Dec. 29, 1942. H. BERTHOLD 2,306,859

RADIO RECEIVING CIRCUIT

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Fig. 1

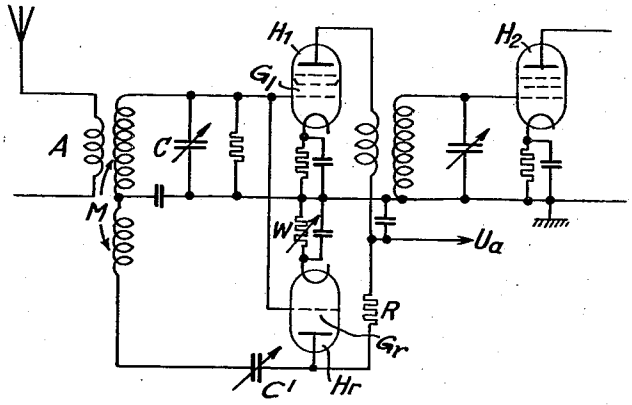
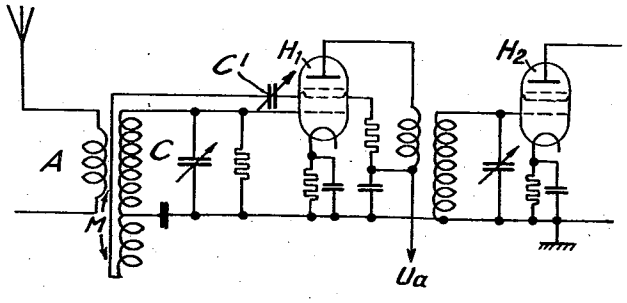


Fig. 2



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RADIO RECEIVING CIRCUIT

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2 Claims. (Cl. 179—171)

This invention relates to radio receiving circuits, and more particularly to circuit arrangements for radio receiving sets involving feed back and high frequency amplification. The grid-plate capacity of the input tube of such receiving sets tends to bring about interfering cross modulation which cannot be removed in the subsequent receiving stages. This drawback, however, may be avoided by improving the first high frequency stage. However, difficulties will arise when applying feed back in the way heretofore used. In the event of feed back being derived behind the detecting tube and being supplied to the input stage, the high gain present therebetween will be detrimental. Likewise it will not be advisable to derive feed back behind the first high frequency stage, since variations in the tuning between two stages will affect the feed back factor.

These disadvantages are avoided by the present invention by taking the feed back voltage from a point which is independent of plate oscillatory circuits with respect to constant resistance. The invention may be realized, for instance, by means of an auxiliary tube connected in parallel with the grid of the input tube for producing the feed back voltage, but the same effect may also be obtained in other ways such as by means of a screen grid with the feed back voltage being derived from the screen grid.

My invention will be more readily understood from the following description, taken in conjunction with the accompanying drawing, in which:

Fig. 1 is a circuit diagram embodying one solution according to my invention, while Fig. 2 is a modification of the arrangement shown in Fig. 1.

Referring to Fig. 1, reference letter A denotes any type of antenna circuit, such as the loop aerials when direction finders are concerned. This antenna circuit A is coupled to a high frequency amplifying tube H_1 which is followed by a further tube H_2, etc. According to the main feature of this invention, an auxiliary tube H_r is connected in parallel with the input high frequency tube H_1. The control grids g_1, g_r of these tubes are directly interconnected with one another while their plate circuits are independent of each other as is clear from the drawing. The attenuation reduction in the output circuit is effected over a feedback path through the auxiliary tube H_r and the coupling means M. The amount of feedback may be varied by adjusting a resistor W. A composite inductive and capacitive feedback circuit will preferably be employed in order to render independent of frequency the amount of gain involved. The constants of such a frequency independent feedback circuit have already been worked out ("Hochfrequenztechnik und Elektroakustik" volume 40 (1932) page 167) according to the following equations:

$$M=\frac{L}{2D}+\sqrt{\frac{L^2}{4D^2}-G\cdot R_i}$$

and

$$C=\frac{L/D+M}{R_0+R_i}$$

in which.

L =Oscillating inductance
M=Reactance inductance
D ="Through-grip" of the tube H_r
R_i=Internal resistance of the tube H_r
R_o=D. C. resistance of the oscillating circuit
G =Increase of oscillating circuit effective resistance
C =Oscillating circuit capacity.

The "through-grip" (D) is the ratio of the plate-cathode capacity to the grid-cathode capacity as represented by the formula

$$\frac{C_a\cdot K}{C_g\cdot K}$$

In other words, if the feedback circuit is determined in accordance with the above formula, this circuit will give a gain which will be wholly independent of frequency. The abovementioned circuit arrangement involves the further advantage that the amount of feedback may be regulated in a very simple manner by adjusting the condenser C' in connection with a suitable operating point in the characteristic of the tube instead of the much more complicated mutual, adjustment between the condenser C' and the inductance M which heretofore was necessary in receiving equipment having the feedback tube serially interposed between the amplification stages, in which case this tube had to be fixedly adjusted to a given operating point of its characteristic.

On cooperatively connecting a suitable resistor in series or in parallel with the feedback tube, such that the resulting resistor circuit together with the internal resistance of the tube H_r offers a total impedance which is substantially constant independent of the operating point of this tube, frequency stability of the gain thus involved may be secured by correspondingly dimensioning the condenser C', and even the amount of this gain may be varied at will by adjusting the degree of amplification involved by the feed-

back tube, as long as the "through-grip" of this tube remains constant. In cases when one or more of the amplifier stages should be regulated simultaneously with the adjustment of the feedback tube in such manner that the amplification increases when the gain of the feedback tube and, hence, the amount of feedback are caused to decrease, or vice versa, the sharpness of the resonance response of the receiver may be augmented in a simple way without changing the overall selectivity thereof. On the other hand, the rate of amplification may, by slightly varying the setting of condenser C', assume a frequency characteristic which is adapted partly to compensate the frequency characteristic of the remaining receiving circuits as a result of the resonance increase in the tuning circuits thereof.

The optimum phase relations in the above-mentioned feedback circuit employing a special auxiliary tube, and the fact that the feedback is independent of the actual amplifying circuits, enable the gain to be increased considerably higher before the circuit gets unstable, than possible in the heretofore known feedback circuits.

The combination of a feedback circuit and a particular auxiliary tube is likewise applicable in all other stages of a receiver when high gain is found desirable.

The use of a particular tube for producing the feedback voltage is by no means limited to composite inductive and capacitive feedback circuits, since such auxiliary tube may beneficially be applied to feedback paths employing transformers, voltage dividers and the like. Even the type of the auxiliary tube, whether a triode or a multigrid tube, is immaterial for the correct operation of the circuit. Moreover, one single multi-electrode tube may substitute the two tubes H_1 and H_r of Fig. 1.

Instead of deriving the feedback voltage from a particular auxiliary tube or tube system, the feedback gain may likewise be rendered approximately independent of the synchronism of the tuning circuits if this voltage is derived from the screen grid of an amplifying tube following the circuit subject to attenuation decrease, because of the fact that this screen grid works into a constant impedance which is independent of the anode circuit. The corresponding circuit diagram is shown in Fig. 2.

What is claimed is:

1. A regenerative radio receiving arrangement comprising at least one radio frequency amplifying stage, having at least a grid circuit and an anode circuit, an auxiliary tube having a grid circuit, a cathode circuit and an anode circuit, said grid circuit being connected in parallel to the grid circuit of said radio frequency stage, the plate circuit of said auxiliary tube including a resistor proportioned with respect to the internal plate resistance of the auxiliary tube so that the total effective relative impedance offered by the auxiliary tube and the said resistor remains substantially constant and independent of the operating point of the auxiliary tube on its characteristic curve, the plate circuit of said auxiliary tube being effectively isolated from the plate circuit of the said amplifying stage, a feedback path comprising a condenser and inductive means for feeding back to the grid circuit of said amplifying stage voltages derived from the anode of said auxiliary tube, and a variable resistor in the cathode circuit of said auxiliary tube.

2. A regenerative radio receiving arrangement according to claim 1 in which said plate circuit resistor is high compared to said plate resistance and is connected in series with the plate circuit of said auxiliary tube.

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