Dec. 28, 1926. 1,611,990

C. E. BONINE

ELECTRICAL CONDENSER

Filed May 28, 1924 2 Sheets-Sheet 1

FIG. I.

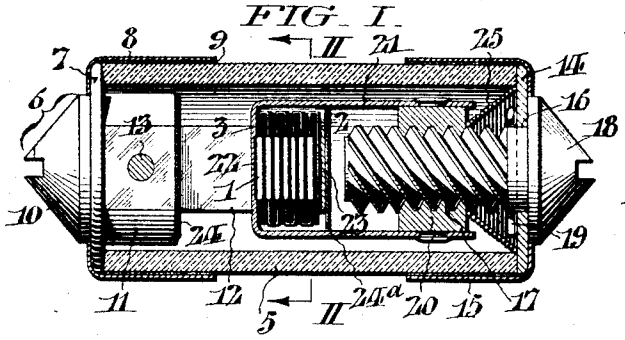



FIG. II.

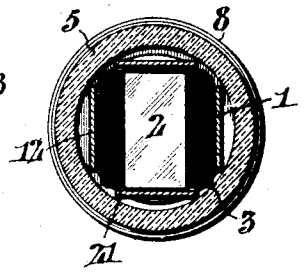



FIG. III.

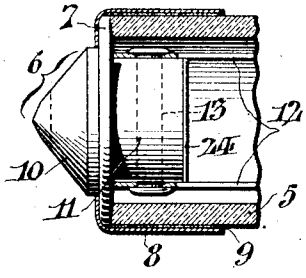



FIG. V.

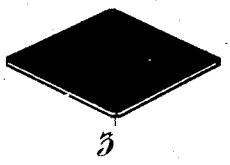



FIG. IV.

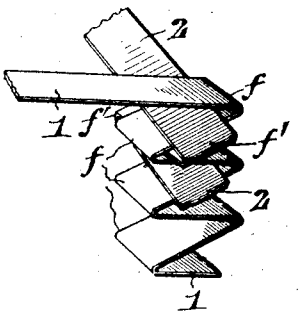



FIG. VII.

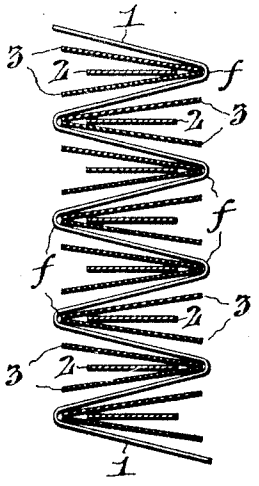



FIG. VI.

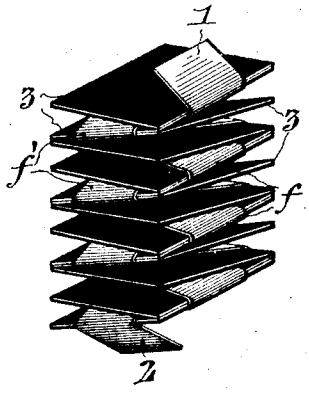



FIG. IX.

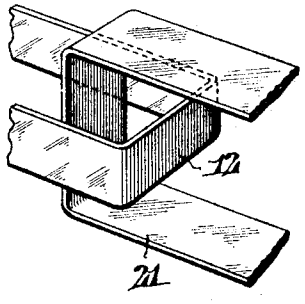
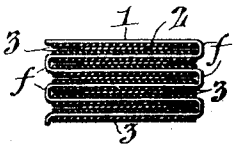



FIG. VIII.




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ELECTRICAL CONDENSER

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FIG. X.

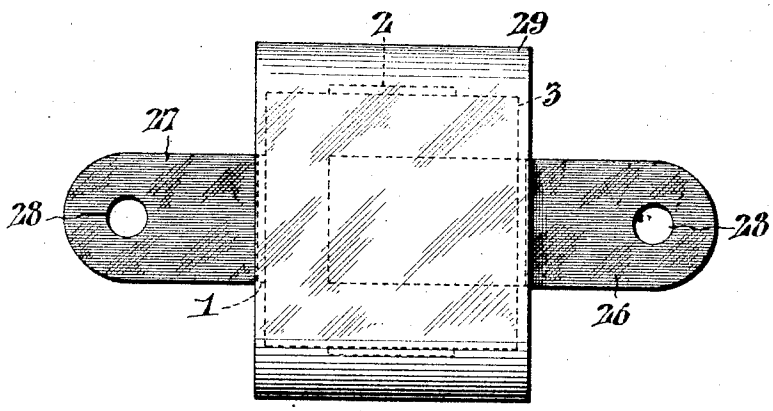



FIG. XI.

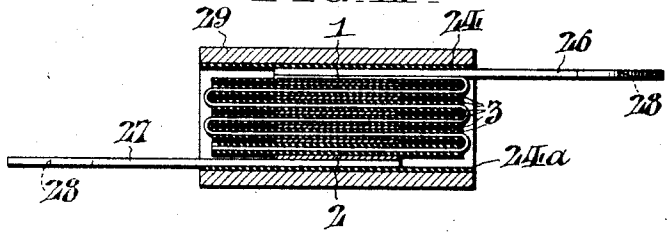
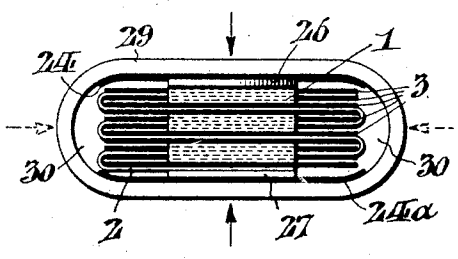



FIG. XII.




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# UNITED STATES PATENT OFFICE.

CHARLES E. BONINE, OF MELROSE PARK, PENNSYLVANIA.

## ELECTRICAL CONDENSER.

Application filed May 28, 1924. Serial No. 716,317.

This invention relates to condensers, more especially to a type useful in instances where very delicate capacity variations are required or desired. An ideally constructed condenser of this type should be extremely compact, efficient and reliable in action, capable of minute adjustments, yet free against derangement in continued use; and my invention is, in the main, directed to the production of a capacity device having these attributes to the very highest degree.

Other objects and attendant advantages will be apparent from the detailed description which follows of two different typical forms in which my improved condenser may be conveniently embodied, the appended claims serving to indicate those features which I believe to be novel and therefore patentable.

In the drawings, Fig. I is an illustration of one form of the condenser in longitudinal section.

Fig. II is a cross section of the same taken as indicated by the arrows II—II in Fig. I.

Fig. III is a fragmentary detail sectional view taken at right angles to the plane of Fig. I as indicated by the arrows on the latter illustration.

Fig. IV is a diagrammatic view showing the manner in which the elements constituting the condenser plates are assembled, the insulation employed between them being purposely omitted for clarity in the illustration.

Fig. V is a perspective view of a sheet insulation insert which I employ between contiguous folds of the condenser elements.

Fig. VI is a view similar to Fig. IV showing the condenser elements in complete assemblage with the insulation inserts.

Fig. VII is a diagrammatic view in section showing the condenser elements expanded to a position determining minimum capacity effect.

Fig. VIII is a similar view showing said elements closely compressed for increased capacity effect.

Fig. IX is a perspective view showing relative disposal of the means which are instrumental in effecting movement of the condenser elements.

Figs. X, XI and XII are respectively a plan, a longitudinal section, and an end view of an alternative embodiment of my invention.

The operation of my improved condenser is based upon the principle that variable capacity effects may be obtained by increase and decrease of the spacing between the metallic elements that serve as the current conductors to the dielectric media in which the electric charges are stored. The manner in which I make practical application of this principle in the present instance, is illustrated diagrammatically in Fig. IV of the drawings, from which it will be observed that the opposed metallic condenser plate elements, respectively designated at 1 and 2, are in the form of comparatively narrow strips of sheet metal with plicated folds, $f$, $f'$, and said folds interlapped to produce, on the whole, an accordion-like structure capable of being expanded and contracted longitudinally to correspondingly increase and decrease the spacing between respectively contiguous folds. A convenient way of effecting such interlapping of the strips 1, 2 is by folding them successively at right angles after the fashion of a "tom-cat ladder" construction as the illustration shows. In order to offset the possibility of short-circuiting between the strips 1, 2, I insert between contiguous folds $f$, $f'$, rectangular or to be more exact, square pieces of sheet insulation 3, see Fig. V, the completed assemblage as a result appearing finally as illustrated in Fig. VI. These insulation sheets 3, it will be noted, are well proportioned to provide ample marginal space for insurance of complete and adequate electrical insulation between the opposed metallic strips 1, 2 and furthermore, that said sheets are free to adjust themselves positionally to accommodate the relative movement of the strips.

In Figs. I, II and III, I show how an expansible condenser constructed as above described is incorporated into a convenient unit useful more especially as a condenser in connection with audion tubes of radio apparatus. This unit comprises a tubular protective shell 5 of transparent insulating material, preferably glass, so as to permit observance of the condenser adjustments from the exterior. One extremity of the tubular shell 5 is closed by a metallic plug 6 having a peripheral flange 7; and a flanged ferrule 8 which overlaps the flange and thus holds the plug in place. The ferrule 8 is permanently attached to the shell 5 by means of any suitable cementitious compound shown conventionally at 9. A conical head 10 of the

plug 6 projects outwardly through an axial opening in the ferrule 8 and serves as an exterior contact terminal, said head 10 being transversely slotted for engagement by means associated with any suitable type of holder for the unit, so that the latter is held against rotation for a purpose which will presently become apparent. The inner end 11 of the plug 6 is of a diameter somewhat less than the internal caliber of the shell 5 thereby facilitating attachment to its opposite sides, of the extremities of a U-shaped or yoked binding strap 12 constructed of comparatively stout strip metal. An escutcheon pin 13 extending diametrically through the plug, affords a means to anchor the ends of the strap 12, as will be understood by reference to Fig. III.

The opposite end of the shell 5 is closed by a disk 14; and a flanged ferrule 15 similar to the one previously described is employed to secure said disk in place. This disk 14 is axially pierced as at 16 to constitute a bearing for a screw 17 that is characterized by a slotted conical head 18 corresponding exactly to the head 10 of the plug 6, and designed to function as the other external contact for the unit. The screw 17 is held against axial movement by a cotter pin 19 that cooperates with the inside of the closure disk 14, said screw engaging a nut 20 secured to, and extending crosswise of the extremities of a yoked metallic strap 21 precisely like the one 12 already described. The strap 21 is arranged in interlinked relation with the first 12, the transverse bars of the two, being, as a consequence, crossed right angularly as shown diagrammatically in Fig. IX to afford a spacial interval for accommodating the condenser element assemblage of Fig. VI with freedom for longitudinal expansion and contraction, the side members of the straps preventing displacement of the insulation sheets 3 in a manner obvious from Fig. I. The relatively opposed ends of the two condenser strips 1, 2 are electrically secured (preferably by soldering) to the transverse members of the straps 12, 21 as conventionally indicated at 22 and 23 in the illustration. Thus, as the screw 17 is rotated in opposite directions, the binding straps 12 and 21 are relatively moved so that the condenser element assemblage is either expanded or contracted with the result that the air spaces between their folds *f*, *f'*, are increased or decreased, as diagrammatically shown respectively in Figs. VII and VIII of the drawings, to correspondingly vary the capacity of the unit as already understood. In order that such adjustment may be accomplished with comparative rapidity, the threading of the screw 17 is purposely made very coarse as shown. A strip of insulation 24 over the inner face of the plug 11, prevents direct metallic contact between said plug and the cross member of the binding strap 21 when the condenser plate elements 1, 2 are fully expanded. A strip of insulation 24ª over the end of the adjusting screw 17 similarly avoids the possibility of short-circuiting with the contiguous end of the strap 12. Lost motion, which is liable to cause imperfect electrical contact between the screw 17 and the nut 20, is prevented by interposing a helico-volute compression spring 25 between the nut 20 and the contiguous face of the closure disk 14. With the device supported in a spring clip holder of the type ordinarily employed in the art to which my invention pertains, and with the plug head 10 (and the casing 5) held against movement as previously suggested, it will be apparent that the screw 17 may be readily rotated in making the desired adjustments of the condenser plate elements, by any suitable means engageable with the slot in its head 18.

In Figs. X to XII, I have shown my invention as embodied in a form which may be considered as of the fixed condenser variety, yet in which the electrical capacity can be varied within small limits either for convenience of calibration during manufacture, or subsequently in adapting the same to any special use in practice. In this instance, the yoked binding straps 12, 21 of the first form are replaced by metallic connector lugs 26, 27 which are pierced at their outer ends as at 28 for a purpose well understood. The condenser assemblage together with the lugs 26, 27 are enveloped by a metallic band 29 which may be conveniently fashioned to the configuration shown in Fig. XII by flattening cylindric tubular material of a diameter such as will afford clearance spaces 30 beyond opposite ends of the insulation sheets 3 as in the illustration. With this construction it will be apparent that by application of pressure upon the band 29 in the direction of the arrows in full lines in Fig. XII, greater compacting with increased capacity of the unit will result; while easement through pressure applied to the bowed ends of the band, as indicated by the dotted arrows, will result conversely in decreased capacity.

Having thus described my invention, I claim:

1. An electrical condenser comprising a pair of cross-wise-folded metallic condenser plate elements with free intervening insulation plates, metallic yoke straps arranged in inter-linked relation to afford a spacial interval for accommodating the assemblage of the plate elements and having their cross bars electrically connected to relatively opposed ends of the metallic elements, and means whereby the yoke straps may be relatively moved for the purpose of expanding and contracting the condenser plate elements

to effect variation in the air spaces between their folds and corresponding gradation in the capacity of the condenser.

2. An electrical condenser comprising a pair of interfolded metallic condenser plate elements, individual pieces of sheet insulation interposed between contiguous folds of said plate elements, yoked metallic binding straps arranged in interlinked relation to afford a spacial interval for accommodating the condenser plate assemblage with provision for preventing displacement of the insulation sheets, and means whereby the binding straps may be relatively moved for the purpose of expanding and contracting the condenser plate elements to effect variation in the air spaces between their folds and corresponding gradation in the capacity of the condenser.

3. An electrical condenser comprising a pair of interfolded metallic condenser plate elements, a tubular insulating casing, a plug with a projecting contact head closing one extremity of the casing and electrically connected to the end of one of said condenser plate elements, a screw with a projecting contact head rotatable in the other extremity of the casing, and a nut connected to the relatively opposed end of the other of said condenser elements and operable by the screw to expand and contract said condenser plate elements for the purpose of effecting variation in the air spaces between their folds and corresponding gradation in the capacity of the condenser.

4. An electrical condenser comprising a pair of interfolded metallic condenser plate elements, a tubular insulating casing, a metallic plug with a projecting contact head closing one extremity of the casing and electrically connected to the end of one of said condenser elements, a screw with projecting contact head rotatable in the opposite extremity of the casing, a nut electrically connected to the relatively opposed end of the other of said condenser plate elements operable by the screw to expand and contract the condenser plate elements for the purpose of effecting corresponding variation in the air spaces between their folds and corresponding gradation in the capacity of the condenser, and means to take up lost motion between the screw and the nut to ensure efficient electrical connection therebetween.

5. An electrical condenser comprising a pair of interfolded metallic condenser plate elements, a tubular insulating casing, a metallic plug with a projecting contact head closing one extremity of the casing and electrically connected to the end of one of said condenser plate elements, a screw with a projecting contact head rotatable in the opposite extremity of the casing, a nut electrically connected to the relatively opposed end of the other of said condenser plate elements operable by the screw to expand and contract said condenser plate elements for the purpose of effecting variation in the air spaces between their folds and corresponding gradation in the capacity of the condenser, and a helical spring to prevent lost motion between the screw and the nut to ensure efficient electrical connection therebetween.

6. An electrical condenser comprising a pair of interfolded metallic condenser plate elements, metallic yoke straps arranged in inter-linked relation to afford a spacial interval for accommodating the assemblage of the plate elements and having their cross bars electrically connected to relatively opposed ends of the respective condenser elements, a tubular insulating casing, a plug with a projecting contact head closing one extremity of the casing and providing an anchorage for one of the straps, a screw with a projecting contact head rotatable in the other extremity of the casing, and a nut secured to the other of said straps operable by the screw to effect expansion and contraction of the condenser plate elements for the purpose of varying the spacing of their folds and effecting corresponding gradation in the capacity of the condenser.

In testimony whereof, I have hereunto signed my name at Philadelphia, Pennsylvania, this 26th day of May, 1924.

CHARLES E. BONINE.