May 14, 1940. H. BARTELS ET AL 2,201,022

CONTROL OF AUDIO FREQUENCY TRANSMISSION

Filed Nov. 17, 1936

Fig. 1a

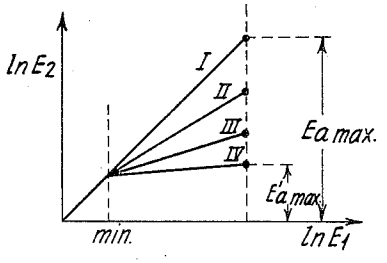


Fig. 1b

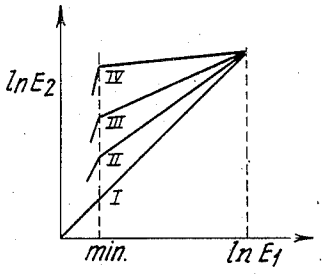
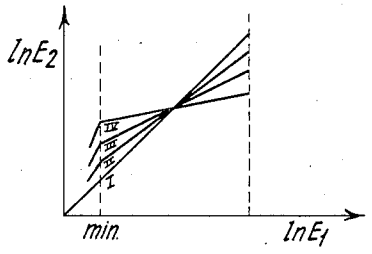


Fig. 1c



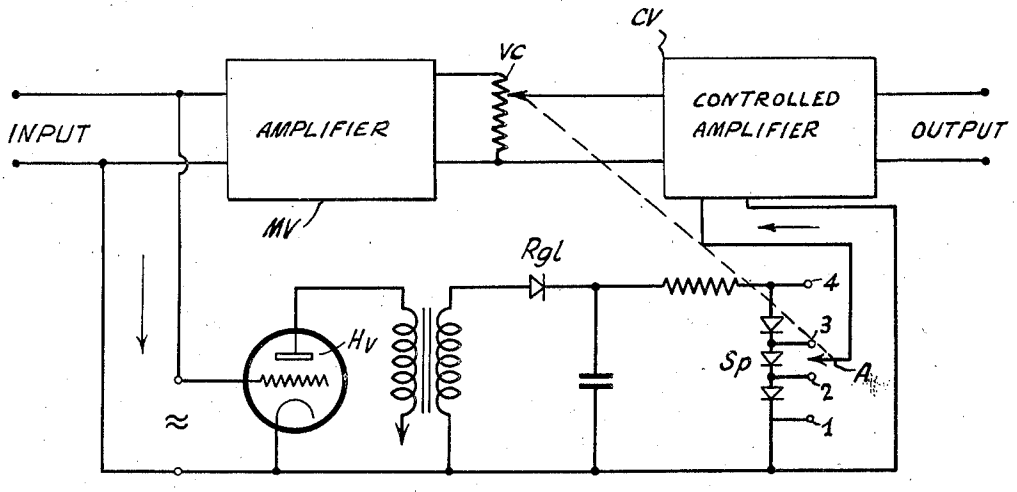


Fig. 2.

INVENTORS
HANS BARTELS AND
GÜNTHER ULBRICHT

BY H. G. Grimes
ATTORNEY

Patented May 14, 1940 2,201,022

UNITED STATES PATENT OFFICE

2,201,022

CONTROL OF AUDIO FREQUENCY TRANSMISSION

Hans Bartels and Günther Ulbricht, Berlin, Germany, assignors to Telefunken Gesellschaft für Drahtlose Telegraphie m. b. H., Berlin, Germany, a corporation of Germany

Application November 17, 1936, Serial No. 111,236
In Germany December 10, 1935

3 Claims. (Cl. 179—171)

This invention relates to a circuit arrangement for controlling the intensity range of audio-frequency transmission stations.

In arrangements for controlling the intensity range in audio-frequency transmission stations (microphone modulation arrangements, talking film arrangements, transmitter modulation arrangements and the like) it was found to be of advantage that various intensity range control curves for the amplifier can be adjusted to, since various optimum control curves are assigned to different conditions of recording. The most favorable degree of control is dependent to a greater or lesser degree on the type of programs. Therefore, it is of advantage to so design the control apparatus that various control curves can be selectively obtained. On account of the logarithmic volume response of the human ear, variation in the intensity range of electro-acoustic performances between equal limit values will be least noticeable if the proportion between the amplitudes of the voltages ahead and after the control member is adjusted to a logarithmic curve, when plotted on a linear scale, or a linear curve in a double-logarithmic scale. That is, if the curve of the controlled voltage follows a logarithmic variation in the linear scale or a linear course in a double logarithmic scale.

This is accomplished in accordance with the invention in that in the transmission path of the auxiliary control circuit a voltage divider formed of resistance depending on current such as rectifiers is provided, and from which the voltage passing to the control member is tapped in accordance with the desired control curve.

Since the amplification path of the main amplifier is calculated for the maximum voltage, it is advisable also when reducing the auxiliary voltage by the voltage divider circuit of the non-linear resistance, that care be taken that the main amplifier is utilized always up to the limit of its output capacity. In certain cases it may be of advantage to adjust to the average volume. This is done in such manner that simultaneously with the variation of the tapping at the rectifier-voltage divider a volume control device in the amplifier, such as a potentiometer located between two amplifier stages, is correspondingly varied.

Figures 1*a*, 1*b* and 1*c* are curves illustrating our improvement while Figure 2 is a fragmentary circuit diagram embodying our invention.

The methods of control according to my invention are elucidated by the Figures 1*a*, 1*b*, and 1*c*. Fig. 1*a* shows in logarithmic scale the alternating output potential as function of the alternating input potential. The line I inclined by 45° towards the abscissa axis corresponds to the uncontrolled state. The line II indicates for instance the control 1:3. The line III shows for instance the control 1:6, the line IV for instance the control 1:10. As seen from the diagram, the maximum alternating output potential $E_{a_{max}}$ available is not fully utilized. Only the value $E_{a'_{max}}$ is utilized.

In order to assure a more favorable operation of the amplifier, therefore, simultaneously with the setting of the tap point at the non-linear resistances of the auxiliary circuit, also a volume control device in the transmission path is adjusted so that degrees of control according to Fig. 1*b* are obtained. The uncontrolled state is again represented by the line I. The lines II, III, and IV again represent the corresponding conditions according to Fig. 1*a*. The line IV shows, for instance, the control ratio 1:10. In certain cases, it is desirable to adjust to an average volume instead of setting the maximum volume. In this case, the volume control and the voltage divider formed of the non-linear resistances in the auxiliary circuit would have to be dimensioned in such manner as indicated in the diagram 1*c*, that is as regards volume there is to be maintained stationary a point within the range between the minimum input potential and the maximum input potential.

Fig. 2 shows an example of embodiment of the idea of the invention, indicating however, only the auxiliary control circuit in detail. The impulses derived from the main transmission path at the input of amplifier MV are applied to the auxiliary amplifier HV and are rectified in the control rectifier Rgl. The detected voltage is applied to the voltage divider Sp formed of the non-linear resistances such as detector for instance. The taps connected to the control grid of the controlled amplifier CV are designated by 1, 2, 3 and 4. When tap A is in contact with terminal point 1 the auxiliary amplifier Hv has no effect on the signals. In accordance as to whether the tap A contacts the points 2, 3 or 4 a direct potential having a higher or lower value will be applied to the control grid, and thereby the desired switching of the control curves obtained.

As shown in Figure 2 the volume control VC is conveniently inserted between amplifier stages MV and CV in the main signal channel. When

tap A is in contact with one of the points identified by numerals 1, 2, 3 and 4 the amplifier operates along one of the characteristic curves shown in Figures 1*a*, 1*b*, 1*c* having the corresponding Roman numerals.

As already explained with reference to Figs. 1*a*–1*c*, it may also be of advantage to couple automatically the tap point A with a volume control VC inserted in the amplification train, so that at changing of the control curve, also a change in the average transmission level will be simultaneously obtained.

What is claimed is:

1. In combination, an amplifier circuit having input terminals, an auxiliary control channel connected to said input terminals, a rectifier for rectifying signals in said auxiliary channel, a tapped voltage divider comprising a non-linear resistance connected to said rectifier, means for applying selected portions of the voltage developed across the said divider to a control circuit of said amplifier, a volume control in said amplifier said volume control and said last mentioned means being mechanically coupled together.

2. In combination, an amplifier circuit having input terminals, an auxiliary control channel connected to said input terminals, a second amplifier in said auxiliary channel, a rectifier for rectifying signals to said second amplifier, a tapped voltage divider including a non-linear resistance connected to said rectifier, means for applying selected portions of the voltage developed across said divider to a controlled circuit of the first named amplifier, a volume control in said first named amplifier, said volume control and said last mentioned means being mechanically coupled together.

3. In combination, an amplifier circuit having input terminals and an output, said input terminals being adapted to have varying amplitude signals applied thereto, an auxiliary control channel connected to said input terminals, a rectifier for rectifying signals in said auxiliary channel, a tapped voltage divider including a non-linear resistance connected to said rectifier, means for so applying selected portions of the voltage developed across said divider to a control circuit of said amplifier that the amplitude of signals in said output varies logarithmically with respect to the amplitude of signals at said input terminals.

HANS BARTELS.
GÜNTHER ULBRICHT.