Dec. 12, 1950 P. R. COURSEY 2,533,716

ELECTRICAL CONDENSER

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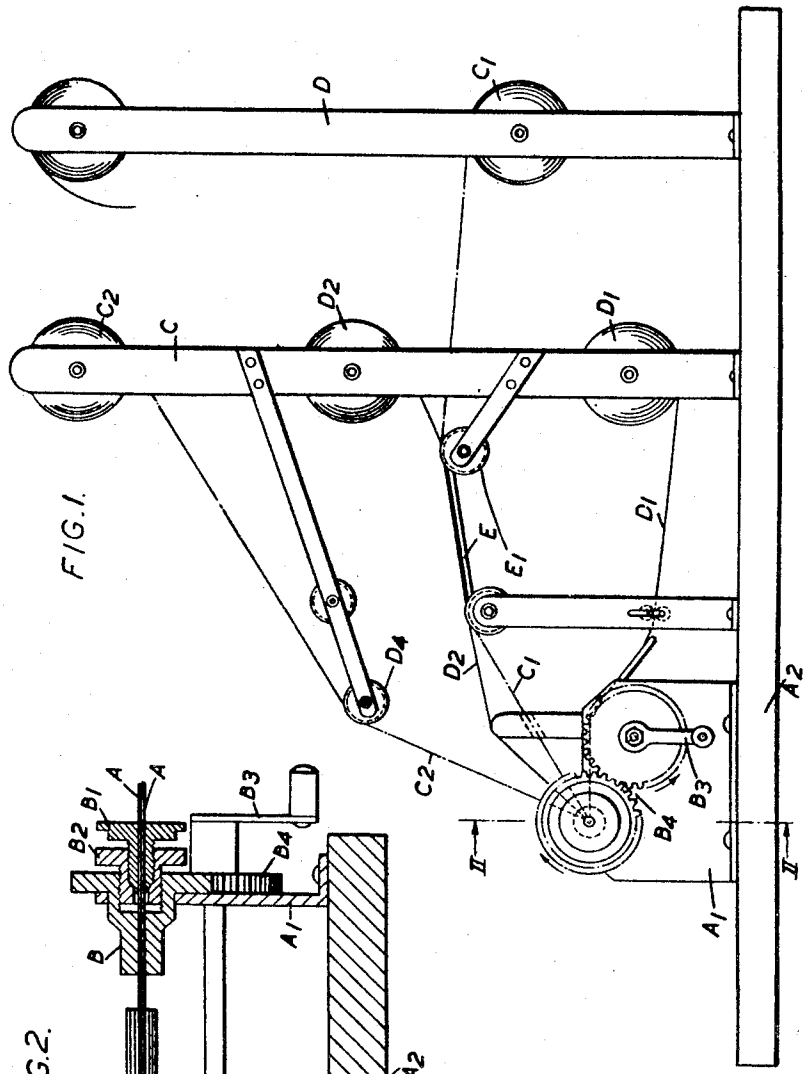


FIG. 1.

FIG. 2.

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FIG. 3.

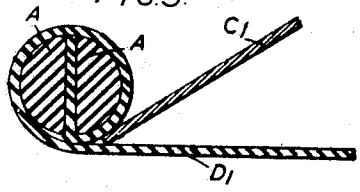


FIG. 4.

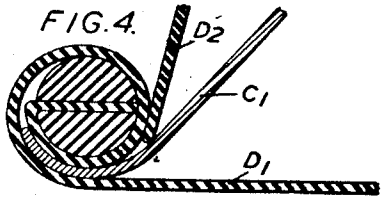


FIG. 5.

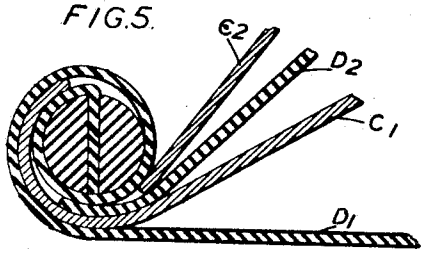


FIG. 6.

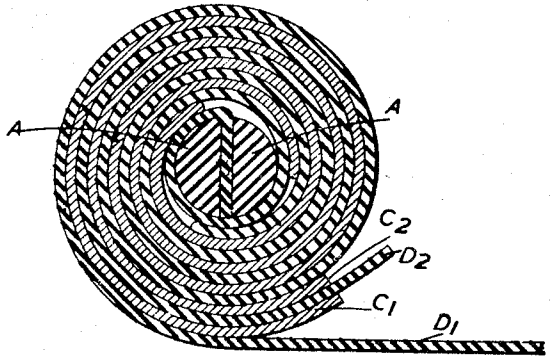


FIG. 7.

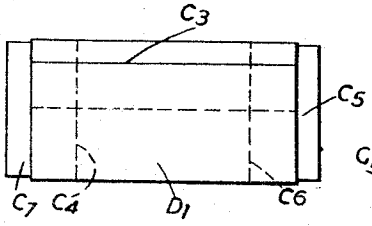
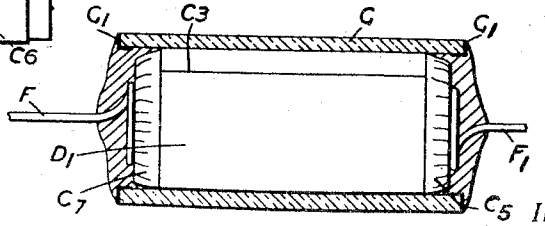


FIG. 8.



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FIG. 9.

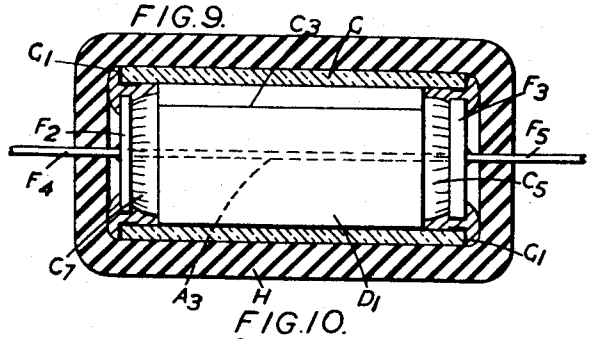


FIG. 10.

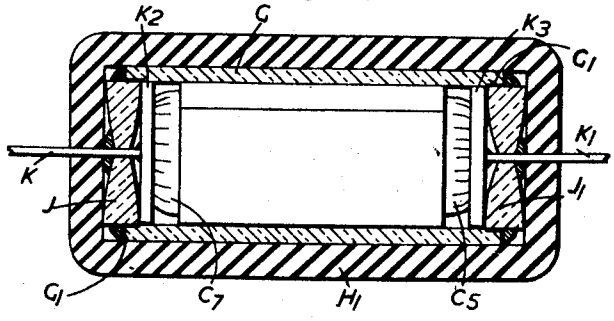


FIG. 11.

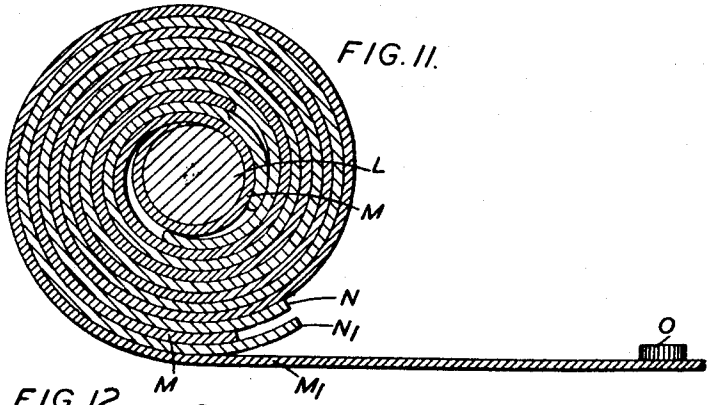
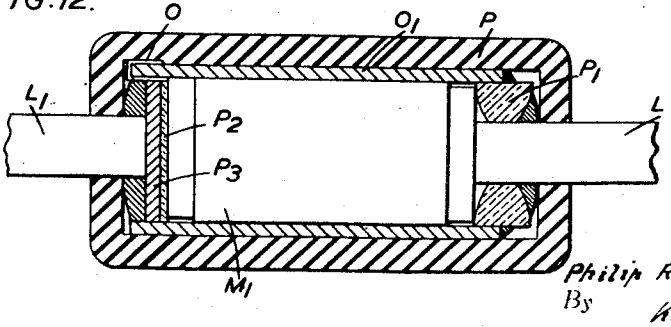


FIG. 12.



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FIG. 13.

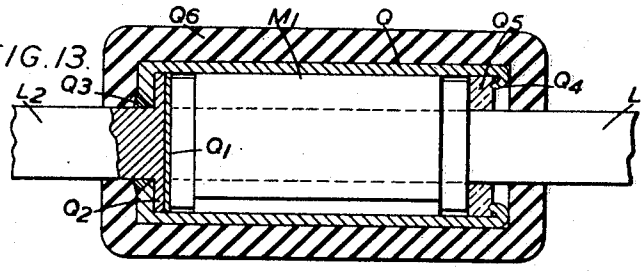


FIG. 14.

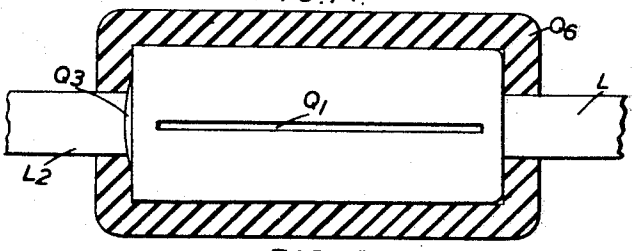


FIG. 15.

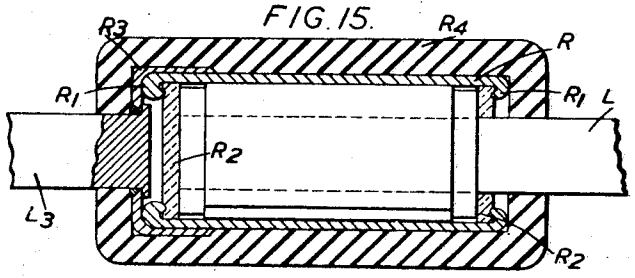


FIG. 16.

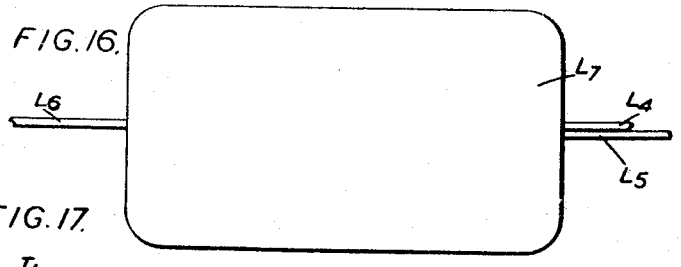


FIG. 17.

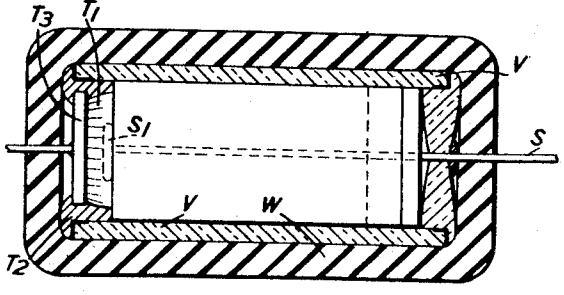
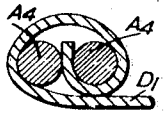


FIG. 18.



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UNITED STATES PATENT OFFICE

2,533,716

ELECTRICAL CONDENSER

Philip Ray Coursey, Liss, England, assignor to Engineering Development Laboratories, Inc., New York, N. Y., a corporation of New York

Application February 28, 1947, Serial No. 731,507
In Great Britain December 6, 1946

9 Claims. (Cl. 175—41)

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This invention relates to electrical condensers of the kind in which the electrodes and insulating spacers are constituted by interleaved flexible elements of sheet material spirally wound about a central axis, so that the convolutions of the electrode elements, such for example as metal foil, are separated by the convolutions of the flexible spacer elements, such for example as paper or other fibrous or porous material, the rolled unit being usually treated with a suitable impregnant.

According to the specification of the United States of America patent application Serial No. 718,634, dated December 27, 1946, the flexible elements are wound on a single central core held in tension while being rotated about the longitudinal axis of the core which is preferably constituted by a wire driven at both ends simultaneously. It has, hitherto, been found desirable for some purposes to enclose a small condenser of the rolled type within a casing of mouldable material, such for example as Bakelite. The condenser is usually wound, impregnated and the terminal leads attached, this unit being finally enclosed, by means of a moulding press, within the said casing. With this method, however, it is difficult to obtain moisture-proof seals where the terminal leads leave the casing, so that moisture may find access to the rolled condenser within the casing. Moreover, the heat applied during the moulding operation is liable to affect the insulation and electrical qualities of the condenser unit, and one object of the present invention is to overcome these difficulties. A further object of the invention is to provide improvements in or modifications of the core upon which the interleaved flexible elements are spirally wound. These and further objects will become apparent from the appended claims and the following description of the accompanying drawings, in which

Figure 1 is a diagrammatic representation, in side elevation, of apparatus for spirally winding the interleaved flexible elements,

Figure 2 illustrates in vertical section on the line II—II of Figure 1, the chucks and winding gear only,

Figures 3 to 6 show on an enlarged scale the steps involved in anchoring the ends of the flexible strips relatively to the core,

Figure 7 shows the rolled unit in side elevation,

Figure 8 illustrates the condenser unit of Figure 7 arranged within a ceramic tube which is shown in longitudinal section,

Figures 9 and 10 are views similar to that of Figure 8 but of modified arrangements,

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Figure 11 is a view similar to that of Figure 6 but for a rolled unit employing a conducting core,

Figure 12 illustrates one arrangement of a condenser unit according to Figure 11 arranged within a moulded casing shown in longitudinal section,

Figures 13 and 14 are similar views of yet a further arrangement, Figure 13 showing the metal pot in section whilst Figure 14 shows the pot in elevation,

Figures 15 to 17 show three modified arrangements respectively, and

Figure 18 indicates a modified arrangement of a twin core which may be employed.

As shown in Figures 1 and 2, two plastic monofilm or similar threads A having an overall diameter of approximately 0.0012 to 0.0015 of an inch are threaded through the axial bores in two aligned rotary chucks B respectively, carried between supports A_1 mounted on a base A_2, one or each of the chucks having an axial micrometer adjustment B_1 (Figure 2) whereby the threads A can be subjected to a required degree of mechanical tension after the core A has been gripped in the chucks B by tightening the heads B_2. The two chucks B are driven, in synchronism, through a handle B_3 and tooth gearing B_4, so that the drive is applied to both ends of the core A simultaneously. Carried by members C, D on the base A_2 with their axes parallel to the axis of rotation of the core A are a plurality of supply rolls two of which C_1, C_2 are constituted by strips of metal foil whilst the two others D_1, D_2 are constituted by strips of paper which are to constitute the insulating spacers between the foils or electrodes. The foils C_1, C_2 have a thickness of, say, not more than five microns (0.0002 inch approximately) whilst the spacers D_1, D_2 may have a thickness of up to 12 microns (0.0005 inch approximately) if used singly or up to 6.5 to 7.0 microns (0.00025 to 0.0003 inch approximately) if used in pairs. Where single paper spacers are used it is sometimes found advantageous to coat one or both sides of them, but preferably one side only, with a layer of lacquer or varnish for the purpose of filling up the irregularities in the paper surface which is adjacent to a metal electrode and so to reduce the liabilities to breakdown through this portion of the tissue.

As shown in Figure 3 the free end of the paper strip D_1 is inserted between the insulating threads A of the core extending between the chucks B so that when the core is rotated by means of the handle B_3 the paper strip D_1 will be wound on the core which then acts as a mandrel until the strip

D_1 laps the core as shown. The end of the foil C_1 is taken over two guide rollers E_1 interconnected by an inclined ramp E and thence to the angle formed between the core A and the first paper strip D_1 tangential thereto. The handle B_3 is now turned slightly so that the end of the foil C_1 is wound in, whereupon the end of the second paper strip D_2 is laid over the foil C_1 and thence to the angle between the strip C_1 and the first convolution of the strip D_1, as shown in Figure 4. Having again turned the handle B_3 through a small angle to wind in the end of the paper strip D_2, the end of the second foil C_2 is laid over a guide roller D_4 and inserted into the angle between the second paper strip D_2 and the adjacent convolution of the first paper strip D_1. The handle B_3 is now turned until the several foils and paper strips are wound as shown in Figure 6, the foils C_1 and C_2 and the second paper strip D_2 being cut so that the strip D_2 extends beyond the ends of the foils. The winding is now completed until the first paper strip D_1 laps the roll whereupon the paper strip D_1 is severed and has its end secured by adhesive as shown at C_3 (Figure 7).

The foils are so wound relatively to the paper spacers that whilst one edge C_4 of the foil C_1 lies wholly within the confines of the paper strips D_1, D_2 the other edge C_5 of the foil C_1 projects beyond the confines of the said paper strips. Similarly one edge C_6 of the foil C_2 lies wholly within the confines of the paper strips D_1, D_2 whilst the other edge C_7 of the foil C_2 projects beyond the paper strips. Thus the two metal foils C_1, C_2 have their marginal edges C_5, C_7 projecting so as to constitute terminal connections for the purpose described below. It will be understood that the distances between the ends of the paper convolutions and the adjacent edges C_4, C_6 of the foils are considerably exaggerated for the sake of clarity of illustration, only narrow margins being actually required in practice. Having cut off the two projecting ends of the core A, the rolled unit shown in Figure 7 is inserted in a ceramic tube G (Figure 8) having internal metallised areas G_1 so that when terminal leads F, F_1 are soldered to the opposite terminal connections C_5, C_7, these are simultaneously soldered to the metallised areas G_1. These soldered connections are such that they provide moisture-proof seals at the ends of the ceramic tube G whose contents, that is to say the rolled condenser elements, are thus sealed against the entry of moisture.

It will be understood that though in the arrangements above described the core is constituted by two insulating threads, the core may be constituted by a single insulating thread, such for example as a synthetic resin, the first flexible element being then merely attached to the core by adhesive. Moreover, since the core is of insulating material and is not employed as one of the condenser terminals, either one of the flexible spacer elements, or one of the foils, may be connected to the core for initiating the winding operation.

The rolled unit shown in Figures 7 and 8 may be treated with an impregnant of mineral wax, oil, jelly or the like, or with an impregnant of high dielectric constant, such for example as one of the chlorinated naphthalenes or chlorinated diphenyls or a wax-like hydrogenated or hydroxylated castor oil, impregnation being effected before the terminal leads F, F_1 are soldered to the terminal connections so as to seal the convolutions of the rolled unit.

When two or more threads are included in the core, for example the threads A in Figures 1 to 6, the threads may be of circular cross-section as shown at A_4 in Figure 18, or in the form of flat strips or other cross-sectional shapes (e. g. of D-section when twin threads are employed as in Figures 1 to 6), which will fit together to form the requisite cross-sectional profile for the core.

In Figure 9 the rolled unit is as described with reference to Figure 7 except that the interleaved flexible foils and paper strips are wound on a single core A_3 of insulating material, the first paper strip D_1 being secured to the core A_3 by means of adhesive whereupon the unit is wound as described with reference to Figures 3 to 6 above. Having severed the two ends of the core A_3 level with the projecting ends C_5, C_7 of the foils C_1, C_2, two terminal end plates F_2, F_3 soldered (or otherwise attached e. g. by riveting or welding) to terminal leads F_4, F_5 are themselves soldered to the projecting terminal connections C_5, C_7 and to the metallised areas G_1 within the ceramic tube G, so as to form moisture-proof joints therewith, thus again sealing the rolled unit within the tube G. The sealed unit thus formed is now moulded in a housing of mouldable insulating material H, for example of Bakelite with the terminal leads F_4, F_5 extending from opposite ends of this insulating housing.

In the modification shown in Figure 10 the ends of the ceramic tube G are closed by metallised ceramic plugs J, J_1 which are soldered to the metallised ends G_1 of the ceramic tube G, the terminal leads K, K_1 extending from the terminal connections C_7, C_5 through apertures in the plugs J, J_1 with the leads K, K_1 soldered to the plugs J, J_1 around said apertures, the terminal leads K, K_1 being soldered to the connections C_7, C_5 through metal discs K_2, K_3. Though this condenser may be employed without a surrounding insulating housing, Figure 10 shows the sealed unit moulded within a casing H_1, for example of Bakelite or other mouldable material.

It will be apparent that instead of the tube G being of ceramic material, it may be of metal into which the ceramic plugs J, J_1 are soldered. Alternatively, whether the tube G is of ceramic material or of metal, only one ceramic plug may be used, the other terminal being connected to the metal tube by insertion of a solid disc of metal to close one end of it.

The unit rolled upon an insulating core may, if desired, be disposed and sealed within a metal sleeve or thimble, the sealing being effected by an insulating washer or bush such for example as a ceramic plug through which the terminal lead extends. The sealed unit may then be moulded within a casing of mouldable insulating material such for example as Bakelite.

Figure 11 shows a construction in which the flexible foils and paper strips are wound on a central metallic core or wire L which is held under tension between the chucks B in the manner described above. With this arrangement a first metallic foil M is soldered to the core L as described in the copending application referred to above, the first and second foils M, M_1 and the spacing paper strips N, N_1 being wound successively as described. The second foil M_1 laps the outer circumference of the rolled unit and a terminal tag O wound into the unit is connected as shown in Figure 12 to a tinned metal sleeve or cylinder O_1 which is open at both ends. Inserted into one end of the cylinder O_1 is a metallised ceramic plug P_1 through which one end of the conducting core or wire L extends, the other end of said core

being cut off flush with the adjacent end of the rolled unit. The plug P_1 is circumferentially soldered to the tinned metal cylinder O_1 whilst the part of the plug P_1 embracing the core L is similarly soldered thereto. The ceramic plug P_1 thus seals the corresponding end of the cylinder O_1. An insulating washer P_2, for example of mica, is inserted into the other end of the cylinder O_1 whereupon a metal disc P_3 electrically and mechanically connected to a terminal lead L_1 is inserted over the washer P_2 and this terminal lead soldered to the cylinder O_1 and tag O. Thus, one end of the core or mandrel L constitutes one terminal lead whilst the other terminal lead L_1 is connected to the metallic cylinder whose interior is sealed at both ends against access of moisture. Before sealing, the rolled unit is treated with an impregnant as indicated above. The impregnated and sealed condenser with its axially projecting terminal leads L, L_1 is now moulded in a Bakelite or similar plastic housing P thus forming an insulating moulded unit with the terminal leads L, L_1 extending from the housing or casing P.

It will be apparent that with constructions in which the sealed unit is moulded within an insulating housing, the paper strips and foils of the condenser will be protected, not only against mechanical and electrical damage by direct contact with the mouldable material, but also against the direct action of the moulding heat whilst, since the rolled unit itself will be moisture-proof, access of moisture to the spirally wound elements will be prevented even should the joints where the leads emerge from the moulded casing not be wholly moisture-proof.

In the arrangement shown in Figures 13 and 14 the condenser unit rolled on a metal core L as described with reference to Figure 12 is arranged in a pot-like terminal thimble Q of tinned metal and having a longitudinal slit Q_1 whose edges are electrically connected to the exposed portion of the outer metal foil M_1 by applying a soldering iron thereto. Arranged in the base of the thimble Q is an insulating disc Q_1, and a terminal disc Q_2 connected to or formed integral with one terminal lead L_2 for the condenser is placed over the insulating disc Q_1 which lies over the severed end of the core or mandrel L. The aperture in the base of the thimble Q through which the terminal lead L_2 extends is slightly chamfered and soldered at Q_3, to the lead L_2 so that this is electrically connected to the thimble Q whose base is completely sealed by the soldered joint Q_3. The other, or open, end of the thimble Q is spun over into a bead Q_4 which bears against a sealing washer Q_5 of moisture-resisting material such, for example, as synthetic rubber or the like, thereby sealing the end of the thimble Q from which the projecting end of the wire core or mandrel L extends through a central aperture in the rubber washer Q_5. The terminal leads L, L_2 are thus again substantially coaxial with the rolled unit and thimble Q whose interior is again completely sealed against moisture. With this construction the rolled unit may be treated with impregnant before soldering the terminal thimble Q along the slot Q_1, the impregnant finding ingress through the said slot. The complete condenser is thereupon moulded into a housing Q_6 of "Bakelite" or other mouldable insulating material.

Instead of employing a conducting pot-like thimble, a conducting sleeve R (Figure 15) open at both ends may be used, the ends of the sleeve

R being sealed by spinning the annular edges R_1 thereof over sealing washers R_2 as described above. The wire core terminal L then extends through one sealing washer R_2 whilst the sleeve R is provided at its other end with a terminal tag R_3 or cap to which the second condenser terminal lead L_3 is connected by soldering. Impregnation having been effected (before the sealing washers R_2 are applied) the sealed condenser unit is moulded into the insulating casing R_4 as above described.

Figure 16 shows an arrangement in which the wire core upon which the flexible foils and paper strips are wound comprises a plurality of wires L_4, L_5, the first flexible electrode element M (Figure 12) being attached to the core by insertion between the wires L_4, L_5 in the manner described with respect to the insulating core of Figures 3 to 6. This obviates the necessity for soldering the end of the first electrode element M to the core. In Figure 16 the second terminal lead L_6 may be connected to the metallised sleeve or pot within the insulating housing L_7 after the manner described with reference to Figure 15, suitable sealing washers R_2 being provided so that the rolled unit is again sealed against access of moisture before the housing L_7 is moulded thereon.

In the modification shown in Figure 17, the core is constituted by a single wire S to which the first foil is soldered. The second foil projects at T_1 from one end of the rolled unit and is soldered at T_2 to a terminal disc T_3 and to a metallised ceramic tube V, an insulating disc S_1 being placed over the severed end of the core S to insulate this from the foil T_1. Thus, whilst one foil lies wholly within the confines of the paper spacers W the other foil projects from one end of the rolled unit to form one of the terminal connections. If desired, the ceramic tube V may be replaced by a metal tube to which the terminal disc T_3 at one end, and the ceramic bush at the other end, are soldered, the whole being moulded into Bakelite or other mouldable plastic material as already described.

What I claim as my invention and desire to secure by Letters Patent is:

1. An electrical condenser comprising a core formed of at least one thread of insulating material, a plurality of interleaved flexible conducting and insulating elements wound spirally on said core to form a rolled unit, the conducting elements projecting from the confines of the insulating elements at opposite ends of the rolled unit respectively so as to form terminal connections, an insulating tube embracing the rolled unit, said tube being metallised adjacent to the said terminal connections, and terminal leads soldered to the terminal connections and to the metallised parts of the tube so as to seal the rolled unit within the tube.

2. An electrical condenser comprising a core formed of at least one thread of insulating material, a plurality of interleaved flexible conducting and insulating elements wound spirally on said core to form a rolled unit, the conducting elements projecting from the confines of the insulating elements at opposite ends of the rolled unit respectively so as to form terminal connections, an insulating tube embracing the rolled unit, said tube being metallised adjacent to the said terminal connections, terminal leads soldered to the terminal connections and to the metallised parts of the tube so as to seal the rolled unit within the tube, and an insulating housing moulded

about the rolled unit and insulating tube, the terminal leads extending through said housing.

3. An electrical condenser comprising a core formed of a plurality of threads of insulating material, a plurality of interleaved conducting electrode and insulating spacing strips wound spirally upon said core to form a rolled condenser unit, the first flexible strip being inserted between the threads of said core and successive flexible strips being wound in between said core and said first strip with the conducting strips of opposite polarity projecting from opposite ends of the rolled unit to form terminal connections, an insulating tube embracing said unit, said tube having metallized portions adjacent to said terminal connections, and terminal leads soldered to said terminal connections and said metallized portions, whereby to seal said unit within said tube.

4. An electrical condenser comprising a core formed of a plurality of threads of insulating material and a plurality of interleaved conducting and insulating strips, one of said strips having an end inserted between the threads of said core and the remaining strips being successively inserted in longitudinally staggered relation between said first mentioned strip and said core and wound therewith into a rolled condenser unit.

5. An electrical condenser comprising a core formed of a plurality of relatively thin threads of insulating material, a plurality of interleaved conducting and insulating strips, one of said strips having an end inserted between the threads of said core and the remaining strips being successively inserted in longitudinally staggered relation between said first mentioned strip and said core and wound therewith into a rolled condenser unit, the conducting strips projecting beyond the insulating strips at the opposite ends of said unit to form terminal connections, an insulating tube enclosing said unit in snug fitting relation, and terminal elements in electrical contact with said terminal connections and secured to the ends of said tube.

6. An electrical condenser comprising a core formed of a pair of juxtaposed threads of insulating material, a pair of conducting strips interleaved with insulating strips, one of said strips having an end inserted between the threads of said core and the ends of the remaining strips being progressively inserted in longitudinally staggered relation between said first mentioned

strip and said core and wound therewith into a rolled condenser unit.

7. An electrical condenser comprising a core formed of a pair of juxtaposed insulating threads of a diameter of the order of 0.0012" to 0.0015", a plurality of interleaved conducting and insulating strips, one of said strips having an end inserted between the threads of said core and the remaining strips being progressively inserted in longitudinally staggered relation between said first mentioned strip and said core and wound therewith into a roller condenser unit.

8. In a condenser as claimed in claim 7, wherein the conducting strips project beyond the confines of the insulating strips at opposite ends of said unit to form terminal connections, an insulating tube enclosing said unit in snug fitting relation, and conducting terminal members in electric contact with said terminal connections and hermetically secured to the ends of said tube.

9. An electrical condenser comprising a core formed of a plurality of monofil threads of plastic insulating material, a plurality of interleaved conducting strips and insulating strips, one of said strips having an end inserted between the threads of said core and the ends of the remaining strips being progressively inserted in longitudinally staggered relation between said first mentioned strip and said core and wound therewith into a rolled condenser unit.

PHILIP RAY COURSEY.

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