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H. F. ELLIOTT

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STABLE RECEIVING SYSTEM

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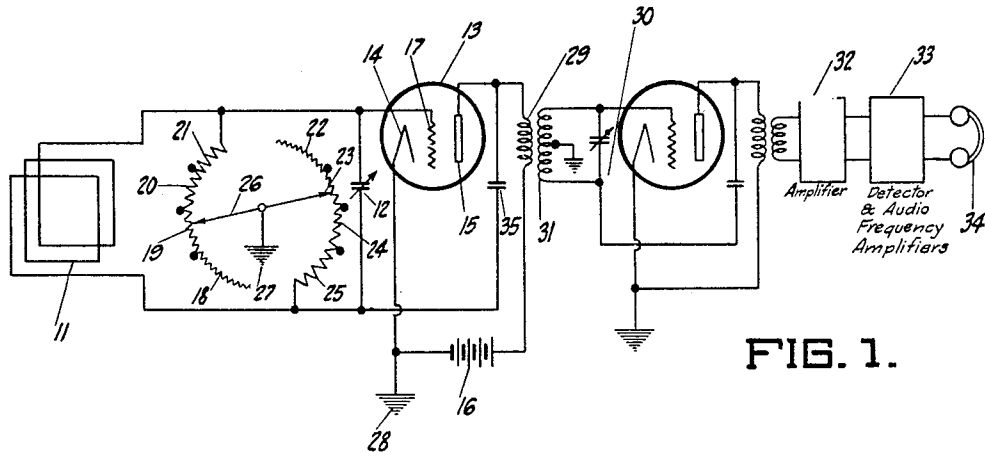


FIG. 1.

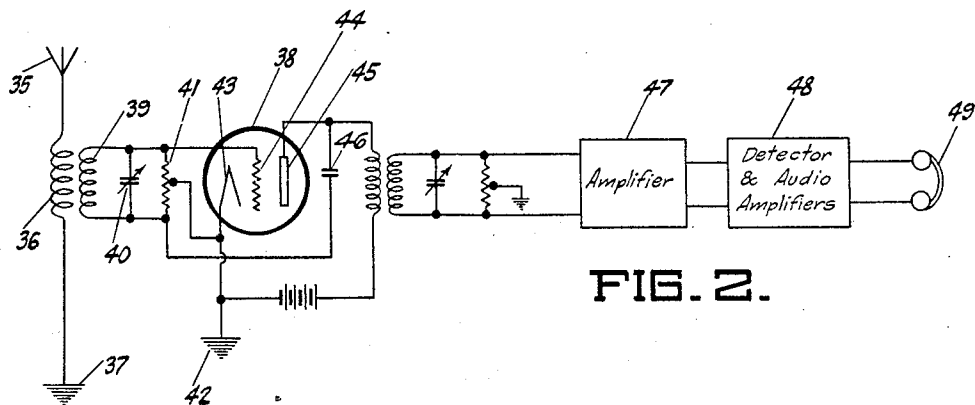


FIG. 2.

INVENTOR

Harold F. Elliott

BY

John Flam

HIS ATTORNEY

UNITED STATES PATENT OFFICE

HAROLD F. ELLIOTT, OF PALO ALTO, CALIFORNIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO RADIO CORPORATION OF AMERICA, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

STABLE RECEIVING SYSTEM

Application filed March 13, 1928. Serial No. 261,310.

This invention relates to radio receiving systems, and particularly to such systems that utilize one or more stages of radio frequency amplification.

It is now common to utilize electronic emission devices for the amplifier stages. Such devices, when amplifying the feeble impulses received by the set at radio frequency, have been found to be unstable. It was discovered that this instability was caused by the parasitic capacity coupling between the electrodes of the device, which caused undesired oscillations to be produced.

To overcome this instability, various expedients have heretofore been proposed and used; such for example as circuits which aimed to neutralize these capacity effects. In many instances such circuits have given satisfaction; but frequently they do not and cannot give good stability. It is accordingly one of the objects of my invention to improve the degree of stability of such systems.

It is another object of my invention to provide a simple and compact arrangement that provides this stability and that also serves effectively as a volume control for the receiving set.

My invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of several embodiments of my invention. For this purpose I have shown a few forms in the drawings accompanying and forming part of the present specification. I shall now proceed to describe these forms in detail, which illustrate the general principles of my invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of my invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a schematic wiring diagram showing one form of my invention; and

Fig. 2 is a diagram of a modification thereof.

In Fig. 1, I show my invention as applied to a system utilizing a loop 11 for the pick-up system. This loop is bridged by a variable condenser 12 to form a tunable radio frequency circuit. This circuit is arranged to

affect an amplifier 13 of the electronic emission type. This amplifier includes the usual sealed and evacuated envelope, in which there are a plurality of electrodes. One of these is an electron emitting electrode, such as a heated filament 14; and another, spaced therefrom, is an anode or plate 15 which receives the electrons emitted from filament 14. This anode is kept at a potential positive with respect to filament 14, as by the aid of a battery 16 that is in a circuit connecting these two electrodes externally.

It has been found that the "space current" formed between these two electrodes by the emission of electrons can be accurately controlled in accordance with the impulses to be amplified, as for example by the use of a control electrode or grid 17 that is sealed in the tube 13 and that affects the path of the electrons. Thus if there be variations in potential differences between the grid 17 and filament 14, which variations correspond to the signaling impulses, then there are corresponding augmented variations in the electron emission. It is this property that is utilized to provide amplification.

A serious drawback to such amplifiers has been the effect of the capacity between the grid 17 and plate 15, which causes instability. In accordance with my invention, this instability is corrected in a novel manner. For this purpose, I provide a bridging non-inductive resistance across loop 11, so arranged that its center point is connected at all times to filament 14. Thus there are two sets of resistances, one including a series of sections such as 18, 19, 20, and 21; and the other, a series of sections such as 22, 23, 24, and 25. A variable contacting arm 26 connects to similar points on both sets, and is grounded as shown at 27. The movement of the arm 26 maintains both sets of resistances always at the same value, although the total resistance is varied. The filament 14 is also grounded, as shows at 28; it is evident therefore that it is connected, by way of grounds 27 and 28, to a central point on the resistance bridging loop 11.

One terminal, such as the upper one, of loop 11 is connected to grid 17, and thus the

connections to the input electrodes 14 and 17 are completed. The output circuit, connecting electrodes 14 and 15, includes in addition to battery 16, the coil 29 by the aid of which the amplified impulses in this output circuit are transferred either to further amplifier stages or to a detector. An amplifier stage 30 is shown in the present instance, coupled by coil 31 to coil 29, and having its output shown as coupled to still further amplifiers 32. In turn this amplifier passes its impulses to a detector and if desired, to one or more stages of audio frequency amplifiers. The detector and these amplifiers are all indicated diagrammatically at 33. Thence the impulses can be conducted to a translating device, such as a loud speaker or phones 34. Since such detecting and amplifying systems are well-known, further elucidation thereof is unnecessary.

A stabilizing circuit extends from the lower terminal of loop 11 to anode 15, and includes a small sized condenser 35. The capacity of this condenser is made substantially equal to the capacity between grid 17 and plate 15. This parasitic capacity, capacity 35, and the resistances controlled by arm 26 form a balanced, symmetrical bridge circuit, having two equal parts, each part including a resistance and a capacity. Therefore the output circuit which connects to symmetrical points on the bridge (that is, between ground 28 and plate 15) is equally and oppositely affected thereby.

I have found that this system of stabilization effectively prevents parasitic oscillations, and is independent of closely coupled inductances which were necessary in prior forms of neutralizing systems. Furthermore, it is easily adaptable to loop pick-up systems. There is no chance, in such loop systems, for circulating currents to be set up therein, as might be the case if a centre tap be used on the loop 11, such as has been used in prior systems.

The variable resistance across loop 11 formed by sections 18 to 25 forms in addition a convenient volume control. As less and less resistance is included by rotating arm 26 in a clockwise direction, less and less energy is permitted to influence the amplifier 13. Preferably the sections 18 to 21 are tapered as well as sections 22 to 25, to effect a uniform volume control. Thus for example, sections 18 and 22 can each have say, 100,000 ohms resistance; sections 19 and 23, about 10,000 ohms; sections 20 and 24, about 1,000 ohms; and sections 21 and 25, about 100 ohms. Thus the resistance shunting loop 11 is at first rapidly decreased, and more slowly as the arm 26 moves in a clockwise direction.

The same system of stabilization can be used for the usual open circuit type of pick-up. Thus in Fig. 2, a pick-up circuit 35, 36, 37 is shown, having the elevated conductors

35, coupling coil 36, and ground 37. A tunable circuit 39—40 is coupled to the pick-up circuit, and is bridged by a large resistance 41, grounded at its central point as shown at 42. The filament 43 of amplifier 38 is also connected to this central point. The grid 44 is connected to one terminal of coil 39, and the other terminal of coil 39 connects to plate 45 by way of a stabilizing circuit including capacity 46. In this system, resistance 41 is the equivalent of the sets of resistances 18 to 25 of Fig. 1. In all other respects the two systems operate substantially the same.

The first amplifier stage of Fig. 2 is coupled to succeeding stages if desired, the further amplifiers being indicated at 47. These amplifiers can be stabilized just as the first stage, and can pass the amplified impulses to the detector and audio frequency amplifiers 48. In turn, the output from this amplifier system can be connected to a translating device, such as a loudspeaker or phones 49.

I claim:

1. In apparatus of the class described, the combination of an amplifier having input and output electrodes, a resistance, an input circuit for said amplifier connecting one terminal and an intermediate point of said resistance to said amplifier, a circuit including capacity connecting the other terminal of said resistance to said output electrode, and means for varying said resistance to control the amount of energy delivered to said amplifier by said input circuit.

2. In apparatus of the class described, an oscillating circuit, a non-inductive resistance shunted across said circuit, means for varying said resistance, an amplifier having input and output electrodes, an input circuit for said amplifier connecting one terminal and an intermediate point of said resistance to said amplifier, and a stabilizing circuit including capacity connecting the other terminal of said resistance to said output electrode.

3. In apparatus of the class described, the combination of an amplifier having input and output electrodes, a resistance, an input circuit for said amplifier connecting one terminal and the central point of said resistance to said amplifier, a circuit including capacity connecting the other terminal of said resistance to said output electrode, and means for simultaneously and equally varying the two halves of said resistance.

4. In apparatus of the class described, an oscillating circuit, a non-inductive resistance shunted across said circuit, an amplifier having input and output electrodes, an input circuit for said amplifier connecting one terminal and the central point of said resistance to said amplifier, a stabilizing circuit including a capacity connecting the other terminal of said resistance to said output electrode,

and means for simultaneously and equally varying the two halves of said resistance.

5. In apparatus of the class described, an amplifier having a grid, filament and plate, a resistance having its central point connected to said filament, neutralizing means connected to said plate, the opposite terminals of said resistance being connected to said grid and neutralizing means, and movable contacts for varying the amount of resistance in circuit between said central point and said grid and said neutralizing means respectively.

6. In apparatus of the class described, an amplifier having a grid, filament and plate, a resistance having its central point connected to said filament, a neutralizing capacity connected to said plate, means connecting opposite terminals of said resistance to said grid and capacity, movable contacts for varying the amount of resistance in circuit between said central point and said grid and said capacity respectively, and means for simultaneously and equally moving said contacts.

7. In apparatus of the class described, an amplifier having a grid, filament and plate, a resistance having its central point connected to said filament, a neutralizing capacity connected to said plate, means connecting said grid and capacity to opposite terminals of said resistance, and movable contacts, for varying the resistance in circuit between said grid and central point and said capacity and central point, said resistances being tapered so that the change of resistance for a given movement of said contacts decreases as the amount of resistance in circuit decreases.

8. In apparatus of the class described, an amplifier having a grid, filament and plate, a resistance having its central point connected to said filament, a neutralizing capacity connected to said plate, means connecting said grid and capacity to opposite terminals of said resistance, movable contacts for varying the resistance in circuit between said grid and central point and said neutralizing means and central point, and means for simultaneously moving said contacts equal amounts, the halves of said resistance being similarly tapered so that the change of resistance for a given movement of said contact decreases as the amount of resistance in circuit decreases.

9. In apparatus of the class described, the combination of an amplifier, an input circuit therefor, means for neutralizing the capacity between electrodes of said amplifier including a resistance shunted across said input circuit, and means for varying said resistance to control the amount of energy delivered to said amplifier.

In testimony whereof I have hereunto set my hand.

HAROLD F. ELLIOTT.