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J. L. BONANNO

2,040,426

CONSTANT BAND WIDTH RECEIVER

Filed Aug. 20, 1929

Fig. 1

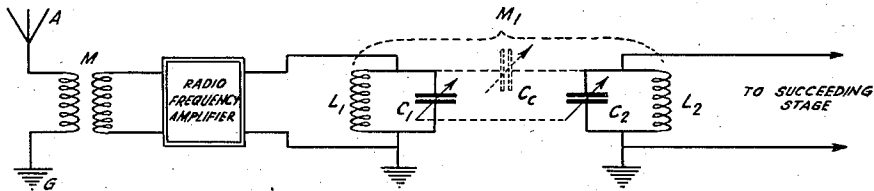


Fig. 2

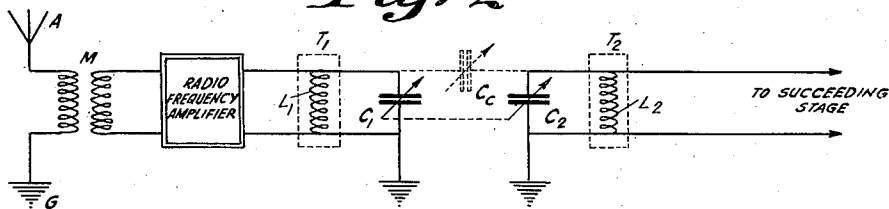


Fig. 3

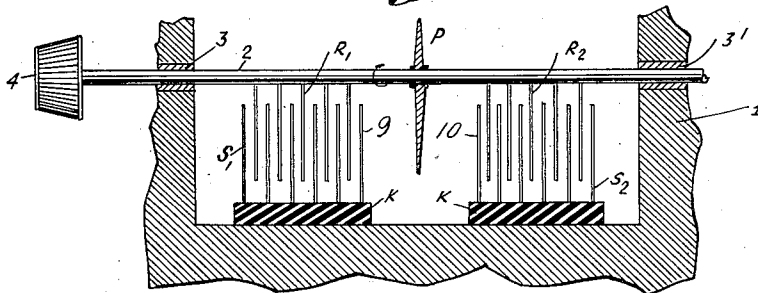


Fig. 3a

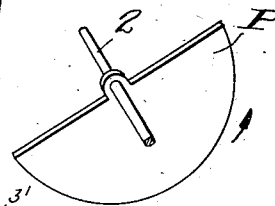


Fig. 4

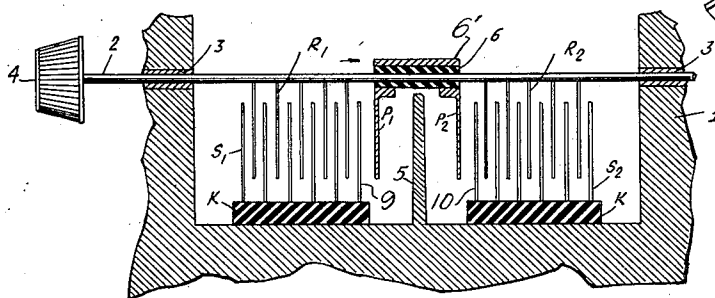
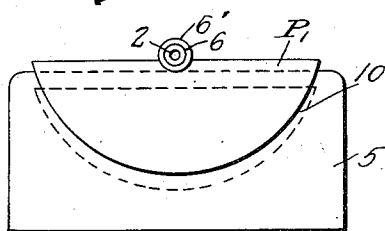


Fig. 4a



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CONSTANT BAND WIDTH RECEIVER

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10 Claims. (Cl. 178—44)

My present invention relates to couplings for radio circuits, and, more particularly, to a method of, and means for, maintaining a constant band width in a radio receiver.

When employing either pure magnetic or capacity coupling between radio circuits, it is found that the coupling increases more rapidly at higher resonant frequencies than is desired. It has been determined, however, that by combining magnetic and capacity coupling in proper phase relation the capacity coupling can be made to diminish the total coupling so that an improved resonance curve results at the high frequency end of the range.

Now, I have devised a method of obtaining a constant coupling between a pair of radio circuits, or, generically considered, a method of obtaining any desired rate of variation of coupling, as the resonance frequency is varied, and this method is one of the main objects of my present invention.

Another important object of the invention is to provide a radio receiver comprising a plurality of circuits tuned by means of a gang of condensers, in which the shielding effect of an element, usually a rotor, is employed to vary the inter-stator capacity of adjacent end stator plates of adjacent condensers.

Another important object of the invention is to provide a radio receiver including a plurality of tunable circuits, a gang of condensers for tuning the circuits, said gang including a rotatable plate between a predetermined pair of stators, the capacity between the stators being thereby variable and controlled by the rotor to secure a predetermined coupling between said circuits at any frequency.

Still another object of the invention is to provide a radio receiver including a plurality of circuits tuned by a gang of condenser groups, the gang having at least one grounded rotor plate between each pair of condenser groups, the rotor plate being designed in any predetermined shape to secure a desired variation of capacity coupling between said tuned circuits throughout the frequency range whereby a predetermined resonance curve is secured over said range.

Other objects of the invention are to improve generally the simplicity and efficiency of tuned circuit couplings, and to provide a coupling for radio circuits which is reliable in operation, follows a predetermined law of variation through a given frequency range, and is economical to manufacture.

The novel features which I believe to be char-

acteristic of my invention are set forth in particularity in the appended claims, the invention itself, however, as to both its organization and method of operation will best be understood by reference to the following description taken in connection with the drawing in which I have indicated diagrammatically several circuit organizations whereby my invention may be carried into effect.

In the drawing,

Fig. 1 shows schematically a circuit employing combined transformer and variable capacity coupling.

Fig. 2 is a diagrammatic view of a circuit solely employing variable capacity coupling.

Fig. 3 is a sectional view of a gang condenser embodying one form of the present invention.

Fig. 3a shows a side elevation of the plate P, in isometric.

Fig. 4 is of a sectional view of a gang condenser embodying a modified form of the invention.

Fig. 4a is a side elevation looking in the direction of the arrow in Fig. 4.

Referring to the accompanying drawing in which like characters of reference indicate the same parts in the different figures, there is shown in Fig. 1 a receiving circuit including combined transformer and capacity coupling between tuned radio frequency stages. A grounded antenna circuit A, G is coupled, as at M, to a conventional radio frequency amplifier, the output of the latter being coupled, as at M₁, to the input circuit of the succeeding stage.

The output circuit of the first radio stage includes an inductance L₁, tuned by a variable condenser C₁, the latter having its rotor plates R₁ grounded. The secondary coil L₂ of the transformer coupling M₁ is tuned by a variable condenser C₂, the latter being connected in parallel with the coil, the rotors R₂ of the condenser also being grounded. The rotor plates R₁ and R₂ of the two condensers are mounted on a common shaft, in practice.

As explained, heretofore, by properly combining the capacity coupling C_c, between the end stator plates of adjacent condensers C₁ and C₂, and the transformer coupling M₁, in the proper phase relation, the capacity coupling C_c can be made to decrease the total coupling so that an improved shape of resonance curve results at the high frequency end of the working range. In other words, the capacity coupling and magnetic coupling M₁ are to be combined in opposite phase. The coils L₁ and L₂ are poled, of course, for

proper phase. It follows, then, that with a given set of coils one has merely to pole, or connect, the coils relatively to each other in the sense that transfers the least power.

5 In Fig. 2, I have shown a method of coupling radio frequency circuits to produce a constant band width throughout the frequency band of the receiver, no magnetic coupling being employed. The arrangement shown consists of a
10 grounded antenna circuit A, G coupled, as at M, to a conventional radio frequency amplifier, the output of the latter being coupled to the input of the succeeding stage solely by capacitive means.

15 The coils L_1 and L_2 are the inductances of the coupled stages, and the condensers C_1 and C_2 are their respective tuning capacities. No magnetic coupling exists between the coils, the shields T_1 and T_2 being shown in dotted lines, coupling being
20 accomplished solely by the capacity C_c . It is understood, of course, that the rotors of C_1 and C_2 are mounted on a common shaft, and that the capacity C_c represents the inter-stator capacity of the end stator plates of the two condensers C_1
25 and C_2 , variation of C_c being secured by a rotatable plate mounted on the said common shaft.

In Fig. 3, there is shown a structural embodiment of the capacities C_1 , C_c , C_2 . The stators S_1 and S_2 of the condensers C_1 and C_2 are supported
30 on insulation spacers K. The casing 1 of the condensers is of a bath-tub shape, and is made of metal. A metallic rotor shaft 2 is supported in bearings 3, 3', and is actuated by a knob 4.

The rotor plates R_1 and R_2 mesh with their
35 respective stators S_1 and S_2 , the former being affixed to the shaft 2 for rotation therewith, in the usual manner. Between the end stator plates of the two sections of the gang condenser, there is disposed a metallic rotor P, which is grounded
40 through the bath-tub shell 1 because it is directly connected to the metallic shaft 2.

Thus, in Fig. 3, there is disclosed a gang condenser of the grounded rotor type, the capacity
45 between the stators of the condenser groups being equal to, or greater than, the maximum required at any frequency. This coupling capacity C_c is decreased to suit the circuit requirements, at various frequencies, by interposing a grounded, variable shield, i. e., the grounded rotor plate P,
50 between the end stators 9 and 10.

In Figure 3a, the plate P is shown in isometric side elevation, it being understood that any desired contour may be assigned to the plate. For
55 example, those skilled in the art may readily realize that if the plates R_1 and S_1 are semi-circular, then a contour for the plate P, as shown in Figure 3a will result in a decrease in capacity
60 between plates 9 and 10 as the plates R_1 and R_2 mesh with stator plates S_1 and S_2 , assuming that the plate P moves in the direction of the arrow, shown in Figures 3 and 3a, as the plates R_1 and R_2 move into mesh and in the opposite direction.

In Fig. 4, I have shown a second form of gang condenser, embodying the present invention, the
65 normal coupling between stators being practically zero, due to the grounded metallic partition 5, between the end stators 9 and 10. The construction of this gang condenser is practically the same as in Fig. 3, similar parts being designated
70 by corresponding reference numerals and letters.

The normal capacity coupling C_c , between the end stators 9 and 10 being zero, in Fig. 4, the coupling may be increased, and made any desired

value, by the metallic rotor plates P_1 and P_2 , mounted on the shaft 2.

Between the end stator of each gang section and the partition 5, is disposed a rotor plate. Thus, plates P_1 and P_2 are provided for varying
5 the coupling capacity between the end stators of the gang sections. The plates P_1 and P_2 connected by sleeve 6' are mounted on an insulating bushing 6, the bushing being concentric with the rotor shaft 2. In Figure 4a is shown the relation
10 between the areas of the partition 5, the plates P_1 and P_2 , and the stator plates 9 and 10.

Plates P , P_1 and P_2 can be given any desired shape, the latter being such that the plates cooperate with the exposed stator end plates to vary
15 the capacity C_c , according to any desired law. In Fig. 4, practically all of the capacity coupling is determined by the plates P_1 and P_2 , because of the shielding partition 5. It will, of course, be understood that any predetermined combinations
20 of variable and fixed capacitances may be used to secure the desired coupling capacity at any frequency.

It is to be understood that the condensers shown in Figs. 3 and 4 may be used interchangeably
25 in either of the circuits shown in Figs. 1 and 2. Thus, according to my invention, I have provided two systems of coupling, both including variable capacitive coupling, and two novel modes of securing the variation in capacitive
30 coupling, one of the systems embodying a variable coupling secured both by magnetic and capacitive coupling, the capacitive coupling being obtained for example, by inter-stator capacity controlled by a grounded plate rotating with the gang
35 condenser shaft; the other system embodying a variable coupling secured solely by capacitive coupling, the latter being obtained, as a modification of the first mode, by inter-stator capacity controlled by a plate rotating with the gang
40 condenser shaft, but insulated therefrom, it being particularly noted that the two modes of varying capacitive coupling are equally adapted for use with either of the said two systems.

While I have indicated and described several
45 systems for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organizations shown and described, but that many modifications in the circuit arrangements,
50 as well as in the apparatus employed, may be made without departing from the scope of my invention as set forth in the appended claims.

What I claim is:

1. A high frequency network comprising a pair
55 of resonant oscillation circuits having fixed inductors with substantially zero mutual inductances between them, variable tuning condensers connected to said inductors having a mutual capacitance between stator elements
60 thereof, said capacitance providing electrostatic coupling between said circuits, a single means for simultaneously adjusting said tuning condensers, and means controlled by said single adjusting means for varying said electrostatic coupling between the resonant circuits.

2. The invention defined in the preceding claim wherein the electrostatic coupling means is simultaneously varied with the tuning in a predetermined manner.

3. The invention defined in claim 1 wherein the electrostatic coupling means comprises an earthed rotor plate which is mounted upon the single adjusting means and which is adapted to operate as a variable shielding member between
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stator elements providing the aforesaid mutual capacitance.

4. A high frequency network comprising a pair of resonant oscillation circuits having fixed inductors, variable tuning condensers connected to said inductors having a mutual capacitance between stator elements thereof, said capacitance providing electrostatic coupling between said circuits, a single means for simultaneously adjusting said tuning condensers, and means controlled by said single adjusting means for varying said electrostatic coupling between the resonant circuits, said electrostatic coupling means comprising an earthed rotor plate which is mounted upon the single adjusting means and which is adapted to operate as a variable shielding member between stator elements providing the aforesaid mutual capacitance.

5. A high frequency network comprising a pair of resonant oscillation circuits having fixed inductors, means for shielding said inductors whereby there exists substantially zero mutual inductance between them, variable tuning condensers connected to said inductors having a mutual capacitance between stator elements thereof, said capacitance providing electrostatic coupling between said circuits, a single means for simultaneously adjusting said tuning condensers, and means controlled by said single adjusting means for varying said electrostatic coupling between the resonant circuits.

6. A high frequency network comprising a pair of oscillation circuits, each provided with a variable condenser having rotors and stators, a common mechanical control for the condenser rotors of both circuits, and means operatively connected with the common control to variably adjust the capacity coupling provided between adjacent end stators of said condensers, said capacity coupling providing the sole energy transfer path between said oscillation circuits.

7. A high frequency network comprising a pair of oscillation circuits, each provided with a variable condenser having rotors and stators, a common mechanical control for the condenser rotors of both circuits, and means operatively connected with the common control to variably adjust the capacity coupling provided between predetermined stators of said condensers, said capacity coupling providing the sole energy transfer path between said oscillation circuits, an inductance

coil included in each of said circuits, said two coils having substantially zero mutual inductive coupling between them.

8. A high frequency network comprising a pair of oscillation circuits, each provided with a variable condenser having rotors and stators, a common mechanical control for the condenser rotors of both circuits being adjacent each other to function as a tuning unit, and means operatively connected with the common control to variably adjust simultaneously with tuning the capacity coupling provided between predetermined stators of said condensers, said capacity coupling providing the only energy transfer path between said oscillation circuits, an inductance included in each oscillation circuit, and means for preventing magnetic coupling between said inductances.

9. A high frequency network comprising a pair of oscillation circuits, each provided with a variable condenser having rotors and stators, a common mechanical control for the condenser rotors of both circuits being adjacent each other to function as a tuning unit, and means operatively connected with the common control to variably adjust the capacity coupling provided between predetermined stators of said condensers, said capacity coupling providing an energy transfer path between said oscillation circuits, said coupling adjusting means comprising an electrostatic shield interposed between said predetermined stators and movable relatively thereto upon adjustment of said common control.

10. A high frequency network comprising a pair of oscillation circuits, each provided with a variable condenser having rotors and stators, a common control shaft for the condenser rotors of both circuits being adjacent each other to function as a tuning unit, and means operatively connected with said control shaft to variably adjust the capacity coupling provided between predetermined stators of said condensers, said capacity coupling providing an energy transfer path between said oscillation circuits, an electrostatic shield disposed between the said predetermined stators, said coupling adjusting means comprising a conductive element electrostatically coupling said predetermined stators, said element being insulatingly mounted upon said common control shaft.

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