Nov. 28, 1950 K. DE BOER 2,532,150

STEREOPHONIC SOUND RECORDING SYSTEM

Filed April 8, 1946

FIG. 1.

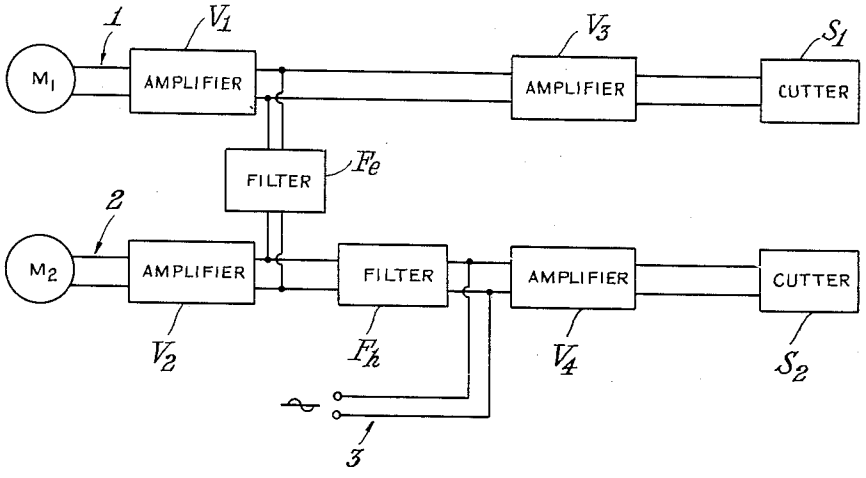
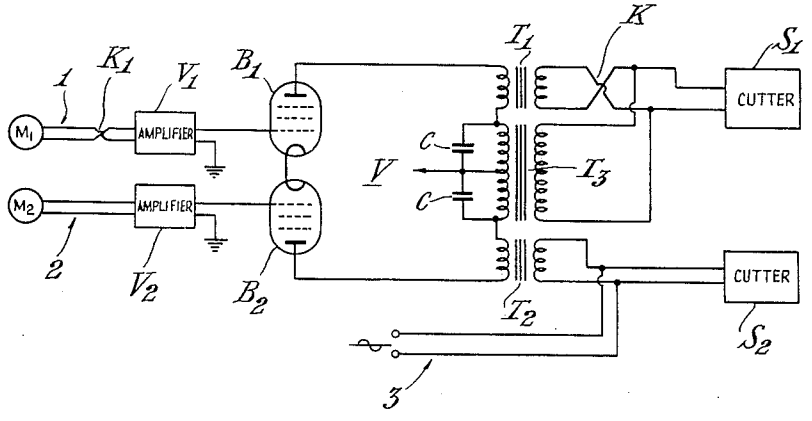


FIG. 2.



KORNELIS DE BOER
INVENTOR.

BY

ATTORNEY.

Patented Nov. 28, 1950 2,532,150

UNITED STATES PATENT OFFICE

2,532,150

STEREOPHONIC SOUND RECORDING SYSTEM

Kornelis de Boer, Eindhoven, Netherlands, assignor, by mesne assignments, to Hartford National Bank and Trust Company, Hartford, Conn., as trustee

Application April 8, 1946, Serial No. 660,323
In the Netherlands June 6, 1944

Section 1, Public Law 690, August 8, 1946
Patent expires June 6, 1964

8 Claims. (Cl. 179—100.4)

1

The present invention relates to a method and apparatus for stereophonically recording a sound wave.

In addition to a single track sound recording, the necessity for one or more individual auxiliary records is often felt with stereophonic sound records, for example for volume control, stereophonic effects, or the like. However, as there are already two records for the sound, it is generally very inconvenient with a view to the space available to provide a third additional track for this recording.

It has therefore been suggested before to accommodate such an auxiliary oscillation in one of the tracks, the frequency of this oscillation lying outside the audible range. This method, however, has the disadvantage that, if the frequency of the auxiliary oscillation lies below the audible range, it can be separated from the sound frequencies with difficulty only and if it lies above this range, for example if it is 20,000 c./s., recording is very difficult, because the customary recording members are not suited for this purpose.

In connection with gramophone records it is also known to accommodate in one of the tracks all sound oscillations of one channel and in the other track only the high tones, for example those exceeding 300 c./s., of the other channel with the purpose of obtaining a narrower track so that it may be possible to accommodate more tracks side by side on a normal gramophone record.

Though, as is well known, the low tones generally do not contribute towards the stereophonic effect and hence in reproduction only one reproducing device need be used for the low tones, it has, however, been found in practice, that if the sound oscillations supplied to this reproducing device for the low tones only come from one of the channels a lowering of the quality of the sound reproduced occurs in certain cases. If, for example, a source of sound producing many low tones is located adjacent one of the microphones and this microphone is associated with the channel from which the low tones are omitted, these low frequencies will be reproduced by the other microphone only and hence be comparatively too weak.

The present invention is based on recognition of the fact that the omission of the low tones from one of the channels is generally undesirable, so that for example the use of the aforesaid method which is known for recording on a gramophone record and in which this omission

2

is carried out in order to reserve the range of say from 0 to 3000 c./s. for the auxiliary oscillations, would have a detrimental effect on the reproduction.

In view of the foregoing the invention has for its object to provide a method of recording stereophonic sound oscillations, in which the whole of the sound detected by the microphones, and hence not part thereof, is accommodated in two tracks and in which in one of these tracks are recorded, in addition, one or more auxiliary oscillations having a frequency which does not lie outside but inside the audible range.

According to the invention, this object is attained by accommodating the high tones of one channel in one of the tracks and the high tones of the other channel jointly with the low tones of both in the other track and by recording in the track accommodating the high tones only, in addition, one or more auxiliary records whose frequencies lie inside the audible range, but below the separating frequency between high and low tones, which is practically located close to a frequency between 250 and 600 c./s.

The advantage of the method according to the invention resides in that fact that at all times the low tones detected by the two microphones are actually reproduced and hence have always the desired volume.

One preferred embodiment of apparatus functioning in accordance with the above-described method comprises means for separating the high and low tones in one of the channels and for transmitting the low tones of this channel into the other channel. The apparatus further comprises means for subsequently supplying one or more auxiliary oscillations to the first-mentioned channel.

For this purpose, use is preferably made of a device as described in the copending patent application Ser. No. 728,118, filed February 12, 1947, now abandoned, in which the sound oscillations of the two channels are supplied in phase-opposition to a push-pull amplifier, whose output circuit includes two transformers which are constructed in such manner that each of them only transmits the high tones of one of the channels. In the present case the secondary circuit of one of the transformers has furthermore supplied to it the auxiliary oscillation and the secondary circuit of the other transformer having supplied to it in common the low tones amplified in push-pull of the two channels by a transformer which only transmits the low tones.

In order that the invention may be clearly

understood and readily carried into effect, it will now be set out more fully with reference to the accompanying drawing, in which

Fig. 1 is a diagram of a device according to the invention, from which the principle of the invention is apparent.

Fig. 2 shows a device according to the invention with the use of the said push-pull amplifier.

Referring to Fig. 1, M_1 and M_2 designate two microphones which are spaced apart in the manner used in stereophonic sound recording. The detected oscillations are supplied to channels 1 and 2 respectively and amplified by two amplifiers V_1 and V_2 respectively. The oscillations coming from the amplifier V_2 are split up in two branches, one of which is transmitted through a filter F_h which only gives passage to oscillations above the separating frequency, for example, 600 c./s., and the other of which is transmitted through a filter F_l for the low tones to the first channel 1. The modulations thus obtained are passed on via amplifiers V_3 and V_4 respectively to cutters S_1 and S_2, each of which produces a separate track on a carrier. All of the oscillations coming from the filter F_h consequently have frequencies above the separating frequency, so that the zone below this frequency is free for the accommodation of one or more auxiliary oscillations which can be admitted for example through the channel 3.

Referring to Fig. 2 the oscillations coming from the amplifiers V_1 and V_2 are supplied to the grids of two tubes B_1 and B_2 respectively of the push-pull amplifier V. As in this case the oscillations must be in phase opposition the polarity of the lines of one of the channels is reversed at K_1. The anode circuits of the tubes B_1 and B_2 include transformers T_1, T_2 and T_3. T_1 and T_2 are constructed in such manner (the primary winding has, for example, a low inductance) that they only allow the passage of the high tones of the channels 1 and 2 respectively. The primary or, as the case may be, the secondary winding of the transformer T_3 is shunted by a capacity, so that it only passes on the low tones of the two channels amplified in push-pull. The oscillations coming from this transformer are added in the channel 1 to the high tones of this channel and supplied to the cutter S_1 jointly with these oscillations. In order to compensate the change of polarity at K_1 this channel has its polarity changed again at K_2. In addition, in the channel 2 one or more auxiliary oscillations whose frequency lies below the separating frequency (between 250 and 600 c./s.) are admitted via the channel 3 and supplied to the cutter S_2. The auxiliary or control oscillations serve, when reproducing the signals from channels 1 and 2, to effect a predetermined influence on the reproduced signals, such as volume control, stereophonic effects and the like.

What I claim is:

1. The method of recording stereophonic sound oscillations in two tracks on a record carrier, which consists in microphonically detecting the sound at two spaced locations; generating separate response voltages over the entire frequency range of the sound as heard; segregating the high frequency band portion from the low frequency band portion of a first one of the response voltages and recording the high frequency band portion in one track on the record carrier; combining the low frequency band portion of said first response voltage with the entire second response voltage and recording the combined voltage effects in the second track on the carrier; and additionally recording in said first track an auxiliary voltage whose frequency range lies within the range of the low frequency band portion.

2. A stereophonic recording system comprising two spaced microphones; a first amplifier driven by one microphone for detecting a sound wave over substantially the entire audible frequency range and converting the detected wave into corresponding voltage variations; a second amplifier driven by the second microphone; a first recorder head; a second recorder head; a channel from the first microphone amplifier to the first recorder head for passing the entire range of voltage variations to said first head; a channel from the second amplifier to the second recorder head and including means for passing only a predetermined high frequency band of the audible frequency range to the recorder head; means for transmitting the related low frequency band of the audible frequency range from the second amplifier to the first recorder head; and means for supplying a control signal to the second recorder head at a frequency within the low frequency band portion of the audible range.

3. A stereophonic recording system comprising two spaced microphones; a first amplifier driven by one microphone; a second amplifier driven by the second microphone; a first recorder head; a second recorder head; means for supplying to the first recorder head the output over the entire audio frequency range from the first microphone amplifier together with the output over a predetermined low frequency band from the second microphone amplifier; means for supplying to the second recorder head the output over a predetermined high frequency band from the second microphone amplifier; and means for additionally supplying to the second recorder head, a control signal frequency within the range of the low frequency band.

4. The method of stereophonically recording a sound wave on a record carrier having two tracks comprising the steps of detecting the wave over substantially the full audible frequency range at first and second spaced points and converting the detected wave into corresponding voltage variations, separating the high frequency band portion from the low frequency band portion in the frequency range of voltage variations derived at said first point, recording said high frequency band portion on one of said tracks, combining said low frequency band portion with the full range of voltage variations derived at said second point, recording the combined voltage variations on the other track, and further recording in said one of said tracks an external signal whose frequency range lies within the range of said low frequency band portion.

5. In a system for stereophonically recording a sound wave and an external control signal having a frequency range within the low frequency band portion of the full frequency range of the sound wave on a record carrier having first and second tracks, the combination comprising first and second microphones disposed in spaced relation for detecting the wave over substantially the full audible frequency range and converting the detected wave into corresponding voltage variations, first and second recording heads for recording in the respective tracks on said carrier, means coupling said first microphone to said first recording head to record the full frequency range of voltage variations produced thereby, filter means coupled to said second microphone

for separating the high frequency band portion from the low frequency band portion in the frequency range of voltage variations produced thereby, means for applying said low frequency band portion to said first recording head, means for supplying said high frequency band portion to said second recording head, and means for supplying the external control signal voltage having a frequency range within said low frequency band portion to said second recording head to effect a predetermined influence in reproduction upon the stereophonic sound wave.

6. In a system for stereophonically recording a sound wave and an external control signal having a frequency range within the low frequency band portion of the full frequency range of the sound wave on a record carrier having first and second tracks, the combination comprising first and second microphones disposed in spaced relation for detecting the wave over substantially the full audible frequency range and converting the detected wave into corresponding voltage variations, first and second recording heads for recording in the respective tracks on said carrier, first and second amplifiers whose inputs are coupled respectively to said first and second microphones, third and fourth amplifiers coupling the outputs of said first and second amplifiers to said first and second recording heads respectively, a high-pass filter interposed between said second and fourth amplifiers for passing solely the high frequency band portion in the range of variations of said second microphone to said second recording head, a low-pass filter connecting the output of said second amplifier to the input of said third amplifier for passing solely the remaining band portion of said second microphone to said first recording head, and means for applying the external control signal to the input of said fourth amplifier whose frequency range is within the range of said remaining band portion to effect a predetermined influence in reproduction upon the stereophonic sound wave.

7. A system for stereophonically recording a sound wave and an external control signal having a frequency range within the low frequency band portion of the full frequency range of the sound wave on a record carrier having first and second tracks, the combination comprising first and second microphones disposed in spaced relation for detecting the wave over substantially the full frequency range and converting the detected wave into corresponding voltage variations, a pair of recording heads, a push-pull amplifier including a pair of electron discharge tubes each having a cathode, a grid and an anode, means for applying the voltage variations from said first microphone to the grid of one of said tubes, means for applying the voltage variations from the second microphone in phase opposition to those of the first microphone to the grid of the other of said tubes, a pair of transformers having a primary and a secondary, each of said pair of transformers being responsive solely to the high frequency band portion in the frequency range of voltage variations, the primaries of said pair of transformers being serially connected between the anodes of said tubes, the secondary of one of said transformers being connected to one of said recording heads and the secondary of the other of said transformers being connected to the second of said recording heads, an auxiliary transformer network responsive solely to the low frequency portion of said frequency range and including a primary interposed between the primaries of said pair of transformers and a secondary connected to said first recording, and means for applying the external control signal to said second recording head whose frequency range is within said low frequency band portion to effect a predetermined influence in reproduction upon the stereophonic sound wave.

8. An arrangement, as set forth in claim 7, further including means to reverse the phase of the voltage applied to said first head from the secondary of one of said transformers with respect to the voltage applied to said second head from the secondary of the other of said transformers.

KORNELIS DE BOER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,765,517	Wier	June 24, 1930
1,811,839	Arnold	June 30, 1931
1,883,562	Chipman	Oct. 19, 1932
2,014,528	Keller	Sept. 17, 1935
2,019,616	Morfield	Nov. 5, 1935
2,031,605	Jenkins et al.	Feb. 25, 1936
2,114,471	Keller et al.	Apr. 19, 1938
2,126,370	Doolittle	Aug. 9, 1938

FOREIGN PATENTS

Number	Country	Date
54,397	Netherlands	Mar. 18, 1934