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R. A. WILKINS

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ELECTRIC CONDENSER

Filed May 18, 1929

Fig. 1.

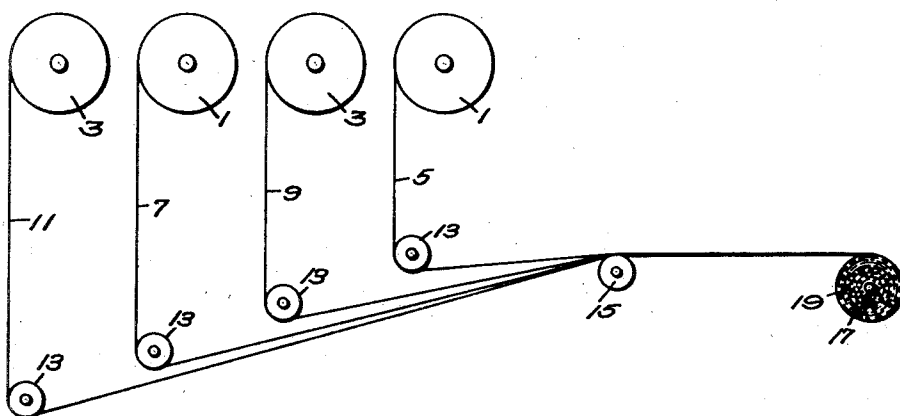


Fig. 2.

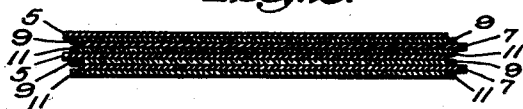


Fig. 3.



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UNITED STATES PATENT OFFICE

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ELECTRIC CONDENSER

Application filed May 18, 1929. Serial No. 364,162.

My invention, which relates to electric condensers, and has among its objects an increased effective area of the conductive sheets without a corresponding increase in the mass of the condenser, will be best understood from the following description of one example of the invention, the scope of which will be more particularly pointed out in the appended claims.

10 In the drawing:—

Fig. 1 schematically shows apparatus for forming a condenser constructed according to the invention;

15 Fig. 2 is a section of a fragment of a condenser constructed according to the invention; and

Fig. 3 is a magnified fragmentary section of one form of metal foil employed.

Referring to the drawing, a condenser 20 made according to the present invention may be fabricated by the common process of providing alternate rolls 1 and 3 respectively of metal foil and dielectric sheet material such as paper. From said rolls strips of metal foil 5 and 7, and strips 9 and 11 of the dielectric sheet material, are guided by rollers 13 and 15 and wrapped on the mandrel 17 to provide a roll 19 consisting of alternate layers of the metal foil and dielectric sheet material, said roll forming an electric condenser, 30 and, if desired, being pressed after it is formed to a suitable non-cylindrical shape, commonly rectangular.

35 In Fig. 2 is illustrated a fragment of a condenser so formed in which the layers 5 and 7 are of metal foil, corresponding to the strips 5 and 7 of Fig. 1, and the layers 9 and 11 are of dielectric sheet material, such as paper, corresponding to the strips 9 and 11 of Fig. 1. 40 Preferably the construction is such that the edges of the sheets 7 project beyond the paper sheets at one side of the condenser, while the sheets 5 project beyond the paper sheets at the opposite side of the condenser, for a 45 purpose which will hereinafter be described.

After the condenser is otherwise fabricated it may be impregnated with a suitable dielectric substance, preferably a wax such as chlorinated naphthalene, halo-wax, high melting 50 point paraffin, montan-wax resulting from

coal distillation, etc., by placing the condenser in a container, evacuating the container, pouring molten wax into the container, and then withdrawing the condenser from the container and allowing the wax to cool.

55 The foil employed according to the present invention is minutely perforated. For example, but without limitation thereto, I may use electrolytically deposited copper foil made according to the process described in pending application of Richard A. Wilkins, 60 Serial No. 332,108, filed January 12, 1929, which foil, for example, but without limitation thereto, may for purposes of the present invention be from 0.0002 to 0.0004 inches in thickness, and has in the order of 1000 micro- 65 scopic perforations per square inch, these perforations being mostly diagonal and of various diameters, but mostly in the order of 0.00005 inches in diameter. Copper foil of 70 this character 0.0002 inches in thickness has a calculated surface area, neglecting perforations, of about 15,000 square inches per pound, but has an effective area of about 21,000 square 75 inches per pound; in other words, an increase in effective area over calculated area of about 40%, or a decrease of 28.6% in weight per unit area.

80 This increase in effective area is probably due to the minute perforations of the foil, particularly those portions of the inclined perforations which are adjacent the exterior surfaces of the foil, as may be comprehended from Fig. 3 which shows a fragmentary enlarged section of the foil 5 having the perforation 21. The effect of the perforations also is to increase the effective spacing 85 between the adjacent sheets of copper foil, and further to cause the dielectric wax better to adhere to the sheets of the condenser, all of which is secured without corresponding 90 increase in the mass of the condenser.

95 It is helpful, in understanding the effect on the capacity of the condenser of perforations which are small relative to the thickness of the plate, from observing that the tendency of the cross-sectional area of the perforation to decrease the capacity is a function of πr^2 where r is the radius of the perforation, and that the tendency to increase the capacity

caused by the effect of the area of the walls of the perforation is a function of $2\pi r t$ where t is the thickness of the plate. From a comparison of these two expressions it will be observed that when t is large compared to r , $2\pi r t$ is greater than πr^2 . Mathematically, however, these two functions do not tell the whole story, because the walls of the perforation are at a greater distance from the adjacent plate than the flat surface of the plate having the perforation. The comparison, however, as above stated, is helpful in understanding the invention.

Conveniently both sides of the foil may be given a "blush" 23 of electrolytically deposited tin, or preferably, a blush of electrolytically deposited tin followed by a slightly thicker blush 25 of electrolytically deposited lead and a final blush 27 of electrolytically deposited tin. The tin effectively prevents corrosive action of the wax on the copper, and, where the tin and lead layers are provided, the projecting edges of the foil at opposite ends of the condenser may be effectively soldered without the use of flux, in cases where it is desired electrically to unite alternate layers of foil, as in a non-inductive condenser.

It will be understood that wide deviations may be made from the example of the invention herein described without departing from the spirit of the invention.

I claim:

1. An electric condenser comprising microscopically perforated conductive sheets separated by a dielectric substance, the microscopic perforations of said sheets being mostly diagonal.

2. An electric condenser comprising a body formed of separated perforated sheets, said body impregnated with a heat softening dielectric substance, the perforations of said sheets being of such small size relative to the thicknesses of said sheets as will materially increase the electrical capacity of the condenser per unit weight of said sheets.

3. An electric condenser comprising a body formed of separated sheets, the latter having microscopic perforations which are mostly diagonal, said body impregnated with a heat softening dielectric substance.

4. An electric condenser comprising closely adjacent sheets of metal foil separated by a dielectric substance, said foil having a multitude of perforations of such small size relative to the thickness of the foil as will materially increase the electrical capacity of the condenser per unit weight of said foil.

5. An electric condenser comprising closely adjacent sheets of metal foil separated by a dielectric substance, said foil having a multitude of microscopic perforations, which perforations are mostly diagonal.

6. An electric condenser having, in combination, a body comprising alternate layers of

metal foil and dielectric sheet material, said body impregnated with a heat softening dielectric substance, said foil having a multitude of perforations of such small size relative to the thickness of the foil as will materially increase the electrical capacity of the condenser per unit weight of said foil.

7. An electric condenser having, in combination, a body comprising alternate layers of copper foil and dielectric sheet material, said body impregnated with a heat softening dielectric substance, said foil having a multitude of perforations of such small size relative to the thickness of the foil as will materially increase the electrical capacity of the condenser per unit weight of said foil.

8. An electric condenser having, in combination, a body comprising alternate layers of metal foil and dielectric sheet material, said body impregnated with a heat softening dielectric substance, said foil having a multitude of microscopic perforations, which perforations are mostly diagonal.

9. An electric condenser having, in combination, a body comprising alternate layers of copper foil and dielectric sheet material, said body impregnated with chlorinated naphthalene wax, said copper foil being not over about 0.0004 of an inch in thickness and having microscopic perforations in the order of about 1000 per square inch.

10. An electric condenser having, in combination, a body comprising alternate layers of copper foil and paper, said body impregnated with chlorinated naphthalene wax, said copper foil being not over about 0.0004 of an inch in thickness and having microscopic perforations in the order of about 1000 per square inch.

11. An electric condenser having, in combination, a body comprising alternate layers of copper foil and dielectric sheet material, said body impregnated with chlorinated naphthalene wax, said copper foil being not over about 0.0004 of an inch in thickness and having microscopic perforations in the order of about 1000 per square inch, said perforations being mostly diagonal.

12. An electric condenser having, in combination, a body comprising alternate layers of copper foil and paper, said body impregnated with chlorinated naphthalene wax, said copper foil being not over about 0.0004 of an inch in thickness and having microscopic perforations in the order of about 1000 per square inch, said perforations being mostly diagonal.

13. An electric condenser having, in combination, a body formed of sheets of metal foil separated by a dielectric substance, said foil being not over about 0.0004 of an inch in thickness and having a multitude of perforations the diameters of which are much less than said thickness.

14. An electric condenser having, in com-

5 bination, a body comprising alternate sheets of paper dielectric and copper foil, said body impregnated with a heat softening dielectric substance, said foil being not over about 0.0004 of an inch in thickness and having a
10 multitude of perforations the diameters of which are much less than said thickness.

15 15. An electric condenser having a body comprising sheets of minutely perforated metal foil having an exposed coating of tin, said body impregnated with a dielectric wax chemically inert with respect to tin.

20 16. An electric condenser having a body comprising sheets of copper foil coated with soldering material, said body impregnated with a dielectric wax chemically inert with respect to said soldering material.

25 17. An electric condenser having a body comprising sheets of copper foil coated with soldering material comprising an exposed coating of tin, said body impregnated with chlorinated naphthalene wax chemically inert with respect to tin.

30 18. An electric condenser having a body comprising sheets of copper foil coated with alternate layers of tin and lead, a tin layer being exposed, said body impregnated with a dielectric wax chemically inert with respect to tin.

35 19. An electric condenser having a body comprising sheets of copper foil coated with alternate layers of tin and lead, a tin layer being exposed, said body impregnated with chlorinated naphthalene wax.

40 20. An electric condenser comprising closely adjacent thin perforated sheets of conductive material separated by a dielectric substance, the perforations of said sheets being of such small size relative to the thicknesses of said sheets as will materially increase the electrical capacity of the condenser per unit weight of said sheets.

In testimony whereof, I have signed my name to this specification.

45 RICHARD A. WILKINS.