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MONITORING SYSTEM

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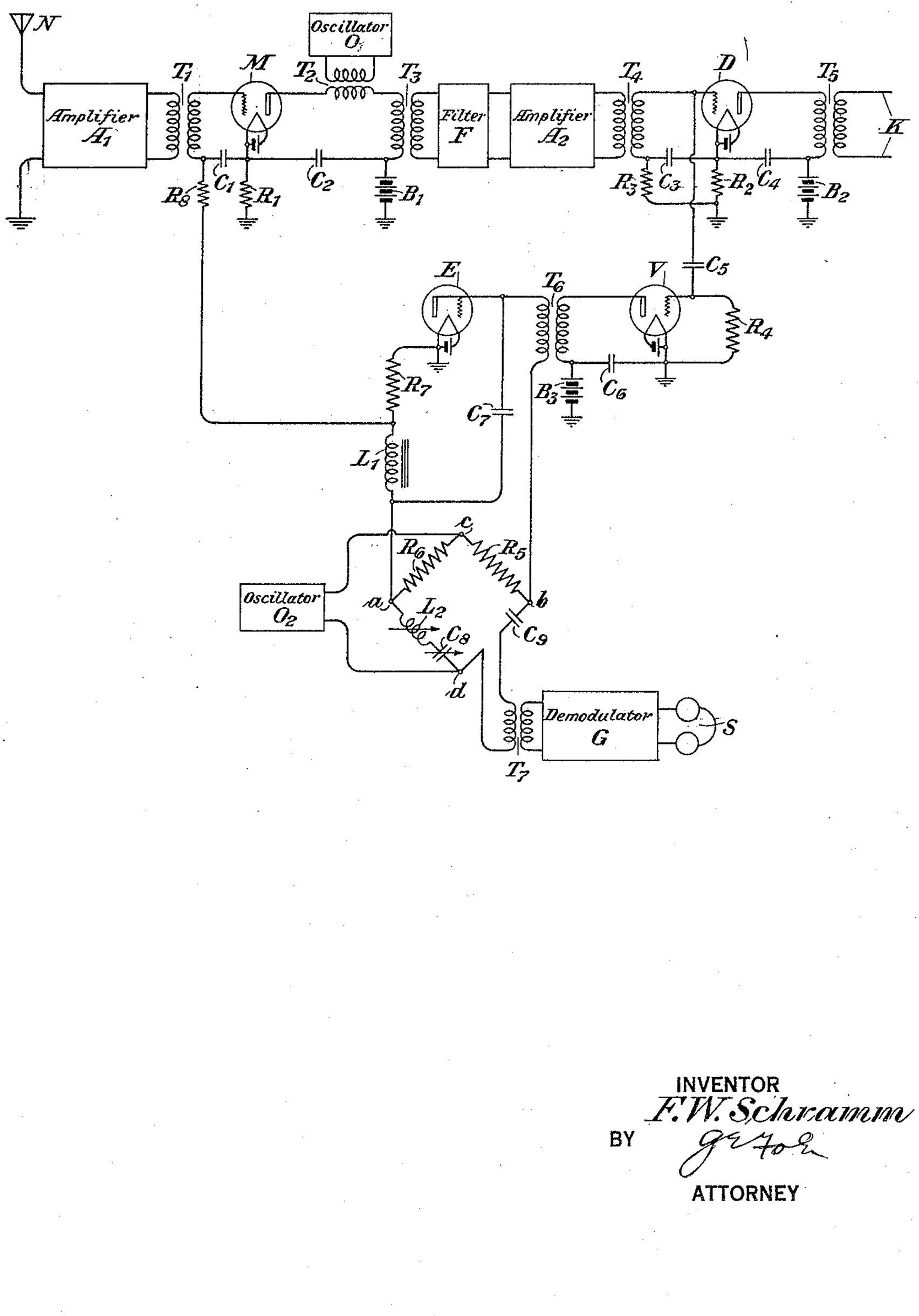

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MONITORING SYSTEM

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This invention relates to signaling systems. More particularly this invention relates to apparatus and methods for monitoring said systems.

In radio receivers of, for example, the double detection type, the intermediate frequency amplifying apparatus generally includes, in addition to one or more amplifying elements, a band-pass filter or its equivalent which transmits only a certain, well defined band of frequencies. The incoming signals which may be in the form of a carrier wave and both side bands, are modulated with current of a beating oscillator in order to produce currents corresponding to the carrier and its side bands lowered in the frequency spectrum and lying within the range of the band-pass filter. If variations occur either in the frequency of the incoming carrier wave or in the frequency of the beating oscillator, the intermediate frequencies will be thrown wholly or partly outside the transmission band of the filter, causing greater attenuation of some frequencies than of others, thereby reducing the intelligibility of the signals.

When it is desired to determine the stability of the frequency of the incoming carrier wave or of the frequency of the oscillator used for beating purposes in the process of modulation, the intermediate frequency corresponding to the carrier wave and resulting from modulation may be adjusted to some predetermined point lying within the limits of the transmission band of the filter by obtaining a zero beat with the current of another local oscillator fixed at this frequency. While this adjustment is being made, however, the beat note will appear in the output of the receiver and the receiver must be temporarily removed from service in order to avoid the introduction of this interference into the output. The suspension of service is, of course, highly undesirable. This invention is intended to provide arrangements for making this adjustment and for continuously monitoring the various frequencies without any interference from a beat note.

This invention will be better understood from the detailed description hereinafter following, when read in connection with the accompanying drawing showing one embodiment of the invention merely for the purpose of illustration.

Referring to the drawing, the reference character N represents an antenna upon which may be impressed a plurality of carrier waves and corresponding side bands representing different speech or other signaling currents, only one of the carriers and its corresponding side bands being desired. The desired carrier and its side bands may, of course, be selected in any way well known in the art. The selected carrier wave and its side bands will be transmitted through an amplifier A_1, amplified thereby and then transmitted through a transformer T_1 to the input circuit of a modulator designated M.

The selected and amplified carrier wave and its side bands reach the grid and filament electrodes of the tube M through a condenser C_1. The output circuit of this modulator includes the secondary winding of a transformer T_2, the primary winding of a transformer T_3, a condenser C_2 and the plate and filament electrodes of the tube M. An oscillator designated O_1 is connected to the primary winding of the transformer T_2 and supplies current of the beating frequency to be employed in the process of modulation whereby the selected carrier wave and its side bands will be lowered in the frequency spectrum to the range of the filter F. Positive potential for the plate electrode of the tube M is supplied by a battery B_1 through a circuit which includes the primary winding of transformer T_3, the secondary winding of transformer T_2, the plate and filament electrodes of the tube M, a resistance R_1 and ground. It will be shown hereinafter how the drop in voltage across the resistance R_1 provides part of the negative bias for the grid electrode of the tube M.

The carrier wave and its side bands lowered in the spectrum to intermediate frequencies as a result of modulation are transmitted through a band-pass filter F and then amplified by an amplifier designated A_2. The filter is of any well known type, having fixed frequency limits which may be spaced

by, for example, twice the width of the ordinary speech band. This filter will freely transmit the carrier wave and its side bands lowered in the spectrum through the process of modulation and all frequencies outside of its range will be greatly suppressed.

After amplification by the amplifier A_2 the currents of the intermediate frequencies are then transmitted through a transformer T_4, and a condenser C_3, to the grid and filament electrodes of a detector designated D. The detector D further reduces the frequencies of the currents impressed upon its grid and filament electrodes to such low values as may be rendered audible by such devices as loud speakers. The detected currents are bypassed by a condenser C_4 and are transmitted through a transformer T_5 to an output circuit designated K. Any form of loud speaker may, for example, be connected or coupled to the output circuit K.

It is to be noted that a battery B_2 supplies the necessary positive operating potential for the plate electrode of the tube D, the completed circuit including battery B_2, the primary winding of transformer T_5, the plate and filament electrodes of the tube D, a resistance R_2 and ground. The resistance R_2 is also connected in series with the grid and filament electrodes of the tube D, the completed circuit including resistance R_2, a resistance R_3, the secondary winding of transformer T_4 and the grid and filament electrodes of the tube D. The drop in voltage across the resistance R_2 supplies the negative bias for the grid electrode of the tube D.

The intermediate frequency potentials reaching the grid and filament electrodes of the tube D are also impressed between the grid and filament electrodes of an amplifying tube V, the grids of tubes D and V being separated by a condenser C_5. Condenser C_5 prevents such direct currents as may flow through any of the circuits of the tube D from reaching the grid electrode of the tube V. The grid of the tube V may be connected to its grounded filament through a resistance R_4. All of the intermediate frequency currents amplified by the tube V will flow through its output circuit which includes a condenser C_6, the primary winding of a transformer T_6 and the plate and filament electrodes of the tube V. The positive operating potential for the plate electrode of the tube V is supplied by battery B_3.

The secondary winding of the transformer T_6 is connected in a circuit which includes resistances R_5 and R_6, a choke coil L_1, a resistance R_7 and the plate and filament electrodes of a rectifying tube E. By virtue of the rectifying action of the tube E there results a direct current which will produce a drop in potential across the resistance R_7 and this potential drop will vary with the amplitude of the carrier wave as it reaches the tube D at a reduced frequency. As the amplitude of this wave increases, the potential drop across the resistance R_7 will be increased, and conversely, as the amplitude of this wave decreases, the potential drop across the resistance R_7 will be decreased.

It is to be noted that the filament of the tube E is grounded and that the resistance R_7 is connected in a series circuit which includes a resistance R_8, the secondary winding of transformer T_1, the grid and filament electrodes of tube M, resistance R_1 and ground. It will be apparent that any change in the potential drop across the resistance R_7 will correspondingly vary the negative bias of the grid electrode of the tube M. As the voltage across the resistance R_7 increases, the grid electrode of the tube M will become more negative and correspondingly reduce the gain of the tube M. Moreover, any reduction in the voltage drop across the resistance R_7 will increase the gain of the tube M.

The winding L_1 is of the iron core type and it tends to prevent alternating currents from flowing through resistance R_7 and through any part of the rectifying apparatus including the tube E. Moreover, a condenser C_7 freely transmits all alternating currents impressed upon the secondary winding of the transformer T_6 to the circuit including the resistances R_5 and R_6. Of course, the condenser C_7 also tends to prevent any alternating currents from flowing through the rectifying circuit formed in part by the tube E.

The resistances R_5 and R_6 form two of the arms of a Wheatstone bridge. Another of the arms of this bridge includes a winding L_2 of adjustable inductance and a condenser C_8 of adjustable capacity. The fourth arm of the bridge includes a condenser C_9 and the primary winding of a transformer T_7. This bridge may be balanced at any one frequency merely by adjustments of the reactive values of the winding L_2 and condenser C_8. The intermediate frequency currents passed by condenser C_7 reach the diagonal of the bridge designated by the point *a* and *b*. An oscillator O_2 is connected to the other diagonal of the bridge determined by the points *c* and *d*. The secondary winding of the transformer T_7 is connected to a demodulator G, in the output circuit of which there may be any form of indicating device such as a telephone receiver S.

The frequency of the oscillator O_2 is adjustable as is the frequency of the oscillator O_1. The frequency of the oscillator O_2 may be fixed at any point which may lie within the limits determined by the filter F, this frequency being that to which it is desired to adjust the frequency of the intermediate carrier wave. If the Wheatstone bridge circuit is balanced for the frequency of the oscillator O_2, no current of this frequency will be impressed upon the diagonal determined by the

points *a* and *b*, and consequently, current of this frequency will not affect the elements employed for the control of the amplification of the tube M. Inasmuch as current of the frequency of the oscillator O_2 cannot reach the input circuit of the tube M, that current will not be modulated with the currents transmitted by the amplifier A_1, and, of course, no beat notes will be produced and transmitted to the output circuit K.

The frequency of the carrier wave lowered by modulation does reach the diagonal of the Wheatstone bridge determined by the points *a* and *b*. If this frequency is different from that of the oscillator O_2, both frequencies will be transmitted through the transformer T_7 to the demodulator G. A beat note will then be heard in the telephone receiver S. The operator may then adjust the frequency of the oscillator O_1 until the intermediate frequency of the carrier wave becomes equal to that of the frequency of the oscillator O_2. When that occurs, no sound will be heard at the telephone receiver S.

It will be apparent that the monitoring apparatus is continually in operation and that the carrier frequency is continually monitored, and any deviation in its frequency or in the beating frequency of the oscillator O_1 will be instantly indicated by a low frequency beat note. Not only does the intermediate carrier frequency appear at the diagonal of the Wheatstone bridge determined by the points *a* and *b*, but the frequencies of the side bands representing the signals will also appear at these points and will pass through the primary winding of T_7. Since this winding also carries currents from oscillator O_2, the output of demodulator G will consist only of the voice frequency components of the signal when the intermediate carrier frequency is adjusted to be the same as the frequency of the oscillator O_2. Thus, the quality of the speech signals may also be monitored continuously.

While this invention has been shown in certain particular arrangements merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A monitoring apparatus for a double detection radio receiver comprising in combination with said radio receiver, means for by-passing part of the energy of the carrier wave at an intermediate frequency, means for producing a wave of substantially the same frequency, and means for obtaining a beat note from said frequencies and for preventing that beat note from being introduced into the circuits of the radio receiver.

2. The combination of a double detection radio receiver, a Wheatstone bridge, one diagonal of which is coupled to said radio receiver for receiving intermediate frequencies therefrom, a source of oscillations connected to the other diagonal of the Wheatstone bridge, a modulator connected to one of the arms of the Wheatstone bridge, and means for detecting the currents derived from the modulator.

3. A monitoring apparatus for a double detection radio receiver comprising a Wheatstone bridge which is balanced, an oscillator connected to one diagonal of the bridge, means for impressing on the other diagonal of the bridge the currents resulting from the first step of modulation in said radio receiver, a modulator coupled to one of the arms of the bridge, and means for detecting the currents derived from the modulator.

4. Apparatus for radio receiving systems comprising a circuit supplied with current from a radio receiver, a balanced Wheatstone bridge, a resistance, a rectifier connected in series with said resistance and said circuit as one of the diagonals of the bridge, a source of alternating current connected as the other diagonal of the bridge, a modulator coupled to one of the arms of the bridge, and means for detecting the currents derived from the modulator.

5. The combination of a radio receiver having a plurality of circuits, a balanced Wheatstone bridge, a resistance, a rectifier connected in series with said resistance as one of the diagonals of the bridge, a source of alternating current connected as the other diagonal of the bridge, means for coupling the series circuit of said rectifier and said resistance with one of the circuits of the radio receiver so that the voltage drop across said resistance will be proportional to the level of the energy flowing through said radio receiver, means for connecting said resistance to another of the circuits of the radio receiver so as to control the gain of the radio receiver in accordance with the voltage drop across said resistance, a modulator coupled to one of the arms of the bridge, and means for detecting the currents derived from the modulator.

6. The method of monitoring the carrier curent of a signaling system without interfering with the quality of transmission over the signaling system which consists in by-passing part of the carrier current, and comparing the frequency of the carrier current with current of a desired, predetermined frequency to determine whether said currents are synchronous.

7. The method of monitoring the carrier current of a signaling system which consists in by-passing part of the energy of the carrier current, modulating the by-passed energy with the energy of an independently produced current of predetermined fre-

quency, and preventing any of the products of modulation from interfering with the transmission of signals over the system.

8. Monitoring apparatus for carrier receiving circuits comprising in combination with said carrier receiving circuit, means for by-passing part of the carrier current, means for producing current having substantially the same frequency as that of the carrier current, means for obtaining a beat note from said currents, and means for preventing the introduction of said beat note into said receiving circuits.

9. Monitoring apparatus for carrier circuits comprising in combination with said carrier circuits, means for by-passing part of the energy of the carrier current, means for generating current having a frequency equal to the normal frequency of the carrier current, and modulating means for beating the by-passed current with the generated current, said modulating means including means to prevent any of the products of modulation from becoming impressed upon said carrier circuits.

10. The method of monitoring a signaling system employing carrier current which consists in by-passing and separating from the signaling system some of the energy of the carrier current, comparing the frequency of the carrier current with the frequency of an independently generated current to determine whether these currents are of the same frequency, and changing the frequency of the carrier current until the currents compared are of the same frequency.

11. The method of monitoring the circuits of a high frequency signaling system which consists in by-passing and separating from the signaling system some of the carrier current, modulating the by-passed current with other current of predetermined frequency without introducing any of the products of modulation into the signaling circuits, and changing the frequency of the carrier current so that the difference between the frequency of the carrier current and the other frequency used in modulation is zero.

12. The method of controlling a carrier signaling system which consists in maintaining the gain of the system constant, simultaneously and conjointly monitoring the carrier energy of the system, and preventing the monitor of the carrier energy of the system from introducing alternating potentials which may interfere with the control of the gain of the system.

13. A carrier signaling system comprising means for controlling the gain of the system and maintaining it constant and means directly connected to the gain controlling means for monitoring the frequency of the carrier energy of the system without introducing alternating potentials flowing in the monitoring means into the gain controlling means.

14. In a carrier signaling system, the combination of means for controlling the gain of the system, means directly connected to the gain controlling means for monitoring the frequency of the carrier current, and means for preventing the monitoring means from introducing alternating potentials which may affect the gain controlling means.

In testimony whereof, I have signed my name to this specification this 5th day of December, 1930.

FRED W. SCHRAMM.