

Sept. 5, 1933.

C. F. WOLL

1,925,828

VARIABLE CONDENSER

Original Filed Sept. 10, 1930

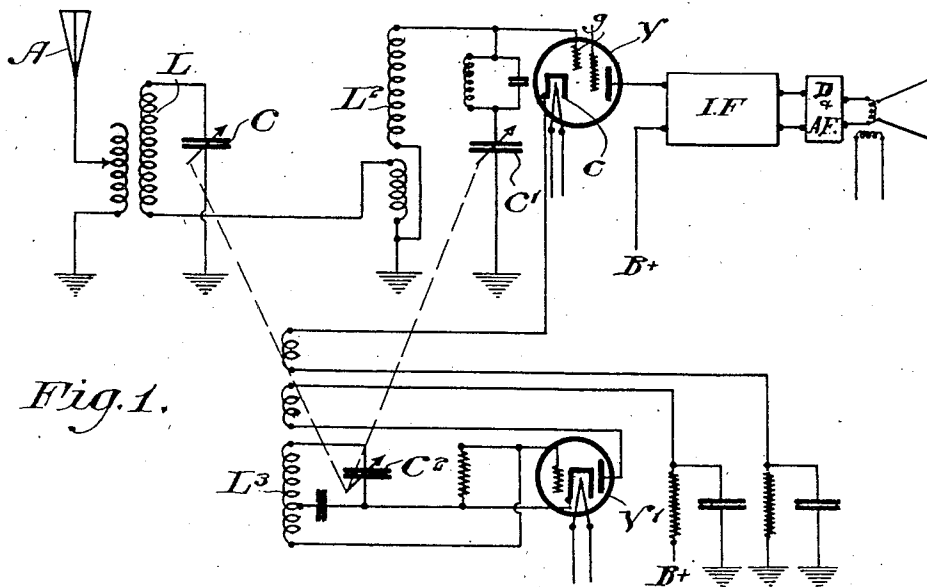


Fig. 1.

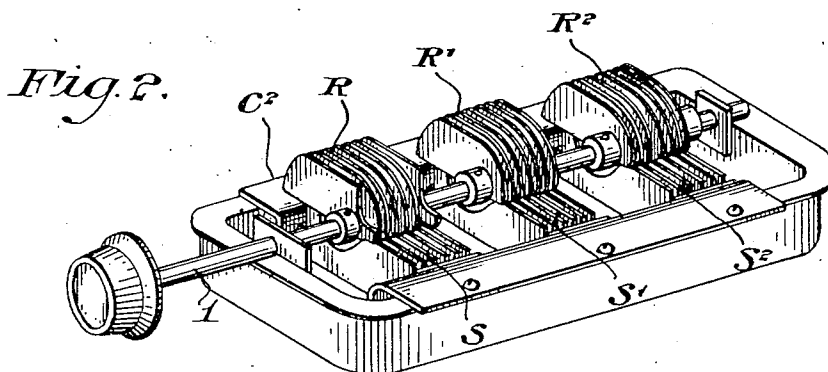


Fig. 2.

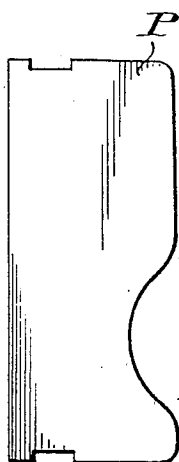


Fig. 3.

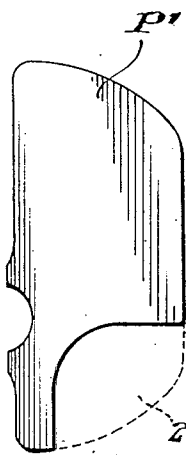


Fig. 4.

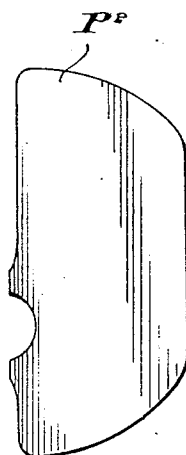


Fig. 5.

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1,925,828

VARIABLE CONDENSER

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Application September 10, 1930, Serial No. 480,868. Renewed March 13, 1933

4 Claims. (Cl. 175-41.5)

My invention relates to variable condensers of the type comprising interleaving rotor and stator plates utilizable for tuning circuits of radio receiving apparatus, and more particularly the signal selecting and oscillator circuits of a heterodyne receiver.

Heretofore, to effect more or less precise tracking of variable condensers whose rotors were mechanically connected for movement in unison, some of the plates, as rotor plates, were bent manually. In accordance with my invention, this expensive and tedious operation is made unnecessary by utilizing one or more plates, as of the rotor, which are provided with a cut-away portion.

More specifically, in superheterodyne receivers employing mechanically coupled condensers similar in capacity and rate of change of capacity, a constant frequency difference, corresponding to the intermediate frequency, was not maintained throughout the range of adjustment of the condensers, the frequency difference departing from the desired magnitude, particularly as the high frequency, or low capacity, end of the adjustment was approached. Substantially perfect tracking of the condensers for the maintenance of a constant frequency difference, is effected in accordance with my invention, by including in one or more of the coupled condensers, one or more plates, having a cut-away portion adjacent the low capacity end of the adjustment, that is, at the higher frequencies.

My invention resides in the features of construction and arrangement hereinafter described and claimed.

For an understanding of my invention and for illustration of condenser structure utilizing it, reference is to be had to the accompanying drawing in which:

Fig. 1 represents diagrammatically a superheterodyne radio receiver.

Fig. 2 in perspective illustrates a plurality of simultaneously adjustable condensers utilizable in the system of Fig. 1.

Fig. 3 is a plan view of the stator plates of the condensers of Fig. 2.

Figs. 4 and 5 are plan views of different types of rotor plates utilized in the condensers of Fig. 2.

Referring to Fig. 1, signals impressed upon

the antenna A are selected by cascaded circuits tunable by the condensers C and C1, and the selected energy at signal frequency is impressed upon the input electrodes *g* and *c* of the detector or mixer tube V1. There is also impressed upon the input circuit of the tube V oscillations locally generated by the tube V1 and associated circuits, the frequency of these locally generated oscillations being determined by the adjustment or setting of the condenser C2.

The signal energy in the output circuit of the tube V is amplified at beat frequency by the intermediate amplifier I. F. and thereafter rectified and amplified at audio frequency. The output of the audio frequency amplifier is impressed upon a loud speaker or other reproducer.

For simplicity, the circuits, tubes, current-supply, etc. of the intermediate amplifier, the second detector and audio-frequency amplifier have not been shown.

The pre-selecting circuits tunable by the condensers C and C1 and the oscillator arrangement shown are specifically of the type disclosed in co-pending Macnabb application Serial No. 470,557, filed July 25, 1930, although it will be understood that other known arrangements for signal selection and generation of local oscillations may be utilized.

The condensers C, C1 and C2 are mechanically coupled for movement in unison, more specifically the rotors are connected so that they all move to like extents for any given adjustment, the condenser C and C1 tuning to oscillations of signal frequency and the condenser C2 tuning the oscillator circuit so that the locally generated oscillations will be of proper frequency to interact with the signal oscillation to produce oscillations of beat frequency corresponding to the resonant frequency of the intermediate amplifier. As shown in Fig. 2 the rotors R, R1, and R2 of the condensers may be mounted upon a common adjusting shaft 1 suitably mounted for example, on a support for the stators S, S1 and S2 which cooperate with the rotors respectively.

The intermediate frequency amplifier may be resonant to a frequency corresponding to the difference between the signal frequency and the frequency of the locally generated oscillations. For example, the condensers C and C1 may tune

their associated circuits from 550 to 1500 kilocycles, the present broadcasting range, and with an intermediate frequency amplifier resonant at 130 kilocycles, the oscillator tuning condenser C2 is adjustable to produce frequencies varying from 680 to 1630 kilocycles. For proper operation, it is necessary that the difference between the oscillator frequency and the signal frequency be maintained constant at a value corresponding to the resonant frequency of the intermediate frequency amplifier.

It was found that when the condensers C, C1 and C2 were similar as to capacity and rates of change of capacities, and connected to properly chosen inductances (L, L2, L3), the difference frequency did not remain constant throughout the range of adjustment of the condenser rotors. Although the condensers were precisely made, and connected to carefully measured inductances, the resulting resonant circuits C L and C1 L2 did not track with C2 and L3 to give constant frequency differences, particularly at the higher frequencies. Although the frequency difference was constant, and equal to the intermediary frequency when the rotor and stator plates were interleaved to effect the higher magnitudes of capacity, as the rotors were adjusted for lower values of capacity, the difference frequency changed with the result that in view of the selective characteristic of the intermediate frequency amplifier, the amplification of the beat-frequency oscillations was greatly reduced, and in some cases practically eliminated. In any event the final output was greatly reduced.

Prior to my invention, to effect more or less precise tracking of the condensers to insure constant frequency differences it was necessary to bend the condenser plates of each receiver until the desired result was obtained or approximated. In accordance with my invention, this expensive and tedious bending of rotor blades is obviated. Precise tracking of the condensers to effect constant frequency differences throughout their adjustment, and including the higher frequency end of the range, may be obtained by including in the rotor assembly R of one or more of the coupled condensers, preferably of the oscillator tuning condenser C2, one or more plates P1, Fig. 4, having a cut-away portion 2, a reentrant notch, adjacent the low capacity end of the plate. In the particular receivers constructed, it was sufficient to replace the two outside rotor plates of the condenser C2 having the shape shown in Fig. 5, by the modified shape of plate P1 of Fig. 4. The remaining plates of the rotor R and all of the rotor plates of C and C1 are of the same size and shape and correspond to the plate P2 of Fig. 5. The stator plates of all the condensers may be similar in size and shape, for example, they may correspond to Fig. 3. Without this change, the condensers C, C1 and C2 are similar in capacity and rates of change of capacity.

The condensers are preferably of the type described and claimed in co-pending Kent application Serial No. 458,185, filed May 31, 1930, of which it is characteristic that the rotor and stator plates are of simple shapes, each comprising parallel straight sides, materially reducing the waste when stamped from sheet or strip stock. The axis of the rotors is offset to one side and in such position that as the plates interleave the change of capacity per unit of rotor

movement from position of minimum capacity is less than in condensers having a straight line capacity characteristic, and in the region of maximum capacity, the change of capacity per unit of movement of the rotors is greater than in the case of a condenser having a straight line capacity characteristic. Notwithstanding the unusual shape of the condenser plates and the position of the rotor axis, the characteristic representing change of capacity with rotor movement is smooth or without abrupt changes.

While my invention has been described as of particular utility in effecting tracking of mechanically coupled condensers in a superheterodyne receiver, it will be understood that it may be utilized to advantage when the condensers are used in circuits of a different type, to ensure the desired frequency relation between the circuits tunable respectively by the condensers. The number of condensers will, of course, vary, depending upon the number of tunable circuits for which simultaneous adjustment is desired.

For example, there may be two condensers, at least one of which includes one or more plates of modified shape or there may be more than three condensers, one or more of whose rotors include plates of modified shape to ensure tracking.

What I claim is:

1. In a heterodyne receiving system having signal-selecting and oscillator circuits, variable condensers in said circuits comprising interleaving rotor and stator plates, means mechanically coupling the rotors of said condensers to effect like extents of movement thereof in unison, and means for insuring constant difference between the frequencies of the oscillator and signal-representing currents as said condensers are adjusted in unison comprising, in at least one of said condensers, at least one plate having a notch, reentrant from the edge of the plate, reducing the plate area to substantial extent.
2. In a heterodyne receiving system having signal-selecting and oscillator circuits, variable condensers in said circuits comprising interleaving rotor and stator plates, means mechanically coupling the rotors of said condensers to effect like extents of movement thereof in unison, and means for insuring constant difference between the frequencies of the oscillator and signal-representing currents as said condensers are adjusted in unison comprising, in the oscillator tuning condenser, at least one rotor plate having a notch, reentrant from the edge of the plate, reducing the plate area to substantial extent in the low capacity range of its adjustment.
3. In a heterodyne receiving system having signal-selecting and oscillator circuits, variable condensers in said circuits comprising interleaving rotor and stator plates, means mechanically coupling the rotors of said condensers to effect like extents of movement thereof in unison, both the rotor and stator plates of one of said condensers having straight parallel long sides, the axis of rotation disposed adjacent a long side of a rotor plate and offset from the middle of said long side, and means for insuring constant difference between the frequencies of the oscillator and signal-representing currents as said condensers are adjusted in unison comprising, in said one of said condensers, at least one rotor plate of the character aforesaid having a notch reentrant from the edge of said

plate, reducing the plate area to substantial extent in the low capacity range of its adjustment.

4. In a heterodyne receiving system having
5 signal selecting and oscillator circuits, variable
condensers in said circuits having similar rotor
plates and similar stator plates, means mechan-
ically coupling the rotors of said condensers to
effect like extents of movement in unison, and

means for insuring constant difference between
the frequencies of the oscillator and signal-rep-
resenting currents as said condensers are ad-
justed in unison comprising, in at least one of
said condensers, at least one rotor plate having
a notch reentrant from the low capacity end of
the plate. 80

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