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AMPLIFIER OF ELECTRICAL CURRENTS

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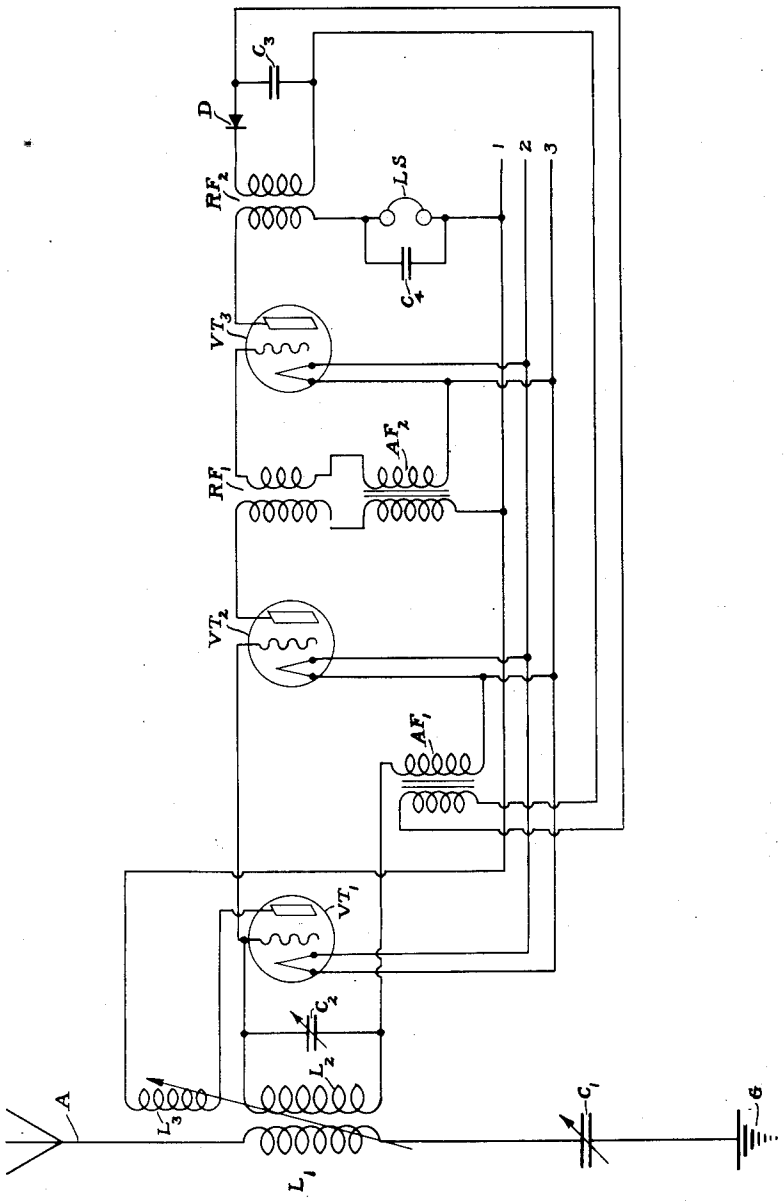

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AMPLIFIER OF ELECTRICAL CURRENTS

Application filed June 22, 1923. Serial No. 647,028.

While my invention relates generally to amplifiers of electrical currents it has for a particular object the amplification of electrical currents of a single radio frequency to the exclusion of currents of slightly different frequency.

A further object is the employment of the same amplifying devices for a simultaneous amplification of radio frequency and audio frequency electrical currents. Another object is the employment of means to prevent the creation of undesirable electrical oscillations in the circuits of the amplifying system, or distortion due to reactive or regenerative effects.

A further object is the use of a feed-back or regenerative arrangement for the double purpose of obtaining selectivity and increasing amplification, and at the same time providing means for controlling the regenerative effect to prevent oscillations and distortion.

In my co-pending application Serial No. 647,027, filed June 22, 1923, I have illustrated an amplifier system wherein the same amplifying devices are used for the double function of amplifying radio frequency and audio frequency currents, with means for preventing oscillations and regenerative distortion. While the system illustrated in that application is extremely effective as an amplifier, it is somewhat broad, making it difficult to prevent interference with the desired signal by signals on nearby frequencies or wave lengths. My present invention provides means for overcoming to a considerable degree this difficulty.

My invention will be best understood by reference to the figure in the accompanying drawing in which the amplifier system is illustrated in its use in connection with the reception of radio signals. A is an antenna circuit grounded at G, and including the tuning elements inductance L_1 and variable capacity C_1. Inductance L_2 and variable capacity C_2 are elements of a tunable circuit included in the input circuit of the amplifying device, a three-electrode vacuum tube VT_1, the input circuit being coupled to the antenna through the coupling of inductances L_1 and L_2. L_3 is an inductance in the output circuit of the vacuum tube VT_1, the coupling between inductances L_3 and L_2 forming a coupling means between the input and output circuits, thereby providing a regenerative or feed-back arrangement between these two circuits. A second vacuum tube VT_2 has its input circuit in common with that of the input circuit of the first tube. The output circuit in this second tube includes devices for transferring energy to additional amplifying circuits and devices, such as the vacuum tube VT_3, in any number desired. The amplified radio frequency currents are transferred to a detector circuit through the radio frequency transformer RF_2, this circuit including a detecting or rectifying device D, which may be a crystal detector, a vacuum tube detector, or other well known form, to aid in converting the modulated radio frequency currents into audio frequency currents characteristic of the modulations. The low frequency currents are returned to the amplifying devices and circuits through the audio frequency transformer AF_1, and these audio frequency currents are also amplified by the amplifying devices and finally translated in the loud speaking device LS or other suitable translator of electrical currents into sound signals. Radio frequency transformer RF_1 and audio frequency transformer AF_2 serve to pass the radio frequency and audio frequency currents from the vacuum tube output circuit of VT_2 to the input circuit of vacuum tube VT_3. Capacity C_3, in shunt with the detector circuit, is not essential to the operation of the system, but I find that providing this low impedance by-pass for radio frequency currents gives a more stable and satisfactory operation of the detecting device. Capacity C_4 in shunt with the loud speaking device LS is the customary radio frequency by-pass around the high impedances ordinarily had in the construction of translating devices. The filaments of the vacuum tubes are heated by supplying a source of electrical current to lines 2 and 3 and by making the line 3 the negative side of this source a bias or negative potential is applied to the grids of the tubes as they are shown connected in the figure, this bias causing them to function

as amplifiers. A source of electrical energy is also applied to lines 1 and 2 to furnish the usual plate circuit energy for vacuum tubes, the source being so connected that line 1 is made positive, thereby applying a positive potential to the plates of the vacuum tubes.

The secondary winding of transformer AF_1 is included in the input circuit common to vacuum tube VT_1 and VT_2, in series with the radio frequency tunable circuit L_2 and variable capacity C_2. I have found it particularly beneficial not to materially reduce the impedance of this secondary winding to radio frequency currents, as would be done by placing a capacity in shunt therewith as is the usual practice when low frequency devices are included in radio frequency circuits. The winding of the secondary of this transformer has a small amount of distributed capacity which permits the passage of radio frequency current with substantial impedance, and this impedance has a choking effect on any tendency of the circuits to oscillate or distort through regeneration tending to create currents with abnormal rises or peaks. This choking effect does not interfere to any derogatory extent with the amplification qualities of the amplifying devices and associated circuits. While the impedance of the secondary winding of the transformer AF_1 is materially increased over that which could be had if the winding were shunted with a condenser of substantial capacity to by-pass radio frequency currents, yet the impedance so created is not of the same order as that had in the tunable circuit having inductance L_2 and variable capacity C_2 to currents having a frequency resonant to this circuit, as it is well known that such circuits offer a tremendous impedance to resonant frequency currents. From this reasoning it will be seen that the distribution of the differences of potential in the input circuit to resonant frequency currents is such that the greater difference of potential exists across the radio frequency circuit rather than across the winding of transformer AF_1. On the other hand for interfering currents not resonant to this circuit a low impedance will be offered and the distribution of potentials changes such that the difference of potential across the winding of transformer AF_1 may become the greater part of this distribution. It is this latter feature which causes the winding to have a beneficial effect on the elimination of interference, thereby materially aiding in the improvement of the selectivity of the system.

The selectivity is further improved by the regenerative action or coupling between the input circuit and output circuit of the vacuum tube VT_1, it being well known that such arrangements aid materially in improving the selectivity of vacuum tube devices.

The radio frequency input circuit to the second vacuum tube being in common with that of the first vacuum tube, the system benefits in selectivity by avoiding the use of an additional coupling device between the two stages of amplification as is the usual practice, this improvement being further enhanced from an economical point of view by the saving of of a radio frequency transformer.

Having described my invention I claim:

1. An electrical amplifying system including a pair of amplifiers, an input circuit common to said amplifiers having a portion responsive to high frequency currents and a portion responsive to lower frequency currents, and independent output circuits associated with said amplifiers, one of said output circuits being so coupled to said input circuit as to transfer said high frequency currents therebetween, and one of said output circuits being adapted to transfer said lower frequency currents therefrom.

2. An electrical amplifying system including a pair of amplifiers, an input circuit common to said amplifiers having a portion responsive to high frequency currents and a portion responsive to lower frequency currents, and independent output circuits associated with said amplifiers, one of said output circuits being so coupled to said input circuit as to transfer said high frequency currents therebetween, and one of said output circuits being adapted to transfer both said high frequency and said lower frequency currents therefrom.

3. An electrical amplifying system including a pair of amplifiers having a common input circuit, means for exciting said input circuit simultaneously with high and lower frequency currents, and independent output circuits for said amplifiers, one of said output circuits being coupled to said input circuit so as to transfer high frequency currents therebetween.

4. An electrical amplifying system including a pair of amplifiers having a common input circuit, means for exciting said input circuit simultaneously with high and lower frequency currents, independent output circuits for said amplifiers, means for transferring said high frequency currents from one of said output circuits to said input circuit, a succeeding electrical system, and means for simultaneously transferring said high and lower frequency currents from the other of said output circuits to said succeeding system.

5. In an amplifier system, a pair of amplifier tubes connected in cascade and having a wholly common input circuit and wholly independent output circuits, and means for exciting said common input circuit simultaneously with high and lower frequency currents.

6. An electrical amplifying system including a pair of amplifier tubes connected in

cascade and having a wholly common input circuit, means for exciting said input circuit simultaneously with high and lower frequency currents, and wholly independent output circuits for said amplifiers, said common input circuit including means for tuning it to said high frequency.

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