Aug. 9, 1938. P. BELLEVILLE 2,125,982

REGENERATIVE RECEIVER

Filed April 1, 1937

Fig. 1

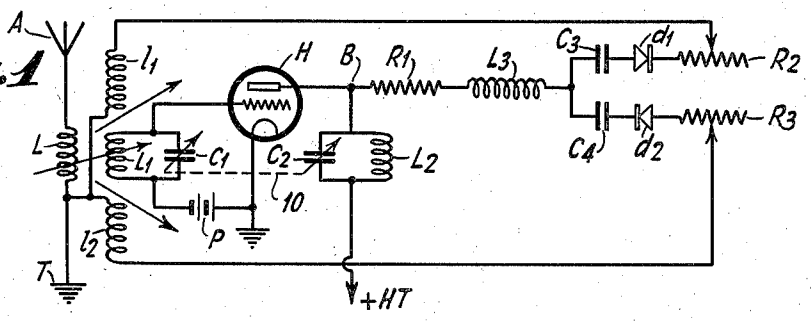


Fig. 2

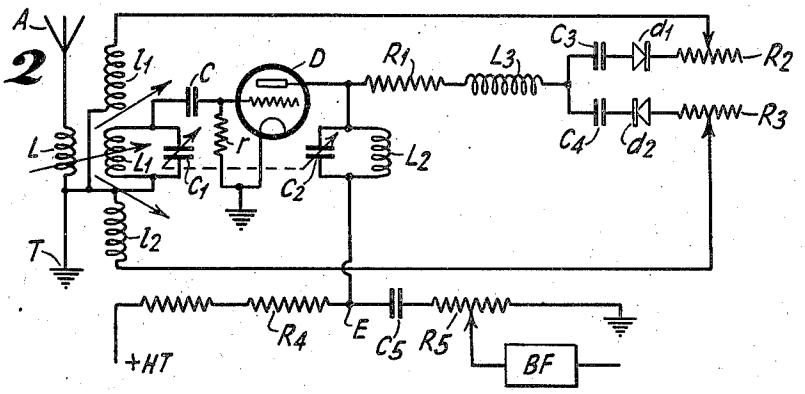
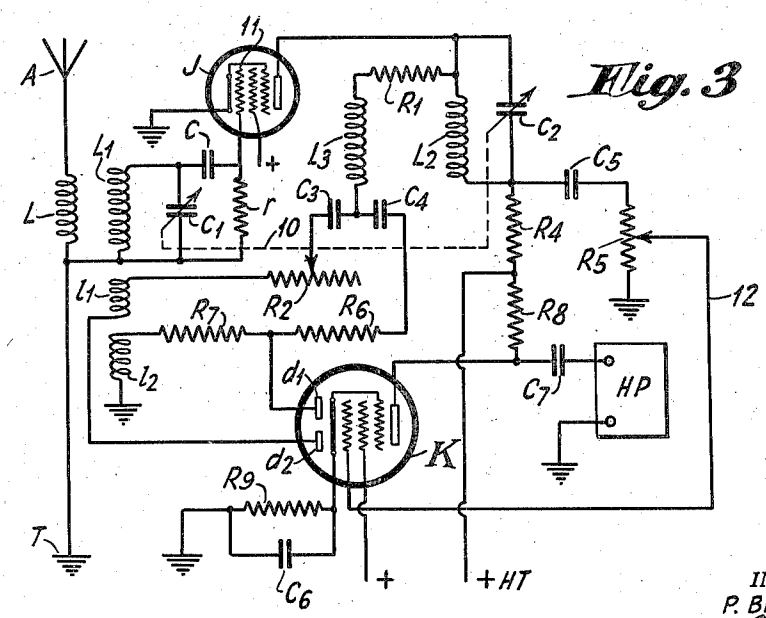


Fig. 3



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REGENERATIVE RECEIVER

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5 Claims. (Cl. 250—20)

It is known that in the ordinary regenerative receivers, the amplification due to the feedback is limited by the appearance of distortions and in the cases of modulated telephony or telegraphy by the loss of stability of the system.

The method called superregeneration permits of carrying the feedback much further by obliging the detector tube to reassume periodically its stability. This circuit has serious disadvantages among others its lack of selectivity and the appearance of a hissing due to the so called cut-off frequency which is difficult to eliminate.

The method and circuits forming the subject matter of the present invention, has for its object to obtain large amplifications while conserving a selectivity compatible with a favorable quality, an absolute silence in the absence of signals and a favorable sensitivity.

Its principle consists essentially in releasing a feedback phenomenon during all alternations of the same sign of a signal arriving in the grid circuit, while all alternations of opposite sign produce an inverse phenomenon obliging the arrangement of the system (tubes and oscillatory circuits) to resume its stability.

The invention will be better understood by referring to the accompanying figures showing by way of example and without limiting the invention thereto, various modes of constructions.

In the drawing, Figure 1 illustrates a high frequency stage having applied to it regeneration in accordance with the present invention;

Figure 2 is a schematic representation of the invention applied to a detector circuit; and,

Figure 3 illustrates schematically a circuit utilizing the invention in conjunction with a multifunction tube.

Fig. 1 shows in a schematical manner a high frequency amplifier stage with regeneration in accordance with the invention. In this figure, there is shown at H an amplifier tube having in the grid circuit and plate circuit two resonance circuits L_1C_1 and L_2C_2 which can preferably be tuned to the carrier frequency by means of a common drive means 10. The signals as received at the antenna A are transmitted to the circuit L_1C_1 by the mutual induction of the coils L and L_1. The feedback potential at B is likewise brought back to the circuit L_1C_1 across two different paths including the resistor R_1, the self inductance L_3, the condensers C_3, C_4 the rectifiers d_1, d_2 connected in opposition, the two variable resistors R_2, R_3, and finally the two induction coils l_1, l_2 acting in opposite directions upon the self inductance L_1 with which they are coupled.

The two rectifiers may be dry rectifiers, diodes, detector tubes or any similar means.

These two rectifiers are connected in inverse sense, each of which permits production of the feedback in the circuit L_1C_1 only during one of the alternations. The coils l_1, l_2 act on the other hand, in the opposite sense, the one of which carries during one of the alternations, a positive feedback potential, i. e. it tends to decrease the damping of the circuit L_1C_1 and to favor the sustenance of the oscillations of this circuit, while the other one which acts during the other alternation, carries a negative feedback potential i. e. it tends to increase the damping of the circuit L_1C_1 and to restrain its oscillations.

In order that these two feedback potentials be in correct phase, i. e. respectively in phase and phase opposition with the oscillations induced in the antenna, and in order that on the other hand, the time constants of the two feedback paths be sufficiently low thus providing sufficient time for this feedback to act during the duration of a single alternation, in these two paths the above indicated control elements R_1, L_3, C_3 and C_4 are inserted. These elements will be controlled in such a manner that the feedback phases are correct for an intermediate frequency of the range of the receiver. Owing to the introduction in these circuits of sufficiently high resistances, it is furthermore achieved that the phase displacements remain low (of the order of a few degrees for instance) even for the ends of the range, without subsequent adjustment of the tuning control of these circuits. It should be noted that this last arrangement which forms one of the particular features of the invention, is a very general one, and can be applied to many circuits with simple regeneration. The rheostats R_2 and R_3 finally permit of controlling the value of the feedback potentials carried respectively by each of the two paths to the oscillatory circuit L_1C_1.

According to a possible explanation of the phenomena, one of the advantages of the method forming the subject matter of the present invention appears to reside in the possibility of bringing the positive feedback in the one of the alternations to a value which surpasses the conditions for sustaining oscillations of the system, but acting in the opposite sense in the other alternation in such a manner that these oscillations cannot continue. In fact it is found that the apparatus is very sensitive, with sufficient selectivity, and that the control of the intensity

and of the feedback is much less critical than in the ordinary circuits in which the feedback acts in the same sense for the two alternations. In practice, in a receiver with double feedback, the one positive and the other one negative in accordance with the invention, the control of the feedback can be had once and for all between very extended limits of the frequency range of the apparatus.

The circuit of Fig. 1 indicates only the circuit of a high frequency stage with regeneration in accordance with the invention. It will however be understood that this stage could act thereafter on another stage, detector, low frequency amplifier etc., not shown for the sake of clearness in the drawing.

Fig. 2 shows schematically a particularly interesting mode of embodiment of the invention applied to a detector tube D operating for instance with grid current. There is shown in C and r the connection condenser and the usual leakage resistor. The other elements of the circuit are the same as in Fig. 1 and have the same reference characters. The high frequency potential of the feedback is also derived at B and applied in the inverse sense across two different paths to the circuit L_1C_1 which receives the oscillations of the antenna. The detected oscillations derived at E at the terminals of the resistor R_4 are hereafter applied to all suitable audio-frequency amplifier stages designated by BF across a connection condenser C_5 for instance, and a potentiometer R_6 serving for the volume control.

Fig. 3 finally represents by way of example only, a mode of embodiment of the invention in which the two rectifiers d_1 d_2 and the first stage BF are obtained from a single double diode and pentode K for instance. The two rectifiers are hereby formed of two diode elements d_1 d_2 of this tube and the pentode part serves as audi-frequency amplifier. In this circuit, the detector tube is likewise shown in the form of a pentode J, but it should be understood that these representations are not limiting the invention.

The functioning of this circuit is as follows: when a signal arrives at the grid 11, only the alternations which render the plate positive benefit the feedback phenomenon since the diodes can only function when they are positive, while the opposite alternations of the signal impart to the grid circuit L_1C_1 an impulse in the inverse sense which tends to oppose the excitation of oscillations. This latter phenomenon is controlled by the construction by adopting a suitable value for the resistor R_6, while the feedback can be controlled at will by the operation of the variable resistor R_2. The audio frequency voltage developed across resistor R_4 is, as in Fig. 2, transmitted through condenser C_5 and lead 12 to the signal control grid 13 of the pentode amplifier K, the plate of which is resistance coupled by resistor R_8 and condenser C_7 to the input terminals of any suitable translating device HP.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. An amplifying device comprising in combination, an electron discharge tube having an input circuit and an output circuit, means for impressing an alternating signal voltage on said input circuit, a feedback connection between said output and input circuits arranged to cause regeneration of said input circuit, means for making this regeneration operative during one half of the signal voltage cycle and a second feedback connection between said output and input circuits arranged to cause degeneration of said input circuit, and means for making this deenergization operative during the opposite half of the signal voltage cycle.

2. An amplifying device comprising in combination, a vacuum tube having a cathode, a signal grid and an anode, an input circuit connecting said signal grid and cathode, an output circuit connected to said anode, means for impressing an alternating signal voltage on said input circuit, a feedback connection between said output and input circuits including a rectifier, and a second feedback connection between said output and input circuits including a second rectifier, said rectifiers being poled in opposite directions.

3. An amplifying device comprising the combination of a vacuum tube having a cathode, a signal grid and an anode, a circuit tuned to a desired signal frequency connecting said signal grid and cathode, an output circuit connected to said anode, means for impressing an alternating signal voltage on said resonant circuit, a feedback connection between said output circuit and said resonant circuit including the series connection of a resistor and a rectifier and a second feedback connection between said output circuit and said resonant circuit including the series connection of a second resistor and a second rectifier, said first and second rectifiers being poled in opposite directions.

4. A radio receiver comprising the combination of a vacuum tube having a cathode, a signal grid and a plate, an input circuit connecting said signal grid and cathode, an output circuit connected to said plate, a second vacuum tube having a cathode and two anodes, a feedback connection between said plate and input circuit including a coil connected to one of said anodes, and a second feedback connection between said plate and input circuit including the series connection of a second coil and the other of said anodes.

5. The arrangement of claim 4 in which each of said feedback connections includes a series connected stopping condenser.

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