

June 15, 1926.

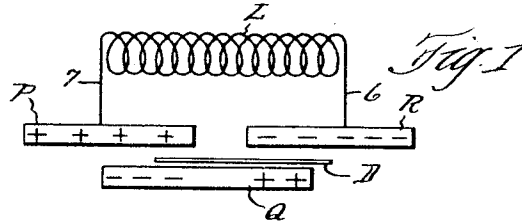
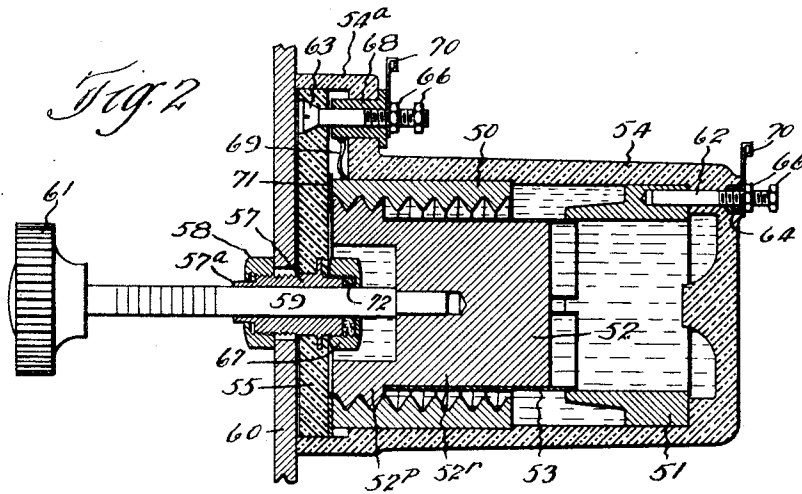
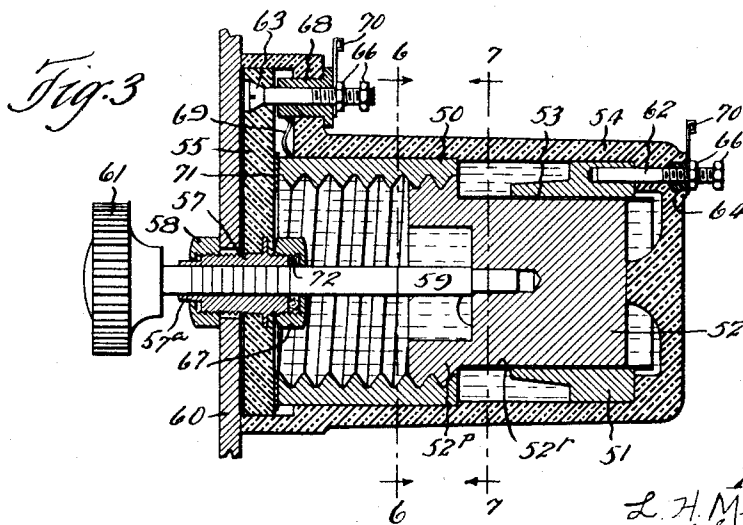
1,589,204

L. H. MILLER ET AL

VARIABLE CONDENSER

Filed Dec. 14, 1922

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 4

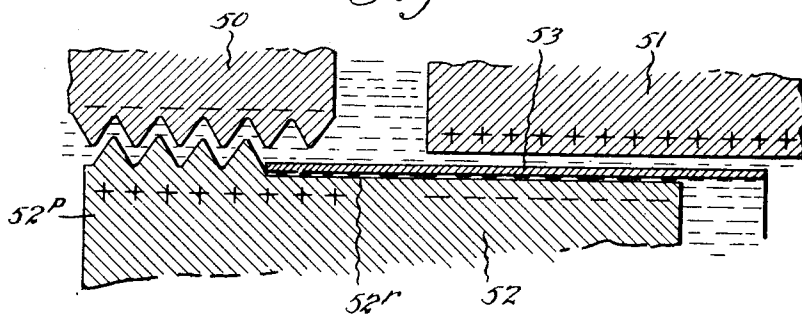


Fig. 5

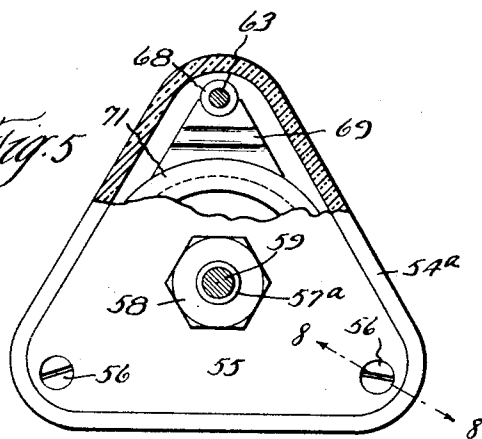


Fig. 8

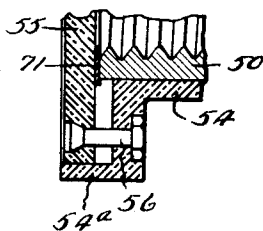


Fig. 6

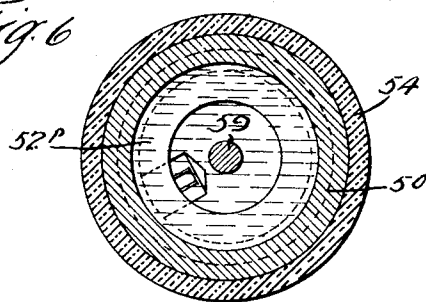
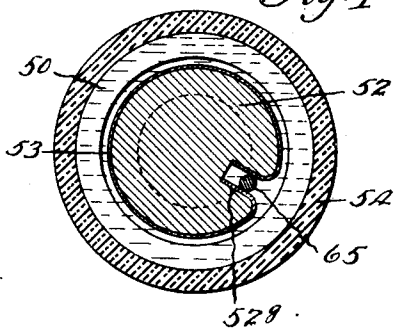


Fig. 7



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VARIABLE CONDENSER.

Application filed December 14, 1922. Serial No. 606,835.

This invention relates to variable condensers, and is particularly adapted and intended for use in radio systems, although not limited to such use.

5 Variation in condenser capacity and consequent oscillation periods has heretofore been accomplished by the use of adjustable terminal plates, rotary segmental interleaved plates, and in various other ways. 10 The present invention embodies a new principle involving the use in a variable condenser of a pair of fixed plates or terminal members and a movable static plate or member, varying the capacity according to the 15 position of the movable plate and the consequent charges induced therein. This will more fully appear from the following description and the accompanying drawings, in which—

20 Fig. 1 is a diagram illustrating the principle involved; Figs. 2 and 3 are longitudinal sections of the condenser in which the principle is practically applied, the former showing the instrument at minimum and 25 the latter at maximum capacity; Fig. 4 is an enlarged detail in section; Fig. 5 is a front elevation partly in section; Figs. 6 and 7 are transverse sections taken on the lines 6—6 and 7—7 respectively of Fig. 3; 30 and Fig. 8 is a fragmentary section taken on the line 8—8 of Fig. 5.

The two fixed plates or members referred to are most conveniently placed opposite to each other in the same plane, and referring 35 to Fig. 1, P and R indicate the two fixed plates connected in series by leads 6 and 7 to the induction coil L of the inductance-capacity circuit of a wireless set for example, wherein the variation of capacity of 40 the condenser will cause a corresponding change in the period of oscillation. Q is a movable plate in capacitative relation to said fixed plates.

45 The movable plate Q can be moved along the plane parallel to P and R separated by the dielectric D. As Q is moved to a position opposite a part of R the contrivance will act as a variable condenser. The reason for this is as follows: Referring to Fig. 1, 50 if the charge through conductor 6 is negative 7 must be positive. The plate R must be negative and plate P is positive. To cause an oscillatory current to flow, the internal action of the condenser must be such

that its terminal plates P and R are always 55 of unlike charges. This will always occur because, as R is negatively charged the adjacent end of movable plate Q will have a positive "bound" charge, the opposite end 60 P will have a negative charge, and the plate P will have a positive charge. In fact the negative end of Q is a "bound" charge also because plate P is positive by reason of the inductance coil. Conversely, if P has a 65 negative charge plate R must have a positive charge through the condenser as well as through the inductance. Instead of only one plate Q, a condenser may be built with more than one movable, or "free static oscillating," plates in lapped relation. 70

One practical application of this principle is shown in the other figures, and referring thereto, the structure embodies:

A plunger 52, threaded at one end 52^a and in cylindrical form at the other, is the ad- 75 justable element or member. It is engaged in the threaded metal bushing 50 which acts as one fixed plate represented by P in Fig. 1. The member can thus be moved in a 80 combined reciprocating and rotary motion through the metal bushing 51 which acts as the other fixed plate as represented by R in Fig. 1. These plates are encased in a 85 shell 54 made of some insulating material with a cover 55 fitted into the flange 54^a and secured by two or more bolts 56. Through this cover passes a bushing 57 90 molded in the cover and threaded at the inside end for a packing nut 67, and at the other end a male threaded portion with a 95 thimble 57^a projecting through the hexagonal nut 58. This hexagonal nut bears against the panel board 60 and is the only means needed of fastening the condenser to the panel. Through the bushing 57 passes 100 a graduated shaft 59 fitted into plunger 52 and having a standard knob 61 mounted on the opposite end. 63 acts as a bolt for holding cover 55 in shell 54 as well as a terminal connector for the threaded bushing 50. The terminal bushing 68 is inserted 105 from the shouldered end as shown and the flexible connector 69 is soldered to this and the bushing 50. When the cover is in place the bolt 63 is run through this bushing and a soldering clip 70 and nuts 66 put on, while at the corners the bolts 56, are run through the flange of the shell and a nut ap-

plied. 62 is a binding post stud inserted through the shell end and pressed into the cylinder 51 for the other terminal connector. A ring gasket 71 is held between 50 and 55, packing 72 under the nut 67 and packing 64 under clip 70 for the purpose of sealing condenser against the leakage of oil or admission of foreign matter.

Around the cylindrical body 52^r of the plunger is mounted or stretched a thin durable sheet 53 of some material with dielectric properties. This sheet is secured by pressing a pin 65 into a groove 52^s wedging the ends of the sheet between the pin and sides of the groove. Another dielectric substance of a fluid nature, such as castor oil, is used to fill up all voids between the sheet and the plunger, the sheet and the cylinder 51, the male threads on the plunger and the female threads in the bushing 50. The parts inside the shell are flooded with oil before the cover is put on. Any one dielectric or more than one may be used; but there is an advantage in using one durable material such as tracing cloth mica, waxed or bakelite paper.

It can be seen that a film of oil is formed around all parts, thus forming a dielectric between the two fixed plates and the plunger. This film is hard to break down, as is well known. The distance between these members, or the thickness of the dielectric, is very small, and the value of the dielectric used is higher than average. For example, such a dielectric used by us has a thickness of 0.005" and a value of about 6. For this reason it is possible to obtain a compact condenser of a high capacity by reducing the effective area of the parts.

As seen in Fig. 5 the flange 54^a of the shell is made triangular so that the condenser can be operated conveniently unmounted. This prevents rolling while turning the knob.

Only one hole needs to be drilled in the panel for mounting this condenser. The nickel plated nut 58 holds the condenser against the back of the panel securely and with a very neat appearance.

The action of this condenser can be seen by studying Fig. 4, in which the enlarged bushing, cylinder and plunger are shown with an enlarged dielectric thickness.

If the bushing 50 is charged negatively the plunger will have a positive "bound" charge at the surface 52^p and a negative charge along the surface 52^r. The cylinder 51 will have a positive charge which is opposite to the charge of 50. The converse of this being also true will show why such an arrangement works, as explained in the foregoing.

Fig. 3 shows a longitudinal section of the condenser fully engaged at maximum capacity. It will be noticed that a part of

the plunger screw 52^p is out of engagement with its female thread in the bushing. It follows then, that the limiting capacitance must not be governed by the remaining threads in engagement. The capacity at this end of the plunger must be at all times equal to, or greater than, the maximum capacity obtainable by the opposite end for it is this end that determines the variable capacity. The developed area along the surface 52^p when in least engagement, taken together with the distance between members, and calculated with a dielectric value equal to the fluid used must equal the maximum capacity at the other end.

Now supposing in practical use the oil film between the male and female threads should break down by reason of pressure or a puncture caused by a metallic particle of dust. The oil film will cease to be a dielectric and an electrical contact will be made between the bushing and plunger. It will still work, for if 50 has a negative charge, 52 will have a like charge because of a flow of current, and 51 will have a positive charge due to the dielectric existing between 51 and 52. One durable, puncture proof dielectric 53 must be employed, for if both ends of the plunger formed an electrical contact the device would cease to function.

Therefore, with a condenser so constructed, the plunger, or movable static member, may be moved in or out, varying the induced charges in said member and consequently the value of the capacity, the time of the cycle in the inductance coil, and therewith the period of oscillation, frequency of waves, and the wave length. The advantages of the condenser may be summarized as follows:

High degree of selectivity, i. e., being capable of selecting and absorbing energy produced by the strongest wave in the band which is the theoretical wave any station transmits.

The quality of sound detected is clearer and without distortion as at times caused by condensers of less selectivity. Due to these improvements the signals seem to be louder.

Very high degree of adjustment. This offsets the nervous effect of the hand when attempting to tune in with a less range of angular movement.

Almost entire elimination of body capacity.

Almost entire elimination of interference due to static electricity in the air.

Almost entire elimination of interference due to other stations sending near the same wave length.

Never loses its adjustment because it is always "counter-balanced."

Simple graduation for the purpose of reading the capacity in micro-micro-farads.

Can be used in any position without being mounted on the panel.

Elimination of panel mounting screws and holes except the hole for the shaft.

5 It is dust proof, compact, unbreakable and of good appearance.

We claim:

10 1. A condenser having relatively fixed members each having an electrical terminal associated therewith and a movable static member in capacitative relation thereto and separated therefrom by a dielectric, the fixed members being coaxial cylinders insulated from each other and the movable member 15 being adjustable parallel to the axis of the cylinders, the movable member being coaxial with and enclosed within the cylinders.

20 2. A condenser having relatively fixed terminal members and a movable static member in capacitative relation thereto and separated therefrom by a dielectric, the fixed members being coaxial cylinders spaced apart and arranged in minimum capacitative relation with respect to each other 25 and the movable member being adjustable parallel to the axis of the cylinders, the movable member comprising a plunger working within the cylinders.

30 3. A condenser having relatively fixed terminal members and a movable static member in capacitative relation thereto and separated therefrom by a dielectric, the fixed members being coaxial cylinders and the movable member being adjustable parallel 35 to the axis of the cylinders, the movable member comprising a plunger working within the cylinders, one of said cylinders being

threaded and the plunger being threaded to screw therein. 40

4. A condenser having relatively fixed terminal members of opposite polarities and a movable static member in capacitative relation thereto and separated therefrom by a dielectric, the fixed members being coaxial 45 cylinders and the movable member being adjustable parallel to the axis of the cylinders, the movable member comprising a plunger working within the cylinders, the dielectric including a shell enclosing the 50 plunger.

5. A condenser having relatively fixed terminal members of opposite polarities and a movable static member in capacitative relation thereto and separated therefrom by 55 a dielectric, the fixed members being coaxial cylinders and the movable member being adjustable parallel to the axis of the cylinders, the movable member comprising a plunger working within the cylinders, a casing enclosing said members and plunger, and an 60 operating rod connected to the plunger and extending outside the casing.

6. A condenser comprising a casing, a pair of fixed spaced tubular terminals of 65 opposite polarities in opposite relation, a plunger movable axially in the terminals across the space therebetween, a shell of dielectric material fixed to and surrounding the plunger and movable therewith, and a 70 liquid dielectric enclosed in the casing.

In testimony whereof, we do affix our signatures.

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MALVERN W. SEVERANCE.