Sept. 4, 1934. R. HIGGINS 1,972,590

MEANS FOR CONTROLLING THE ELECTROSTATIC FIELD FOR INSULATOR BUSHINGS

Filed Sept. 14, 1933 2 Sheets-Sheet 1

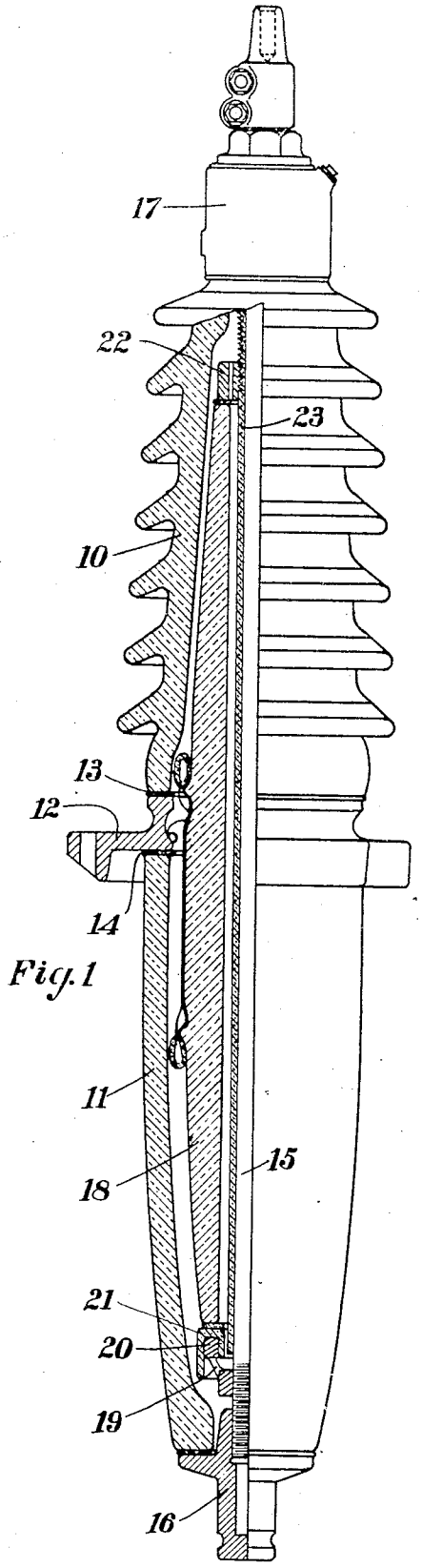


Fig. 1

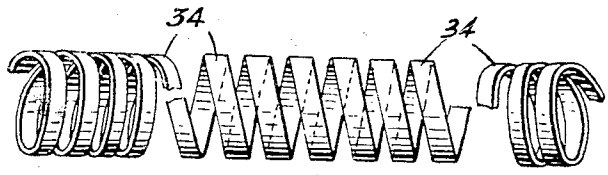


Fig. 3

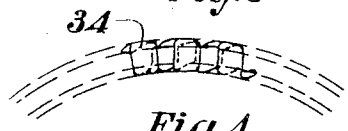


Fig. 4

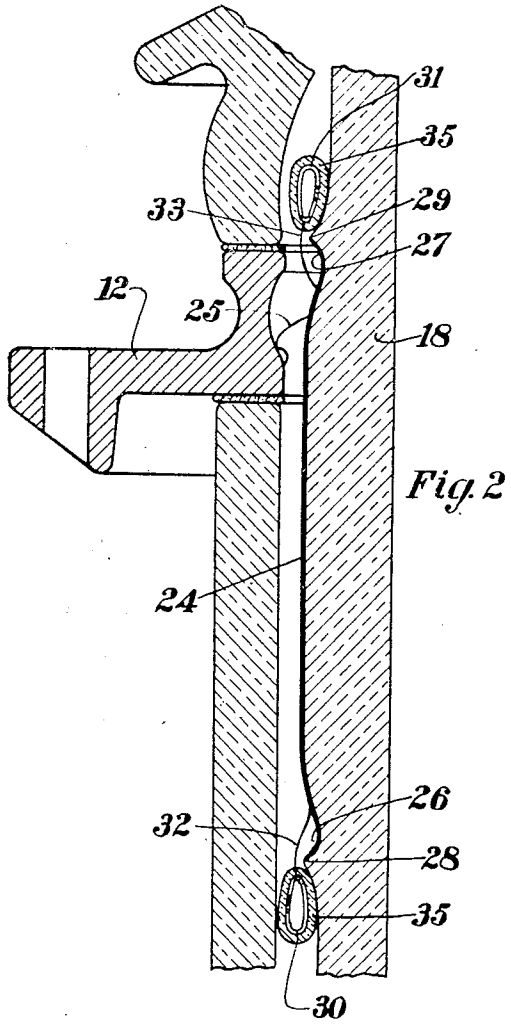


Fig. 2

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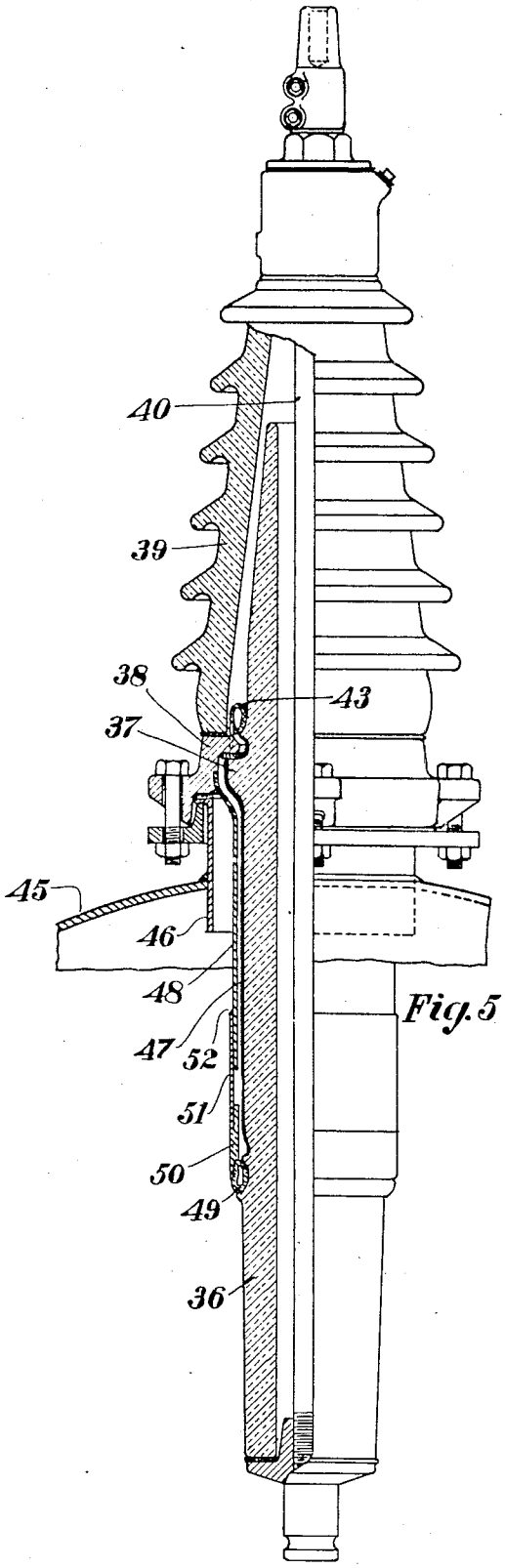


Fig. 5

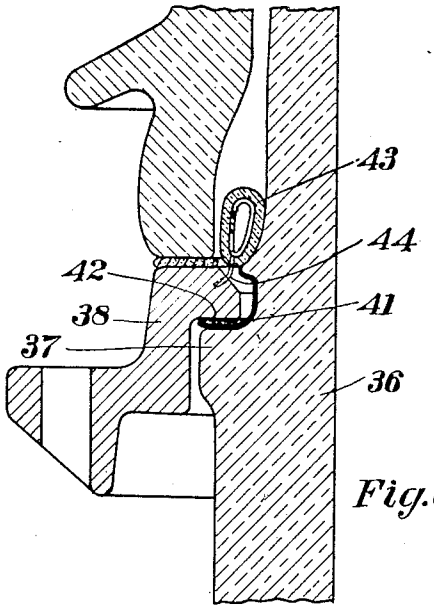


Fig. 6

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MEANS FOR CONTROLLING THE ELECTROSTATIC FIELD FOR INSULATOR BUSHINGS

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13 Claims. (Cl. 173—318)

This invention relates to bushing insulators and particularly to bushing insulators of the compression type in which the mounting flange is clamped between bearing shoulders of the dielectric members.

One object of the invention is to distribute the electrostatic field adjacent the mounting flange so as to prevent danger of breakdown of the dielectric member at this point.

A further object of the invention is to provide a device of the class named which shall be 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 drawings and described in the following specification, and it is more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is an elevation with parts in section showing one embodiment of the present invention applied to a bushing insulator of the compression type.

Fig. 2 is a fragmentary section of a portion of the insulator shown in Fig. 1 but on a larger scale.

Fig. 3 is a fragmentary elevation of the conductor element of a flux control member used in the invention.

Fig. 4 is a fragmentary top plan view of the element shown in Fig. 3.

Fig. 5 is a view similar to Fig. 1 showing a modified form of the invention.

Fig. 6 is a fragmentary section of a portion of the bushing shown in Fig. 5 but on a larger scale, and with the downwardly extending flux screen of Fig. 5 omitted.

In the operation of oil filled insulators, it has been found advantageous to form the insulators so that the joints between the metal and dielectric parts will be under pressure to prevent the escape of oil through the joints. Where the metal parts are cemented to the porcelain members, difficulty has been experienced in preventing the leakage of oil through the cement joints. This difficulty has been avoided by providing flanges or bearing members on the metal parts which project between shoulders on the porcelain members. Gaskets are placed between the bearing surfaces and the shoulders are pressed against the gaskets by spring pressure. Usually the conductor rod extending through the bushing is utilized to hold the porcelain members against the metal parts; a spring being interposed between the conductor rod and one of the dielectric members to provide resilient pressure. Where a construction of this kind is used, the metal supporting flange projecting between the dielectric members produces a concentration of electrostatic flux, which has a tendency to produce electrical discharges within the bushing. The present invention provides means for preventing such discharges.

In the form of the invention illustrated in Fig. 1, the numerals 10 and 11 designate the upper and lower shells respectively of a bushing insulator; the shells preferably being made of porcelain or other suitable dielectric material. The porcelain shells bear upon the upper and lower faces of a supporting flange 12, gaskets 13 and 14 being interposed between the bearing faces. A conductor 15 extends through the insulator and is provided with a terminal 16 bearing against the lower end of the shell 11 and a housing member 17 resting upon the upper end of the member 10; the parts 10 and 11 being held against the shell 12 by tension in the conductor 15. A tubular baffle 18 of porcelain surrounds the conductor 15 and overlaps the joint between the members 10 and 11. The lower end of the baffle 18 is supported upon a spider 19 carried by the conductor 15 and having a supporting ring 20 covered by a dielectric member 21. The dielectric member 21 aids in preventing discharge from the supporting ring 20 toward the flange 12. The upper end of the baffle 18 may be held in place by a collar 22 threaded on an insulated sleeve 23 directly surrounding the conductor 15. The sleeve 23 may be made of suitable insulating material, such as fibre or a phenolic condensation product.

In order to prevent concentration of electrostatic flux at points on the flange 12 or on the supporting structure to which the flange is secured, means for controlling the distribution of electrostatic flux is provided, which is shown more clearly in Fig. 2. The outer surface of the baffle 18 is metallized, as indicated by the heavy line 24. The metallized surface 24 is electrically connected to the flange 12 by any suitable form of jumper 25. This arrangement will provide a grounded conducting surface closer to the conductor 15 than the exposed points on the flange 12 and will overcome any tendency to arc from the corners or projections of the flange toward the porcelain member 18. Without the shield or screen 24, there would be a tendency for streamers to start from the extreme portions of the flange 20 which would penetrate the oil sur-

rounding the baffle 18, not only tending to destroy the insulating properties of the oil but acting to puncture or chip the baffle at concentrated points. In order to prevent the formation of discharge streamers or corona at the extremities of the screen 24, the porcelain is provided with depressions 26 and 27 near the extreme edges of the screen 24 and with beads or ribs 28 and 29 at the very edges of the screen. Electrostatic flux at the edges of the screen 24 is directed inwardly toward the conductor 15 and the inwardly extending portion of the screen at the points 26 and 27, together with the outwardly extending beads 28 and 29, tend to prevent concentration of the flux at the edges of the screen and formation of corona or other discharge streamers emanating from these edges.

Further to grade the electrostatic flux at the edges of the screen 24, flux control members 30 and 31 are electrically connected to the screen 24 by jumpers 32 and 33 and are disposed just beyond the edges of the screen 24. The flux control members 30 and 31 may be formed of any suitable conducting material and may be in the shape of a helical ribbon 34, shown in Figs. 3 and 4. The control members are wrapped or covered with an insulating material 35, such as varnished cambric, to prevent electrical discharge from the extremities of these control members. The material 35 preferably has a lower specific inductive capacity than the porcelain of the member 18 so as to reduce the tendency for the flux to concentrate at the control members 30 and 31. This prevents concentration of the flux not only at the extremities of the screen 24 but also at points along the conductor 15 adjacent the extremities of the screen. The dielectric coverings 35 are fitted closely to the outer surface of the member 18 so as to prevent electrical discharge between the surfaces of the dielectric parts. The screen 24 extends a greater distance downwardly than upwardly for the reason that there are usually downwardly extending portions of the housing to which the bushing is attached, and the downwardly extending screen 24 prevents concentration of flux on these downward projections of the housing.

Fig. 5 shows the invention applied to a compression type bushing formed of two porcelain members, one telescoped within the other. The lower member 36 is provided with a peripheral shoulder 37 which engages the lower bearing face of the supporting flange 38. The upper porcelain member 39 rests upon the upper face of the bearing flange 38, and gaskets are interposed between the bearing flange and the dielectric members to form tight joints. The porcelain members are held tightly against their gaskets by tension on the conductor 40. The porcelain member 36 above the shoulder 37 is provided with a gradually rounded surface covered with a metallic coating 41. This metallic coating is electrically connected to the supporting flange 38 by any suitable means. This may be done by a gasket 42 having a thin sheet metal cover, such as is commonly used in connection with gaskets for spark plugs. This will prevent any tendency to discharge across the space between the supporting flange 38 and the surface of the porcelain member 36, and will also prevent concentration of electrostatic flux at projecting points on the surface of the flange 38 since the conductor coating 41 is nearer the conductor 40 than the innermost portion of the supporting flange 38. Concentration of the flux at the inner edge of the shoulder 37 is prevented by the widely rounded curve of the coating 41 at this point. Concentration of flux at the upper edge of the coating 41 is prevented by a flux control member 43 made like the control members 30 and 31, in Fig. 2, and electrically connected to the supporting flange 38 by any suitable connection 44.

Where the bushing is mounted on a housing, such as that shown at 45 having a downwardly extending flange 46, concentration of flux at the edge of the flange 46 may be prevented by a screening member 47, in the form of a metallized coating on the surface of the porcelain tube 36. The metallized surface 47 may be protected by a surrounding metal sleeve 48, and the lower edge of the screen 47 is provided with a flux control member 49, similar to that shown at 30 in Fig. 2. The flux control member 49 is held in place by a collar 50 of fiber or other insulating material, which also serves to hold the sleeve 48 in place. The sleeve 48 is slipped into position from the lower end of the bushing until the upper end bears against the flange 38. A second ring 51 bears upon the ring 50 and telescopes with the lower edge of the sleeve 48. When the parts are in position, the sleeve 48 and ring 51 may be soldered together, as at 52, to hold them in place.

In order to prevent destructive discharges at the extremities of the charged metal fittings and at the edges of the flux screen, the form of flux control shown at 43 in Fig. 6 has proven most effective. In order for an insulated flux control to be effective in operation, it is desirable that the insulation be pressed tightly against the charged conductor and also that the opposite face of the insulation be held closely against the surface of the adjacent dielectric member. If there is a space between the conductor and insulating covering or between the insulating covering and the adjacent dielectric member, there is a tendency for streamers or arcs of discharge across this space.

Attempts have heretofore been made to cover the inner extremity of the supporting flange 38 with cambric or other insulating material or to provide an upwardly projecting ring on the inner edge of the flange and cover this ring with insulating material. It is of course impossible to wrap such a termination for the member 38 with insulation passing entirely around the metal part, and it has also been found practically impossible to fill completely the space between the metal and the dielectric baffle with insulation or to hold the insulation tightly against either the metal or the dielectric, and trouble has been experienced by cracking or checking of the porcelain due to discharges from the projecting corners of the supporting flange.

By metallizing the surface of the dielectric 36 at the point 41 and by giving the metallized surface a widely rounded curve at this point, concentration of flux at the inner corner of the shoulder 36 is avoided, and any possibility of discharge between the metal and the surface of the dielectric is overcome because of the fact that the metal coating is placed directly on the surface of the dielectric and there is no possibility of a space between the metal and the dielectric. Discharge from the upper edge of the coating 44 is avoided by the control member 43.

By using the form of conductor core shown at 34 in Fig. 3, the dielectric covering, which may be of varnished cambric or other suitable material, can be wrapped tightly entirely about the

metal core member, thus insuring tight contact with the metal. The core member is resilient so that it may be compressed by the material wound about it and thus it will have a yielding pressure against the material, insuring tight contact at all times. The core member also will stretch circumferentially of the bushing, in the direction of the axis of the helix, so that when the completed control is slipped tightly over the baffle 36, there will be a tendency for the control to contract, thus binding it tightly against the surface of the baffle and insuring close engagement. The fact that the core member of the control is not rigidly attached to the supporting flange 38, provides what may be called a floating flux control; that is, the control is free to yield so as to hug closely against the surface of the baffle. The control member itself is yielding so that it is free to conform to the contour of the surface of the baffle or to any irregularities of said surface so that it will fit tightly against the baffle at all points.

By forming the flux control 43 separately rather than integral with the flange 38, assembly of the insulator is greatly facilitated. Heretofore, effort has been made to provide a flux control formed integral with the member 38 and projecting upwardly between the dielectric members 38 and 39 and to insert a dielectric packing between the inner portion of the member 38 and the baffle 36 after the two parts are assembled. This method of forming the flux control is difficult and somewhat uncertain in its final results and requires considerable time. Where the gasket 41 is provided with a coating to insure a tight joint, there is danger that the coating may harden during the insertion of the packing about the inner edge of the flange 38 where the old method of assembly is employed. With the present invention, the insertion of the ready formed flux control requires but a very short time and the other parts of the bushing can be assembled and pressure brought to bear upon the gaskets without danger of the coating on the gaskets drying. In this way the ready formed flux control is not only more efficient but saves considerable time in assembling and avoids danger of leaking about the gaskets.

The control member 49 in Fig. 5 of the drawings is made like that shown in Fig. 6 and is held in place by the collar 43 which is slid downwardly over the outer periphery of the control member to press the control inwardly against the baffle 36 and hold it in place so that it may not be displaced by accidental contact with external devices. In Fig. 5 the baffle 36 is provided with a downwardly extending screen 47, as previously explained. In cases where there are no downwardly extending parts on the housing and particularly in housings of the conservator type where the oil level is above the top of the housing, the screen member 47 may be omitted, as in Fig. 6.

I claim:

1. In a bushing insulator a supporting flange, hollow dielectric members bearing against opposite faces of said flange, means for pressing said dielectric members against said flange to form a tight joint therewith, a conductor extending through said dielectric members and flange, an insulating baffle surrounding said conductor and extending past the joint between said dielectric members and said flange, an electrostatic screen of conducting material on the outer surface of said baffle and electrically connected with said flange, and means for preventing concentration of flux at the extremity of said screen, said means comprising a circumferential depression in the outer surface of said baffle near the extremity of said screen and into which said screen extends and a circumferential projection on said baffle located beyond said depression and upon which projection the extremity of said screen is located, and a flux control member of conducting material electrically connected with said screen and positioned beyond the extremity thereof and covered with dielectric material having a lower specific inductive capacity than that of said baffle, said dielectric material being in close contact with the outer surface of said baffle.

2. The combination with electrodes adapted to be differently charged, of a baffle of dielectric material interposed between said electrodes, an electrostatic screen of conducting material disposed on one surface of said baffle and electrically connected to the electrode adjacent thereto, a portion of said screen adjacent the extremity thereof being disposed closer to the oppositely charged electrode than the portion of said screen at the immediate extremity thereof, and a flux control member of conducting material electrically connected to said screen and positioned beyond the extremity thereof and covered with dielectric material having a lower specific inductive capacity than that of said baffle to effect distribution of the electrostatic flux adjacent the extremity of said screen.

3. A bushing insulator comprising a supporting, ring shaped flange, hollow dielectric members engaging opposite portions of said flange respectively, a conductor extending through said bushing insulator and holding said dielectric members against said flange, a dielectric baffle surrounding said conductor and extending through the opening in said flange and past the joint formed by said dielectric members and said flange, an electrostatic screen comprising a metallic coating on the outer surface of said baffle, said coating being disposed closer to said conductor near the extremity of said screen than at said extremity, and a flux control member of conducting material electrically connected with said screen and positioned beyond the extremity thereof and covered with dielectric material of lower specific inductive capacity than said baffle.

4. A bushing insulator comprising a supporting, ring shaped flange, dielectric members having bearing faces engaging opposite faces of said flange and a dielectric baffle bridging the joint between said dielectric members and flange, the outer face of said baffle adjacent said flange being metallized and electrically connected with said flange, and a flux control member of conducting material extending beyond the extremity of the metallized surface on said baffle and electrically connected with said metallized surface and having the extremity thereof covered with dielectric material.

5. The combination with a metallic supporting flange having an opening therethrough and a conductor extending through said opening, of a bushing insulator comprising dielectric members bearing against said flange and held in position thereon by said conductor, a dielectric baffle surrounding said conductor and extending through the opening in said flange, a spider of conducting material mounted on said conductor and supporting said baffle, the portion of said spider adjacent said flange being covered with dielectric material, said baffle having the surface

thereof adjacent said flange metallized to form a flux control screen, the portions of said screen adjacent the extremities thereof being disposed closer to said conductor than the immediate extremities of said screen to prevent concentration of electrostatic flux at said extremities, said screen being electrically connected with said flange to prevent discharge across the space between said flange and said baffle, and flux control members disposed beyond the extremities of said screen and electrically connected with said screen, said flux control members being covered with dielectric material having lower specific inductive capacity than that of said baffle.

6. In combination spaced electrodes arranged to be charged to different potentials, a dielectric member interposed between said electrodes, a flux control member for regulating the electrostatic field about one of said electrodes, said control member comprising a core of conducting material electrically connected to said electrode, a wrapping of insulating material extending about said core member and bearing against the surface of said dielectric member, said flux control member being movable relative to said electrode to permit close conformity thereof to said dielectric member.

7. In combination spaced electrodes arranged to be charged to different potentials, a dielectric member interposed between said electrodes and a flux control for distributing the electrostatic field adjacent one of said electrodes, said control comprising a resilient core of conducting material, a winding of insulation disposed about said core and held tightly against the surface of said core by compression exerted by said winding upon said core, said winding being disposed in close contact with the surface of said dielectric member and pressed with force against said surface.

8. In combination spaced electrodes adapted to be charged to different potentials, a dielectric member interposed between said electrodes and a flux control for distributing the electrostatic field about one of said electrodes, said flux control comprising a core member of conducting material, and a winding of insulation disposed about said core member and contacting the face of said dielectric member and pressed against said face, said flux control being yieldable to conform to said face.

9. A bushing insulator comprising a supporting flange, a baffle of dielectric material disposed adjacent said flange and means for controlling the electrostatic field adjacent said flange, said means comprising a metallized coating on the surface of said dielectric member and electrically connected with said flange, and a flux control including a yielding core of conducting material electrically connected to said flange and a wrapping of dielectric material disposed about said core, said wrapping contacting with the surface of said dielectric member adjacent the edge of said metallic coating and free to move relative to said flange and yieldable to conform to the surface of said dielectric member.

10. A bushing insulator comprising a supporting metal flange having an opening therethrough, a tubular porcelain baffle extending through said opening and having an external shoulder thereon engaging one side of said flange, a porcelain shell member surrounding one end of said baffle and bearing against said flange at the side thereof opposite said shoulder, the surface of said baffle at the inner edge of said shoulder being widely rounded and covered with a metal coating electrically connected with said flange, said baffle having an outwardly projecting bead thereon at the edge of said coating and a flux control engaging the surface of said baffle at the side of said bead opposite the termination of said metal coating, said flux control comprising a resilient metal core member electrically but yieldingly connected with said supporting flange, and a covering of insulating material having a lower specific inductive capacity than said baffle wound tightly about said metal core and held tightly against the surface of said baffle by the resiliency of said core.

11. In a bushing insulator a tubular dielectric member having an electrostatic shield of conducting material on the outer surface thereof, a flux control member at the end of said shield, and a dielectric ring engaging said flux control member and holding said control member closely against the surface of said tubular dielectric member.

12. In combination an insulator having a flux control shield of conducting material on the outer surface thereof, a flux control member at the termination of said shield comprising a yielding core of conducting material and a covering of dielectric material surrounding said core, and a dielectric ring engaging said flux control member and holding said control member closely against the surface of said insulator.

13. A bushing insulator comprising a tubular dielectric member, a supporting flange for said tubular member, a coating of conducting material on a portion of the outer surface of said tubular member, a flux control at the termination of said coating comprising a yielding core of conducting material and a covering of dielectric material, a metal sleeve surrounding said coating and having one end thereof bearing against said flange, a dielectric ring bearing against said flux control and pressing said flux control against said tubular dielectric member, and means connecting said dielectric ring and said metal sleeve for holding said dielectric ring in position.

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