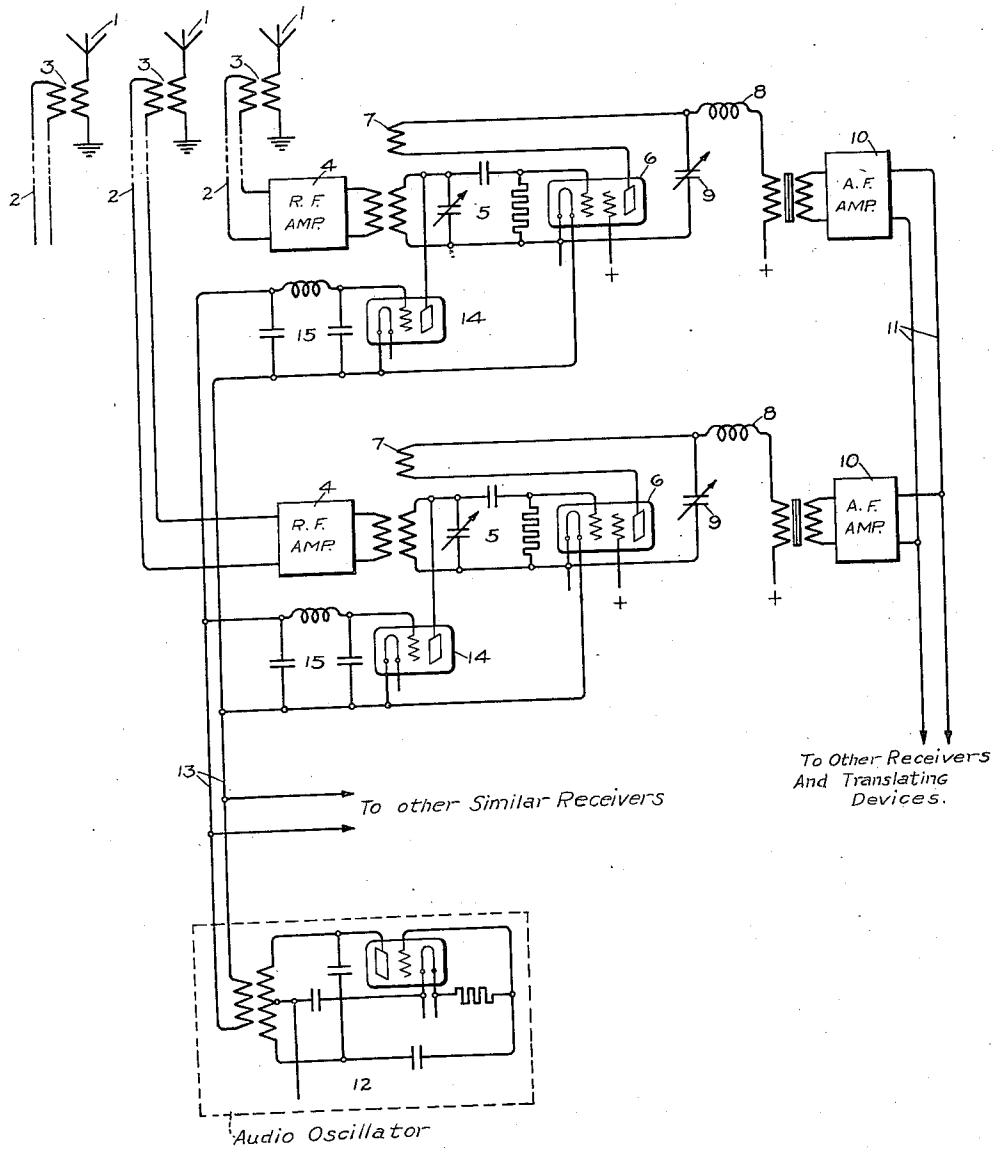


Oct. 29, 1935.

E. F. CARTER
DIVERSITY RECEPTION SYSTEM

Filed Jan. 30, 1932

2,019,335



Inventor:
Emmett F. Carter;
by *Charles V. Tulla*
His Attorney.

UNITED STATES PATENT OFFICE

2,019,335

DIVERSITY RECEPTION SYSTEM

Emmett F. Carter, Laurelton, N. Y., assignor to
General Electric Company, a corporation of
New York

Application January 30, 1932, Serial No. 589,882

6 Claims. (Cl. 250—8)

My invention relates to radio signal receiving systems and more particularly to systems of that character commonly known as diversity factor reception systems in which a plurality of antennae and receivers are employed to obtain reliable signal reception.

My invention has for one of its objects to provide an improved diversity factor reception system employing a plurality of super-regenerative receivers in which the radio telegraph signals received by the various receivers are simultaneously modulated in the various detector circuits of said receivers by a constant audio frequency to provide constant frequency audio signals in the respective output circuits of the various receivers which may be combined directly in a common audio output circuit.

In accordance with my invention, the various receivers of a diversity reception system are provided with regenerative detectors, and by introducing into the input circuit of these detectors by means of control tubes, an audio frequency component, a combination of a super-regenerative action and a modulation action is obtained which permits the various outputs of the detector circuits to be combined directly in a common output circuit, regardless of phase difference, to obtain a constant frequency audio signal. By means of this arrangement, the modulation and the detection of the signals is accomplished by a single electron discharge device and circuit. This arrangement produces a very sensitive system which is simple to construct and operate.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, will be better understood by reference to the following description taken in connection with the accompanying drawing in which the single figure represents a preferred embodiment of my invention.

Referring to the drawing, I have illustrated therein a plurality of receiving antennae 1 located at geographically separated points so chosen that fading and disturbances will be different at the various points of reception. Each of the antennae is coupled to one of a plurality of transmission lines 2 by means of a suitable coupling device 3. The transmission lines 2 may each be connected to a radio frequency amplifier 4 to amplify the radio telegraph signal before impressing it upon the input circuit 5 of an electron discharge detector 6. The input circuit

5 of the electron discharge detector 6 is of a suitable type of tuned circuit which may employ grid condenser and leak detection. Each electron discharge detector 6 is arranged in a regenerative circuit. Regeneration may be obtained in any one of a number of well-known ways, which for example, may be obtained as illustrated by coupling the anode circuit of the electron discharge detector 6 to input circuit 5 by means of a regeneration coil 7. To facilitate the control of the regeneration, I have arranged a radio frequency choke 8 in series with the coil 7, and a variable capacitor 9 in parallel with the anode-cathode circuit. The output of the detector circuit may be coupled to an audio frequency amplifier 10, the output of which is connected to the common output circuit 11.

An audio frequency oscillator is coupled to the input circuits 5 of the various detectors 6 by means of an audio frequency line 13 and the control tubes 14. The output of the control tube 14 is connected across the detector input circuit 5 by means of a connection from the anode of the control tube 14 to the grid end of the inductance in the input circuit 5 of the detector and a connection between the cathode of control tube 14 and the cathode of the electron discharge detector 6. To prevent the incoming signal energy from being fed into the audio frequency line 13, the filter section 15 is provided, which is composed of an inductor and capacitors.

In operation, the signal energies are picked up by the antennae 1 and transferred to the transmission lines 2 by means of the coupling devices 3. The signal energies are then amplified in the radio frequency amplifiers 4, the outputs of which are coupled to the input circuits 5 of the electron discharge detectors 6. The various antennae and receivers may be arranged to receive signals which are simultaneously transmitted over a plurality of different frequency channels. The audio oscillator 12 is arranged to provide oscillations of a frequency suitable for the tone desired in the common output circuit. These oscillations are then fed to the control tubes 14 by means of the line 13, which cause the grid elements of control tubes 14 to become alternately positive and negative. This alternation of potential on the grid elements of the control tubes 14 periodically varies the impedance of control tubes 14, which in turn causes the impedance of the detector input circuits 5 to be varied. This periodic variation of the impedance of detector input circuits 5 is sufficient to introduce a super-regenerative action into the detector circuits which have

been adjusted to the desired condition of regeneration. This variation of the impedance of the detector circuits also introduces a modulation action into the electron discharge detectors 6 which modulates the incoming signal energy with the audio frequency of the audio oscillator. This combined action of modulation and super-regeneration results in a very sensitive detector action and provides a signal output having a constant audio frequency note. Inasmuch as all of the grids of the control tubes 13 are driven together, the signal energies in the various receiver circuits, which may be operating on different frequency channels, are all modulated with the same audio frequency. The signals derived from the various detector circuits may be amplified by their respective audio frequency amplifiers and then combined in a common output circuit to provide a signal having a constant audio frequency. Because of the fact that the signal outputs of the various detectors are all of the same audio frequency, it is possible to combine these outputs directly without the use of direct current amplifiers and elaborate keying systems, usually employed to produce a constant frequency audio signal.

My invention has the advantage that a plurality of super-regenerative receivers may be employed to provide very sensitive detector circuits in which the signals are simultaneously modulated by a constant audio frequency to produce audio signals which may be combined directly into a common output circuit. My invention has the further advantage that the outputs of a plurality of super-regenerative receivers in a diversity reception system operating on the same frequency may be combined directly without synchronization of the beat notes occurring between the respective receivers.

While I have shown and described my invention in connection with certain specific embodiments, it will, of course, be understood that I do not wish to be limited thereto, since it is apparent that the principles herein disclosed are susceptible of numerous other applications, and modifications may be made in the circuit arrangements and in the instrumentalities employed without departing from the spirit and scope of my invention as set forth in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. A system for eliminating the effects of phase difference between receivers in a diversity signal reception system including a plurality of geographically spaced antennæ each coupled to one of a plurality of super-regenerative receivers, means common to all said receivers for modulating the signals in said receivers with a constant frequency audio component whereby the output signals of said receivers will be of the same constant audio frequency, and common output circuit for combining the output signals of said receivers into a single constant frequency signal.

2. A system for reducing the effects of fading in a radio receiving system including a plurality of different frequency signaling channels, a plurality of geographically spaced antennæ each coupled to one of a plurality of radio receivers,

each of said receivers being responsive to a different one of said signaling channels, means common to all said receivers for producing a constant frequency audio modulation of the signals and a super-regenerative detector action in said receivers, and means for combining the outputs of said receivers to provide a substantially constant frequency audio signal.

3. A diversity factor receiving system including a plurality of antennæ each coupled to one of a plurality of radio receivers, each of said receivers having a regenerative detector circuit with a control tube connected across the input of said detector circuit, an oscillator providing audio frequency oscillations, connections between said oscillator and said control tubes whereby the oscillations introduce a super-regenerative action in said detector circuits, and a common output circuit for combining the various outputs of said detectors.

4. In a diversity signal reception system, the combination of a plurality of geographically spaced antennæ, a plurality of radio receivers each coupled to one of said antennæ, said radio receivers having regenerative detector circuits, a plurality of control tubes each connected across the input of one of said detector circuits, an audio frequency oscillator, connections from said oscillator to said control tubes whereby a super-regenerative action is introduced into said detector circuits and the signal currents are modulated with an audio frequency, and a common output circuit for combining the signal outputs of said detector circuits.

5. The method of radio reception which consists in collecting radio signal energy at a plurality of geographically separated points, transmitting said various signal energies to a central receiving station, generating a single audio frequency wave for modulating said signal energies, simultaneously modulating the various signal energies with said single audio frequency wave and detecting the various signal energies to produce audio frequency currents in the output circuits of said detectors, and directly combining said audio frequency currents to produce a single constant frequency audio signal.

6. In a diversity reception system employing a plurality of regenerative detectors having input and output circuits, the method of radio reception which consists in collecting radio signal energy transmitted over a plurality of different frequency channels, impressing said various signal energies upon said plurality of detectors each operating on a different frequency channel, generating an audio frequency wave, simultaneously varying the impedances of the input circuits of said detectors in accordance with said audio frequency to produce a super-regenerative action and to modulate simultaneously the signal energies of the various frequency channels, detecting the modulated signal energies of the various frequency channels to produce audio currents in said output circuits, and directly combining the various audio currents to produce a single constant frequency audio signal.

EMMETT F. CARTER.