATENT OFFICE

1,967,654

INSULATOR

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Application December 26, 1931, Serial No. 583,190

15 Claims. (Cl. 173—318)

This invention relates to electric insulators and has for one of its objects the provision of means for overcoming the effect of fog, dirt or other materials which may be deposited upon the insulator from the atmosphere.

A further object is to provide an insulator of improved construction and operation.

Other objects and advantages will appear from the following description.

The invention is exemplified by the combination and arrangement of parts shown in the accompanying drawing and described in the following specification, and it is more particularly pointed out in the appended claims.

In the drawing:

Fig. 1 is an elevation with parts in section showing one embodiment of the present invention.

Fig. 2 is a view similar to Fig. 1 showing a different form of the invention.

Fig. 3 is a vertical sectional view showing another modification.

In the insulation of high voltage transmission and distribution lines, considerable difficulty is encountered in providing adequate insulation for localities where the insulators are subjected to fogs, dust or chemical deposits. A combination of fog and dirt on the surface of an insulator not only increases the leakage current very materially but requires greater insulation than would otherwise be necessary to prevent flashover even at comparatively low voltages. The so-called salt fog districts located in the proximity of salt water cause considerable trouble as the leakage and charging current under these conditions not only tends to cause flashover but frequently destroys the metal parts of the insulators. The rusting or corrosion of the metal parts, aggravated by the increased leakage, frequently cause cracking or destruction of the dielectric members forming the insulators.

The nature of the insulating surface is far more important in providing reliability than the amount of the surface. By providing sufficient insulation and improving the quality or reliability of the insulating surface, it is possible materially to improve operating conditions, thereby providing more effective insulation. By use of the present invention, it is possible greatly to reduce the cost frequently necessary for cleaning the surfaces of insulators of ordinary types. In addition, the improved type of insulator permits the material economies incident to high voltages heretofore not practical in the severe districts referred to above.

In my improved type of insulator, the insulating surfaces are made more effective and, in general, will vary in accordance with the voltage and conditions, and different zones having different properties may be used in order to provide insulation for a wide range of conditions which prevail over a period of time.

An insulator subjected to rain may have quite different properties from those it will have when subjected to fog or a very light drizzle. Heavy rains tend to wash insulating surfaces and it is frequently advisable to provide surfaces adapted for this washing action. Until contaminated surfaces are washed, however, it is necessary to provide adequate insulation in another part of the insulator so that a flashover will not take place or leakage currents become excessive. Leakage or charging currents frequently cause serious radio interference and it is therefore advisable to improve the insulation so as to remove this difficulty. The application of the invention may take many forms other than those shown.

The invention contemplates covering part or all of the insulating surfaces with an insulating material of open or porous structure and of very high resistance. A coating or blanket of such material protecting the main dielectric surface is provided. The covering layer of material is porous or open so that fog or moisture will not condense readily upon the covered surface, due to the heat absorption of the main dielectric members. The covering zone or blanket should preferably be such that a discharge or a heavy leakage streamer will not cause a fault which will be transferred to the main dielectric member. If the material is of an open nature, the discharge of a streamer through it may cause the blanket and conducting material caught thereon to be fused so as to leave an effective insulator.

In the form of the invention shown in Fig. 1 an insulator having dielectric members 9 and 10 is provided with insulating zones 11, 12 and 13 of material of open or porous structure. The conductor 14 and tie wire 15 form one electrode, and the pin 16 forms the other. In practice, the leakage and charging current tends to travel over the surface of the insulating members between the tie wire 14 and the pin 16. During heavy rains the projecting part 10 furnishes a water shed so that not all surfaces are wet. The exposed surfaces are readily washed by heavy rains. In many places, the surfaces are likely to be heavily coated with dust, salt or other material which may greatly reduce the effective insulation of the surface, particularly when wet by

a fog. When the insulators are cold, the surfaces are readily wet by condensation; therefore, a surface which has poor heat conductivity will be of material benefit in reducing condensation. Where leakage or charging currents can be used to warm the surface, condensation may be greatly reduced or eliminated, thereby increasing the effectiveness of the surface. A surface covering such as 11, 12 and 13 greatly improves conditions.

The surface covering may be formed of open structure refractory or other insulating material during the burning operation of the insulator or it may be applied later. The covering may be formed of material of approximately the same composition as the body of the insulator but mixed with some substance which will burn out, leaving the covering very porous. This is readily accomplished by using a mixture of body slip to which is added fibre or cork dust, sawdust or other material which will burn out, leaving a porous structure. This surface coating may also be made up of a combination of porcelain or refractory materials mixed with a slip which will become porous. The refractory material or porcelain particles may be porous or solid, if desired, and pre-fired so that the shrinkage of the coating will not be too great. The layer may be of any desired thickness and form.

The coat may be of uniform thickness or be provided with ribs 17 which will increase the surface of the covering. If a discharge or leakage takes place through or over the coating, the discharge may fuse the coating material or cause portions of the material to be thrown off, providing a new surface. The covering is very effective in the protection of an insulator from a power arc following flashover as the arc is held away from the surface of the main dielectric so that the main dielectric member is not fused or cracked. This permits a restoration of the surface which might not otherwise be possible.

A layer or blanket of porous or fibrous material may be attached to the dielectric members by a suitable varnish, paint or other binding material which will harden either under heat or under normal conditions. The layer may be placed in grooves or recesses. The layer or zone of mineral wool 18 is held in a recess formed by projections 19 and 20. The layer 18 may be wound around the insulator or made up in sections which are readily slipped into place. If desired, the covering material may be held on by bands 21. These bands if made of conducting material may be located in any zone at right angles to the leakage path but if they are formed of insulating material, their location is not so important. If the bands are located at the edges of the zone, they may replace the projections 19 and 20 which form the groove or pocket for the covering. In applying the covering to old insulators, the covering will have to be held on by an air drying varnish, lacquer or by some binding scheme.

Since the surface of the insulator is materially affected by the deposit of dirt or foreign material and moisture, anything which will prevent the deposition of any of these substances will be of material benefit in improving the efficiency not only of the insulator but of the covering used to protect the main surface of the dielectric members.

Metallic jackets or weather sheds have been used but these are open to the objection that the washing action of rain on the surface of the insulator is prevented and in many cases eddies or air spaces are produced which permit the deposit of dust or dirt carried by the wind.

An improved type of shield 22 is shown in Fig. 1 formed of wire screen. This shield, while tending to prevent small particles of water from being deposited on the insulator in the case of fog, permits the wind to blow through and heavy rains to wash the surfaces inside of the screened area. A series of screens 22, 23, 24 and 25 may be used.

Owing to electrostatic stress, the fog particles tend to be deposited on the screens or become charged so that they will be deposited on a screen having a difference in potential from the charged particles. These screens also affect the deposition of the dust. The number will depend upon the design of the insulator; the object being to prevent a coating of dirt and moisture upon the insulator.

The dielectric member 9 may be provided on its inner surface with a circumferential groove 34 for containing insulating oil or other liquid into which the coating 13 dips. The coating 13 will act as a wick and will be impregnated with the liquid in the recess 34.

In the arrangement shown in Fig. 2 the insulator cap 26 is provided with a shield 27 which encloses a space between the shield and the insulating flange 32. A ring of mineral wool 29 or other suitable material is placed in the space between the shield 27 and the disc 28. This tends to maintain a good insulating surface at the point of maximum stress where the charging current tends to increase the discharge, particularly when aggravated by leakage. During fogs the insulators may be subjected to a high frequency oscillation due to corona from the wet conductor or from discharges on the insulators. This tends to produce streamers of low resistance. These streamers, in addition to having a very material effect in lowering the surface resistance, tend to produce hot spots which may destroy insulation or cause corrosion of the metal parts from which the streamers start. The effective insulation at these points increases the voltage at which discharge will start which may be very beneficial in preventing radio disturbances, as well as preventing destruction of the insulator or the insulating surface. The weather shed 27 tends to protect the ring 29 from becoming wet with drip water. The space between the pin 30 and the petticoat 31 may also be filled with a ring of mineral wool 32 or other suitable material for reasons above explained. Part or all of the lower surface of the dielectric may be covered with a layer of porous material 33 which may be burned on during the firing operation.

Where the porous coatings are made of refractory or vitreous materials or others which will not carbonize, they may be coated or impregnated with material which will reduce the resistance slightly, particularly when the surfaces become wet. This will tend to smooth out the voltage gradient and allow leakage and charging current to flow without producing shunt streamers which tend to eliminate the insulation furnished by the zones of highest resistance. In general, the ordinary accumulation of dirt or moisture will lower the resistance of a layer.

As particles of fog are deposited on the surface of open material, the capillary attraction will tend to draw them into the mass, producing a high resistance conductor, particularly where there is some salt or other conducting material already upon the surface or combined with the fog itself.

A very weak solution of sodium or calcium chloride may be used to augment this effect.

In the form of the invention shown in Fig. 3, insulating zones are provided with the porous coating or blanket and, in addition, a portion of the leakage current is caused to flow across a high resistance which will tend to dry off the insulator as the leakage current increases. With the zones protected with coatings or blankets 37, 38, 39, 40 and 41, serious leakage which would cause flashover may be prevented until such time as the leakage current flowing through the shunt resistance 42 will warm the oil 43 inside of the insulator. The warm oil flows upward and causes a drying of the insulator surface. Since the leakage current flowing through 42 must also flow over the surface of the insulator, it is evident that the loss in 42 will only be appreciable when the conditions are such as to occasion heavy leakage. Ordinarily, the only current flowing through this resistance will be that due to charging current which will be exceedingly small unless the frequency is high or the electrostatic capacity of the insulator to ground is greatly increased by the wet surfaces. A high frequency current produced by corona on the conductor may be increased by attaching the upper end of the resistance 42 to a metallic shield 44. This shield may be in the form of a wire screen or a metal shield as previously described. The upper end of the resistance 42 connects to a metal band 45 and the lower end to a suitable cap or fitting 46. If desired, the insulator may be equipped with other screens or baffles 47 and 48. The insulator may have all protected surfaces covered with the porous insulating layer. In some cases, it may be advisable to place a porous layer 49 on a surface which will become wet. Resistance in a surface of this kind acts as a balancing resistance, tending to prevent the formation of a shunting streamer. The heat absorption of the material with a limited amount of current in a streamer or static discharge tends to be absorbed by the material; the action being somewhat similar to that in certain types of lightning arresters.

Where radio interference will not cause serious disturbance, the resistance may be provided with a series gap 50. This gap may be either inside or outside of the insulator but if placed outside must have sufficient insulation so that voltage can be built up before discharge can take place. Normally, the gap would discharge a number of times during a single alternation. A high frequency oscillation set up will increase the effective current and I^2R losses in resistance 42, thereby increasing the heating effect. Under normal operating conditions, the gap may be so set that it will not discharge. The discharge of the gap would therefore be an indication of the conditions set up and might be used to determine the general condition of the insulator at any time by means of a radio set used in the vicinity. The disturbance therefore might be used to determine the advisability of cleaning or surfacing the insulator or replacing some of the insulating jackets or parts to improve the insulating value of the insulator.

I claim:

1. The combination with an insulator, of a covering of porous insulating material for a portion of the surface of said insulator, and a heating element connected in series with a portion of the path of leakage currents flowing over said surface.

2. The combination with an insulator, of a heating element disposed in shunt with a portion of the surface of said insulator to cause leakage currents over the remainder of said surface to flow through said heating element.

3. An insulator having an internal cavity adapted to contain an insulating liquid, and a heating element disposed in said cavity and connected in series with a portion of the surface of said insulator and in shunt with another portion of said surface.

4. An insulator having a heating element disposed adjacent thereto and in series with a portion of the surface of said insulator and in shunt with another portion of said surface, and a discharge gap in series with said heating element.

5. An insulator having a portion of the exposed surface thereof formed of fibrous insulating material, the fibres of said material being unbonded to one another.

6. An insulator having a portion of the exposed surface thereof formed of fibrous mineral wool, the fibres of said wool being unbonded to one another.

7. An insulator comprising a body member and a covering of open or porous material disposed upon a portion of the surface of said body member and forming an open or porous, exposed surface for said insulator, said covering being removable from said body member to permit renewal of said covering when contaminated by exposure to the atmosphere.

8. An insulator having a covering of porous material disposed on a portion of the surface thereof, said material being separately formed from said insulator and secured to said surface by a binder.

9. An insulator having a covering of open or porous material disposed upon a portion of the surface thereof and held in place by attaching bands which leave the major portion of the open or porous surface thereof exposed.

10. An insulator having a recess formed in a portion of the surface thereof and porous material disposed in said recess and filling the major portion of said recess and having its outer surface exposed to the open atmosphere.

11. The combination with an insulator having a protected portion of its surface covered with an open or porous covering and having an exposed portion of its surface smooth to permit washing by rain, of a perforate screen mounted adjacent the exposed surface of said insulator for the precipitation of conducting material to prevent said material from accumulating on the surface of the insulator but permitting rain to reach said smooth surface through the perforations in said screen.

12. An insulator having a covering of porous material disposed over a portion of the surface thereof and having a portion of said surface smooth and exposed, and a protective screen for said covering formed of metal wire fabric to permit rain to reach said smooth portion through said fabric.

13. The combination with an insulator, of a heating element for said insulator formed separately from the surface of said insulator but constituting a portion of the path of leakage or charging current flowing over said surface and in series with a portion of said surface and in shunt with another portion of said surface.

14. An insulator formed of vitreous material having a smooth upper surface thereof exposed to falling rain to permit washing of said portion of the surface, and having a lower surface there-

of covered with loose porous material to prevent accumulation of moisture on said lower surface.

15. An insulator comprising a vitreous body having a smooth portion of the surface thereof exposed to falling rain to permit washing of said portion, and having a different portion of the surface protected from falling rain and covered with open or porous material to prevent accumulation of moisture on said covered portion.

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