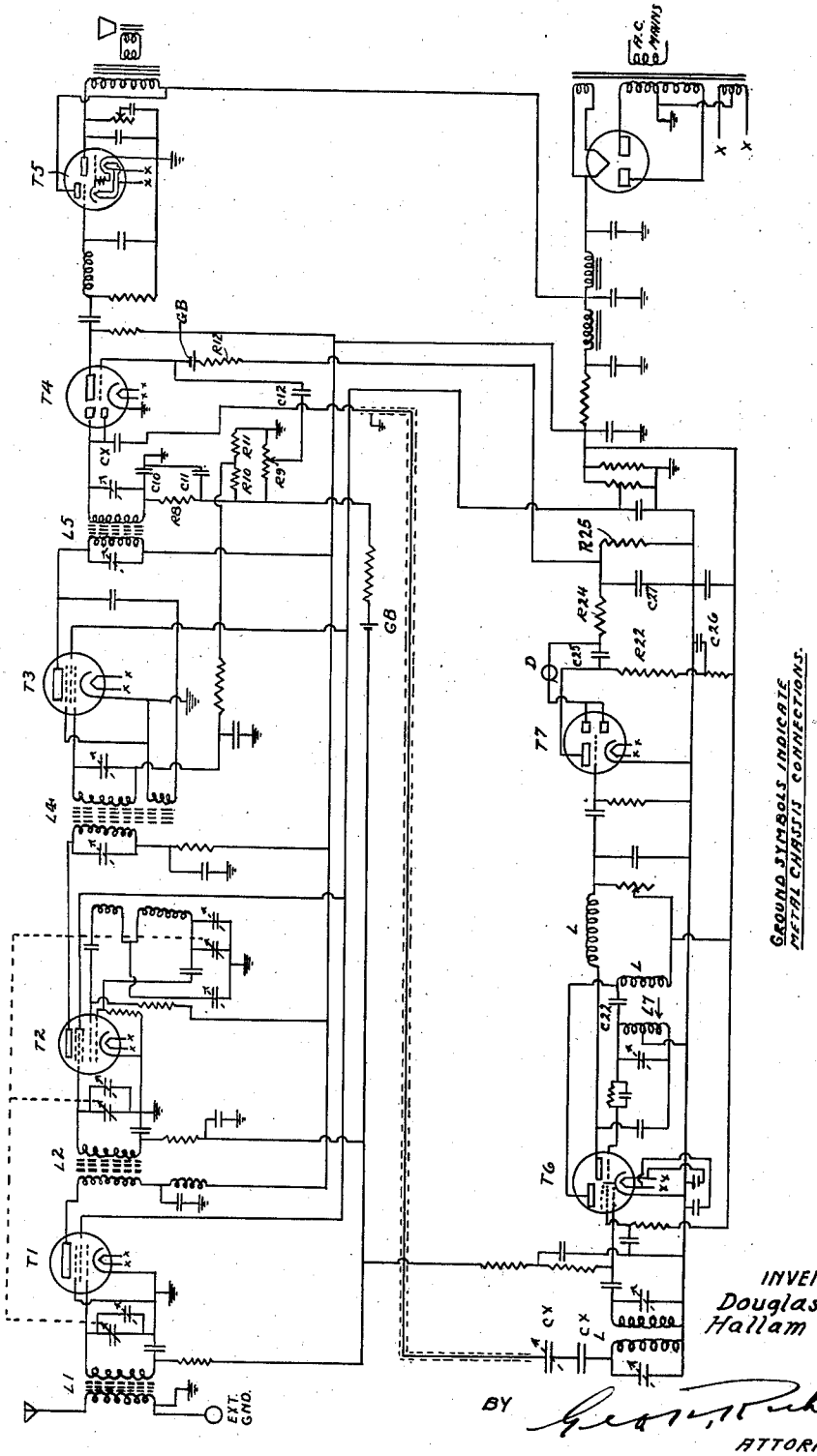
Dec. 10, 1940. D. HALLAM, JR 2,224,224

METHOD AND APPARATUS FOR RESONANCE ASSURANCE DEVICES

Filed Dec. 10, 1937



Patented Dec. 10, 1940

2,224,224

UNITED STATES PATENT OFFICE

2,224,224

METHOD AND APPARATUS FOR RESONANCE ASSURANCE DEVICES

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Application December 10, 1937, Serial No. 179,178

12 Claims. (Cl. 250—20)

The object of the invention is to provide an automatic resonance assurance device and/or method which will assure that the superheterodyne receiver with which it is incorporated will not, as a whole, be usefully responsive to a signal unless the tuning control, by which the tuned circuits of the receiver are adjusted to the correct electrical relationship with the desired signal, is correctly adjusted, and also to provide, where desired, intersignal noise suppression of an improved type.

This object is accomplished in one embodiment of my invention by causing the intermediate frequency carrier component of a received signal to heterodyne, by suitable means, the signal generated by a fixed frequency oscillator tuned to the effective resonant frequency of the intermediate frequency "channel" of the receiver, detecting the resultant heterodyne, and by rectifying the heterodyne signal utilize the resultant direct current potential to bias one or more of the receiver amplifier tubes to effective plate current cut off, thus rendering the receiver substantially inoperative.

When the intermediate frequency carrier component of a received signal is of substantially the same frequency as the said fixed-frequency oscillator signal then no useful heterodyne will be produced and thus the receiver will be operative and correctly tuned to resonance with the desired signal. Where interstation noise suppression is desired, the circuits involved are so designed that the intermediate frequency component of the interference is detected by the same means utilized to detect the aforementioned heterodyne. The resultant detected interference component is rectified by the same means employed to rectify the said heterodyne, producing a direct current potential in order to bias one or more amplifier tubes to effective plate current cut-off, thus rendering the receiver substantially inoperative.

A suitable apparatus for carrying out my method of resonance assurance is diagrammatically shown in the accompanying drawing. It will be, of course, understood that many modifications and alternatives of this embodiment of my invention will be apparent to those skilled in the art to which this invention appertains.

Referring to the drawing, in the superheterodyne circuit T1 indicates the signal-frequency amplifier tube, T2 the pentagrid mixer-oscillator tube, L4 an intermediate frequency transformer, T3 an intermediate frequency amplifier tube, L5 an intermediate frequency transformer, T4 a double diode-triode detector, A. V. C., and audio amplifier tube, and T5 an audio output tube. GB indicates a grid bias battery or cell.

In the resonance assurance and noise suppression circuit, L6 indicates an intermediate frequency transformer, T6 intermediate frequency buffer amplifier (pentode section) and fixed-frequency oscillator-detector (triode section), L7 an oscillator-detector coil, L a radio frequency choke, and T7 the double diode-triode heterodyne and noise amplifier, and heterodyne and noise rectifier tube. The intermediate frequency component of an incoming signal is introduced into the secondary circuit of intermediate frequency transformer L5 and is demodulated by means of the diode section of T4. The load (and RF filter) network of this demodulator is composed of resistors R8, R10, R11, and R12, volume control potentiometer R9, condensers C10, C11, and C12, and associated components and circuits. The demodulated signal, which is the audio frequency modulation component of a received signal, is therefore applied to the grid of the triode section of T4. The said audio signals, upon application to the grid of the triode section of T4, are amplified and are introduced into the control grid circuit of the output tube T5 in a straightforward manner.

The direct current potential across R9, caused by rectification of an incoming signal, is introduced by suitable method, for the purpose of automatic gain control, to the control grids of tubes T1, T2 (signal-frequency control grid), and T6 (pentode section). Similarly, the direct current potential across R11, caused by rectification of an incoming signal, is introduced for the purpose of automatic gain control to the control grid of T3.

The intermediate frequency component of an incoming signal is introduced into the primary circuit of the intermediate frequency transformer L6 by means of a capacity (marked CX). By conventional method the intermediate frequency component of an incoming signal is applied to the control grid of the pentode section of the triode-pentode T6, which pentode section is utilized as an intermediate frequency amplifier.

The intermediate frequency component of an incoming signal is applied to the detector-oscillator (autodyne detector) which incorporates the triode section of T6, by means of coupling condenser C22. The said autodyne detector-

oscillator is adjusted to generate energy of a frequency substantially equal to the effective resonant frequency of the intermediate frequency circuit of the receiver. Thus if the receiver is detuned somewhat from resonance with an incoming signal, the intermediate frequency carrier component of the incoming signal will differ in frequency with the said energy generated by the said autodyne detector-oscillator and the said autodyne detector-oscillator will detect the resultant heterodyne.

This heterodyne signal is introduced by conventional means to the grid of the triode section of T7, said triode section amplifying the said heterodyne signal. The output load network of the triode section of T7 includes the following components, as well as associated circuits and components: resistors R22, R24 and R25, condensers C25, C26 and C27, and the diode section of T7. The said network is so designed that upon application of the aforementioned heterodyne signal the said heterodyne signal is rectified by means of the diode section of T7, which is incorporated in the circuit, and thus the negative grid bias voltage applied to the grid of the tube T4 triode section is increased to a value which will prevent plate current flow of this tube (T4 triode section). In short the triode section of T4 is biased to effective plate current cut off upon application of the aforementioned heterodyne to the said network. The said network is designed so as to have useful time-constant properties. The diode connection lead may be broken (at D on drawing) and a battery or cell inserted in order to provide a diode current delay voltage.

In the said resonance assurance device the circuits are so designed that when the receiver is not tuned to a signal of effective strength, or when the receiver is effectively tuned to a signal of effective strength but when a sufficiently unfavourable signal-strength/interference strength ratio ("signal-noise ratio") is effective; and when natural and/or parasitic interference ("noise-level") of sufficient strength and of suitable characteristics is effective, the intermediate frequency component of the interference will be usefully detected by means of the said autodyne detector (incorporating triode section of T6). The resultant detected interference component is applied conventionally to the grid circuit of the triode section of T7, said triode section amplifying the said detected interference component. The output load network of the triode section of T7, which includes the diode section of T7, rectifies the said detected interference component and the resulting direct current potential is utilized to bias the triode section of T4 to effective plate current cut-off.

The conditions imposed by the automatic gain control (A. V. C.) upon the circuits and signals involved have a bearing on the results obtained from the described embodiment of my invention. The circuits involved in the afore-described embodiment of the aforementioned resonance assurance and noise suppression method are so designed that the modulation component of a received signal, and other residual and unwanted signals, are not usefully or detrimentally rectified by the aforesaid heterodyne and noise-rectifying means (diode section of T7, and associated network), without the presence of the aforementioned heterodyne signal or/and detected noise component in a useful capacity.

The intermediate frequency component of a received signal, which is the heterodyne (or difference frequency) between the received and oscillator produced signals, (in a superheterodyne receiver with which the aforementioned device and/or method is incorporated), is so transmitted or/and processed that the carrier component of the said intermediate frequency signal is caused to heterodyne, by suitable means, the signal of an oscillator generating fixed-frequency energy, though (under some operating conditions) not necessarily energy of substantially fixed-frequency characteristics, and the said heterodyne is detected.

The heterodyne frequency signal, resulting from the aforementioned heterodyne between the intermediate frequency signal carrier component and the signal generated by the aforementioned fixed-frequency oscillator is utilized to render the receiver inoperative, or substantially inoperative, by means of rectifying this signal and feeding the resultant direct current potential to bias to effective plate current cut-off one or more of the amplifier or/and converter tubes in the receiver, or/and associated amplifiers, such as tube T4 as illustrated in the drawing, or the said heterodyne signal may be applied to any suitable means, in order that the receiver will be effectively inoperative upon application of said heterodyne signal to said means.

In the aforementioned device and/or method for resonance assurance, when the aforementioned carrier component of the intermediate frequency signal is of substantially the same frequency as the energy of the signal generated by the aforementioned fixed-frequency oscillator, or oscillator means, no useful heterodyne is rendered and the receiver is thus rendered operative.

If the fixed-frequency oscillator is adjusted to generate energy of a frequency substantially equal to that of the effective resonant frequency of the intermediate frequency circuit frequency response characteristic, then the receiver will be usefully responsive to a signal only when the receiver is tuned substantially to resonance with a signal carrier.

In instances where it is desired to tune the receiver not substantially to resonance with a received signal carrier, but detuned from resonance with the carrier in order to gain the most suitable results, as is desirable under many conditions and classifications of transmission and reception, then the fixed-frequency oscillator may be caused to generate energy of the correct frequency, in the frequency response characteristic of the intermediate frequency "channel" of the receiver, other than the resonant frequency, or mid-band frequency.

In applying the aforementioned resonance assurance device and/or method so that the receiver will be usefully responsive to a signal, not only when the intermediate frequency carrier component of this signal is of substantially the same frequency as the energy generated by the aforementioned fixed-frequency oscillator but when the frequencies of these signals do not depart from being equal by more than a predeterminable, pre-fixed or/and suitable value, then high-pass, band-pass, or/and band elimination, frequency preference filters may be utilized in circuits concurrent with the heterodyne signal derived from the interaction of the intermediate-frequency signal carrier component with the aforementioned signal generated by the fixed-frequency oscillator. As an alternative or

concurrent method the circuits involved may be so designed that when the intermediate frequency carrier component of an incoming signal is sufficiently equal to the natural frequency of the signal produced by the aforementioned fixed-frequency oscillator "frequency-locking" or "pulling" will occur and the frequency of this oscillator produced signal will automatically assume a frequency equal, or substantially equal, to the frequency of the said intermediate frequency carrier component.

The frequency multiple energy of the signal generated by the fixed-frequency oscillator may be utilized to heterodyne the intermediate frequency carrier component of a received signal.

In a radio-telephone receiver in which the above device and/or method is utilized, if it is desired that it shall have "silent-tuning" properties, the circuits concurrent with the aforementioned rectified or detected heterodyne may be designed to have time constant properties which will ensure that no signal or signals will be heard during the operation of the tuning control mechanism, unless the tuning control mechanism is being operated at a sufficiently low mechanical rate.

In a radio-telephone receiver with which the above resonance assurance method is incorporated, and where noise suppression of the aforementioned type is desired, the circuits involved may be so designed that where the receiver is not tuned to a signal of effective strength, or where the receiver is effectively tuned to a signal of effective strength but where a sufficiently unfavourable signal-strength/interference-strength ratio ("signal/noise ratio") is effective, and where natural and/or parasitic interference ("noise-level") of sufficient strength and of suitable characteristics is effective, the interference will be usefully detected (by means of the detector or mixer means which are utilized to detect the aforementioned heterodyne between the intermediate frequency carrier component of an incoming signal and the aforementioned fixed-frequency oscillator signal). The resulting detected interference component is applied to the rectifier (utilized to rectify the aforementioned heterodyne) and the resulting potential is utilized to bias one or more tubes to effective plate current cut-off in order to silence the receiver. The said detected interference component, in order that silencing of the receiver will take place, may be applied to any suitable means to which the aforementioned heterodyne may be applied for receiver silencing purposes.

In reference to the claims, the words "in order to render the aforesaid receiver inoperative" indicate that the receiver is rendered incapable of effectively delivering its output signal. For example, a radio-telephone receiver is silenced.

In reference to the claims which mention detection of "the intermediate frequency component of natural and parasitic interference," it should be noted that beat products, caused by the "locally generated signal" (mentioned in the claims) heterodyning said interference component, will also be detected. The resultant detected component of these beat products (and of similar beat products) may be considered to be part of the "detected component of interference" mentioned in the claims.

Having thus fully described my invention what I claim as new and desire to secure by Letters Patent is:

1. In combination with a superheterodyne receiver having customary means for detecting the modulation component of the intermediate frequency component of an incoming signal, means for causing the intermediate frequency carrier component of an incoming signal to heterodyne a locally generated signal of substantially the frequency assumed, under conditions of correct tuning of said receiver to an incoming signal, by the intermediate frequency carrier component of an incoming signal; means for detecting the resultant heterodyne; means responsive to the resultant heterodyne signal; means for applying the said heterodyne signal to said heterodyne signal responsive means in order to render the aforesaid receiver inoperative; and means for inhibiting detrimental presence of the aforementioned locally generated signal at said first mentioned means.

2. In combination with a superheterodyne receiver having customary means for detecting the modulation component of the intermediate frequency component of an incoming signal, means for causing the intermediate frequency carrier component of an incoming signal to heterodyne a locally generated signal of substantially the frequency assumed, under conditions of correct tuning of said receiver to an incoming signal, by the intermediate frequency carrier component of an incoming signal; means for detecting the resultant heterodyne; means responsive to the resultant heterodyne signal; means for applying the said heterodyne signal to said heterodyne signal responsive means in order to render the aforesaid receiver inoperative; and buffer amplifier means for inhibiting detrimental presence of the aforementioned locally generated signal at said first mentioned means.

3. In combination with a superheterodyne receiver having customary means for detecting the modulation component of the intermediate frequency component of an incoming signal, means for causing the intermediate frequency carrier component of an incoming signal to heterodyne a locally generated signal of substantially the frequency assumed, under conditions of correct tuning of said receiver to an incoming signal, by the intermediate frequency carrier component of an incoming signal; means for detecting the resultant heterodyne; means for rectifying the resultant heterodyne signal; means responsive to resultant rectified signal energy; means for applying said rectified signal energy to said rectified signal energy responsive means in order to render the aforesaid receiver inoperative; and means for inhibiting detrimental presence of the aforementioned locally generated signal at said first mentioned means.

4. In combination with a superheterodyne receiver having customary means for detecting the modulation component of the intermediate frequency component of an incoming signal, means for causing the intermediate frequency carrier component of an incoming signal to heterodyne a locally generated signal of substantially the frequency assumed, under conditions of correct tuning of said receiver to an incoming signal, by the intermediate frequency carrier component of an incoming signal; means for detecting the resultant heterodyne; a detector, responsive to the resultant heterodyne signal, including thermionic means having a control electrode, said control electrode being connected so as to form an integral part of the input circuit of said detector; means for applying said heterodyne signal to said input circuit, in order to modify the effective

value of current passed by said thermionic means; means which are responsive to a sufficiently modified effective value of current passed by said thermionic means in order to render the aforesaid receiver inoperative; and means for inhibiting detrimental presence of the aforementioned locally generated signal at said first mentioned means.

5. In combination with a superheterodyne receiver having customary means for detecting the modulation component of the intermediate frequency component of an incoming signal, means for causing the intermediate frequency carrier component of an incoming signal to heterodyne a locally generated signal of substantially the frequency assumed, under conditions of correct tuning of said receiver to an incoming signal, by the intermediate frequency carrier component of an incoming signal; means for detecting the resultant heterodyne and also for detecting the intermediate frequency component of natural and parasitic interference; means responsive to the heterodyne signal resulting from detection of the aforesaid heterodyne by said third mentioned means, and also responsive to the detected component of interference resulting from detection of the aforesaid intermediate frequency component of natural and parasitic interference by said third mentioned means; means for applying the aforesaid heterodyne signal to said fourth mentioned means in order to render the aforesaid receiver inoperative and also for applying the aforesaid detected component of interference to said fourth mentioned means in order to render the aforementioned receiver inoperative; and means for inhibiting detrimental presence of the aforementioned locally generated signal at such first mentioned means.

6. In combination with a superheterodyne receiver having customary means for detecting the modulation component of the intermediate frequency component of an incoming signal, means for causing the intermediate frequency carrier component of an incoming signal to heterodyne a locally generated signal of substantially the frequency assumed, under conditions of correct tuning of said receiver to an incoming signal, by the intermediate frequency carrier component of an incoming signal; means for detecting the resultant heterodyne and also for detecting the intermediate frequency component of natural and parasitic interference; means responsive to the heterodyne signal resulting from detection of the aforesaid heterodyne by said third mentioned means and also responsive to the detected component of interference resulting from detection of the aforesaid intermediate frequency component of natural and parasitic interference by said third mentioned means; means for applying the aforesaid heterodyne signal to said fourth mentioned means in order to render the aforesaid receiver inoperative and also for applying the aforesaid detected component of interference to said fourth mentioned means in order to render the aforesaid receiver inoperative; and buffer amplifier means for inhibiting detrimental presence of the aforementioned locally generated signal at said first mentioned means.

7. In combination with a superheterodyne receiver having customary means for detecting the modulation component of the intermediate frequency component of an incoming signal, means for causing the intermediate frequency carrier component of an incoming signal to heterodyne a locally generated signal of substantially the mid-band intermediate frequency; means for detecting the resultant heterodyne; means responsive to the resultant heterodyne signal; means for applying the said heterodyne signal to said heterodyne signal responsive means in order to render the aforesaid receiver inoperative; and means for inhibiting detrimental presence of the aforementioned locally generated signal at said first mentioned means.

8. In combination with a superheterodyne receiver having customary means for detecting the modulation component of the intermediate frequency component of an incoming signal, means for causing the intermediate frequency carrier component of an incoming signal to heterodyne a locally generated signal of substantially the mid-band intermediate frequency; means for detecting the resultant heterodyne; means responsive to the resultant heterodyne signal; means for applying the said heterodyne signal to said heterodyne signal responsive means in order to render the aforesaid receiver inoperative; and buffer amplifier means for inhibiting detrimental presence of the aforementioned locally generated signal at said first mentioned means.

9. In combination with a superheterodyne receiver having customary means for detecting the modulation component of the intermediate frequency component of an incoming signal, means for causing the intermediate frequency carrier component of an incoming signal to heterodyne a locally generated signal of substantially the mid-band intermediate frequency; means for detecting the resultant heterodyne; means for rectifying the resultant heterodyne signal; means responsive to resultant rectified signal energy; means for applying said rectified signal energy to said rectified signal energy responsive means in order to render the aforesaid receiver inoperative; and means for inhibiting detrimental presence of the aforementioned locally generated signal at said first mentioned means.

10. In combination with a superheterodyne receiver having customary means for detecting the modulation component of the intermediate frequency component of an incoming signal, means for causing the intermediate frequency carrier component of an incoming signal to heterodyne a locally generated signal of substantially the mid-band intermediate frequency; means for detecting the resultant heterodyne; a detector, responsive to the resultant heterodyne signal, including thermionic means having a control electrode, said control electrode being connected so as to form an integral part of the input circuit of said detector; means for applying said heterodyne signal to said input circuit, in order to modify the effective value of current passed by said thermionic means; means which are responsive to a sufficiently modified effective value of current passed by said thermionic means in order to render the aforesaid receiver inoperative; and means for inhibiting detrimental presence of the aforementioned locally generated signal at said first mentioned means.

11. In combination with a superheterodyne receiver having customary means for detecting the modulation component of the intermediate frequency component of an incoming signal, means for causing the intermediate frequency carrier component of an incoming signal to heterodyne a locally generated signal of substantially the mid-band intremediate frequency; means for de-

tecting the resultant heterodyne and also for detecting the intermediate frequency component of natural and parasitic interference; means responsive to the heterodyne signal resulting from detection of the aforesaid heterodyne by said third mentioned means, and also responsive to the detected component of interference resulting from detection of the aforesaid intermediate frequency component of natural and parasitic interference by said third mentioned means; means for applying the aforesaid heterodyne signal to said fourth mntioned means in order to render the aforesaid receiver inoperative and also for applying the aforesaid detected component of interference to said fourth mentioned means in order to render the aforementioned receiver inoperative; and means for inhibiting detrimental presence of the aforementioned locally generated signal at such first mentioned means.

12. In combination with a superheterodyne receiver having customary means for detecting the modulation component of the intermediate frequency component of an incoming signal, means for causing the intermediate frequency carrier component of an incoming signal to heterodyne a locally generated signal of substantially the mid-band intermediate frequency; means for detecting the resultant heterodyne and also for detecting the intermediate frequency component of natural and parasitic interference; means responsive to the heterodyne signal resulting from detection of the aforesaid heterodyne by said third mentioned means and also responsive to the detected component of interference resulting from detection of the aforesaid intermediate frequency component of natural and parasitic interference by said third mentioned means; means for applying the aforesaid heterodyne signal to said fourth mentioned means in order to render the aforesaid receiver inoperative and also for applying the aforesaid detected component of interference to said fourth mentioned means in order to render the aforesaid receiver inoperative; and buffer amplifier means for inhibiting detrimental presence of the aforementioned locally generated signal at said first mentioned means.

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