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SIGNALING SYSTEM

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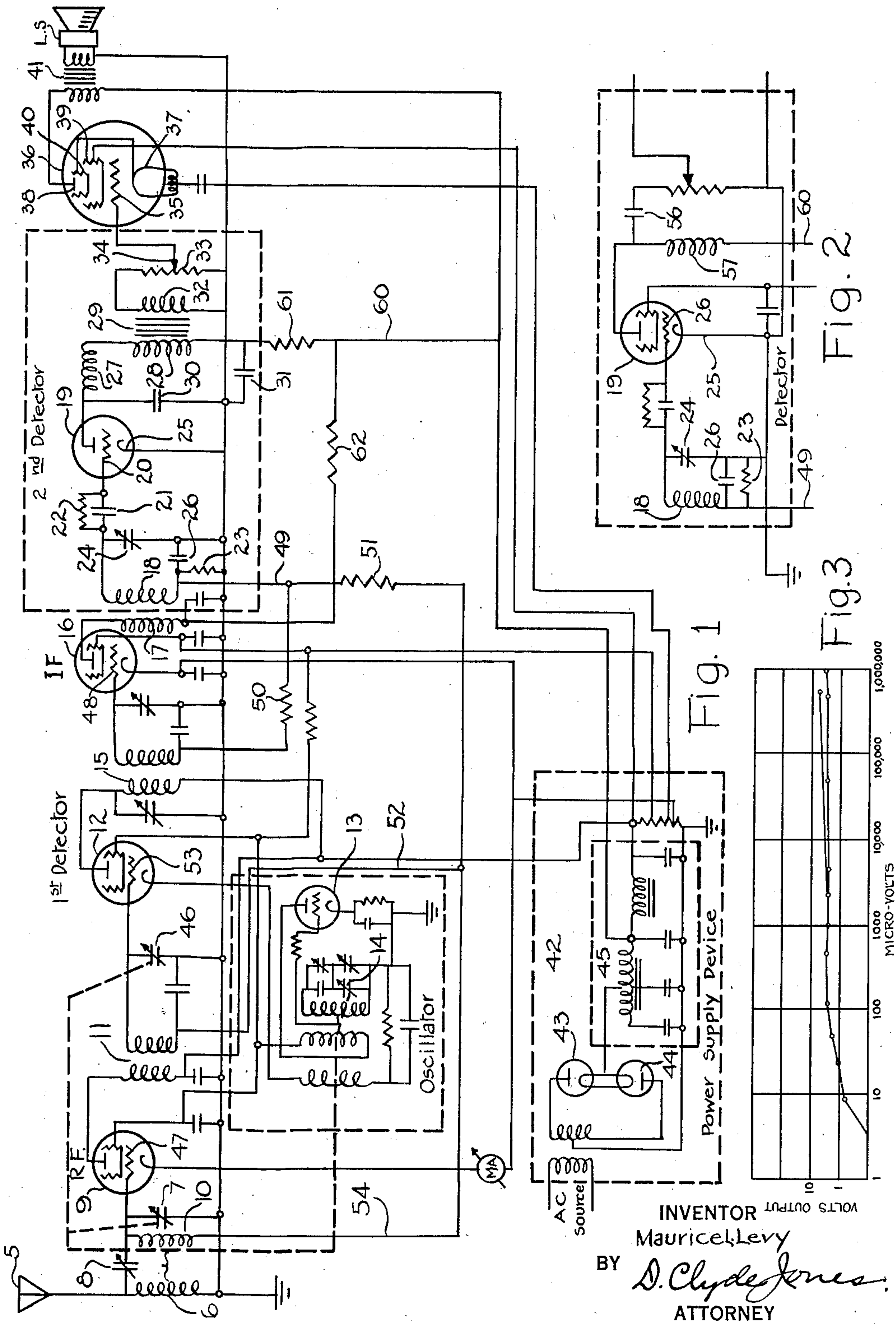


Fig. 1

Fig. 2

Fig. 3

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SIGNALING SYSTEM

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1 Claim. (Cl. 250—20)

This invention relates to signaling systems and more particularly to radio signaling systems.

In radio receiving systems, it has been proposed to utilize the carrier wave of a transmitted radio signal to control the degree of amplification in one or more amplifier stages thereof. In one form of such a system, in addition to the regular demodulator, a separate rectifier has been provided to control the degree of amplification in a portion of the radio receiver. In another form of proposed system for regulating the degree of amplification in such a receiver, a two-electrode vacuum tube is provided to demodulate the signal and to rectify the carrier wave to effect the desired control. In this arrangement, however, no amplification is effected in the rectifier and it is necessary to add an amplifying stage to amplify the demodulated signal to a level equal to that usually applied to an audio amplifier. A third form of system utilizes a three-electrode vacuum tube incorporating the usual cathode, control grid, and anode, in which the cathode and one of the other electrodes function to demodulate the modulated carrier signal and the cathode together with the other electrode functions to set up a condition to control the degree of amplification in the amplifier preceding the demodulator.

In accordance with the present invention, there is provided a demodulator of the type which not only demodulates the incoming signal but which also amplifies it, and which also serves to establish a condition which automatically regulates the degree of amplification in the amplifier preceding the demodulator so that all receivable incoming signals are applied to the input of the demodulator at substantially uniform signal strength. A further feature of the invention relates to the method of controlling the degree of amplification in an amplifier preceding a demodulator which comprises utilizing a current flowing in the input circuit of the demodulator to set up a condition whereby the degree of amplification in the amplifier compensates for inequalities in the strength of signals introduced into the amplifier. A further feature of the invention relates to a radio receiving system including an amplifier and a grid-leak detector in which current flowing through the grid-leak of the detector and corresponding to the strength of carrier signal introduced into the detector regulates the bias on the amplifier whereby said amplifier varies its degree of amplification to compensate for inequalities in the strength of signal applied thereto.

Referring to the drawing, Fig. 1 diagrammati-

cally represents a radio receiver including a radio frequency amplifier, a frequency translating device in the form of a first detector and an oscillator, an intermediate frequency amplifier, a second detector, an audio frequency amplifier and a suitable power supply device for supplying the several voltages essential to operating the radio receiver; Fig. 2 is a modified form of second detector or demodulator employing a tetrode or screen grid tube which may be substituted for the second detector of Fig. 1 wherein there is employed a triode or three-electrode tube; and Fig. 3 is a chart showing the relation between the input signal voltage introduced into the radio receiver and the amplified output voltage available for actuating the loud speaker.

Referring to Fig. 1, 5 designates an antenna having in series therewith an inductor 6, the lower terminal of which leads to ground and is connected to the lower terminal of a variable condenser unit 7, while the upper terminal of the inductor is connected through a variable condenser 8 to the other terminal of the variable condenser 7. The inductor 6 and the condenser 7 constitute a tuned input circuit of a radio frequency amplifier including the tetrode tube 9, the common terminal of the condensers 7 and 8 being connected to the control electrode 47 of the vacuum tube 9. The common terminals of inductor 6 and condenser 7 are connected through power supply device to the cathode of the tetrode tube 9. There is also connected in the input circuit of the amplifier in a manner to be described, an inductor 10 coupled to the inductor 6 to develop therewith a mutual inductance, this mutual inductance together with the condenser 8 serving to compensate for variations in antennae that may be connected to the radio receiver. The output of the radio frequency amplifier is coupled by means of a transformer 11 to the input circuit of a first detector tuned by the variable condenser unit 46 and including a tetrode tube 12. This detector has associated therewith an oscillator including the triode tube 13 and having in its network a variable condenser unit 14 mounted on a shaft in common with the condenser units 7 and 46 to be adjusted simultaneously therewith.

As is well-known, the oscillator cooperates with the first detector to translate the frequency of incoming signal into an intermediate frequency which is always of the same frequency for any given receiver. The output of the first detector is coupled by a transformer 15 to the tuned input circuit of an intermediate frequency amplifier including the tetrode tube 16, while the out-

put of the intermediate frequency amplifier is coupled by means of a transformer, having primary winding 17 and a secondary winding 18, to the input of a second detector or demodulator including the triode tube 19.

The input circuit of this demodulator includes the control grid 20 of the triode tube, a grid condenser 21 and a grid leak 22 in multiple therewith, connected to a common terminal of a tuned circuit including the secondary winding 18 of the transformer and resistor 23 in multiple with the condenser 24, the other common terminal of the tuned circuit being connected to the detector cathode 25. There is connected in multiple with the resistor 23, a fixed condenser 26 to function as a radio frequency by-pass to ground and as part of an audio filter, the purpose of which will be further described. The output of this second detector includes an inductor 27 and the primary winding 28 of an audio transformer 29 with a fixed by-pass condenser 30 connecting the free terminal of the inductor 27 to ground and with a fixed by-pass condenser 31 connecting the free terminal of the primary winding 28 to ground. A secondary winding 32 of audio transformer 29 has connected across its terminals a resistor 33 with a common terminal of the resistor and the secondary winding connected to ground. An adjustable wiper 34 engaging the resistor, is connected to the control grid 36 of a pentode or five-electrode tube 36. This tube is provided with a cathode 37, a control grid 35, an anode 38 and a screen 39 shielding the control grid 35 from the anode 38 to prevent regeneration, while a fifth electrode 40 connected to a midpoint on the cathode 37 functions normally to prevent secondary emission from the screen or shield 39. The output of the pentode audio tube is coupled by means of an audio transformer 41 to a loud speaker LS which may be of the moving coil type.

For simplicity in disclosure the connections for energizing the field of the loud speaker have been omitted but these connections may be similar to those shown in my copending application Serial No. 517,190, filed February 20, 1931, Patent No. 1,901,350, March 14, 1933. In order to supply the various voltages necessary for operating the several vacuum tubes of the system, a power supply device generally designated 42 is provided. This device includes the rectifier tubes 43 and 44 connected as a full wave rectifier serving to translate alternating current from the power supply source into pulsating direct current, the pulsations of which are eliminated by a filter generally designated 45. In this system, the circuits for energizing the heaters of the several vacuum tubes and also the filaments of the rectifier tubes have been omitted, but they may be similar in arrangement to the corresponding circuits shown in my mentioned copending application.

In the operation of the system, the radio receiver is tuned to the frequency of any desired incoming signal by adjusting the adjustable condenser units 7, 14 and 46. The selected incoming signal is amplified in the radio frequency amplifier and thereafter the frequency of the amplified signal is translated into an intermediate frequency by means of the oscillator cooperating with the first detector. The signal thus translated in frequency is amplified in the intermediate frequency amplifier and is then demodulated in the second detector or demodulator after which it is amplified at audio frequencies by the pentode audio amplifier and then is regenerated into sound by the loud speaker.

The signals intercepted on the antenna are of varying strength not only due to the difference in distance between the several broadcasting stations and the antenna, but also due to the fact that there may be "fading" of the selected signal. In order to compensate for varying signal strengths due to these reasons, an automatic volume control arrangement is provided whereby any signals above a predetermined signal level are delivered to the input of the second detector or demodulator at a uniform given value. This result is effected by utilizing the variations in the strength of carrier wave of selected signals to apply a compensating biasing potential, developed in the second detector or demodulator, to the control grids, such as 47, 48 and 53, in the vacuum tubes 9, 16 and 12 in the radio frequency, the intermediate frequency amplifiers and the first detector respectively. It has been pointed out that this demodulator or detector is of the grid-leak type in that its connection from the tuned circuit in the input of the detector to the control grid 20 thereof includes a condenser 21 connected in multiple with a grid-leak 22. It is well-known that such a type of detector in addition to functioning to demodulate the incoming signal also operates to amplify the demodulated signal. In such a detector a negative charge accumulates through the condenser 21 on the control grid 20 of the detector tube during the negative portion of each cycle of the incoming signal wave, and during the positive portion thereof the negative charge leaks away to ground through the grid-leak 22 in a circuit including the control grid 20, the space between this grid and the cathode 25, resistor 23, secondary winding 18 of the transformer, grid-leak 22 and thence to the control grid 20. Current flowing in this circuit develops a drop in potential across the terminals of the resistor 23 and this negative potential is applied over conductor 49, resistor 50, secondary winding of the transformer 15 to the control grid 48 of the vacuum tube 16 in the intermediate frequency amplifier and in multiple therewith through resistor 51, conductor 52, secondary winding of transformer 11, control grid 53 of the first detector and over conductor 54, inductor 10, to the control grid 47. It should be noted that if the incoming signal is particularly strong, the negative charge accumulating on the control grid 20 of the detector will be of relatively large magnitude and consequently the current flowing in the input circuit of the detector, as just described, will be correspondingly large so that the drop in potential across the resistor 23 will likewise be large. Whereas if the incoming signal is weak, the charge accumulating on the control grid 20 will be relatively small and the current flowing in the input circuit of the detector will also be small so that the drop in potential, developed by this current across the terminals of the resistor 23, will be correspondingly small. Thus if the incoming signal is strong, a larger negative bias is applied to the control grids 47, 53 and 48 of the several vacuum tubes preceding the demodulator thereby reducing the amplification effected therein, whereas if the signal is weak, the negative bias on the electrodes of these tubes will be small permitting them to effect a higher degree of amplification.

It should be pointed out that the current flowing in the input circuit of the demodulator is modulated at audio frequency corresponding to the original modulation of the intercepted carrier signal and it is essential to filter out this

audio component from the current flowing in the input circuit. For this purpose, the fixed by-pass condenser 26 is provided and owing to the relatively high impedance of the resistors 50 and 51, the audio frequency component of this current flows through this by-pass condenser to ground instead of disturbing the biasing potential applied to the control grids of the several tubes.

In the foregoing arrangement, a triode or three-electrode tube 19 has been used as a demodulator. In the modified form of the invention shown in Fig. 2, a tetrode detector or demodulator is shown. This demodulator may be substituted for that portion of the demodulator designated second detector and included within the dotted rectangle of Fig. 1. In this instance, the output of the demodulator instead of being coupled to the pentode audio amplifier 36 by a coupling transformer, is coupled to this audio amplifier by impedance coupling including the condenser 56 and the impedance 57. The operation of this demodulator for effecting automatic volume control is substantially the same as in the arrangement shown in Fig. 1 and need not be further described.

In order to illustrate the degree of compensation effected for varying strengths of incoming signals so that a uniform, predetermined, audio signal is applied to the loud speaker, the chart of Fig. 3 is provided. In this chart, the ordinates represent the audio volts output to the loud speaker when the system is adjusted for non-overload on the power tube 36, while the abscissae represent micro-volts input on the antenna binding posts through a dummy antenna. From the curve in this chart, it will be noted that incoming signals of any value between 100 micro-volts

and one volt are delivered to the loud speaker at substantially uniform amplification.

In the arrangement of Fig. 1, the following values of the several elements were used:

Grid-leak 22 equals 1 megohm, 5
Grid condenser 20 equals .0001 microfarad,
By-pass condenser 26 equals .04 microfarad,
Resistor 23 equals .5 megohm,
Resistors 50 and 51 each equal .1 megohm, 10
Inductance 6 has a value of .9 millihenry,
Inductor 27 in the plate circuit of the detector 19 has a value of 10 millihenrys,
By-pass condenser 30 equals .001 microfarad,
By-pass condenser 31 equals 2 microfarads, 15
Resistors 61 and 62 are equal respectively to 30,000 ohms and 10,000 ohms,
Resistor 33 equals 2 megohms.

It will be understood that the invention is not limited to the above values but they are given 20 merely by way of illustration. Although the invention has been illustrated in connection with a superheterodyne type of radio receiver, it is equally applicable to a radio receiver of the tuned radio frequency type. 25

What I claim is:

In a signaling system, an amplifier including a vacuum tube provided with a control grid, a detector coupled to said amplifier, said detector being provided with a cathode, a control grid and 30 an anode, an input circuit at said detector including said control grid and cathode, an output circuit for said detector including said anode and said cathode, means for shielding said control grid from said anode whereby regeneration is 35 prevented, and means for applying to the control grid of said amplifier a potential developed by current flowing in said input circuit.

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