

April 11, 1939.

M. L. LEVY

2,154,311

WAVE SIGNALING SYSTEM

Filed June 5, 1936

2 Sheets-Sheet 1

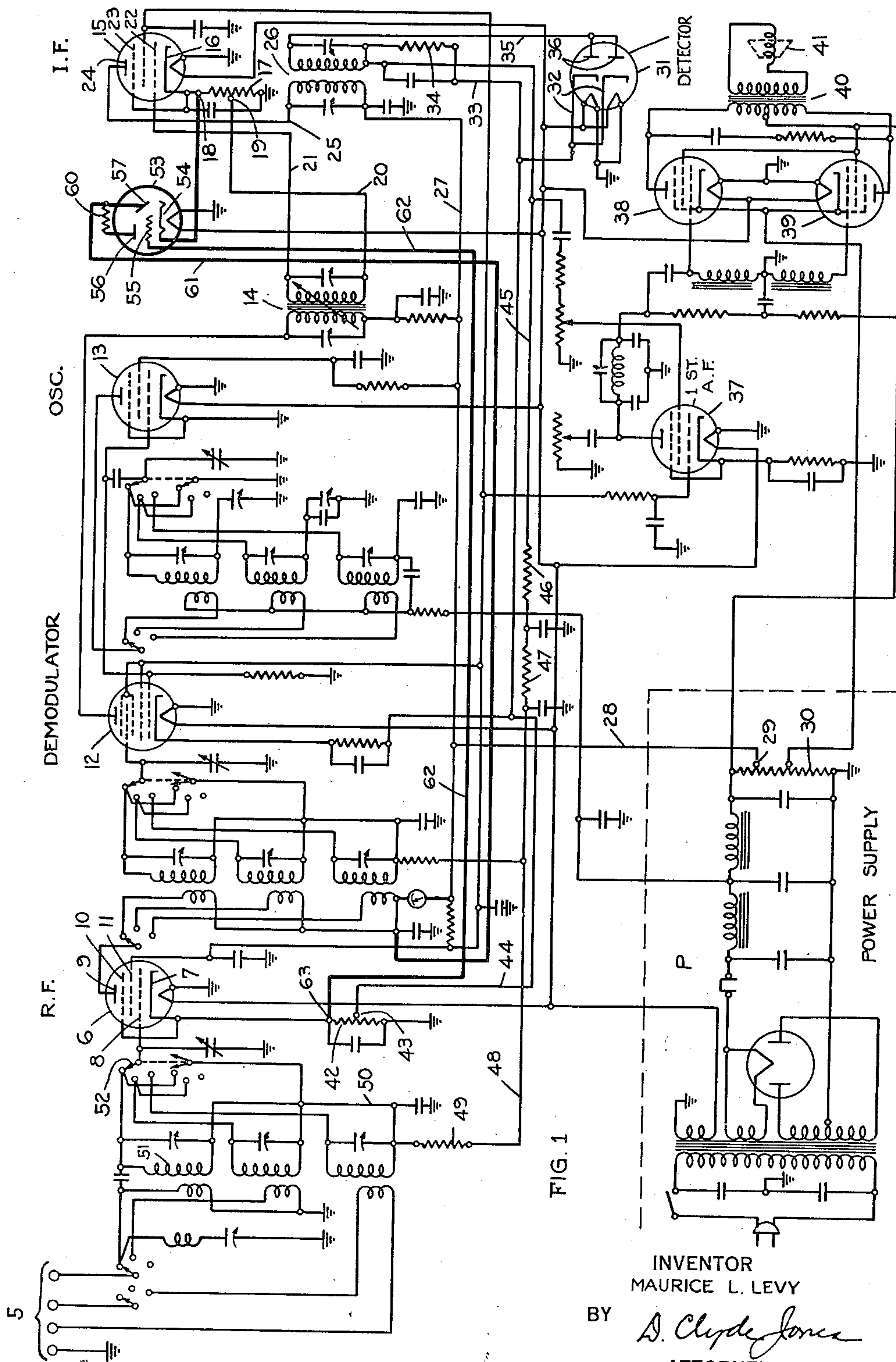


FIG. 1

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2 Sheets-Sheet 2

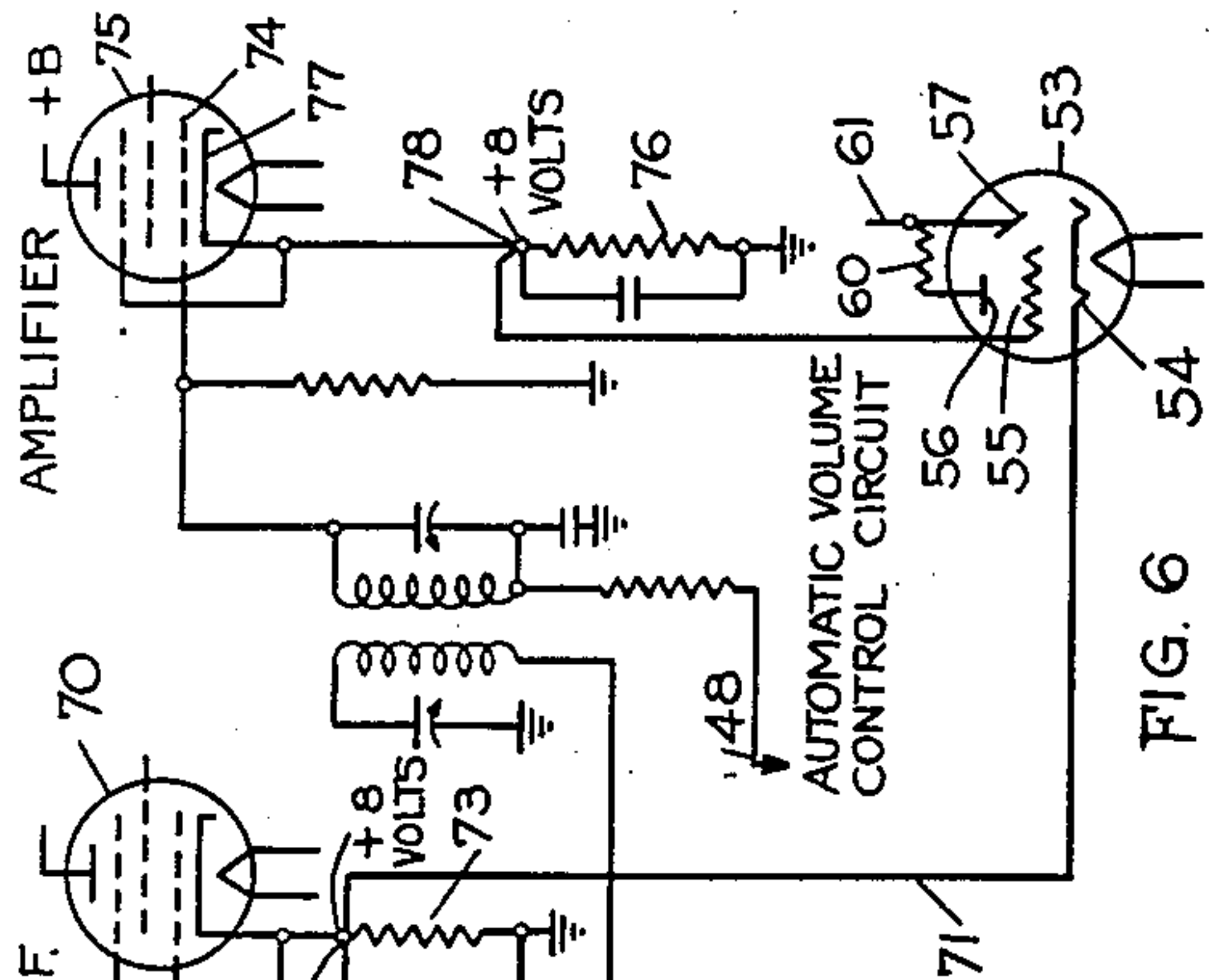


FIG. 6

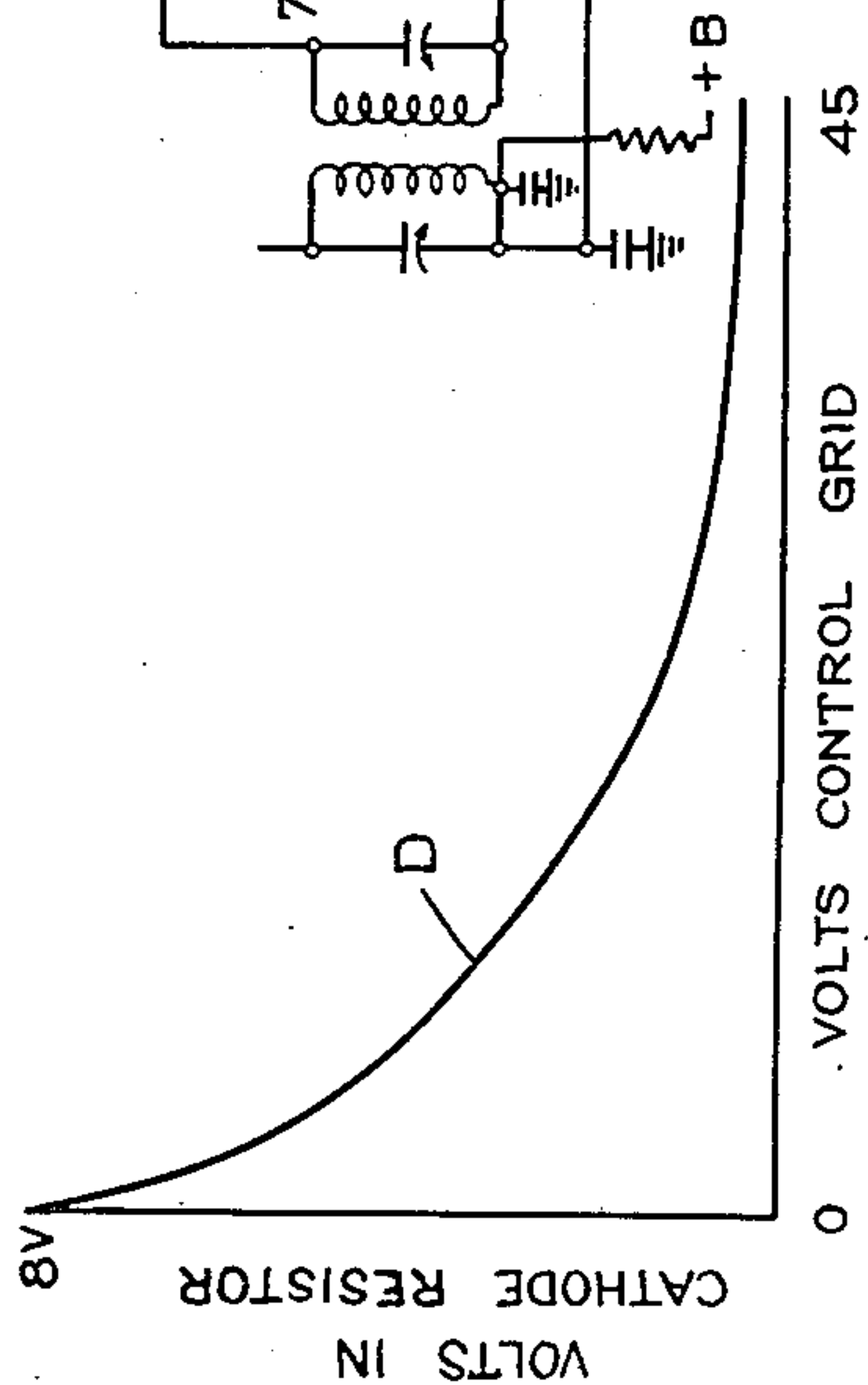


FIG. 4

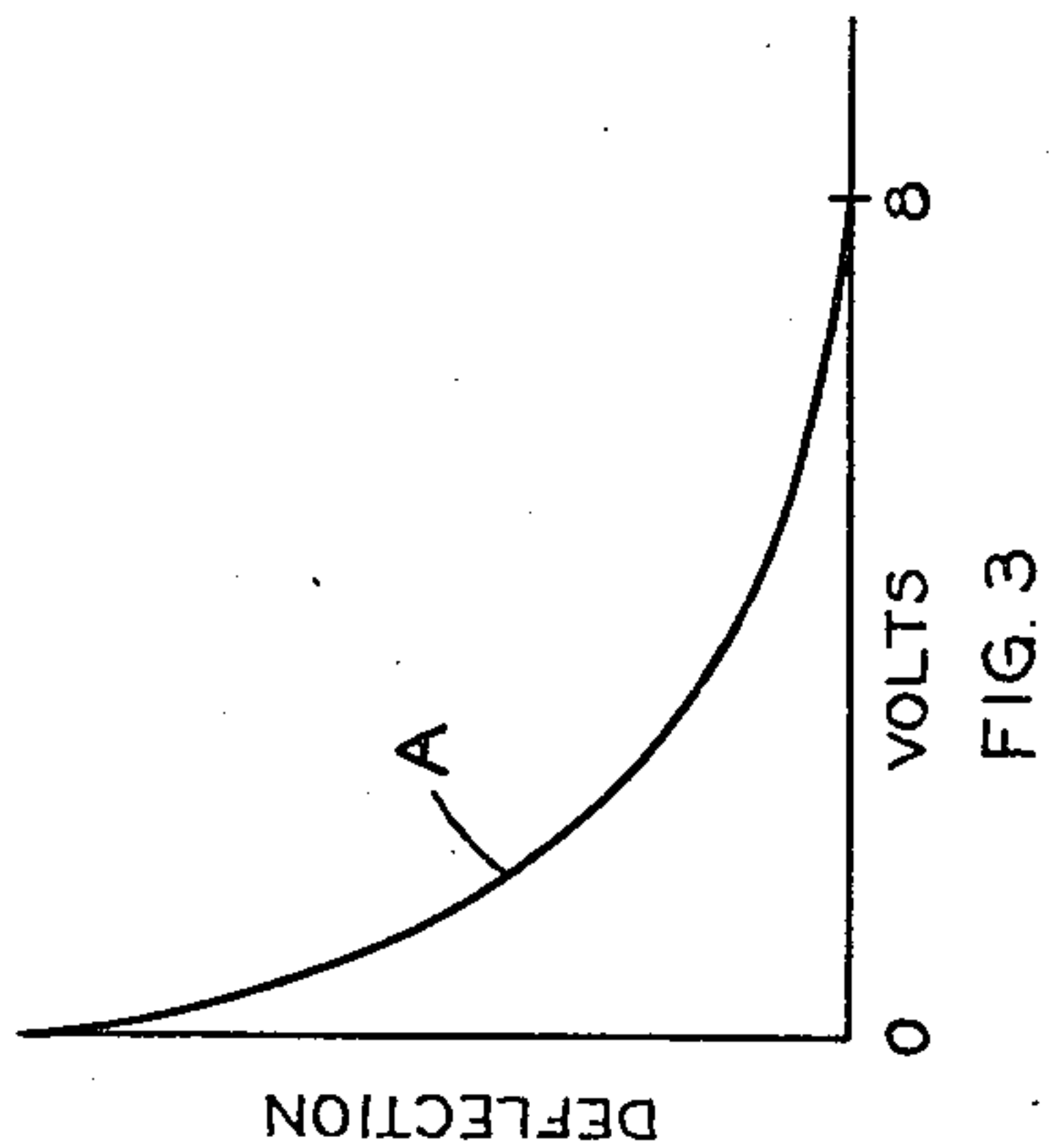


FIG. 3

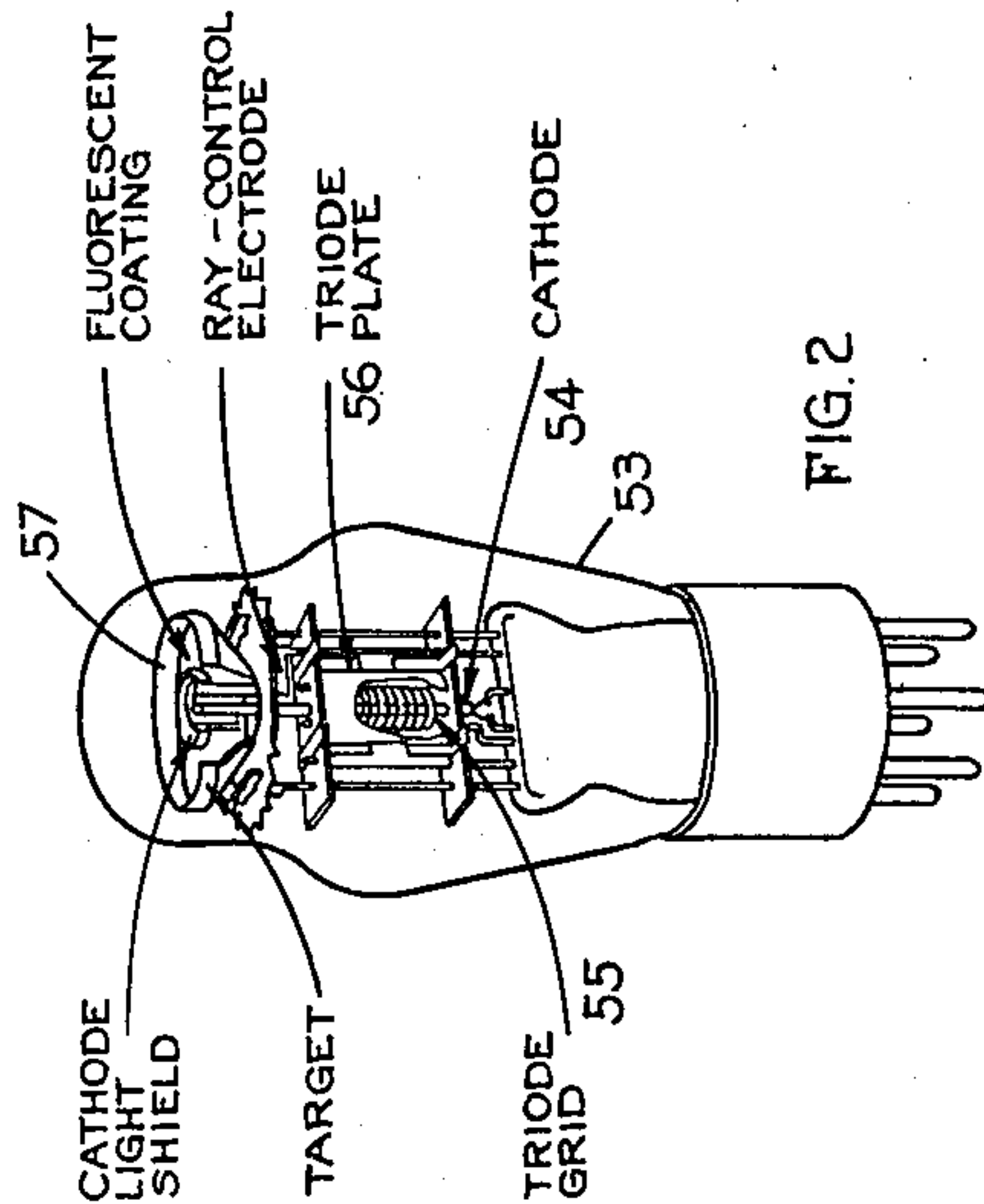


FIG. 2

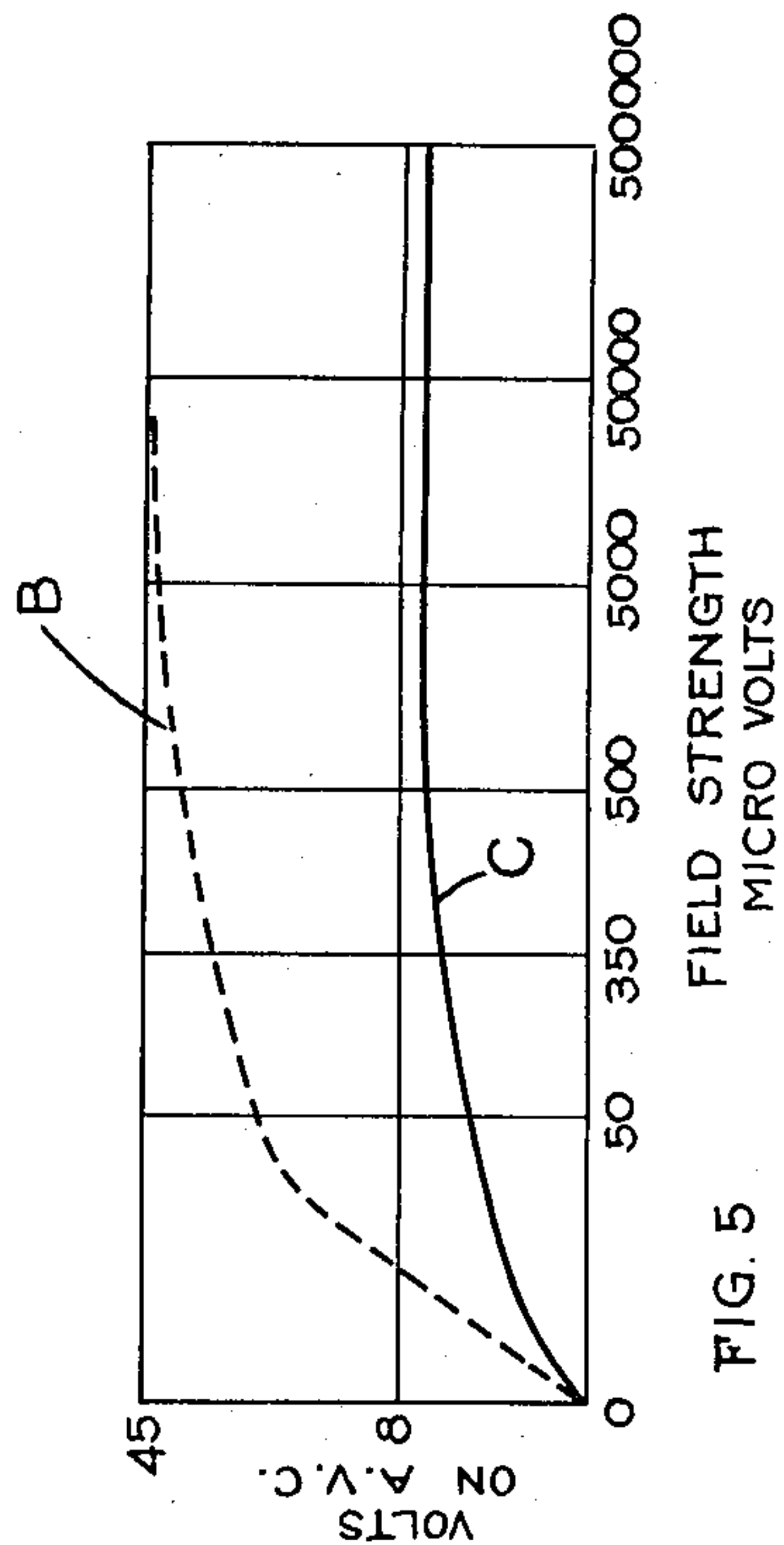


FIG. 5

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WAVE SIGNALING SYSTEM

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6 Claims. (Cl. 250—40)

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

At the present time an electron ray tube indicator employing a fluorescent target is employed to indicate accurate tuning of a radio receiver to the desired broadcast signal. Such an electron ray tube when employed for this purpose in a radio receiver is governed by the automatic volume control voltage derived from the carrier current which voltage is applied to the control grid or grids in the vacuum tube or tubes of one or more amplifier stages in the radio receiver. The present type of electron ray tube has such characteristics that when a voltage in excess of minus eight volts is applied to the control grid thereof, the entire area of its target becomes fluorescent and therefore it fails to afford any tuning indication. In radio receivers commonly in use, the automatic volume control voltage applied to the control grid or grids of certain amplifier tubes, varies from zero to approximately forty volts depending on the strength of the carrier current. Since as mentioned, the entire area of the target of the electron ray tube becomes fluorescent when eight volts negative are applied to its control grid, the total automatic volume control voltage cannot be used, instead only about one-fifth thereof can be utilized. However, in order that the electron ray tube will give a satisfactory visual indication by the fluorescing of distinguishable areas of its target, substantial voltages must be applied to its control grid and yet these voltages must not be in excess of eight volts since otherwise the entire area of the target will fluoresce and no visual indication of the tuning will be given. While the automatic volume control voltages can be divided so that the voltages applied to the control grid of the electron ray tube, instead of ranging from zero to minus forty volts will range from zero to eight volts, the sensitivity or visual indication afforded by the tube will be sacrificed by a ratio of five to one.

In accordance with the present invention, a novel circuit arrangement is provided in which the automatic volume control voltage applied to the control grid of the electron ray tube varies between zero and eight volts negative and yet the sensitivity or visual indication afforded by the tube is not decreased.

For a clearer understanding of the invention and its various features and advantages, reference is made to the drawings, in which Fig. 1 is a diagrammatic showing of a radio receiver having the present invention incorporated therein;

Fig. 2 is a perspective view partially broken away of an electron ray tube suitable for use in the circuit of Fig. 1; Figs. 3, 4 and 5 are charts useful in explaining the present invention, and Fig. 6 is a fragmentary showing of the modified circuit arrangement including the present invention. 5

Referring especially to Fig. 1, the numeral 5 generally designates the terminals of the radio receiver which are connected to ground and to a suitable antenna system (not shown). This radio receiver is herein illustrated as being of the superheterodyne type, although it will be understood that the invention is equally adaptable to radio receivers of other types including the tuned radio frequency type. The present receiver is also illustrated as being of the multi-band type although the invention is not limited to this type of receiver. The ground and antenna system are connected to the input circuit of a tuned radio frequency stage including the vacuum tube 6, which includes a cathode 7, a control grid 8 and a plate or anode 9. This tube is also provided with a suppressor grid 10 and with a screen electrode 11 which function in the well-known manner. The output of the radio frequency tube is coupled by means of a multi-winding transformer to the tuned input circuit of a demodulator including the vacuum tube 12. This demodulator functions with an oscillator including the vacuum tube 13 to translate the radio frequency of the incoming signal, which has been amplified by the vacuum tube 9, into a predetermined intermediate frequency. This intermediate frequency signal is introduced by a transformer 14 for further amplification, into an intermediate frequency stage including the vacuum tube 15. The cathode 16 of this tube is connected through a resistor 17 to ground so that its terminal 18 has a plus voltage of eight volts. The input circuit of this intermediate frequency tube extends from ground, the lower portion of the resistor 17 as far as the terminal 19, conductor 20, secondary winding of the transformer 14, conductor 21, to the control grid 22 of the intermediate frequency tube. It will be understood that the drop in potential across the upper portion of the resistor 17 between 18 and 19 affords the negative bias applied to the control grid 22 for the proper operation of the intermediate frequency stage. The output circuit of the intermediate frequency stage extends from the anode 24 of the vacuum tube 15, conductor 25, primary winding of the transformer 26, conductors 27 and 28 to the terminal 29 of the power 55

supply unit P, resistor 30 to ground. This output circuit is coupled by the transformer 26 to a second demodulator or detector which includes a vacuum tube 31 of the diode type. The circuit of this detector is traceable from the cathodes 32 which are connected in multiple, conductor 33, resistor 34, secondary winding of the transformer 26, conductor 35 to the anodes 36 of the diode which are also connected in multiple. The diode circuit is resistance coupled to an audio driver stage including the vacuum tube 37, the output of which is coupled to a push-pull audio amplifier including the vacuum tubes 38 and 39. The output of this last-mentioned amplifier is linked by means of the audio transformer 40 to a loud speaker 41.

In order to control automatically the volume of the reproduced signal, an automatic volume control circuit is provided whereby voltage derived from a rectified component of the carrier wave of the received signal is applied to the control grid of the radio frequency tube 6. This automatic volume control circuit is traceable from ground, through the lower portion of the resistor 42 to terminal 43 thereof, which may be connected to this resistor at a point thereon having a plus voltage of three volts, conductors 44 and 33, resistor 34, conductor 45, resistors 46 and 47 of an alternating ripple filter, conductor 48, resistor 49, conductor 50, transformer winding 51 through the blade 52 of the multi-stage switch, to the control grid 8 of the radio frequency amplifier tube 6. It will be noted that the resistor 34 in the automatic volume control circuit is also common to the circuit of the second demodulator stage so that rectified current flowing in this resistor develops a difference in potential across its terminals which potential difference is applied to the control grid 8 as a negative voltage varying in accordance with the strength of the incoming signal. This automatic volume control circuit functions in the well-known manner to maintain reproduced signals at substantially a uniform desired volume.

In order to provide a visual indication of the correctness of the tuning of the radio receiver to any desired broadcasting station, an electron ray tube indicator 53 is provided. This tube is of the high vacuum, heater-cathode type including the cathode 54, a control grid 55 and an anode 56 enclosed in the tube envelope, to function as a triode amplifier. This tube also includes within its envelope, an annular target 57 having its exposed surface coated with material which fluoresces when bombarded by electrons from the cathode 54. The target and anode 56 of this tube are in effect, resistance-coupled through the resistor 60 and are connected to the high voltage terminal of the B power supply by the conductor 61. The cathode 54 of the electron ray tube is connected to the terminal 18 which is also common to the cathode 16 of the intermediate frequency tube 15. This terminal 18, it will be recalled is uniformly at a voltage of plus eight volts so that the drop between the cathode 54 and the control grid 55 applies an effective negative voltage of eight volts to this control grid. The control grid 55 of the electron ray tube is connected by conductor 62, terminal 63 of the resistor 42, to ground. The terminal 63 is normally at a plus voltage of eight volts. This last-mentioned circuit thus applies a positive voltage of eight volts to the control grid 55 and the drop across the resistor 17 in the circuit of the cathode 54 applies a uniform negative voltage of eight

volts to this control grid so that the resultant voltage on the control grid is zero. However, when an incoming signal is amplified in the radio frequency amplifier, a varying plate current will flow through the resistor 42 so that the resultant voltage on the control grid 55 will vary exponentially from zero to the maximum negative bias of eight volts. In response to the varying resultant negative voltage applied to the control grid 55, a varying area of the target 57 in the electron-ray tube, will fluoresce.

Commercial electron ray tubes that are now available have a characteristic represented by the curve A to Fig. 3 in which voltage on the control grid of the electron tube is plotted against deflection or variable fluorescent area of its target. In other words, in response to eight volts applied to its control grid, the entire annular area of the target 57 will fluoresce so that any increase of negative voltage on the control grid can effect no further deflection. In prior radio receivers, the automatic volume control voltage varied between zero and forty-five volts as indicated by the dotted curve B in Fig. 5. However, in the present arrangement, the exponentially varying voltage, applied to the control grid of the electron ray tube, is represented by the curve C (Fig. 5) and by the curve D (Fig. 4) from which it will be noted that this voltage never exceeds eight volts even on the signals of maximum field strength introduced into the radio receiver.

The modified form of the invention shown in Fig. 6 differs from that illustrated in Fig. 1 in that the negative bias for the control grid 55 of the electron ray tube 53 is derived from the cathode circuit of an intermediate frequency amplifying tube 70 of the radio receiver and a separate amplifier connected to the automatic volume control circuit 43 effects the application of the varying positive voltage to the control grid 55. Specifically the negative bias for the control grid 55 is derived by connecting the cathode 54 of the electron ray tube 53 over conductor 71 to a terminal 72 in the cathode circuit of the intermediate frequency amplifier 70. This cathode circuit includes a resistor 73 so proportioned that the terminal 72 is uniformly at a voltage of plus eight volts. Thus the cathode 54 of the electron ray tube has a voltage of plus eight which in effect applies a negative bias of eight volts to the control grid 55. The automatic volume control circuit 43 which may be connected into the radio receiver in the same manner as indicated in Fig. 1, is connected to the control grid 74 of a vacuum tube amplifier 75. The output circuit of this amplifier includes the resistor 76 and the cathode 77 of the amplifier. The resistor 76 in this circuit is so proportioned that its terminal 78 has a maximum positive voltage of eight volts thereon, but this voltage varies as the exponentially varying current flowing through the resistor 76 in the output circuit. Since the control grid 55 is connected to the terminal 78 it will be at a positive voltage which varies between zero and a maximum of eight volts depending on the value of the current in the mentioned output circuit.

The present disclosure is given merely as an example and is not to be construed in a limiting sense since there can be many modifications and variations thereof within the scope of the appended claims without departing from the spirit of the invention.

What I claim is:

1. The method of operating an electron ray tube to indicate the tuning of a radio receiver to a

incoming signal, said tube having a fluorescent screen which is variably illuminated by the impingement of electrons thereon and having an electron emitting source and a control grid to vary the flow of electrons from said source to said screen which method comprises applying a uniform voltage of one sign to said grid, applying to said grid a voltage of opposite sign, and varying said last-mentioned voltage exponentially in accordance with an incoming signal, between zero and a value substantially equal to the value of said first-mentioned voltage.

2. The method of operating an electron ray tube to indicate the tuning of a radio receiver to an incoming signal, said tube having a fluorescent screen which is variably illuminated by the impingement of electrons thereon and having an electron emitting source and a control grid to vary the flow of electrons from said source to said screen which method comprises applying a uniform negative voltage to said grid, applying to said grid a positive voltage, and varying the positive voltage exponentially in accordance with the incoming signal between zero and a value substantially equal to the value of the negative voltage.

3. The method of operating an electron ray tube to indicate the tuning of a radio receiver to an incoming signal, said tube having a fluorescent screen which is variably illuminated by the impingement of electrons thereon and having an electron emitting source and a control grid to vary the flow of electrons from said source to said screen, which method comprises applying a uniform voltage of one sign to said grid, and applying to said grid a voltage of opposite sign and variable exponentially in response to an incoming signal between zero and a value substantially equal to the value of said first-mentioned voltage.

4. The method of operating an electron ray tube to indicate the tuning of a radio receiver to an incoming signal, said tube having a fluorescent screen which is variably illuminated by the impingement of electrons thereon and having an electron emitting source and a control grid to

vary the flow of electrons from said source to said screen which method comprises applying a uniform negative voltage to said grid, applying to said grid a positive voltage of opposite sign and variable exponentially in response to an incoming signal, between zero and a value substantially equal to the value of said negative voltage.

5. In a radio receiver, an amplifier for amplifying an incoming signal at frequencies above audibility, said amplifier including a vacuum tube having a control electrode, an anode and a cathode, an output circuit for said amplifier including said cathode and said anode, means for demodulating an amplified signal and for rectifying a component of said signal, means for applying to said control electrode a negative voltage which varies as a function of said rectified component, an electron ray tube including a fluorescent screen, a control grid and a cathode, means for energizing said last-mentioned cathode, means for applying to said last-mentioned control grid a negative voltage of a predetermined value, and means for also applying to said last-mentioned control grid, a positive voltage which varies as a function of an exponentially varying current flowing in said output circuit, said positive voltage having a maximum value equal to said negative voltage.

6. The method of indicating the tuning of a radio receiver to an incoming signal, said radio receiver including an amplifier serving to amplify signals above audible frequency and having an input circuit and an output circuit, said radio receiver being also provided with an electron ray tube equipped with a fluorescent screen, an electron-emitting source and a control grid for controlling the flow of electrons from said source to said screen, which method comprises applying a negative voltage of a given value to said control grid and also applying to said control grid a positive potential which varies as the exponentially varying current in said output circuit, said positive voltage having a maximum value equal to said negative voltage.

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