(No Model.)

J. C. LEE, W. R. WESTCOTT & E. C. ROBES.

ELECTRICAL CONDENSER.

No. 575,653. Patented Jan. 19, 1897.

Fig. 1.

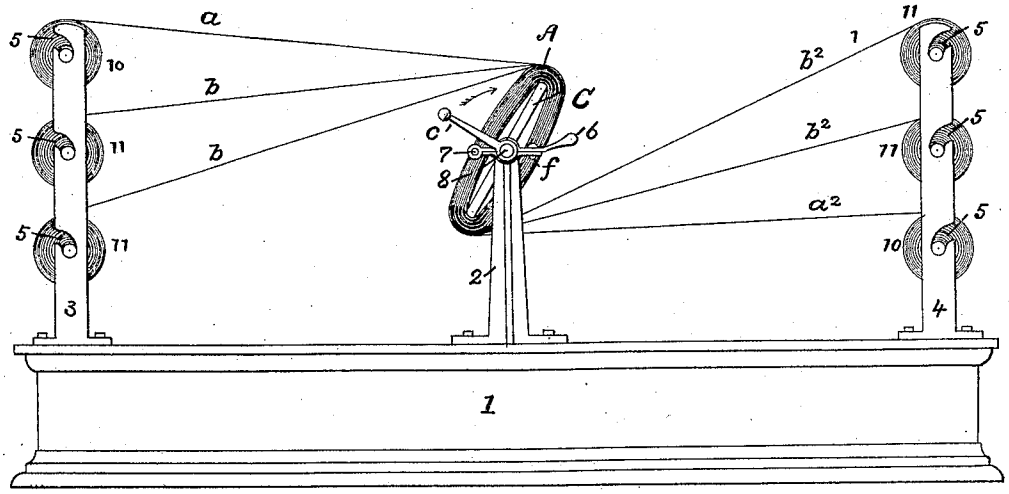


Fig. 4.

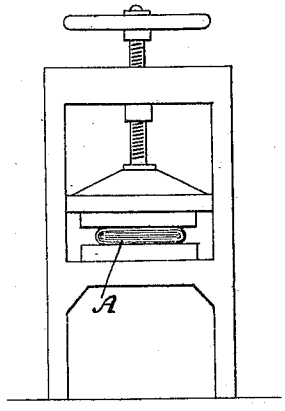


Fig. 2.

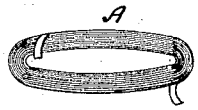


Fig. 3.

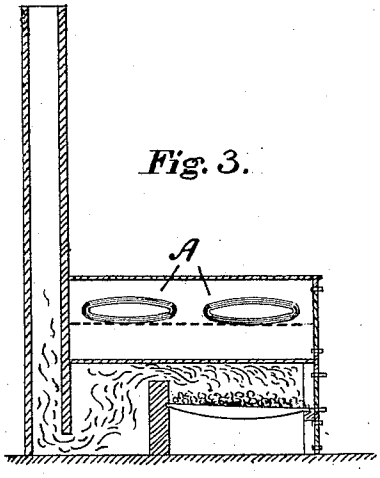


Fig. 5.

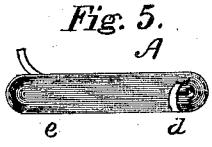


Fig. 6.

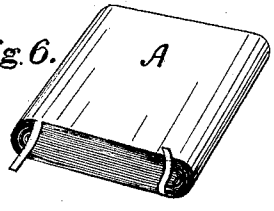
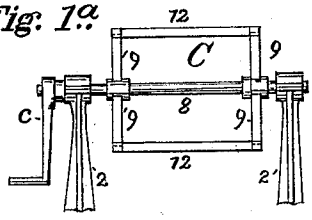


Fig. 1a.



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UNITED STATES PATENT OFFICE.

JOHN C. LEE, OF BROOKLINE, WILLIAM R. WESTCOTT, OF CAMBRIDGE, AND ERNEST C. ROBES, OF MEDFORD, MASSACHUSETTS, ASSIGNORS TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

ELECTRICAL CONDENSER.

SPECIFICATION forming part of Letters Patent No. 575,653, dated January 19, 1897.

Application filed July 8, 1896. Serial No. 598,392. (No model.)

To all whom it may concern:

Be it known that we, JOHN C. LEE, residing at Brookline, WILLIAM R. WESTCOTT, residing at Cambridge, and ERNEST C. ROBES, residing at West Medford, in the State of Massachusetts, have invented certain Improvements in Electrical Condensers and the Art of Manufacturing the Same, of which the following is a specification.

The present invention relates to improvements in electrical condensers and in the art of manufacturing the same; and it consists in a condenser of the construction hereinafter specified and in a method or process by which they may be made continuously and with comparative rapidity, without the aid of skilled labor, at very much reduced cost per unit of capacity and in a much more compact form than they are produced by the present method of manufacture.

Ordinary electrical condensers, such as are employed in the commercial or industrial applications of electricity, consist, essentially, of two large conductive surfaces (technically termed "plates") provided with terminals for connection with the circuit or circuits in intimate inductive relation with one another, but conductively separated by a thin interposed layer of suitable non-conducting material forming the dielectric. The usual mode of constructing them heretofore has been to pile up alternate layers of tin-foil and sheets of paraffined paper and to electrically unite all of the alternate conductive plates in two series, each plate of each series being separated from its neighboring plate of the other series on both sides by the interposed sheets of the dielectric. When the mass has been thus prepared, it is subjected to pressure and is placed in a suitable casing, the two opposing plates consisting of a number of conducting-sheets being each fitted with its appropriate terminal attachment.

Condensers have also been made by rolling up together in the form of a cylinder alternate layers of conducting and non-conducting material in sheets of preferred form, but so far as we know these have failed, for the reason that no efficient plan has been devised for applying to them a sufficient pressure to give them proportionately an electrostatic capacity comparable to that of those made in the flat form, in which by applying such extreme pressure the opposed plates can be brought very close to each other.

Condensers made by the former plan are bulky, of inconvenient shape, and very expensive, and the process itself is slow and cumbersome, involving an undue expenditure of time and labor.

The object of the present invention is to shorten and reduce the cost of manufacture, to produce a condenser of lesser bulk and convenient form, and to make condensers having a shape so nearly cylindrical as to be available for use under conditions which make that form desirable, which, however, shall possess such excellence and efficiency in use as heretofore have been found in the flat form only.

The electrical condenser forming part of our invention consists of a flat rectangular solid having rounded ends made up of continuous alternate strips, sheets, or layers of the conductor and non-conductor or dielectric and provided with suitable terminals.

The process or method of our invention consists in unwinding long strips from rolls of the conductor which is to constitute the plates and the non-conductor which forms the dielectric in winding them into a roll substantially flat or elliptical in form, heating the said roll to a temperature sufficiently high to remove the moisture and to soften the dielectric and not high enough to injure the same, and in subjecting it to suitable pressure, whereby it is forced into the form of a thin flat parallelepipedon with rounded ends, which is placed and sealed up in a suitable box or case.

The tin-foil and paraffined paper are obtained from the manufacturer in desired width tightly rolled upon reels or drums. These rolls are mounted in bearings in a suitable frame, so that the material may be reeled off without much friction. On the same frame is mounted a revolving shaft carrying a flat rectangular frame capable of being readily disjointed or taken apart. The ends of the strips of the tin-foil and of the dielec-

tric are then attached to this flat frame in such order that when the frame is revolved the strips of foil and of insulating material are wound together on the frame in alternate layers.

The layers of dielectric may be composed each of one or more sheets or plies of suitable material. When sufficient material has been wound on to give the desired surface to the plates, the strips of foil and dielectric are cut off, and the flat frame with the roll is removed from its bearings and the former taken to pieces, so that the roll may be removed. The roll of foil and paraffined paper is then placed in an oven and maintained for six or eight hours at a temperature below that which will cause destructive distillation of the dielectric, but sufficiently high to drive off moisture and soften the same. The roll is then put under pressure and forced into a thin flat rectangular solid or parallelepipedon with rounded ends, pressing out any superfluous insulating material and greatly increasing the electrostatic capacity by reducing the distance between the electrodes.

The condenser-terminals may be made of quite thin brass strips, which are slipped in during the process of winding, at the beginning or at the end of the process, and are preferably soldered to the electrodes. The substantially flat form of the roll made by this method, which gives it a rectangular cross-section, enables it to be subjected to the same pressure that is applied to flat multiple sheet-condensers with all of the advantages accruing therefrom, together with the increased electrostatic capacity which is due to the large size of the plates for the same volume of material. Moreover, the character of the method reduces the cost of the manufacture very materially.

We are not restricted to the use of paraffined paper as a dielectric, since other non-conducting material, such as oiled silk, can be employed for the same purpose, and in that event the condenser-roll will not require to be subjected to heat. In such a modification the process is therefore shortened by one of its steps, and when the roll is removed from the reel it can be placed immediately in the press and compressed to the desired dimensions.

The method will now be described in connection with the accompanying drawings, of which—

Figure 1 represents a side view of the condenser-winding apparatus; Fig. 1ª, a view of the frame upon which the condenser-plates and dielectric are wound. Fig. 2 shows an end view of the condenser when removed from the winding-frame. Fig. 3 represents the condensers in a heating-oven, and Fig. 4 the same when pressure is applied. Fig. 5 represents an end view, and Fig. 6 a perspective view, of a condenser completed and ready to be sealed into an insulating and protecting box.

Referring to Figs. 1 and 1ª, 1 is a bed or frame which may be placed upon any suitable support, as a table, or upon legs, and 3 and 4 are pairs of standards bolted to the frame 1, two at each end, having slotted bearings 5, into which the axles of the rolls 10 and 11 are inserted and rotate.

2 2 are standards bolted to the center frame 1 and are provided with bearings upon their tops. The upper part of the bearings are represented as being pivoted at one side, 7, and provided with a handle 6 at the opposite side. 8 is a shaft arranged to rotate in the bearings upon the standards 2 2 and is provided with a crank *c* upon one end.

C is a frame supported by the shaft 8 and is constructed in any suitable manner, so that it can be readily taken apart. It is shown as having end pieces, consisting of hubs, secured to the shaft, with arms 9 9 projecting from opposite sides thereof. The connecting-bars 12 12 are arranged to slide off from the ends of the arms 9 9.

The materials for making the condensers, consisting of rolls of tin-foil a and a^2 and of rolls of paraffined paper $b\,b^2$, wound upon the drums or axles 11 11, are placed in the bearings 5 5 in the standards 3 and 4. The foil a and the paper b, from, say, the left-hand rolls a and $b\,b$, are unrolled and secured to the frame C, at one edge thereof, and the paper and foil from the right-hand rolls $b^2\,b^2$ and a^2 are unwound and secured to the opposite edge of the frame, which is then rotated by means of the crank *c* in the direction of the arrow until a sufficient amount has been unwound from the rolls and wound upon the frame C to make a condenser of the required capacity, whereupon the foil and paper are cut off by any suitable means. The shaft, with the frame C, is then removed from its bearings, the clamps *f*, which hold the upper sides 6 thereof, being unfastened, so that they can be swung back by their handles and the condenser pushed to one side, carrying with it the bars 12 12, which are easily replaced.

Thin brass terminals for each plate may be slipped in between the foil and paper as the winding is being done and soldered, if desired. When a sufficient number of condensers have been wound, as described, they are placed in a heated oven and kept at a temperature sufficiently high to draw out the moisture and to soften the paraffined paper. Each condenser is then placed in a press and subjected to great pressure, compressing it into a thin, flat parallelepipedon with two opposite ends rounded, as shown in Figs. 5 and 6.

The condenser is now ready to be sealed and insulated in a suitable box and the two brass terminals connected to appropriate screw-posts upon the box.

Having thus described our invention, we claim—

1. The improvement in the art of manufacturing electrical condensers, which con-

sists in winding strips of the material constituting the plates, such as metal foil, and of the dielectric, such as paraffined paper, in alternate layers into a flat roll; in heating the roll for a suitable time at a temperature sufficiently high to drive off moisture and to soften the dielectric without injuring the same; and in subjecting the roll to pressure great enough to compress it into a flat, rectangular solid having rounded ends, as set forth.

2. The herein-described method or process of manufacturing electric condensers, which consists in simultaneously unwinding long strips of the material constituting the plates and the dielectric from rolls of the same, and in continuously winding them together in alternate layers into a flattened roll; then heating the roll to a temperature sufficiently high to remove the moisture and to soften the dielectric; and finally forming it by pressure into a flat rectangular solid having rounded ends, as set forth.

3. The herein-described method or process of manufacturing electric condensers, which consists in winding strips of the material constituting the plates and of the dielectric, in layers into a flattened roll, and in subjecting it to pressure whereby the material of the dielectric is caused to yield, and the strips constituting the plates and dielectric are brought into intimate contact and caused to cohere, thereby forming the roll into a thin, flat, rectangular solid having rounded ends, as set forth.

4. As an article of manufacture, an electrical condenser in the form of a flat rectangular solid having rounded ends, and composed of alternate layers of a conductor and a non-conductor, wound together to constitute plates and dielectric of like contiguity throughout, the conductor-layers being provided with suitable terminal attachments, substantially as described.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 4th day of June, 1896.

JOHN C. LEE.
WILLIAM R. WESTCOTT.
ERNEST C. ROBES.

Witnesses:
GEO. WILLIS PIERCE,
KATHARINE DURFEE.