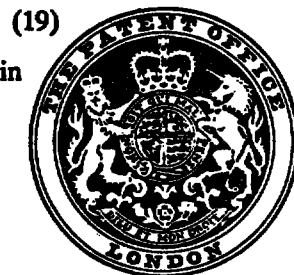


PATENT SPECIFICATION

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H3Q DRT



(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 receiver for television signals having a vision carrier and first and second sound carriers which are respectively frequency modulated by first and second sound signals, the receiver comprising a vision intermediate frequency section and first and second sound demodulation circuits for reproducing the first and second signals respectively, the first sound demodulation circuit being connected through a first detector to the vision intermediate frequency section.

Such a receiver is disclosed in the article "Das Zwei-Tonträger Verfahren" by S. Dinsel, published in "Funkschau", 1971, Vol. 4, pages 105-108, which describes a system for the transmission of television signals having first and second sound carriers which are frequency modulated by first and second sound signals respectively.

With the prior art receiver the television signal of the picture intermediate frequency section is supplied to the first detector wherein the translated amplitude-modulated vision carrier and the two translated frequency-modulated sound carriers are mixed.

At the output of this first detector the first and second sound signals are available as a frequency-modulation on a first and second intermediate carrier frequency being equal to the frequency interval between the vision carrier and the first sound carrier and to the frequency interval between the vision carrier and second sound carrier respectively. A

further processing of the sound signals on the respective first and second intermediate frequency sound carriers is thereafter effected in the respective first and second sound demodulation circuits which are connected to the output of the first detector. So the two sound signals are each recovered from the television signal in accordance with the conventional intercarrier method. In the system described in the article the frequency interval between the vision carrier and the first sound carrier is 5.5 MHz and that between the vision carrier and the second sound carrier is approximately 5.75 MHz. The minimum frequency interval between the second sound carrier and the picture carrier of an adjacent channel is, at a channel band-width of 7 MHz, only 1.25 MHz. If the receiver is tuned to the adjacent channel this second sound carrier must be attenuated to a sufficient degree to prevent disturbances in the vision signal. To this end the amplitude of the relevant second sound carrier must be small. However, this results in the amplitude of the second sound intermediate frequency carrier at the output of the first detector is small which, for the prior art receiver, may lead to the second sound intermediate frequency carrier being exceeded by higher order products of the picture signal.

The invention provides a receiver of the type described in the opening paragraph in which the second sound demodulation circuit comprises a first bandpass filter connected to the vision intermediate frequency section for selecting the resulting two translated sound carriers from the signal of the vision intermediate frequency section, a first mixing stage connected to an output of the first bandpass filter for mixing between the first and second translated sound carriers, a second bandpass filter connected to the output of the mixing stage having a passband frequency which corresponds to the frequency interval between the first and the second

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translated sound carrier for selecting this frequency from the output signal of the mixing stage and a combining circuit for recovering the second sound signal from the output signal of the second bandpass filter, a first input of the combining circuit being connected to the first sound demodulation circuit and a second input of the combining circuit being connected to an output of the second bandpass filter.

The invention is based on the recognition that intercarrier demodulation is also possible with two carriers which are both frequency-modulated, namely the first and the second sound carrier. By separating both translated sound carriers from the vision signal before mixing them in the first mixing stage higher order products of the translated vision carrier are avoided and only intermodulation products of the two translated sound carriers are obtained at the output of this mixing stage. Because generally the two translated sound carriers have the same drift, for example because the television signal has passed a tuner unit which is provided before the vision intermediate frequency section and which is liable to drift, that product at the output of the first mixing stage is selected the frequency of which corresponds to the frequency interval between the first and the second translated sound carrier. In this selected product the drift of the first translated sound carrier is compensated by the drift of the second translated carrier. The product selected by the second bandpass filter comprises the signal difference between the first and the second translated sound carrier. To be able to recover the second sound signal therefrom the inter-carrier sound signal obtained from the beating between the first translated sound carrier and the translated vision carrier in the first detector is added, by means of the combining circuit, with such phase and amplitude to said difference signal that the component of the first sound signal is compensated therein. Such a compensation is possible both prior and after demodulation to the audio-frequency range. A compensation in the audio-frequency range can be realized with a matrixing circuit wherein the demodulated first audio-frequency sound signal is combined with the demodulated, audio-frequency signal difference between the first and the second sound signal. For an acceptable compensation the first sound signal should be available with a phase and an amplitude which accurately agrees to that of the first sound signal component of the signal difference. In practice this can only be achieved by means of complicated and expensive control circuits.

Such control circuits can be avoided the combining circuit comprises a second mixing stage which is connected *via* the first input to the connection between the first detector and

the first sound demodulation circuit and *via* the second input to the output of the second bandpass filter, the combining circuit being provided with third bandpass filter connected to an output of this mixing stage and having a center frequency which corresponds to the frequency interval between the second sound carrier and the vision carrier. The inter-carrier sound signal at the output of the first detector and the first sound component of the signal difference between the first and the second translated sound carrier at the output of the second bandpass filter are both derived from the same frequency modulated first sound signal of the intermediate frequency signal. Therefore these both signals accurately agree to each other.

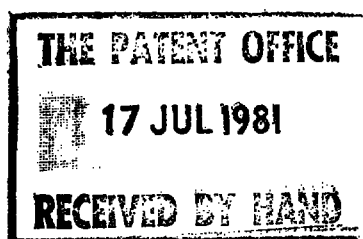
A beating between the output signal of the second bandpass filter and the output signal of the first detector in the second mixing stage results in a product which exclusively contains the second sound signal frequency-modulated on a carrier having a frequency corresponding to the frequency interval between the second sound carrier and the vision carrier.

The above and other features of the invention will now be described with reference to the accompanying drawing the sole Figure of which shows a block diagram of a receiver according to the invention.

The Figure shows a receiver 1, comprising 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 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 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 and connected thereto, in this sequence: *via* an output terminal 25 of the first bandpass filter 23 to a first mixing stage 27 for mixing the first and the second trans-

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lated sound carrier, via an output terminal 29 of the first mixing stage 27 to a second bandpass filter 31 for selecting that frequency corresponding to the frequency interval between the first and the second translated sound carrier from the output signal of the mixing stage 27, via an output terminal 33 of the second band pass filter 31 to a combining circuit 39 which is connected by means of a first input 35 to the connection between the first detector 9 and the first sound demodulation circuit 13 and, by means of a second input 37, to the output terminal 33 of the second bandpass filter 31. The combining circuit 39 comprises a second mixing stage 51 which is connected via the first input 35 to the connection between the first detector 9 and the first sound demodulation circuit 13 and, via the second input 37, to the output 33 of the second bandpass filter 31. An output of the second mixing stage 51 is connected via a bandpass filter 53 to a frequency detector and signal amplifier 55, an audio-frequency output of which is connected to the second loudspeaker 21.

If the intermediate frequency signal of the vision intermediate frequency section 7 has 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_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 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 ($S_1 + S_2$) and the difference carrier (0.24 MHz) is frequency modulated with the difference signal ($S_1 - S_2$). 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 ($S_1 + S_2$) 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 ($S_1 - S_2$) i.e. the difference between the two translated sound carriers and has for this purpose a centre pass band frequency which corresponds to the

frequency interval between the first and the second translated sound carrier, which in this example is 0.24 MHz.

In order to recover the second sound signal S_2 from the difference signal ($S_1 - S_2$) being frequency modulated on a 0.24 MHz carrier, this difference signal is multiplied in the second mixing stage 51 by the first sound signal $-S_1$ which is frequency modulated on a 5.5 MHz carrier being available at the output of the first detector 9. Because in the first detector 9 the first translated sound carrier is mixed with the translated vision carrier, the phase of the first sound signal at the output of the detector 9 is opposite to the phase of the first sound signal of the intermediate frequency signal.

At the output of the second mixing stage 51 there is a product in which the second sound signal is frequency-modulated on a carrier having a frequency which is equal to the frequency interval between the second translated sound carrier and the translated vision carrier, that is to say 5.74 MHz.

As the frequency swing of the signal $-S_1$ at the first input 35 is equal to the frequency swing of the signal S_1 in the difference signal ($S_1 - S_2$) at the second input 37, because the two signals have the same origin, namely the first sound signal S_1 in the intermediate frequency signal of the vision intermediate frequency section 7 and because differences in delay between the two signal are negligibly small at a proper choice of the phase frequency characteristic of the bandpass filters a full compensation of the signal S_1 in the difference signal ($S_1 - S_2$) is possible, so that only the second sound signal is present in said product at the output of the second mixing stage 51.

These delay differences can possibly be fully cancelled by using simple delay networks, not shown in the drawing. They can, for example, be connected between the first detector 9 and the first input 35 and/or between the second bandpass filter 31 and the second input 37.

To select the mixed product with the second sound signal S_2 from other mixed products, the output of the mixing stage 51 is connected to a third bandpass filter 53 whose centre passband frequency is equal to said frequency interval.

Demodulation and amplification of the second sound signal S_2 which is frequency-modulated on a carrier, the given example with a frequency of 5.74 MHz, is thereafter performed in a frequency detector and amplifier 55, connected to the third bandpass filter 53, whereafter reproduction takes place by means of the second loudspeaker 21.

The separation between the first and the second sound signal by means of the receiver 1 is large enough to reproduce, for example

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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" 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 production.

WHAT WE CLAIM IS:

1. A receiver for television signals having a vision carrier and first and second sound carriers which are respectively frequency modulated by first and second sound signals, the receiver comprising a vision intermediate frequency section and first and second sound demodulation circuits for reproducing the first and second sound signals respectively, the first sound demodulation circuit being connected via a first detector to the vision intermediate frequency section, the second sound demodulation circuit comprising a first bandpass filter connected to the vision intermediate frequency section for selecting the resulting two translated sound carriers from the signal of the vision intermediate frequency section, a first 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 passband frequency which corresponds to the frequency interval between the first and the second translated sound carrier for selecting this frequency from the output of the mixing stage, and a combining circuit for recovering the second sound signal from the output signal of the second bandpass filter, a first input of the combining circuit being connected to the first sound demodulation circuit and a second input of the combining circuit being connected to an output of the second bandpass filter.

2. A receiver as claimed in Claim 1. in which the combining circuit comprises a second mixing stage which is connected through the first input to the connection between the first detector and the first sound demodulation circuit and through the second input to the output of the second bandpass filter, the combining circuit being provided with a third

bandpass filter connected to an output of this mixing stage and having a centre frequency which corresponds to the frequency interval between the second sound carrier and the vision carrier.

3. A receiver for television signals having a vision carrier and first and second sound carriers which are respectively frequency modulated by first and second sound signals, substantially as herein described with reference to the accompanying drawing.

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