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(54) METHOD OF RECORDING TELEVISION VIDEO INFORMATION

(71) We, PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED, of Abacus House, 33 Gutter Lane, London, E.C.2., a British Company, 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 method of recording television video information (which may include colour information), on a record medium, in which method the information is produced in the form of a composite signal containing components relating to a carrier frequency-modulated by luminance information and at least one further carrier modulated by further information, which modulated further carrier lies in a lower part of the frequency spectrum than does the frequency-modulated carrier.

Copending Application 29938/71 (Serial No. 1,334,411) discloses one such method for use in recording a colour video signal on a magnetic tape, the further information being colour information. The modulated further carrier is superposed on the frequency-modulated carrier and the resulting signal is recorded on the tape, the frequency-modulated carrier acting effectively as a magnetisation bias signal for the modulated further carrier. The signal ultimately recorded by this method has components of varying frequency and amplitude. Thus it is necessary that the record medium is capable of carrying such amplitude variations (which of course a magnetic tape can).

However, some record media are only capable of carrying information in the form of two signal levels. One such medium is the disc described in copending Application 9487/72 (Serial No. 1,391,541) on which the information is recorded in a spiral track in the form of a high-and-low pattern, the said track being scanned by means of a beam of radiation during playback. (In this Patent Specification 1,391,541 is claimed an information carrier of disc form having a number

of tracks constituting the successive turns of a spiral or a number of separate circular concentric tracks wherein:—

(a) Audio and/or video signals are stored in the tracks as a topographical structure composed of first areas which all lie in a first plane and are separated by second areas which all lie in a second plane parallel to and spaced from the first plane by a distance comparable to a wavelength of optical radiation,

(b) Said signals are represented by variations in the lengths of said first areas and/or said second areas in the track direction,

(c) The first areas have coefficients of optical reflection or of optical transmission equal to each other and to those of the second areas and,

(d) The carrier and its track structure are such that the optical path length for a read beam of optical radiation reflected from or transmitted through the carrier at a first area differs from the corresponding path length at a second area in such manner that radiation reflected at or transmitted by the first areas has a phase difference with respect to radiation reflected at or transmitted by the second areas.) Another such medium is a disc on which the information is recorded in a spiral track in the form of a black-and-white pattern. It will be evident that such a pattern cannot carry information about amplitude variations directly.

Even if a record medium, such as magnetic tape, is used which does allow variations in signal amplitude to be recorded, it is sometimes advantageous to record a signal which does not carry amplitude variations, because any undesired amplitude variations occurring during playback need have no effect. In the known method of recording referred to above in which the amplitude of the recorded signal carries the colour information, signal amplitude variations will obviously be disturbing, unless special precautions are taken.

According to one aspect the invention provides a method of recording television video information on a record medium, said method comprising the steps of (a) producing the in-

formation in the form of a composite signal comprising a carrier which is frequency-modulated by luminance information and the oscillation representing which has the instants at which its ascending and descending edges cross a reference level shifted in mutually opposite dependence upon at least one further carrier modulated by further information, which modulated further carrier lies in a lower part of the frequency spectrum than does the frequency-modulated carrier, and (b) recording information about said composite signal on said medium, which last information is concerned only with said instants.

According to another aspect the invention provides apparatus for recording television video information on a record medium, said apparatus comprising means for producing said information in the form of a carrier which is frequency-modulated by luminance information and the oscillation representing which has the instants at which its ascending and descending edges cross a reference level shifted in mutually opposite dependence upon at least one further carrier modulated by further information, which modulated further carrier lies in a lower part of the frequency spectrum than does the frequency-modulated carrier, and means for recording information about said composite signal on said medium, which last information is concerned only with said instants.

It has been recognised that both the luminance information and the further information can be recovered solely from a knowledge of said instants. Moreover, such recovery may be readily effected using suitable filters.

Preferably the frequency-modulated carrier has a constant slope over as large an amplitude range as possible around said reference level, because this amplitude range determines the maximum permissible amplitude of the modulated further carrier, a larger amplitude of the further carrier resulting in non-linear shifts in said instants with changes in the amplitude of the modulated further carrier. In this respect the most suitable shape for the frequency-modulated carrier would be triangular, because it would then have a constant slope over its entire amplitude range. However, sometimes a certain non-linear dependence of the shift in said instants upon the amplitude of the further carrier may be desirable, for example in order to compensate for other non-linearities occurring in the recording and playback processes. Sufficient linearity may be obtained with a sinusoidal frequency-modulated carrier, provided that the amplitude of the modulated further carrier added to it is not excessive.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 shows a first example of a spectrum of a colour television video information signal,

Figure 2 shows signal wave-forms,

Figure 3 shows a second example of a spectrum of a colour video information signal,

Figure 4 shows television recording apparatus,

Figure 5 shows an alternative television recording apparatus,

Figure 6 shows a third example of a spectrum of a colour video information signal,

Figure 7 shows a fourth example of a spectrum of a colour television video information signal,

Figure 8 shows a fifth example of a spectrum of a colour video information signal, and

Figure 9 shows apparatus by means of which a record medium provided with television information can be played back.

In the spectrum shown in Figure 1, which is of a colour video signal such as is recorded on a magnetic tape by known apparatus, E_L denotes the frequency band occupied by a luminance component of the signal, which component comprises luminance information frequency-modulated on a carrier of frequency F_L . Similarly E_C denotes the frequency band of a colour component of the signal, which component comprises colour information modulating a carrier of frequency F_C . The latter component may be obtained by separating the colour signal from a conventional colour video signal, mixing it with a signal having a fixed frequency, and separating said component from the resulting signal. The fixed-frequency signal may have a frequency which bears a fixed relationship to the repetition frequency of line synchronizing pulses in the video signal, or it may be produced by an independent oscillator. In the latter case a pilot signal is recorded on the tape by the known apparatus to enable the colour signal to be restored to the correct frequency during playback.

In the known apparatus the colour component E_C is superposed on the luminance component E_L , and the entire signal is recorded on the tape, the luminance component E_L , which has a higher frequency than the colour component E_C , acting as a magnetization bias signal for this colour component. The signal recorded by the known apparatus, which contains both the colour information and the luminance information, has components of varying amplitude and frequency. Figure 2a shows the luminance component E_L as a sinusoidal signal the frequency of which is a function of the luminance information. Similarly, Figure 2b shows the colour component E_C (which has an amplitude considerably smaller than that of the luminance component E_L). In the PAL and NTSC systems

this colour component is a carrier which is modulated both in amplitude and in phase, whereas in the SECAM system it is modulated in frequency only. If the two components E_y and E_c are added together the sum signal $E_y + E_c$ shown in Figure 2c is obtained, which is in a form suitable for recording on magnetic tape, but apparently not on a medium which can accommodate only two levels, such as a disc having only black-and-white or high-and-low patterns, because such a medium cannot record amplitude variations.

Figure 2c shows, however, that, because the luminance component is in the form of an oscillation the slope of which where it crosses the zero or mean-value line is finite, the superposition of the colour component thereon has produced a sideways shift (x) of the crossing points of said zero or mean-value line by the luminance component. The magnitude of this shift depends upon the instantaneous value of the colour component E_c and also upon the actual slope of the luminance component oscillation in the vicinity of the zero or mean-value line.

Assuming the slope of the luminance oscillation to be constant about the zero or mean-value line within an amplitude range which corresponds to the maximum amplitude of the colour component, the shift of the crossing points is directly proportional to the instantaneous value of the colour component. Thus the positions of the crossing points of the sum signal $E_y + E_c$ are a measure of both the luminance information contained in the component E_y and the colour information contained in the component E_c .

If the signal of Figure 2c is applied to a level detector, for example a hysteresis-free Schmitt trigger, which takes up a first state as soon, and as long, as the sum signal has a positive value and takes up a second state as soon, and as long, as this sum signal has a negative value, a pulse signal may be obtained as shown in Figure 2d. (The terms "positive" and "negative" are to be understood to be relative to the zero or mean-value line of the original luminance component E_y , which line may lie at a voltage other than zero owing to the presence of a direct-voltage component).

The cross-points of the zero or mean-value line of the signal shown in Figure 2d correspond to those of the sum signal $E_y + E_c$, and such a signal is in a form suitable for recording on a record medium which can accommodate only two levels, such as the aforementioned discs having high-and-low or black-and-white patterns.

The pulse signal shown in Figure 2d may alternatively be obtained by applying the sum signal $E_y + E_c$, possibly after amplification, to a limiter which limits its positive and negative excursions to, for example, a maximum value L (see Figure 2c).

As an alternative the signal of Figure 2d may be replaced by a series of pulses each of which corresponds to the position of one crossing point.

In any case it is recorded by means not shown on a record medium, so that the only information the record medium contains about the signal of Figure 2c is information concerning the instants at which it crosses its zero value.

In practice non-linearities may be produced for example, in the process of recording, and also may occur because the slope of the luminance component oscillation is not absolutely constant. These non-linearities can give rise to mixing products between the frequency bands in the sum signal. The conversion of the sum signal into a pulse signal may also give rise to mixing products. However, if the various signal components are suitably chosen, these mixing products can be tolerated, which will be explained with reference to the spectrum of the sum signal shown in Figure 3 and the pulse signal obtained from this sum signal.

For simplicity Figure 3 shows only the carrier frequencies. Similarly to Figure 1 the sum signal $E_y + E_c$ contains a luminance carrier frequency F_y and a colour carrier frequency F_c . If this sum signal is applied to a limiter, the output signal of the limiter contains a colour carrier frequency F_c' at the same frequency as F_c and a component at the mirror frequency with respect to F_y , i.e. at a frequency of $2F_y - F_c$. Further components at frequencies of $F_y \pm n(F_y - F_c)$ are produced, as are mixing products at $F_y \pm mF_c$. The components at frequencies higher than F_y are of no consequence because only the lower sideband of the modulated carrier F_y need be utilised during playback and hence these components can be filtered out. It has been found that most disturbance is produced by the component at the frequency $F_y - 2F_c$, since it has the largest amplitude and cannot be eliminated by filtering (because it lies within the frequency band of the luminance component). However the adverse effect of this component can be kept within tolerable limits provided that the amplitude of the modulated colour carrier is not too large, because then the amplitude of said component also stays comparatively small.

An alternative or additional measure is to choose a colour carrier frequency such that the second-order sideband $F_y - 2F_c$ lies at a frequency such that the moiré pattern produced thereby on display has a form such as to give rise to minimum disturbance. For example, in the NTSC system the colour carrier frequency F_c may be such that the frequency $2F_c$ is equal to an odd multiple of one half of the line frequency. In the PAL system (latest version) this colour carrier frequency F_c may be such that $2F_c$ is an

odd multiple of one quarter of the line frequency plus or minus 25 Hz. Such a choice of colour carrier frequency results in the disturbing pattern due to the second lower sideband $F_y - 2F_c$ moving diagonally across the display screen.

Apart from the mixing products produced the spectrum is found to be identical with that shown in Figure 1. The amplitude of the colour carrier is however, reduced by more than half, but this may be compensated for by additional amplification during playback.

Figure 4 shows a circuit arrangement for producing a signal similar to that shown in Figure 2d. In Figure 4 a video signal V to be recorded, which may for example be built up according to the PAL, NTSC or SECAM system, is applied to a separating filter 1 in which the colour component E_c' is separated from the luminance signal E_y' by means of a band-pass filter and the luminance signal is obtained from the signal V via a low-pass filter. The carrier F_y , which is generated by an oscillator 3 and may, for example, have a square-wave form, is frequency-modulated by the luminance signal in known manner in a modulator 2. The output signal from the modulator 2 is applied to a low-pass filter 4 which has the function of ensuring that the luminance component oscillation E_y which appears at its output has edges of finite slope and, owing to its location succeeding the modulator, also ensures that the slope of the said edges is approximately independent of the frequency of the luminance information.

The colour component E_c' separated by the separating filter 1 is converted down in known manner by mixing it in a mixer stage 5 with a mixing signal produced by an oscillator 6. This oscillator may, for example, have a frequency related to the line frequency, which simplifies subsequent reconversion of the colour signal. The converted colour component E_c obtained from the mixer stage 5 and the luminance component E_y are added together in a summing stage 7 to give the sum signal $E_y + E_c$.

This sum signal is applied to a detector circuit 8 which detects the crossings of the zero or mean-value line by the sum signal and in response thereto generates a pulse signal having corresponding crossings, which pulse signal V_R is recorded on a record medium. The detector circuit 8 may, for example, comprise a level detector having two possible stable states depending upon whether the applied signal exceeds or does not exceed a given value.

As has been mentioned hereinbefore, the detector circuit 8 may be replaced by a limiter which limits its input signal to a predetermined amplitude and thus produces a signal which, possibly after amplification, has a suitable pulse form.

Figure 5 shows a second circuit arrange-

ment for obtaining the desired recording signal V_R . In this arrangement the frequency-modulated carrier E_y (which may have a substantially square-wave form) is applied to a separating stage S which separates the leading edges of this signal from its trailing edges and applies signals which correspond to these edges to two identical variable delay devices R_1 and R_2 such as "bucket-brigade" delay lines. The modulated carrier E_c is applied to a control circuit C which is connected to the delay control inputs of the two delay devices R_1 and R_2 . To indicate that the delay periods introduced by the two delay devices vary in opposite senses in accordance with the modulated carrier E_c , an inverter I is included in the connection between the control circuit C and the control input of the delay device R_2 .

Thus the crossing points of the zero or mean-value line by the modulated carrier E_y are given the desired shifts by means of the two delay devices R_1 and R_2 . The desired recording signal V_R is obtained by combining the output signals from these two delay circuits in a combining circuit O.

The separation of the leading edges from the trailing edges may be effected in a very simple manner by initially modulating the luminance information on a carrier having twice the desired frequency, and then dividing the frequency of the resulting signal by two. The leading and trailing edges are already obtainable independently of one another on carrying out such a division operation so that in this case the separating stage S will be effectively included in the divider.

Recording an audio signal associated with the video signal may advantageously be effected in a manner identical with that used in recording the colour information. For this purpose the audio signal present in the original video signal is converted to a frequency below the frequency band occupied by the luminance signal, to result in an overall spectrum of the form shown in Figure 6. The sound modulates a sound carrier of frequency F_s , so that a sound component E_s having an amplitude lower than the colour component E_c and a bandwidth of, say, 75 kHz about a carrier frequency of, say, 250 kHz is obtained. The addition of the sound requires the colour carrier frequency F_c and the carrier frequency F_y to be slightly higher (for example 1 MHz and 4 MHz respectively) than would otherwise be necessary, so that a slightly wider frequency band is required. Obviously the sound component frequency band may alternatively lie between those of the colour component E_c and the luminance component E_y .

To enable the sound signal to be recorded in this manner the arrangement shown in Figure 4 may be modified either by including a sound mixer stage by means of which this sound signal (which is assumed to initially

modulate an intercarrier frequency) is converted down and an additional input on the adder 7, enabling a sum signal $E_y + E_c + E_s$ to be obtained, (which sound mixer stage may be fed with a mixing signal from a further oscillator or from the oscillator 6) or by feeding the sound carrier to the mixer 5 in addition to the colour carrier.

In a practical embodiment the frequency of the colour carrier was made 64 times the line frequency, i.e. 1 MHz, whilst the frequency of the sound carrier was 250 kHz. The resulting simple relationship between these two frequencies facilitates the production of the mixing products required for the conversion of the colour and sound components.

If the input signal is a standard demodulated colour T.V. carrier the sound signal can be converted down by means of the same mixing signal as is used for converting the colour signal down. In a PAL system in which a colour signal modulates a colour carrier of 4.43 MHz, and sound modulates a carrier of 5.5 MHz, after conversion by means of a mixing signal having a frequency higher than 5.5 MHz these two carriers will still have a frequency spacing of $5.5 - 4.43 = 1.07$ MHz. This spacing is greater than that required, which may mean a waste of bandwidth.

To obviate this disadvantage the mixing signal frequency may be chosen to lie between the colour carrier (4.43 MHz) and the sound carrier (for example 5.5 MHz), as illustrated in the spectrum shown in Figure 7. In this Figure the colour carrier frequency is denoted by F_c' and the sound carrier by F_s' . The mixing signal F_m is chosen to have a frequency of 5.3 MHz. After the colour and sound carriers F_c' and F_s' have been mixed with the mixing signal F_m the colour carrier F_c and the sound carrier F_s are produced at 0.87 MHz and 0.2 MHz respectively. These carriers are spaced by only 0.7 MHz, so that the available bandwidth is used to considerably better account and the minimum permitted spacing between the two frequency bands is approximated to.

When the resulting recorded signal is played back and reconverted to a standard television signal an upper sideband F_{c2} at a frequency of 6.17 MHz will be produced in addition to the desired colour carrier F_{c1} at 4.43 MHz. This may be easily eliminated as it lies outside the spectrum of the desired signals. Also a lower sideband at 5.1 MHz will be produced in addition to the desired sound carrier at 5.5 MHz. The latter may be eliminated together with the mixing signal F_m used to reconvert the recorded signal by means of a band-pass filter.

Figure 8 shows the spectrum of a recorded colour video signal which may be reproduced by both a receiver operating according to the PAL system and a receiver operating according to the SECAM system, without the

necessity to employ a PAL/SECAM converter. The spectrum contains both a colour carrier F_{cp} quadrature-modulated by first and second colour signals according to the PAL system and a colour carrier F_{cs} frequency-modulated by first and second colour signals alternately from line-to-line of the video information according to the SECAM system. The two signals E_{cp} and E_{cs} are superposed, if desired, together with a sound signal, on the luminance component E_y comprising the frequency-modulated carrier F_y and converted into a pulse signal and recorded in a manner as described hereinbefore. Depending on the type of receiver used in playback either the signal E_{cp} or the signal E_{cs} is retransferred to the appropriate frequency band, and the undesired colour signal is eliminated.

Figure 9 shows a circuit arrangement for playing back a record made by the apparatus described with reference to Figures 4 or 5, which playback apparatus may be in combination with the recording apparatus. A signal V_R (corresponding to the signal V_R originally recorded) derived from the record medium is applied to a separating filter 11 which has pass characteristics corresponding to the parts of the spectrum occupied by the various components of V_R and which therefore separates these various components (in the example considered the luminance component E_y and the colour component E_c only). The luminance component is applied to a demodulator 12 in which the luminance information signal E_y' is demodulated from its modulated carrier. The colour component E_c is applied to a mixer stage 13 to which is also applied a mixing signal produced by an oscillator 14. Mixing produces the colour component E_c' in the desired part of the spectrum. This colour component E_c' is added to the luminance signal E_y' and the resulting signal V may be applied to a suitable input of a television receiver. By modulating this sum signal V on a high-frequency carrier in a stage 16 a signal V_{HF} is obtained which may be applied directly to the aerial input of the receiver via a twin-lead cable.

If the signal V_R derived from the record medium also contains sound information situated in a separate frequency band (which information may relate to monophonic, stereophonic or even quadrophonic sound) this frequency band or bands must also be separated out by the filter 11, and the sound signal subsequently reconverted to the correct frequency band in a similar manner to that described for the colour signal. The mixing signal produced by the oscillator 14 may also be used for this reversion if the same mixing frequency has been used for both when they are initially converted to lower frequency bands.

The mixing frequency produced by the oscillator 14 may bear a fixed simple rela-

tionship to the line frequency or to the frequency of the colour carrier (4.43 MHz in the PAL system).

5 The record medium in all the embodiments described may comprise an information track which is either spiral or comprises concentric circles and comprises blocks of constant height separated by intermediate spaces, variations in the lengths of the blocks and/or
10 of the intermediate spaces corresponding to said information.

WHAT WE CLAIM IS:—

1. A method of recording television video information on a record medium, said method
15 comprising the steps of (a) producing the information in the form of a composite signal comprising a carrier which is frequency-modulated by luminance information and the oscillation representing which has the instants
20 at which its ascending and descending edges cross a reference level shifted in mutually opposite dependence upon at least one further carrier modulated by further information, which modulated further carrier lies in a
25 lower part of the frequency spectrum than does the frequency-modulated carrier, and (b) recording information about said composite signal on said medium, which last information is concerned only with said instants.

30 2. A method as claimed in Claim 1, wherein the reference level is the mean d.c. level of the frequency-modulated carrier.

3. A method as claimed in Claim 1 or 2, wherein the oscillation representing the frequency-modulated carrier has a finite slope around said reference level and the composite
35 signal is formed by adding the or each modulated further carrier to this frequency-modulated carrier.

40 4. A method as claimed in Claim 3, wherein said slope is substantially linear on each side of said reference level over an amplitude at least equal to the maximum amplitude of the further carrier or carriers.

45 5. A method as claimed in any preceding Claim, wherein a signal is recorded on the record medium which only has two values transitions between which correspond to said instants.

50 6. A method as claimed in Claim 3 or Claim 4, or in Claim 5 as appended to Claim 3 or Claim 4, wherein the frequency modulated carrier is derived from a low-pass filter after which the or each modulated further
55 carrier is added to it.

7. A method as claimed in any of Claims 3, 4 or 6, or in Claim 5 as appended to Claim 3 or Claim 4, wherein the composite signal is bilaterally limited.

60 8. A method as claimed in any preceding Claim wherein the further information is colour information.

9. A method as claimed in any of Claims

1 to 7, wherein the further information is sound information.

10. A method as claimed in any of Claims 1 to 7, wherein the composite signal includes first and second such further carriers which occupy mutually different parts of the frequency spectrum, the first further carrier
70 being modulated by colour information.

11. A method as claimed in Claim 10, wherein the composite signal is produced from an input signal comprising a luminance signal, colour information modulating a colour carrier, and sound information modulating a sound carrier by mixing the modulated colour and sound carriers with a common mixing signal to produce said further carriers.

12. A method as claimed in Claim 11, wherein the frequency of the mixing signal lies between the frequency bands occupied by the modulated colour and sound carriers.

13. A method as claimed in Claim 10, wherein the first further carrier is quadrature-modulated by first and second colour signals, and the second further carrier is frequency-modulated by first and second colour signals alternately from line-to-line of the video information.

14. A method of recording television video information on a record medium, substantially as described herein with reference to any of Figures 2 to 8 of the drawings.

15. Apparatus for recording television video information on a record medium, said apparatus comprising means for producing said information in the form of a carrier which is frequency-modulated by luminance information and the oscillation representing which has the instants at which its ascending and descending edges cross a reference level shifted in mutually opposite dependence upon at least one further carrier modulated by further information, which modulated further carrier lies in a lower part of the frequency spectrum than does the frequency-modulated carrier, and means for recording information about said composite signal on said medium, which last information is concerned only with said instants.

16. Apparatus as claimed in Claim 15, wherein the reference level is the mean d.c. level of the frequency-modulated carrier.

17. Apparatus as claimed in Claim 15 or Claim 16, wherein the means for recording information includes means for producing a pulse signal edges of which coincide in time with said instants, and means for recording said pulse signal on said medium.

18. Apparatus as claimed in Claim 15, 16 or 17, wherein said means for producing said information comprises an adder, means for applying the frequency-modulated carrier in a form the oscillation representing which has a finite slope around said reference level to a first input of said adder, and means for applying the or each modulated further carrier to

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tionship to the line frequency or to the frequency of the colour carrier (4.43 MHz in the PAL system).

- 5 The record medium in all the embodiments described may comprise an information track which is either spiral or comprises concentric circles and comprises blocks of constant height separated by intermediate spaces, variations in the lengths of the blocks and/or
- 10 of the intermediate spaces corresponding to said information.

WHAT WE CLAIM IS:—

1. A method of recording television video information on a record medium, said method comprising the steps of (a) producing the information in the form of a composite signal comprising a carrier which is frequency-modulated by luminance information and the oscillation representing which has the instants at which its ascending and descending edges cross a reference level shifted in mutually opposite dependence upon at least one further carrier modulated by further information, which modulated further carrier lies in a lower part of the frequency spectrum than does the frequency-modulated carrier, and (b) recording information about said composite signal on said medium, which last information is concerned only with said instants.
2. A method as claimed in Claim 1, wherein the reference level is the mean d.c. level of the frequency-modulated carrier.
3. A method as claimed in Claim 1 or 2, wherein the oscillation representing the frequency-modulated carrier has a finite slope around said reference level and the composite signal is formed by adding the or each modulated further carrier to this frequency-modulated carrier.
4. A method as claimed in Claim 3, wherein said slope is substantially linear on each side of said reference level over an amplitude at least equal to the maximum amplitude of the further carrier or carriers.
5. A method as claimed in any preceding Claim, wherein a signal is recorded on the record medium which only has two values transitions between which correspond to said instants.
6. A method as claimed in Claim 3 or Claim 4, or in Claim 5 as appended to Claim 3 or Claim 4, wherein the frequency modulated carrier is derived from a low-pass filter after which the or each modulated further carrier is added to it.
7. A method as claimed in any of Claims 3, 4 or 6, or in Claim 5 as appended to Claim 3 or Claim 4, wherein the composite signal is bilaterally limited.
8. A method as claimed in any preceding Claim wherein the further information is colour information.
9. A method as claimed in any of Claims

1 to 7, wherein the further information is sound information.

10. A method as claimed in any of Claims 1 to 7, wherein the composite signal includes first and second such further carriers which occupy mutually different parts of the frequency spectrum, the first further carrier being modulated by colour information.

11. A method as claimed in Claim 10, wherein the composite signal is produced from an input signal comprising a luminance signal, colour information modulating a colour carrier, and sound information modulating a sound carrier by mixing the modulated colour and sound carriers with a common mixing signal to produce said further carriers.

12. A method as claimed in Claim 11, wherein the frequency of the mixing signal lies between the frequency bands occupied by the modulated colour and sound carriers.

13. A method as claimed in Claim 10, wherein the first further carrier is quadrature-modulated by first and second colour signals, and the second further carrier is frequency-modulated by first and second colour signals alternately from line-to-line of the video information.

14. A method of recording television video information on a record medium, substantially as described herein with reference to any of Figures 2 to 8 of the drawings.

15. Apparatus for recording television video information on a record medium, said apparatus comprising means for producing said information in the form of a carrier which is frequency-modulated by luminance information and the oscillation representing which has the instants at which its ascending and descending edges cross a reference level shifted in mutually opposite dependence upon at least one further carrier modulated by further information, which modulated further carrier lies in a lower part of the frequency spectrum than does the frequency-modulated carrier, and means for recording information about said composite signal on said medium, which last information is concerned only with said instants.

16. Apparatus as claimed in Claim 15, wherein the reference level is the mean d.c. level of the frequency-modulated carrier.

17. Apparatus as claimed in Claim 15 or Claim 16, wherein the means for recording information includes means for producing a pulse signal edges of which coincide in time with said instants, and means for recording said pulse signal on said medium.

18. Apparatus as claimed in Claim 15, 16 or 17, wherein said means for producing said information comprises an adder, means for applying the frequency-modulated carrier in a form the oscillation representing which has a finite slope around said reference level to a first input of said adder, and means for applying the or each modulated further carrier to



a further input or inputs of said adder, an output of said adder being coupled to an input of said means for recording information.

5 19. Apparatus as claimed in Claim 18 including a low-pass filter in series with the first input of the adder.

20. Apparatus as claimed in Claim 18 or 19, when appended to Claim 17 wherein said means for producing a pulse signal comprises a limiter in series with the output of said adder.

21. Apparatus as claimed in any of Claims 18 to 20, including means for producing said composite signal from an input signal comprising a luminance signal, colour information modulating a colour carrier, and sound information modulating a sound carrier, said means comprising first and second mixer stages, means for supplying the modulated colour and sound carriers to the first and second mixer stages respectively, and a single oscillator for supplying the same mixing signal frequency to each of said mixer stages, outputs of said mixer stages being coupled to said further inputs of the adder.

22. Apparatus as claimed in any of Claims 18 to 20, including means for producing said composite signal from an input signal comprising a luminance signal, colour information modulating a colour carrier, and sound information modulating a sound carrier, said means comprising a mixer stage, means for supplying the modulated colour and sound carriers to said mixer stage, and an oscillator for supplying a mixing signal to said mixer stage, an output of said mixer stage being coupled to said further input of the adder.

23. Apparatus for recording television video information, substantially as described herein with reference to any of Figures 2 to 8 of the drawings.

24. Apparatus for recording television video information on a record medium and playing back the recorded information, comprising the combination of recording apparatus as claimed in any of Claims 15 to 23 and playback apparatus including a filter for separating a carrier frequency-modulated by luminance information from at least one further carrier modulated by further information, which modulated further carrier lies in a lower part of the frequency spectrum than does the frequency-modulated carrier, a demodulator for the frequency-modulated carrier, means for feeding the separated fre-

quency-modulated carrier to said demodulator, a mixer stage for converting said modulated further carrier to a high frequency, an oscillator having an output coupled to an input of said mixer stage for feeding a mixing signal thereto, means for feeding the separated modulated further carrier to said mixer stage, and an adder having inputs coupled to outputs of the demodulator and mixer respectively.

25. A record medium on which has been recorded video information by a method as claimed in any of Claims 1 to 14.

26. A record medium as claimed in Claim 25, wherein the information is on a track which is either spiral or comprises concentric circles and comprises blocks of constant height separated by intermediate spaces, variations in the lengths of the blocks and/or of the intermediate spaces corresponding to said information.

27. A record medium as Claimed in Claim 25 of disc form having a number of tracks constituting the successive turns of a spiral or a number of separate circular concentric tracks, wherein said video information is stored in the tracks as a topographical structure composed of first areas which all lie in a first plane and are separated by second areas which all lie in a second plane parallel to and spaced from the first plane by a distance comparable to a wavelength of optical radiation, wherein said information is represented by variations in the length of said first areas and/or said second areas in the track direction, wherein the first areas have coefficients of optical reflection or of optical transmission equal to each other and to those of the second areas, and wherein the medium and its track structure are such that the optical path length for a read beam of optical radiation reflected from or transmitted through the medium at a first area differs from the corresponding path length at a second area in such manner that radiation reflected at or transmitted by the first areas has a phase difference with respect to radiation reflected at or transmitted by the second areas.

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