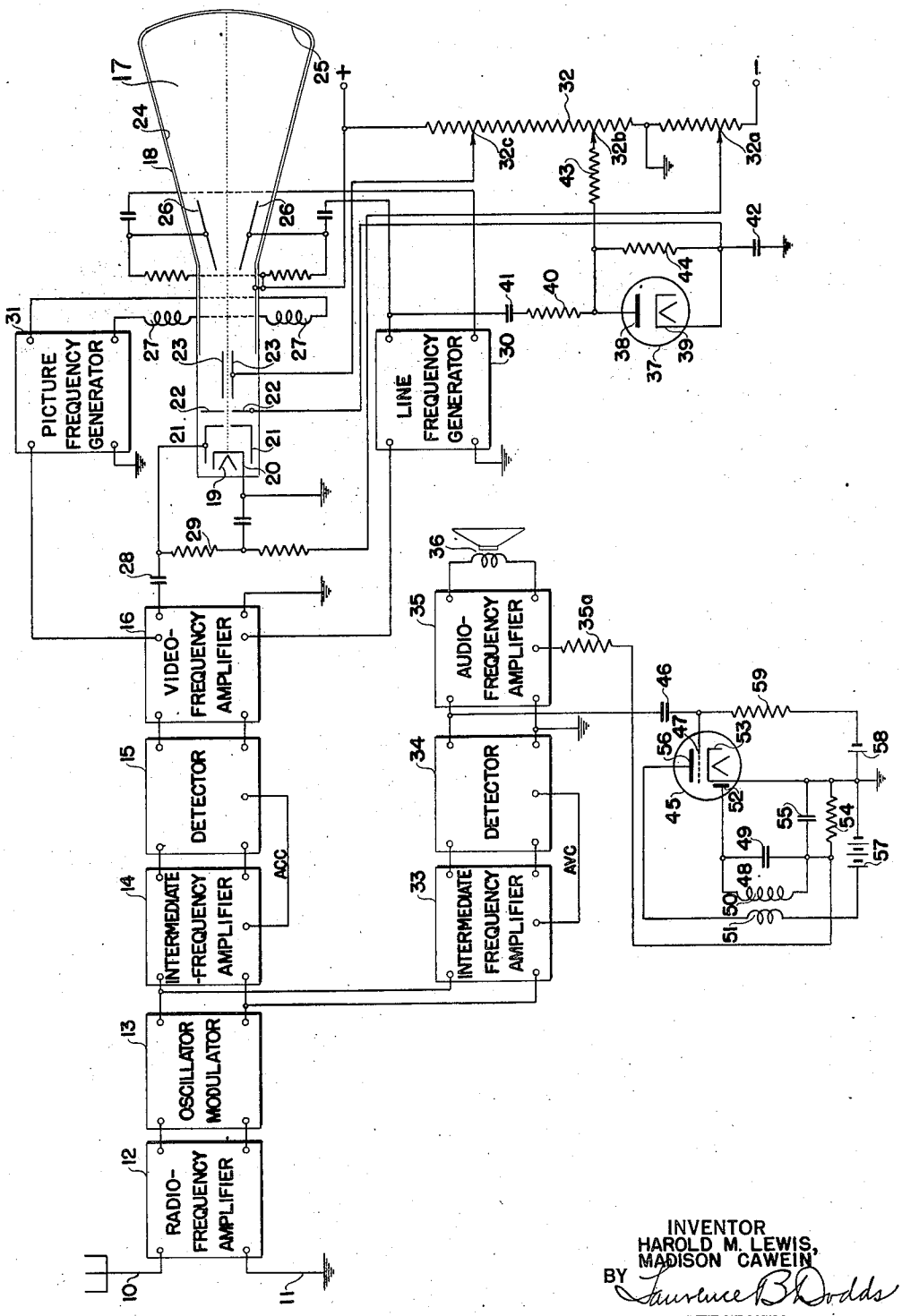
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RADIO RECEIVER

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RADIO RECEIVER

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This invention relates to audio-frequency modulated-carrier signal receivers and more particularly to methods of, and apparatus for, automatically controlling such receivers to provide improved operation.

The invention is especially directed to the automatic control of a receiver for reproducing sound from desired audio-frequency modulated-carrier signals, but subject to the reception of other signals having components of predetermined characteristics, to modify the transmission characteristics of the receiver when such other signals are received.

This application is a division of applicants' copending application Serial No. 43,548, filed October 4, 1935, Patent No. 2,137,123, dated November 15, 1938, wherein there is disclosed an improved television and sound receiving system embodying novel and improved means for the automatic control of the cathode-ray television reproducing tube, whereby the cathode ray is present with sufficient intensity to illuminate the screen only at such times as a signal of the proper type and of sufficient amplitude for reproducing an intelligible signal is being received and proper scanning action is being provided; embodying also improved means for automatically controlling the contrast of the picture detail in accordance with the amplitude of the received television carrier; and, further, embodying improved automatic control means to prevent the reproduction of sound when undesired signals are present in the sound channel of the receiver. The invention of the present application is directed particularly to this latter feature.

The automatic control of a sound-reproducing receiver in accordance with the reception of signals other than a desired selected signal is desirable for various purposes. For example, in certain cases it is desirable that the sound-reproducing receiver be silenced when undesired signals having components of predetermined characteristics are received. For example, in the reception of television programs in which alternate carriers have sound and vision modulations, during a tuning operation the sound channel of a combined television and sound receiver is tuned to alternately tune to a vision-modulated carrier which would be reproduced as a harsh and disagreeable noise.

It is, therefore, a primary object of this invention to provide an improved method of, and means for, modifying the transmission characteristics of a sound-reproducing receiver when signals other than the desired signals are received.

A particular object of the present invention is to provide an improved method of, and means for, automatically controlling the reproduction of sound in a receiver designed for the reception of programs in a system in which alternate carriers are modulated by sound and vision to prevent undesirable effects of the vision-modulated signal in the sound channel of the receiver.

For a better understanding of this invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In accordance with the present invention, there is provided a receiver for reproducing sound from desired audio-frequency modulated-carrier signals and subject to the reception of other signals having components of predetermined characteristics. The receiver comprises a single channel for selecting, amplifying, and detecting any one of a plurality of desired signals and discriminating against other signals. Means are provided for converting the detected signal into sound and further means are provided, responsive only to the presence in the sound-signal channel of a signal component which has one of the predetermined characteristics, to modify the transmission characteristics of the receiver.

One satisfactory embodiment of the present invention comprises a combined sound and television receiver designed for the reception of alternate carriers modulated by sound and vision frequencies. The reproduction of sound is controlled so as to prevent video frequencies from being reproduced by the sound channel of the receiver, as would otherwise result when the sound channel is tuned through a vision carrier. This is preferably accomplished by applying a voltage from the audio-frequency channel to a selecting, amplifying, and rectifying arrangement to derive therefrom a negative biasing voltage only if and when video frequencies are present in the sound channel of the receiver. This biasing voltage may be applied to the control grids of the audio-frequency amplifier tubes, or other suitable tubes to silence the sound reproducer.

In the accompanying drawing, the single figure is a circuit diagram, partially schematic, of a complete television receiving system embodying the present invention and including both vision-

and sound-modulated carrier receiving and reproducing channels.

Referring now more particularly to the drawing, the system there illustrated comprises a receiver of the superheterodyne type including an antenna and ground system 10—11, connected to a radio-frequency amplifier 12, which is connected in cascade with an oscillator-modulator 13, an intermediate-frequency amplifier 14, a detector 15, a video-frequency amplifier 16, and a cathode-ray tube 17, constituting the vision-frequency channel of the receiver. The elements or components 10—16 may all be of conventional well-known construction so that detailed illustration and description thereof is deemed unnecessary herein.

The cathode-ray tube 17 comprises the usual envelope 18 containing, in the order named, a cathode heater 19, a cathode 20, a main or video-control grid 21, a screen 22, a first anode 23, a second anode 24, and the usual fluorescent screen 25 at the end of the tube. Line-frequency electro-static deflecting or scanning plates 26 are disposed within the envelope 18, and picture-frequency electromagnetic deflecting or scanning coils 27 are disposed at opposite sides of the tube for deflecting the beam in a direction normal to the direction of deflection effected by the plates 26. The output of the video-frequency amplifier is connected to the control grid 21 by way of the coupling condenser 28 and isolating resistance 29 for controlling the intensity of the cathode ray in accordance with the video frequencies, as in usual practice.

For developing saw-tooth voltage waves for the plates 26 and saw-tooth current waves for the coils 27, to effect scanning action by the cathode ray, a line-frequency generator 30 and a picture-frequency generator 31 are provided. The output of the video-frequency amplifier 16 is connected to these generators for controlling or operating them in proper synchronism with the scanning at the transmitter. The generators may be of any well-known or suitable design, such as, for instance, that described in United States Letters Patent No. 2,052,184, issued August 25, 1936, to Harold M. Lewis on an application Serial No. 5,781, filed February 9, 1935. The generators, however, are not limited to any particular type and, furthermore, by virtue of the automatic fade-out control system, presently to be described in detail, the generators, instead of being continuously operative, as has heretofore been the practice, may be entirely controlled or driven by the output voltage of the video-frequency amplifier so as to operate only when proper synchronizing-frequency impulses are being supplied thereto.

For supplying operating potentials to the various electrodes of the tube 17, there is provided a voltage divider 32, adapted for connection to a suitable direct current power source, not shown, and the several electrodes are connected to appropriate taps on the divider. Certain of these taps, as, for instance, 32*a*, 32*b*, and 32*c*, for the control grid 21, the screen 22, and the first anode 23, respectively, are preferably manually adjustable for regulating the initial bias voltages applied to these electrodes and for controlling the operation of the system, as will be presently more fully described. Current for the cathode heater 19 may be supplied in a conventional manner by a suitable circuit, not shown.

There is also provided a sound-frequency channel connected to the output of the oscillator-modulator 13 and comprising, in cascade, an intermediate-frequency amplifier 33, a detector 34, the audio-frequency amplifier 35, and sound reproducer 36.

Since the system shown in the drawing, as thus far described, is, in general, conventional and well understood in the art, a detailed explanation of its general operation is deemed unnecessary. Briefly, however, the vision- and sound-modulated carrier waves intercepted by the antenna 10—11 are selected and amplified in the radio-frequency amplifier 12 and supplied to the oscillator-modulator 13, where the signals are converted to intermediate frequencies in the usual manner. The output of the oscillator-modulator is delivered to the intermediate-frequency amplifiers 14 and 33. The amplifier 14 is tuned to select a vision-modulated intermediate-frequency carrier which, in systems where alternate carriers are modulated, respectively, by vision frequencies and sound frequencies, will be spaced of the order of one or more megacycles from the sound-modulated intermediate-frequency carrier, to which the amplifier 33 is tuned. The selected frequencies are amplified in the amplifiers 14 and 33 and supplied therefrom to the detectors 15 and 34, respectively.

The detector 34 produces the audio frequencies of modulation of the sound carrier and supplies them to the audio-frequency amplifier 35 whereby they are amplified and supplied in the usual manner to the loud-speaker 36 for reproduction.

It should be here noted that the detector 15 of the television channel is designed to develop in its output and deliver to the amplifier 16 video frequencies corresponding to the envelope of a vision-modulated carrier, particularly a self-synchronizing, negatively modulated carrier.

The video frequencies of modulation derived from the television carrier by the detector 15 are supplied to the video-frequency amplifier 16 wherein they are amplified and supplied in the usual manner to the control grid 21 of the cathode-ray tube and to the scanning generators 30 and 31.

With the proper potentials supplied to the electrodes of tube 17, an electron beam is emitted from the cathode 20 and its intensity is modulated or controlled by the grid 21, in accordance with the video-frequency voltages impressed thereon. The screen 22 serves to control the average intensity of the beam in a manner hereinafter to be explained, while the first anode 24 co-operates with the second anode 25 to accelerate and focus the electron beam.

Saw-tooth voltage waves are generated in the line-frequency generator 30 and applied to the plates 26 to produce an electrostatic field to deflect the beam in one direction, while saw-tooth current waves are generated in the picture-frequency generator 31 and are applied to the coils 27 to produce a magnetic field of saw-tooth wave form to deflect the beam in a direction normal to the deflection by the plates 26. The well-known rectilinear scanning pattern is thus traced on the screen by the beam. The generators 30 and 31 are preferably so adjusted as to operate only when sychronizing impulses are being supplied thereto. The operation of the generators 30 and 31 is controlled and synchronized with the corresponding scanning actions at the transmitter by the impulse components of the modulation frequencies supplied by the amplifier 16. Suitable selective circuits, not shown, may be provided in the input circuits of the generators 30

and 31, in the usual manner, for discriminating against undesired impulse frequencies.

In accordance with certain features of the invention claimed in the said copending application Serial No. 43,548, an automatic fade-out control positive bias voltage is derived by rectification of a part of the line-frequency saw-tooth voltage output of the scanning generator 30. For this purpose a rectifier 37 is provided, having an anode 38 and a cathode 39, the anode being connected to the high voltage output terminal of the generator 30 through a resistance 40 and a coupling condenser 41 and to the adjustable tap 32b on the voltage divider 32 through an isolating resistor 43. The cathode 38 is connected to ground through a condenser 42. A resistor 44 is connected across the rectifier 37 to develop the automatic fade-out control bias voltage output of this rectifier. An initial positive biasing potential is applied to the screen 22 from the tap 32b on the voltage divider, through the path which includes the resistors 43 and 44.

The biasing potential applied to the screen 22 from the tap 32b is of such magnitude and polarity that the electron beam is normally insufficient to illuminate the fluorescent screen. Whenever the generator 30 is in operation, however, an additional bias voltage is developed by the rectifier 37 across the resistor 44, and this voltage is applied positively to the screen 22 so as to raise its potential, and permit the beam to become sufficiently intense to illuminate the fluorescent screen.

The output voltage of the rectifier 37 may or may not be proportional to the amplitude of the received vision-modulated carrier wave, according to the design of the generator 30. As above mentioned, in this embodiment of the invention the generator 30 is preferably so designed that the amplitude of the periodic voltage developed therein and supplied to the rectifier 37 is substantially independent of the amplitude of the control voltage supplied to it from the video-frequency amplifier 16, unless such control voltage falls below a predetermined minimum, as disclosed in afore-mentioned United States Letters Patent No. 2,052,184. Hence, the input voltage to the rectifier 37 will be supplied only when the generator 30 is operating, and automatic fade-out control voltage will be developed for illuminating the screen 25 of the tube 17 only in the presence of a received signal and without appreciable gradation in the control of the screen illumination. It will also be appreciated that the farther removed the automatic fade-out control detector is from the system input, the more independent will be the amplitude of the automatic fade-out control bias from the amplitude of the received carrier and the more effective will be the protection of the cathode-ray tube by the automatic fade-out control.

For the purpose of controlling the contrast of the picture detail, a unidirectional bias voltage is derived by rectification of the intermediate-frequency carrier by the detector 15, and is applied to the control grids of one or more of the amplifying tubes of the intermediate-frequency amplifier 14. This automatic contrast control bias voltage is a negative voltage proportional to the amplitude of the received carrier and its application to the tubes of the amplifier 14 controls their amplification so as to maintain the output of this amplifier within a relatively narrow range for received signals of a wide range of intensities and above a predetermined value.

Where the receiver just described is employed in systems in which alternate carrier waves have vision and sound modulation, respectively, and the receiver is properly tuned, the output of the amplifier 33 will be detected, amplified, and reproduced as sound in the manner afore-described. When, however, the receiver is being tuned through a range of such alternate carriers, vision- and sound-modulation intermediate-frequency carriers will be present alternately in each of the amplifiers 14 and 33. As has been seen, the automatic fade-out control will prevent the screen 25 from being illuminated when a sound-modulated carrier is present in the amplifier 14, since such a carrier will not have the proper frequency components of modulation for effecting scanning and operation of the automatic fade-out control.

By virtue of the arrangement provided by the present invention, the reproduction of noisy television signals by the sound reproducer is prevented when the vision-modulation frequencies are present in the sound channel of the receiver. This arrangement comprises amplifying, selecting, and detecting means, arranged to control the audio-frequency amplifier 35. A part of the audio-frequency output of the detector 34 is supplied through a coupling condenser 46 to the grid 47 of a tube 45. In the plate circuit of the tube 45 is effectively included a selective circuit 48, which is tuned to the line-scanning frequency of the vision-modulated carrier, that is, the beat-note signal resulting from detection of the vision-modulated carrier and its sideband frequencies. The circuit 48 comprises a condenser 49 and an inductance 50 coupled to a coil 51 connected in the plate circuit of tube 45. The tuned circuit 48 is connected to a diode rectifier which may comprise an auxiliary anode 52 and the cathode 53 of the tube 45, which, as illustrated, may be of the diode-triode type. The load circuit of the rectifier 52—53 comprises a resistor 54 and bypass condenser 55. Suitable operating potentials are applied to the plate 56 and grid 47 of the tube 45, as by batteries 57 and 58, respectively, and a blocking resistor 59 may be interposed in the connection to the grid 47.

When vision-modulated intermediate frequencies are present in the amplifier 33 and are rectified by the detector 34, a part of the output of the detector is impressed upon the grid 47 through the condenser 46 and amplified in the triode section of the tube 45. Voltage of the beat-note line-scanning frequency is then developed across the circuit 48 and rectified by the diode 52—53, producing a unidirectional biasing voltage across the resistor 54 in the well-known manner. This biasing voltage is applied negatively, by way of the isolating resistor 35a, to the control grid of one or more of the tubes in the audio-frequency amplifier 35 and acts to suppress the audio-frequency amplifier 35 and to silence the loud-speaker 36.

It will be apparent that, in the embodiment of the invention just described, a single sound signal channel is provided for selecting, amplifying, and detecting a desired audio-frequency modulated-carrier signal, that this channel is subject to the reception of other signals than that desired, and that there is incidentally developed therein, in response to such other signals, beat notes of predetermined frequency characteristics. The term "predetermined characteristics" is used herein to describe any characteristic unique to a particular signal component, such as frequency, wave form, and the

like, and definitely to exclude mere differences in signal intensity or amplitude. In the present instance, the beat notes comprise line-scanning frequencies which are developed by the beating of the television carrier and its sideband frequencies in the detector 34. The amplifier 45, selective circuit 48, and rectifier 52 thus comprise an arrangement which is selectively responsive to the beat notes, develops a control-bias voltage therefrom, and utilizes this voltage to modify the transmission characteristics of the receiver, specifically in the system described, to prevent the reproduction of sound.

Various other arrangements utilizing the present invention in equivalent systems will be readily apparent to those skilled in the art. Obviously, the present invention may be employed in any system of which it is desired to modify the transmission characteristics when signals, other than a desired signal, are received with sufficient amplitude to cause an undesired signal component of appreciable amplitude to be present in the output of the selecting and amplifying channel.

While there have been described what at present are considered the preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A receiver for reproducing sound from desired audio-frequency modulated-carrier signals and subject to the reception of undesired signals having periodically recurring modulation components of predetermined characteristics, comprising a single signal-translating channel for selecting, amplifying, and detecting any one of a plurality of said desired signals and discriminating against said other signals, means for converting the detected signal into sound, and means selectively responsive only to the presence in the detected output of said channel of a signal component corresponding to one of said undesired signal modulation components of predetermined characteristics for modifying the transmission characteristics of said receiver.

2. A receiver for reproducing sound from desired audio-frequency modulated-carrier signals and subject to the reception of undesired signals having periodically recurring modulation components of predetermined characteristics, comprising a single signal-translating channel for selecting, amplifying, and detecting any one of a plurality of said desired signals and discriminating against said other signals, means for converting the detected signal into sound, means selectively responsive only to the presence in the detected output of said channel of a signal component corresponding to one of said undesired signal modulation components of predetermined characteristics for developing a control-bias voltage, and means for utilizing said voltage for modifying the transmission characteristics of said receiver.

3. A receiver for reproducing sound from desired audio-frequency modulated-carrier signals and subject to the reception of undesired signals having periodically recurring modulation components of predetermined characteristics, comprising a single signal-translating channel for selecting, amplifying, and detecting any one of a plurality of said desired signals and discriminating against said other signals, means for converting the detected signal into sound, and means selectively responsive only to the presence in the detected output of said channel of a signal component corresponding to one of said undesired signal modulation components of predetermined characteristics for preventing the reproduction of sound by said receiver.

4. A receiver for reproducing sound from desired audio-frequency modulated-carrier signals and subject to the reception of undesired signals including predetermined modulation components, comprising a single signal-translating channel for selecting, amplifying, and detecting any one of a plurality of said desired signals and incidentally developing in response to one of said undesired signal modulation component beat notes of a predetermined frequency, means coupled to said channel for converting the detected signal into sound, and means selectively responsive to said modulation component beat notes for modifying the transmission characteristics of said receiver.

5. A receiver for reproducing sound from desired audio-frequency modulated-carrier signals and subject to the reception of undesired signals including predetermined modulation components, comprising a single signal-translating channel for selecting, amplifying, and detecting any one of a plurality of said desired signals and incidentally developing in response to one of said undesired signal modulation component beat notes of a predetermined frequency, means coupled to said channel for converting the detected signal into sound, and means selectively responsive to said modulation component beat notes for reducing the amplification in said channel.

6. A receiver for reproducing sound from desired audio-frequency modulated-carrier signals and subject to the reception of undesired signals including predetermined modulation components, comprising a single signal-translating channel for selecting, amplifying, and detecting any one of a plurality of said desired signals and incidentally developing in response to any one of said undesired signal modulation component beat notes of a predetermined frequency, means coupled to said channel for converting the detected signal into sound, means selectively responsive to said modulation component beat notes for developing a control-bias voltage, and means for utilizing said voltage for modifying the transmission characteristics of said receiver.

7. A receiver for reproducing sound from desired audio-frequency modulated-carrier signals and subject to the reception of undesired signals including predetermined modulation components, comprising a single signal-translating channel for selecting, amplifying, and detecting any one of said desired signals and incidentally developing in response to one of said undesired signal modulation component beat notes of a predetermined frequency, means coupled to said channel for converting the detected desired signal into sound, and means selectively responsive to said modulation component beat notes for preventing the reproduction of sound by said receiver.

8. In an audio-frequency modulated-carrier receiver for reproducing sound subject to the reception of video-frequency modulated carriers having synchronizing-frequency modulation components, means for selecting, amplifying, and detecting received waves to derive therefrom audio-frequency modulated voltages, means for con-

verting said voltages into sound, and means selectively responsive to the presence of synchronizing-frequency voltages in said receiver for preventing the reproduction of sound.

9. In an audio-frequency modulated-carrier receiver for reproducing sound subject to the reception of video-frequency modulated carriers having synchronizing-frequency modulation components, an audio channel including means for detecting received carriers to derive audio-frequency modulation voltages, means for converting said audio-frequency modulation voltages into sound, an amplifier connected to the output of said detector, a rectifier, a selective circuit tuned to said synchronizing-frequency modulation components coupling said rectifier to said amplifier, and means for applying the output voltage of said rectifier to said audio-frequency amplifier to suppress the reproduction of sound.

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