Oct. 9, 1928. 1,687,061

H. J. J. M. DE R. DE BELLESCIZE

ANTIPARASITE RECEIVER FOR WIRELESS COMMUNICATION SYSTEMS

Filed June 2, 1923 2 Sheets-Sheet 1

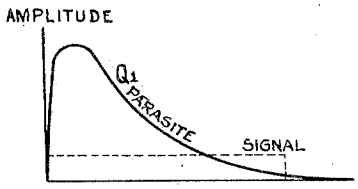
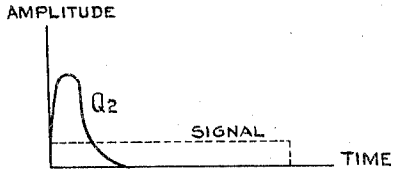
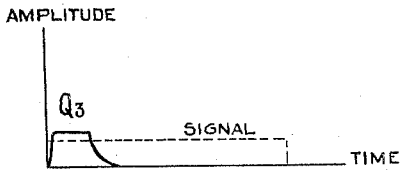
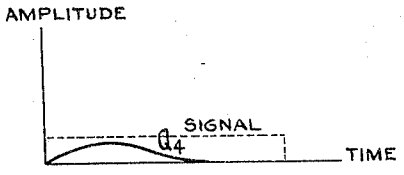
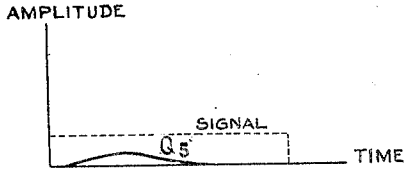


Fig. 1









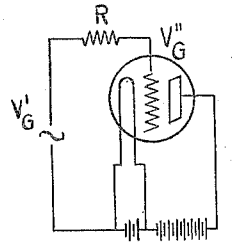
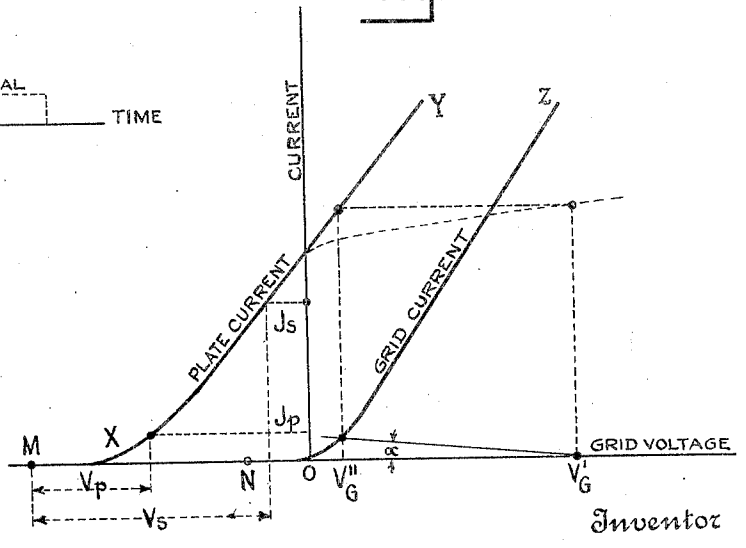


Fig. 3

Fig. 2



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ANTIPARASITE RECEIVER FOR WIRELESS COMMUNICATION SYSTEMS

Filed June 2, 1923 2 Sheets-Sheet 2

Fig. 4

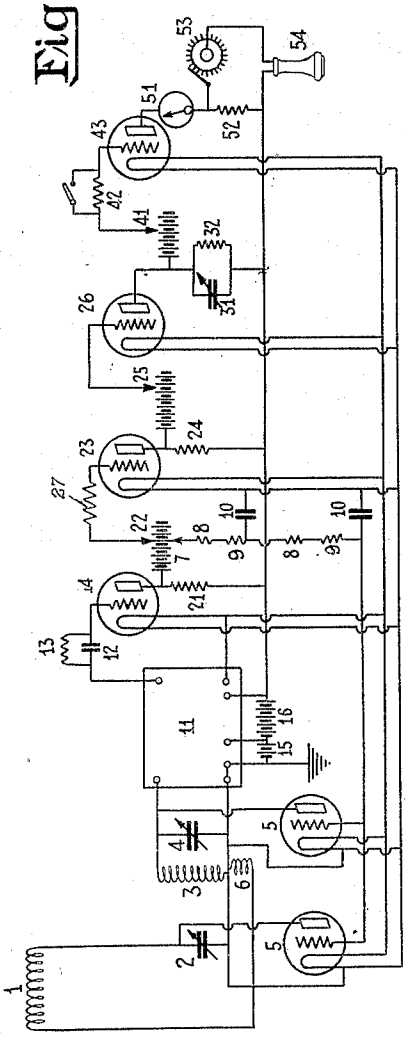
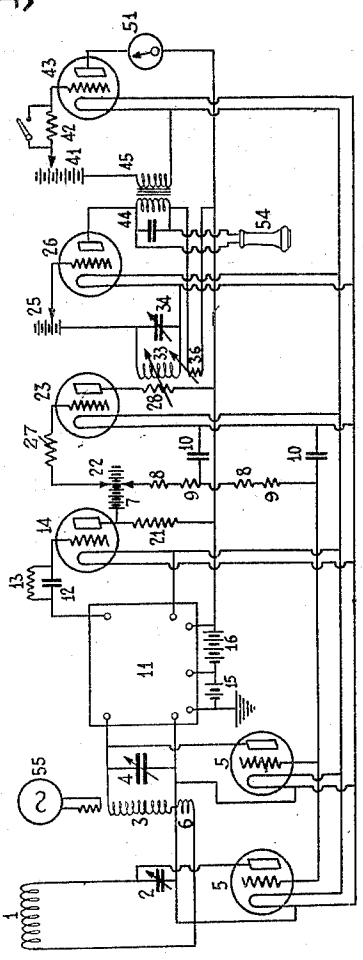


Fig. 5



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Patented Oct. 9, 1928. 1,687,061

UNITED STATES PATENT OFFICE.

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ANTIPARASITE RECEIVER FOR WIRELESS COMMUNICATION SYSTEMS.

Application filed June 2, 1923, Serial No. 642,882, and in France July 21, 1922.

The present invention has for its object the provision of an improved receiver applicable to wireless communication systems and making possible the elimination of damped disturbances the initial amplitude of which is very much greater than that of the signal which it is desired to receive.

The receiver forming the object of the present invention comprises arrangements described in the following two patents of the same inventor:

U. S. Patent No. 1,443,011 "atmospheric disturbance reducing means."

U. S. Application, Serial No. 624,286, filed March 10, 1923, "oscillation control."

The essential characteristic of the present invention consists in the combination of the arrangements forming the objects of the above mentioned patent and application with new arrangements to be hereinafter described.

In the drawing,

Fig. 1 represents the various stages of a disturbing train of oscillations in my invention,

Fig. 2 shows the characteristic of a vacuum tube as used in my invention,

Fig. 3 shows a way of connecting a tube so as to obtain the desired characteristics, and

Figs. 4 and 5 are two forms of receiver according to my invention.

The receiver forming the object of the present invention comprises the following elements:

A—An open or closed antenna followed eventually by a certain number of high frequency resonators, an amplifier, a detector, a low frequency filter and damping tubes.

B—A limiting arrangement for preventing the oscillations from exceeding the amplitude of the signal.

C—One or a plurality of circuits which may be aperiodic or in resonance with the modulation frequency of the signal and the time constant of which is adjusted to as high a value as the speed of signal transmission permits.

D—A tube the grid potential of which is normally adjusted to a value which is slightly more negative than the value necessary for annulling the plate current but whose amplification is worked out in such a manner that the signal will impart to this grid a potential which largely surpasses the elbow of the grid-voltage plate current characteristic.

Reference is now had to Fig. 4 of the drawing which shows, by way of example, the invention applied to a radio receiving circuit. The receiver has a closed antenna circuit, including the inductance 1, and variable condenser 2. Oscillations received in this circuit cause corresponding oscillations in a resonant circuit comprising inductance 3 and variable condenser 4. The oscillations are then amplified by any desired means, represented conventionally by 11, and detected by the tube 14, having in its grid circuit the condenser 12 and grid leak 13. The rectified currents in the output circuit of tube 14, traverse resistance 21 and, thereby, increase the plate potential of tube 14, these increases being suitably controlled by the adjustable contact 7 forming the battery connection. The resulting oscillations are transmitted through a low frequency filter provided for the purpose of preventing the return of high frequency oscillations to the grids of the damping tubes. The filter is represented diagrammatically by the elements 8, 9 and 10 and is connected on its output side to the two tubes 5, the filament-plate circuit of one of which is connected across the antenna circuit 1—2 and the filament-plate circuit of the other of which is connected across the resonant circuit 3—4. This device operates as explained in the patent and application above referred to, to increase the damping of disturbing oscillations.

The apparatus thus far described comprises the element A of the system and serves to reduce the duration of all parasitic trains of impulses whose amplitude exceeds that of the signal. If let alone these trains would have the form of the curve Q_1 in Fig. 1, but due to the operation of this apparatus they assume the form indicated by Q_2.

These oscillations now having the form indicated by Q_2 in Fig. 1, are impressed on the input circuit of tubes 23 and 26 connected in cascade which, together with their circuits, comprise the element B of the system and serve to limit the amplitude of the disturbing oscillations in their output circuits. Due to a suitably selected grid

potential, the tube 23 transmits the oscillations without deforming them and the oscillations will be translated with a reduction of potential at the top of resistance 24. The grid potential of tube 26 is adjusted by means of movable contact 25, forming an adjustable battery connection, to such an initial value that the signal will cause the plate current of this tube to fall nearly to zero, whereby, no matter what the force of a disturbance may be, it will also be reduced to the same value. This reduction in amplitude changes the form of the disturbance from that shown as Q_2 in Fig. 1, to that shown in Q_3.

This element B and its function form an important feature of the invention and will be described more in detail hereinafter.

The oscillations are now impressed on a circuit, comprising a resistance 32 and a variable capacity 31, which should be as high as permitted by the sending speed. The larger this capacity, the less will be the difference of potential caused by a given disturbance. This circuit comprises the element C of the system and, owing to its high time constant, the parasitic train at its output is elongated as to time but its amplitude falls to a value which is less than that of the signal. In its passage through this circuit the disturbing oscillation will be changed from the form represented by Q_3 in Fig. 1 to that represented by Q_4.

The amplitude of the disturbing oscillations is then further reduced to negligible value by means of the tube 43 which with its grid resistance 42, its adjustable battery connection 41 and the associate circuits, comprises element D of the system. The effect of this unit is to change the form of the disturbing oscillation from that shown as Q_4 in Fig. 1, to that shown as Q_5. The operation of this unit will also be described in considerable detail hereinafter, as it comprises a very important feature of the invention.

The output circuit of the tube 43 is connected to any desired signaling means. In the drawing, this output circuit includes a registering device 51 and resistance 52 in series. The potential across the resistance 52 causes current flow in the telephone receiver 54, interrupted by a musical vibrator 53. The received signals can then be visually and audibly indicated.

Referring to Fig. 1 it should be noted that the weakening of the disturbances has the two following phases:

First: reduction from Q_1 to Q_3 by diminishing the duration followed by a limitation of the amplitude. After this reduction the quantity of electricity comprised between the curve Q_3 and the axis of time will be less than that generated by the signal.

Second: reduction from Q_3 to Q_5 by passage through a circuit having a very large time constant, and the utilization of an incurved portion of a characteristic.

In accordance with the present invention the above mentioned limiting arrangement designated as the element B may be composed as follows:

Only a single tube is required and the arrangement will limit the effect of the reduction in the grid potential by utilizing the curvature of the plate characteristic. On the other hand the effect of an increase in the potential of the grid is limited by the curvature of the grid characteristic. The circuit arrangement consists in introducing a very high resistance R (e. g. several megohms) in series with the grid of the tube in question (Fig. 3). The operation is as follows: Assuming a certain potential for the plate battery, XY (Fig. 2) and OZ are the curves which show the plate and grid currents as functions of the grid potential.

If the grid potential is negative then the grid current will be zero and the tube will operate as though the resistance R did not exist. That part of the characteristic which is to the left of the axis of current will not be modified.

Let us assume however, that the grid circuit is subjected to a positive potential V'_G the grid current being other than zero; a drop of potential will then be caused in the resistance R in such a manner that the effective value of the grid potential will drop to V''_G. In the graphical illustration in Fig. 2, we may trace point by point the new plate characteristic, the angle α being refined by

$$\left(\tan \alpha = \frac{1}{R}\right).$$

The plate current follows therefore only the grid potentials comprised between zero and a certain negative value which may be brought as near to zero as desired by varying the potential of the plate battery.

The reduction of the amplitude of the disturbances in the second phase of the operation of the system is effected by the curvature of the plate characteristic of tube 43. The initial potential of the grid is by means of a movable contact 41 adjusted to a value OM (Fig. 2) which is slightly more negative than is absolutely necessary for annulling the plate current.

This arrangement will diminish the effect of the disturbance whose initial amplitude has already been reduced by the preceding devices in the circuit to a value V_p, which is less than V_s, the amplitude of the signal. Referring to Fig. 2 it will be noted that the plate current due to the grid voltage V_s, due to the signal current and represented by J_s is very much greater than that due to the

disturbing grid voltage V_p as represented by J_p. In other words, the ratio of the plate current due to the disturbance to that due to the signal, $\frac{J_p}{J_s}$ is very much smaller than the ratio $\frac{V_p}{V_s}$ and the effect of the disturbances in the receiving device will be negligible as compared to the effect of the signal.

Finally the tendency of the signals to be cut up by parasites may be attenuated by introducing in the grid circuit the resistance 42 and by adjusting the amplification to a value which is sufficient for the signals to develop in the resistance 32 a potential variation V_s which is sufficient to pass easily through the upper elbow of the new plate characteristic.

Fig. 5 shows an arrangement which is based on the same principle and is applied to receiving by means of a heterodyne 55.

The first limitation in the amplitude is obtained by means of the resistance 27 which is inserted in the grid circuit of the tube 23. The elongation of the disturbances is effected for the purpose of reducing their relative amplitude by means of the resonator 33—34 which is tuned to the modulation frequency. By means of a variable reaction 36, the apparent decrement of the resonator may be diminished, that is to say its time constant may be increased as much as the corresponding sending speed permits. Due to the provision of the tube 43 all the operations described in connection with Fig. 4 and also the rectification of modulated signals may be performed for the purpose of causing their recording by means of register 51.

Having described my invention, what I claim is:

1. The method of reducing the effect of damped disturbances on electrical indicating apparatus which comprises the steps of converting such disturbances into trains of impulses of less duration and amplitude, converting such shortened trains of impulses into trains of impulses of predetermined maximum value and converting such trains into trains of increased duration and decreased amplitude.

2. The method of reducing the effect on electrical indicating apparatus of atmospheric disturbances normally giving rise to trains of impulses of relatively large magnitude and low damping, which consists of the steps of causing a decrease in the normal magnitude and an increase in the damping of such trains, limiting the amplitude of such trains, and increasing the duration and decreasing the amplitude of such trains.

3. In a radio receiving apparatus, the combination of an antenna, a tuned circuit coupled to said antenna, a detector coupled to said tuned circuit, means coupled to said tuned circuit to reduce the duration of an atmospheric impulse, means coupled to said detector to reduce the amplitude of said atmospheric impulse, means connected to said last mentioned means to increase the time duration of said impulse, and a second means coupled to said amplitude reducing means to further reduce the amplitude of the said impulse after it has been increased in duration.

4. In a radio receiving apparatus an antenna, a detector associated therewith, a first means for varying the damping of the received oscillations in accordance with the amplitude of detected currents and a second means associated with said first means for limiting the amplitude of disturbing oscillations.

5. In a radio receiving apparatus an antenna, a detector associated therewith, means associated with the detector for varying the damping of the received oscillations in accordance with the amplitude of detected currents and means for thereafter limiting the amplitude and increasing the duration of the damped oscillations.

6. In a radio receiving apparatus a tuned circuit and detector associated therewith, means associated with the detector for varying the damping of said tuned circuit in accordance with the amplitude of detected currents, means associated with said first mentioned means for limiting the amplitude of disturbing oscillations, and a circuit of high time constant for further decreasing the amplitude of the disturbing oscillations and increasing their duration.

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