Jan. 20, 1931. A. GEORGIEV 1,789,949

ELECTROLYTIC CELL

Filed Oct. 18, 1930 2 Sheets-Sheet 1

Fig. 1.

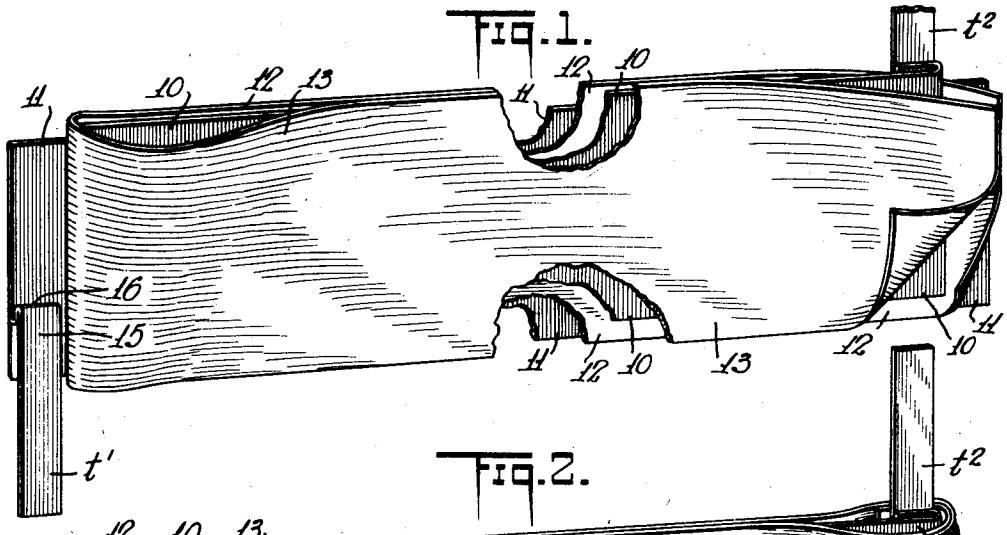


Fig. 2.

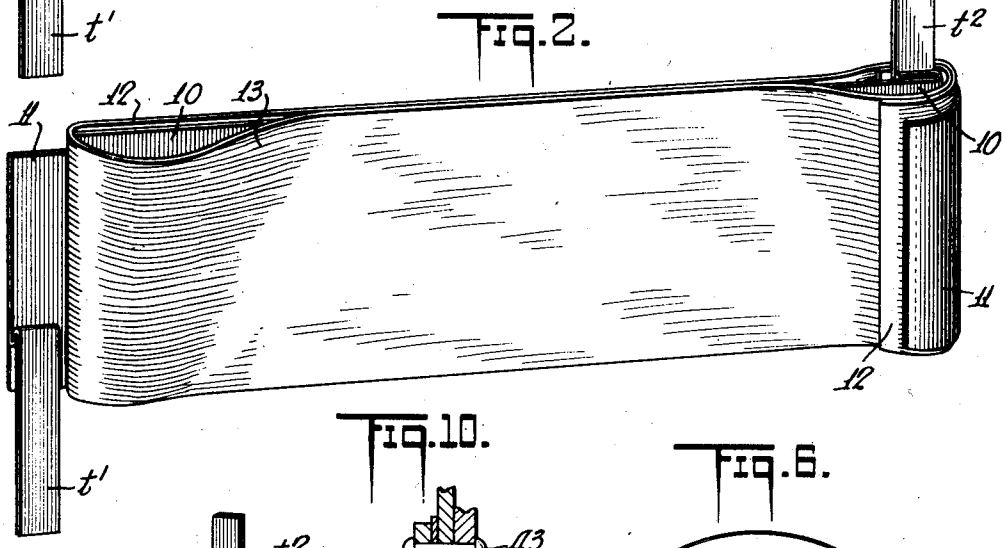


Fig. 10.

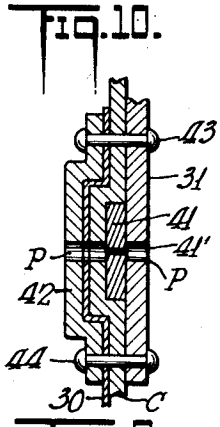


Fig. 6.

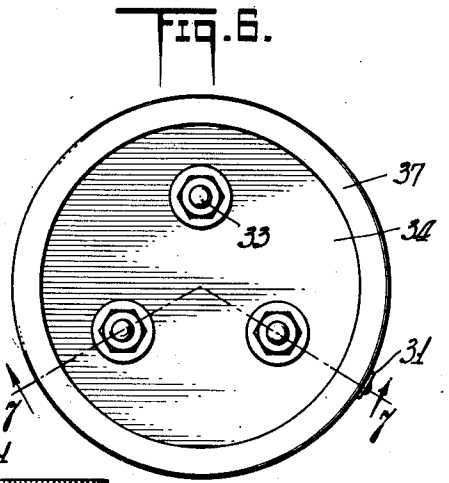


Fig. 3.

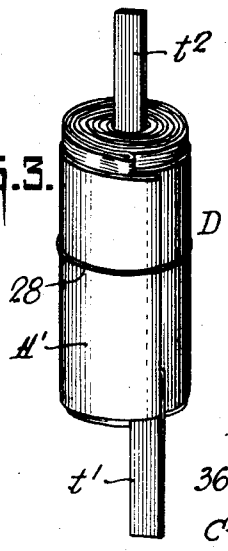
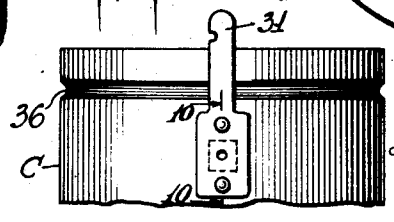


Fig. 9.



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ELECTROLYTIC CELL

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Fig. 7.

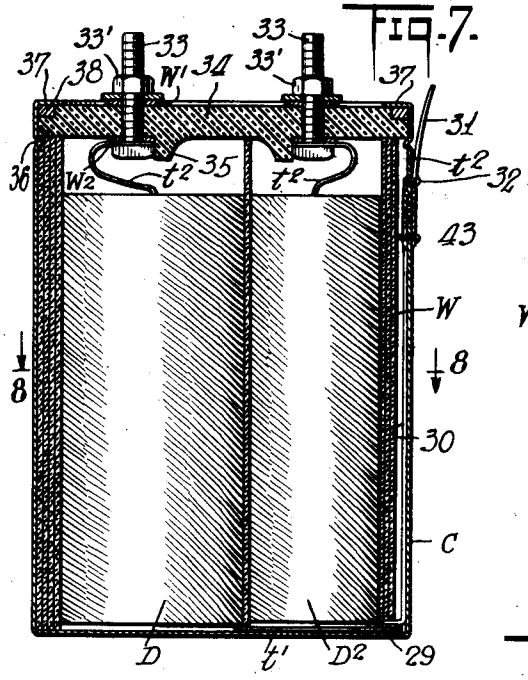


Fig. 8.

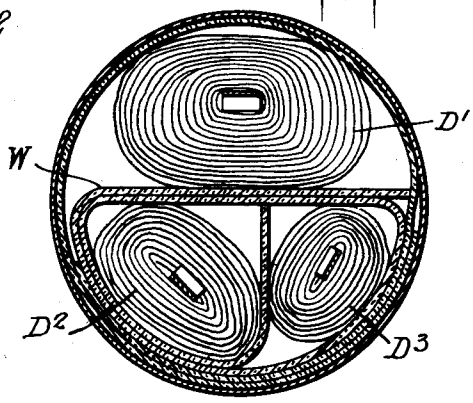


Fig. 4.

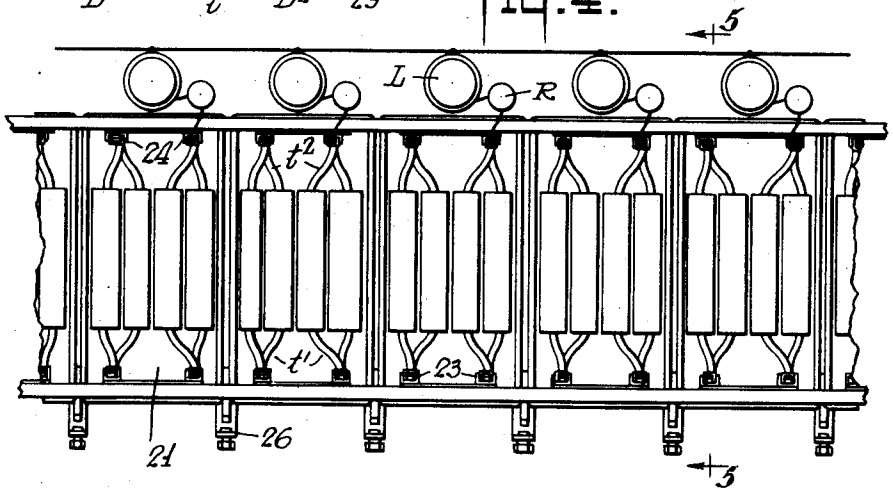
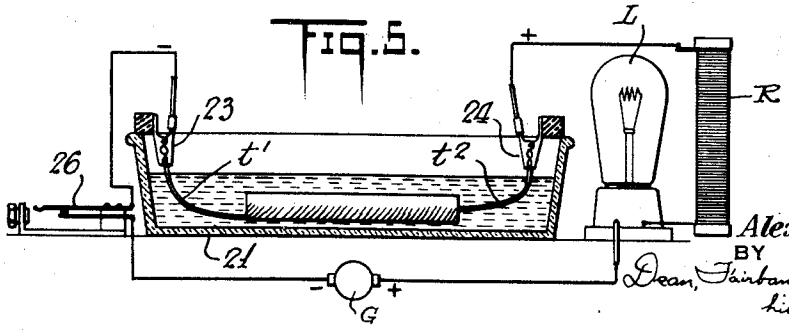


Fig. 5.



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6-209

Patented Jan. 20, 1931 1,789,949

UNITED STATES PATENT OFFICE

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ELECTROLYTIC CELL

Application filed October 18, 1930. Serial No. 489,531.

My present invention relates to electrolytic cells, useful as rectifiers and lightning arresters, but is more especially applicable to condensers of the electrolytic type, in which the di-electric is formed in a thin film upon the surface of the anode by electro-chemical action.

It is an object of the invention to provide an essentially dry condenser of the above type, of stable and dependable character, affording high capacitance in small bulk, of low electrical leakage, self-healing in character and which may be used without likelihood of breakdown in filter circuits and power supply units of radio receiving sets, in telephony and in other relations.

Another object is to provide a simple and practical method for producing and forming condensers of the above type, which shall require no expensive or highly specialized equipment, or close attention or delicate adjustment or regulation by highly skilled supervisors.

Another object is to avoid the loss in capacitance and the consequent increase in cost and bulk, incurred when the expedient of series-connection of two or more condensers is resorted to, in order to prevent breakdown under high voltages, the condenser by its mode of construction being rendered operative under higher voltages than ordinary electrolytic condensers.

Another object is to provide a condenser of the above type, devoid of liquid apt to slosh around in the casing and yet not subject to excessive heating or excessive evolution of gas pressure during use.

Another object is to provide a condenser of the above type, light in weight and compact in construction, which can be employed with substantially equal effectiveness, upright, inverted, horizontal or at any inclination, according to the space left available by associated apparatus.

Another object is to provide an electrolytic condenser of the above type, of a minimum number of elements, or parts, yet with adequate shielding between the individual condenser sections, enclosed in the same can and superior in performance though devoid of any filling of pitch, paraffin or the like.

Another object is to provide a condenser of the above type, devoid of joints, connections or other surfaces, subject to corrosion by galvanic action or otherwise, which will maintain its full efficacy after even long period of use or of idleness or disuse, without high leakage currents when operation is resumed.

A feature of the invention is the lateral misalignment, as by staggering of the longitudinal edges of the anode and cathode foils of the condenser roll. By virtue of this staggering, the edge of the cathode is spaced at a substantial distance from that of the anode, and the concentration of electrostatic field at the anode edge is consequently reduced; the undesirable consequences of imperfect film formation at the anode edge (such as excessive electrical leakage and sparking over) being, to a great extent, overcome. By this arrangement, while the capacitance of the condenser is not reduced for practical purposes, as compared with a condenser in which the foils are in registry, yet the gap at the edges of the roll is so greatly increased that the leakage and the likelihood of break-down at these regions are greatly reduced and the condenser may be made to serve satisfactorily and with low power losses, at high peak voltages.

Another feature is the electrostatic shielding of the condenser roll by the simple expedient of the outermost convolution of the outer or cathode foil completely encircling the condenser roll therewithin.

Another feature is the use of the identical metal, preferably aluminum for the cathode, the anode, the can, the rivets and any and all other metal elements in the completed structure, thus precluding galvanic action.

Another feature is the method of forming the pre-wound condenser section by impregnating the same in hot electrolyte and then forming, by applying direct current though a resistor in series with the condenser section, which is immersed throughout formation in a tray containing electrolyte of the same composition as that used for the impregnation. By this expedient, as the di-electric film is

formed and the ohmic resistance of the condenser increases, the effective application of voltage rises in a direct proportion therewith, thereby insuring the formation of a uniform tough adherent film on the anode foil.

Another feature is the treatment of all screws or metallic washers and similar parts connected to the anode and entering into the condenser construction, to form a di-electric film thereon, similar to that on the anode foil, thus to preclude areas of high leakage.

Another feature is the arrangement of condenser roll or rolls loosely within an otherwise empty can, to which the cathode terminals are directly connected, the anode being connected to binding posts through an insulating can cover.

The method of impregnation and forming is not claimed herein but is the subject matter of a divisional application Ser. No. 504,911 filed Dec. 16, 1930.

In the accompanying drawings in which is shown one of various possible embodiments of the several features of the invention,

Fig. 1 is a perspective view showing the constituent elements of the condenser before winding,

Fig. 2 is a perspective view showing the condenser partly wound,

Fig. 3 is a perspective view showing the condenser completely wound.

Fig. 4 is a plan view indicating the method of forming,

Fig. 5 is a transverse sectional view on the line 5—5 of Fig. 4, showing the forming arrangement,

Fig. 6 is a top view of the complete encased condenser,

Fig. 7 is a transverse sectional view taken on the line 7—7 of Fig. 6,

Fig. 8 is a view in transverse cross-section of the condenser on line 8—8 of Fig. 7,

Fig. 9 is a fragmentary detail of vent construction, and,

Fig. 10 is a section on a larger scale on line 10—10 of Fig. 9.

Referring now to Fig. 1 of the drawings, the condenser is made preferably of a pair of armature foils comprising an anode 10 and a cathode 11, of suitable film forming metal preferably aluminum, with an absorbent separator, which may comprise an interposed sheet 12, preferably of gauze, paper or the like, of width greater than that of the foils, reversely folded over an end of foil 10 to provide an additional sheet 13 superposed over foil 10. Of course, two or more superposed sheets of gauze or paper may be used depending on the nature and texture of the interlay, the character of the electrolyte and the voltage at which the apparatus is to be used. The absorbent separator should cover the total area of the anode in order to assure maximum capacity and best forming of the anode.

As shown on the drawings, the long edges of the foils or armatures are laterally spaced with respect to each other as by staggering, preferably by a distance in the order of one-quarter inch more or less, and the ends of the sheets are spaced from each other by a distance of two inches more or less, as shown. The cathode foil 11 is provided with a terminal tab t' preferably formed by slitting the foil preferably transversely near one end for nearly the entire width thereof, to provide a tongue 15, which is reversely bent as at 16, so that the tab t' may protrude beyond one end of the condenser roll. The anode foil 10 is similarly provided with a similar terminal tab t^2, preferably at the other end, cut from the opposite longitudinal edge to protrude from the opposite end of the condenser roll.

The superposed layers of foil and fabric are wound together to provide a flattened roll with the terminal tabs t' and t^2 of the two foil ends protruding from opposite ends of the roll, the anode foil tab t^2 from the axis of the roll, the cathode foil tab t' from the surface of the roll. The gauze or other electrolyte retainer should extend at least to the free protruding edge of the anode foil and preferably also of the cathode foil.

The outer foil preferably affords extra length to provide one or two extra turns 11′ about the condenser, which is kept from unwinding by an encircling band 28. The outer turn or turns 11′ perform the threefold function of a unitary capacitative shield, a mechanical protector for the roll during handling prior to final assembly and a superior conductor to dissipate heat generated in use.

The interlay of the condenser roll is now impregnated with a suitable liquid electrolyte. This is accomplished by immersion of the completed dry roll prepared as just set forth, in a tank containing the hot electrolyte. The general advantages of my invention are attained by the use of any of the electrolytes commonly employed for the purpose, for instance glycerol and carbonate of soda, as disclosed in the prior patent to Hickley No. 900,278 of October 6, 1908, but the voltage withstood by the condenser and its capacitance will depend largely upon the choice of electrolyte.

The condenser elements are then subjected to the forming operation, preferably by laying them in trays or pans 21 of glass, aluminum or other material unaffected by the solution, filled preferably with liquid identical with the batch in the impregnation tank. Preferably the condenser terminals t' and t^2 are connected to releasable terminal clips 23 and 24 respectively mounted at opposite edges of the tray and above the level of the liquid therein. Care is taken that the foil 11 form-

ing the electrostatic shield is connected to the negative terminal of the current source, to constitute the cathode. In series with the condensers, a few only of which are connected in parallel in each tray 21 is connected a resistor R preferably of about 2000 ohms more or less depending on the voltage, the number of sections and their dimensions. Each resistor is in turn connected in series with a corresponding incandescent lamp L, the remaining terminal of which is connected to the positive terminal of the source of current G, which is preferably of a voltage slightly in excess of the peak voltage for which the condenser is to be adapted. The trays as indicated in Fig. 4, may be conveniently arranged in rows on racks or tables and all connected in parallel across the terminals of said source of forming current G. A closed circuit jack 26 is disposed in each circuit, for ready connection of a milli-ammeter, for metering leakage current in ascertaining completion of the forming process.

In the forming operation, the initial resistance of the immersed condenser roll is very low since the current flows only across a thin film of conductive electrolyte of large area interposed between the two condenser electrodes. The initial voltage across the condenser will be very small as practically the entire voltage drop will be across resistor R and lamp L. The small voltage on the condenser roll will form a very thin film upon the anode foil 11, the electrical resistance of which rises accordingly. Therefore, a larger proportion of the applied voltage will now be applied across the condenser foils, which brings about the formation of a greater thickness of film, resulting in the application of still higher voltage to the condenser. In this manner, the voltage applied across the condenser foils will gradually and automatically increase in a direct proportion with the formation of the di-electric film, until, upon the completion of the forming operation, the resistance of the condenser will be vastly higher than that of the resistor R and practically all of the voltage will be applied across the condenser terminals. This operation is continued until the voltage impressed across the condenser foils is slightly in excess of the peak voltage on which the condenser is to be used. Where the peak voltage is 500, the forming voltage is preferably about 510.

With the arrangement above described, the lamp L serves to give visual indication when the forming process is about completed. At the beginning of the forming operation, and while it is in progress, the voltage applied to the lamp will be sufficiently high for incandescence thereof, but as the formation proceeds and the resistance of the condenser dominates, the lamp will become dimmer due to the resulting reduction in voltage thereacross and finally will be extinguished. The supervisor will thus be apprised of the substantial progress of the forming operation and thereafter, with the aid of the milli-ammeter applied at the closed circuit jack 26, he will know when the forming operation has been completed, at which time the condenser roll is removed from the tray. The condenser roll thus formed, will have a di-electric film upon the anode 10 of thickness depending on the voltage and duration of forming operation, and the interlay will be soaked with the electrolyte liquid in contact with the film.

The individual formed condenser is preferably enclosed in a can C, preferably of the same metal as the condenser electrodes. Preferably the cathode tab t' is at the bottom of the can and the anode t^2 at the top, as shown in the drawings. Depending on the choice of capacitances desired in the completed unit, one, two or more separate condenser rolls in parallel may be used. In the example shown in the drawings, three such condenser rolls D′, D² and D³ are shown, separately and jointly encircled by a single wrapping band W of insulating fiber or paper, as shown, the upper edge of which, as shown, extends above the condenser rolls. Preferably, no electrolyte, except what remains absorbed in the interlay 12—13 is put in the can, nor is the same sealed with pitch, paraffin or other filling composition.

To complete the assembly, the one, two or more terminal tabs t' of the cathode, protruding from the lower ends of the condenser rolls are riveted, soldered or welded at 29 to a metal strip 30 extending downward within the can C from near the upper end thereof, or the tabs may, if desired, be riveted or otherwise connected directly to the can. A terminal lug 31 is riveted as at 43 to the exterior of the can C, said rivets also mechanically holding the upper end of the conductive strip 30, thereby connecting the lower terminals of the condenser rolls to the can, which itself serves as one terminal of the condenser assembly. The other terminals t^2 of the condenser elements are respectively clamped directly as shown, under the heads of screws 33. The screws 33 extend upward through the insulating cover 34 of the can and with corresponding nuts 33′, serve as binding posts. The cover is preferably molded with shoulders 35, which lock the square headed binding post screws, and prevent turning thereof, when the corresponding nut 33′ is tightened or loosened. The can is preferably formed with a bead 36 upon which the cover 34 rests and the rim of the can is turned inward as at 37 to permanently affix said cover, an interposed gasket 38 assuring a tight connection. Preferably rubber washers w' and w^2 encircle each binding post screw and are pressed against opposite faces of cover 34, thereby to prevent any

possible ooze of electrolyte by creepage from the interlay 12—13.

The binding posts 33, rivets 29 and preferably also the rivets 43 and 44, hereinafter described, are joints at which corrosive action might occur in the absence of other precautions. According to the present invention, these screw connectors and rivets are made of the same metal, aluminum, as the electrodes, and the can, and in addition, the binding posts and other aluminum fittings or parts, such as the washers connected to the anode, are subjected to a forming operation, prior to incorporation into the condenser. This forming operation is analogous to that performed on the condenser rolls themselves. The washers and screws in a perforated can are submerged in electrolyte liquid, preferably identical with that used in the condenser rolls, and there subjected to direct current until a thin tough film has formed over the surface of said elements. The anode tab t^2 being an integral part of the anode foil and submerged in the electrolyte is formed simultaneously with the anode.

Preferably, the condenser, after complete assembly thereof, as shown in Figs. 7 and 8, is subjected to further forming operation by connection across generator G to assure completion of the filming.

The condenser, as described, is not subject to disturbance by agitation, as would be incurred in use on airplanes or other rapidly moving vehicles, if unabsorbed liquid were present in the condenser, and if a non-volatile electrolyte of substantially non-aqueous character be employed, as preferred, it will not be subject to freezing or evaporation.

The substantial absence of liquid, also affords considerable advantage in installation, as the can may may be emplaced upright, inverted, horizontal or inclined, and may thus be fitted in many relations, where a wet condenser could not be employed without increasing the bulk of the apparatus.

By the present invention, the use of paper, oil cloth or other wrapping for the individual condenser rolls, the paraffin or wax dipping and the pitch sealing, all are eliminated, with a resultant product of reduced weight, reduced cost for labor and materials, and reduced bulk for a given capacitance.

By the elimination of paraffin, wax or pitch, there is avoided, on the one hand, any injury to the electrolytic film, due to the heat of such composition, when poured in, and, on the other hand, any heat generated in use of the condenser is more readily dissipated due to the absence from the structure of any such poor heat conductors as paper, oil-cloth, wax or pitch. Substantial voids between the condenser roll and can are substantially devoid of filling composition, thereby to facilitate convection currents of air and heat dissipation.

No disturbing coupling effects occur as between the individual condenser sections within the can, each such section though not otherwise enclosed, being completely shielded electrostatically by the outermost turn or turns of the cathode foil.

The film being built up or formed upon the pre-wound condenser, it is not subject to such injurious strain as may be incurred where the foil section is formed first, and the section then wound. The film by my forming method having, moreover, been built up gradually on the pre-wound condenser section, such film is homogeneous, tough and permanent, so that the condenser remains effective even after long periods of use or idleness, and requires no reforming operation to restore it to operativeness.

The formation occurring in a tray with a comparatively large quantity of electrolyte, free circulation thereof occurs and excessive heat especially in the inner convoutions of the section is avoided, and at the same time complete retention of liquid electrolyte in the interstices of the absorbent interlay is assured.

By the staggering of the electrode foils, there is effected a multiplication in the length of path for leakage current of flash-over between the sharp edge of the anode and the sharp edge of the cathode foils, at which edges the greatest electrostatic intensity occurs. Thus both leakage current and danger of breakdown are minimized.

Where the cathode and anode foils are not staggered, breakdown at the edge of the anode is likely to occur because of the proximity of two sharp edges of high electrostatic intensity, and because of the comparative imperfection of forming at the sharp more or less jagged anode edge, and such breakdown is apt to be permanent.

By staggering, the distance between the anode and cathode edges is greatly increased, correspondingly reducing the probability of flash-over or sparking between the two edges. should such flash-over nevertheless occur under an abnormal surge of voltage, it would be attenuated and therefore reforming or healing of the affected part on the anode edge would take place more readily.

Unlike the case of non-inductively wound wax impregnated condensers, no marked loss in effective area of the electrolytic condenser results by staggering of the foils, since the dielectric film will form on substantially the entire area of the anode, even on that protruding beyond the cathode, the electrolyte in the gauze which is the true cathode being in engagement with the entire area of the dielectric film.

All metal parts being of aluminum and all washers and screws associated with the anode being electrolytically formed, the condenser has long life, as there are no parts, subject

to corrosion by chemical or galvanic action, and no objectionable variations in leakage, capacitance or in power factor occur.

While in use of the condenser, gas pressure is not apt to be evolved to any great degree, nevertheless it is preferred to provide means for automatically venting the can without, however, permitting entry of dust or dirt.

In a preferred embodiment, the can C has preferably a rectangular indentation, and lodges a piece of soft rubber 41 with a pin-hole 41′ therethrough. Terminal lug 31 on the can is superposed over the rubber washer. The conductive strip 30 passes over the protuberance within the can formed by the indentation, and is preferably backed by a heavier metal washer 42, the latter assisting in secure mechanical and electrical contact of the parts, held together by rivets 43 and 44 through the lug 31, the can C, the strip 30 and the backing washer 42. The lug, the indentation, the strip 30 and the washer 42 are perforated at *p* for venting through the rubber washer 41, which has a pin hole 41′ therethrough, shown exaggerated in the drawings.

The pin hole 41′ is normally closed and excludes dust and dirt and other foreign matter. Under eventual gas pressure within the case, the rubber will expand to open the pinhole and allow venting therethrough by way of perforations *p*, the vent immediately closing when the pressure has thus been relieved. The vent thus normally closed, also prevents escape of any electrolyte by creepage from the moist interlay.

It will thus be seen that there are herein described, apparatus and methods, in which the several features of this invention are embodied, and which in service attain the various objects of the invention and are well suited to meet the requirements of practical use.

As many changes could be made in the above disclosure, and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. An elctrolytic cell having an active cell element comprising cathode and anode foils displaced with respect to each other with substantially the entire length of the anode edge protruding with respect to the corresponding length of the cathode edge, said cell including a thin dielectric film closely adhering substantially to the entire effective area of the anode foil, means for retaining a layer of electrolyte interposed between the cathode and anode foils and extending at least to the free protruding edge of the anode foil, a container enclosing the active cell element and presenting substantial voids therein, said protruding foil edge freely exposed to the air within said container to facilitate cooling and the escape into the voids in the container of gas generated in the cell during operation.

2. An electric condenser roll including convolute cathode and anode foils having their longer edges at the ends of the roll displaced with respect to each other longitudinally of the roll with the cathode foil protruding at one end of the roll beyond the anode and the latter similarly protruding beyond the cathode at the opposite end of the roll, said condenser including a thin film of dielectric closely adhering substantially to the entire effective area of the anode means for retaining a layer of electrolyte interposed between the cathode and anode foils and extending at least to the free protruding edge of the anode foil and means for establishing terminal connection of the respective foils at the respective protruding edges thereof.

3. An electrolytic condenser comprising elongated cathode and anode foils of substantially equal width, an interposed sheet of fibrous material having electrolyte absorbed therein, said foils and sheet being convolute to form a roll, the foils staggered with respect to each other lengthwise of the roll with the anode edge protruding beyond the cathode at one end of the roll and the cathode edge beyond the anode at the opposite end of the roll, said sheet of fibrous material extending at least to the protruding edges of both cathode and anode foils.

4. An electrolytic condenser comprising a pair of metal foils of substantially the same width including elongated cathode and anode foils, the latter having a dielectric film over substantially the entire area thereof, an absorbent separator sheet interposed between said film and said cathode foil and having electrolyte absorbed therein, said foils and sheet being rolled together and the long edges of the foils being staggered with respect to each other, said separator sheet extending at least to the protruding edges of both cathode and anode foils and terminal tabs unitary with the respective foils and extending from the respective protruding edges thereof.

5. An electrolytic condenser having an active condenser element including a pair of elongated metal foils with an interposed absorbent separator sheet, electrolyte absorbed therein, said foils and sheet being rolled together, the various edges of said foils being non-aligned with respect to each other, said separator sheet superposed over the entire area of said metal foils, a container enclosing and determining substantial voids about said active condenser element, said container being substantially devoid of filling composi-

tion or of electrolyte externally of the active condenser element, thereby to facilitate convection currents of air.

6. An electrolytic condenser comprising a roll having convolute layers of anode foil and cathode foil, a dielectric film upon the anode foil in contact therewith, the foil at the exterior of the roll having an outer turn completely encircling the roll, the outer end of said outer foil protruding beyond the end of the other foil, and directly overlying and engaging the underlying area of said outer foil.

7. An electric condenser comprising a roll having convolute layers of anode foil and cathode foil, a dielectric film upon the anode foil in contact therewith, the cathode foil being at the exterior of the roll and having an outer turn completely encircling the roll the outer end of said cathode foil protruding beyond the end of the anode and directly overlying and engaging the underlying cathode area.

8. An electrolytic condenser roll comprising an elongated cathode foil, an elongated anode foil, the long edges of said foils staggered with respect to each other and a fibrous interlay sheet impregnated with electrolyte, said foil and sheets being rolled together with the cathode foil completely encircling the exterior of the roll the outer end of said cathode foil protruding beyond the end of the anode and directly overlying and engaging the underlying cathode area.

9. An electrolytic cell comprising anode and cathode foils extending in substantially superposed relationship, with the anode foil protruding beyond the edge of the cathode foil and coated with a thin adhering film of di-electric, said cell having an encircling layer of metal about and in electrical and mechanical contact with the cathode foil and constituting an electro-static shield.

10. An electrolytic condenser roll including convolute cathode and anode foils, having their longer edges at the ends of the roll displaced with respect to each other longitudinally of the roll, said condenser including a thin film of di-electric closely adhering to the entire effective area of the anode foil, means for retaining a layer of electrolyte interposed between the film and the cathode, the outer convolution of the cathode foil completely encircling the roll the outer end of said cathode foil protruding beyond the end of the anode and directly overlying and engaging the underlying cathode area whereby said outer convolution constitutes an electro-static shield.

11. An electric condenser comprising a conductive container, a wound electrolytic condenser roll therein and extending longitudinally thereof, a terminal strip protruding from one end of said roll and mechanically joined directly to the wall of said container, said container having an electrical terminal cooperating with said joint, a cover of insulating material for said container, and a binding post through said cover and affixed to the other terminal of said condenser.

12. An electrolytic condenser comprising a sheet metal can, an electrolytic condenser roll therein longitudinally thereof, said roll having one terminal near the lower end of said can and the other at the upper part thereof, a terminal lug at the exterior of the can wall, a sheet metal strip riveted to said terminal lug, the lower terminal of said condenser roll affixed to said sheet metal strip an insulating cover for said can, a binding post therethrough, the outer terminal of said condenser roll connected to said binding post, said can being substantially devoid of filling compound.

13. An electrical condenser comprising an active electrolytic condenser unit including cathode and anode foils, the latter coated with a dielectric film, a separator between said film and said cathode and impregnated with electrolyte, a metal jacket about the condenser unit, a can enclosing the jacketed unit and having an insulating cover, the cathode having a terminal strip electrically and mechanically joined to the body of the can for electrical connection thereat, an electrical terminal cooperating with said joint, and a terminal through the cover of the can connected to the anode.

14. An electric condenser comprising a condenser roll including an anode and a cathode foil in superposed relationship, a thin dielectric film closely adhering to the anode foil, a fibrous interlay between the film and the cathode and impregnated with electrolyte, the cathode foil being at the exterior and having one or more outer convolutions completely encircling the roll, the outermost part of the cathode foil protruding beyond the anode and the interlay to directly overlie and engage the cathode area thereunder, a metal can enclosing said roll, the cathode being electrically connected to the can, and the anode being electrically insulated with respect to the can.

15. An electrolytic condenser comprising a sheet metal can, an electrolytic condenser therein extending longitudinally thereof comprising an anode foil, a cathode foil, an interposed fibrous layer soaked with electrolyte, said superposed layers in rolled relation, with the cathode at the exterior and presenting an outer convolution encircling the roll, the outermost part of the cathode foil protruding beyond the anode and the layer to directly overlie and engage the cathode area thereunder, said roll having one terminal tab at the bottom and the other at the top of the can, means electrically connecting the bottom terminal with respect to the can wall, an insulating cover for the can and a bind-

ing post therethrough and connected to the upper condenser terminal.

16. An electrolytic condenser comprising a sheet metal can, a plurality of electrolytic condenser rolls therein each including a convolute cathode, anode and fibrous interlay, the latter having electrolyte soaked therein, each of said condensers having the cathode foil as an outer enclosing layer thereof, insulating sheet material isolating the several condenser rolls with respect to each other, a terminal lug on the condenser can, the cathode terminals of the respective condenser rolls electrically connected to said terminal tab, and an insulating cover for the can having binding posts therethrough connected to the respective anode terminals of the condenser rolls.

17. An electrolytic condenser comprising an anode foil, a fibrous sheet and a cathode foil in superposed relation, wound in a roll with the anode foil protruding beyond the cathode foil at one end of the roll, the cathode foil having one or more turns at the exterior completely encircling said roll, the outermost part of the cathode foil protruding beyond the anode and the sheet to directly overlie and engage the cathode area thereunder, a metal can enclosing said roll, the cathode electrically connected to the wall of the can and the anode electrically insulated from the wall of the can.

18. An electrolytic condenser comprising anode and cathode foils of aluminum, fibrous sheet means between said foils and impregnated with electrolyte, a closely adhering film of dielectric on the anode area, a can of aluminum enclosing said condenser roll and presenting air spaces thereabout, an aluminum part unitary with said cathode foil and in direct mechanical contact with the lateral wall of said can for terminal connection thereto, the anode having a terminal insulated from the can, the voids between the condenser roll and the can being substantially devoid of filling composition thereby to facilitate convection currents of air.

19. An electrolytic condenser including an active condenser element having electrodes of identical metal, a dielectric film formed on one of said electrodes, an enclosing metallic can of the same metal as said electrodes, the wall of which determines air spaces about the active condenser element, a terminal for said latter electrode insulated from the can, a terminal for the other electrode directly affixed to said can mechanically and electrically, metallic connecting members electrically and mechanically associating said electrodes with their respective terminals, each of said metallic connecting members being of the same metal as said electrodes, the voids between the active condenser element and the can being substantially devoid of filling composition, thereby to facilitate convection currents of air.

20. An electrolytic condenser including an active condenser element having electrodes including an anode and cathode of identical metal, a di-electric film formed on said anode, an enclosing metallic can, metallic connecting means associating the condenser element in electrical and mechanical relation with the can, each of said metallic connecting members being of the same metal as said electrodes, those of said connecting members that are affixed to the anode having a film formed thereon of substantially the same composition as the di-electric film on the anode foil.

21. An electrolytic condenser comprising an aluminum can, a condenser unit contained therein comprising electrodes of aluminum, the anode having an electrolytic film adhering to the active surface thereof, a fibrous interlay between the two electrodes impregnated with a liquid electrolyte, aluminum connectors mechanically and electrically bonding the cathode to said can, an insulating cover for said can, aluminum binding post screws and associated metal parts of aluminum in electric contact with the anode foil, said aluminum screws and parts having each a film formed thereon of substantially the same composition as the anode film.

22. In an electrolytic condenser, a can having an indentation, a piece of rubber in said indentation having a pin-hole therethrough, a terminal lug superposed over said rubber and affixed to said condenser, said can and said lug having each a small aperture at opposite faces of the rubber piece and substantially aligned with the pin-hole therein.

23. An electrolytic condenser including an anode foil having an integral terminal tab, a cathode foil contiguous to said anode, and an electrolytic film upon said anode, said condenser section being enclosed in a metal can, said cathode electrically connected to said can, an anode binding post insulated with respect to said can, means clamping said anode terminal tab to said binding post, said anode tab, said binding post and associated metal elements being all of the same metal as said anode and having an electrolytic film thereon identical with that of said anode.

24. An electrolytic cell including cathode and anode foils displaced with respect to each other with substantially the entire length of the anode edge at one end of the cell protruding beyond the corresponding edge of the cathode area, said cell including a thin electrolytic film closely adhering substantially to the entire area of the anode foil, means for retaining a layer of electrolyte interposed between the cathode and anode foils and extending at least to the free protruding edge of the anode foil, the cathode foil having a portion encircling the anode parts and insulated therefrom and having an end portion

protruding beyond the anode and directly engaging and overlying the cathode area thereunder.

25. An electrolytic condenser including convolute cathode and anode foils having their longer edges at the ends of the roll displaced with respect to each other longitudinally of the roll, said condenser including a thin film of dielectric closely adhering substantially to the entire area of the anode foil, means for retaining a layer of electrolyte interposed between the cathode and anode foils, and extending at least to the free protruding edge of the anode foil, the cathode foil being at the exterior and having one or more outer convolutions completely encircling the roll, the outermost end of the cathode foil protruding beyond the anode to directly overlie and engage the cathode area thereunder.

26. An electrolytic condenser including an active condenser element having cathode and anode elements of identical metal displaced with respect to each other with the entire length of the anode edge protruding beyond the cathode at one end of the condenser, said cell including a thin electrolytic film closely adhering substantially to the entire area of the anode foil, means for retaining a layer of electrolyte interposed between the cathode and anode foils, and extending at least to the free protruding edge of the anode foil, the cathode presenting one or more convolutions at the exterior of the cell insulated with respect to the anode and presenting a free protruding end portion in direct engagement with the underlying cathode portion, an enclosing can of the same metal as said electrodes, the cathode having a unitary metal part electrically and mechanically connected to the side wall of said can, the anode having a unitary metal part insulated with respect to the can, said can being devoid of filling composition.

Signed at New York, in the county of New York and State of New York, this 16th day of October, A. D. 1930.

ALEXANDER GEORGIEV.

DISCLAIMER

1,789,949.—*Alexander Georgiev,* Brooklyn, N. Y. ELECTROLYTIC CELL. Patent dated January 20, 1931. Disclaimer filed February 27, 1936, by the assignee, *Aerovox Corporation.*

Hereby enters its disclaimer to claims 6 and 7 of said patent.

[*Official Gazette March 17, 1936.*]