Oct. 8, 1946. D. H. MITCHELL 2,409,058

CONTROL SYSTEM FOR WAVE-SIGNAL RECEIVERS

Filed Dec. 18, 1944

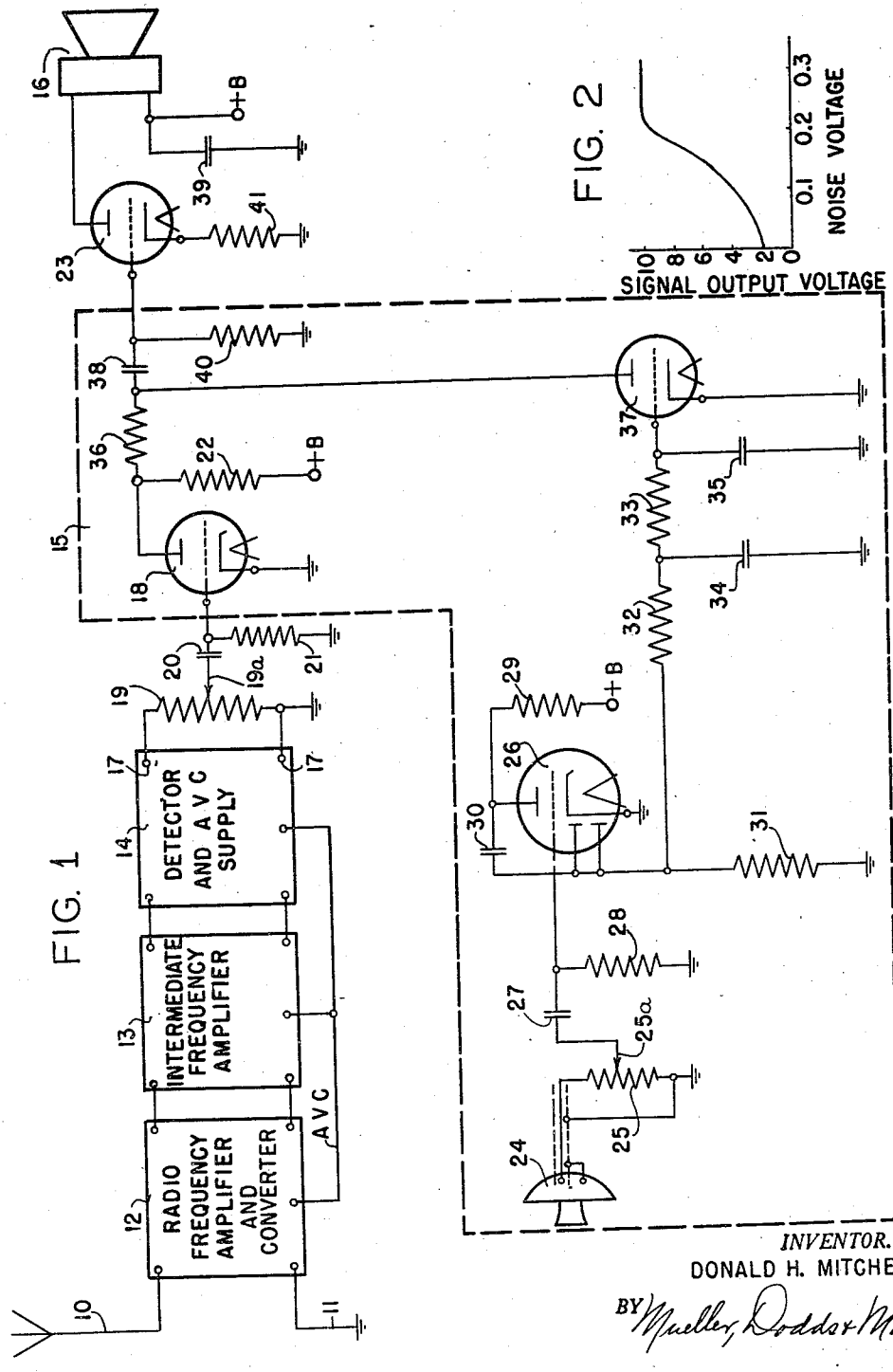

FIG. 1

FIG. 2

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Patented Oct. 8, 1946 2,409,058

UNITED STATES PATENT OFFICE

2,409,058

CONTROL SYSTEM FOR WAVE-SIGNAL RECEIVERS

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Application December 18, 1944, Serial No. 568,635

5 Claims. (Cl. 250—20)

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This invention relates to control systems for wave-signal receivers adapted to operate under noise levels of a wide range of values and more particularly to such systems effective to vary the signal output of the receiver directly in accordance with the ambient noise level.

Certain applications of wave-signal receivers, as to automobile broadcast receivers, are subject to operation under a wide range of noise levels. For example, in the operation of an automobile at moderate speed along a country road, the noise level is relatively low while in city traffic at any speed the noise level is likely to be abnormally high, particularly when traveling near trolley cars, trains, etc. It is recognized that intelligibility or apparent loudness of the sound output of a broadcast receiver is dependent on the ambient noise level; that is, with a high noise level the sound output of the receiver must be very much greater than at low noise levels in order to obtain the same apparent loudness.

A partial solution of the problem has heretofore been proposed in the form of various arrangements for controlling the sound volume output of an automobile broadcast receiver in accordance with some factor varying with the speed of the automobile; for example, the ignition voltage, the speedometer output, the air velocity of the automobile, the battery-charging generator output, or the displacement of the accelerator pedal. However, none of these arrangements takes into consideration noises other than the engine noise while such other noises are often the principal components of the general noise level. The present invention is concerned with a control system for wave-signal receivers adapted to operate under noise levels of a wide range of values, including provisions for varying the signal output of the receiver directly in accordance with the ambient noise level as determined by all noise contributing factors.

It is an object of the invention, therefore, to provide a new and improved control system for wave-signal receivers adapted to operate under noise levels of a wide range of values including provisions for varying the signal output of the receiver directly in accordance with the ambient noise level, by means of which one or more of the disadvantages and shortcomings of the arrangements of the prior art may be avoided.

It is another object of the invention to provide a new and improved control system for wave-signal receivers of the type described including provisions for varying the signal output of the receiver directly in accordance with the ambient noise level in which the control is in response to an actual measurement of the noise including all noise contributing factors.

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It is another object of the invention to provide a new and improved control system for wave-signal receivers in which the apparent loudness of the sound output of the receiver for any given setting of the volume control remains substantially constant for variations in the noise level within a wide range.

In accordance with the invention, there is provided in a modulated-wave-signal receiver adapted to operate under ambient noise levels of a wide range of values and including a signal-responsive device, a control system comprising a signal-translating stage, means responsive to the ambient noise in the vicinity of the receiver for developing a control effect, and means for utilizing the control effect to vary the signal output of the stage directly in accordance with the ambient noise level. In a preferred form of the invention, the signal-responsive device is a sound-reproducer and the signal output of the stage is varied by varying the signal input to the stage.

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

Referring now to the drawing, Fig. 1 is a circuit diagram, partly schematic, of a complete modulated-wave-signal receiver embodying the invention, while Fig. 2 is a graph representing an operating characteristic of the system of Fig. 1 to aid in the explanation of the invention.

Referring now to Fig. 1 of the drawing, there is represented a modulated-wave-signal receiver adapted to operate under noise levels of a wide range of values and including in cascade, in the order named, an antenna ground circuit 10, 11, a radio-frequency selector, amplifier and converter unit 12, an intermediate-frequency amplifier 13 of one or more stages, a detector and AVC supply unit 14, a control system 15 embodying the present invention, and a signal-responsive device such as a sound-reproducer 16. An automatic amplification control or AVC bias is supplied from unit 14 to one or more of the tubes of the units 12 and 13 over the connection AVC in a conventional manner. The elements 10–14, inc., and 16 may all be of conventional construction and connection so that a detailed description thereof is unnecessary.

The control system 15 comprises signal-input

terminals or circuit 17, 17, a first audio-frequency amplifier 18 which, as illustrated, may be of the triode vacuum tube type. There is also provided a volume control device coupling the control system 15 to the input circuit 17 and including a voltage divided resistor 19 provided with an adjustable contact 19a which is connected to the grid of the amplifier 18 through a coupling condenser 20, the grid of the tube 18 being provided with a grid leak 21. The space current for the vacuum tube 18 is supplied from a suitable source +B through a load resistor 22.

The control system 15 also includes means, such as a microphone 24, displaced from the sound-reproducer 16 but disposed in such a location as to be responsive to the ambient noise in the vicinity of the receiver, for developing a control effect. Specifically, the control effect may be a noise signal developed by the microphone 24 and appearing across its load resistor 25 which is provided with an adjustable contact 25a from which a selected portion of the noise signal is applied to the triode section of a duplex diode-triode 26 through a coupling condenser 27, the grid being provided with a grid leak 28. Space current for the triode section of tube 26 is provided from a suitable source +B through a load resistor 29. The anode of the tube 26 is coupled to the diode anodes in parallel through a coupling condenser 30, while the diode anodes are provided with a common load resistor 31. The noise signal rectified by the diode anodes of tube 26 is applied to an audio-frequency filter comprising series resistors 32, 33 and shunt condensers 34, 35 to develop a unidirectional control bias varying directly in accordance with the ambient noise level.

The control system 15 also includes means for utilizing the control effect or control bias developed as described to vary the signal output of the audio-frequency amplifier stage 23 in accordance with the ambient noise. The control of the output of the stage 23 may be made either directly, as by varying the gain of the stage 23, or indirectly, by controlling the signal input to the stage. The circuit illustrated operates in accordance with the latter method and comprises a voltage divider including a resistor 36 and a bias-responsive impedance device, such as a triode tube 37 to which the rectified control bias from the filter 32–35 is applied. The input signal is applied to the voltage divider from the load resistor 22 of the audio-frequency amplifier 18, the voltage divider 36, 37 serving to couple the audio-frequency amplifiers 18 and 23. Specifically, the system includes circuit means such as a coupling condenser 38 for applying the signal across the bias-responsive triode 37 to the audio-frequency amplifier 23 to vary the signal input thereto and thus the signal output thereof. Space current for the amplifier 23 may be supplied from a suitable source +B through the actuating winding of the sound-reproducer 16, the source +B being by-passed to ground for audio-frequency currents through a condenser 39. The grid of the amplifier 23 is provided with a grid leak 40, while its cathode may be biased by a suitable cathode bias-resistor 41 which, if unbypassed, as shown, serves as an audio-frequency degenerative resistor to improve the linearity of the amplifier 23 and the fidelity of its output, in a manner well understood in the art.

The operation of the wave-signal receiver described, with the exception of the control system 15, is entirely conventional so that a detailed explanation thereof is unnecessary. In brief, modulated-wave signals intercepted by the antenna circuit 10, 11 are selected and amplified and converted into an intermediate-frequency signal in unit 12 and are thereupon selectively amplified in the unit 13 and applied to the unit 14 wherein the modulation-signal is detected and a unidirectional bias varying with the average intensity of the signal-carrier-wave is developed. This bias is utilized in a conventional manner as an automatic amplification control or AVC bias and applied to one or more of the tubes of the units 12 and 13 to maintain the amplitude of the signal applied to the detector 14 within narrow limits for a wide range of received signal intensities. Neglecting for the moment the operation of the control system 15, the audio-frequency signal derived by the unit 14 is amplified in audio-frequency amplifiers 18 and 23 and applied to the loud-speaker 16 for reproduction. In practice, the volume control voltage divider resistor 19, 19a may be preset on installation and need not be provided with means for adjusting in normal use.

Coming now to the control system 15, any extraneous noise signals in the vicinity of the receiver are picked up by the microphone 24; for example if the invention is applied to an automobile broadcast receiver, the microphone 24 may be placed either inside or outside of the automobile provided that it is not too close to the loud-speaker 16 to be influenced primarily thereby. The microphone 24 develops a noise signal across its load resistor 25 which varies directly with the ambient noise level. A selected portion of this noise signal is picked up at the adjustable contact 25a and applied through the coupling condenser 27 to the grid of the triode amplifier 26. The adjustment of contact 25a is determined at installation and is not ordinarily altered thereafter during normal use. The amplified noise signal developed at the anode of amplifier 26 is applied through a coupling condenser 30 to the diode anodes of the tube 26 operating in parallel, wherein the amplified noise signal is rectified and develops across the load resistor 31 to the diode anodes a unidirectional control bias. This bias includes also the noise frequency components which are suppressed by the filter comprising the elements 32–35, inclusive, so that a substantially pure unidirectional bias voltage is derived and applied to the grid of the triode vacuum tube 37. This tube functions as a bias-responsive impedance device and, together with the resistor 36, constitutes a voltage divider connected across the load resistor 22 of the audio-frequency amplifier 18. The portion of the audio-frequency signal appearing across the impedance of the tube 37 is applied through a coupling circuit 38, 40 to the second audio-frequency amplifier 23.

With the arrangement described, the impedance of the tube 37 increases directly and substantially proportionally with the noise signal developed by the microphone 24 so that the amplitude of the audio-frequency signal appearing as a voltage drop thereacross also increases proportionately with the noise level; that is, the signal input to the audio-frequency amplifier 23 increases directly with the ambient noise level with the result that the signal output of this amplifier 23, as reproduced by the loud-speaker 16, also increases directly with the ambient noise level so that the intelligibility or apparent loudness of the reproduced signal, for any given setting of the volume control 19, 19a, remains substantially con-

stant over a wide range of values of the ambient noise level.

By a proper selection of circuit constants, any desired characteristics may be imparted to the control system 15. For example, in Fig. 2 there is represented a characteristic of one particular control system. From this characteristic it is seen that, with negligible ambient noise, the minimum signal output of the amplifier 23 approximates 2 volts. This signal increases rapidly as the noise level rises and approaches a maximum of approximately 10 volts for a noise signal of approximately 0.225 volt at the microphone 24. This condition represents the maximum anode impedance of the control tube 37 when biased to cut off. Further increases in noise level result in no further increase in the signal output of the amplifier 25 but a noise signal of 0.225 volt at the microphone 24 represents a condition in which reproduction of intelligible sound is no longer practicable with the power available in the particular receiver. Thus a ratio of maximum sound voltage output to minimum sound voltage output of more than 5 to 1 is procured under the extreme range of noise levels. This corresponds to a power ratio of 25 to 1.

A slightly modified circuit has produced a sound voltage output ratio of as high as 16 to 1 for 0.15 volt noise signal at the microphone 24. While the constants of the control system 15 may vary within wide limits in accordance with installation requirements, for one installation in an automobile broadcast receiver giving a power ratio of 49 to 1 the control system 15 was given the following circuit constants:

Resistor 25	megohm	1
Resistor 28	do	3.3
Resistor 29	do	0.25
Resistor 31	do	1
Resistors 32, 33	megohm each	0.47
Resistor 36	megohm	0.13
Resistor 40	do	0.27
Condenser 27	micro-farad	0.02
Condenser 30	do	0.2
Condensers 34, 35	do	0.1
Condenser 38	do	0.05
Tubes 18 and 26		6SQ7-GT
Tube 23		6V6-GT
Tube 37		½6SN7-GT

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit or scope of the invention.

What is claimed as new is:

1. In a modulated-wave-signal receiver adapted to be installed in an automobile and to operate under ambient noise levels of a wide range of values encountered while the automobile is in motion and including a sound-reproducer, a control system comprising, a signal-translating stage, a microphone displaced from said sound-reproducer and responsive to ambient noise in the vicinity of said receiver for developing a control signal, and means for utilizing said control signal to vary the signal output of said stage directly in accordance with said ambient noise.

2. In a modulated-wave-signal receiver adapted to be installed in an automobile and to operate under ambient noise levels of a wide range of values encountered while the automobile is in motion and including a sound-reproducer, a control system comprising, a signal-translating stage, a microphone displaced from said sound-reproducer and responsive to ambient noise in the vicinity of said receiver for developing a noise signal, means for rectifying and filtering said noise signal to derive a unidirectional control bias, and means for utilizing said control bias to vary the signal output of said stage directly in accordance with said ambient noise.

3. In a modulated-wave-signal receiver adapted to operate under ambient noise levels of a wide range of values and including a sound-reproducer, a control system comprising, a signal-translating stage, means displaced from said sound-reproducer and responsive to ambient noise in the vicinity of said receiver for developing a control bias, and a variable bias-responsive impedance device for controlling the signal output of said stage directly in accordance with said ambient noise.

4. In a modulated-wave-signal receiver adapted to operate under ambient noise levels of a wide range of values and including a sound-reproducer, a control system comprising, a signal-translating stage, means displaced from said sound-reproducer and responsive to ambient noise in the vicinity of said receiver for developing a control bias, a voltage divider including a bias-responsive impedance device to which the signal input of the system is applied, and circuit means for applying said control bias to said device and for applying the signal across said device to said stage to vary the signal input of said stage directly in accordance with said ambient noise.

5. In a modulated-wave-signal receiver adapted to operate under ambient noise levels at a wide range of values and including a sound-reproducer, a control system comprising, a signal-input circuit, first and second audio-frequency amplifiers, a volume-control device coupling said first amplifier to said input circuit, a voltage divider coupling said first and second amplifiers and including a bias-responsive impedance device, means displaced from said sound-reproducer and responsive to ambient noise in the vicinity of said receiver for developing a control bias, and circuit means for applying said control bias to said device and for applying the signal across said device to said second amplifier to vary the signal input thereto directly in accordance with said ambient noise.

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