Feb. 14, 1933. P. PASCHEN ET AL 1,897,818

INSULATING BODY

Filed April 9, 1931 3 Sheets-Sheet 1

Fig. 1

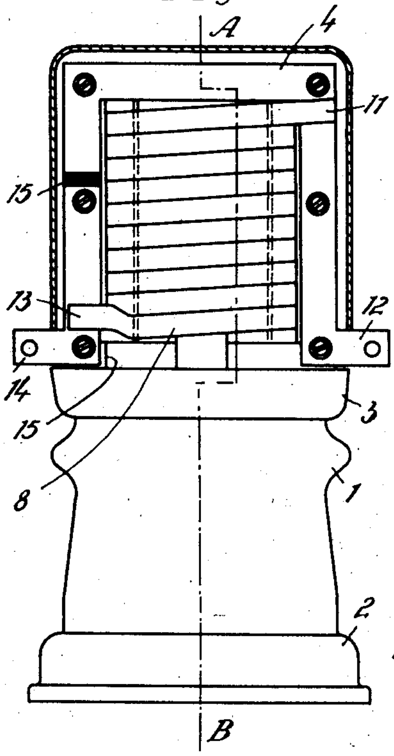


Fig. 2

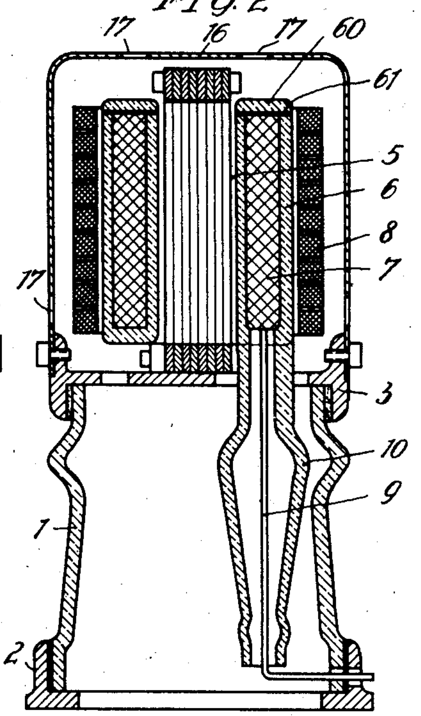
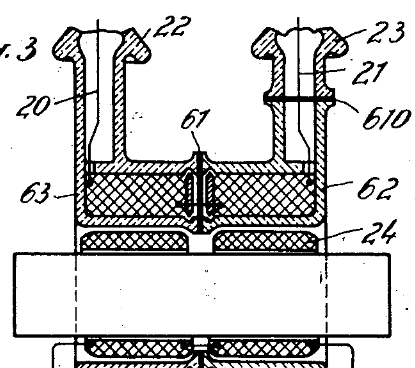


Fig. 3



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INSULATING BODY

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Fig. 4

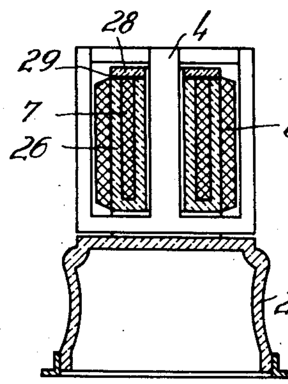


Fig. 5

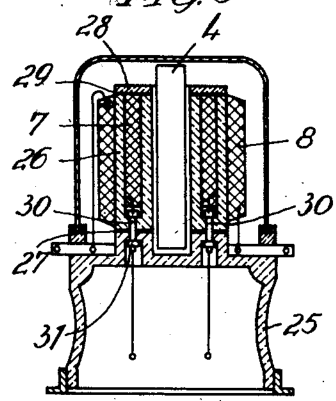


Fig. 6

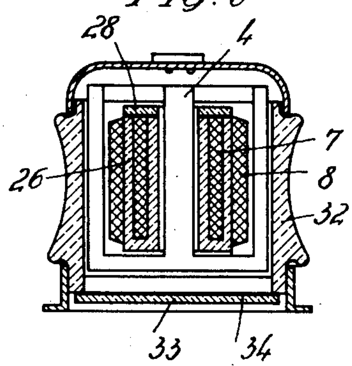
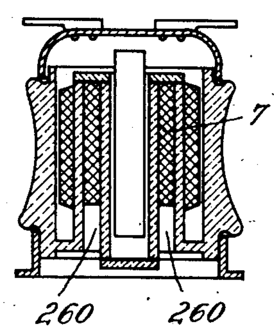


Fig. 7



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INSULATING BODY

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Fig. 8

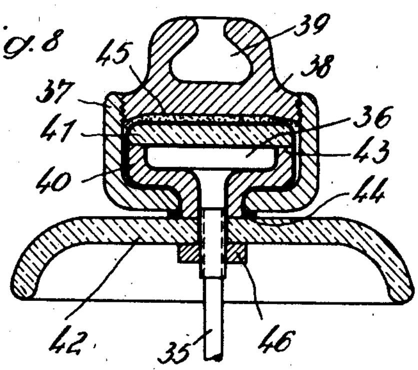


Fig. 9

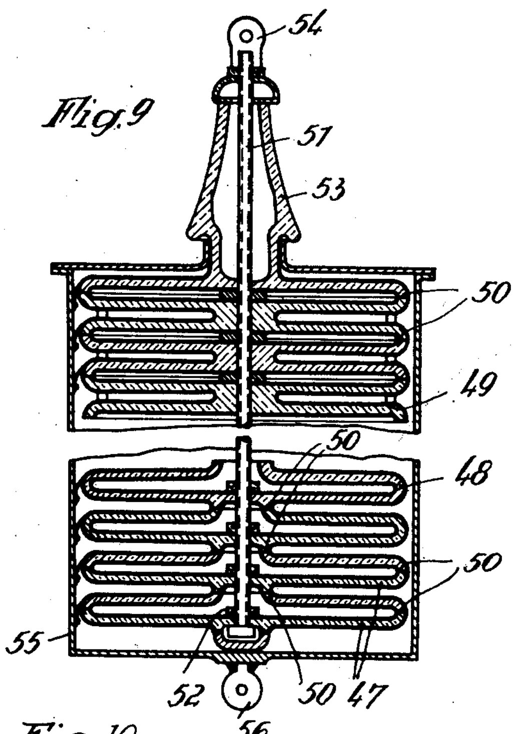
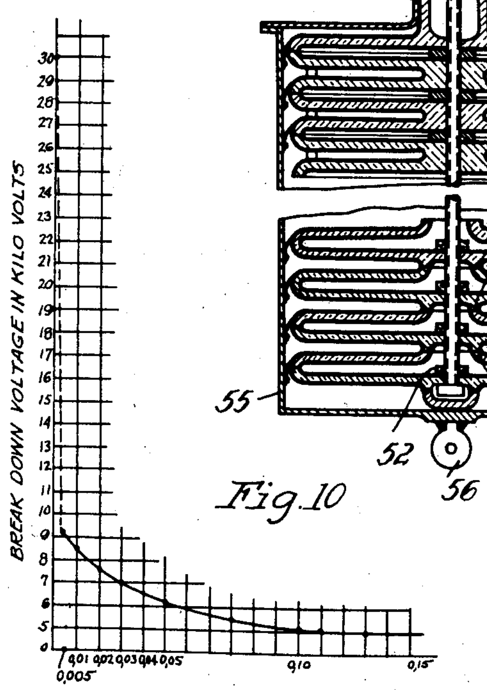


Fig. 10



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1,897,818

UNITED STATES PATENT OFFICE

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INSULATING BODY

Application filed April 9, 1931, Serial No. 528,846, and in Germany April 14, 1930.

Our invention relates to insulating members and more particularly to an insulating member made of ceramic material, for example, of porcelain, for electro-technical purposes having a wall or walls for separating and insulating from one another two objects of differential potential. The insulating member is composed of several parts, which form component portions of said separating and insulating wall. These portions are according to the invention joined dielectrically tight to one another, i. e. they are joined to one another in such a manner that the dielectric strength at the joint is substantially the same as at the other parts of the wall; one of the principal features and great advantages of the invention is, that at the joint the thickness of the separating wall is not increased. The joint used according to our invention extends "through" the wall, i. e. from one side of the wall to the other, as distinguished from an overlapping joint usually employed in the art in joining insulating members used for the aforementioned separation purposes. Accordingly the definition of the joint as "extending through the wall" used in the annexed claims should be understood in the light of the foregoing explanation.

Our invention will be described with reference to the accompanying drawings, illustrating examples for carrying out the invention.

Fig. 1 shows a view of a high-tension instrument current transformer, partially in section.

Fig. 2 shows a longitudinal section through the same instrument transformer taken on the plane A—B of Fig. 1.

Fig. 3 shows a high-tension instrument potential transformer in longitudinal section.

Figs. 4 and 5 show another constructional form of a measuring transformer, in two vertical sections at right angles to each other.

Figs. 6 and 7 show a high-tension instrument potential transformer, in two vertical sections at right angles to each other.

Fig. 8 shows a suspension-type insulator in longitudinal axial section;

Fig. 9 shows a high-tension condenser in longitudinal axial section; and

Fig. 10 represents a graph, showing the dielectric strength of insulating material joints as a function of the joint thickness.

The different modifications shown and described are merely examples of the types of electric device in which our invention is of particular advantage, and should not be understood as limiting the invention to these types.

Referring to Figs. 1, 2, on the supporting insulator of tubular shape 1 with the foot 2, the metallic base 3 is fixed. On this base is mounted the laminated three-legged iron core 4, the middle leg of which passes through the opening 5 of the annular porcelain receptacle or casing 6. In the annular space inside the receptacle the low-tension winding 7 is placed, and on its outside, the high-tension winding 8. The connecting leads 9 of the winding 7 are led out through the tubular insulator extension 10, the axis of which is parallel to the axis of the annular receptacle 6 and to the axis of the supporting insulator 1. The insulator 10 is disposed inside the tubular supporting insulator 1. One of the ends 11 of the winding 8, is electrically connected with the iron core 4 at which the angle-shaped member 12 is provided, serving as the terminal for that winding end; the other winding end 13 leads to the angle-shaped terminal 14, which is also fastened to the iron core 4, but is insulated therefrom by interposed insulating material 15.

The annular receptacle 6 consists of two parts, of the annular receptacle proper having a U-profile and of a flat annular cover 60, the parts being joined together in a dielectrically tight manner. For this purpose at the joint 61 the two parts are carefully plane ground. The grinding must be so fine that the joint is extremely close and constitutes practically a uniform surface-to-surface contact throughout the joint width. It is most essential to make the joint so close that its "thickness" in the direction at right angles to the joint surfaces, caused by possibly remaining minute uneven portions in the surfaces, amounts to not more than 1/100 to 1/200 mm. We have found that at such closeness of the joint its dielectric strength suddenly rises and rapidly increases with further reduction in thickness. It is therefore better to make the joint still thinner than 1/200 mm., and for instance a thickness of from one to two microns is preferable.

In Fig. 10 is shown a graph which is made from actual tests, and which shows that above a thickness of 0.02 mm. the joint has a relatively small influence upon the dielectric strength. Below a joint thickness of 0.01 mm. however the dielectric strength very rapidly increases to values, which are of the order of that of the high class insulating materials themselves. We have found in some instances with a joint thickness which was with certainty below 0.005 mm. break downs only at from 12.2-18 kilovolt occur. The material was a glass plate 4 mm. thick joined by a butt joint according to the present invention. At one place where the joint was practically a continuous close contact for an appreciable distance, the joint broke down only at 30 kilovolt, at which also the solid portion of the glass plate broke down. These tests have proven that with a sufficiently finely finished joint, the dielectric strength of the material itself can be attained for the joint, or at least a strength which is of the order of the material strength.

It is advisable to join together the surfaces of the parts of the insulating member meeting at the joint by means of a very thin layer, or film of material of great dielectric strength, such as resin, asphalt, tar etc. The film has the object of filling out possibly remaining inequalities in the surfaces of the joint. It will be noted that while in this particular modification the joint surface extends along one of the surfaces of one of the component elements of the joint (namely along the inner annular surface of ring 60) the joint nevertheless extends "through" the wall of the casing formed by the two elements, as set forth in the claims, as distinguished from an overlapping joint. Also, as stated in the annexed claims, the two component elements of the joint "abut" against one another in the sense that pressure exerted on one element will increase the pressure on the joint surfaces, which would not be true if for instance annular cover 60 were inserted into casing 6, forming a joint parallel to the cylindrical wall of the casing.

It is particularly advantageous to tighten dielectrically the joint of two such component parts by means of artificial resin capable of being hardened. For this purpose the surfaces of the joint are, for example, dipped into a solution of resin or into melted resin, the parts being preferably warmed at the same time. To harden the resin, the parts are then put together and, with the joint surfaces forcibly pressed against each other, are placed in a heated chamber, where they remain a length of time depending upon the degree of hardness desired. The resulting product obtained with this method is of the higher quality, the thinner the resin film in the joint, i. e., the better the parts of the insulating member fit together, and the slower the hardening process is carried out. After the hardening is finished, the wall of the insulating body, as tests show, possesses along the joint the same dielectric strength as at the integral wall portion. According to tests carried out, a joint in a wall of about 1 cm. thickness at the joint, has a puncture strength of 40 to 50 kv. and more, i. e., it has the same puncture strength as the integral wall portion. The resin not only tightens the joint dielectrically, but also makes the connection of the parts of the insulating member mechanically so strong that it is able to offer an extremely great mechanical resistance.

So-called plastic shellac is also particularly suitable for tightening the joint dielectrically. It is produced by saponification of natural shellac or artificial shellac, the shellac molecule or a part of these molecules being decomposed into components, which form a thick liquid mass, which dissolves the molecules which were not decomposed. This plastic shellac may according to requirements be hardened to a greater or lesser degree. The hardening takes place quickly at about 180 deg. C., but the resulting joint is in that case not as good as it might be. For joining, the surfaces are dipped into the shellac mass, then placed upon one another and, with or without the application of pressure, put into a chamber having a relatively low hardening temperature, 100 deg. C. or less. Here again, the resulting product is all the better, the slower and the more careful the hardening of the shellac is carried out.

The great dielectric and also mechanical strength obtained with this method of joining the parts of the insulating member, permits the placing of the joint, if desired, into the electrically highly stressed portion of the insulating member, without danger of break-ing down. There is no necessity for making the wall of the insulating member thicker at the joint, as the dielectric strength of the joint is practically just as great as that of the insulating member itself.

For the above named reasons, joints of component parts of insulating bodies of widely varying forms may be placed, where it is most favorable for the assembly of the insulating member and of the electrical apparatus, and where it permits the most favorable shape for the individual parts of the insulating member, and not where it is furthest removed from dielectric stresses as is customary in the present day art.

This is particularly important with porcelain as insulating material, as here very complicated forms may be subdivided into simple component elements which are easily shaped and do not suffer any distortion in firing. In this manner, it is also possible, as shown in Figs. 1 and 2, to produce porcelain receptacles or casings of very great dielectric strength which are adapted to the shape of, and come into close contact with the windings of an electrical apparatus. Owing to these electric qualities and to the small space which such an article requires, parts of electrical apparatus having a very great difference in potential can be placed very close to one another in a small space. With the current transformer shown in Figs. 1 and 2, this has the special advantage that the mean length of the path in the iron core 4 can be made very short, a feature which according to the known laws ensures great accuracy of measurement with such a current transformer.

To avoid glow discharges, the insulating casing 6 in Figs. 1 and 2 is provided both, inside and outside with a conducting lining which also covers the edges of the joint 61. The lining should extend also over at least a part of the length of insulator 10, containing the connecting low potential wires. Over the electrical parts of the instrument transformer, a cover 16 is placed and provided with openings 17 for air circulation which cools the windings and the insulating casing.

In Fig. 3, the insulating casing of a potential transformer is composed of two approximately symmetrical halves 62, 63. 61 is the joint through the wall of the assembled casing, in this case forming a true butt joint. Into one half 63, part 18 of the high-tension winding is placed, and the other half 62 contains the other part 19 of that winding. The connecting wires 20, 21 of the high-tension winding are led out through insulators 22, 23. The insulators may be formed integral with the pertaining part of the casing, as shown in the left half of Fig. 3, but may also consist of a separate element joined to the casing in a dielectrically tight manner by the butt joint 610. The numeral 24 indicates the low-tension winding.

The space inside of the insulating members, 62, 63, not occupied by windings and leads may be filled with oil or insulating compound to prevent corona occurrence in these spaces. The vertical insulator sleeves may then serve at the same time as expansion vessels for the filling compound.

In Figs. 4 and 5, corresponding substantially to Figs. 1 and 2, the supporting insulator consists of a pot-shaped insulating member 25, onto the bottom of which the insulating casing 26 is joined in a dielectrically tight manner. The joint is indicated by 27. 28 is the cover of the casing, which is also joined to the body 26 of the casing by a dielectrically tight joint 29. 4 is here again the iron core, 7, 8 are the two windings. The threaded bolts 30, which also serve as connecting conductors for the winding 7, pass through the joint 27.

By means of nuts 31 the insulating parts 25, 26 can be tightly drawn together at the joint 27.

Whilst in Figs. 5 and 4 the electrically active transformer parts are positioned on the outer side of the pot-shaped supporting insulator 25, in Figs. 6 and 7 they are accommodated inside the pot. Here, again, 4 is the iron core, 7, 8 are the two windings, 28 is the cover of the casing, 26 is the part of the casing with a U-shaped profile. The casing has openings 260 directed downwardly in the drawings. The wires for connecting up the winding 7 are passed through these openings. The part 26 is integral with the insulator 32; the bottom of the part 32 is provided with an opening for introducing the sheets for the iron core 4, the sheets being placed alternately from the top and the bottom. The opening is closed dielectrically tight through the plate 33 by means of the joint 34. A special feature of this form of instrument transformer is that its dimensions and height are particularly small.

In Fig. 8, a suspension insulator of the so-called cap type is illustrated. 35 is the stem with the head 36. The cap consists of the pot 37 and the cover 38 threaded into the pot and provided with the suspension eye 39. The insulating member is composed of the supporting cup 40, the cover 41 and the bell 42. At the joints 43, 44, the insulating parts are ground and tightened dielectrically against each other in the manner described above. The parts 40, 41 are mechanically held together by the parts 37 and 38, a pad 45 being placed between the pressing and pressed parts. The parts 42 and 40 are clamped together on stem 35, by head 36 and the tightening nut 46 threaded onto stem 35.

This embodiment of the invention shows

that for suspension insulators the insulating member can also be subdivided in the manner the most favorable for assembling and for the purpose in question, and that through the subdivision simple, easily producible porcelain parts are obtained, instead of the otherwise complicated forms of insulators used heretofore.

The advantage of the insulator shown in Fig. 8 consists in the existence of only compression stresses in the insulating material and in that it is impossible for the stem to fall out of the insulating member and for the insulating member in the cap to become loose. As the joints 43, 44 have the same dielectric strength as the wall of the insulating member, they may without hesitation be positioned at places which are exposed to a great electric stresses.

A further application of the invention is shown in Fig. 9. The drawings illustrate a high-tension condenser with porcelain as a dielectric and in which a large capacitance is to be accommodated in a small space. By introducing joints the very complicated insulating member is here subdivided in a series of simple trays or shields 47 as in the bottom part, or of flat bottle-shaped members 48, as in the middle part, or of short pieces of tube with broad flanges 49 at their ends, as in the upper part. The joints are indicated at 50. Here again, the joints are made dielectrically tight in the described manner. The separate parts of the insulator are mechanically held together by the threaded bolt 51 and the nuts 52.

The bolt 51 is passed through the leading-in insulator 53 to the one pole 54 of the condenser. With exception of the surfaces of the joints themselves, the component parts of this entire insulating structure are covered, as shown by the heavy contour lines, inside and outside with electrically conducting coatings of, for example, graphite and waterglass or the like, adhering closely to the insulating material. The inner coatings are connected to the bolt 51, and the outer coatings to the metal housing 55 which is in connection with the other terminal 56 of the condenser.

The condenser according to Fig. 9 has the advantage over known condensers also built up of parts having the form of plates or trays, that the whole surface of the individual elements, of which the assembled insulating body is composed, including the joint edges, can be utilized for placing the coatings, whereas in the known condensers the joint edges must remain free, and the width of these free or blank zones, particularly in high-tension condensers, very great, so that for a certain capacitance much more insulating material is required. Another considerable advantage consists in the avoiding of surface leakage currents over the edges of the component insulator parts, because the entire insulating body, in spite of its complicated form, forms a completely closed vessel which separates the inner and outer coatings. As the dielectric of the condenser consists of porcelain, which material has a very high dielectric constant and great dielectric strength the condenser has a relatively high capacitance and is capable of being electrically overstressed.

The invention may of course be applied to other shapes of insulating members than those illustrated in the drawings and will particularly always offer very considerable advantages in cases in which complicated forms of insulating elements are required. When windings, conducting coatings, supporting parts and the like are to be introduced into the hollow spaces of the members after the baking, the invention is of inestimable value. If an insulating member consisting of several parts is suitably assembled, it will always be possible to avoid a complicated threading through of wire for windings, and to ensure that all supporting parts are well cemented-in and that no parts of the insulating member are subject to mechanical tension stresses. Furthermore, our invention also renders it possible to use superior dielectrics, such as porcelain, in fields of electrical engineering where the prior art has usually employed oil, insulating compound, layers of fibrous material and the like for insulating purposes.

We claim as our invention:

1. A body of electric insulating material, having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two component portions having a joint extending through the wall and having the contacting joint surfaces sufficiently finely finished to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint, and to impart to said joint a dielectric strength of the order of that of the adjacent material.

2. A body of electric insulating material, having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two component portions having a joint extending through the wall and having the contacting joint surfaces finely finished to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint, said joint being not thicker than 1/100 mm.

3. A body of electric insulating material, having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two separate portions abutting against one another to form a joint extending through the wall, and having their contacting surfaces suffi-

ciently finely finished to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint and to impart to said joint a dielectric strength of the order of that of the adjacent material, and a film of dielectrically highly resistive binding material disposed between said joint surfaces.

4. A body of electric insulating material, having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two separate portions abutting against one another to form a joint extending through the wall, and having their abutting surfaces sufficiently finely finished to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint and to impart to said joint a dielectric strength of the order of that of the adjacent material, and a thin film of artificial resin disposed between the joint surfaces.

5. A body of electric insulating material, having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two separate portions abutting against one another to form a joint extending through the wall, and having their abutting surfaces sufficiently finely finished to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint and to impart to said joint a dielectric strength of the order of that of the adjacent material, and a thin film of plastic shellac disposed between the joint surfaces.

6. A body of electric insulating material, having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two separate portions abutting against one another to form a joint extending through the wall, and having their abutting surfaces finely finished to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint, and a thin film of dielectrically highly resistive binding material disposed between the joint surfaces, the thickness of the complete joint being not greater than 1/100 mm.

7. A body of electric insulating material, having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two separate portions abutting against one another, and having their abutting surfaces sufficiently finely finished to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint and to impart to said joint a dielectric strength of the order of that of the adjacent material, said joint surfaces having a plane profile.

8. A body of electric insulating material, having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two separate portions abutting against one another to form a joint extending through the wall, and having their abutting surfaces sufficiently finely finished to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint and to impart to said joint a dielectric strength of the order of that of the adjacent material, the entire surface of the joint being located in one plane.

9. A body of electric insulating material, having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two component portions forming a joint extending through the wall and having their abutting joint surfaces sufficiently finely ground to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint and to impart to said joint a dielectric strength of the order of that of the adjacent material.

10. A body of electric insulating material, having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two component portions forming a joint extending through the wall and having their abutting joint surfaces sufficiently finely ground to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint and to impart to said joint a dielectric strength of the order of that of the adjacent material, and a thin film of dielectrically highly resistive binding material disposed between the ground surfaces.

11. A body of electric insulating material, having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two component portions forming a joint extending through the wall and having their abutting joint surfaces sufficiently finely ground to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint and to impart to said joint a dielectric strength of the order of that of the adjacent material, the entire joint surface being located in one plane, and a thin film of dielectrically highly resistive binding material disposed between the joint surfaces.

12. A body of electric insulating material, having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two component portions forming a joint extending through the wall and having their abutting joint surfaces finely ground to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint, the entire joint surface being located in one plane, and a thin film of dielectri-

cally highly resistive binding material disposed between the joint surfaces, the thickness of the joint amounting to not more than 1/100 mm.

13. A body of ceramic insulating material having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two component portions forming a joint extending through the wall, and having their abutting joint surfaces sufficiently finely finished to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint and to impart to said joint a dielectric strength of the order of that of the adjacent material.

14. A body of porcelain having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two component portions forming a joint extending through the wall, and having their abutting joint surfaces sufficiently finely ground to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint and to impart to said joint a dielectric strength of the order of that of the adjacent material.

15. An electrical insulating body of ceramic material having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two separate portions abutting against one another to form a joint extending through the wall, and having the abutting joint surfaces finely ground to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint, and a thin film of dielectrically highly resistive binding material between the joint surfaces, the thickness of the joint being not more than 1/100 mm.

16. An electrical insulating body of ceramic material having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two separate portions abutting against one another to form a joint extending through the wall, and having the abutting joint surfaces finely ground to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint, and a thin film of dielectrically highly resistive binding material between the joint surfaces, the thickness of the joint being not more than 1/100 mm., said ground joint surfaces extending in one plane.

17. An electrical insulating body of ceramic material having a wall for separating two spaces containing objects of different electrical potentials, said wall comprising at least two separate portions abutting against one another to form a joint extending through the wall, and having the abutting joint surfaces finely ground to form substantially a uniformly close surface-to-surface contact throughout the extent of the joint, and a thin film of dielectrically highly resistive binding material between the joint surfaces, the thickness of the joint being not more than 1/100 mm., the transverse extent of the joint surfaces being approximately in parallel to the lines of electric stresses, and a conducting coating on at least one side of said wall, covering said joint.

18. A body of electric insulating material, having the form of a casing for electrically insulating objects of different potentials disposed inside and outside the casing, said casing comprising at least two component parts assembled to form a joint running through the casing wall, the abutting joint surfaces being sufficiently finely ground to form a plane, substantially uniformly close surface-to-surface contact, throughout the extent of the joint and to impart to said joint a dielectric strength of the order of that of the adjacent material.

19. A body of electric insulating material, having the form of a casing for electrically insulating objects of different potentials disposed inside and outside of the casing, said casing comprising at least two component parts abutting against one another to form a joint running through the casing wall, the abutting joint surfaces being sufficiently finely ground to form a plane, substantially uniformly close surface-to-surface contact throughout the extent of the joint and to impart to said joint a dielectric strength of the order of that of the adjacent material, and a thin film of dielectrically highly resistive binding material disposed between the joint surfaces.

20. A body of electric insulating material, having the form of a casing for electrically insulating objects of different potentials disposed inside and outside of the casing, said casing comprising at least two component parts abutting against one another to form a joint running through the casing wall, the abutting joint surfaces being finely ground to form a plane, substantially uniformly close surface-to-surface contact throughout the extent of the joint, and a thin film of dielectrically highly resistive binding material disposed between the joint surfaces, and forming a joint not thicker than 1/100 mm.

21. A body of electric insulating material, having the form of a casing for electrically insulating objects of different potentials disposed inside and outside of the casing, said casing comprising at least two component parts abutting against one another to form a joint running through the casing wall, the abutting joint surfaces being sufficiently finely ground to form a plane, substantially uniformly close surface-to-surface contact throughout the extent of the joint and to

impart to said joint a dielectric strength of the order of that of the adjacent material, and a conducting coating on at least one side of the casing wall, covering said joint.

22. An electrically insulating body of ceramic material having the form of a hollow ring, for electrically insulating objects of different potentials disposed within the walls of said ring and outside thereof, said ring comprising at least two component parts abutting against one another to form a joint running through the ring walls, the abutting joint surfaces being finely ground to form a plane, substantially uniformly close surface-to-surface contact throughout the extent of the joint, and a thin film of dielectrically highly resistive binding material between the joint surfaces, forming a joint of not more than 1/100 mm. thickness.

23. An instrument transformer having an annular casing of ceramic electrically insulating material, a first winding disposed within the annular casing portion, and a second winding disposed concentrically with the first winding, but outside of one of the casing walls, and a magnet core extending centrally through said casing, said casing comprising at least two component portions forming a joint running through the casing wall, the abutting joint surfaces being finely ground flat to produce a sufficiently close and uniform surface-to-surface contact, to form a joint at least as close as 1/100 mm., and a thin film of dielectrically highly resistive binding material, disposed between the joint surfaces for equalizing the remaining minute uneven portions in the joint surfaces.

24. An instrument transformer having an annular casing of ceramic electrically insulating material, a first winding disposed within the annular casing portion, and a second winding disposed concentrically with the first winding, but outside of one of the casing walls, and a magnet core extending centrally through said casing, for magnetically interlinking said two windings, said casing comprising at least two component portions forming a joint running through the casing wall, the abutting joint surfaces being finely ground flat to produce a sufficiently close and uniform surface-to-surface contact, to form a joint at least as close as 1/100 mm., and a thin film of dielectrically highly resistive binding material, disposed between the joint surfaces for equalizing the remaining minute uneven portions in the joint surfaces.

25. An instrument transformer having an annular casing of ceramic electrically insulating material, a first winding disposed within the annular casing portion, and a second winding disposed concentrically with the first winding, but outside of one of the casing walls, and a magnet core extending centrally through said casing, and an insulating sleeve on said casing extending substantially in parallel to the casing axis, and forming an outlet for said first winding, said casing comprising at least two component portions forming a joint running through the casing wall, the abutting joint surfaces being finely ground flat to produce a sufficiently close and uniform surface-to-surface contact, to form a joint at least as close as 1/100 mm., and a thin film of dielectrically highly resistive binding material, disposed between the joint surfaces for equalizing the remaining minute uneven portions in the joint surfaces.

26. An instrument transformer having an annular casing of ceramic electrically insulating material, a first winding disposed within the annular casing portion, and a second winding disposed concentrically with the first winding, but outside of one of the casing walls, and a magnet core extending centrally through said casing, and an insulating sleeve on said casing, extending substantially in parallel to the casing axis, and forming an outlet for said first winding, said casing comprising at least two component portions forming a joint running through the casing wall, the abutting joint surfaces being finely ground flat to produce a sufficiently close and uniform surface-to-surface contact, to form a joint at least as close as 1/100 mm., and a thin film of dielectrically highly resistive binding material, disposed between the joint surfaces for equalizing the remaining minute uneven portions in the joint surfaces, and a tubular base of insulating material for supporting said casing and surrounding said insulator sleeve.

27. An electrical insulator of ceramic material comprising an annular casing of U-shaped cross-section for electrically insulating from one another objects disposed inside of the casing and outside thereof, and an annular cover for said casing resting upon the wall ends of the casing, the contacting surfaces of said two elements being finely ground in one plane to produce a sufficiently close and uniform surface-to-surface contact to form a joint of a dielectric strength similar to that of the integral wall portions of said two elements.

28. An electrical insulator of ceramic material comprising an annular casing of U-shaped cross-section for electrically insulating from one another objects disposed inside of the casing and outside thereof, and an annular cover for said casing resting upon the wall ends of the casing, the contacting surfaces of said two elements being finely ground in one plane to produce a sufficiently close and uniform surface-to-surface contact to form a joint of a dielectric strength similar to that of the integral wall portions of said two elements, and a thin

film of dielectric highly resistive binding material disposed between the joint surfaces for equalizing the remaining minute uneven portions in the joint surfaces.

In testimony whereof we affix our signatures.

PAUL PASCHEN.
HANS RITTER.
GEORG STAUBER.
WILHELM GEBHARDT.
KARL SCHMIEDEL.