June 3, 1930. C. S. GORDON ET AL 1,760,983

INSULATOR

Filed Dec. 19, 1925

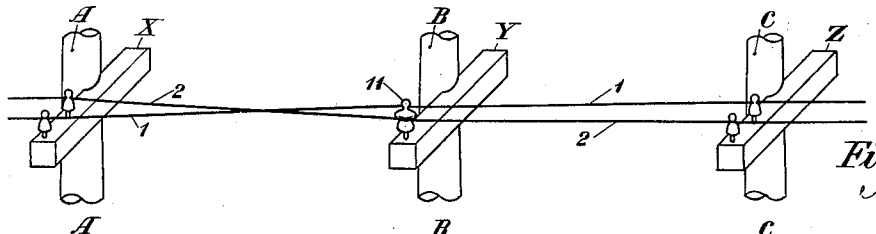



Fig. 1

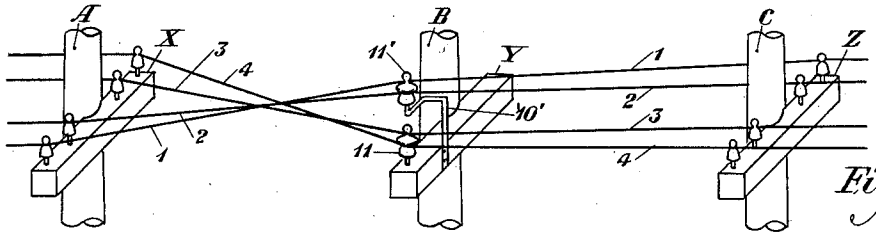



Fig. 2

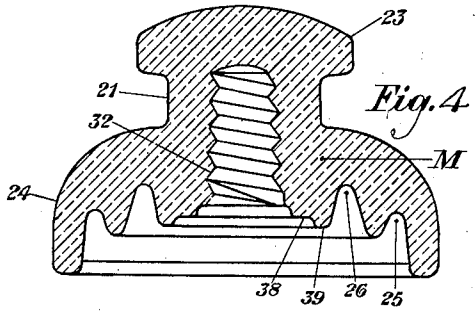



Fig. 4

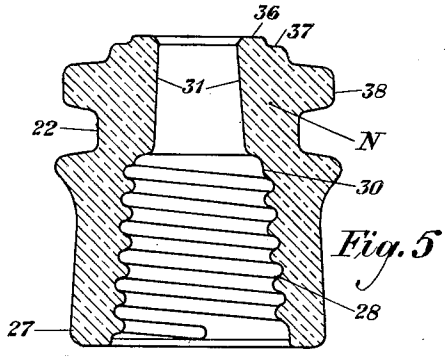



Fig. 5

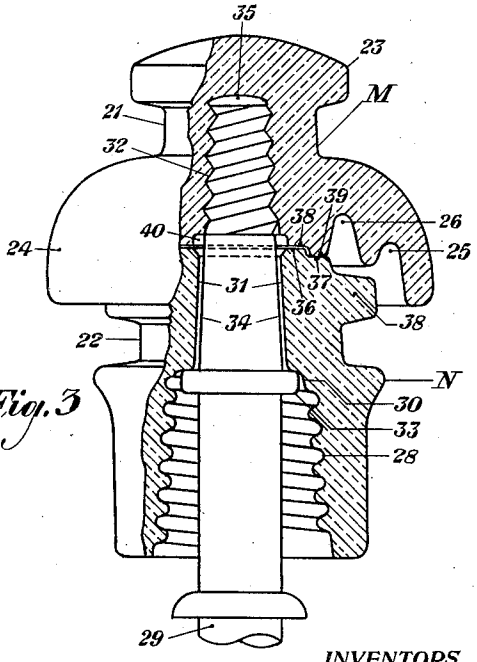



Fig. 3

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Patented June 3, 1930

1,760,983

# UNITED STATES PATENT OFFICE

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## INSULATOR

Application filed December 19, 1925. Serial No. 76,505.

This invention relates to insulators, and more particularly to insulators adapted to carry more than one conductor.

In a transmission system such as a telephone system, it is customary to transpose conductors at certain points along pole lines in order to reduce cross-talk. Where the lines are phantomed, it is the practice not only to transpose the two conductors forming each side circuit but to transpose the pairs of the phantom as well. In order to do this, it is necessary to provide at the pole where the transposition takes place some arrangement whereby the two insulators carrying two line conductors may be arranged one above the other instead of horizontally. In the case of a phantom transposition, it is necessary to arrange four insulators one above the other. This result has heretofore been accomplished by mounting brackets upon the crossarms which may carry one or more insulators above a given insulator on the crossarm.

The provision of the brackets and other hardware necessary to accomplish this result involves a considerable amount of expense, rendering it desirable to have available for use at transposition points an insulator capable of carrying at least two wires, one above the other. Such an insulator would permit of transposing a pair of wires without the use of any brackets whatever, and in the case of a phantom transposition, a single bracket carrying a single double insulator would be all that would be required. When this is contrasted with the complicated form of bracket capable of carrying three insulators, which must be used for the ordinary phantom transpositions, it is readily seen that a double insulator will effect a considerable saving.

Heretofore double insulators have been proposed made up of two units, one mounted upon the pin above the other, each unit serving to carry an individual wire. Such structures have, however, not been practical because it has been impossible to provide a moisture-proof joint betwen the two units, and when moisture collects at the joint of the two parts of the insulator, a double leakage path to the pin is provided, at least for the lower unit, which, of course, results in a considerable transmission loss.

It is therefore one of the objects of the present invention to provide a double insulator, that is, an insulator capable of carrying at least two wires, which may be formed of two units supported on the same pin and having upon the two units interlocking joints of such character as to be practically moisture-proof so that there will be substantially no possibility of a second leakage path due to moisture penetrating between the two parts of the insulator.

This object, as well as other objects of the invention, is accomplished by means of the arrangements shown in the drawing, in which Figure 1 illustrates how a side circuit transposition is made in accordance with the present invention; Fig. 2 illustrates how a phantom transposition is made in accordance with the present invention; Fig. 3 illustrates in detail the two parts of the insulator of the present invention mounted in assembled relation upon a supporting pin, while Figs. 4 and 5 illustrate separate sections taken through the two respective parts of the insulator.

Referring to Fig. 1, poles A, B and C are provided with crossarms X, Y and Z, respectively, and each crossarm carries a pair of insulators upon which the line wire conductors 1 and 2 may be mounted. In effecting a transposition, the problem is to cross the conductors 1 and 2 between the poles A and C. The crossing is effected at the pole B by means of a double insulator such as is illustrated at 11, capable of carrying two wires, this double insulator taking the place of the two insulators and bracket customarily used in the transposition arrangements of the prior art. The transposition may be effected by con-

necting the conductor 1 as it comes from the pole A to the upper part of the insulator 11 and the conductor 2 to the lower part of the insulator 11. The conductors are then given another quarter-twist as they pass from the insulator 11 to the two insulators at pole C.

If it is desired to make a phanton transposition, it will be necessary to provide a bracket to carry three single insulators above the insulator on the crossarm at the pole B, if no double insulators are available. Fig. 2 shows, however, how relatively simple it is to effect a phantom transposition if double insulators are used. Here a bracket 10 is provided which carries a double insulator 11′ above the double insulator 11, mounted directly upon the crossarm of the pole B. The side circuit conductors 1 and 2 may be given a quarter-twist with respect to each other by connecting them to the upper and lower mounting grooves of the double insulator 11′. Likewise, side circuit conductors 3 and 4 may be given a quarter twist with respect to each other by connecting them to the upper and lower mounting grooves of the double insulator 11. At the same time, due to the fact that the insulator 11′ is above the insulator 11, the pair 1—2 is given a quarter-twist with respect to the pair 3—4. The conductors 1 and 2 are given a further quarter-twist with respect to each other by connecting them to the fourth and third insulators, respectively, of the pole C. Likewise, the conductors 3 and 4 are given an additional quarter-twist with respect to each other by connecting them to the second and first insulators, respectively, of the pole C. Since the pair 1—2 is connected to the third and fourth insulators at the pole C and the pair 3—4 to the first and second insulators at the pole C, it is evident that the pairs have been given a further quarter-twist with respect to each other, Consequently, not only are the conductors of each pair completely transposed but the pairs themselves are transposed. All of this is accomplished by using a bracket capable of carrying one insulator.

The form of the double insulator of the present invention is illustrated in assembled form in Fig. 3, the separate parts of the insulator being shown in detail in Figs. 4 and 5. As will be seen, the insulator comprises two main bodies M and N, the part M being provided with a groove 21 and the part N with a groove 22. The two conductors to be supported by the insulator are led in these grooves and secured by means of tie-wires in a manner well understood in the art. Above the groove 21 a flange 23 projects outwardly to complete the groove for retaining the upper wire in position. Just below the groove 21 of the part M an umbrella or mushroom-like flange 24 extends outwardly and downwardly, this flange being formed on its under side with a plurality of deep corrugations 25—26 to form an effective dry path between the conductor attached to the groove 22 of the part N. Below the groove 22 a skirt 27 projects downwardly, the skirt being corrugated on its inner side as shown at 28 to form an effective dry path between the conductor of the groove 22 and the supporting pin 29. On the interior of the skirt 27 a shoulder 30 is formed, a tapered pin opening 31 extending upwardly from the shoulder 30. A corresponding pin opening extends upwardly into the interior of the part M, this part of the pin opening being interiorly screw-threaded as shown at 32.

The pin 29 is provided with a flange 33 upon which the shoulder 30 of the part N of the insulator may rest, and the upper part of the pin is tapered as shown at 34, the tapered part being screw-threaded near its upper end so that the part N of the insulator may be screwed upon the end of the pin with the part N resting upon the shoulder 33. When so mounted, the upper part M of the insulator clamps down upon the part N and holds it firmly in position. As the tapered part 34 of the pin is of smaller diameter than the tapered opening 31 of the part N of the insulator, a small air-space will be provided between the material of the insulator and the pin when the parts of the insulator are mounted upon the pin in the manner above described.

It is evident that when the two parts are mounted upon the pin, as just stated, their contiguous parts will bear upon each other. In order to prevent the possibility of moisture finding its way between the two parts at their bearing surfaces, these surfaces are specially formed. As will be clearly seen in Fig. 3, the upper surface of the part N is stepped as shown at 36 and 37 to form a shoulder. This shoulder is just above an outwardly extending flange 38 of the same general form as the flange 23 already described in connection with the part M. The part M, on the other hand, is likewise stepped as shown at 38 and 39 to form a mating shoulder, the step 39 being, in effect, a small flange extending downwardly from the under side of the part M. When the two parts are assembled upon the pin as shown in Fig. 4 the flange 39 rests upon the step 37, and, as the upper part of the insulator is screwed down, rocks the lower part N of the insulator upon the flange 33 of the pin 29 so that the upper part of the insulator becomes firmly seated upon the lower part. The pin 32 is of slightly less length than the total depth of the opening 31 in the part N and the screw-threaded opening 32 in the part M so that when the part M is screwed down as far as it will go a slight air-space 35 remains above the end of the pin 29. This prevents the upper part of the insulator from being screwed against the end of the pin 29 thereby leaving a small gap

between the parts M and N. Also the air gap at 35 performs a useful electrical function, as will be described later.

If, now, the shape of the assembled structure be noted, it will be seen that the shoulders or steps at 37 and 39 firmly bear upon each other while the adjacent stepped surfaces 36 and 38 do not quite come into contact. The joint thus formed is so close that it would be very difficult for moisture to penetrate between the two parts of the insulator. Furthermore, the shoulder 38 extends outwardly under the lip between the two corrugations 25 and 26, and the outer part of the flange of the mushroom-like flange 24 extends downwardly around the edge of the flange 28. The result is that a tortuous path is provided from the lower edge of the flange 24, the junction point of the two parts of the insulator rendering it very difficult for moisture to be driven to the junction point by the action of rain and wind. Practically the only way in which moisture can collect in this irregular passage is by condensation.

If any moisture should collect or be driven into the passage and through the joint formed by the parts 37 and 39, such moisture would have to be driven through the joint with such force as to rise up over the shoulder 36. If this should happen, the two adjacent parts of the elements M and N are so shaped that an annular space 40 will be formed about the pin 34 to trap the moisture without permitting it to touch the pin. The moisture thus trapped will then run down the interior surface 31 of the insulator (there being an annular space between the tapered part 34 and said inner surface 31), the moisture then passing out over the flange 33 of the pin. The flange 33 does not form a tight joint with the shoulder 30 of the element N so that the moisture can escape.

As has already been pointed out, an air-space is formed around the tapered portion 34 of the pin in the neighborhood of the conductor carrying groove 22. This air-space is an important feature of the present invention as it serves to decrease the attenuation due to leakage. As is now well understood, the attenuation due to the use of insulators is to a large extent made up by leakage losses due to the material of the insulator. These leakage losses are in the nature of a hysteresis loss which is a function of the capacity of the insulator acting as a condenser. The condenser action is due to the line conductor and the wet surface (if any) on the outside of the insulator forming one plate, the other plate being formed by the supporting pin which may be, and frequently is, metallic, and even if not metallic, becomes conductive when wet. The body of the insulator, of course, constitutes the dielectric.

Now, if the dielectric material of which the insulator is composed has a small loss angle, the attenuation will be reduced. This will be clear from the fact that if we consider the insulator as a condenser, we may represent its effect as that of a conductance shunted about a capacity, the conductance being the factor which produces the dielectric loss. If this conductance component which produces the dielectric loss is zero, the only effect on transmission through the condenser is to produce a change in phase without loss of energy. In other words, only a wattless current flows through the insulator in such case.

Consequently, if the material of the insulator be a material having a low loss angle, and consequently a low conductance component, the leakage loss will be greatly reduced. It has been found that the commercial form of glass known as pyrex B has a very low loss angle and for this reason it is preferred to construct the insulator of this material. The effectiveness of the structure to reduce losses is very materially increased, as already stated, by means of the air-space between the tapered portion of the pin and the inner wall of the insulator adjacent to the groove 22. This is for the reason that the air-space forms part of the dielectric, and air, as a dielectric, has a loss angle very closely approaching zero. Consequently, the combined effect of having a glass of low loss angle between the groove 22 and the pin, together with a layer of air, results in a very material decrease in the leakage loss of the insulator so far as the conductor attached to the groove 22 is concerned.

Another factor producing an attenuation loss is the direct current leakage due to moisture extending from the conductor in the groove 22 over the skirt to the pin 29. By providing the corrugations 28 on the inside of the skirt, a part of this path will be practically dry so that the leakage loss due to this factor will be to a considerable extent eliminated. In a similar manner, the direct current leakage due to moisture will be reduced so far as the conductor applied to the groove 21 is concerned, by means of the corrugations 25 and 26 on the under side of the wide flange 24. This flange also extends out a considerable distance for the purpose of maintaining the upper part of the outer surface of the skirt 27 dry just below the groove 22. This results in a substantial elemination of direct current leakage except when a driving rain occurs.

In mounting the insulator upon the pin, the flange 33 of the pin, which coacts with the shoulder 30 upon the insulator, is a very important factor as the interior bore of the insulator is made of such length that when the insulator is screwed on to the pin until the shoulder 30 is firmly seated upon the flange 33, there will be a small air-space between the upper end of the pin and the upper part of the

insulator as shown at 35. When the insulator is wet, the entire upper surface of the flange 23 becomes conductive, and with the conductor in the groove 21, comprises one plate of a condenser of which the other plate is formed by the upper part of the pin 29. This would result in an increase of the capacity of the insulator during wet weather and since, in general, the hysteresis loss increases with the increase in capacity, there will be an increase in the attenuation under these conditions. The fact that a small air-gap 35 is included between the pin and the upper surface of the insulator results in decreasing the dielectric hysteresis due to the flux passing from the upper surface of the insulator to the upper surface of the pin. This again is for the reason that air has a very low loss angle.

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

What is claimed is:

1. An insulator for transmission conductors comprising two bodies of dielectric material, a groove in each of said bodies for the attachment of transmission conductors, the adjacent surfaces of said bodies being correspondingly stepped so as to mate with each other and form a substantially water-tight joint when the two bodies are mounted one upon the other, a downwardly and outwardly extending flange on the upper body below the groove thereof, convolutions arranged in echelon formation on the under side of said flange, and an outwardly extending flange on the lower body above the groove formed therein so related to the convolutions on said first mentioned flange as to form a tortuous passage to prevent moisture from being driven into the joint.

2. An insulator for transmission conductors comprising two bodies of dielectric material of a generally cylindrical form each having a groove in its outer surface for the accommodation of electrical conductors, stepped surfaces upon the adjacent ends of said bodies to form a water-tight joint, a flanged insulator pin, an interiorly screw-threaded opening for the upper body whereby it may be mounted on said flanged insulator pin, a corresponding opening through the lower body, said latter opening being of somewhat larger diameter than the insulator pin to form an air-space between the insulator and the pin, and a shoulder on the lower body to coact with the flange upon the insulator pin so that when the upper body is screwed upon the pin the lower body may be rocked upon the flange of the pin so that the adjacent surfaces of the two bodies will come into intimate contact thereby preventing moisture from entering at the junction point.

3. An insulator for transmission conductors comprising two bodies of dielectric material of a generally cylindrical form each having a groove in its outer surface for the accommodation of electrical conductors, stepped surfaces upon the adjacent ends of said bodies to form a water-tight joint, a flanged insulator pin, an interiorly screw-threaded opening for the upper body whereby it may be mounted on said flanged insulator pin, a corresponding opening through the lower body, said latter opening being of somewhat larger diameter than the insulator pin to form an air-space between the insulator and the pin, a shoulder on the lower body to coact with the flange upon the insulator pin so that when the upper body is screwed upon the pin the lower body may be rocked upon the flange of the pin so that the adjacent surfaces of the two bodies will come into intimate contact thereby preventing moisture from the entering at the junction point, and an outwardly and downwardly extending flange upon the upper body to prevent moisture from penetrating to the joint between the two bodies

4. An insulator for transmission conductors comprising two bodies of dielectric material of a generally cylindrical form each having a groove in its outer surface for the accommodation of electrical conductors stepped surfaces upon the adjacent ends of said bodies to form a water-tight joint, a flanged insulator pin, an interiorly screw-threaded opening for the upper body whereby it may be mounted on said flanged insulator pin, a corresponding opening through the lower body, said latter opening being of somewhat larger diameter than the insulator pin to form an air-space between the insulator and the pin, a shoulder on the lower body to coact with the flange upon the insulator pin so that when the upper body is screwed upon the pin the lower body may be rocked upon the flange of the pin so that the adjacent surfaces on the two bodies will come into intimate contact thereby preventing moisture from entering at the junction point, and a downwardly and outwardly extending flange upon the upper body, said flange having corrugations on its under surface to prevent moisture from penetrating to the junction between the two bodies.

5. An insulator for transmission conductors comprising two bodies of dielectric material of a generally cylindrical form, an interiorly screw-threaded opening for the upper body whereby it may be mounted on a flanged insulator pin, a corresponding opening through the lower body, said latter opening being of somewhat larger diameter than the insulator pin to form an air-space between the insulator and the pin, a shoulder on the lower

body to coact with the flange upon the insulator pin so that when the upper body is screwed upon the pin the lower body may be rocked upon the flange of the pin so that the adjacent surfaces of the two bodies will come into intimate contact thereby preventing moisture from entering at the junction point, an outwardly extending flange upon the upper body, said flange having corrugations on its under surface arranged in echelon, and an outwardly extending flange above the groove in the lower body cooperating with the lips of the corrugations upon said first mentioned flange to prevent moisture from penetrating to the joint.

6. An insulator for transmission conductors comprising two generally cylindrical bodies each having a groove in its outer surface for the accommodation of electrical conductors, stepped surfaces upon the adjacent ends of said bodies to form a water-tight joint, a supporting pin upon which said bodies may be mounted, a flange upon said supporting pin, an interior opening in said lower body of somewhat larger diameter than the supporting pin, and a shoulder upon said lower body whereby the said body will be supported by the flange of the supporting pin with an air-space between the body and the pin, a screw-threaded opening in the upper body whereby it may be screwed upon a threaded portion of the pin, the length of the pin above its shoulder being somewhat less than the total length of the interior openings in said bodies whereby when the upper body is screwed down upon the pin until its lower surface comes in contact with the upper surface of the lower body the lower body will be rocked upon the flange of the pin to bring the two adjacent surfaces into intimate contact to prevent water from entering the joint, the parts when so mounted leaving an air-space between the upper part of the pin and the top wall of the upper body.

7. An insulator for transmission conductors comprising two generally cylindrical bodies each having a groove in its outer surface for the accommodation of electrical conductors, a supporting pin upon which said bodies may be mounted, a flange upon said supporting pin, an interior opening in said lower body of somewhat larger diameter than the supporting pin, a shoulder upon said lower body whereby the said body will be supported by the flange of the supporting pin with an air-space between the body and the pin, a screw-threaded opening in the upper body whereby it may be screwed upon a threaded portion of the pin, the length of the pin above its shoulder being somewhat less than the total length of the interior openings in said bodies whereby when the upper body is screwed down upon the pin until its lower surface comes in contact with the upper surface of the lower body the lower body will be rocked upon the flange of the pin to bring the two adjacent surfaces into intimate contact to prevent water from entering the joint, the parts when so mounted leaving an air-space between the upper part of the pin and the top wall of the upper body, and flanges below the groove on the upper body and above the groove on the lower body, said flanges being shaped to form a tortuous passage to prevent moisture from being driven to the joint.

8. An insulator for transmission conductors comprising two bodies of dielectric material of generally cylindrical form, each having a groove in its outer surface for the accommodation of electrical conductors, a supporting pin upon which the two bodies may be mounted one upon the other, said supporting pin having a flange thereon and a screw-threaded end, an opening through the lower body somewhat larger in diameter than the pin, and said body having a shoulder whereby it may rest upon the flange of the supporting pin without coming into contact with the pin above the flange, an interiorly screw-threaded opening in the upper body whereby it may be mounted upon the screw-threaded end of the supporting pin, and stepped surfaces upon the adjacent ends of said bodies whereby when the lower body is seated upon the flange of the supporting pin and the upper body is screwed upon the pin the lower body will be rocked upon the flange to bring said stepped surfaces into intimate contact to form a substantially water-tight joint, the length of the pin above the flange being somewhat shorter than the total length of the openings in the two bodies so that when mounted upon the pin the upper body may be screwed tightly down upon the lower one.

9. An insulator for transmission conductors comprising two bodies of dielectric material of general cylindrical form, each having a groove in its outer surface for the accommodation of electrical conductors, a supporting pin upon which the two bodies may be mounted one upon the other, said supporting pin having a flange thereon and a screw-threaded end, an opening through the lower body somewhat larger in diameter than the pin, and said body having a shoulder whereby it may rest upon the flange of the supporting pin without coming into contact with the pin above the flange, an interiorly screw-threaded opening in the upper body whereby it may be mounted upon the screw-threaded end of the supporting pin, stepped surfaces upon the adjacent ends of said body whereby when the lower body is seated upon the flange of the supporting pin and the upper body is screwed upon the pin the lower body will be rocked upon the flange to bring said stepped surfaces into intimate contact to form a substantially water-tight joint, the length of the pin above the flange being somewhat shorter than the total length of the openings in the two

bodies so that when mounted upon the pin the upper body may be screwed tightly down upon the lower one, and flanges one upon the upper body below the groove thereof and one upon the lower body above the groove thereof, said flanges being so shaped and related to each other as to form a tortuous passage to prevent moisture from penetrating to the joint between the two bodies.

In testimony whereof, we have signed our names to this specification this 15th day of December 1925.

CHESTER S. GORDON.
JAMES T. LOWE.