May 20, 1930. E. G. GAGE 1,758,940

MEANS FOR SEPARATING UNDESIRED FROM DESIRED ELECTRIC CURRENTS

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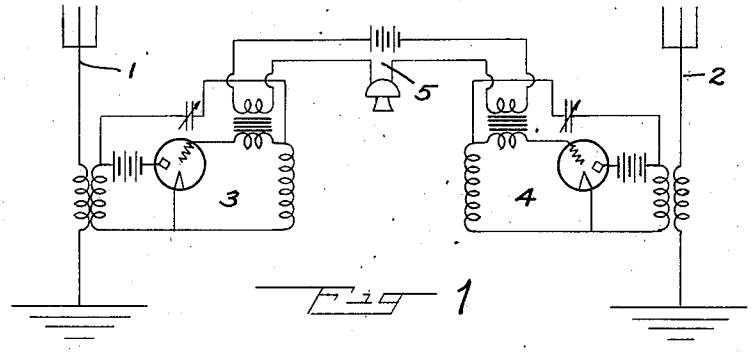


Fig 1

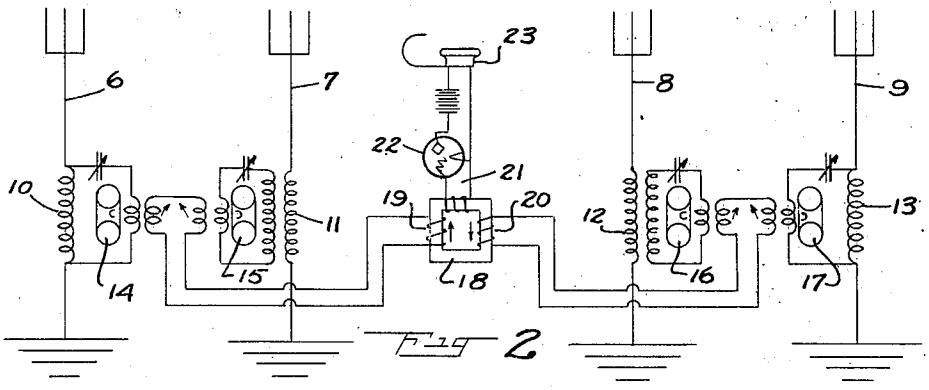
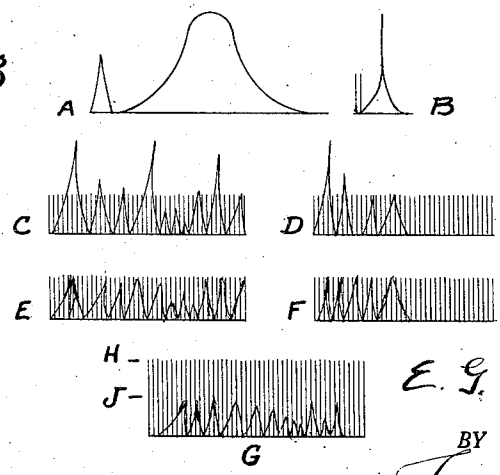


Fig 2

Fig 3



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UNITED STATES PATENT OFFICE

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MEANS FOR SEPARATING UNDESIRED FROM DESIRED ELECTRIC CURRENTS

Application filed February 6, 1924. Serial No. 690,947.

This application is a continuance in part of my prior application Serial No. 463,072, filed April 20, 1921.

In the art of radio telegraphy and telephony, it is found that natural disturbances in the ether interfere with the reception of intelligence.

The object of this invention is to eliminate such disturbances.

Heretofore it has been common practice to provide receiving circuits in opposition in which a broadly tuned wave such as the natural or hereinafter called undesired electric currents were made to cancel, while the signal or hereinafter called desired current, of a sharply tuned wave was retained by detuning one of the circuits.

Such interference preventers act as current limiters by reducing undesired currents to the level of the signal.

This invention relates to a method of raising the level of the signal or desired current above that of the stray or undesired current.

The principle on which my system works depends on the differentiating between what may be termed "decrement bands" of signal and stray, the width of each respective band being shown as the base of the impulse resonance curve. A plurality of these bands being combined, the algebraic sum consists only of signal or desired currents as regards amplitude owing to phase characteristics of each impulse.

To accomplish this, I provide two such systems, each with opposed detectors and selective means, and combine the results in a common receiving circuit as shown.

Each system receives one of two different waves sent out from a transmitter with a common modulator, as shown in Fig. 1.

My invention will best be understood by those skilled in the art by reference to the following description taken in connection with the accompanying drawings, in which,—

Fig. 1 represents a transmitting system for radio telephony or telegraphy having two separate antennæ, each emitting a distinctly different wave length, but modulated simultaneously by a common modulator.

Fig. 2 represents a receiving system comprising four separate antenna systems divided into two sections, each section consisting of receiving circuits in opposition, tuning devices for selecting the desired received currents from the undesired currents of each section, and a transformer with windings for combining the desired currents and transferring them to the amplifier and telephone.

Fig. 3 represents undesired or "static" impulses combined with desired or signal impulses and opposed to various combinations of desired and undesired currents, as hereinafter described.

In the system described, in Fig. 1, the antennæ 1 and 2 are excited by the vacuum valve oscillators 3 and 4 and each oscillator is modulated by the modulating circuit 5 in which a microphone or key is included.

As an example of the wave lengths emitted by the antennæ, it is convenient to specify 2,000 meters for antenna 1 and 3,000 meters for antenna 2, although the system is not limited to this combination.

In Fig. 2 the four receiving antennæ 6, 7, 8 and 9 are connected as follows:

Antenna 6 has connected to it by close coupling 10 a detector 14 shown here as a magnetic detector because that type is peculiarly adapted for the purpose, but it is to be understood that other detectors such as vacuum valves or crystal detectors may be used without departing from the scope of the invention.

Antenna 7 is similar to antenna 6 except that its coupling is inductive and loose.

Antenna systems 8 and 9 are respectively the same as 7 and 6.

The transformer 18 has wound upon it in conjunction the two output circuits from detectors 14 and 15 in opposition and 16 and 17 in opposition, and the input circuit 21 of the vacuum valve amplifier 22. The output circuit of which is led to the telephone 23.

Fig. 3—A and B represent decrement curves of undesired and desired currents respectively.

C and D represent rectified desired and undesired currents present in 14 and 17 respectively.

E and F represent the rectified desired and

undesired currents present in 19 and 20 respectively, after being acted upon by 15 and 16 in opposition.

G represents the rectified desired currents resulting from combining C and E in conjunction, and shows the signal or desired current level H above the stray or undesired current level J.

In operation, the transmitter is caused to emit the two sharply tuned wave lengths of 2,000 and 3,000 meters respectively.

Strays or undesired currents are of both high and low decrement. Those currents of high decrement will tune broadly, while those of low decrement tune sharply. Desired currents of both 2,000 and 3,000 meters wave length tune sharply.

The receiving circuits are adjusted as follows:

Antenna system 6 is tuned to receive the 2,000 meter signal of sharp tuning.

Antenna system 7 is then detuned sufficiently to eliminate the desired 2,000 meter signal, as an example, to 2,100 meters.

Antenna system 9 is tuned to receive the 3,000 meter desired signal of sharp tuning.

Antenna system 8 is detuned sufficiently to eliminate the desired 3,000 meter signal as an example to 3,100 meters.

The result of this operation is as follows:

Antenna system 6 being conductively and tightly coupled, tunes broadly, and at 2,000 meters it receives and detects both desired and undesired currents.

Antenna system 7 being inductively or loosely coupled, tunes sharply, and when tuned to 2,100 meters, the desired signal is eliminated. The undesired, however, being of higher decrement, is nearly as strong at 2,100, as at 2,000 meters. Hence it remains.

Antenna system 9 being conductively coupled, tunes broadly, and receives and detects both desired and undesired signals at 3,000 meters.

Antenna system 8 being inductively or loosely coupled, tunes sharply, and when tuned to 3,100 meters, the desired signal is eliminated, while the undesired remains at practically full strength.

The detected currents from 14 and 15 in opposition and 16 and 17 also in opposition, being combined in conjunction, at the transformer 18, produce in the winding 21 only desired currents, and these are transferred through the amplifier 21 to the telephone 23.

It will be seen that desired signals on both 2,000 and 3,000 meters being detected from a common modulator, are in phase, and therefore add, while strays or undesired currents, when of a decrement as low as the signal, appear in only one detector, and where different stray impulses are present, they are not in phase.

In place of the telephone 23, the input circuit of a system described by me in a previous application, (U. S.) Serial No. 463,072, filed April 20, 1921, may be connected in which a detector is caused to become fatigued by the desired signal, allowing opposed but constant detector to register the signal.

While for the sake of clearness, I have described the application of my invention to a system of elemental design, it will be apparent to those skilled in the art, that it may also be applied to systems in which radio frequency amplifiers are inserted before the detectors in the customary manner and that numerous applications thereof may be made without departing from the scope of the appended claims.

What I claim is:

1. In radio signalling, the method of receiving a plurality of waves of different frequencies subject to disturbance currents, which consists in separately receiving each frequency with its disturbance currents, combining with each frequency in opposite phase relation a portion of the disturbance currents, combining in the same phase relation the currents so obtained and utilizing the resultant currents.

2. In a radio signalling system, the method of combining a plurality of received frequencies each subject to disturbance currents which consists in receiving a plurality of signalling frequencies, in eliminating by opposition the disturbance currents accompanying each of the received frequencies, in combining the remaining currents of each of the received frequencies in additive relationship, and in utilizing the resultant combined currents.

3. In radio signalling systems for simultaneously transmitting and receiving a plurality of frequencies each subject to disturbance currents, means for simultaneously modulating a plurality of transmitted frequencies, means for receiving each of the transmitted frequencies separately combined with a portion of the disturbance currents accompanying the same, means for eliminating the disturbance currents accompanying each of the independent received frequencies by opposition, means for combining received currents of each of the independent frequencies in additive relationship, and means for utilizing the resultant combined currents.

Signed at New York in the county of New York and State of New York this 5th day of February, A. D. 1924.

EDWARD G. GAGE.