March 28, 1939. F. CONRAD 2,151,747

RECEIVING SYSTEM

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Fig. 1.

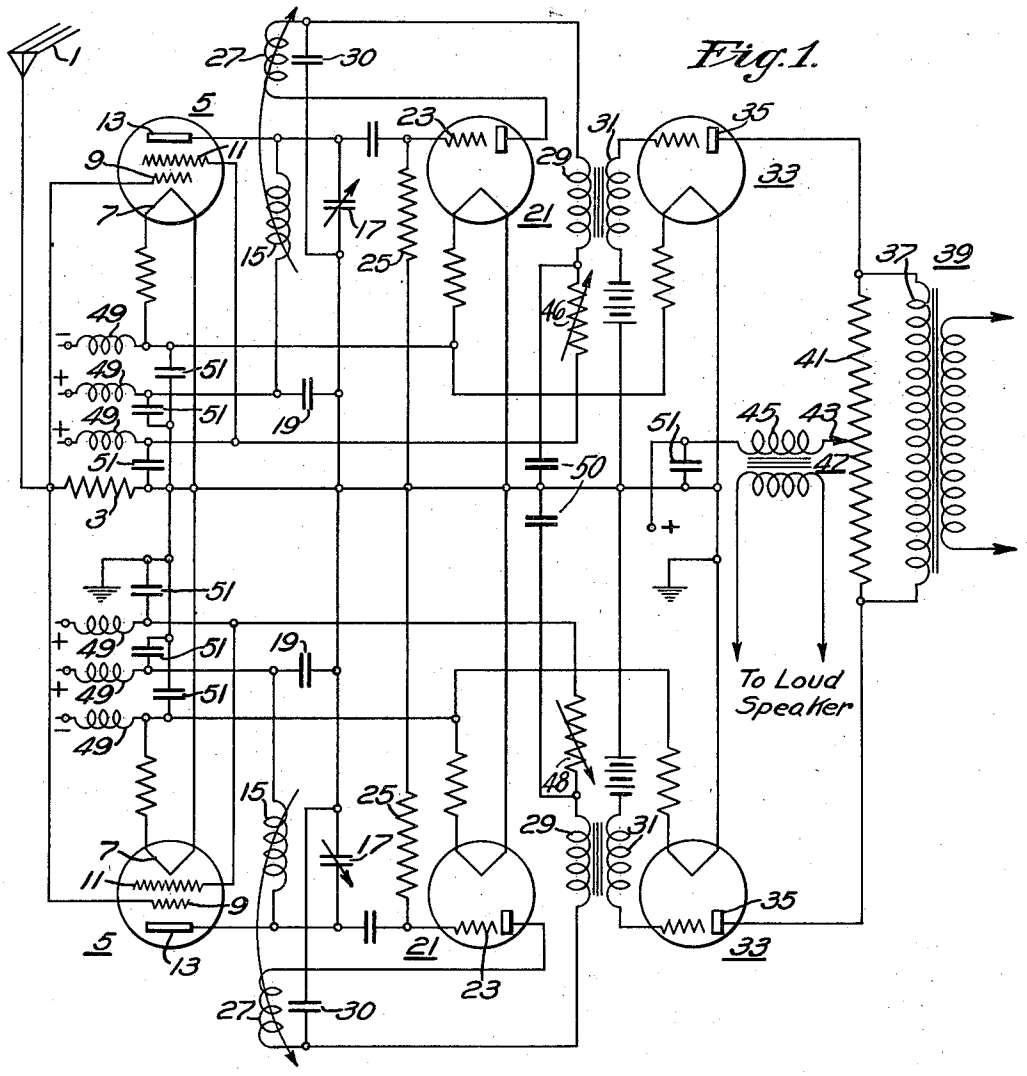
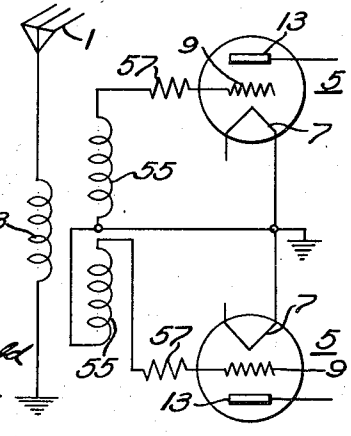


Fig. 2.



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RECEIVING SYSTEM

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4 Claims. (Cl. 250—9)

My invention relates to radio communication and more particularly to a system for receiving more than one signal simultaneously.

It is an object of my invention to provide a receiving circuit capable of receiving a plurality of signals simultaneously.

Another object of my invention is to provide a receiving circuit capable of distinguishing between amplitude modulated signals and frequency modulated signals.

Another object of my invention is to provide a receiving circuit capable of distinguishing between amplitude and frequency modulated signals and capable of utilizing said signals simultaneously for such purposes as may be desired.

Additional objects of my invention will be pointed out in the following disclosure of the same, taken in conjunction with the accompanying drawing wherein:

Figure 1 is a circuit drawing of a system capable of carrying out the objects of my invention; and,

Fig. 2 represents an alternative form of input circuit which may be employed to advantage in lieu of the input circuit of the system of Fig. 1.

The embodiment of my invention as disclosed in Fig. 1 comprises a symmetrical arrangement of what constitutes the equivalent of two receiving circuits having a portion of their input and output circuits in common. An explanation of one side of the system therefor will be equivalent of describing the entire circuit, similar reference characters being used to designate corresponding elements in both sides of the system.

The antenna circuit comprises the antenna 1 connected to one end of a resistor 3 or other high impedance, the other end of which is grounded. This resistor or high impedance constitutes the input circuit to the first electron discharge device 5 utilized in this case as the radio frequency amplifier. This device is of the screen grid type having a cathode 7, control grid 9, screen grid 11 and plate electrode 13, the input impedance 3 being connected between one side of the cathode circuit which is grounded and the control grid 9 of this amplifier. The output circuit of this amplifier includes a tuned tank circuit comprising an inductor 15 tuned by a variable condenser 17, this tank circuit being grounded at radio frequency by means of a large bypass condenser 19 connected therein.

The output energy of the radio frequency amplifier is fed to a detector tube 21 of the three electrode type, the tank circuit being capacitively coupled to the grid 23 of the tube and therefore constituting an effective input circuit to the detector tube, the grid being grounded through a high resistance grid leak 25. In the plate or output circuit of this detector stage there is connected a feed-back coil 27 disposed in inductive relationship to the tank coil 15 for the purpose of obtaining regeneration of the signal. In series with the feed-back coil 27 is the primary winding 29 of an audio frequency coupling transformer, the secondary 31 of which comprises the input circuit to an audio frequency amplifier 33 also of the three-electrode type. The condenser 30 by-passes the radio frequency component of the energy in the feed-back circuit around the high impedance of the primary winding 29 of the audio frequency coupling transformer.

The plate electrodes 35 of the audio frequency amplifiers connect to the extremities of the primary winding 37 of an audio frequency transformer 39, this primary winding being shunted by a potentiometer 41, an intermediate point of which is connected by means of a variable contactor 43 to the positive pole of a plate supply source, by way of the primary winding 45 of another audio frequency transformer 47.

Potentials for the various electrodes of the discharge devices in the circuit are derived from power supply sources such as batteries or rectifier filter units, these power sources supplying energy to the various electrodes through filters comprising series connected choke coils 49 and bypass condensers 51, these condensers providing low resistance paths for the alternating current component of the signals. In the circuit as shown, that side of the power supply sources which is not indicated is considered as being grounded, thus completing return paths to the supply sources.

In adjusting the system described for the purpose of permitting it to differentiate between amplitude and frequency modulated signals and utilizing both types simultaneously, the tank circuits are adjusted for resonance at frequencies which lie on either side of the carrier frequency of the signal being received. Thus one of the tank circuits will be tuned to a frequency slightly higher than that of the carrier whereas the other will be tuned to a frequency which will be slightly lower than the tuned frequency by substantially a like amount. When so adjusted, the impedance of one half of the system will increase as the carrier frequency increases due to a frequency modulated signal, and the impedance of the other half of the system will decrease under the same conditions. For amplitude modulated signals,

each half of the circuit will respond in the same sense in that the incoming signal will increase the signal strength on both sides of the system simultaneously.

Variable resistors **46**, **48** make possible the adjustment of the signal-input to tubes **33** so that, at one base-frequency which may be selected by varying the relative settings of resistors **46**, **48**, the voltage between terminals of transformer **39** is zero. This base-frequency then corresponds to zero signal-intensity for the frequency-modulated branch of the receiver. Variation of the feedback between coils **27** and **15** may play a part in adjustment of voltage across the terminals of transformer **39** in a manner well-known in the regenerative-receiver art.

By-pass condensers **50** may be provided for the resistors **46**, **48** as shown.

Separation of the amplitude modulated signals from the frequency modulated signal takes place in the output circuits of the audio frequency amplifiers. The energy changes represented in the frequency modulated signal being in opposite sense, that is, the energy increasing in one output circuit while decreasing in the other, a potential will be developed across the primary winding **37** with the result that in the secondary winding of the transformer **39** there will appear potential variations representative of the frequency modulated signals.

Amplitude modulated signals, however, produce no such voltages across this primary winding by reason of the fact that there is developed equal and opposite potentials across this primary winding. The primary winding **45** of the second audio frequency transformer **47** which is common to both output circuits has impressed across it, potentials which are equal and in phase, with the result that in the secondary winding of this transformer there will appear signal potentials developed by reason of the energy changes in the circuits due to the amplitude modulated signals.

The tapped connection to the potentiometer shunting the primary winding of the first audio frequency transformer permits of fine adjustment which is quite necessary in balancing the circuits so that modulations of one type will not appear in that portion of the circuit designed to reproduce or translate modulations of the other type.

The secondary windings may be connected to subsequent amplifiers if desired and the signal energy may be utilized for any useful purpose, that is, each may be fed to a loud speaker or the energy in one or both secondary winding circuits may be utilized for synchronizing purposes or to control other types of signal indicators.

In Fig. 2 I have disclosed an antenna coupling circuit which might be used to advantage in feeding the antenna energy to the grids of the radio frequency amplifiers. The antenna circuit includes the primary winding **53** of a radio frequency transformer having two secondary windings **55**, the mid point of which will be connected to the grounded side of the filament circuit either directly or through suitable bias battery. The free ends of the secondary windings are then connected to each grid **9** of the radio frequency amplifiers, preferably through a resistor **57**, the direction of the windings being such that the amplitude modulated signals will be impressed upon the grids in phase, as occurs in the case of the input circuit of Fig. 1. The secondary windings may be so constructed as to be adjustable with respect to the coupling with each other and the primary winding, thus providing a means for obtaining a better balance between the two halves of the system.

While I have disclosed my invention in detail, various modifications thereof may occur to those skilled in the art without departing from the scope of my invention, and I therefore do not desire to be limited in my protection to the specific details disclosed except as may be required by the prior art and the appended claims.

I claim as my invention:

1. In combination, a receptor for signalling energy, a signalling channel from said receptor having branches, means for producing energy changes in each branch corresponding to amplitude modulation of the signalling energy received by said receptor and for producing energy changes in each branch corresponding to frequency modulation of said received energy, means for causing the energy changes corresponding to one type of modulation to be substantially in the same direction, and the energy changes corresponding to the other type of modulation to be substantially opposite in direction, a translating device, means for additively combining the energy changes in the branches and impressing the result upon said translating device, another translating device, means for differentially combining the energy changes in the branches and impressing the result upon said last-named translating device.

2. In combination, a receptor for signalling energy, signal translating means, means for produring two outputs controlled by the energy received at said receptor, means for causing the energy changes in said outputs corresponding to amplitude modulation of said received signalling energy to be in the same direction and the energy changes in said outputs corresponding to frequency modulation of said received energy to be in opposite directions, and means for so impressing the combined outputs upon the signal translating means as to produce a translated signal corresponding to one modulation when additively combined and a translated signal corresponding to the other modulation when differentially combined.

3. In a system for the reception of either frequency modulated or amplitude modulated energy, an energy receptor, a branched communication channel, frequency discriminating devices in each channel, said devices being of such value as to tune one of said channels to a frequency differing from that of the other channel, and means for interpreting either the frequency or amplitude modulation effects of energy changes occurring in said channels.

4. Apparatus for receiving a carrier wave whose frequency and strength are modulated by different signals, comprising; a circuit whose impedance to the carrier wave increases as the carrier frequency increases, and vice versa; a circuit whose impedance to the carrier wave decreases as the carrier frequency increases, and vice versa; and translating means responsive to simultaneous opposite strength modulations in said frequency-variable impedance circuits to render the frequency-modulated signal, and responsive to simultaneous like strength modulations in said circuits to render the strength-modulated signal.

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