Jan. 12, 1932. O. O. CECCARINI 1,840,350

RADIOFREQUENCY AMPLIFIER

Filed Oct. 26, 1927

FIG. 1.

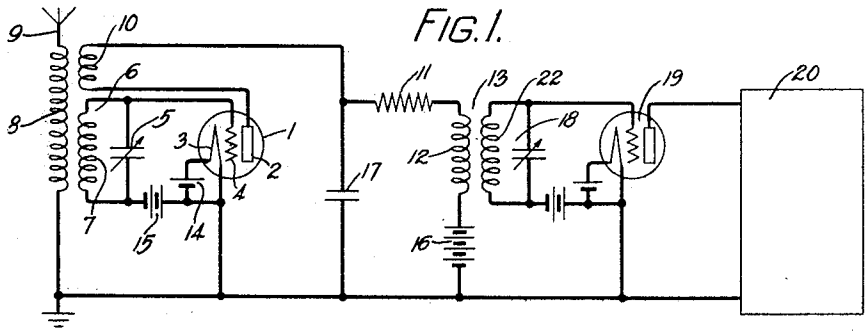


FIG. 2.

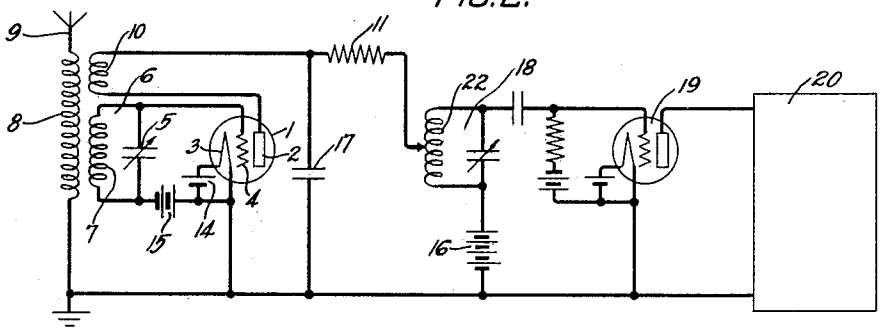
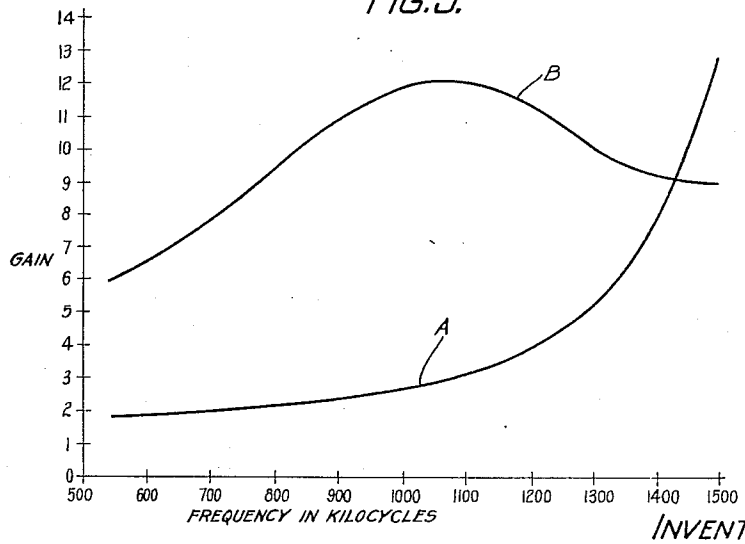


FIG. 3.



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UNITED STATES PATENT OFFICE

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RADIOFREQUENCY AMPLIFIER

Application filed October 26, 1927. Serial No. 228,722.

This invention relates to radio-frequency amplifiers of the thermionic type having means to oppose or neutralize the effect of the inherent capacity in the amplifiers between the input and the output circuits.

An object of the invention is to provide a radio-frequency amplifier having a reverse feed-back circuit that shall effect a substantially uniform gain at high and low radio frequencies.

Another object of my invention is to provide a radio-frequency amplifier having a reverse feed-back circuit from the output circuit to the input circuit that shall be provided with means in the amplifier output circuit to by-pass a porion of the higher radio frequency currents and prevent deamplification of the lower radio frequency currents or excessive amplification of the higher radio frequency currents.

In radio frequency amplifiers of the thermionic type having a cathode, an anode and a grid element, trouble is experienced by reason of the inherent capacity coupling between the anode and the grid element of the thermionic tube. This capacity coupling between the anode and the grid element tends to produce the so-called singing. In order to oppose the effect of the grid to plate capacity in an amplifier tube it has been proposed heretofore to provide a reverse feed-back circuit from the output circuit to the input circuit of the amplifier. Amplifiers provided with a reverse feed-back connecting the output circuit to the input circuit to balance the grid to plate capacity are limited in some respects by reason of the difficulty in controlling the degree of amplification. In an amplifier of this type the gain at the lower radio frequencies in much less than the gain at the higher radio frequencies. Consequently, if the feed-back circuit is adjusted to effect normal gain at the lower frequencies then excessive amplification and the resulting singing is liable to be produced at the higher frequencies. On the other hand if the feed-back circuit is adjusted to effect normal gain at the higher frequencies then deamplification is liable to be effected at the lower frequencies.

In an amplifier system constructed in accordance with this invention, normal gain is effected at the lower radio frequencies and at the higher radio frequencies the gain is so reduced as to prevent excessive amplification and the resulting singing. The reduction in the amplification at the higher radio frequencies is effected by so connecting capacity and resistance elements to the feed-back circuit as to by-pass a portion of high frequency currents and preventing excessive gain and singing when amplifying high frequency radio currents. Preferably a resistance element is connected in the feed-back circuit and a condenser working against the impedance of the resistance element is connected across the output circuit of the amplifier. The condenser by-passes a portion of the high frequency currents and has little effect to by-pass the lower frequency currents.

In the accompanying drawings, Figure 1 is a diagrammatic view of the radio receiving circuit provided with a radio-frequency amplifier constructed in accordance with the invention.

Fig. 2 is a diagrammatic view of a modified radio receiving circuit;

Fig. 3 is a diagrammatic view showing curves to illustrate the gain in a radio frequency amplifier constructed in accordance with the invention.

Referring to Fig. 1 of the drawings a radio receiving circuit is illustrated comprising a radio frequency amplifier 1 having an anode 2, a cathode 3 and a grid element 4. The cathode and grid elements are connected across an adjustable condenser 5 of tuned circuit 6. The coil 7 of the tuned circuit is inductively connected to the coil 8 in the antenna circuit 9. The output circuit of the amplifier tube includes a reverse feed-back coil 10 which is coupled to the coil 7 of the tuned circuit, a resistance element 11 and the primary winding 12 of a coupling transformer 13. Batteries 14 and 15 are provided respectively for heating the cathode 3 and for giving the grid element 4 a negative bias. A battery 16 serves to provide space current.

The coil 10 which is included in the output circuit of the amplifier serves as a reverse

feed-back to oppose the effect of the inherent capacity between the anode 2 and the grid element 4 of the tube 1. The coil operates in the manner disclosed in the patent to R. V. L. Hartley No. 1,183,875, dated May 23, 1916. Across the output circuit of the amplifier tube is connected a condenser 17 which serves to by-pass a portion of the higher radio frequency currents. The condenser 17 is connected on one side to the cathode 3 and on the other side to a point in the output circuit between the feed-back coil 10 and the resistance 11. The resistance element 11 serves as an impedance for the condenser 17 to work against. The resistance element 11 and the condenser 17 may be made variable, but preferably a mean value of each is used. Mean values of the resistance element 11 and the condenser 17 are preferably selected, such that little effect is produced on the lower radio frequency currents and only the higher radio frequency currents are by-passed through the condenser.

The secondary winding 22 of the coupling transformer 13 forms a part of the tuned circuit 18 in the next succeeding stage. The tuned circuit 18 is connected to a thermionic tube 19 which may serve as a modulator or as an amplifier. The tube 19 is connected in any suitable manner to other amplifying and detector stages which are diagrammatically indicated by the reference character 20.

Referring to Fig. 3 of the drawings a curve A is drawn to show the voltage amplification at various frequencies if the condenser 17 and the resistance element 11 are not included in the amplifier circuits. This curve shows that excessive amplification is effected at the higher radio frequencies and such excessive amplification is liable to produce the so-called singing. In order to limit the amplification at the higher radio frequencies the condenser 17 and the resistance 11 are provided to by-pass a portion of the higher radio frequency currents. This also permits a reduction in the reverse feed-back or the use of a smaller number of turns in coil 10, which increases the amplification at the lower frequencies. The curve B in Fig. 3 of the drawings indicates the gain at various frequencies when a portion of the higher frequency currents is by-passed. Comparing curves A and B, it will be noted excessive amplification is prevented when a portion of the high frequency currents is by-passed while the amplification at the lower frequencies is materially increased. The amount of high frequency currents which is by-passed may be controlled by varying the value of the condenser 17 and the resistance element 11.

The radio system shown in Fig. 2 is similar to the system shown in Fig. 1 with the exception of the coupling between the radio frequency amplifier stage and the next stage. In Fig. 2 of the drawings like parts have been indicated by similar reference characters. The tuned circuit 18 in Fig. 2 of the drawings is not inductively connected to the radio frequency amplifier stage as the tuned circuit 18 included in the system shown in Fig. 1 of the drawings. The inductive connection between the two stages shown in Fig. 1 of the drawings renders it possible, if so desired, to ground the tuning condensers. In Fig. 2 the output circuit of the radio frequency amplifier is directly connected to the tuned circuit 18.

While preferred forms of embodiment of the invention have been shown and described it is to be understood that the scope of the invention is not to be restricted to the particular forms disclosed but as defined in the appended claims.

What is claimed is:

1. In an amplifier system, a radio-frequency thermionic amplifier having an input and an output circuit, a reverse feed-back circuit for coupling the output circuit to the input circuit to compensate to an extent tending to vary with frequency for the effect of the inherent capacity coupling in the amplifier between the input and the output circuit, and means connected to the output circuit for controlling said tendency and insuring against excess gain at the higher frequencies.

2. In an amplifier system, a radio-frequency thermionic amplifier having an input and an output circuit, a reverse feed-back circuit for inductively coupling the output circuit to the input circuit to oppose the effect of the inherent capacity coupling in the amplifier between the input and the output circuit, and a by-pass circuit connected across the output circuit to limit the gain at the higher frequencies.

3. In an amplifier system, a radio-frequency thermionic amplifier having an input and an output circuit, a reverse feed-back circuit for electromagnetically coupling the output circuit to the input circuit to oppose the effect of the inherent capacity coupling in the amplifier between the input and the output circuit, and means comprising a condenser connected across said output circuit to limit the gain at selected frequencies.

4. In an amplifier system, a radio-frequency thermionic amplifier having an input and an output circuit, a reverse feed-back circuit for inductively coupling the output circuit to the input circuit to oppose the effect of the inherent capacity coupling in the amplifier between the input and output circuits, a resistance element in said output circuit and means comprising a condenser connected across said output circuit ahead of said resistance to limit the gain at the higher frequencies and increase the gain at lower frequencies.

5. In an amplifier system, a radio-frequency thermionic amplifier having an input

and an output circuit, an inductive coupling between the output and the input circuit to oppose the effect of the inherent capacity coupling in the amplifier between the input and output circuit, a resistance element included in said output circuit, and a capacity element connected across said output circuit at a point between said inductive coupling and said resistance element.

6. In an amplifier system, a radio-frequency thermionic amplifier having a tuned input circuit, an output circuit having a reverse feed-back inductively connected to said tuned input circuit, a resistance element connected in said output circuit, and a condenser connected across said output circuit before said resistance element and behind said reverse feed-back.

7. In an amplifier system, a radio-frequency thermionic amplifier having a tuned input circuit, an output circuit having a reverse feed-back inductively connected to said tuned input circuit, said feed-back serving to oppose the effect of the inherent capacity coupling in the amplifier between the input and the output circuit, a second thermionic tube having a tuned input circuit inductively coupled to said amplifier output circuit, a resistance element included in said amplifier output circuit, and means comprising a condenser connected across the amplifier output circuit before said resistance and behind said feed-back.

In witness whereof, I hereunto subscribe my name.

OLINDO O. CECCARINI.