

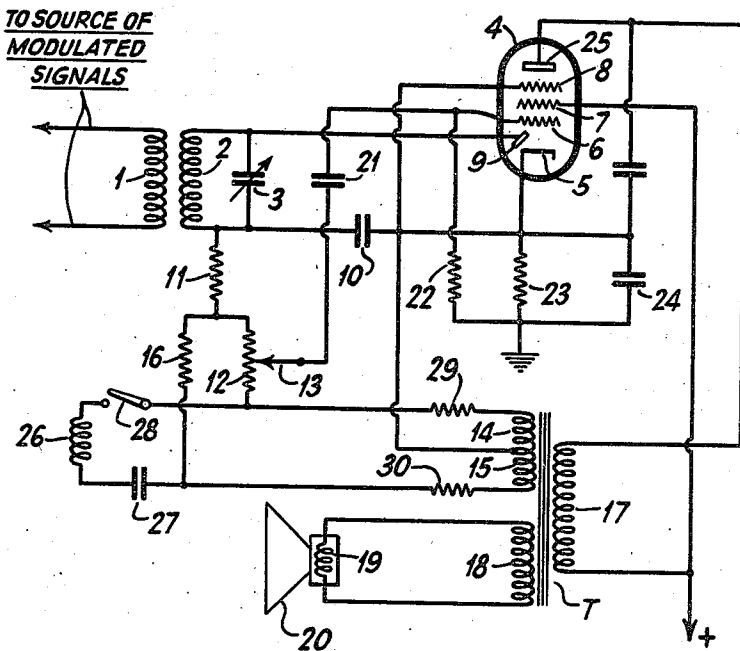
March 2, 1943.

H. A. BROOS

2,312,748

VOLUME CONTROL CIRCUIT

Filed June 22, 1939



BY

INVENTOR.
HENRICUS A. BROOS

ATTORNEY.

H.S. Snow

UNITED STATES PATENT OFFICE

2,312,748

VOLUME CONTROL CIRCUIT

Henricus Adrianus Broos, Eindhoven, Netherlands, assignor, by mesne assignments, to Radio Corporation of America, New York, N. Y., a corporation of Delaware

Application June 22, 1939, Serial No. 280,507
In the Netherlands October 26, 1938

2 Claims. (Cl. 250—27)

My present invention relates to amplifiers with so-called negative feed-back, and it consists in that the control of the amplification is automatically accompanied by a control in the inverse sense of the negative feedback.

Thus, one obtains the desired state in which with small signals the sensitiveness of the amplifier is not reduced by negative feedback, while in the case of strong signals the negative feedback enters into operation and improves the timbre of the sound.

According to the invention, use may be made for this purpose of a voltage divider from which the voltage to be amplified is taken and which, in addition, is traversed by a current which is withdrawn from the output circuit, the arrangement being such that the voltage maximum of the signal to be amplified coincides with the voltage minimum which is fed back.

According to the invention, in order to insure that in the case of the maximum amplification the negative feedback is completely switched out, the voltage divider is preferably connected in one of the branches of a Wheatstone bridge, the negative feed-back voltage being applied between the ends of one diagonal while in the case of the minimum amplification the control grid and the cathode of the back-coupled tube are connected to the ends respectively of the other diagonal. This arrangement offers the further advantage that by connecting a tone filter in the first-mentioned diagonal, tone correction is obtained which depends on the position of the volume control device.

The invention will be more clearly understood by referring to the accompanying drawing which represents, by way of example one embodiment of the invention applied to the final stage of a radio receiver.

The modulated high, or intermediate, frequency oscillations are transmitted by a coil 1 to an input circuit 2, 3 of a diode-pentode tube 4, which input circuit is tuned to the frequency of these oscillations. This tube comprises a cathode 5, three grids 6, 7 and 8, an auxiliary anode 9 and a principal anode 25. The upper end of the circuit 2, 3 is directly connected to the auxiliary anode 9, the lower end being connected through a small condenser 10 to the cathode 5, and through a resistance 11 to one of the diagonal points of a bridge-connection in the four branches of which are located a resistance 12, windings 14 and 15 and a resistance 16. The windings 14 and 15 are located on the same core of transformer T as a primary winding 17, which con-

stitutes the output impedance of the tube 4, and as a secondary winding 18 which supplies the coil 19 of a dynamic loudspeaker 20.

The resistance 12 is formed as a voltage divider having a slide-contact 13 which is connected through a blocking condenser 21 to the control grid 6 of the tube 4. This grid is connected to earth through a leakage resistance 22, while the cathode is earthed through a resistance 23 and a large condenser 24 connected in parallel therewith. The voltage drop across the resistance 23 is used in well known manner as the negative bias voltage of the grid 6.

The modulated oscillations coming in at 1 are detected by the diode 9—5, the low frequency component taking its way through the resistance 11 and the bridge-connection, 12, 14, 16, 15 to the cathode 5, a variable proportion of the loss of voltage thus produced in 12 being applied, by means of the slide-contact 13, through the condenser 21 to the control grid 6. The tube 4, whose grids 7 and 8 act in well known manner as a screen grid and a suppressor grid respectively, amplifies these low frequency oscillations and supplies them for the greater part through 17 and 18 to the loudspeaker 19. The remainder is transmitted to the windings 14 and 15 and thus made operative in the closed circuit 12, 14, 15, 16 and this in a sense such that negative feedback occurs. The values of the four previously mentioned impedances are, therefore, so chosen that:

$$14:15=12:16$$

In this case the electromotive forces induced in the windings 14 and 15 will not bring about a potential difference between the junction point of 14 and 15 and the junction point of 12 and 16. This firstly results in that the voltage fed back has no influence on the detector. Secondly, it is clear that if the slide contact 13 occupies its highest position, which corresponds to the maximum amplification, negative feedback will not occur. The latter, however, always increases accordingly as the contact 13 is slid downwards.

An analogous effect, that is to say a negative feedback which varies inversely with the amplification, is obtained when the above-described arrangement is simplified by omitting the winding 15 and the resistance 16. In this case, however, the negative feedback is never zero since the diode 9—5 represents a resistance which is not negligible. By connecting the free ends of the windings 14 and 15 through the intermediary of a switch 28 to a tone filter 26—27, there is

obtained the further advantage of a so-called physiological tone correction whose influence varies with the position of the volume control device in the same sense as does the influence of the negative feedback. The two resistances 29 and 30 prevent in this case the circuit 26—27 from withdrawing too much energy from the loudspeaker. These two resistances are, however, so small that they do not disturb the equilibrium of the bridge 13, 14, 15, 16.

The invention may be applied in the same purpose and with the same effect to many other circuit arrangements without departing from the spirit of the invention.

What is claimed is:

1. In a signal voltage transmission circuit having a pair of input terminals and a pair of output terminals, a source of signal voltage, a bridge network having one pair of inductive arms, one of the input terminals being connected to the junction of the inductive arms, the second pair of bridge arms being resistive, a frequency discriminatory path connected in shunt with both said resistive arms and acting as a diagonal of said bridge network, an adjustable element connect-

ing the second of the input terminals to one of said resistive arms, and a signal voltage transmission path coupling said output terminals to said inductive arms.

2. In combination with an audio modulated carrier detector provided with a load impedance, an audio voltage transmission tube having at least a control grid, cathode and output electrode, a bridge network comprising a pair of impedance arms, one of said arms being said load, a second pair of impedance arms having its junction connected to said cathode, an adjustable element variably coupling said control grid to said load impedance, means degeneratively applying signal voltage in the output electrode circuit to said second pair of arms, a tone filter network connected across said second pair of arms as a diagonal of said bridge, said arms having the constants thereof so chosen that the bridge is balanced and no degenerative voltage is applied to said control grid when the adjustable element is at the junction of said first pair of arms.

HENRICUS ADRIANUS BROOS.