May 8, 1934. F. S. SMITH 1,957,986

HIGH VOLTAGE TERMINAL CONSTRUCTION

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Fig. 1.

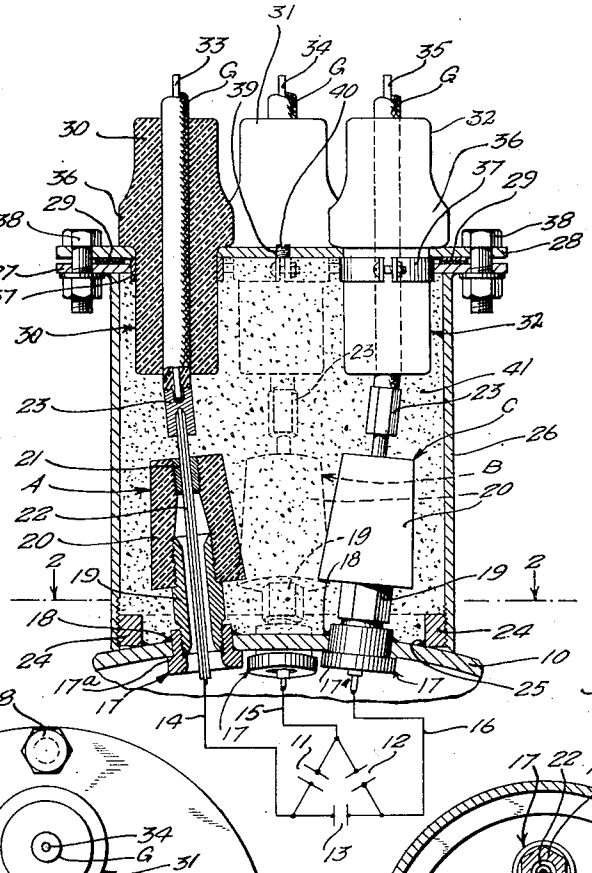


Fig. 3.

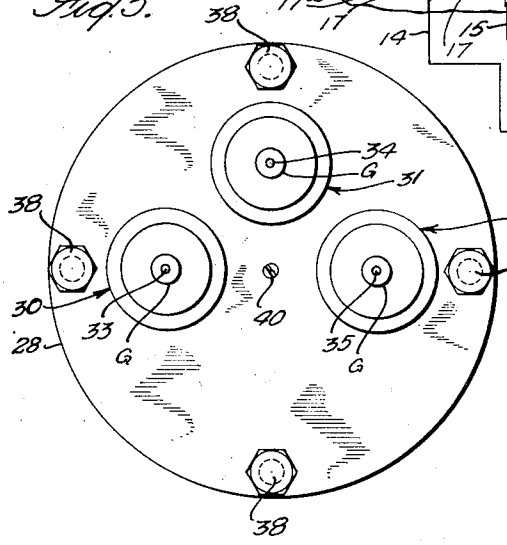
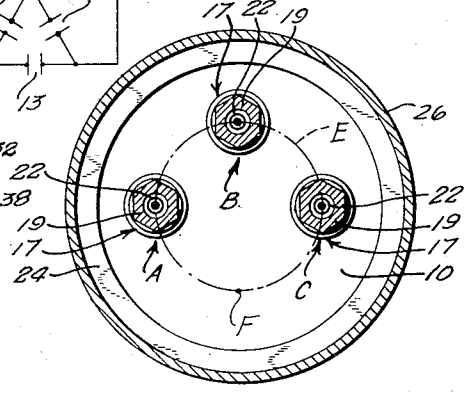


Fig. 2.



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HIGH VOLTAGE TERMINAL CONSTRUCTION

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25 Claims. (Cl. 173—318)

This invention relates to high voltage terminal construction.

One of the objects of this invention is to provide a simple, practical and thoroughly dependable high voltage terminal construction. Another object is to provide a construction of the above-mentioned nature that will function satisfactorily outdoors and that will be well adapted to withstand the varying conditions caused by exposure to the elements. Another object is to provide a practical and thoroughly reliable construction for protecting one or more high voltage terminals, otherwise not intended or adapted for outdoor operation, against the varying effects of the elements and, furthermore, to provide a protecting construction that is inexpensive, capable of rapid assembly, and capable also of convenient and ready disassembly for access to various parts thereof for repair, inspection or replacement. Another object is to provide a high voltage terminal construction embodying solid dielectric material and a gaseous dielectric under high pressure that will be well adapted for efficient and long-continued outdoor service. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter described and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing in which is shown one of various possible embodiments of my invention,

Figure 1 is a central vertical sectional view of a multiple outdoor high voltage terminal construction;

Figure 2 is a horizontal sectional view, as seen along the line 2—2 of Figure 1, and

Figure 3 is a plan view, as seen from above in Figure 1.

Similar reference characters refer to similar parts throughout the several views of the drawing.

Referring now to the drawing and more particularly to Figure 1, there is shown at 10 a wall member through which one or more high voltage conductors are to be passed, and as illustrative of a typical and more frequent form that the wall member 10 assumes in practice, the wall 10 may be considered to be a pressed steel tank or casing within which is contained, for example, a transformer or a condenser with which coacts a gaseous dielectric under pressure greater than atmospheric pressure. By way of further example, the tank or casing 10 contains a chemically neutral gas such as nitrogen under a pressure on the order of fifteen atmospheres.

By way of further illustration the transformer, condenser or other apparatus contained within the tank 10 may necessitate the provision of several relatively high voltage conductors which have to be passed through the wall or tank 10 and by way of illustration, let it be assumed that the tank 10 contains three condenser units or sections indicated at 11, 12 and 13 connected in delta and from which three high voltage conductors 14, 15 and 16 are to be passed through the wall 10.

To pass these high voltage conductors through the wall 10 so that they may be connected to a corresponding high voltage circuit, I employ terminal constructions generally indicated at A, B and C, these terminal constructions being of a character to coact with the gaseous dielectric under pressure and, furthermore, of a character to achieve a certain protective action. The constructions A, B and C are preferably of identical character and hence it will suffice to describe in detail only one of them.

From the inside of tank 10 and through a suitable opening in the wall thereof, I first insert a metal bushing 17 provided with a flange 17ª adapted to abut against the inside face of the wall 10. Bushing 17 is welded to the outside face of wall 10 as at 18, the joint being thus air-tight.

Bushing 17 is interiorly threaded to receive a metal sleeve member 19 whose upper portion is externally threaded to receive a tubular elongated housing 20 of solid dielectric material, such as molded phenolic condensation product, into the upper end of which is threaded a plug 21 supporting a downwardly depending conductor 22 conveniently in the form of a tube.

The threaded joint between bushing 17 and sleeve 19 is air-tight while any suitable means, such as a permanently elastic and resilient cement, may be employed for insuring air-tightness of the threaded joints between the bakelite housing 20 and sleeve 19 and plug 21. Thus, escape of the gaseous dielectric under this pressure on the order of fifteen atmospheres is prevented.

The tubular bakelite housing 20 is made of sufficient thickness to withstand the hgh internal pressure of the gaseous dielectric, to which it is subjected, while its thickness and length are, furthermore, sufficient to withstand the potential of conducting members 21—22 which it supports and assists in insulating from the casing or tank 10.

The tubular conductor 22 extends as is clearly shown in Figure 1, through the plug 21, but in air-tight relation therewith, and extending upwardly through the tubular conductor 22 is the conductor 14 leading from the high voltage apparatus within the casing 10. Conductor 14 and tube 22, thus projecting upwardly beyond the plug 21, are received within a suitable recess in a connector 23, being suitably sweated or brazed or otherwise rigidly secured thereto and sealed therewith.

The tubular conductor 22 passes through the metallic sleeve 19 and is held concentrically with respect to the interior cylindrical wall of the sleeve 19. The radii of the tubular conductor 22 and of the interior cylindrical surface of sleeve 19 are preferably so proportioned that these two parts form the electrodes of a fast discharge gap, sparkover between which takes place without being preceded by corona; moreover, the dimensions are so selected, within the above-mentioned ratio or proportioning of the radii, and with respect to the gaseous dielectric under pressure which fills the gap that spark-over without being preceded by corona takes place at a critical voltage below that at which the apparatus within the casing or tank 10 or any part thereof will be injured.

By way of this construction I am enabled to pass the high voltage conductor 14 through the wall 10 efficiently and dependably and, moreover, with parts of relatively small volume or magnitude, considering the high voltages that may thus be handled. More particularly, the gaseous dielectric under pressure, having very high dielectric strength and hence best adapted to withstand high dielectric stresses, is in the field of highest voltage gradient, namely, in the field between the sleeve 19, which is at ground potential, and the high potential tubular conductor 22. The solid dielectric material of the housing 20 is, on the other hand, in the field of lowest voltage gradient, namely, in the field extending most directly between the plug 21 and the grounded sleeve 19, while both the gaseous dielectric under pressure and the solid dielectric material of housing 20 are in series in fields of intermediate voltage gradient.

The above-described construction and coactions I achieve most efficiently where the housing 20 is made of molded phenolic condensation product or bakelite, the latter functioning excellently not only to achieve the above-mentioned electrical coactions and advantages, but also to withstand the high internal pressure of the gaseous dielectric under pressure. But in order to insure the dependable continuance of these coactions as well as to safeguard the bakelite molding 20 of the terminal constructions A, B and C, which as above noted are identical in both construction and action, against the detrimental effects of exposure to the elements, I provide a coacting construction substantially as follows:—

The several terminal constructions A, B and C are grouped relatively closely and, where three such constructions are employed, I prefer to group them substantially as is shown in the horizontal sectional view in Figure 2, wherein the sleeves 19 of the terminal constructions A, B and C are shown in cross-section and in a convenient grouping. This preferred form of grouping provides sufficient latitude to permit additional terminal constructions to be employed and appropriately grouped with constructions A, B and C; the latter are arranged so that their axes or their center points fall in a circle indicated at E in Figure 2 and at F I have indicated a point on this circle where an additional terminal construction may be attached to the container wall 10.

As is better shown in Figures 1 and 2, there is attached to the wall 10 a ring member 24, member 24 having a diameter materially greater than the circle E of Figure 2. Ring or collar 24 is externally threaded, as is better shown in Figure 1, and is secured to the wall 10 as by welding, as is indicated at 25 in Figure 1, the joint thus made by welding extending throughout the periphery of the ring or collar 24.

Threaded onto the collar 24 is a cylindrical housing 26 preferably made of steel and of sufficient diameter safely to space the high potential conductive parts 23 therefrom (see Figure 1). Housing 26 extends well above the group of terminals A, B, etc., and at its upper end is provided with a flange 27 (Figure 1) extending outwardly therefrom and adapted to receive a cover plate 28 (Figures 1 and 3) with a suitable gasket 29, for example, of cork, interposed therebetween.

The cover plate 28 is provided with as many openings as there are terminal constructions A, B, etc., and in the illustrative example the cover plate has three such openings into and through which extend insulating bushings 30, 31 and 32 (Figures 1 and 3) preferably made of ceramic material such as porcelain and suitably glazed. As appears clearly from Figure 3, the porcelain bushings 30, 31 and 32 are, with the openings through which they extend, arranged preferably in a circle which preferably is of larger diameter than the circle E of Figure 2 and they are, moreover, arranged about this circle similarly as are the terminal constructions A, B and C. Thus, bushings 30, 31 and 32 are disposed respectively substantially above terminal constructions A, B and C.

To the connectors 23 (Figure 1) are connected the high tension connecting wires 33, 34 and 35, each suitably insulated as at G, and suitable lengths of these insulated conductors, after having been secured to the connectors 23, are threaded through the bushings 30, 31 and 32 as the latter with the cover plate 28 are placed in position with respect to the cylindrical housing 26.

The outdoor bushings 30, 31 and 32 are preferably shouldered as at 36 so as to limit the extent to which these bushings may be passed downwardly through the openings in the cover plate 28, a clamping ring 37 extending about each of the porcelain bushings and abutting against the under side of the cover plate 28. The shoulders 36 and the clamping rings 37 thus dependably hold the bushings in fixed position with respect to the cover plate 28.

The relative proportions and shapes of the various parts are substantially as will appear from Figure 1 but it might be pointed out that, considering that the bushings 30, 31, etc., and the terminal constructions A, B, etc., are to be subjected to the same relatively high potential, the ceramic bushings 30, 31, etc. are relatively much larger and bulkier than the bushing constructions A, B, etc. This is in part because such unique coactions as are effective between the solid dielectric material of the tubular housings 20 and the gaseous dielectric under pressure and other features of construction and action cannot be realized with the outdoor type of bushing like the porcelain bushings 30, 31, etc. The latter, therefore, are of sufficient thickness in a radial direction

and of sufficient length axially to insulate the high voltage conductors passing therethrough from the grounded housing 26 and cover 28 and particularly to provide a wet flash-over voltage from the high voltage conductor externally of the bushings 30, 31, etc. to the grounded cover 29 high enough to provide the desired factor of safety.

The cover 28 with the outdoor bushings attached thereto and with the high voltage insulated conductors passed through the latter is secured to the flange 27 by bolts 38 (Figures 1 and 3), the latter being tightened up to compress the gasket 29 and make the joint between the cover 28 and the housing 26 tight.

Through a suitable opening 39 preferably in the cover 28 there is then injected into the otherwise sealed housing 26 a suitable insulating compound, preferably a material like Halowax which is permanently plastic. This material is introduced through the opening 39 in liquid form, being heated, and if desired it may be introduced under pressure. The insulating compound fills all of the spaces about the terminal constructions A, B, etc., about the connectors 23 and about the lower or inside portions of the porcelain insulators 30, 31, etc., and upon cooling, becomes plastic, and is indicated at 41. The hole 39 through which this material was introduced may thereupon be sealed as by a threaded plug 40. Halowax is a chloro-naphthalene substitution product. In its plastic state, I term it a "solid" dielectric to distinguish it from liquid or gaseous dielectrics.

Thus, the high voltage terminals A, B and C are encased in an insulating compound which of itself prevents access of air, water, moisture, or the like, to the bakelite insulating housings 20 and the terminal constructions A, B, etc. are thus dependably protected against the effects, both mechanical and electrical, of these elements thereon, while the metal housing 26—28 with the porcelain bushings 30, 31, etc. dependably encase this insulating compound and insure that the latter is dependably maintained in coacting relation with the terminal constructions A, B, etc. The insulating compound 41, moreover, forms a seal at the junctions of bushings 30, 31, etc., with the cover plate 28 and with the lower ends of the conductors G. Thus, although the entire terminal construction is exposed to the atmosphere and to the varying effects of weather, the intended and desired action of the terminals A, B, etc. is dependably insured. For example, the wetting of the external surfaces of the bakelite housings 20 with consequent decrease in resistance to surface leakage is dependably prevented. Moreover, the intimate contact of the insulating compound with these external surfaces also coacts to greatly minimize the possibility of surface leakage or flash-over from the exterior portions of conducting tubes 22 to the grounded sleeve 19.

On the other hand, the housing 26—28, preferably made of steel, is strong and durable and affords excellent mechanical protection to the insulating devices housed therein. The bushings 30, 31, etc. may be made of any suitable material and adapted for outdoor operation, and as typical of such material I have already above mentioned porcelain. Should flash-over occur from the conductors 33, 34, etc., such flash-over takes place by way of the external surface or surfaces of the porcelain bushings to the cover member 28 which is grounded to the grounded tank 10 by way of the casing walls 26; thus, any disturbances, either electrical or atmospheric, as would cause flash-over are dependable side-tracked from the terminals A, B, etc., and the latter are dependably safeguarded from such action.

Moreover, should the electrical disturbances be of such a character as to result in potentials in any of the conductors 33, 34 or 35 in excess of the critical break-down voltage of the fast gap between the electrodes 22—19, and such may occur due to transients, or the like, the fast gap breaks down instantaneously and not only safeguards the apparatus within the housing 10 but also, in thus providing a quick-acting circuit to ground for this abnormal potential, quickly relieves the porcelain bushings 30, 31, etc. from over-stressing and possible flash-over.

It will thus be seen that there has been provided in this invention a terminal construction in which the various objects hereinbefore noted, together with many thoroughly practical advantages, are successfully achieved. It will be seen that the construction is of a thoroughly practical nature and is well adapted to meet the varying conditions of such hard practical use as is met with in high voltage outdoor apparatus. Moreover, the construction will be seen to be compact and is well adapted for use in connection with transformers, power factor correction condensers, and the like, intended to be mounted outdoors.

As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth, or shown in the accompanying drawing, is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In high voltage terminal construction, in combination, a wall member having an opening through which a high voltage conductor is to be passed; a housing of solid dielectric material supporting a conductor in fast discharge gap relation to said opening, the space within said gap being filled with a gaseous dielectric under pressure, a metallic housing extending about said solid dielectric member and spaced therefrom, said metallic housing having a high voltage bushing passing through an opening therein, said bushing being of a material adapted for outdoor operation and having a conductor passing therethrough and in electrical connection with said first-mentioned conductor, and a dielectric filling the spaces between said solid dielectric housing and said metallic housing, said discharge gap having a critical voltage less than that which would injure said bushing, said dielectric being solid when cool but liquid when heated, and said housing having an opening through which said dielectric, when in liquid form, may be poured into said housing.

2. In high voltage terminal construction, in combination, a wall member having an opening through which a high voltage conductor is to be passed, a housing of solid dielectric material supporting a conductor in fast discharge gap relation to said opening, the space within said gap being filled with a gaseous dielectric under pressure, a metallic housing extending about said solid dielectric member and spaced therefrom, said metallic housing having a high voltage bushing passing through an opening therein, said bushing being of a material adapted for outdoor operation and having a conductor passing therethrough and in electrical connection with said first-mentioned conductor, and a plastic insulating compound which, with said solid dielectric

housing, fills the interior of said metallic housing, said housing having sealable means through which said insulating compound may be injected therein.

3. In high voltage terminal construction, in combination, a plurality of high voltage terminals projecting away from a wall member, each supporting a high voltage conductor and each embodying a member made of phenolic condensation product, metallic means forming a housing spaced about and encasing said plurality of terminals, insulating bushings adapted for outdoor operation extending through said housing, one for each terminal, and adapted to have passed therethrough lead-in conductors, one leading to each terminal, and means preventing moisture or the like from reaching said terminals from the outside of said housing.

4. In high voltage terminal construction, in combination, a plurality of high voltage terminals projecting away from a wall member, each supporting a high voltage conductor and each embodying a member made of phenolic condensation product, metallic means forming a housing spaced about and encasing said plurality of terminals, insulating bushings adapted for out-door operation extending through said housing, one for each terminal, and adapted to have passed therethrough lead-in conductors, one leading to each terminal, and a plastic insulating compound filling the spaces between said terminals and the inside of said housing.

5. In high voltage terminal construction, in combination, a high voltage terminal projecting outwardly from a wall and insulatingly supporting a conductor passed through an opening in said wall, a dielectric about said terminal, metallic means for confining and maintaining said dielectric in coacting relation with the exterior of said terminal, and an insulating bushing passing through and extending to each side of a wall of said last-mentioned means and having a conductor passing therethrough and into electrical connection with said terminal, said dielectric being impervious to and unaffected by moisture and extending into the junction between said bushing and said metallic means and forming a weather-tight seal at said junction.

6. In high voltage terminal construction, in combination, a high voltage terminal including a solid dielectric member supporting a high voltage conductor, a casing spaced from and extending about said terminal, said casing having an insulating bushing extending through a wall thereof for leading a conductor from said high voltage conductor outwardly through said casing, and a dielectric impervious to moisture filling the space between said terminal and said casing and sealing the joint between said casing and said bushing.

7. In high voltage terminal construction, in combination, a terminal including a member of solid dielectric material supporting a conductor, a housing about said terminal, said housing having a removable cover with an aperture therein, an insulating bushing carried by said cover and adapted to support a conductor passing therethrough into electrical connection with the conductor of said terminal, said bushing having a portion extending into said aperture, and means operable from the inside of said cover for detachably locking said bushing to said cover.

8. In high voltage terminal construction, in combination, a terminal including a member of solid dielectric material supporting a conductor, a fluid-tight housing enclosing said terminal, said housing having an opening therethrough, a conductor leading from said terminal conductor through said opening, insulating means for insulatingly carrying said second conductor through said opening, and means sealing said second conductor to said insulating means and said insulating means to said housing.

9. In high voltage terminal construction, in combination, a metallic wall through an opening in which a high voltage conductor is to be passed, an insulating member of a material like phenolic condensation product carried by said wall member and supporting a conductor passing through said opening, means for protecting said insulating member from the effects of weather, said means including a plastic insulating medium surrounding said insulating member, metallic means for holding said plastic medium in place, and means for insulatingly passing a conductor leading to said high voltage terminal through said metallic means.

10. In high voltage terminal construction, in combination, a metallic wall through an opening in which a high voltage conductor is to be passed, an insulating member of a material like phenolic condensation product carried by said wall member and supporting a conductor passing through said opening, means for protecting said insulating member from the effects of weather, said means including a sealed casing about said terminal, said casing having a removable portion with an opening therein, and an insulator related to said last-mentioned opening for insulatingly passing a conductor from the outside of said casing to the conductor of said terminal.

11. In high voltage terminal construction, in combination, a casing having therein an electrical apparatus, a plurality of means, each including solid dielectric material, for insulatingly passing a plurality of conductors through the wall of said casing, means exterior of said casing for enclosing said plurality of means, and a plurality of insulating means, one for each of said first-mentioned plurality of means, for insulatingly passing said conductors through said enclosing means.

12. In high voltage terminal construction, in combination, a casing having therein an electrical apparatus, a plurality of means, each including solid dielectric material, for insulatingly passing a plurality of conductors through the wall of said casing, means exterior of said casing for substantially enclosing said plurality of means, said enclosing means carrying a plurality of insulating means, one for each of said first-mentioned plurality of means and each juxtaposed to one of said first-mentioned plurality of means for passing conductors through said enclosing means.

13. In high voltage terminal construction, in combination, a casing having therein an electrical apparatus, a plurality of means, each including solid dielectric material, for insulatingly passing a plurality of conductors through the wall of said casing, a housing member about said plurality of means and sealed to the exterior wall of said casing, said housing having a removable cover member carrying a plurality of insulating means, one for each of said first-mentioned plurality of means for leading conductors from the latter to the exterior of said housing.

14. In high voltage terminal construction, in combination, a casing having therein an electrical apparatus, a plurality of means, each including solid dielectric material, for insulatingly passing

a plurality of conductors through the wall of said casing, a housing member about said plurality of means and sealed to the exterior wall of said casing, said housing having a removable cover member carrying a plurality of insulating means, one for each of said first-mentioned plurality of means for leading conductors from the latter to the exterior of said housing, and a dielectric medium within said housing.

15. In high voltage terminal construction, in combination, a casing having therein a high voltage apparatus and a gaseous dielectric under pressure, a high voltage terminal for passing a high voltage conductor through said casing, said terminal including a solid dielectric material not adapted for outdoor operation but adapted to coact with said gaseous dielectric under pressure, a solid dielectric medium about said terminal, and means mechanically protecting said dielectric medium.

16. In high voltage terminal construction, in combination, a casing having therein a high voltage apparatus and a gaseous dielectric under pressure, a high voltage terminal for passing a high voltage conductor through said casing, said terminal including a solid dielectric material not adapted for outdoor operation but adapted to coact with said gaseous dielectric under pressure, a solid dielectric medium about said terminal, a metallic housing within which said terminal and said solid dielectric medium are encased, and means for insulatingly passing a conductor through said housing to said terminal.

17. In high voltage terminal construction, in combination, a wall member having an opening through which a high voltage terminal is to be passed, means including a member made of phenolic condensation product and a gaseous dielectric under pressure for insulatingly passing said conductor through said opening, metallic means extending about but spaced from said member, and a high voltage bushing of ceramic material for passing said conductor through said metallic means.

18. In high voltage terminal construction, in combination, a wall member having an opening through which a high voltage terminal is to be passed, means including a member made of phenolic condensation product and a gaseous dielectric under pressure for insulatingly passing said conductor through said opening, metallic means extending about but spaced from said member, a high voltage bushing of ceramic material for passing said conductor through said metallic means, and a solid dielectric medium filling the space between said metallic means and said member.

19. In high voltage terminal construction, in combination, a metallic wall member having an opening therein, a high voltage terminal related to said opening and projecting away from said wall memebr, said wall member having a threaded portion within the area of which is said opening, a metallic casing threaded onto said threaded portion and having an insulating bushing in a wall thereof and projecting outwardly therefrom and adapted for outdoor operation, and a conductor carried through said bushing to said high voltage terminal.

20. In high voltage terminal construction, in combination, a metallic wall member having a plurality of high voltage terminals projecting away therefrom, each supporting a high voltage conductor and each embodying an insulating member made of organic material, a threaded member in sealed connection with said wall member and extending about said plurality of terminals, and a metallic casing threaded onto said threaded member and enveloping said terminals, said casing having a plurality of insulating bushings adapted for outdoor operation, one for each of said terminals, for carrying conductors therethrough to said terminals.

21. In high voltage terminal construction, in combination, a metallic wall member having a plurality of high voltage terminals projecting away therefrom, each supporting a high voltage conductor and each embodying an insulating member made of organic material, a threaded member in sealed connection with said wall member and extending about said plurality of terminals, a metallic casing in threaded connection with said threaded member enveloping said terminals, a plurality of insulating bushings, one for each of said terminals, related to suitable openings in said casing for insulatingly passing through the latter conductors to said terminals, and an insulating medium within said casing.

22. In high voltage terminal construction, in combination, a metallic wall member having a plurality of high voltage terminals projecting away therefrom, each supporting a high voltage conductor and each embodying an insulating member made of organic material, a threaded member in sealed connection with said wall member and extending about said plurality of terminals, a metallic casing in threaded connection with said threaded member enveloping said terminals, a plurality of insulating bushings, one for each of said terminals, related to suitable openings in said casing for insulatingly passing through the latter conductors to said terminals, and a plastic insulating medium sealing the joints between said bushings and said casing and filling the space within the latter.

23. In high voltage terminal construction, in combination, a metallic wall member having a plurality of high voltage terminals projecting away therefrom, each supporting a high voltage conductor and each embodying an insulating member made of organic material, a threaded member in sealed connection with said wall member and extending about said plurality of terminals, a metallic sleeve threaded onto said threaded member, and a cover for said sleeve, said cover having a plurality of insulating bushings adapted for outdoor operation extending therethrough, one for each terminal.

24. In high voltage terminal construction, in combination, a metallic wall member having a plurality of high voltage terminals projecting away therefrom, each supporting a high voltage conductor and each embodying an insulating member made of organic material, a threaded member in sealed connection with said wall member and extending about said plurality of terminals, a metallic sleeve threaded onto said threaded member, a cover for said sleeve, said cover having a plurality of insulating bushings adapted for outdoor operation extending therethrough, one for each terminal, an insulating medium within said sleeve, and means forming sealed connection between said cover and said sleeve.

25. In high voltage terminal construction, in combination, a metallic wall member having an opening therein, a high voltage terminal related to said opening and projecting away from said wall member, said terminal supporting a high voltage conductor extending through said open-

ing, a casing spaced from and extending about said terminal and having an opening therein, an insulating bushing extending through said second opening for leading a conductor from said high voltage terminal through said casing, said bushing having a shoulder resting against the outer face of said casing, and means attachable to said bushing on that portion thereof on the inside of said casing adapted to abut against the latter and hold said bushing in place, and a dielectric filling the space between said terminal and said casing.

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