

PATENT SPECIFICATION

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(54) TELEVISION SOUND SYSTEM

(71) We, N.V. PHILIPS' GLOEILAMPENFABRIEKEN, a limited liability Company, organised and established under the laws of the Kingdom of the Netherlands, of Emmasingel 29, Eindhoven, the Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The invention relates to a television transmission system for the combined transmission of a vision and separate first and second sound signals. The invention also relates to a transmitter and a receiver for use with such a system.

Such a television transmission system is disclosed in the article "Das Zwei - Tonträger Verfahren" by S. Dinsel, published in "Funkschan", 1971, Vol. 4, Pages 105-108 where the first and second sound signals are respectively frequency modulated on first and second sound carriers.

It is an object of the invention to provide an alternative way of modulating said sound signals.

The invention provides a television transmission system for the combined transmission of a vision and separate first and second sound signals, in which said vision signal is modulated on a vision carrier, said first sound signal is frequency modulated on a first sound carrier spaced from said vision carrier by an amount greater than the width of the corresponding sideband of said vision signal, whilst a signal corresponding to the sum of or the difference between said first and second sound signals is frequency modulated on a second sound carrier spaced from said vision carrier by an amount which is also greater than the width of the corresponding sideband of said vision signal, the difference in frequency between the first sound carrier and the vision carrier being greater than the frequency difference between said first and

second sound carriers.

The invention also provides a transmitter for the combined transmission of a vision and separate first and second sound signals, said transmitter comprising first modulating means for receiving a vision signal and for modulating said vision signal on a vision carrier, second modulating means for receiving a first sound signal and for frequency modulation said first sound signal on a first sound carrier, third modulating means for receiving a second sound signal and for frequency modulating said second sound signal on an intermediate sound carrier, a combining circuit having a first input for receiving said modulated first sound carrier and a second input for receiving said modulated intermediate sound carrier, said combining circuit being adapted to combine the carrier signals at its inputs and to produce therefrom at an output a second sound carrier frequency modulated by the sum of or the difference between said first and second sound carriers, the frequency of the intermediate sound signal being equal to the frequency difference between the first and second sound carriers and lower than that of the first sound carrier.

In such a transmitter the combining circuit may comprise a mixer stage having first and second inputs respectively connected to the first and second inputs of the combining circuit, the output of the mixer stage being connected through a bandpass filter to the output of the combining circuit, the centre frequency of the bandpass filter corresponding to the frequency of the second sound carrier.

The invention further provides a receiver for the reception of a television transmission having a vision signal modulated on a vision carrier, a first sound carrier frequency modulated by a first sound signal and a second sound carrier frequency modulated by the sum of or the difference between said first sound signal and a second sound signal, said

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receiver comprising a vision intermediate frequency section, a first sound demodulation circuit connected to said vision intermediate section through a detector for reproducing said first sound signal from the translated first sound carrier, and a second sound demodulation circuit connected to said vision intermediate frequency section for receiving the first and second translated sound carriers and producing therefrom an intermediate sound carrier frequency modulated by the second sound signal, said second sound demodulator being adapted to reproduce said second sound signal.

In such a receiver the second sound demodulator may comprise a first bandpass filter connected for selecting the first and second translated sound carriers from a signal from the vision intermediate frequency section, a mixing stage connected to an output of the first bandpass filter for mixing the first and second translated sound carriers, a second bandpass filter connected to the output of the mixing stage having a centre passband frequency which corresponds to the frequency difference between the first and second translated sound carriers to produce the intermediate carrier, and detector means for frequency demodulating the intermediate carrier.

The above and other features of the invention will now be described by way of example with reference to the accompanying drawing in which:

Figure 1 is a block diagram of a transmitter for use with the transmission system according to the invention, and

Figure 2 is a block diagram of a receiver for use with the transmission system according to the invention.

Figure 1 shows a transmitter 61 for use with the transmission system according to the invention wherein a first sound signal S_1 supplied to a first audio-frequency input 67 is frequency modulated on a first sound carrier and a combination of the first sound signal S_1 and a second sound signal S_2 which is supplied to a second audio-frequency input 69 is frequency modulated on a second sound carrier.

The transmitter 61 comprises a vision modulation circuit 71 having an input terminal 65, and first and second sound modulation circuit 75 and 77 with audio-frequency input terminals 67 and 69 respectively. The vision modulation circuit 71 is connected via a vision amplifier 73 and the two sound modulation circuits 75 and 77 via an adder circuit 78 and a common amplifier 79, to a transmitter output stage 80. In this transmitter output stage 80 a vision signal which is modulated on a vision carrier is combined with two sound signals which are frequency-modulated on a first and a second sound carrier to form a complete television trans-

mission signal. The transmitter output stage 80 is connected to a transmitting aerial 63.

The first sound modulation circuit 75 includes a first frequency modulator 81 having a first modulation frequency m_1 connected to the audio-frequency input 67 and, through an output 93, to the adder circuit 78. The second sound modulation circuit 77 comprises a second frequency modulator 85 having a second modulation frequency m_2 which is connected through an output 95 to a combining circuit 83. An input of the frequency modulator is connected to the audio-frequency input terminal 69. The combining circuit 83 comprises a mixing stage 91 which is connected through a first input 86 to the output 93 of the first frequency modulator 81 and through a second input 87 to the output 95 of the second frequency modulator 85. An output 97 of this mixing stage 91 is connected through a bandpass filter 99 to the adder circuit 78.

If the frequency of the first sound carrier at the output 93 of the first frequency modulator 81 is fixed at a value f_1 , the first modulation frequency m_1 should then be chosen equal thereto.

If the frequency of the second sound carrier at the output of the fourth bandpass filter 99 is fixed at a value f_2 , wherein $f_2 \neq f_1$ then the second modulation frequency m_2 should be chosen to be equal to the frequency difference $f_1 - f_2$, or $f_2 - f_1$.

At the output 97 of the third mixing stage 91 the sum ($S_1 + S_2$) and the difference ($S_1 - S_2$) respectively of the two sound signals are frequency modulated on a carrier at a frequency corresponding to the sum ($m_1 + m_2$) and the difference frequency ($m_1 - m_2$) respectively of the carriers supplied to the inputs 86 and 87.

If f_2 is chosen to be smaller than f_1 then the difference frequency ($m_1 - m_2$) is selected by means of the bandpass filter 99, whose centre pass frequency is equal to f_2 . If f_2 is chosen to be greater than f_1 then the sum frequency ($m_1 + m_2$) is selected by means of this bandpass filter 99. If, in addition, f_1 is chosen to exceed the absolute frequency difference between f_1 and f_2 , so if $m_1 > m_2$, the frequency interval between the two sound carriers f_1 and f_2 will be independent of the first sound signal S_1 both for $f_2 > f_1$ and for $f_2 < f_1$.

The two frequency-modulated sound carriers are amplified in the amplifier 79 of the transmitter 61 and combined in the transmitter output stage 80 with the vision carrier to form a complete television transmission signal. This may require a frequency conversion wherein the first and the second sound carrier f_1 and f_2 are brought to a given frequency distance relative to the vision carrier, for example at frequencies F_1 and F_2 . By choosing the absolute frequency difference (f_1

- f_2) equal to the absolute frequency difference ($F_1 - F_2$) of the first and the second sound carriers to be transmitted, the two sound carriers can be adjusted in the same frequency conversion to the correct position relative to the vision carrier.

Figure 2 shows a receiver 1 for use with a transmission system according to the invention and which comprises a tuner 5, connected to an aerial 3, for converting a desired aerial signal into an intermediate frequency signal, a vision intermediate frequency section 7 connected to the tuner unit 5 for selecting and amplifying the intermediate frequency signal, a first detector 9 connected to the vision intermediate frequency section 7 for demodulating the intermediate frequency signal into a video signal, a video amplifier 11 connected to the first detector 9 and a display tube 17 for respectively amplifying and displaying the video signal, a first sound demodulation circuit 13 which is also connected to the first detector 9 and a first loudspeaker 19 respectively for demodulating and reproducing the first sound signal S_1 from the intercarrier sound signal originating from the first detector, and also comprising a second sound demodulation circuit 15 connected to the vision intermediate frequency section 7 and a second loudspeaker 21 for respectively demodulating and reproducing the second sound signal S_2 from the intermediate frequency signal.

The second sound demodulation circuit 15 comprises a first bandpass filter 23 connected to the vision intermediate frequency section 7 for selecting the two translated sound carriers from the intermediate frequency signal, an output terminal 25 of the first bandpass filter 23 being connected to a first mixing stage 27 for mixing the first and the second translated sound carrier. An output terminal 29 of the first mixing stage 27 is connected to a second bandpass filter 31 for selecting an intermediate carrier whose frequency corresponds to the frequency interval between the first and the second translated sound carrier from the output signal of the mixing stage 27. an output of the second bandpass filter 31 being connected to a frequency modulation detector 41 which demodulates the second sound signal and reproduced on a second loudspeaker 21 connected to an output of the detector 41.

If the intermediate frequency signal of the vision intermediate frequency section 7 has a translated vision carrier at, for example, 38.9 MHz and first and second translated sound carriers at 33.4 and 33.16 MHz respectively at which the sound signal S_1 and ($S_1 + S_2$) or ($S_1 - S_2$) respectively are frequency-modulated then, after demodulation in the first detector 9, the first sound carrier is transposed in accordance with the intercarrier demodulation principle to a frequency of

5.5 MHz. A further demodulation to audio-frequencies is effected in the first sound demodulation circuit 13.

The two translated sound carriers are filtered from the intermediate frequency signal in the first bandpass filter 23 of the second sound demodulation circuit 15 and applied to the first mixing stage 27. Sum and difference components of the two translated sound carriers are present at the output terminal 29. The sum carrier (66.56 MHz) is frequency modulated with the sum signal $S_1 + (S_1 + S_2)$ or $S_1 + (S_1 - S_2)$ and the difference carrier (0.24 MHz) is frequency modulated with the difference signal $S_1 - (S_1 + S_2)$ or $S_1 - (S_1 - S_2)$. A drift of the intermediate frequency signal, for example, because of a drift of the tuning unit 5, produces at the output terminal 29 of the mixing stage 27 a drift in the carrier of the sum signal which is twice as large. In the carrier of the difference signal ($S_1 - S_2$), on the contrary, the drift of the first translated sound carrier fully compensates the equal, but opposite drift of the second translated sound carrier. The second bandpass filter 31 therefore selects the difference carrier of $S_1 - (S_1 + S_2)$ or $S_1 - (S_1 - S_2)$ i.e. the difference between the two translated sound carriers, and has for this purpose a centre passband frequency which corresponds to the frequency interval between the first and the second translated sound carrier, which in this example is 0.24 MHz i.e. ($f_1 - f_2$).

The sound signal S_2 or S_2 respectively is then available at the output of the second bandpass filter 31 from the output signal of the first mixing stage 27 whereafter demodulation to audio-frequency is effected in the frequency detector 41.

The separation between the first and the second sound signal by means of the receiver is large enough to reproduce, for example for a transmitted television programme with two different commentaries, one of the commentaries by switching on one of the two loudspeakers, the other commentary not being audible in the desired commentary.

The requirements imposed on the separation between the first and the second sound signal are less strict for stereo transmissions.

If so desired the sum signal $L + R$ can be used as first sound signal S_1 by means of an audio-frequency matrixing in the transmitter and, for the second sound signal S_2 , the difference signal $L - R$, wherein L represents the "left-hand" and R the "right-hand" sound information of a stereo sound signal. In the receiver 1 a matrixing circuit, not shown, should then be included between the audio-frequency outputs of the two sound demodulation circuits and the two loudspeakers. The cross talk which is introduced in this matrixing circuit can be acceptable in stereo reproduction.

**WHAT WE CLAIM IS:**

5 1. A television transmission system for the combined transmission of a vision and separate first and second sound signals, in which said vision signal is modulated on a vision carrier, said first sound signal is frequency modulated on a first sound carrier spaced from said vision carrier by an amount greater than the width of the corresponding sideband of said vision signal, whilst a signal corresponding to the sum of or the difference between said first and second sound signals is frequency modulated on a second sound carrier spaced from said vision carrier by an amount which is also greater than the width of the corresponding sideband of said vision signal, the difference in frequency between the first sound carrier and the vision carrier being greater than the frequency difference between said first and second sound carriers.

10 2. A television transmission system for the combined transmission of a vision and first and second separate sound signals, substantially as herein described with reference to the accompanying drawing.

15 3. A transmitter for the combined transmission of a vision and separate first and second sound signals, said transmitter comprising first modulating means for receiving a vision signal and for modulating said vision signal on a vision carrier, second modulating means for receiving a first sound signal and for frequency modulation said first sound signal on a first sound carrier, third modulating means for receiving a second sound signal and for frequency modulating said second sound signal on an intermediate sound carrier, a combining circuit having a first input for receiving said modulated first sound carrier and a second input for receiving said modulated intermediate sound carrier, said combining circuit being adapted to combine the carrier signals at its inputs and to produce therefrom at an output a second sound carrier frequency modulated by the sum of or the difference between said first and second sound carriers, the frequency of the intermediate sound signal being equal to the frequency difference between the first and second sound carriers and lower than that of the first sound carrier.

20 4. A transmitter as claimed in Claim 3, in which said combining circuit comprises a mixer stage having first and second inputs respectively connected to the first and second inputs of said combining circuit, the output of said mixing stage being connected through a bandpass filter to the output of said combining circuit, the centre frequency of said bandpass filter corresponding to the frequency of said second sound carrier.

25 5. A transmitter as claimed in Claim 3 or 4, in which said first modulated sound carrier is added to said second modulated sound carrier, which added modulated sound carriers are combined with the modulated vision carrier.

6. A transmitter for the combined transmission of a vision and separate first and second sound signals, substantially as herein described with reference to Figure 1 of the accompanying drawing.

7. A receiver for the reception of a television transmission having a vision signal modulated on a vision carrier, a first sound carrier frequency modulated by a first sound signal and a second sound carrier frequency modulated by the sum of or the difference between said first sound signal and a second sound signal, said receiver comprising a vision intermediate frequency section, a first sound demodulation circuit connected to said vision intermediate section through a detector for reproducing said first sound signal from the translated first sound carrier, and a second sound demodulation circuit connected to said vision intermediate frequency section for receiving the first and second translated sound carriers and producing therefrom an intermediate sound carrier frequency modulated by the second sound signal, said second sound demodulator being adapted to reproduce said second sound signal.

8. A receiver as claimed in Claim 7, in which said second sound demodulator comprises a first bandpass filter connected for selecting the first and second translated sound carriers from the signal from the vision intermediate frequency section, a mixing stage connected to an output of the first bandpass filter for mixing the first and second translated sound carriers, a second bandpass filter connected to the output of the mixing stage having a centre pass band frequency which corresponds to the frequency between said first and second translated sound carriers to produce said intermediate carrier, and detector means for frequency demodulating said intermediate carrier.

9. A receiver for the reception of a television transmission having a vision signal modulated on a vision carrier, a first sound signal frequency modulated on a first sound carrier and a second sound carrier frequency modulated by the sum of or the difference between said first sound signal and a second sound signal, substantially as herein described with reference to Figure 2 of the accompanying drawing.

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