

The present invention relates to a system for the transmission of colour television signals on narrow-band channels or transmission lines.

5 The transmission of television signals on narrow-band channels or transmission lines demands the use of digital techniques of compression and of decompression of the image. According to these techniques, the television signal is converted, on transmission, into digital samples to be stored in a memory in the manner, for
10 example, described in Patent US-A-4,335,393, but, by way of a difference from what is described in this document, the samples are subsequently restored at a rate which is far slower than that which permitted their storage in order either to be retransmitted directly on the trans-
15 mission channel or line or again to permit the restoration of an analog television signal with a format adapted to the characteristics of the audio frequency channel or line used.

The transformation on transmission of the television signal into a signal having the characteristics of an audio frequency signal has as an advantage that it permits the performance of recordings on low-cost media such as magnetic tapes by means of simple tape recorders. However, this recording technique complicates to a great
20 extent the construction, on reception, of the devices for restoring the image. In fact, it is imperative to maintain, throughout the processing of the signal, the precise position of the phase angle of the colour sub-carrier, not only at the location which it must occupy in
25 the space reserved for each line within the video signal, but in addition from lines to lines and from frames to frames, in order to permit a rendering of the retransmitted image which is acceptable to the viewers. When the
30 signal to be transmitted exhibits characteristics having very little variation with time, as is generally so in the case of the signals emanating directly from television cameras, the solutions for resolving this problem
35 lead to simple constructions. On the other hand, when the signals to be transmitted are previously recorded on a

tape recorder, the fluctuations of the speed of travel of the magnetic tape in front of the read heads create difficulty in the precise marking of the components of the television signal which has been recorded. This difficulty involves complications and imperfections in the embodiments of the devices for receiving the image of known receivers.

The object of the invention is to alleviate the aforementioned disadvantages by providing a simple solution to the problem of the fluctuation, over time, of the television signal and sufficient not to involve any defect which is harmful in the restored image.

To this end, the subject of the invention is a system for the transmission of colour television signals on narrow-band channels or transmission lines of the type comprising:

- a transmitter comprising an analog-digital converter for converting the television signal to be transmitted into luminance samples and into chrominance samples, storage means coupled to the analog-digital converter for storing the luminance and chrominance samples delivered by the analog-digital converter, means for reading the storage means for extracting at a much slower rate the luminance samples and then the chrominance samples relative to each one of the stored image lines, a formatting logic coupled to the storage means for juxtaposing the samples of each line to be transmitted according to the rhythm of their extraction from the storage means and for inserting, between each luminance and chrominance sample string, signals for marking each of the thus juxtaposed sample strings, and digital-analog conversion means for converting each luminance and chrominance sample string and for forming the analog signal to be transmitted;

- and at least one receiver, coupled to the transmitter via the channel or the transmission line, comprising an analog-digital converter for transforming the analog signal transmitted by the transmitter into at least one first string of luminance samples and one

second string of chrominance samples, means for storing the sample strings of luminance and chrominance signals delivered by the analog-digital converter and digital-analog conversion means coupled to the storage means for restoring the transmitted television signal in a form capable of allowing its visualisation on a standard television screen,

characterised in that the conversion means of the transmitter are constituted by a programmable synthesizer, whose frequency is linearly controlled as a function of the amplitude of the samples read in the storage means and by a frequency-voltage converter coupled to the programmable synthesizer for converting the frequency delivered by the programmable synthesizer into a voltage proportional to this frequency and by a filtering device, and in that the conversion means of the receiver comprise a dematrixing device coupled to the outputs of the luminance and chrominance memories via a digital-analog converter.

The main advantage of the system according to the invention is that it permits a considerable reduction of the faults which might occur in the course of the restoration of an image from, in particular, video signals read on magnetic tapes. The constitution, within the transmitter, of luminance signal strings separated from chrominance signal strings by marker signals, permits the location, without ambiguity on reception, of the luminance and chrominance signals relative to each one of the lines of the image. It is thus possible to restore faithfully the television signal, irrespective of the fluctuations of speed of the magnetic tapes employed in the course of the recording of the television signal by means of a device for narrow-band transmission according to the invention.

Further features and advantages of the invention will become evident with the aid of the description which will follow, which is given with reference to the accompanying drawings, which are given solely by way of example and in which:

- Figure 1 represents one of the embodiments of the transmission device according to the invention;

- Figure 2 illustrates the chaining of the luminance and chrominance components of a television signal obtained by means of the transmission device of Figure 1;

- Figure 3 is an embodiment of the formatting logics and of the programmable synthesizer of Figure 1;

- Figure 4 is a representation of an embodiment of a receiving device according to the invention.

The transmission device which is shown in Figure 1 comprises a matrixing device 1, two analog-digital converters 2, storage means constituted by a luminance memory 3 and a chrominance memory 4, a formatting logic 5, digital-analog conversion means constituted by a programmable synthesizer 6 and by a frequency-voltage converter 7. The transmission device further comprises a fast addressing counter 8, a slow addressing counter 9, a master oscillator 10, a device for synchronisation of the chrominance and luminance signals 11 and a filtering device 12.

The matrixing device 1 is designed to receive on its inputs the red, green and blue television signals which are customarily delivered by television cameras in order to transform them in a known manner into a luminance component E_Y and into two colour difference components D_R and D_B . The components E_Y , D_R and D_B are applied to the input of the analog-digital converter 2. In Figure 1, E_R , E_V and E_B designate the primary signals representing the red, green and blue components of the television signal and these signals are applied to the input of the matrixing device 1. The elaboration by the matrixing device of the signals E_Y , D_R and D_B is performed, in a known manner, by respecting the relations

$$E_Y = 0.3 E_R + 0.59 E_V + 0.11 E_B$$

$$D_R = E_R - E_Y$$

$$D_B = E_B - E_Y.$$

The conversion into digital samples of the signals E_Y , D_R and D_B is likewise performed in a known

manner by the analog-digital converters 2. In a preferred embodiment of the invention, the analog signal E_v is converted by an analog-digital converter 2 into 512 eight-bit encoded samples per image line. The analog signals representing the colour differences D_R and D_B are likewise encoded in a known manner in 256 samples, each encoded on eight bits. The samples delivered by the analog-digital converters 2 forming the luminance component E_v on the one hand, and those of the chrominance components D_R and D_B on the other hand, are applied respectively to the data inputs of the memories 3 and 4 to be recorded respectively in each one of these at locations addressed by the fast address counter 8. In a preferred embodiment of the invention, the progression of the counter 8 is undertaken in such a manner as to permit the writing in memory of a sample every 100 nanoseconds. The reading of the memories 3 and 4 is executed at a much slower speed by means of the slow counter 9 which progresses, in the preferred embodiment of the invention, at a low frequency close, for example, to 15 kilohertz. The samples which are read within the memories 3 and 4 at the locations designated by the address counter 9 are applied to the inputs of the formatting logic 5 which transforms into a binary train the luminance and chrominance sample strings which are read successively in the memories 3 and 4. In the preferred embodiment of the invention, the formatting logic 5 constructs, for each one of the image lines, a first string of samples Y_1 formed by the 512 points of each image line, a second string of samples R_1 formed by 256 points of the colour difference information D_R which are read in the memory 4, and finally a third string B_1 of 256 information points D_B which are read in the memory 4. The strings Y_1 , R_1 and B_1 are juxtaposed in a row one behind the other in order to form a digital train and each string is separated from the string which precedes it or which follows it by marker signals in order to permit the identification of each one of the luminance or chrominance strings in the digital train thus formed. The digital train formed by the formatting

logic 5 is transmitted to the input of the programmable synthesizer 6, whose output frequency is controlled on the basis of the magnitude of each one of the samples delivered by the formatting logic 5. The value of the frequency delivered by the programmable frequency synthesizer 6 is transformed by the converter 7 into analog signals, the amplitude of which is proportional to the frequency of the signal created by the programmable synthesizer 6. As the frequency of the programmable synthesizer 6 is proportional to the magnitude of the samples of each one of the luminance or chrominance strings delivered by the formatting logic 5, the result is that the analog signal delivered by the converter 7 has an amplitude proportional to the magnitude of each one of the samples created by the formatting logic 5. The converter 7 delivers, under these conditions, an analog television signal composed of separate strings of analog luminance signals Y and of analog chrominance signals D_R , D_B according to the representation of Figure 2. In order to permit the identification of each one of the analog signals within each string, the analog signals are separated from one another by marker signals 13, 14 and 15.

A representation of the assembly composed of the formatting logic 5 coupled to the programmable frequency synthesizer 6 is represented in Figure 3 within rectangles in broken lines. In Figure 3, the formatting logic 5 is reduced to a multiplexing circuit 19 which is connected by three inputs to the corresponding outputs of the luminance and chrominance memories 3 and 4 which transmit respectively the even and odd samples of the luminance signal E_Y and of the colour difference signals D_R and D_B . The multiplexing circuit 19 receives, on its control inputs C_1 and C_2 , the multiplexing instructions Y/C delivered by the synchronisation device 11 of Figure 1. It executes successively the connection of the outputs of the memories 3 and 4 to the input of the programmable frequency synthesizer 6, one construction of which, which is shown in Figure 3 within a rectangle in broken lines,

is composed of a fixed-rank counter 16, of a programmable counter 17 and of a programmable read-only memory 18. The fixed-rank counter 16 has its input coupled to the output of the master oscillator 10 of Figure 1. The operating frequency of the master oscillator 10 is set at 80 MHz, in the preferred embodiment of the invention. The output of the fixed-rank counter 16 is connected to the counting input of the programmable counter 17, the division rank of which is fixed by the contents of the programmable read-only memory 18. As a function of the magnitude of each one of the samples delivered by one of the memories 3 or 4, the memory 18 assigns a rank value to the programmable counter 17 in order to affect the division executed by this counter and to modify the output frequency of the signals delivered by the latter in a manner proportional to the amplitude of the samples delivered by one or the other of the memories 3 and 4. The output of the programmable counter 17 is coupled by the link 21 to the input of the frequency-voltage converter 7 of Figure 1. The amplitude of the output voltage of the converter 7 follows the amplitude of the strings of the samples delivered by the assembly of the memories 3 and 4 in the manner which is represented in Figure 2. The formatting logic comprises, in addition, a generator of marker bits 22 which are applied to a fifth input of the multiplexer 19. These marker bits are applied by the multiplexer 19 between each string of samples delivered by the memories 3 and 4 to the input of the programmable read-only memory 18; this modifies the counting capacity of the programmable counter 17 and the frequency of the programmable synthesizer 6 in order to obtain at the output of the frequency-voltage converter 7 marker signals of the type of those represented at 13, 14 and 15 in Figure 2.

The reception device according to the invention is represented in Figure 4. The receiver, which is represented in Figure 4, comprises a band pass filter 23, a frequency demodulator 24, an analog-digital converter 25, a line memory 26, a demultiplexer circuit 27, a luminance memory 28, a chrominance memory 29,

digital-analog conversion means formed by a digital-analog converter 30, a filter 31, and a dematrixing device 32. The receiver further comprises a write counter 33 controlled from a multiplier by sixteen 34 and from a master oscillator 35, a fast address counter 36, a synchronisation device 37, a synchronisation detection device 38, a delay device 39 and a slow address counter 40. The reception device represented in Figure 4 is more especially adapted for the reception of video frequency signals transmitted by a device of the type of that which is represented in Figure 1, by means, for example, of the audio frequency channel of a frequency-modulation transmitter. This adaptation is performed by means of the band pass filter 23 and of the frequency demodulator 24 which restore the video frequency signal in baseband from the signal received from the audio frequency channel applied to the input A of the filter 23. In this mode of use, the analog-digital converter 25 is coupled to the output of the frequency demodulator 24, to convert the analog signal in baseband delivered by the frequency demodulator 24 into digital samples. The digital samples obtained are applied to the input of the line memory 26 which, in order to be compatible with the device represented in Figure 1, possesses a storage capacity of 256 samples of eight bits each. These samples are passed back within the line memory 26 by means of the write counter 33 which is driven by the master oscillator 35 at a speed which is very much greater, in the example of Figure 4, than the sampling frequency of the analog-digital converter 25. The samples stored within the line memory 26 are read by the read counter 40 and are applied to the input of the demultiplexing circuit 27 which orients the samples delivered by the line memory 26 either to the input of the luminance memory 28 or to the input of the chrominance memory 29. The outputs of the memories 28 and 29 are coupled to the digital-analog converter 30 which restores, to analog form, the strings of the samples stored within the memories 28 and 29 in order to reshape the analog luminance signal E_y and the colour difference

signals D_R and D_B . These luminance and chrominance signals, after filtering and shaping by the filter 31, are applied to the dematrixing device 32, which restores on its outputs the primary signals E_R , E_V and E_B in a form which is directly acceptable by a standard television screen (not shown).

Although the principles of the present invention have been described hereinabove in relation to a particular illustrative embodiment, it is necessary to appreciate that the description has been given only by way of example and does not limit the scope of the invention. In particular, it will be understood that the invention may likewise be applied to systems in which the colour information is transmitted one line in two. In this case, filtering means may be installed in the transmitter in order to avoid the beat phenomena known under the names of "cross colour" or of "cross luminance" which are due to the coloured horizontal transitions. A vertical filtering device may be constructed by transmitting a linear combination of the colour information items and by associating, for example, the digital luminance and chrominance sample strings in the following manner

$$Y_1, R_1, Y_2, B_1, Y_3, R_2, \dots$$

$$\text{with } R_1 = \frac{D_{R_1} + D_{R_2}}{2} \quad B_1 = \frac{D_{B_1} + D_{B_2}}{2}$$

$$R_2 = \frac{D_{R_3} + D_{R_4}}{2}$$

On transmission, the constitution of R_1 and B_1 etc... will be the easier, the slower the speed at which this is to be performed.

On reception, it will be possible to restore the colour information to each line transmitted by inserting a chrominance line memory operating at the rhythm of the television signal in order to fill the memories one line in two. However, in order to preserve the advantage of the hardware compatibility between two vertical full-definition or half-definition chrominance receivers, it will likewise be possible to prefer to inscribe in

chrominance memory two identical successive lines, while maintaining the original chrominance memory capacity.

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CLAIMS

1. System for the transmission of colour television signals on narrow-band channels or transmission lines of the type comprising:

5 - a transmitter comprising an analog-digital converter (2) for converting the television signal to be transmitted into luminance samples and into chrominance samples, storage means (3, 4) coupled to the analog-digital converter (2) for storing the luminance and
10 chrominance samples delivered by the analog-digital converter (2), means (9) for reading the storage means (3, 4) for extracting at a much slower rate the luminance samples and then the chrominance samples relative to each one of the stored image lines, a formatting logic (5)
15 coupled to the storage means (3, 4) for juxtaposing the samples of each line to be transmitted according to the rhythm of their extraction from the storage means (3, 4) and for inserting, between each luminance and chrominance sample string, signals (13, 14, 15) for marking each of
20 the thus juxtaposed sample strings, and conversion means (6, 7) for converting each luminance and chrominance sample string and for forming the analog signal to be transmitted;

 - and at least one receiver, coupled to the trans-
25 mitter via the channel or the transmission line, comprising an analog-digital converter (25) for transforming the analog signal transmitted by the transmitter into at least one first string of luminance samples and one second string of chrominance samples, means (26, 28, 29)
30 for storing the sample strings of luminance and chrominance signals delivered by the analog-digital converter (25), and digital-analog conversion means (30, 31, 32) coupled to the storage means (28, 29) for restoring the transmitted television signal in a form capable
35 of allowing its visualisation on a standard television screen, characterised in that the conversion means (6, 7) of the transmitter are constituted by a programmable synthesizer (6), whose frequency is linearly controlled as a function of the amplitude of the samples



read in the storage means (3, 4) and by a frequency-voltage converter (7) coupled to the programmable synthesizer (6) for converting the frequency delivered by the programmable synthesizer (6) into a voltage proportional to this frequency, and by a filtering device (12), and in that the conversion means (30, 31, 32) of the receiver comprise a dematrixing device (32) coupled to the outputs of the luminance and chrominance memories via a digital-analog converter (30).

2. System according to Claim 1, characterised in that it further comprises a matrixing device (1) for converting the primary signals (E_R , E_V , E_B), which represent the red, green and blue components of the television signal, into signals of luminance E_Y and of colour difference D_R and D_B , and for applying the signals thus obtained to the input of the analog-digital converter (2).

3. System according to Claim 2, characterised in that the formatting logic (5) delivers for each one of the image lines a first string of samples Y_1 consisting of the 512 luminance points of each line, a second string of samples R_1 consisting of the 256 information points of colour difference D_R and a third string B_1 of 256 information points of colour difference D_B .

