

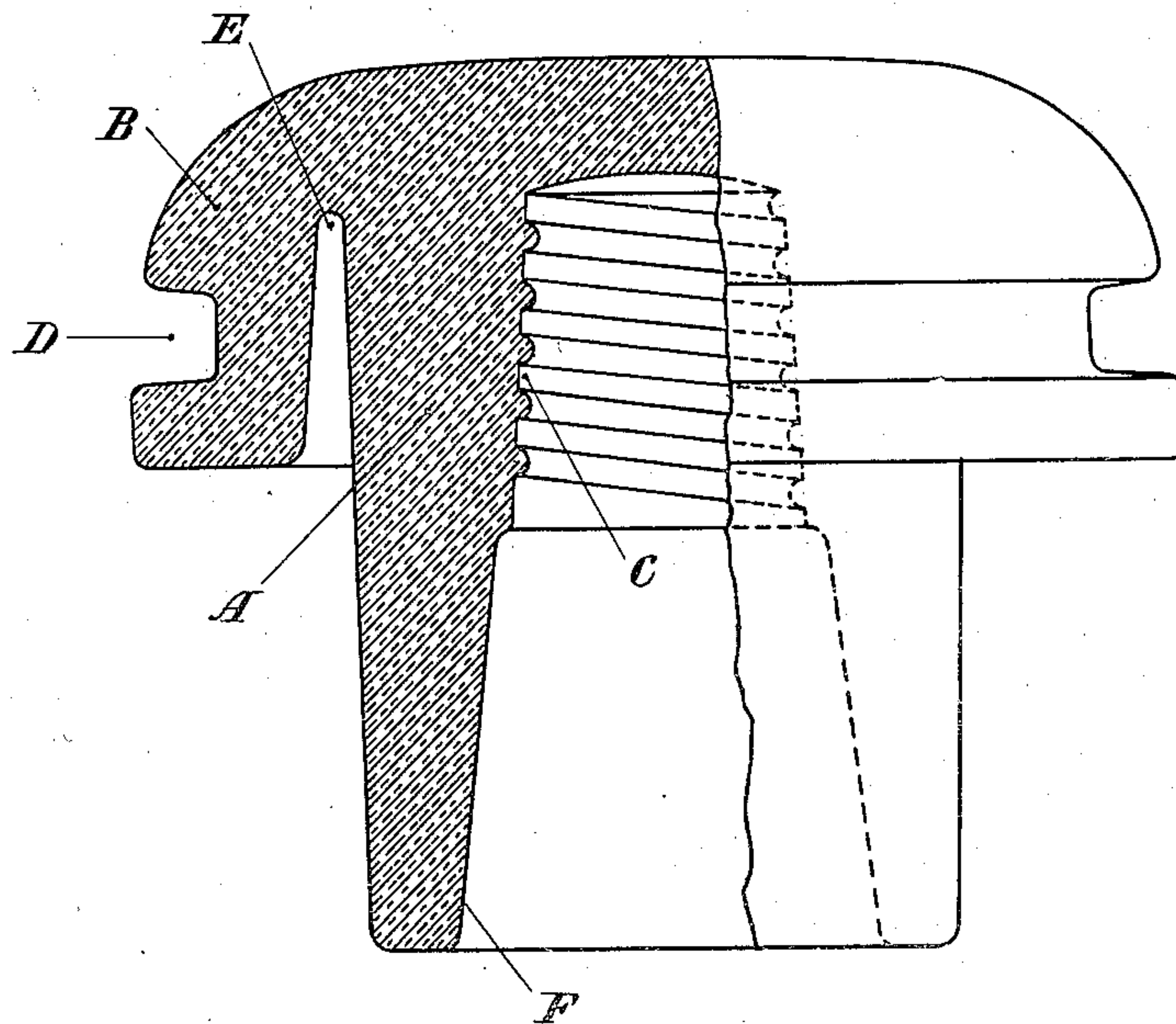
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LOW LOSS INSULATOR

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LOW-LOSS INSULATOR.

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This invention relates to insulators, and more particularly to insulators having a low leakage loss.

Heretofore it has been proposed to produce 5 insulators having low leakage losses by forming the insulators of glass or other dielectric material having very low loss angles. As is fully explained in application Serial No. 40,933, filed July 1, 1925, by H. A. Affel and 10 E. I. Green, the attenuation loss of telephone lines at high frequencies is, to a considerable extent, due to leakage losses dependent upon the dielectric material of the insulator. The nature of the leakage loss, while not fully 15 understood, is apparently dependent upon the dielectric hysteresis of the material of the insulator and the dielectric hysteresis decreases as the loss angle of the dielectric increases. Therefore, if a dielectric material 20 having a low loss angle is used in making up the insulator, the attenuation due to the action of the insulator will be correspondingly decreased.

In general, dielectric materials available 25 for insulator construction tend to be somewhat fragile if their composition is such as to produce a very low effective loss angle. Those materials having the desired low loss angle which have not been readily breakable 30 are more expensive than the flint glasses which have heretofore been employed for ordinary telephone insulators. It is, therefore, desirable that some type of insulator be available which may be constructed of flint 35 or other cheap glass and will at the same time have a relatively low leakage loss. This result is accomplished in accordance with the present invention by so shaping the insulator that the groove in which the conductor is carried 40 is formed on the outer periphery of a flange which is of a diameter relatively large as compared with the diameter of the pin upon which the insulator is supported, the flange being so formed that an air-space will 45 be interposed between the groove and the surface of the pin. As is well known, air considered as a dielectric has a loss angle which very closely approaches zero. Also, its dielectric constant is virtually unity as compared 50 with a value several times as great for air. Therefore, the air which constitutes a part of the dielectric material between the two effective plates of the condenser formed by the conductor attached to the groove and 55 the supporting pin, reduces the leakage loss

due to the condenser action of the insulator, first, because the loss in the air dielectric is negligible, and second, because the capacity of the condenser is reduced.

This reduction in capacity is important in 60 another respect. An essential factor producing leakage loss is the so-called crossarm effect. This loss is proportional to I^2R , where R is the resistance of the crossarm and I is the current flowing through the crossarm. 65 Since decrease in capacity of the insulator decreases the current flowing through the crossarm, the crossarm effect is relatively greatly reduced for a small reduction in the current, being proportional to the square of 70 the current.

The invention may now be more fully understood from the following detailed description when read in connection with the accompanying drawing, the figure of which illustrates the preferred embodiment thereof. 75

As is well understood, the attenuation resulting from the action of an insulator is largely due to dielectric hysteresis loss inherent in the condenser action of the insulator. 80 The line wire and tie-wire connected in the outer groove of the insulator constitute one plate of a condenser, the area of which becomes enlarged when the outer surface of the insulator is wet. The pin upon which the 85 insulator is mounted is sometimes of wood and sometimes of metal. Even when a wooden pin is used, the wood is to some extent a conductor, and is always a conductor to a considerable extent when it is wet. Therefore, 90 the pin forms the second plate of a condenser and between these two plates intervenes the dielectric material of the insulator itself.

Now, dielectric hysteresis loss is a function 95 of the capacity of the insulator, and if the capacity is reduced, the hysteresis loss, and hence the attenuation, will be correspondingly reduced. It has been fully pointed out in an application, Serial No. 40,934, filed July 100 1, 1925, by H. A. Affel and E. I. Green, that where the insulator is cylindrical in form so that its outer surface when wet forms an outer cylindrical plate concentric with the inner cylindrical surface of the pin, the capacity 105 of the insulator may be materially decreased by making the outer diameter of the insulator large as compared with the diameter of the pin.

This result is accomplished in accordance 110

with the present invention by constructing the insulator, whose main body is indicated at A in the figure of the drawing, with an outwardly extending flange B at its top, so that
 5 the diameter of the flange will be large as compared with the diameter of the opening C for accommodating the supporting pin. The flange may be provided with the usual groove D for accommodating the transmis-
 10 sion conductor and the tie-wire. By arranging this groove in a flange instead of a cylindrical insulator having extremely thick walls, a considerable saving of material is effected.

Inasmuch as the decrease in hysteresis loss
 15 resulting from increasing the diameter of the groove for accommodating the tie-wire is necessarily limited for mechanical reasons, it is proposed in accordance with the present invention to combine this structure with the
 20 novel feature of an air-gap interposed between the outer groove and the pin. Accordingly, the flange is provided with a deep groove E extending upwardly from its lower surface, this groove extending well above the
 25 upper side of the conductor supporting groove D. The groove E not only interposes an air-gap between the outer conductor and the pin, but it forms a long dry path between the outer conductor and the skirt F of the
 30 insulator for practically preventing direct current leakage due to moisture particularly in wet weather.

It will be clear from the construction above described that a part of the dielectric inter-
 35 vening between the outer surface of the pin and the plate formed by the transmission conductor and tie-wire is composed of air. Air has a loss angle very closely approaching zero, and as is fully explained in the applica-
 40 tion of Affel and Green, Serial No. 40,933, the dielectric hysteresis is reduced as the loss angle decreases and becomes zero when the loss angle is zero. If we consider the insulator as a condenser, its characteristics may
 45 be thought of as a capacity due to the effective plates on the inner and outer surfaces of the insulator and an effective conductance due to the dielectric hysteresis. The insulator then becomes equivalent to a capacity shunted by a
 50 conductance. As is well known, if such a combination is bridged across a pair of conductors, the transmission through the condenser merely produces a change in phase and the actual attenuation loss is due to the leak-
 55 age through the conductance. If the conductance is eliminated, there will be merely a change in phase as the alternating current is propagated along the conductors without any actual transfer of energy from conductor
 60 to conductor. In other words, the current flowing through the insulator will be a wattless current if there is no conductance component or dielectric hysteresis present. It thus becomes apparent that the interposition
 65 of the air dielectric in the groove E between

the wire mounted on the insulator and the supporting pin very materially reduces the dielectric hysteresis and this, coupled with the decrease in capacity due to the mounting of the wire upon the flange B of large diameter, 70 results in an insulator which, though constructed of ordinary flint glass, will nevertheless be practically as efficient as an insulator constructed of some special glass having a very low loss angle. 75

It will be noted that the groove E is near the top of the insulator and hence a considerable distance above the crossarm. This reduces the possibility of the dry path (the surface within the groove) being rendered 80 less effective due to splashing from the crossarm. Also, since the groove E is located close to the wire groove D, the wet surface conductively connected to the wire is reduced. Consequently, the variation of capacity, due to 85 change in area of the outer condenser plate with variation of weather conditions, is reduced.

In the above description the invention is set forth as an improvement of such nature 90 as to enable the insulator to be made of cheap glass, thus constituting a substitute for an insulator of ordinary form constructed of glass having a low loss angle. It will nevertheless be obvious that the insulator of the 95 present invention may be constructed of glass having a low loss angle, where the additional expense of the glass is not an important consideration, thus obtaining the advantage of reduction of loss due both to the improved 100 form of the insulator and to the inherent characteristics of the glass itself.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different 105 from those illustrated, without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. An insulator having a flange extending 110 outwardly therefrom, a groove in said flange for carrying a line conductor and tie-wire, an interior bore within the insulator whereby it may be mounted on a supporting pin, said groove being located well below the top of 115 said support pin and the diameter of said groove being more than twice the diameter of said internal bore, and a groove extending upwardly into said flange from the under side thereof to a point a sufficient distance above 120 the external groove so that an air-space will intervene between the said external groove and the entire surface of the supporting pin.

2. An insulator comprising a body of dielectric material having an internal bore 125 whereby it may be mounted upon a supporting pin, a flange extending outwardly and downwardly from near the top of said insulator to provide an air-space between said flange and said body, an external groove 130

around the periphery of said flange for accommodating a line conductor and tie-wire, the diameter of said groove being more than twice the diameter of the internal bore of the insulator, and said groove being so located upon the outer surface of said flange that the air in the space between the inner side of the flange and the main body of the insulator will comprise a part of the dielectric path intervening between the conducting material mounted in the external groove and each element of the surface of the supporting pin.

3. An insulator having a flange extending outwardly therefrom, a groove in said flange for carrying a line conductor and a tie-wire, an interior bore within the insulator whereby

it may be mounted upon a supporting pin, said groove being located well below the top of said supporting pin and the diameter of said groove being more than twice the diameter of said internal bore, and a groove extending upwardly into said flange from the underside thereof to a point well above the external groove and approximately as high as said interior bore so that an air-space will intervene between the said external groove and the supporting pin.

In testimony whereof, I have signed my name to this specification this 23rd day of December, 1925.

LEON T. WILSON.