METHOD OF WINDING CONDENSERS

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INVENTOR

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AT ORNEY'S
My invention relates to improvements in methods of making condensers, especially electrical condensers for radio and other apparatus.

An object of this invention is to provide a novel method of manufacturing electric condensers, particularly coiled condensers, including strips of conductive material such as metallic foil, separated by a dielectric, wound or rolled upon one another to a depth consisting of as many layers as desired; my improved process being such that condensers of the type in question can be wound in multiple; that is, in the form of a single body containing the essential parts of two or more condensers, so that the winding or rolling can be easily and expeditiously performed; and then by the simple act of dividing the body at the proper points, the several separate condensers are at once obtained, the several condensers thus being produced with the expenditure of no more time than would otherwise be needed for one condenser; each condenser being ready for finishing by being encased, supplied with terminals for the conductive elements of opposite polarity and otherwise put into condition for use in an electric circuit.

Other objects and advantages of this invention will be apparent from the following description, taken with the accompanying drawings, and the characteristics of the invention are defined in the appended claims. But this disclosure is explanatory only, and I reserve the right to vary the shape, size, and arrangement of parts, or the steps or order of proceeding, without departing from the principle which the invention embodies.

On the drawings,

Figure 1 is a side view showing how the method of winding condensers according to my invention is practiced;

Figure 2 is a side view of the mechanism shown in Figure 1;

Figure 3 is a section on line 3—3 of Figure 2;

Figure 4 is a top view of the layers of conductive material and dielectric in the relative positions occupied by them during the winding process;

Figure 5 is a view similar to Figure 2, illustrating the manner of winding a larger number of condensers; and

Figure 6 is a section on the line 6—6 of Figure 5.

The same numerals identify the same parts throughout.

In the practice of my invention, I make use of a number of shafts, indicated on Figures 1 and 2 by the numerals 1, 2, 3 and 4. These shafts may be arranged in any desired relation and are preferably placed one higher than another, with the shaft 1 uppermost. On the shaft 4 are reels P, each consisting of a coiled or wound-up strip p of suitable dielectric material, such as paper. The nearest shaft 3 above the shaft 4 carries a pair of rolls or reels F, each consisting of a coiled or wound-up strip f of some suitable conductive material, such as metallic or tin-foil; the two rolls F being in such position that the edges of the strips f overlap or extend beyond the edges of the paper strips p along the far sides of the latter. On the next highest shaft 2, is a pair of rolls P, similar in all respects to the rolls P on the shaft 4, and so placed that the strips p, as they are unwound from the rolls P on the shaft 2, will coincide along their side edges with the side edges of the strips p, coming from the rolls upon the shaft 4. The highest shaft 1 carries a reel F, consisting of a rolled-up strip of metal foil f; this strip being relatively wide so that it will lie across the space between the strips p of paper directly beneath it. As the rolls P, F, and F are unwound, they pass beneath guide rods g, mounted in a suitable upright support U to a shaft S, on the opposite side of the guides g and by means of this shaft, the strips of conductive material and dielectric are wound-up into the form of a coiled condenser. The guides g may simply be parallel rods in horizontal or other position, and the supports U, only one of which is shown in Figure 1, will engage the rods g at their opposite ends.

With the conductive and dielectric strips and the sheets 1, 2, 3 and 4 disposed as illustrated in Figures 1, 2, 3 and 4, I can wind more than one condenser, in this instance,
two condensers, at the same time; and the period required is no longer than what would ordinarily be needed for a single condenser. The rolls P and paper strips p on the shaft 4 are placed the required distance apart. The shaft 4 may be fixed and the rolls P may turn freely thereon as the strips p are unwound. On the next higher shaft 3, the reels F may be mounted in the same way, but they are a little farther apart, so that the far ends of the two reels F extend beyond the far ends of the two reels P. Further the two reels P, carried by the shaft 2, are as close together as the reels P carried by the shaft 4, and the strips of paper of the reels carried by the shaft 2 are of the same width as the paper of the reels carried by the shaft 4. Also the rolls F carried upon the shaft 4 and delivering the relatively wide strip f is shorter than the distance between the far ends of the reels P. Hence, when the reels are rotated to unwind the strips p, f and f therefrom, the rolls P carried by the shaft 4 may be considered as supplying two strips of paper p arranged side by side, and the two rolls F on the shaft 3 may be regarded as furnishing two strips of metallic foil f, one of which is to be laid upon each of the strips p, as the strips are rolled up into the condenser C, but with the edges of the strips f along the far sides of the strips f, extending beyond the edges of the strips p along the far sides of these two strips; and with the adjacent or near edges of the two strips f terminating short of the adjacent or near edges of the two strips p. Similarly, the rolls P upon the shaft 2 lay down upon the foil strips f, strips of paper p, the side edges of each of which coincide with the side edges of the strips p delivered from the reel P, upon the shaft 4 directly beneath the strips f. Hence, the edges of the two strips f along their far sides project beyond the edges along the far sides of the two strips p between which the two strips f are laid. On top of the strips p as the reels P on the shaft 2 are unrolled, is laid the strip of metallic foil f from the reel F, mounted upon the shaft 1. This relatively wide strip f extends over or bridges the space between the two strips p directly beneath it; but terminates short of the edges along the far sides of these two strips p.

Then as the shaft 3 rotates, the condenser C is wound thereon in multiple, so to speak; the strips being rolled up in two sections, each section comprising two paper strips p with a strip of metallic foil f between them; and the two sections having a wide strip f in common, as indicated in Figure 3. Hence, the condenser C consisting of a single body containing the essential parts of two distinct condensers, the body of the condenser during the winding operation being a single body because the wide strip f extends over from one section to another and unites these sections, when the winding is completed, the body of the condenser C can be divided by cutting it in two, crosswise, along the line D—D, indicated in Figures 2, 3 and 4. Thus two rolled condensers of the "outside wound" type are produced with the coils of the two strips f of each of these condensers projecting beyond the edges along one side of each of the strips p, and the divided parts of the strip f, which has now become two strips like the two strips f, have their edges projecting beyond the edges of the two strips p, along the opposite sides of the same. The two rolled condensers can then be finished, each by uniting the projecting edges of the coils or turns of the strip f together at one end, and the projecting edges of the half of the strip f together at the opposite end, so that the turns of the strip f, which will be of one polarity, can be united to one terminal of the circuit in which the condenser is to be placed, and the turns of the other strip, consisting of the half of the strip f, which will be of opposite polarity, can be conveniently united to the other terminal of the circuit; and each condenser can be flattened, enclosed in a suitable case, and otherwise finished as desired.

In Figures 5 and 6, I show a method of winding three condensers at one time, in the same way. Shafts 1, 2, 3 and 4 are employed as before, and the highest shaft 1 will carry a roll F, consisting of a coiled strip f, beside another coil F, consisting of a coiled strip of relatively great width f; these two strips f and f being of conductive material and separated by a suitable distance. On the next lower shaft 3 will be mounted three reels P of paper, and on the shaft 3 below the shaft 2 will be mounted a reel F, similar to the reel F of the shaft 1, and a reel F similar to the reel F upon the shaft 1, but in reverse position; this is, the reel F will be at the right on shaft 1, and the reel F at the left; while the reel F on the shaft 3 will be at the right; and the reel F furnishing the wide strip of foil, will be at the left. The lowest shaft 4 will carry three rolls of paper P.

As shown clearly in Figure 5, the rolls P on the shafts 2 and 4 will be all of the same width, and the side edges of the strip p delivered by any one of the rolls P upon the shaft 2, will be in coincident position with respect to the side edges of the strip p of the reel in alignment therewith upon the shaft 4; that is to say, the side edges of any two strips p directly upon each other will be in vertical alignment. But the end of the roll F of the shaft 3 will extend beyond the adjacent ends of the two nearest rolls P and its opposite end will terminate short of the other ends of these two rolls P; while the roll F of the shaft 2 will lie across the space between the other two rolls of paper P; but the opposite ends of the roll F will not be as far apart as the
far ends of these other two rolls P, on the shaft 4. In the case of the shaft 1, the roll F₁ supplying the wide strips f₁, being at the right instead of at the left, as shown on the shaft 3; this wide strip will bridge the two paper strips at the right of Figure 4; while the roll F₀ on the shaft 1, will have one end projecting beyond the adjacent end of the nearest reel P on the shaft 2, and its opposite end terminating short of the opposite end on this reel P. When all the strips p of dielectric, and the conductive strips f₁ and f₂ are wound up by the shaft S in the form of a coiled condenser, the operation is in multiple as before, and the condenser will at first consist of a single body including three sections united in pairs by the relatively wide strips of foil f₂. First the three strips p are arranged or laid side by side, being taken off the reels Ρ of the shaft 4 and constituting the lower layer of paper strips when one considers a section such as is presented in Figure 6. The reel F₀ on the shaft 3 supplies a strip of foil f₀ to be laid upon the strip p at the right, this strip being for convenience designated as the first dielectric strip; and at the same time, the reel F₀ on the shaft 3 supplies the wide strip of foil f₀ to be laid down upon the second and third strips p, with the far edge of the strip p, that is to say, the edge which is more remote from the strip p₁ projecting beyond the adjacent edge of the strip p beneath it, and the opposite edge of the strip f₁ terminating short of the opposite edge of the said strip p. Strip f₂, although it extends across the space between the second and third strips p, has its opposite edges terminating short of the far or more distant edges of these two strips. From the reels Ρ on the shaft 2, the strips of paper or other dielectric p are taken and laid upon the strips f₁ and f₂ in such a way that the opposite edges of each strip of paper are directly above and flush or coincident with the opposite lateral edges of the strip p of the first layer. At the same time, the reel F₁ on the shaft 1 supplies the strip of foil f₁, to be laid upon the third strip p of the second layer in the same relation thereto as the first strip f₁, and with one edge of the strip f₁ projecting beyond the edge of the two strips p, and in the opposite direction with respect to the corresponding projecting edge of the first strip f₁. Similarly, the relatively wide strip f₂ is unwound from the reel F₂ on the shaft 1, and laid upon the first and second strips p of the second layer of the three strips p, bridging these two strips p, but with its opposite edges terminating short of the far or more distant edges of these two strips p. Hence by means of the wide strips f₂, each of the three sections of the body wound upon the shaft S, is at first connected to the other two sections, and this body now contains the essential parts of three distinct condensers. After the winding is finished, the body can be divided by cutting it across along the two lines D—D, so that each of the two wide strips f₂ becomes two narrow strips, made up of one of the halves of the wide strips. The section at the right, for example, consists of two strips p, the foil strip f₁ and half of one of the wide foil strips f₂; while the section in the middle consists of two strips p and two strips of foil each being the half of one of the wide strips f₂; and the section at the left comprises two strips p, the strip of foil supplied by the reel F₁, upon the shaft 1, and half of the wide strip of foil f₁ delivered by the reel F₂ on the shaft 3. The three condensers thus obtained can be further worked so as to connect the projecting edges of one strip of foil to one terminal, and the projecting edges of the other coiled strip of foil to another terminal, for inclusion in an electric circuit, and each condenser can be flattened, enclosed in a casing or otherwise finished as desired.

With the apparatus and method illustrated in Figures 5 and 6, three condensers can be wound in multiple in no longer time than would be required for a single condenser.

In the practice of my invention, the arrangement of the rolls, and the motion of the strips are such that the operator can easily watch the strips p, f₁ and f₂, whether a double or a triple condenser is being wound, and the operation so controlled that the various strips can be kept moving in perfectly parallel directions so as to be wound in correct position upon the shaft S.

Having described my invention, what I believe to be new and desire to secure and protect by Letters Patent of the United States is:

1. The process of making condensers, which consists in arranging strips of dielectric material side by side, laying a strip of conductive material upon each of said dielectric strips so that one of the strips of conductive material will have one edge extending beyond the edge of the corresponding strip of insulating material at the far side thereof with respect to the other strip, and so that the other strip of conductive material will have one edge extending beyond the edge of the other dielectric strip at the far side thereof, then laying upon each of said strips of conductive material a second strip of dielectric material in position to coincide at the edges with the first strips of dielectric material, then laying upon said last named strips of dielectric material a relatively wide strip of conductive material which will extend across the space between them, but terminate short of the edges at the far sides thereof, and then winding all said strips together to form a rolled body which can be divided by severing the coils of the wide strip between the dielectric strips.
2. The process of making condensers, which consists in arranging a pair of strips of dielectric material side by side, laying a strip of conductive material on each of said dielectric strips, with the edges of the strips of conductive material projecting beyond the edges of the dielectric strips at the far sides thereof, but terminating short of the edges of the dielectric strips at the near sides thereof, laying another dielectric strip on each of the conductive strips in position to coincide with the first dielectric strips, laying upon the other dielectric strips a relatively wide strip of conductive material which extends from one to the other, but terminates with its lateral edges short of the lateral edges of said other dielectric strips at the far sides thereof, winding all said strips together, in said positions, and then cutting through the coils of said wide strip between the coils of the first named conductive strip.

3. The process of making condensers which consists in arranging three dielectric strips side by side, laying upon the first of said strips a strip of conductive material whose one edge terminates short of the edge of said strip on the side near the second strip, but whose opposite edge extends beyond the other edge of said dielectric strip, placing a second strip of conductive material upon the second and third dielectric strips, said second conductive strip bridging the adjacent side edges of said dielectric strips but terminating short of the opposite edges, placing upon the conductive strips three separate dielectric strips in position to coincide along their side edges with the first three dielectric strips, placing upon such dielectric strips a second relatively wide conductive strip directly above the first and second dielectric strips of the first layer, said second wide strip extending over the adjacent side edges of the two dielectric strips of the second layer, but terminating short of the edges at the far sides thereof, placing upon the third dielectric strip of the second layer another conductive strip of the same width and in the same relative position as the first conductive strip upon the first dielectric strip of the lower layer, then winding all said strips to form a single body, and then dividing the body by cutting through the coils of said wide conductive strips between the dielectric strips.

4. The process of making condensers which consists in simultaneously winding relatively wide and narrow strips of conductive material in staggered relation separated by dielectric material, controlling said strips while winding in such manner that certain of the strips are laid side by side in spaced relation to form a unit containing a plurality of condenser bodies, and subsequently dividing the relatively wide conductive strips in such manner as to separate the condenser bodies, whereby a plurality of outside wound condensers are formed with one winding operation.

In testimony whereof I affix my signature.

RICHARD H. CUNNINGHAM.