

PATENT SPECIFICATION

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(54) DROPOUT COMPENSATION DEVICE

(71) We, NORTH AMERICAN PHILIPS CORPORATION of 100E 42nd Street, New York 10017, New York, United States of America, organised under the laws of the State of Delaware and N.V. PHILIPS' GLOEILAMPEN-FABRIEKEN a Limited Liability Company organised 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 dropout compensation device for the compensation of signal dropouts in a video signal, which signal comprises a colour television signal with a luminance and a chrominance component, which colour television signal is modulated on a carrier wave, which device comprises an input terminal for receiving a video signal, a first circuit coupled to said input terminal, including a demodulator for supplying a demodulated colour television signal, a second circuit adapted to supply a luminance component of the colour television signal delayed by substantially one line period with the aid of a first delay means, a third circuit adapted to derive a chrominance component delayed by substantially one line period from the demodulated colour television signal with the aid of a second delay means, a recombining circuit for recombining the luminance component supplied by the second circuit and the chrominance component supplied by the third circuit, and a switching means controlled by dropout detector, which means is adapted to normally transfer the colour television signal supplied by the first circuit to an output terminal and during a signal dropout transfer the signal supplied by the recombining circuit.

The invention in particular relates to a device for the compensation of signal dropouts in a video signal, which is read from a record carrier, for example a record carrier a tape or

disk. With such record carriers flaws in the recording medium may give rise to interruptions or deviations in the read-out signal, which are generally termed signal dropouts.

The invention further and in particular relates to a device for the compensation of signal dropouts in a video signal which consist of a colour television signal which is modulated on a carrier wave, which colour television signal comprises a luminance and chrominance component, which two components are thus modulated on a common carrier wave. In this respect it is obvious that first of all a colour television signal is considered which is in accordance with an existing standard, in particular the NTSC standard, which is modulated directly, i.e. without further transformation, onto a carrier wave.

A device of the type mentioned in the preamble is known from United States Patent Specification 3,463,874. In this known device the colour television signal, which is added to a carrier wave as a frequency modulation, is demodulated and normally transferred to the output terminal via the first circuit. Further, this demodulated colour television signal is applied to the second and the third circuit, which two circuits derive therefrom a luminance and chrominance component delayed by one period, which two components are recombined in the recombining circuit and during a signal dropout are applied to the output terminal as a substitute signal. Care is then taken that the delay realized in the third circuit is essentially not exactly one line period, but has a deviation of half a period of the chrominance carrier wave with respect to a line period. Thus it is automatically achieved that the chrominance component inserted during a signal dropout has the correct colour phase, which colour phase changes every line in an NTSC standard colour television signal.

In this known device a problem occurs if for the delay means required in the second

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circuit use is to be made of ultrasonic delay lines, i.e. delay lines in which the applied electrical signal is converted into an ultrasonic wave, which after travelling through a generally vitreous medium is re-converted into a delayed electrical signal. In the present state of the art the delay line is not capable of handling very low frequencies. However, the luminance component to be delayed in the second circuit has a frequency spectrum which extends to zero frequency and hence it cannot be supplied directly to such a delay line. Therefore, when such a delay line is used in the known device, this luminance component is first amplitude-modulated on a carrier wave, subsequently delayed and then demodulated again. This means that to avoid the above-mentioned problem the known device requires an additional modulator, a carrier-wave oscillator and a demodulator.

The invention provides a dropout compensation device of the type described in the opening paragraph in which the second circuit is adapted to receive the video signal directly from the input terminal and includes a demodulator for demodulating the luminance component of the delayed video signal.

The invention makes highly effective use of the fact that the read-out video signal as such occupies a limited frequency band around the carrier wave, which does not comprise extremely low frequencies at any rate. This read-out video signal may therefore readily be applied to a first delay line of the above mentioned type. Furthermore, as in fact that first delay line merely serves to correctly transmit the luminance component of the colour television signal, whilst the chrominance component is delayed with the aid of a second delay line which receives a signal derived from the demodulated colour television signal, the advantage is retained that owing to the separate processing of the luminance and the chrominance component the requirements imposed on the two delay lines are limited and the risk of undesired phase shifts, in particular with respect to the chrominance component, is minimal.

The invention will be described in more detail with reference to the drawing, in which Figure 1 shows an embodiment of the known device, and

Figures 2, 3 and 4 show three embodiments of the device according to the invention.

The known device of Figure 1 comprises an input terminal 1, to which the video signal V which is read from the record carrier is applied. The video signal V consists of a colour television signal E with a luminance and a chrominance component which signal is modulated on a carrier wave, generally frequency modulated. In the case of a so-termed "direct system" the colour television signal is a standard colour television signal, for example in accordance with the NTSC standard.

The video signal V is applied to a first circuit 7, which is included between the input terminal 1 and a first input 4 of a switching means 3. The first circuit comprises a demodulator 8, at whose output the demodulated colour television signal E is available. In the case of a "direct system" this is a standard colour television signal, which is then normally applied to the output terminal 6 via the switching means 3.

The switching means 3 is controlled by a dropout detector 2, which is connected to the input terminal and which normally maintains the switching means 3 in the position shown and only during the occurrence of a signal dropout in the video signal which is applied to the terminal 1 sets the switching means to the position in which the second input 5 is coupled to the output terminal 6. Upon the occurrence of such a dropout a compensation signal E' is applied to the output terminal 6 via the switching means 3, which compensation signal is derived from the video signal of the preceding line of the recorder television picture.

The compensation signal E' is obtained with the aid of two circuits 9 and 14 and a recombining circuit 18. The two circuits 9 and 14 are connected to the output of the demodulator 8 and are adapted to supply a luminance component Y' and chrominance component F' respectively, delayed by one line period. The circuit 9 therefore first of all includes a low-pass filter 10 for extracting the luminance component Y from the demodulated colour television signal E. Furthermore, the circuit 9 includes a delay means 12 for delaying the luminance component Y by one line period.

However, in order to enable for example an ultrasonic delay line to be used for the delay means 12, it is necessary to transpose the extracted luminance component Y first to a frequency band, which in any case does not contain the frequency zero. For this purpose, a modulator 11 precedes the delay line 12, which modulator receives a carrier wave from an oscillator 19, and modulates the luminance component Y on the carrier wave. The signal which is modulated on the carrier wave is subsequently delayed by one line period by the delay line 12, after which with the aid of a demodulator 13 the luminance component Y' delayed by one line period is obtained from the modulated delayed signal.

The circuit 14 comprises a band-pass filter 15 for extracting the chrominance component F from the demodulated standard colour television signal E. As the chrominance component F occupies a limited frequency band around the standard chrominance carrier wave, the chrominance component may be applied directly to an ultrasonic delay line 16, which delays the chrominance component by one line period. The delay line is finally followed by a variable amplifier and phase inverter 17. In the case of an NTSC standard colour

television signal the phase inverter *inter alia* serves to ensure that the phase of the delayed chrominance component F' is opposed to the phase of the chrominance component F. This is necessary, because in an NTSC standard colour television signal the colour phase changes every line as has been extensively described in the cited United States Patent Specification 3,463,874.

The signal components F' and Y' supplied by the two circuits 9 and 14 are recombined by the recombining circuit 18 to form a compensation signal E', which is applied to the input 5 of the switching means 3 during a dropout of the disturbed signal E.

Figures 2 to 4 show three embodiments of the device according to the invention, corresponding elements being denoted by the same reference numerals as in Figure 1.

The embodiment of Figure 2 largely corresponds to the device of Figure 1. The essential difference is that the circuit 9 for obtaining the luminance component Y' which is delayed by one line period does not receive the demodulated colour television signal E, but is directly coupled to the input terminal 1. This has far-reaching consequences. As the video signal V applied to the input terminal 1 consists of a colour television signal which is modulated on a carrier wave, the video signal, in contradistinction to the demodulated luminance component Y, is suitable for application to an ultrasonic delay line. This means that the delay line 12 in the circuit 9 may be coupled directly to the input terminal and a video signal delayed by one line period is available at its output.

For this, the delay line 12 need not have a bandwidth which covers the full bandwidth of the video signal, but only the bandwidth of the luminance component which is modulated on the carrier wave, for the circuit 9 merely needs to supply the luminance component Y'. This luminance component Y' is now obtained by demodulating the delayed output signal of the delay line 12 with the aid of a demodulator 21, which may be identical to the demodulator 8, and by extracting the luminance component Y' from the demodulated signal with the aid of the low-pass filter 22.

A comparison of Figures 1 and 2 directly reveals that by the step according to the invention a substantial reduction of the required number of electronic elements in the circuit 9 is achieved.

The embodiment of the device according to the invention shown in Figure 3 fully corresponds to the embodiment of Figure 2 in respect of the circuits 8 and 9, the switching means 3 and the recombining circuit 18. The embodiment of the circuit 14 as such is also identical. However, in contradistinction to Figure 2 the input signal for the circuit 14 is now taken from the output terminal 6, which makes no essential difference to the operation of the device.

In the embodiment of Figure 4 only the delayed luminance component Y' is applied to the second input 5 of the switching means 3. The recombining circuit 18 is now included between the output of the switching means 3 and the output terminal 6. The input signal for the circuit 14 is also taken from the output of the switching means 3 or, as is shown dashed, from the output of the demodulator 8. In circuit 14 an additional switch 23 is included with a first input 25 which is connected to the amplifier and phase inverter 17, a second input 26, which is at earth potential, and an output 27 which is connected to the recombining circuit 18. The switch 23 is coupled to the switching means 3, which is indicated by the dashed line 24.

Normally, the two switches 3 and 23 are in the positions shown. As the recombining circuit 18 then receives no signal from the switch 23 the demodulated colour television signal E will be available at the output terminal 6. On the occurrence of a signal dropout the recombining circuit 18 receives the delayed luminance component Y' via the circuit 9 and the switching means 3, and the delayed chrominance component F' via the circuit 14 and the switch 23, which two components are then combined.

With respect to the specific embodiment of the device according to the invention, it is evident that various obvious further modifications and extensions are possible. For example, it is evident that the device as such is not capable of compensating for a dropout of longer than one line period or for a signal dropout which occurs exactly one line period after a previous dropout, because then no suitable compensation signal is available. In respect of the luminance component this may be remedied by including an additional switch 28 before the delay means 12, which switch is coupled to the switch 3, which is denoted by the dashed line 29 in Figure 4. With the aid of the switch 28 the output of the delay line 12 is connected to its input upon the occurrence of a dropout, so that a closed loop system is obtained. Of course, an amplifier should be included in the feedback circuit, in order to compensate for the attenuation of the delay line. It is obvious that a similar step may be employed with respect to the chrominance component by circulating the signal in the delay line 16. In the embodiment of Figure 4 it is also possible instead of using the direct coupling 24 between the switch 23 and the switching means 3, to include in the coupling a logic control with a delay of one line period. This logic control thus returns the switch 23 to the shown position after time interval of one line period after a signal dropout. In the event that within this time interval another dropout occurs, the colour television signal at the output terminal 6 will not exhibit an incorrect colour, but the colour will be suppressed. The same may of course also be achieved in the other embodiments, by including a switch in

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the circuit 14, which switch during the time interval reduces the output signal of the circuit to zero.

5 Finally, it will be evident that in general it will be necessary to include additional delay networks in certain circuits in order to modify the transit times in the various circuits to each other.

WHAT WE CLAIM IS:-

10 1. A dropout compensation device for the compensation of signal dropouts in a video signal, which signal comprises a colour television signal with a luminance component and a chrominance component, which signal is
15 modulated on a carrier wave, which device includes an input terminal for receiving a video signal, a first circuit coupled to said input terminal, including a demodulator for supplying a demodulated colour television signal, a second
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second delay means, a recombining circuit for recombining the luminance component supplied by the second circuit and the chrominance component supplied by the third circuit, 30 and a switching means controlled by a dropout detector, which means is adapted to normally transfer the colour television signal supplied by the first circuit to an output terminal and during a signal dropout transfer the signal 35 supplied by the recombining circuit, the second circuit being adapted to receive the video signal directly from the input terminal and includes a demodulator for demodulating the luminance component of the delayed video signal. 40

2. A dropout compensation device substantially as herein described with reference to Figures 2, 3 or 4 of the accompanying drawing.

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