April 8, 1941. L. BRÜCK 2,237,407

AUDIO FEEDBACK CIRCUIT

Filed Jan. 21, 1939

Fig. 1

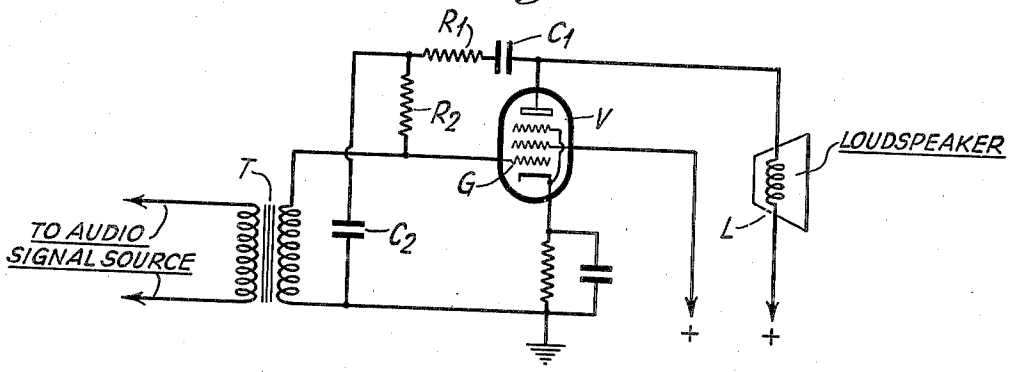
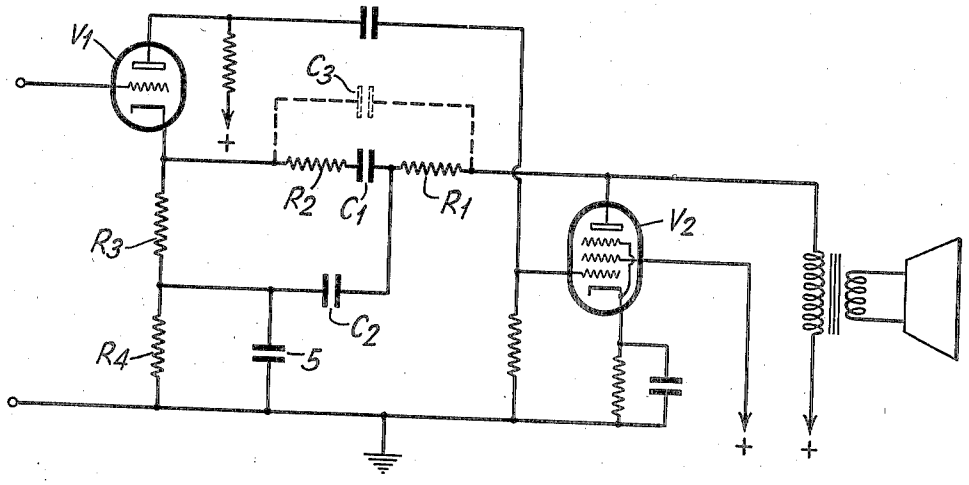


Fig. 2



INVENTOR.
LOTHAR BRÜCK

BY H. B. Brower

ATTORNEY.

Patented Apr. 8, 1941 2,237,407

UNITED STATES PATENT OFFICE

2,237,407

AUDIO FEEDBACK CIRCUIT

Lothar Brück, Berlin, Germany, assignor to Telefunken Gesellschaft für Drahtlose Telegraphie m. b. H., Berlin, Germany, a corporation of Germany

Application January 21, 1939, Serial No. 252,129
In Germany February 17, 1938

2 Claims. (Cl. 179—171)

Receivers are known in the earlier art comprising negative feedback means in the audio amplifier, said means being particularly effective for the median frequencies of the audio band. In this known circuit organization, the output alternating potential is fed back to the input end in phase opposition by way of a channel, or path, operating as a function of the frequency. This channel comprises ohmic resistances and two oscillatory circuits consisting each of a coil and a condenser, one of these being tuned to a frequency close to the upper limit, or cut-off, of the transmission band, while the other one is tuned to a frequency near the lower cut-off. For these two frequencies, the negative feedback, and thus the reduction of the gain, is substantially less than for the whole median range. Apart from a reduction of the non-linear distortions, this insures an improvement in the frequency response.

According to the invention, the transmission channel, or feedback path, for the negative regeneration potential comprises a series condenser, two ohmic series resistances, and a shunt condenser connected to the transmission channel between the two ohmic resistances.

The advantage residing in this invention is as follows: Oscillatory circuits of the kind used in the arrangement of the prior art have, basically, a more or less long building-up period. Building-up actions, as well known, involve a vitiation of sound. Now, in the arrangement here disclosed this drawback is unable to arise since only ohmic resistances and condensers insure the negative feedback acting upon, and affecting, the median frequencies. This action is obtained by simple means since only two ohmic resistances and two condensers are required. Moreover, condensers are far less expensive than coils, the latter, moreover, involving mostly the drawback of possessing troublesome self-capacitance. For this reason the arrangement of the invention is of greater advantage even over a scheme which includes only coils and ohmic resistances.

In the drawing:

Figure 1 shows one embodiment of the invention,

Figure 2 is a diagram of a modification.

An exemplified embodiment of the invention is shown in Fig. 1 as applied to the power stage of a receiver. The alternating potential to be amplified is fed to the control grid G of tube V, which is of the pentode type, by way of the transformer T; the loudspeaker L being included in the plate circuit of the said pentode. The plate is connected with the control grid G by way of a series path comprising a capacitor C_1 and two ohmic resistances R_1 and R_2. The junction of the two resistances R_1 and R_2 is connected through a condenser C_2 with the casing (chassis) or the filament of tube V.

The negative feedback of the tone control is independent of the frequency if the capacity of condenser C_1 is very high, and that of condenser C_2 very low. The more the size of condenser C_1 is cut down, the less markedly will the low audio frequencies be affected by the reverse regeneration, or negative feedback, so that the overall effect consists of an emphasis on the low audio frequencies compared with the median frequencies. The greater the action of condenser C_2, the more will the high audio frequencies be filtered out of the negative feedback channel, so that the high audio frequencies are subjected to less marked negative feedback and are emphasized likewise in proportion to the median audio frequencies. In order to obtain this last-named effect, it is necessary to divide the ohmic resistance in the negative feedback path and to connect the condenser C_2 at a point which is separated both from the plate as well as from the grid by an ohmic resistance in each case lest a capacitive load be placed on the grid or on the plate with the result that the high audio frequencies are slighted rather than emphasized.

Another embodiment is shown in Fig. 2 which illustrates a resistance-coupled two-tube amplifier. The plate of the second tube V_2 is connected with the filament of the input tube V_1 by way of a negative feedback path comprising in series the resistance R_1, the capacitor C_1, and the resistance R_2. Included in the cathode lead of tube V_1 is resistance R_3 which is not shunted capacitively, and resistance R_4 which is shunted by a capacity 5, to produce a negative grid biasing voltage. The junction point between condenser C_1 and resistance R_1 is connected by way of condenser C_2 with the junction point of the resistances R_3 and R_4.

The constants which are chosen for the resistances R_1 and R_2 and for the condenser C_1, just as in the scheme of Fig. 1, govern the reduction of the negative feedback for the low audio frequencies, while the constants of R_1, R_2, C_2 determine the decrease in the negative feedback for the high audio frequencies. In some instances it is desirable, for frequencies approximately between 6000 to 7000 cycles, to obtain a rise of the transmission curve, while for still higher frequencies, say of 9000 cycles, the characteristic should drop again. In the present case

this is obtained by connecting the plate directly with the filament of tube V_1 by way of a condenser C_3 of very low capacity, as indicated in Fig. 2 by the dash-line. In this manner it is possible to make conditions so that for the highest frequencies of the transmission range the reverse regeneration, and thus the gain reduction, become very high again.

In a practical embodiment, the said circuit elements were of the following values:

R_1=60 kilo-ohms
R_2=7 kilo-ohms
R_3=200 ohms
C_1=20,000 micro-micro-farads
C_2=9000 micro-micro-farads
C_3=300 micro-micro-farads

With these values at frequencies of 100 cycles and 6000 cycles for which, in the absence of negative feedback there occurs a very pronounced drop of the amplification characteristic (in contrast with the gain for the median audio frequencies), it is possible to obtain a rise, while above 7000 cycles the characteristic drops rapidly to small values.

What is claimed is:

1. In combination with an amplifier tube provided with at least a cathode, signal grid and plate, an audio voltage input network coupled to the grid and cathode, an audio output circuit coupled to said plate, a negative audio voltage feedback path connected between said plate and input network, said path comprising a condenser and a pair of resistors all arranged in series between the plate and grid of said tube, and a second condenser connected from a point between said resistors to a point of the input network which is at a different alternating potential than the point to which said path is connected.

2. In an audio voltage transmission circuit, an amplifier tube having at least a control grid, a cathode and a plate, an audio voltage input circuit connected between the grid and cathode, an output circuit coupled to the plate, an audio voltage feedback path, including a condenser and a pair of resistors in series relation, connected between the plate and grid, and a condenser element connected between the junction of the resistors and the cathode side of the input circuit.

LOTHAR BRÜCK.