May 30, 1933. P. E. GILLING 1,911,360

CONDENSER

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Fig. 2.

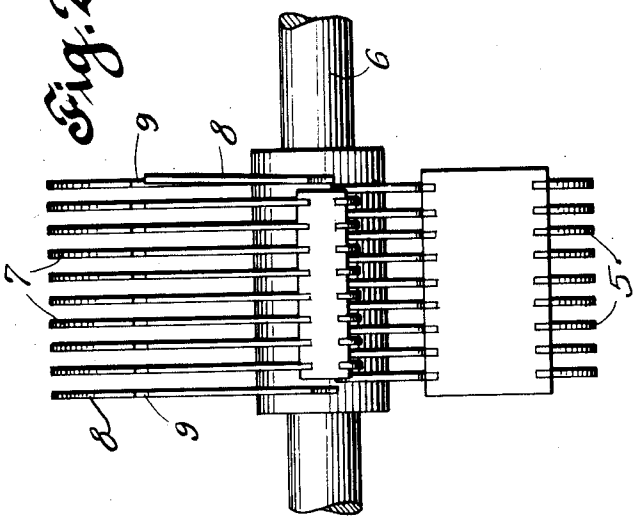


Fig. 4.

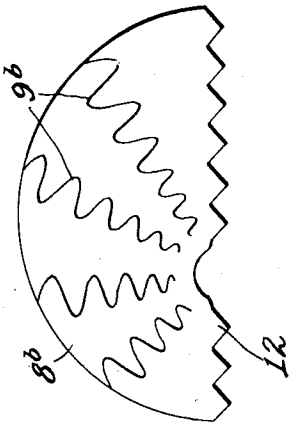


Fig. 3.

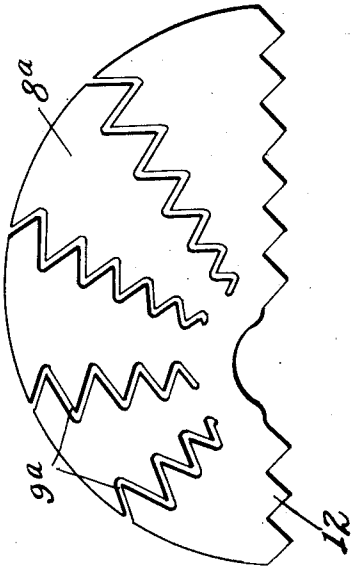
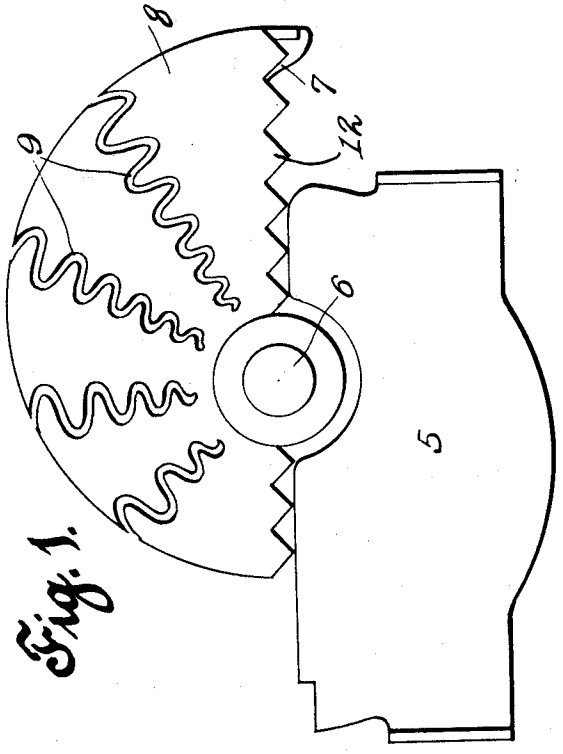


Fig. 1.



INVENTOR
Preston E. Gilling
BY
Frank C. Fischer
ATTORNEY

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Fig. 5

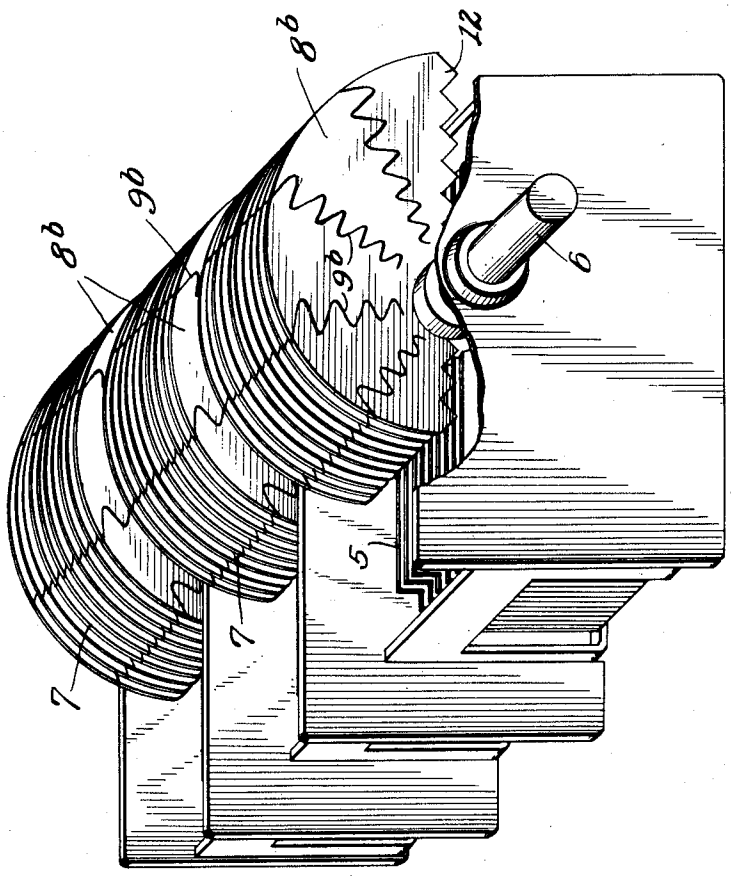
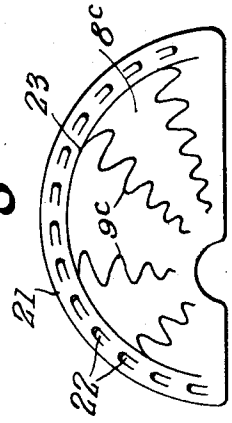


Fig. 6.



INVENTOR
Preston E. Gilling
BY
Frank C. Fischer
ATTORNEY

Patented May 30, 1933 1,911,360

UNITED STATES PATENT OFFICE

PRESTON E. GILLING, OF HADDON HEIGHTS, NEW JERSEY, ASSIGNOR TO RADIO CONDENSER COMPANY, OF CAMDEN, NEW JERSEY, A CORPORATION OF NEW JERSEY

CONDENSER

Application filed October 10, 1930. Serial No. 487,669.

This invention relates to electro-static tuning condensers, and particularly provides for varying the rate of change of capacity of such condensers in either single or multiple operation.

Heretofore, there have been produced electro-static condensers provided with a plate which may be flexed in two or more points for the purpose of varying the rate of change of capacity of the condensers. This plate may be associated with either the stator or the rotor plates.

In order to facilitate the flexing, the plate is provided with a plurality of spaced, straight slots which divide the plate into a number of sectors. However, it has been found that plates having the straight slots are objectionable in that the slots introduce a number of "dead" areas.

Also the straight slots plate is not well adapted for flexing purposes, inasmuch as the slots are narrow and the flexing is accomplished at the periphery of the sector and not along the edges of the slot. This construction obviously confines most of the adjustments or distortions of the plate adjacent the perimeter, with practically no material change in the body of the plate.

It is an object of this invention to provide an auxiliary resonating plate for electrostatic condenser, which plate may be easily flexed by hand, in the interior portion thereof as well as the perimeter.

A further object is the provision of an auxiliary resonating plate divided into a plurality of sectors in such a manner that there will be no dead spaces during the change of the capacity of the condenser from the minimum to the maximum.

Heretofore, condensers have been designed especially to meet certain conditions. (See Bureau of Standards Circular No. 74, March 10, 1924, pages 114 to 118). For example, the simplest type of variable condenser comprises semi-circular plates with the axis of rotation at the center of the rotor plates, and this type of condenser is intended to give equal capacity changes per degree of rotation.

Another type of condenser is the uniform wave-length type, the shape of the rotor plates being especially designed so that the capacity will vary as the square of the angle of rotation. This condenser is intended for the purpose of reading the wave lengths directly on a scale, the scale being calibrated so that the change in wave length per degree of rotation will be uniform. The rotor plates of such a condenser have a configuration bounded by a curve following a square law.

A still further type of condenser is that of the logarithmic type in which the rotor plates have a configuration bounded by a logarithmic curve, it being the intent that the percent change in capacity for a given rotation of the rotor plate shall be the same at all parts of the scale.

While all of the above condensers are desirable under certain conditions, in the manufacturing of radio receiving apparatus a number of other factors are present which tend to destrov the effect of the peculiar configuration of the rotor plates, and consequently, the plates must be adjusted independently for each receiving apparatus.

In other words, from a manufacturing standpoint, it is inexpedient to confine operations to one particular type of condenser such for example, as the logarithmic type, since when such condensers are manufactured and installed in receiving apparatus, they are found to give results considerably different from those which would be produced under ideal circumstances.

These and other advantageous objects, which will later appear, are accomplished by the simple and practical construction and arrangement of parts hereinafter described and exhibited in the accompanying drawings, forming part hereof, and in which:

Figure 1 represents an end view of a condenser embodying the invention.

Figure 2 represents a side view of the condenser shown in Figure 1.

Figure 3 represents a plan view of a modified form of auxiliary plate.

Figure 4 represents a plan view of another form of auxiliary plate.

Figure 5 represents a perspective view of a gang of condensers embodying the invention.

Figure 6 represents a modification of the invention.

Referring to the drawings, there is shown a condenser having a plurality of stator plates 5 which may be interleaved with a plurality of rotor plates 7, the latter being attached to a rotor shaft 6, to which shaft are also attached the two auxiliary adjusting plates 8, there being an adjusting plate 8 at each end of the rotor plate assembly.

While the drawings show the invention applied to the rotor plates, it is obvious that it may readily be used in connection with the stator plates without resort to invention.

The plate 8 is divided, by means of a plurality of spaced slots 9, the slots 9 having a wave-shape. It will be obvious that as the rotor shaft is actuated there will be no dead spaces as the wave-shape of the slots 9 always presents an area traversing the upper edge of the stator plates. Were the slots 9 straight, it is obvious that as each slot would come into parallelism with the upper edge of the stator plate, there would be a "dead" space in which the capacity would be negligible.

The end plates 8 are provided with a plurality of tangs 12 which extend down to the upper edges of the stator plates when the capacity is a minimum, see Fig. 1. By means of these tangs 12, the minimum capacity of the condenser may be readily adjusted.

The wave shape of these slots 9 also enable minute adjustments and flexing of the sectors to points very close to the rotor shaft 6. As will be seen, each one of the peaks of the wave may be easily flexed and also other points of each sector may be flexed as may be desired.

By means of resonating plate provided with slots, of the type herein described, the rate of change of capacity of the invention may be adjusted to almost any degree, and adjustment may be made manually without the aid of tools.

As shown in Figures 2 and 5, all of the rotor plates are slotted or severed to divide them into sectors corresponding to the sectors of the end plates 8.

Such an arrangement enables very fine adjustment and the shaping of the capacity curve of the condenser to conform with any of the desired shapes, such as the logarithmic and square law curves.

In Figure 3 is shown a modified form of the plate in which the sectors 8*a* are separated by slots 9*a*, which are zigzag in shape. The results obtained from a plate of this type are similar to those described in connection with the plate shown in Figure 1, the advantage of the plate shown in Figure 3 being that the cutting of the slots 9*a* may be performed with less effort than the cutting of the slots 9.

In Figure 4 is shown a resonating plate 8*b* which is divided into sectors by a plurality of spaced line cuts 9*b*, which are wave-shaped. The plate is merely severed along the lines 9*b* and no material is removed, consequently the plate in Figure 4 has no slots, but presents a continuous area, and the line cuts 9*b* enables the plate to be flexed in a plurality of points with a minimum of effort.

In this form of plate, it is obvious, that the possibility of dead spaces is entirely eliminated. These plates, as herein described, are of great advantage when used in connection with a gang of simultaneously controlled condensers.

It is customary to calibrate each condenser at the factory so that it has a capacity of a predetermined value; but as soon as the condensers are installed in the radio receiving circuit, their capacities are materially altered due to the uncertain capacities of the tubes, coils, and other elements of the circuit.

It therefore, is necessary to adjust the condensers so that they will all have substantially equal values after they have been installed in the receiving apparatus.

The plates herein described, obviously, greatly facilitate such adjustment and balancing of condensers so that they may have substantially the same rate of change of capacity throughout the movement of the rotor shaft.

In condensers having auxiliary compensating plates such as the plates 8, the rotor plates 7 may be solid, or they may be provided with slots 9′ similar to the slots in the auxiliary plates 8, or the rotor plates may be divided into a plurality of bendable sectors in accordance with the showing in Figure 4.

When all of the rotor plates, are slotted or divided into a plurality of bendable sectors, the plates being substantially semi-circular in shape, and the axis of rotation is offset from the center of curvature of the plates, it is possible to adjust the plates so that the condenser will produce a capacity curve following the square law, the logarithmic law, or any desired law.

While the general shape of the rotor plate is circular, the path followed by the plate during its rotation is complicated, since the axis of rotation of the plate is eccentric to the true center of the circle.

The equation for the curve generated during the rotation of the plates, when ex-

pressed in terms of the variable angle is as follows:

$$r = \sqrt{a^2 - b^2 \sin^2 \theta} + b \cos \theta$$

where r is the distance of any point on the curve from the center of rotation, a is the radius of the circle, and b is the distance of the center of rotation from the center of the circle.

Now, it is obviously, simpler to manufacture semi-circular plates than it is to manufacture plates of special configurations such as those governed by a square law or a logarithmic law. By off-setting the axis of rotation as herein disclosed, the rotor plates produce curves simulating those obtained by specially constructed condensers of the logarithmic type, for example. Of course, the capacity curve produced by a logarithmic rotor plate would not exactly coincide with that produced by the rotor plates herein described; but since the later rotor plates may be flexed at various points, they may be adjusted readily to produce a curve coinciding exactly with the curve produced by any of the especially designed condensers.

The adjustment is made by flexing or distorting the rotor plates in as many points as may be necessary, the slots or line cuts in the plate facilitating such adjustment.

From the above description, it will be seen that a condenser provided with rotor plates as herein disclosed is highly desirable in the manufacture of radio receiving apparatus.

For example, these condensers may be installed in a radio receiving circuit, and then adjusted to produce the same results as a condenser of the logarithmic type or a condenser following a square law, or if desired, the rotor plates may be adjusted to produce the same effect as though the axis of rotation were at the true center of curvature of the plates. The condenser, obviously, may be readily adjusted to compensate for the distributed capacity due to the wires, tubes etc., in a radio receiving circuit.

In Figure 6 is shown a modified form of plate having a line cut 23 spaced slightly from and concentric with the perimeter 21 of the plate to provide a narrow band. The plate is further divided into a plurality of bendable sectors 8c by the wave shaped line cuts 9c. The narrow band has a plurality of bendable tangs 22 by means of which small capacity changes may be made.

With this form of plate, it will be seen, that there will be a continuous capacity curve and that there will be no points, due to slots or the like, where the capacity will be abruptly changed. By means of the arrangement shown, it is obvious, that extremely fine adjustments may be made; and this type of plate is highly desirable for use in receiving circuits where it is necessary to make capacity adjustment as fine as one-tenth of a micro-farad.

The foregoing disclosure is to be regarded as descriptive and illustrative only, and not as restrictive or limitative of the invention, of which obviously an embodiment may be constructed including many modifications without departing from the general scope herein indicated and denoted in the appended claims.

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

1. In an electrostatic condenser, a bendable adjusting plate divided into sections by a plurality of line cuts, said line cuts being irregular in shape.

2. In a variable electrostatic condenser, a rotor plate having a straight edge provided with a plurality of bendable tangs to enable the minimum capacity of the condenser to be varied.

3. A plate for an electorstatic condenser, having a line cut spaced from and concentric with the perimeter of the plate, and a plurality of wave-shaped radiating line cuts extending to the first mentioned line cut to divide the plate into a plurality of bendable sectors.

4. A plate for an electorstatic condenser, having a line cut spaced from and concentric with the perimeter of a plate to form a narrow band, a plurality of bendable tangs punched up from the band, and a plurality of wave-shaped radiating line cuts extending to the first mentioned line cut to divide the plate into a plurality of bendable sectors.

5. In a variable electrostatic condenser, a bendable substantially semi-circular adjusting plate rotatable about an axis disposed from the center of curvature of the plate, said plate being divided into bendable sections by a plurality of wave shaped line cuts radiating from the axis of rotation.

6. In a variable electrostatic condenser, a bendable plate rotatable about an axis disposed from the center of curvature of the plate, said plate having a plurality of slots radiating from the axis, each of said slots having the shape of a plurality of connected waves which decrease in amplitude as they approach the axis.

This specification signed this 27th day of May, 1931.

PRESTON E. GILLING.