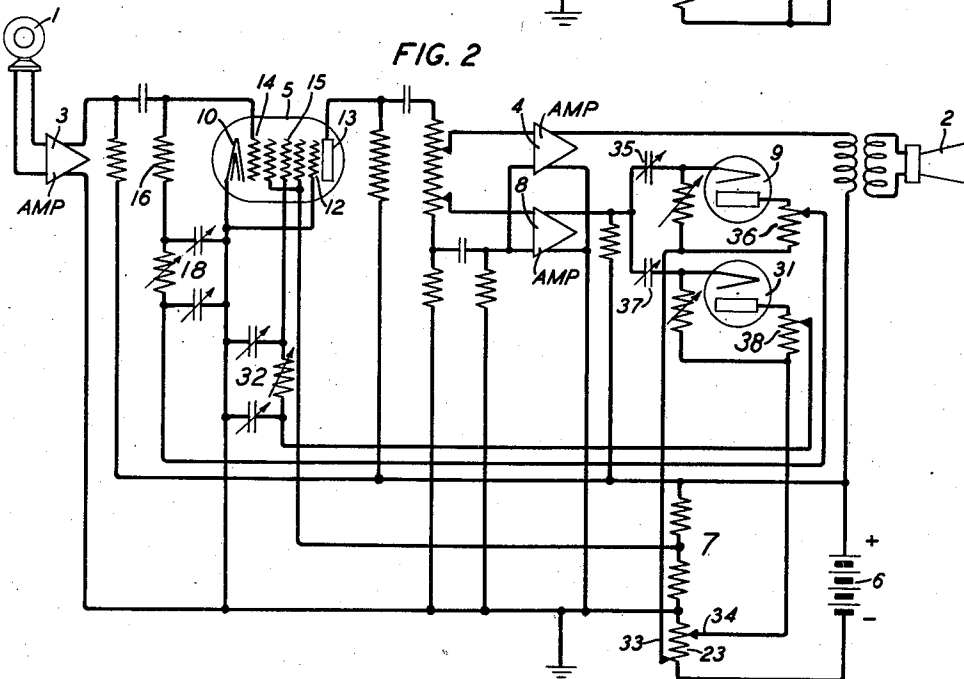
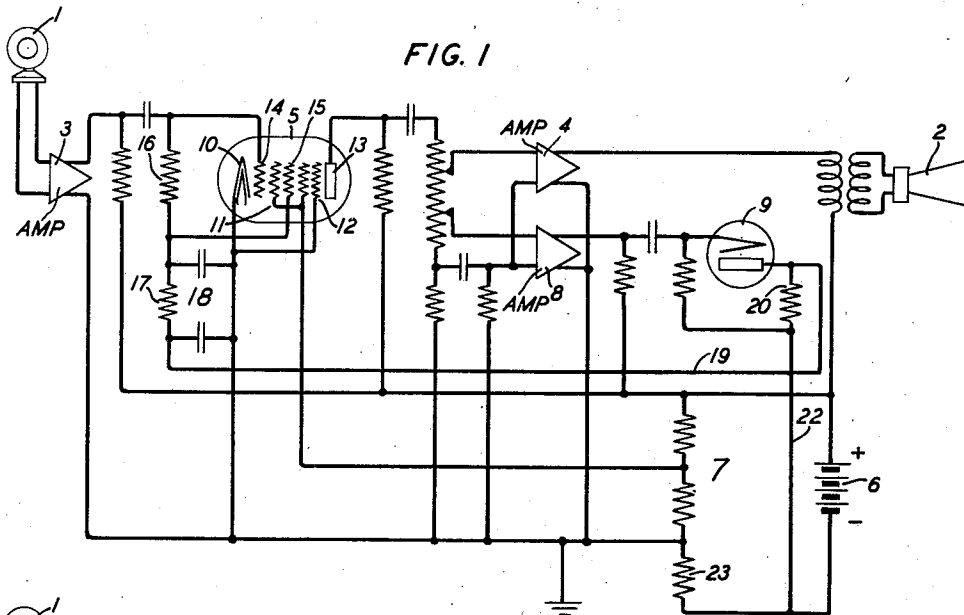


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N. C. NORMAN
GAIN CONTROL SYSTEM

2,199,080

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2,199,080

GAIN CONTROL SYSTEM

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3 Claims. (Cl. 179-171)

This invention relates to amplifying systems in which the gain is varied automatically to keep the output of the system within predetermined limits.

5 Since the volume range capacity of amplifying, recording and reproducing systems is often more limited than the volume range of the original sounds it is frequently necessary or advantageous to compress the range of amplitudes of the currents representing the sounds to a range 10 which the system can transmit without distortion. One such compression system is shown in Patent 1,922,602 granted to me, August 15, 1933.

In some systems, particularly those of high 15 power capacity, it is also desirable to provide some means for limiting the maximum strength of signal which can be transmitted to some predetermined value. It has been proposed heretofore to accomplish this in various ways such, 20 for example as by a device which decreases in impedance with increasing applied potential, connected in shunt to the line to be protected. A volume limiter of this type is shown in Patent 2,059,194 granted to D. T. Bell, November 3, 25 1936.

The object of this invention is to compress the volume range of the signal and limit its maximum value by means of a relatively simple, inexpensive and stable circuit.

30 According to the invention a portion of the output of an amplifier is rectified and fed back as a negative bias to a tube having two control grids of different grid bias-transconductance characteristics. One of the grids preferably has 35 the remote cut-off characteristic of the variable-mu pentode type tubes and the other has a sharp cut-off characteristic. With the proper bias voltages applied simultaneously to the two grids the former effects compression of the signal and the latter becomes effective for signals of high 40 amplitude to limit the output to the desired maximum value.

The invention will be more clearly understood from the following detailed description and the 45 drawing in which:

Fig. 1 is an amplifying system having the volume compression and overload limiting features of the invention; and

50 Fig. 2 is a modified circuit in which the biases on the two control grids are independently variable.

In the system shown in Fig. 1, the microphone 1 or other source of signal currents is connected to the loud-speaker 2 or other receiving device 55 through the conventional amplifiers 3 and 4

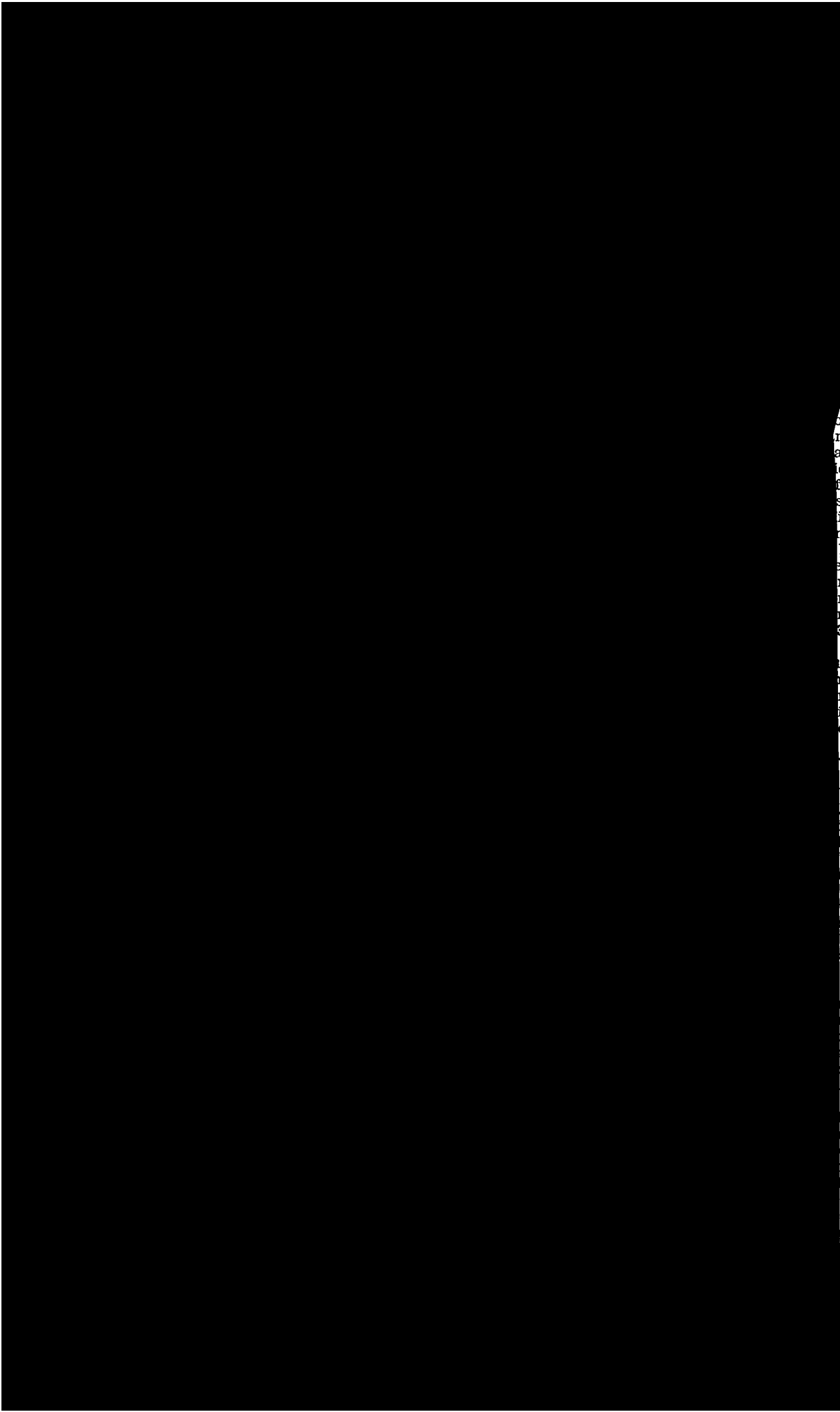
of suitable gain and the volume range controlling stage 5, all of which are interconnected by resistance capacity coupling of the well-known type.

The battery 6 or other power source supplies 5 potential to the voltage dividing network 7 from which the various operating potentials required for amplifiers are obtained in the usual way. An amplifier 8 supplies power from the output of the tube 5 to the rectifier 9 from which are 10 derived the bias voltages for controlling the gain of the tube 5 as explained more fully below.

The tube 5 is a pentagrid mixer amplifier known as the 6L7 tube which comprises, in addition to a cathode 10, a screen grid 11, a suppressor grid 12 and a plate 13, two grids 14 and 15 which 15 control the grid-plate transconductance in different ways. The grid 14 serves as the signal grid and has the remote cut-off characteristic of the variable-mu pentode tubes while grid 15 20 controls the transconductance in such a way that the gain of the tube in volts is a linear function of the bias on this grid in volts.

With the tube working into a 100,000 ohm load resistance and a grid bias applied simultaneously 25 to grids 14 and 15, it was found that in the region of low transconductance the gain variation with change in bias was approximately hyperbolic which indicated that linear volume compression of the desired ratio mentioned below 30 could be obtained with a backward-acting control circuit of the type shown in Patent 1,922,602 referred to above. It was also found that in the region of cut-off due to grid 15 the decrease in transconductance with increasing negative bias, both expressed in decibels, becomes 35 increasingly rapid. This phenomenon suggested that overload limiting at a desired level could be obtained simultaneously with volume compression by applying a bias to grid 15 such that 40 the tube operates on the proper point of the grid bias-transconductance characteristic.

In backward-acting compressors of the type under discussion, singing around the feedback path and excessive modulation of the signal by 45 the control voltage is avoided by making the loss through the signal transmission path high for the relatively low frequency control circuit currents. The necessity for elaborate high pass filters in the signal path is avoided by keeping 50 the gain around the feedback path as low as is consistent with obtaining sufficient control voltage without overloading the variable gain stage. Since these considerations limit both the amplification and the operating level of the tube 5 it 55



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