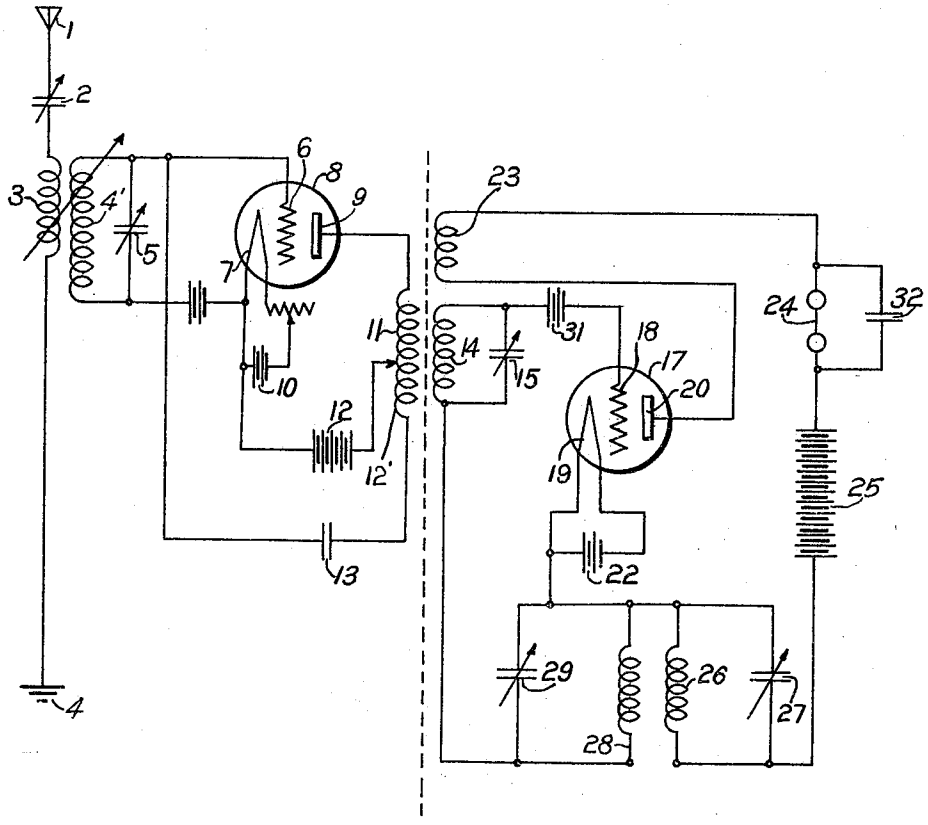
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AMPLIFYING CIRCUITS

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WITNESSES:

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AMPLIFYING CIRCUITS

Application filed April 12, 1926. Serial No. 101,286.

My invention relates to systems for the amplification of high-frequency varying currents and it has particular reference to such systems making use of the super-regenerative principle to greatly increase the amplification obtained.

In the patent to Armstrong, No. 1,424,615, there is disclosed and claimed a system of amplification wherein the signal strength obtainable is much greater than with the ordinary amplifying systems. The system disclosed by Armstrong makes use of the well-known principle of regeneration but further embodies means for periodically stopping the regenerative action. Systems of this general type have come to be known as "super-regenerative" by reason of the fact that, with the same number of tubes, they give a greatly increased volume of output.

In operation, there is constantly generated in the super-regenerative system a local or variation frequency, which may reach a considerable amplitude. When the super-regenerative system is coupled to an antenna in the usual and well-known manner, this variation frequency is radiated and is extremely annoying to persons operating receiving sets in the near vicinity. It is also noted that with the super-regenerative system alone, the tuning is quite broad and considerable difficulty is experienced in separating the carrier waves of stations broadcasting on frequencies which differ but slightly from each other. For these reasons, the super-regenerative circuit has not gone into very extensive use.

It is, accordingly, one object of my invention to provide means whereby a super-regenerative system will be prevented from radiating.

Another object is to sharpen the tuning of a super-regenerative system.

Another object is to increase the sensitivity of a super-regenerative system.

Still another object is to so arrange a super-regenerative system that is extremely easy to tune.

A further object is to so improve the stability of a super-regenerative amplifying system that the reception of signals will not be interrupted by undesired oscillations.

I attain these objects, and others which will be stated later, by interposing between the antenna or source of signal energy and the super-regenerative system, an amplifier which is so arranged that signal energy may pass from the antenna to the super-regenerative system but cannot pass in the reverse direction.

More specifically, I employ, between the antenna and the super-regenerative detector, one or more steps of radio frequency amplification, each of which is neutralized against oscillation according to the teachings of Rice Patent No. 1,334,118. The interposition of one or a plurality of steps of neutralized radio frequency amplification between the source of varying energy and the super-regenerative amplifier prevents the local oscillations of the amplifier from reaching the antenna, stabilizes the signal voltages impressed on the super-regenerative system and gives rise to additional unforeseen advantages which will be brought out later.

Referring now to the drawing and the following description, from which a more complete understanding of my invention may be had,

The single figure is a diagrammatic view of a preferred form of my invention, in which the radio frequency amplifier is shown as a single step.

An antenna 1 is connected through a variable condenser 2 and a variable inductor 3 to the ground 4. This is merely indicative of a source of varying signal energy as my invention may be employed with other signal sources. Variably coupled to inductor 3 is a second inductor 4' shunted by a variable condenser 5, connected between the grid 6 and

the filament 7 of a thermionic amplifier 8. The thermionic amplified 8 is provided with the usual anode 9 and has connected thereto a filament lighting battery 10. The output circuit of the thermionic device 8 comprises an inductor 11 and a high potential battery 12 in series between the anode 9 and the filament 7.

Coupled to the inductor 11 is a second inductor 12′, which is connected to the grid 6 through a condenser 13. The inductors 11 and 12′ are preferably formed as a single coil with a tap at, or near, the center for the connection from the battery 12. The output inductor 11 is coupled to an inductor 14, which is shunted by a condenser 15, the elements 14 and 15 being connected in the grid circuit of a second thermionic device 17. The thermionic device 17 is provided with a grid 18, a filament 19 and an anode 20 in the usual and well-known manner. The filament is provided with a source of power 22 and in series with the anode 20 and the filament 19 is a tickler or feed-back coil 23, a pair of telephones 24, a source of anode potential 25, and a tuned circuit comprising inductor 26 and condenser 27. Included serially between the tuned circuit 14—15 and the filament 19 is another tuned circuit comprising inductor 28 and condenser 29. A grid-biasing battery 31 may be used, if desirable, and the telephones 24 may be by-passed by a condenser 32.

In the operation of my system, the incoming signals, which are impressed by way of inductor 4′ across the grid filament circuit of the thermionic device 8, are amplified therein and are repeated with greatly increased amplitude in the output inductor 11.

The function of the inductor 12′ and the condenser 13 is to impress upon the grid of the device 8 a potential 180° out of phase with any potential impressed upon the inductor 11 by reason of its coupling with the inductor 14. The capacity of the condenser 13 is so chosen that the product of this capacity and the inductance of the inductor 12 is equal to the product of the capacity existing between the grid 6 and the anode 9, and the inductor 11.

By reason of this connection, varying potentials induced in inductor 11, on account of current changes in inductor 14, will not cause any potential to be set up in inductor 4′ since the condenser 13 will apply to the grid a voltage 180° out of phase with the voltage applied thereto through the grid anode capacity. This system of neutralization is within the teachings of the Rice patent referred to. The signal variations, however, existing in the output inductor 11 are impressed through the coupling between inductors 11 and 14 upon the input circuit of the super-regenerative system, illustrated at the right of the dotted line.

As explained in the Armstrong patent referred to, inductors 28 and 26, together with condensers 29 and 27, control the rate at which high frequency oscillations in the super-regenerative system are started and stopped. This variation frequency is usually in the neighborhood of 10,000 cycles per second and, if allowed to react on the antenna system 1—2—3—4, would prove extremely annoying to the operators of neighboring receiving sets. Such reaction is further detrimental by reason of the fact that the oscillations set up in the super-regenerative system would persist in the antenna circuit after the cessation of an incoming signal, and would act as a trigger to set the super-regenerative system again into oscillation, causing the signal to become blurred.

This feed-back of energy from the super-regenerative system into the antenna gives rise to a broadness of tuning which, as explained above, is undesirable. By providing the thermionic amplifier device 8, which is interposed between the antenna and the super-regenerative system, with means for the prevention of feed-back therethrough, all oscillations in the super-regenerative portion of the system are prevented from reaching the antenna.

It is also feasible to use a loop instead of the antenna shown, and in such case I may provide the loop with a center tap to the filament of the device 8, and with a connection through a condenser to the anode 9 from the end attached to the grid.

It is noted, when operating a system arranged according to my invention, that the tuning is much sharper than usual. It is also noted that the sensitivity of the system as a whole is greatly increased, permitting the reception of signals from stations ordinarily out of reach of the usual super-regenerative circuit.

When properly adjusted, the system of my invention will cause no annoyance to persons operating other receiving sets near by. It is extremely stable in operation and displays no tendency to produce undesired oscillations.

Although I have illustrated and described herein a specific embodiment of my invention, I am fully aware that many other modifications are possible. I, accordingly, do not intend to be limited except in so far as is necessitated by prior art and is indicated in the scope of the appended claim.

I claim as my invention:

In a signal-receiving system, a thermionic amplifier having input and output terminals, means, capable of oscillating, for receiving signal energy and impressing it across said input terminals, a super-regenerative detector capable of simultaneously generating oscillations at a plurality of frequencies, coupling means between the output terminals of said amplifier and said detector for transferring signal energy to said detector, and an

auxiliary coil and condenser connected between the input terminals of said amplifier and being so inductively associated with the aforesaid coupling means as to apply potentials across said amplifier input terminals out of phase with the oscillatory potentials applied thereacross from the detector by reason of the inter-electrode capacity of said amplifier, whereby the signal-energy-receiving means is prevented from being kept in a state of oscillation by energy from said detector, and the sharpness of tuning of the system is increased.

In testimony whereof, I have hereunto subscribed my name this 29th day of March, 1926.

VERNON D. LANDON.