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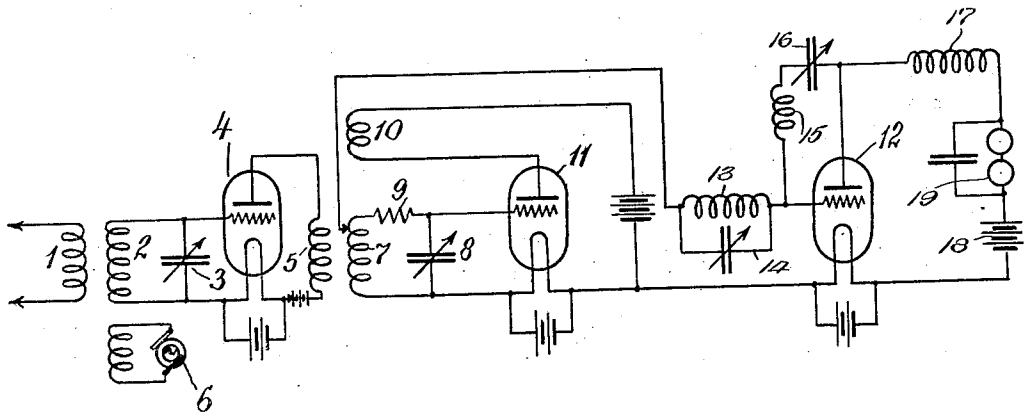
E. H. ARMSTRONG

WAVE SIGNALING SYSTEM

Filed June 8, 1922



Edwin H. Armstrong INVENTOR

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UNITED STATES PATENT OFFICE.

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WAVE SIGNALING SYSTEM.

Application filed June 8, 1922. Serial No. 566,685.

To all whom it may concern:

Be it known that I, EDWIN H. ARMSTRONG, residing at 1032 Warburton Avenue, Yonkers, in the county of Westchester, State of New York, have invented certain new and useful Improvements in Wave Signaling Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to an electric regenerative system for amplifying varying electric currents, particularly radio or other high frequency signaling currents, wherein the varying potential of the current to be amplified is impressed on the system and the relation between the amount of regeneration and the degree of damping of the system is periodically varied to produce transient free oscillations proportional to the amplitude of the impressed potential and wherein the resulting free oscillations and the system are continuously maintained in this transient ordinarily unstable state to obtain superregenerative amplification or action as described in my Patent 1,424,065, granted July 25, 1922, on a copending application, Serial No. 480,563 filed June 27, 1921.

The invention has for its object the provision of a method and apparatus for increasing the selectivity of super-regenerative systems, since it has been found that it is difficult to secure very sharp tuning, particularly of telephone signals, when a high super-audible auxiliary frequency is employed to periodically vary the relation between the amount of regeneration and the degree of damping of the system. The reason for this is that the periodic variation produced by the auxiliary frequency widens out the response of the tuning circuits to include a band of frequencies.

The solution of this problem would appear to lie in the insertion of a sharply tuned circuit ahead of the super-regenerative system, but this, however, entails another difficulty which is very hard to overcome. The reaction of a super-regenerative system on a sharply tuned circuit preceeding it would produce oscillations in the tuned circuit, and since this type of circuit is but slightly damped it would be kept in a state of irregular oscillation which would greatly impair the efficiency of the super-regenerative system.

To overcome the difficulty above mentioned and in accordance with the invention, a sharply tuned circuit is employed ahead of the super-regenerative system but the oscillations received by it are applied first to a vacuum valve and subsequently to the system. The frequency of the oscillations received in the circuit and present in the input circuit of the vacuum valve are changed or converted, however, to a varying current of some other frequency and value and the resulting or new varying currents or frequencies present in the output circuit of the valve are impressed upon the super-regenerative system wherein they are amplified and received. In this manner the oscillations in the super-regenerative system cannot react on the sharply tuned circuit preceeding it since this circuit is tuned to a widely different frequency.

A more complete understanding of the invention may be had by reference to the accompanying drawing and the following description:

Referring now to the drawing—the source 1, of the incoming signals or the varying current to be amplified, is associated with the sharply tuned circuit 2, 3 which in turn is connected to the vacuum valve 4 in the grid circuit thereof. The output circuit of the valve 4 containing the coil 5 is associated with the input side of the super-regenerative system. A source of high frequency alternating current 6 (a local source of oscillations) is also associated with the source 1 and the tuned circuit 2, 3. The frequency of the oscillations supplied from the source 6 should be such that when combined with the incoming signal oscillations and rectified by the valve 4 a beat frequency is produced of some predetermined value which will permit the super-regenerative system to function efficiently while amplifying the said frequency. It is to be understood, however, that the frequency of the local oscillations supplied from the source 6 may be adjusted so as to produce a beat frequency which is either higher or lower than the frequency of the incoming signals or the varying current to be amplified. As pointed out above, the combined currents

are rectified by the vacuum valve 4 and supplied to the super-regenerative system which is tuned to the new frequency. Because of the fact that the new beat frequency current is of a different frequency from that to which the circuit 2, 3 is tuned, the reaction on that circuit is eliminated.

The super-regenerative system comprises the circuit 7, 8, 9 connected in the grid circuit of the valve 11, the feed-back coil 10 in the plate circuit thereof, and the self-oscillating vacuum valve system including the valve 12, which serves to supply an auxiliary frequency to the regenerative system for producing a periodic variation in the relation between the amount of regeneration and the degree of damping of the system. The super-regenerative system in this case is the one described in my co-pending application 566,681 filed concurrently herewith.

The super-regenerative system includes a high-frequency vacuum-tube generator 11 having a tuned circuit 7—8 in the grid circuit and a feed-back coil 10 in the plate circuit. A connection from an adjustable point in the tuned circuit 7—8 goes to the grid of a second vacuum-tube generator 12. This connection includes a tuned circuit 13—14. The feed back of the tube 12 is provided for by a connection from the plate circuit to the grid circuit including an adjustable condenser 16 and a small inductance 15. The plate circuit proper includes a large inductance 17, a telephone 19 and a source, 18, of energy. The way in which these devices cooperate to produce a super-regenerative action is explained in detail in the above-identified co-pending application.

It is to be understood, however, that any one of the many forms of super-regenerative systems may be employed in its stead since the operation of the entire system is independent of the particular characteristics of the specific super-regenerative system employed. The underlying principle of the present invention is the indirect amplification of the signal by the super-regenerative system by use of a tuned circuit and the changing of the frequency of the incoming oscillations received by the tuned circuit to some other value before amplifying them in the super-regenerative system whereby the reaction on the tuned circuit is eliminated.

It is to be understood that the present invention is adapted to receive all types of radio signals, including radio telephone signals, when associated with an antenna, loop or other energy collecting device and to receive wired wireless signals (so-called wire carrier current transmission) when associated with conductors of such signals. It should be understood that modifications may be made in the specific circuit connections above described without departing from the spirit and scope of the invention.

I claim:

1. The method of selectively amplifying varying electric currents which comprises impressing the current to be amplified on a circuit tuned to the frequency of said current, combining the current with locally generated oscillations to produce a current of different frequency, impressing said different frequency current upon a regenerative system having a certain degree of damping and periodically varying the relation between the amount of regeneration and the degree of damping of the system, whereby super-regenerative action is obtained.

2. Apparatus for selectively amplifying varying electric currents comprising a circuit tuned to the frequency of the current to be amplified, a source of local oscillations, means for combining said current with the local oscillations to produce a current of different frequency, a regenerative system having a certain degree of damping upon which the different frequency is adapted to be impressed and means for periodically varying the relation between the amount of regeneration and the degree of damping of the system, whereby super-regenerative action is obtained.

3. In a radio receiving system, an oscillation generator including a tuned circuit, means for periodically varying said generator from super-regenerative to non-regenerative condition, means responsive to the received signaling energy for impressing a controlling energy on said tuned circuit, the frequency of said controlling energy being different both from the frequency of said period and from the frequency of the signaling energy.

In testimony whereof I affix my signature.

EDWIN H. ARMSTRONG.