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R. S. OHL

RADIO SIGNALING SYSTEM

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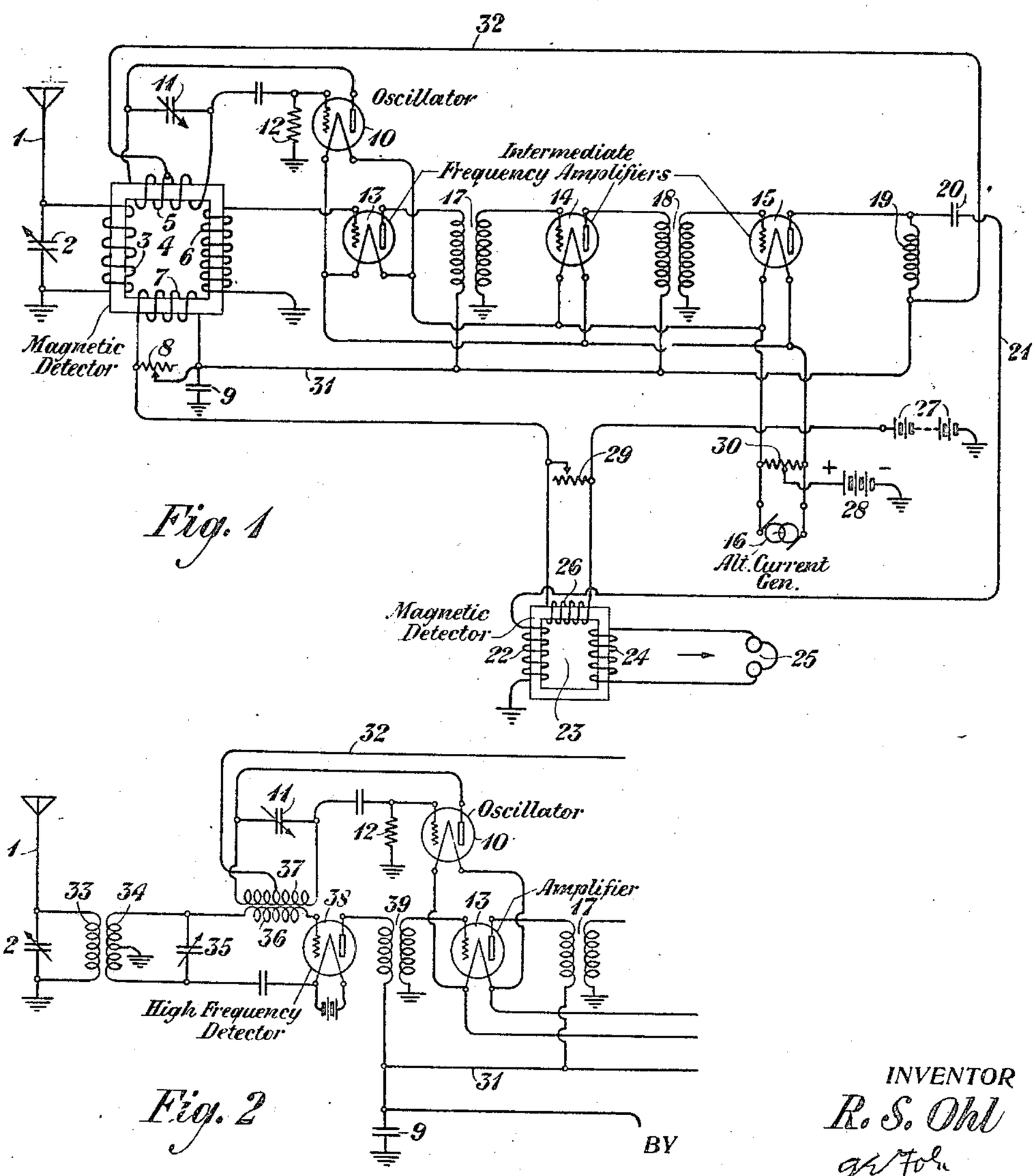

Fig. 1

Fig. 2

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RADIO SIGNALING SYSTEM.

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This invention relates to high frequency signaling systems, and particularly to a receiving circuit of such systems characterized by the use of alternating current for heating the filaments of the vacuum tubes used in the receiving circuit.

The use of batteries, particularly of the storage type, in connection with high frequency receiving sets is objectionable, not only because of high first cost and maintenance but also because of the trouble incidental to keeping such batteries charged. It is accordingly desirable to avoid their use. It has been found that an alternating current supply, such, as the 60-cycle lighting circuits, may be used for the heating of the filaments of vacuum tube amplifiers without producing appreciable noise in the receiver connected with the output side thereof, provided excessive amplification is not produced. However, a vacuum tube detector whose filament is heated by alternating current is not satisfactory, because the frequency of the filament heating current modulates the frequencies impressed upon the tube by the circuit connected with its grid and produces an audi-frequency current in the output circuit of the detector which interferes with detection of the signals.

This invention consists in an arrangement for detecting and amplifying radio signals, which is characterized by the use of one or more magnetic detectors and by intermediate frequency amplification utilizing vacuum tubes, the filaments of which are heated by alternating currents.

Other objects of this invention will be apparent from the following description, when read in connection with the attached drawing, of which Figure 1 shows a form of embodiment of the invention employing two magnetic detectors and intermediate frequency amplification, and Fig. 2 shows the use of a vacuum tube for the intermediate frequency detection and a magnetic detector for the audio-frequency detection.

In Fig. 1, the antenna 1 is connected with a resonant input circuit comprising the variable condenser 2 and an inductance 3, which constitutes one winding of the magnetic detector 4. Another winding 5 of this detector is connected with the oscillator 10. A third winding 6 is connected with the vacuum tube amplifier, and a fourth winding 7 is connected with a source of direct current, namely the plate battery, for the purpose of biasing magnetically the detector 4. The cores of this detector are preferably made of permalloy, the characteristics of which are fully set forth in a paper by Arnold and Elmen, published in the Journal of the Franklin Institute, volume 195, No. 5, dated May, 1923. A variable resistance 8 is connected in parallel with the winding 7 to control the current therein and a condenser 9 is connected to ground for reasons which will be clear from later description. A variable condenser 11 is connected across the winding 5 to provide a resonant-feed-back circuit of the oscillator 10, and a resistance 12 is connected to ground from the grid circuit of this tube. The amplifier may contain any number of tubes, such as 13, 14 and 15, coupled together by means of transformers 17 and 18. The inductance 19 is connected with the plate of the last tube 15. The plate of this tube is connected through condenser 20 with conductor 21, which is connected with the winding 22 of the magnetic detector 23. Another winding 24 is connected with a signal indicating device such as a telephone receiver 25. A biasing winding 26, similar to 7 of detector 4, is connected with detector 23 and a shunt 29 controls the current through this winding. The filaments of the amplifier and also of the oscillator are connected with an alternating current generator 16, across which is connected the resistance 30, the midpoint of which is connected with the positive pole of the battery 28, the negative pole of which is grounded. This battery applies the negative bias to the grids of the amplifier and oscillator. Battery 27 serves by means of conductors 31 and 32 to apply the positive plate potential to all of the tubes and also to provide the biasing current for the windings 7 and 26 of the magnetic detectors.

The manner in which this arrangement operates to detect signals is as follows: the currents of signaling frequency received by the antenna 1 will be impressed by the resonant circuit 2—3 upon the magnetic detector 4, wherein such currents will be beaten to an intermediate or different frequency by another frequency impressed upon the winding 5 by the oscillator 10. The resultant intermediate frequency will be impressed upon the amplifiers 13, 14 and 15, and after being amplified to the required degree, the said intermediate frequency carrying the signal will

be impressed upon the winding 22 of the detector 23. The signal will be detected thereby and impressed upon the receiver 25 by the winding 24.

Fig. 2 shows an embodiment of the invention in which a detector of the vacuum tube type is used for the detection of the intermediate frequency. The circuit of Fig. 2 differs structurally from that of Fig. 1 in the use of a vacuum tube detector in place of the magnetic detector shown in Fig. 1 for beating down the incoming frequency to an intermediate frequency. In the arrangement of Fig. 2 the high frequency signaling currents received by antenna 1 will be impressed upon the resonant circuit 2—33 which in turn will impress them upon the resonant circuit 34—35 connected with the grid circuit of the vacuum tube detector 38. Coupled with this grid circuit by means of the windings 36 and 37 is a source of high frequency current similar to that shown in Fig. 1. The intermediate frequency current resulting from detection by the tube 38 will be impressed by the transformer 39 upon an amplifier similar to that shown in Fig. 1, but of which tube 13 only is shown in Fig. 2. The remainder of the circuit of Fig. 2 for the detection of the audio-frequency signals should be the same as shown in Fig. 1. The arrangement shown in Fig. 2 is preferable where the incoming frequency is so high that satisfactory detection of the intermediate frequency cannot be effected by means of any known type of magnetic detector.

While this invention has been disclosed as embodied in a particular form, it is to be understood that it is capable of embodiment in other forms without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a radio receiving system, the combination with an antenna of a magnetic detector connected therewith, an amplifier connected with the output of the said detector, a second magnetic detector connected with the output of the said amplifier, and a signal receiving instrument connected with the said second detector.

2. In a radio receiving system, the combination with an antenna of a magnetic detector connected therewith, a vacuum tube amplifier connected with the output of the said detector, the said amplifier having a source of alternating current connected with the filament thereof for heating the said filament, a second magnetic detector connected with the output of the said amplifier, and a signal receiving instrument connected with the said second detector.

3. In a radio receiving system, the combination with an antenna of a magnetic detector connected therewith, a vacuum tube amplifier having a plurality of tubes connected with the output of the said detector, a source of alternating current connected with the filaments of the said vacuum tubes for heating the same, a second magnetic detector connected with the output of the said amplifier, and a signal receiving instrument connected with the said second detector.

4. In a radio receiving system, the combination with a tuned receiving circuit of a magnetic detector including a plurality of windings mounted upon a magnetic core, one of said windings constituting one of the elements for tuning the said receiving circuit, a vacuum tube oscillator connected with another of the said windings, a source of biasing current connected with a third one of said windings, a vacuum tube amplifier connected with a fourth of said windings, a source of alternating current to supply the heating current for the filaments of the said oscillator and said amplifier, a second magnetic detector having a plurality of windings, one being connected with the output of the said amplifier, another being connected with the said source of biasing current, and a signal receiving instrument connected with a third winding of said second detector.

5. In a radio receiving system, the combination with a magnetic detector having a plurality of windings, of an input circuit connected with one of said windings, an oscillator connected with a second winding of said detector, an amplifier having its input side connected with a third winding of the said detector, and a source of current connected with the fourth winding of the said detector to magnetize the core thereof.

6. In a radio receiving system, the combination with a magnetic detector having a plurality of windings, of an input circuit connected with one of said windings, an oscillator connected with a second winding of said detector, an amplifier having its input side connected with a third winding of the said detector, a source of current connected with the fourth winding of the said detector, and means to limit the magnitude of the current through the said fourth winding depending upon the magnetic characteristic of the detector.

7. In a radio receiving system, the combination with a plurality of magnetic detectors each having a plurality of windings, one detector being designed for the detection of intermediate frequencies and the other of audio frequencies, of an input circuit connected with one winding of the intermediate frequency detector, an oscillator connected with a second winding of the said intermediate frequency detector, an amplifier having its input connected with a third winding of said intermediate frequency detector and its output connected with a winding of the audio frequency detector, a receiving device connected with a second winding of said audio frequency detector, and a source of direct

current connected with a fourth winding of the intermediate frequency detector and also with a third winding of the audio frequency detector to provide a predetermined degree of magnetization of the cores of the said detectors.

8. In a radio receiving system, the combination with a magnetic detector having a plurality of windings, of an input circuit connected with one of said windings, a vacuum tube oscillator connected with a second winding of said detector, a vacuum tube amplifier having its input side connected with a third winding of said detector, a source of plate voltage connected with the plates of said vacuum tubes and also with the fourth winding of the said detector, and a source of alternating current connected with the filaments of the said vacuum tubes.

9. In a radio receiving system, the combination with a plurality of magnetic detectors each having a plurality of windings, one detector being designed for the detection of an intermediate frequency and the other of an audio frequency, of an input circuit connected with one winding of the intermediate frequency detector, a vacuum tube oscillator connected with a second winding of the intermediate frequency detector, a vacuum tube amplifier having its input connected with a third winding of the intermediate frequency detector and its output connected with a winding of the audio frequency detector, a receiving device connected with a second winding of the said audio frequency detector, a source of alternating current connected with the filaments of the said vacuum tubes, and a source of plate voltage connected with the plates of the said vacuum tubes and also with a fourth winding of the intermediate frequency detector and a third winding of the audio frequency detector.

In testimony whereof, I have signed my name to this specification this 21st day of June, 1924.

RUSSELL S. OHL.