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P. G. WEILLER

RADIO RECEPTION

Filed April 23, 1924

*Fig. 1,*

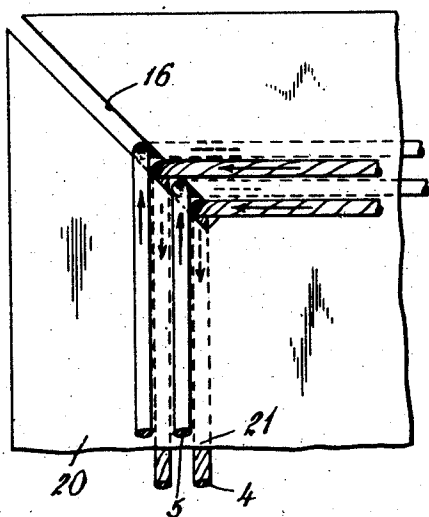


*Fig. 2,*

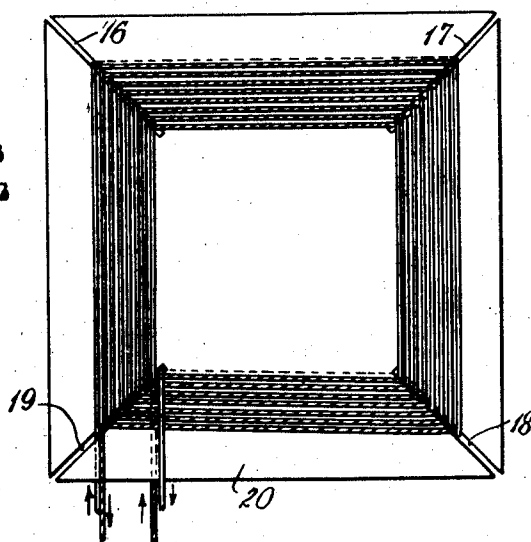
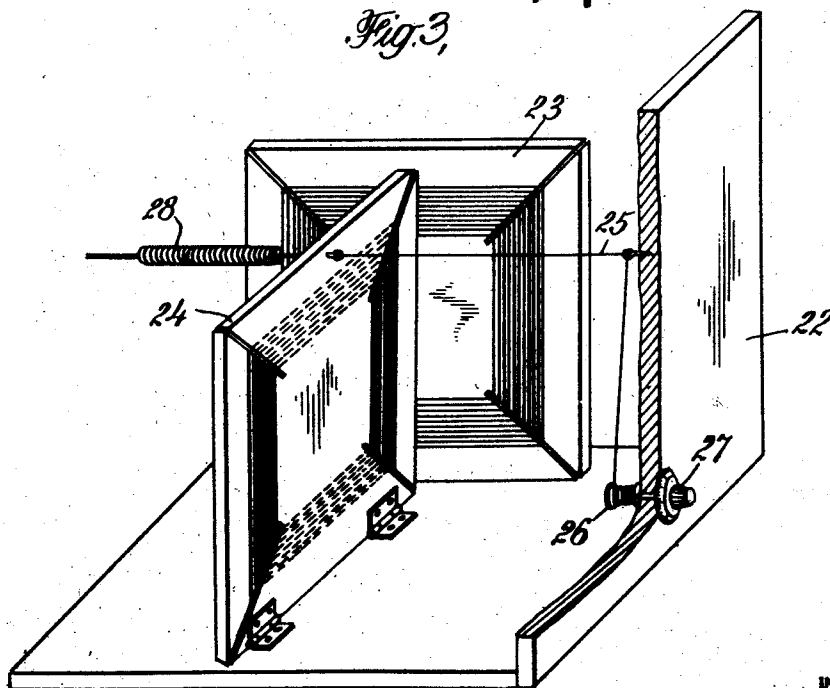


*Fig. 3,*



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## UNITED STATES PATENT OFFICE.

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## RADIORECEPTION.

Application filed April 23, 1924. Serial No. 708,341.

This invention relates to the reception of wireless telephone and telegraph signals by means of vacuum tubes and associated tuning circuits.

It is the object of the present invention to provide an improved circuit arrangement for the reception of wireless signals whereby selectivity and ease of control are greatly increased and distortion of the received signal is materially reduced.

In this improved form of receiver vacuum tubes of the three-electrode type are employed. An inductance is connected in the usual manner in the grid-filament circuit, and this inductance is closely coupled to another inductance of approximately the same value which is connected at one end to the plate of the vacuum tube. When this inductance is connected directly to the plate, the telephones and source of energy for the plate circuit are connected between the filament and plate in the usual manner. The tuning of the grid and plate circuits is preferably accomplished by means of a single variable condenser which is connected either across the grid inductance or across the plate inductance. It is possible for this single condenser to tune both circuits simultaneously by virtue of the close coupling of the grid and plate inductances. The incoming energy is supplied to the grid circuit through an inductance which is loosely coupled to the combined grid-plate inductances. This loosely coupled inductance may be in the antenna circuit or other circuit from which the energy to be received is supplied.

If the relative values of the component parts of these receivers are correct, the vacuum tube will normally oscillate, and the variation of the single condenser will serve to vary the frequency of the oscillations. The variation of the coupling between the antenna inductance and the grid inductance will serve to control the oscillations in the vacuum tube circuits, but will not materially vary the tuning of these circuits if the inductive and capacity coupling between the antenna inductance and the grid inductance is sufficiently small. Better control of the oscillations is obtained by coupling to either the grid or the plate inductance, or both, an inductance shunted by a variable high resistance. When the resistance is adjusted to the correct value, oscillation of the tube will cease, but the received signal intensity will be undiminished. Apparently any absorp-

tion of energy by this control circuit is offset by the increased voltage on the grid due to change in phase between the received voltage and current caused by the resistance.

In order to receive a signal of an unknown wave length with this receiver, the single variable condenser is varied until the characteristic beat notes of autodyne reception are heard, and the condenser is then set so that the receiver is tuned between the beat notes of the received signal. The antenna circuit is then tuned until the maximum of energy is received. The antenna coupling may then be varied until the oscillation of the receiver ceases. Or the oscillation of the receiver can be eliminated by adjusting the resistance across the inductance associated with the grid or plate circuit until the correct value is found.

The ordinary regenerative receiver when tuned by the zero beat method, that is when both plate and grid circuits are tuned alike, is extremely critical, and gives great distortion of the received signal. With the present circuit, however, there is no difficulty in tuning, as there is but one tuning control (aside from any antenna tuning that may be provided) and the other control serves merely to eliminate the oscillation which causes the distortion in an ordinary regenerative receiver.

This invention is readily adapted to radio frequency amplification, and makes such amplification possible without distortion or disturbing oscillation. The change from the circuit just described is small. A choke coil is substituted for the telephones, and either end of the plate inductance is connected through a condenser to the grid of another vacuum tube which may be used as a detector. In this circuit arrangement it is particularly advisable to utilize an inductance associated with the grid or plate inductance of the radio frequency tube and shunted by a variable high resistance to control the oscillations of the radio-frequency tube and thus prevent distortion.

It has been found that particularly good operation can be obtained with the specially wound coils herein claimed and wherein the grid and plate coils are simultaneously wound on the same form. This will be more particularly described hereinafter, but it is to be understood that the invention is not limited to this particular embodiment.

A clearer understanding of the invention may be had from the following description of the preferred embodiment illustrated in the accompanying drawings.

5 In these drawings,

Fig. 1 illustrates in detail a preferred form of winding for the closely coupled grid and plate coils;

10 Fig. 2 illustrates the completely wound grid and plate coils; and

Fig. 3 shows the antenna inductance coupled to the combined grid and plate inductances and means for varying the coupling between these circuits.

15 It has been found that the operating characteristics of the circuit are especially good when the inductances are wound as illustrated in Fig. 1. Diagonal slots such as 16 of Fig. 1 (16, 17, 18, 19 of Fig. 2) are cut in a dielectric frame 20. The two coils are then wound on this framework in the manner illustrated in Fig. 1. The winding of the grid coil 4, for example, is begun at 21, and the winding of the plate coil 5 is begun on the opposite side of the frame but close to the grid coil. When the slot 16 is reached, the coil 4 is led through the slot and continues along the obverse side of the frame, whereas the coil 5 is led through the slot and continues along the reverse side of the frame. When the slot 17 is reached, the opposite procedure takes place and the coils are thus wound side by side but on opposite sides of the framework. The winding thus continues until the desired amount of inductance is wound on the frame. It has been found that this method of winding gives a very compact inductance element in which the inductive coupling is approximately 80% and the capacity coupling is sufficient to give the desired characteristics to the plate and grid circuits and make it possible to tune them to the same frequency simultaneously by one condenser.

45 It is to be understood, of course, that these coils may be wound on a frame having more than four slots in it.

50 In Fig. 3, 22 represents the side of a container for this radio receiving set within which the combined antenna and grid inductances 23 and the antenna inductance 24 are mounted. The antenna inductance 24 is placed at right angles to the inductances 23 and is hinged at the bottom to permit of movement with respect to the inductance 23. This movement is secured by means of a small cord 25 which is wound on a reel 26 prefer-

ably controlled from the outside of the cabinet by means of a knob 27. The spring 28 tends to maintain the inductance 24 in its normal vertical position. This arrangement 60 of apparatus has been found to give particularly good results, but it is not intended to limit the present invention in any way to the embodiment illustrated.

I claim:

65 1. A combined inductance for the grid and plate circuits of a vacuum tube receiver comprising a frame having a plurality of radial slots therein, a wire wound on said frame beginning at the center and alternating from 70 one side of the frame to the other at each slot, a second winding begun simultaneously with said first winding and from the same point but on the opposite side of said frame and continuing with said first mentioned 75 winding but always on the opposite side of said frame.

2. A combined inductance comprising a flat support having an even number of substantially radially disposed slots and two 80 windings engaged in said slots with the turns of one overlying the turns of the other and disposed at opposite sides of the support.

3. A combined inductance comprising two windings wound in zigzag fashion to opposite sides of a common plane with the turns of one winding supported on the turns of the other winding at the points of crossing from one side to the opposite side of the common plane and with the sections of the two windings between such crossings disposed to opposite sides of the common plane. 85 90

4. A combined inductance comprising a grid winding and a plate winding arranged in non-variable closely coupled relation with each turn of one winding immediately overlying a turn of the other winding and crossed to opposite sides of an intermediate plane to position the adjacent sections of the two windings substantially parallel at opposite 100 sides of the intermediate plane.

5. A combined inductance made up of a plurality of windings crossed in the course of each turn to opposite sides of an intermediate plane with the turns of one winding supported on the turns of the other winding at such points of crossing and adjacent sections of the different windings at opposite sides of the intermediate plane. 105

In witness whereof, I have hereunto set my hand this 12th day of April, 1924. 110

PAUL G. WEILLER.