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SUPER-REGENERATIVE RADIO RECEIVER

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Fig. 1

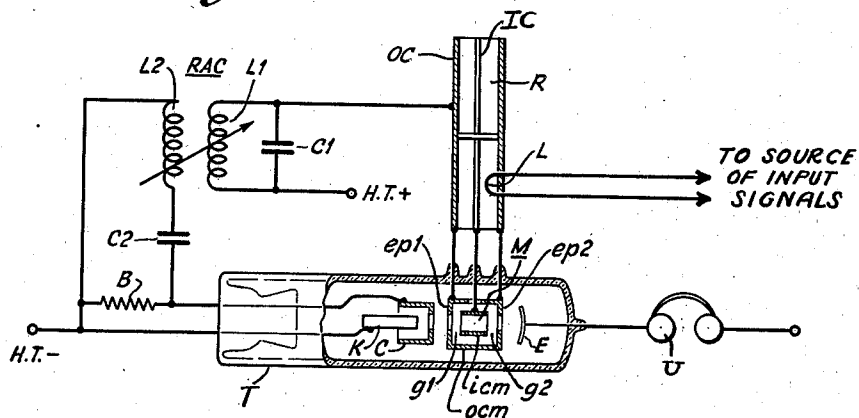
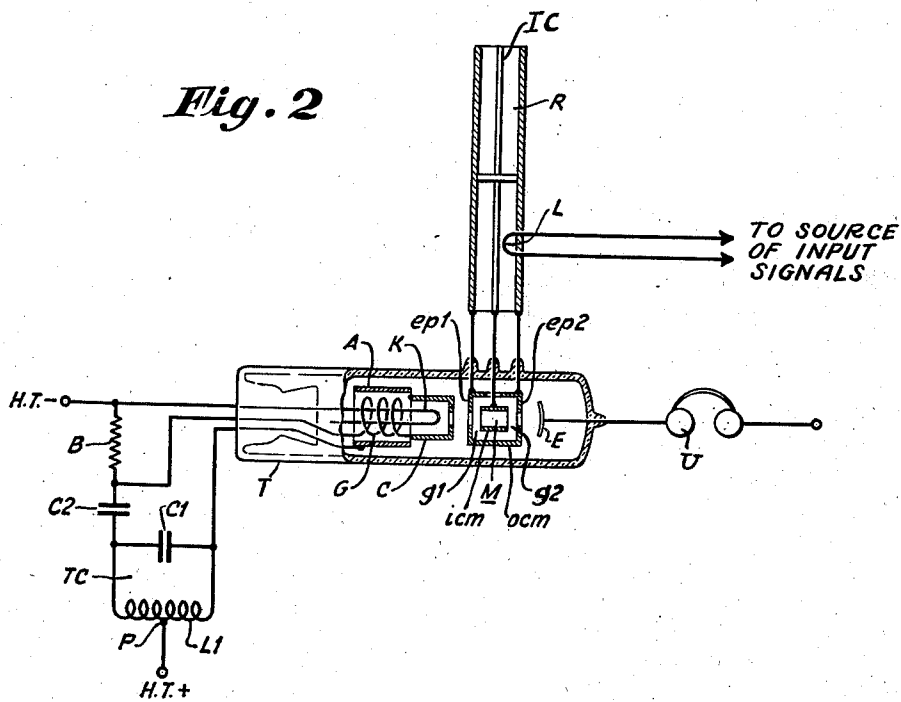


Fig. 2



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SUPERREGENERATIVE RADIO RECEIVER

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4 Claims. (Cl. 250—20)

The present invention relates to super-regenerative radio receivers. It also relates to velocity modulation tubes and provides a velocity modulation tube which generates two frequencies, one the operating short, or ultra-short, wave frequency and the other the quenching frequency.

Velocity modulation tubes are described in a paper which appears in the "Proceedings of Radio Engineers," February 1939, at pages 106 to 116, and at page 113 reference is made to velocity modulation tubes operating as oscillators. It is suggested in that paper that such tubes, so operating, may be used in super-regenerative radio receivers by injecting a quenching frequency at either the collector or focussing grid. No reference is made to the source of the quenching frequency.

According to the present invention a velocity modulation electron tube and circuit arrangement operating as an oscillator is provided with a feedback circuit extending between an electrode in said tube and the control electrode so that the tube generates, by means including said feedback circuit, and utilizes a quenching frequency oscillation in addition to the frequency generated by velocity modulation. The function of the first-mentioned electrode may be provided by the velocity modulation system as a whole, or it may consist of an anode adjacent to the cathode with a grid extending between the said anode and cathode.

In either embodiment of the invention, both of which are illustrated in the accompanying drawing wherein Figs. 1 and 2 show different embodiments of the invention, the tube includes within an envelope T, a cathode K, a control electrode C, a velocity modulation system M and a collector electrode E. The velocity modulation system includes inner and outer cylinders *icm* and *ocm*, actually the termination of coaxial-line resonator R, the outer cylinder being provided with centrally-apertured end-plates *ep1* and *ep2* and the cylinders being so coaxially disposed as to provide gaps *g1* and *g2* between the two ends of the inner cylinder *icm* and the two end-plates. The distance between the gaps *g1* and *g2* is such that the time of transit of an electron is one-half cycle. Thus, the effect of the gaps is additive, in known manner. The velocity modulation system is associated with a coaxial-line resonator R to which input signals are applied as by a coupling loop L. The detected output is taken from the collector electrode E. The telephones U reproduce the detected signals.

In one embodiment of the invention, that illus-

trated in Fig. 1 the electrode from which the quench frequency feedback circuit extends consists of the velocity modulation system M as a whole. A retroactive circuit RAC couples the outer conductor OC of the coaxial line resonator R to the control electrode C so that the velocity modulation system M as a whole acts as the anode of a three-electrode valve, the other two electrodes being the cathode K and the control electrode C. The retroactive circuit RAC comprises a parallel-tuned circuit comprising inductor L1 and condenser C1. The circuit L1C1 has the high alternating potential side thereof connected to the outer conductor OC of the coaxial-line resonator R, and the other side thereof is connected to the positive terminal HT+ of a source of high-tension energy (not shown). The inductor L1 is adjustably coupled to an inductor L2, and one end of inductor L2 is connected to the control electrode C through a blocking condenser C2. The other end of inductor L2 is connected to the cathode K and to the negative terminal HT- of the said source, a bias resistor B being connected across the control-electrode to cathode space. Since the inner cylinder *icm* of the modulator M is directly connected by a lead to the inner conductor IC of the resonator R and the outer cylinder *ocm* is conductively connected to outer cylinder OC, the entire modulation system M will be at the high positive potential HT+. The circuit L1C1 is of course tuned to the desired quench frequency. The oscillations of quench frequency interrupt the high frequency velocity modulated oscillations produced in the modulator system M. This produces the desired super-regenerative detection of the input signals.

In an alternative embodiment of the invention, that illustrated in Fig. 2 the electrode from which the quench frequency feedback circuit extends consists of an anode A adjacent to the cathode K, a grid G extends between the said anode A and cathode K. This grid G may consist of an extension of the control electrode C the extension being in the form of a cylindrical grid G surrounding the cathode. The anode A consists of a separate cylindrical member surrounding the said extension G. In this case the system comprising the cathode, grid-form extension G of the control electrode C and anode A is used as a normal three electrode valve, and is caused to generate quench frequency oscillations by a simple circuit consisting of a parallel tuned circuit TC comprising inductor L1 and condenser C1. The circuit TC has one end connected to the said anode A and the other end connected, through a blocking con-

denser C2 to the grid extension G of the control electrode C, a bias resistor B being connected across the control electrode to cathode space. The midpoint P of the parallel tuned circuit TC is connected to the positive terminal HT+ of a source of high-tension energy (not shown). The cathode is connected to the negative terminal HT- of the said source.

The oscillations generated in the system which simulates a three electrode valve are at a comparatively low frequency compared to the resonant frequency of the coaxial-line resonator R or the frequency of the incoming wave, and thereby represent a modulation of the density of the electron beam, periodically quenching the oscillations generated in the resonant circuit of the velocity modulation system.

It will thus be seen that I provide means to generate oscillations of a quenching frequency which space charge modulates the electron stream. In Fig. 1, the cathode K and control electrode C function exactly as the corresponding parts in a conventional triode oscillator. The coaxial line resonator R produces high frequency waves by virtue of the fact that it is excited at the incoming signal frequency. The electron stream passing through the terminating modulation elements M is velocity modulated by the excitation of the resonator R. In Fig. 2, the cathode and control electrode of the velocity modulation system are also employed at the quenching frequency oscillator, but here a separate anode element A is employed to complete the triode oscillator circuit arrangement. In both places, it will be noted, the quenching oscillator circuit arrangement is in energy transfer relation to the electron stream emanating from the cathode which, in turn, is used both for the velocity modulation and for the quenching circuits.

What I claim is:

1. A super-regenerative radio receiver comprising a velocity modulation tube functioning as a super-regenerative detector, said tube including at least a cathode, a control electrode, a modulation element and an electron collector, and circuit means in energy transfer relation to the electron stream emanating from said cathode for supply-

ing to said control electrode a quenching oscillation of lower frequency than the frequency applied to said modulation element.

2. A super-regenerative radio receiver comprising a velocity modulation tube functioning as a super-regenerative detector, said tube including at least a cathode, a control electrode, a modulation element and an electron collector, and circuit means in energy transfer relation to the electron stream emanating from said cathode for supplying to said control electrode a quenching oscillation of lower frequency than the frequency applied to said modulation element, said circuit means including said cathode and said control electrode of said velocity modulation tube, and a tuned circuit, resonant to said quenching frequency, coupled to said control electrode.

3. A super-regenerative radio receiver comprising a velocity modulation tube functioning as a super-regenerative detector, said tube including at least a cathode, a control electrode, a modulation element and an electron collector, and circuit means in energy transfer relation to the electron stream emanating from said cathode for supplying to said control electrode a quenching oscillation of lower frequency than the frequency applied to said modulation element, said circuit means including a feedback circuit deriving energy for said modulation element and supplying energy representative of said derived energy to said control electrode, said feedback circuit including a tuned circuit resonant to the quenching frequency.

4. An ultra short wave super-regenerative receiving system comprising a velocity modulation tube, said tube including at least an electron emitter, a control electrode, a modulation element and electron collection means, an anode positioned on the side of said modulation element opposite to that at which said collection means is located, a tuned circuit coupled between said control electrode and said anode, and said tuned circuit being resonant to the frequency of desired quenching oscillations whereby said tube functions as a super-regenerative detector.

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