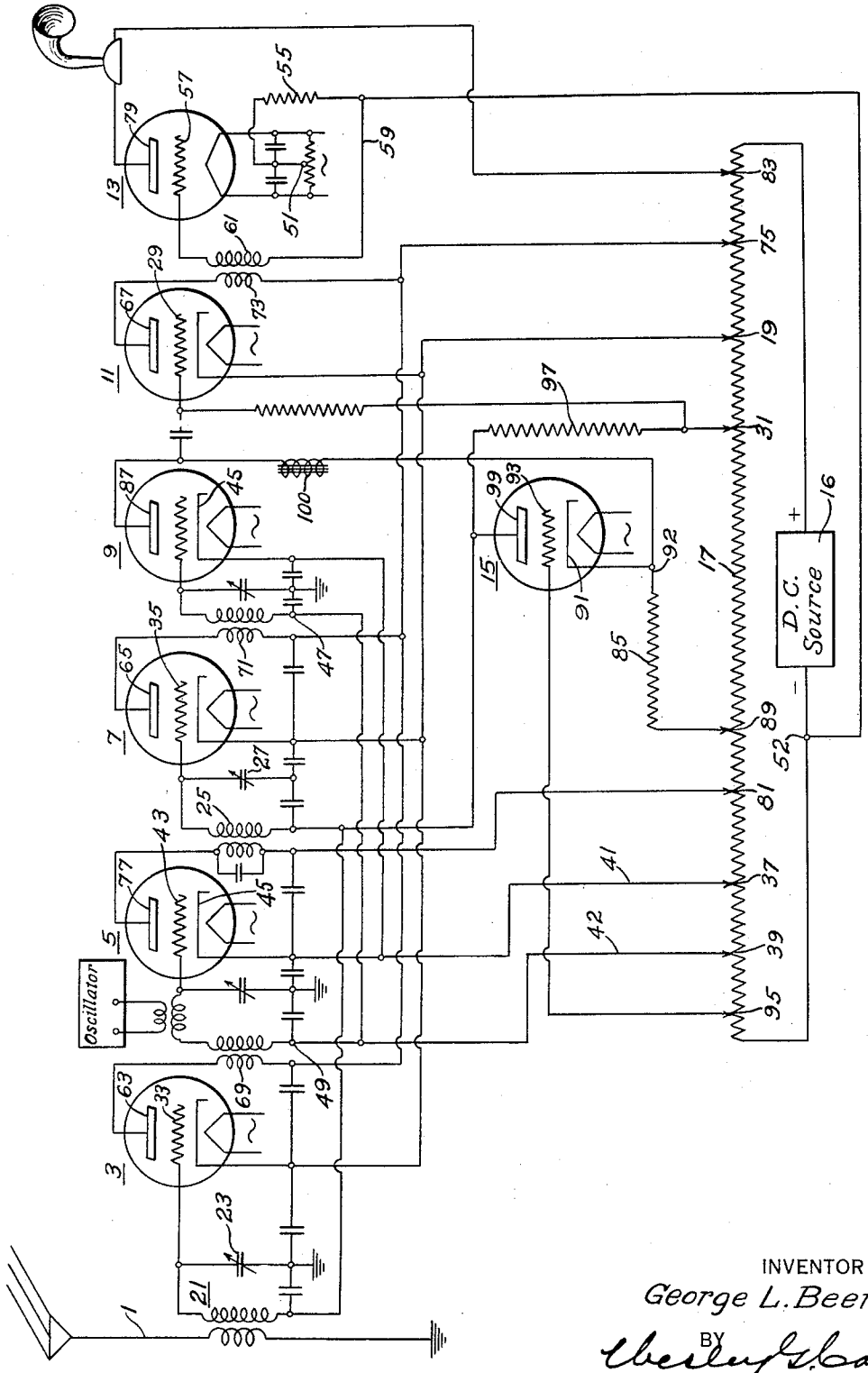
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AMPLIFYING SYSTEM

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AMPLIFYING SYSTEM

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1 Claim. (Cl. 250—20)

My invention relates to amplifying systems and, more particularly, to volume-control devices therefor.

In my prior application, Serial No. 212,791, filed August 13, 1927, and assigned to the Westinghouse Electric and Manufacturing Company, I have disclosed means for automatically maintaining substantially uniform volume-control in a radio-receiving circuit. All the species described therein relate to generic means for accomplishing the desired result, the particular method comprising impressing the variable grid potentials of any one of a number of tubes in the circuit upon the grid of a control tube and, subsequently, causing a corresponding variation in the potential drop across a resistor in the plate circuit of the control tube to be impressed, in reverse phase, upon the grids of certain of the tubes, to affect the grid bias thereon in a desired manner.

In the preferred embodiment, the grid of the control tube is operated from the grid of the detector. This particular system works to advantage with a power detector tube of the type 224 or 227 in the circuit, as the grid swing on those tubes is sufficient to operate the control tube directly, tubes of the above types being powerful enough to produce an efficient loud-speaker output with a single stage of audio amplification.

It is an object of this invention to provide an amplifying system having automatic volume control and being capable of operating with tubes of the common types.

A more specific object of my invention is to provide an amplifying system wherein a volume-control tube may be controlled by a weak signal.

Other objects of my invention will be pointed out in the following description taken in conjunction with the drawing, the single figure of which illustrates my invention as embodied in a radio circuit of the superheterodyne type.

The system, as disclosed, comprises an antenna circuit 1, a radio-frequency amplifier 3, first detector stage 5, an intermediate-frequency amplifier 7, a second detector stage 9, two stages of audio frequency 11 and 13 and a control tube 15. A source of direct-current potential 16 is provided, across a voltage divider 17, to supply the necessary potentials to the various elements of the system, said source comprising any of the well-known means of obtaining a direct-current voltage, e. g., a battery, a direct-current generator, a rectifier and filter circuits or the like.

All the tubes, except the second audio-frequency amplifier 13, are illustrated as of the alternating-current heater type, but it is apparent that tubes of other types may be employed.

The cathodes of the radio-frequency, the intermediate-frequency and the first-audio stages are connected to a point 19 on the voltage divider 17. The input circuits, comprising the inductor 21 and capacity 23 and the inductor 25 and capacity 27 of the radio-frequency and intermediate-frequency stages, respectively, and the grid 29 of the first audio stage are similarly connected to another point 31 on the voltage divider. The portion of the divider between the points 19 and 31, therefore, provides a fixed grid bias on the grids 33, 35 and 29 of the tubes referred to above.

In like manner, that portion of the voltage divider between the points 37 and 39 provides grid-biasing potential for the first and second detector stages, for it will be seen that connections from both points can be traced, by means of conductors 41 and 42, to the cathodes 43 and 45 and the low potential sides 47 and 49, respectively, of the input circuits of both of said tubes.

The second stage of audio-frequency amplification comprises a three-element tube, the midpoint 51 of the filament circuit being connected to the low potential end 52 of the voltage divider, through a resistor 55 which provides grid-bias potential on the grid 57 of the tube by means of the conductor 59 connecting the lower end of the input circuit 61 to the negative end of the aforementioned resistor 55.

Plate potential for the various tubes is also supplied from the voltage divider. The anodes 63, 65 and 67 of the radio-frequency, intermediate-frequency and first audio stages are connected, through their respective output circuits 69, 71 and 73, to the point 75 of the voltage divider. The anodes 77 and 79 of the first detector tube and the second audio are connected to points 81 and 83, respectively, on the voltage divider.

As regards the second detector tube, it is shown coupled to the first audio stage by means of the choke coil 100 and the resistance coupling 85, the circuit being traced from the anode 87, through the choke coil and the resistance element, to the point 89 on the voltage divider, the cathode 91 of the control tube making connection to this circuit at the high-potential end 92 of the resistor element 85.

To create a bias potential on the grid of the control tube, a connection is made from the grid 93 to a point 95 near the negative end of the potential source. This contact is adapted to be

shifted, whereby it is possible to alter the volume level of the circuits to any desired value.

A resistor 97 in the common lead from the voltage divider at point 31 to the grid circuits of the RF and IF stages is electrically connected to the plate 99 of the control tube. It will be noted that this resistor comprises the plate circuit of the control tube, as well as constituting a portion of the grid circuits of the RF and IF stages. Therefore, any variation in the potential drop across said resistor will react upon the grids 33 and 35 of the tubes in the above circuits. The resistance of resistor 97 should be several times as great as that of resistor 85, since, otherwise, the plate current of the control tube flowing through resistor 85 would nullify the effect of the plate current of the second detector flowing through this same resistor. Approximate values of the above resistors may be set at 20,000 ohms for the value of resistor 85 and 200,000 ohms for resistor 97. The manner in which this particular effect is made use of in fulfilling the objects of my invention will be pointed out in the description of the operation of the above-described system.

I will assume that the proper volume level has been secured by adjustment of the contact 95. Thereafter, if the incoming signal tends to increase in strength, the current in the plate circuit of the second detector will tend to increase, causing a tendency of the voltage drop across the coupling resistor 85 to become greater. This, in turn, will vary the grid bias of the control tube to make it less negative, with a resultant increase of current in the plate circuit. This increase in current in the plate circuit of the control tube results in an increase in potential across the resistor 97 which, located as it is, in the grid circuits of the radio-frequency and intermediate-frequency amplifiers, will increase the negative bias in the grids of those tubes, thereby forestalling the tendency of the incoming signal being amplified above the volume level for which it was set.

Should the signal strength decrease, the effects on the system will be the reverse of what they are when the signal strength increases. The energy factor of the circuits will be increased to compensate for the deficiency in signal energy and, in this manner, maintain a substantially uniform volume level in the output of the system.

The effect on the input circuits of the amplifiers, therefore, may be considered as being equivalent, but in reverse phase relationship, to the apparent changes in the output circuit of the amplifier associated with the control tube.

By connecting the input electrodes of the control tubes across the resistance coupling of the detector tube, the control tube is adapted to be actuated by incoming weak signals, as well as by the strong signals, for the amplified potentials across the coupling are sufficiently large to work the control tube.

Transformer coupling might be used, in lieu of the inductive and resistance coupling illustrated, with equally efficient results. The inductance 100 might, likewise, be eliminated and only the resistance coupling used.

Therefore, while I have described my invention in great detail, I do not desire to be limited to such details except insofar as is necessitated by the prior art and by the spirit of the appended claim.

I claim as my invention:

In an amplifying system, an amplifier and a detector device each having an input and output circuit, and means for controlling the volume level of said system, said means comprising an electric discharge device having an input and an output circuit, said input circuit including a cathode circuit, an impedance common to said cathode circuit and the output circuit of said detector device, and an impedance common to the output circuit of said electric discharge device and the input circuit of said amplifier, said second mentioned impedance being materially greater in value than said first-mentioned impedance.

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