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S. RUBEN
ELECTRICAL CONDENSER
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Fig. 1.

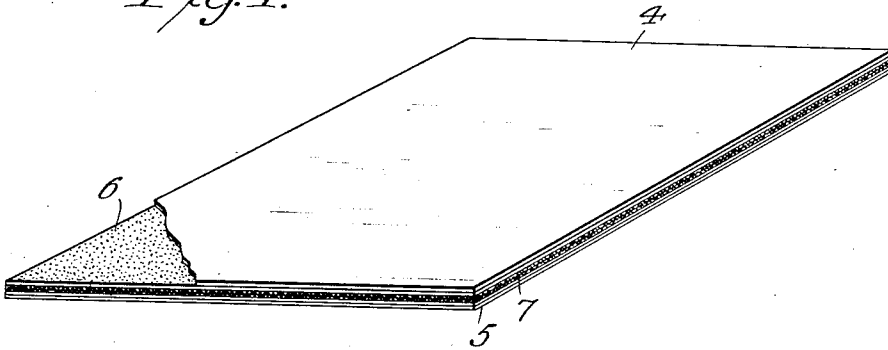


Fig. 3.

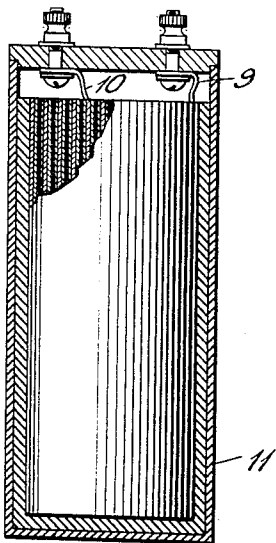
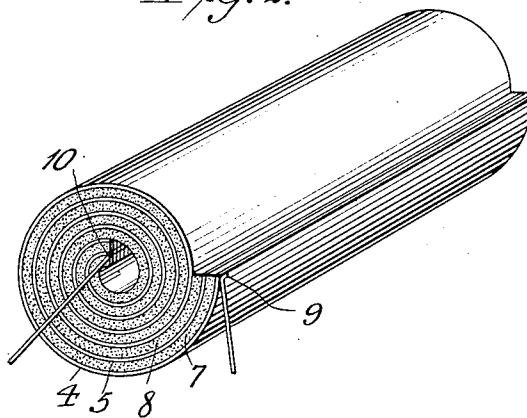


Fig. 2.



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ELECTRICAL CONDENSER

Application filed May 6, 1927. Serial No. 189,231.

This invention relates to electrostatic condensers and has for an object the adaptation of solid materials, such as crystalline products, for use as dielectric mediums.

5 Another object is the provision of an electrostatic condenser having long life with good operating characteristics over a wide range of operating conditions.

10 Another object is the provision of a dielectric medium for electrostatic condensers which possesses a high specific inductive capacity and which may be readily applied in a thin layer of uniform thickness between the condenser plates.

15 Briefly these objects are accomplished by the use of a dielectric medium formed by admixing a solid material having a high specific inductive capacity in finely divided or pulverulent form with a binder or suspension
20 medium. In one feature of my invention this binder medium comprises a viscous dielectric composition, such as a petroleum jelly, in which the solid in pulverulent form is suspended and the mixture applied as a paste to
25 a suitable spacer for interposition between the condenser plates. In another feature, the binder medium comprises a suitable plastic composition in fluid form, as a dissolved hard rubber, which may be heated or baked
30 to effect the removal of the solvent and the formation of a hard enamel-like product. By using this latter class of binder material, the use of a spacer is dispensed with and it is possible to apply the dielectric directly to
35 the plate surfaces substantially as a paint coating of thin, uniform thickness. In this manner, solid materials and particularly crystalline products which in themselves possess usually high specific inductive capacities
40 are adapted for satisfactory use as dielectric mediums for electrostatic condensers, such a mixture being not only chemically but also physically and mechanically stable. Furthermore the suspension medium may be so
45 chosen as to provide additional inductive capacity and the actual specific inductive capacity or dielectric constant of the mixture regulated or controlled by suitably controlling the proportions of solid material and
50 suspension medium.

To these and other ends, my invention consists in further features all of which will be more thoroughly understood and fully described with the aid of the following description in connection with the accompanying drawings, the novel features being particularly set forth in the appended claims. 55

In the drawings:—

Fig. 1 is a perspective view, partly broken away, of a flat plate condenser embodying 60 the principles of the invention.

Fig. 2 is a perspective view of a modification, showing the arrangement of the invention applied to a condenser of coiled form.

Fig. 3 is a vertical sectional view of the 65 arrangement of Fig. 2 enclosed within a protective casing.

In the drawings, the same reference characters have been used to denote similar parts.

In choosing a dielectric medium for use in 70 an electrostatic condenser, it is desirable that the particular medium employed possess a high specific inductive capacity (or dielectric constant) and be applicable between the plates of a condenser in a thin layer of uniform depth. Furthermore, such a medium 75 preferably possesses not only chemical but also physical stability so that when applied between the plates of a condenser, no unusual care need be employed in handling and 80 using the completed article.

I have found in accordance with my invention that solid materials and particularly crystalline compounds or products, which in themselves possess particularly desirable 85 high specific inductive capacities but are physically unsuitable for use as dielectric mediums on account of their inherent nature preventing their application in thin layers of uniform depth, may be made to form highly satisfactory dielectric mediums by mixing 90 them in pulverulent or finely divided form with a suitable suspension medium to form a pastelike mixture therewith. In such a mixture the suspension medium acts substantially 95 as a binder for the solid particles which provide the dielectric qualities desired. In this manner, I am able to form a composition possessing especially high dielectric qualities and which at the same time, if the fineness of 100

the solid dielectric is made sufficiently high, will be of uniform constitution and density so that it can be applied in a thin layer of uniform depth possessing a substantially uniform dielectric constant throughout. Furthermore, if desired, the suspension medium may be so chosen that it possesses a substantial specific inductive capacity value and in this manner added dielectric qualities can be supplied to the composition.

In accordance with one feature of my invention, the binder medium is one which is miscible with a large proportion of powdered solid dielectric material to form a paste-like composition which is applicable between the plates of a condenser in a thin layer of uniform depth and possesses sufficient chemical and physical stability to provide the condenser with long life. Furthermore, such a suspension medium is also preferably non-electrolytic in character and does not react chemically with the electrodes or the solid dielectric material employed. Various compositions may be satisfactorily employed to provide such a viscous suspension medium but as a general rule I have found that organic compositions possessing high viscosity values and chemical stability such as heavy oils, petroleum products, higher alcohols and the like are particularly satisfactory. Petroleum jelly, for example, is well adapted for this use and may be said to be additionally satisfactory in possessing per se a high dielectric constant.

In employing such a paste mixture formed in accordance with my invention between the plates of a condenser, I have found the use of a coated reticular spacer serving as a base for the application of the paste and to aid in holding it in the desired form between the electrodes to be especially satisfactory. Such a spacer is disclosed in my pending application Serial No. 176,881, filed March 21, 1927, and comprises generally, a wide mesh cloth which has been provided with a non-conductive and preferably waterproof coating, as paraffine. The use of such a spacer is shown in the figures of the drawings and referring to them, Fig. 1 illustrates a flat plate condenser comprising a pair of spaced electrode plates, as tin foil, 4 and 5 (anode and cathode respectively) in which the dielectric is supplied as a paste 6 applied to a retiform spacer 7, disposed between the electrodes.

The paste mixture is preferably prepared by first heating the suspension medium, and then thoroughly intermixing the solid dielectric material in pulverulent form. After preparation it may be applied to the spacer by merely spreading it thereon as a cold paste but I have obtained more satisfactory results by applying the paste in a fluid or semi-fluid state, obtained by heating the mass to a temperature of approximately 140° Fahrenheit, and subjecting the combination of electrode

plates and coated or impregnated spacer to the action of a vacuum to secure thorough penetration of the paste throughout the interstices between both the individual strands of the spacer and the individual fibres of the strands. In this way, greatly increased capacity may be obtained since air pockets between the plates are more completely obviated.

The advantage of a paste dielectric is that it immediately gives substantial intimate contact with the electrode surface and when used in conjunction with a suspending spacer, needs no further treatment, the paste dielectric and spacer affording a quick method of assembling an electrostatic condenser. The loss in capacitance due to the thickness of the spacer which acts solely as a base to hold the paste dielectric between the condenser plates is more than adequately compensated by the use of the highly insulating solid dielectric material in the paste.

In Figs. 2 and 3, I have shown a condenser of coiled form, in which an additional spacer 8 is provided on the outer surface of one of the electrodes before coiling, to thus keep the electrodes spaced apart or separated the desired distance and by a dielectric of the desired strength at all points. This coiled form is preferred since a more constant and uniformly distributed pressure may be easily maintained when the plates are coiled into cylindrical form, thus appreciably reducing the likelihood of occurrence of localization of pressure which produces leakage effects.

Terminals 9 and 10 are provided on one edge of the electrode plates and the entire unit may be assembled within a suitable enclosing housing 11 if desired, as shown in Fig. 3.

The invention is adaptable for use with a large number of various solid materials which possess exceptionally high dielectric constant values but which are not suited for use in condensers due to their physical nature which makes them inapplicable in thin layers of uniform depth. Titanium dioxide crystals, such as rutile, brookite, arkansite, possesses unusually high specific inductive capacity values; rutile crystals, for example, possess the specific inductive capacity values of 89, when measured along their transverse axis, and 173, when measured along their parallel axis, and when measured at a wave length of 75 cm., but in the crystalline form are not suitable for use as a dielectric medium since the actual dielectric constant of such a mass of crystals would be the average value of the crystals per se and the air separating them and furthermore the minimum thickness of a layer of each crystalline material would be the thickness of the crystals themselves. In using such solid materials, I find it desirable to grind them to a fineness of approximately, 200 mesh.

the unevaporated solvent may be removed and the hardening completed by further heating.

The temperature at which the heat or baking operation is carried out will be dependent upon the particular solvent employed and when benzene or xylol is employed, I have found a temperature of approximately 100° C. to be satisfactory.

Various proportions of solvent and binder may be employed but a mixture containing in the neighborhood of 10% solvent when the binder is hard rubber gives satisfactory results, greater quantities of solvent requiring longer times for baking to effect removal of the same.

The particular dielectric mixture of titanium di-oxide crystals in pulverulent form with hard rubber as a binder, when prepared in accordance with the method described, has been found by measurement to possess the unusually high dielectric constant value of 110.

What I claim is:—

1. In an electric condenser, the combination with spaced electrodes, of a dielectric medium interposed therebetween and comprising as the main dielectric a titanium dioxide compound in crystalline form to afford high capacitance to the condenser, said compound being in a finely divided form to adapt its use as a dielectric and suspended in a binder medium of suitable dielectric strength.

2. In an electrostatic condenser, the combination with a pair of spaced condenser plates and a reticular spacer disposed between them, of a dielectric paste applied to the spacer and comprising as the main dielectric crystalline titanium dioxide in pulverulent form suspended in a viscous suspension medium of suitable dielectric constant, said spacer serving solely as the means to hold the paste dielectric between the pair of plates.

3. A dielectric material for use in electric condensers comprising as the main dielectric a compound of titanium dioxide in crystalline form to afford high capacitance to the condenser, said compound being in finely divided form to adapt its use as a dielectric, and a binder medium of suitable dielectric constant, the dielectric constant of said dielectric material being capable of varying between wide limits, owing to the high dielectric constant value of said crystalline compound, by suitably proportioning the binder medium and crystalline compound.

4. A dielectric for electrostatic condensers comprising a mixture of crystalline titanium dioxide as the main dielectric to afford high capacitance, pulverized to adapt its use as a dielectric, with a viscous dielectric composition, the proportions being such as to produce a paste-like consistency.

In the use of a viscous suspension medium to form a paste with the pulverulent solid dielectric material, it is substantially essential that a foundation or base, as a spacer, to which the paste may be applied, be used, and in many cases this is undesirable in that it increases the minimum thickness of dielectric which may be used and also decreases the actual dielectric qualities of the dielectric combination by introducing foreign matter and impurities. In order to obviate these difficulties, I have produced in accordance with another feature of my invention a dielectric composition containing a large proportion of solid dielectric material in pulverulent form mixed with a smaller proportion of binder material which may be applied substantially as a paint in thin coatings to the electrode surfaces and which will be transformed into a hard enamel-like product of uniform depth having high dielectric qualities by heating or baking. Materials which are satisfactory for use as binders in obtaining these results are exemplified by those which at ordinary temperatures are solids or plastics possessing a comparatively high degree of adhesiveness and which may be applied in solution, the solvent being removed by heating and by those which are fluids or semi-fluids transformable by heat into solids. In this manner, a dielectric product having high dielectric qualities and which after application possesses physical stability with long life is produced.

In the preferred form of this feature, I mix the pulverulent solid dielectric with a solution of a hard rubber composition, similar to that disclosed in my copending application Serial No. 115,793, filed June 14th, 1926, maintaining the proportion of dielectric as high as possible without making the mixture unapplicable as a paint to the electrode surfaces. This mixture is then applied as a paint to one of the electrodes and the latter subjected to a heating operation to remove the rubber solvent, leaving a hard plastic product. Such a rubber solution might comprise for example, a mixture of sulfur and rubber in finely divided form combined to a point just below that of complete vulcanization and dissolved in a suitable solvent such as xylol or benzene. After application of this mixture to one of the electrode surfaces, I have found it advantageous to subject the coated plate to the action of a pair of heated flat cooperating rollers before removal of the solvent and thereby insure the production of coatings of uniform depth. In order to secure a close contact between the coated and the uncoated plates, I have found it desirable to discontinue the heating or baking operation just short of complete hardening, thus leaving the coating in possession of a certain portion of adhesive character. After the assembly with the other or uncoated plate,

5. A dielectric composition for electric condensers comprising a mixture of finely divided crystalline titanium dioxide and a suspension medium.

5 6. A dielectric paste composition for electric condensers comprising a mixture of pulverized titanium dioxide and petroleum jelly.

7. In an electric condenser, the combination with spaced electrode plates, of a cellulose wide meshed spacer interposed between the plates and a dielectric paste comprising a viscous suspension medium and a pulverized crystalline titanium dioxide composition as the main dielectric to afford high capacitance to the condenser, said spacer serving solely as a base to hold the dielectric paste between the plates.

8. A dielectric composition for electric condensers, comprising a mixture of finely divided crystalline titanium dioxide and a viscous organic binder medium.

This specification signed and witnessed this 28th day of April, 1927.

SAMUEL RUBEN.

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