PATENT SPECIFICATION (11) 1 549 822

(21) Application No. 20445/76 (22) Filed 18 May 1976

(31) Convention Application No. 7 505 938 (32) Filed 21 May 1975 in

(33) Netherlands (NL)

(44) Complete Specification published 8 Aug. 1979

(51) INT. CL.² H04N 5/76

(52) Index at acceptance H4F D12X D1B1 D1B3 D1D1 D24 D30B D30T1 D30T2 EF

(19)

(54) APPARATUS FOR READING RECORD DISCS

(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 apparatus for reading a record or information carrier of disc form (hereinafter referred to as a "disc" or a "record") on which a colour television signal is recorded in substantially parallel tracks, which apparatus is provided with a scanning unit for scanning the record, a decoding device for converting the signal, which has been read with the aid of the scanning unit, into a standard colour television signal, and a command device for controlling the sequence according to which the information on the record is scanned.

Such an apparatus is described in Patent Specification 1,429,882. As scanning unit the apparatus described in said Patent Specification employs an optical system which, with the aid of a beam of radiation reads the information which is recorded on the record or disc. Alternatively, if the record is a magnetic disc, the information may be read with the aid of a magnetic head or heads, whilst there are also records of disc form which can be read mechanically or capacitively.

A colour television signal recorded on such a disc or record is generally not a standard colour television signal, but is especially coded in order to be able to make optimum use of the limited bandwidth of said records. As an example a coding system is mentioned in which the standard television signal as a whole is frequency-modulated on a carrier wave, and coding systems in which the luminance signal and chrominance signal are added to separate carrier waves in separate frequency bands. In order to allow the read apparatus to be directly connected to a standard reproducing or display apparatus, a decoding device is incorporated, which converts the read-out signal into a standard colour television signal in accordance with the PAL, SECAM (Registered Trade Mark) or NTSC standard.

As is described in the abovementioned Patent Specification, a video disc or record is very suitable for obtaining modified displays such as slow-motion, fast motion, reverse motion or still pictures. In particular with optical read systems the scanning point on the record carrier which point is determined by the scanning unit, can be moved freely over said disc without any damage. For example, in the case of a disc with a spiral track, a stationary picture can be obtained by moving said scanning spot back by one track pitch after every revolution of the record carrier. Conversely, in the case of a disc with a number of concentric tracks, a stationary picture is automatically obtained when one such track is continuously followed. In either case the sequence in which the information is read from the record is controlled by a command device whose operation has also been described in the previously cited Patent Specification.

When using such modified display speeds by scanning the information on the record in a sequence other than that used for recording, a problem presents itself if the colour signal is to be applied to a standard PAL or SECAM display apparatus. For which systems the invention is therefore especially of importance. As the problems which occur are basically the same for the two systems, only the problems associated with the PAL standard

will be described hereinafter for simplicity.

The standard PAL colour-television signal is characterized by a line-sequentially alternating phase of one of the colour components of the chrominance signal. In order to enable comparatively simple signal processing to be used during normal reproduction or display of the recorded programme, the recorded colour signal generally also exhibits said line-sequentially alternating phase. *Inter alia* in order to obtain a stationary picture in the most favourable manner, it is useful to record one television image per track *i.e.* per revolution of the disc. Since for a standard PAL colour television signal the number of lines of a television picture is 625, this means that the PAL-phase of the colour signal is the same for the first and the last line of television picture

However this means that when a stationary picture is obtained the line-sequential alternation of the PAL phase is disturbed at the transition from a first reproduction of a recorded television picture to the next reproduction of the same recorded television picture. As a result the reproduction of the colour signal in a standard PAL reproducing apparatus is disturbed. It will be evident that in the case of other modified display speeds the same problem occurs, when e.g. each television picture is scanned twice in succession for slow motion.

It is an object of the invention to provide a simple and inexpensive solution to this problem. To this end the invention provides apparatus for reading a record of disc form on which in substantially parallel tracks a colour television signal is recorded, the chrominance signal of which shows a line sequential alternating pattern, the apparatus being provided with a scanning unit for scanning the record, a decoding device for converting the signal read from the record carrier into a standard colour television signal, and a command device for selectively repeating the scanning of predetermined picture of the television signal recorded on the record, characterized in that the decoding device is provided with a correction circuit which comprises an input terminal for receiving a colour television signal derived from the read-out signal, a first filter for extracting the luminance signal contained in said derived colour television signal, a second filter for extracting the chrominance signal contained in said derived colour television signal, delay means in series with said second filter for delaying the extracted chrominance signal by one line interval and a signal controlled recombination circuit switchable in response to signals from the command device into one of two modes such that in the first mode the recombination circuit produces an output signal comprising the sum of a luminance signal, and a chrominance signal both obtained from said derived colour television signal, that in the second mode the recombination circuit produces an output signal comprising the sum of a luminance signal obtained from said derived colour television signal and of said delayed extracted chrominance signal, and that during the repetition of the predetermined picture said signal controlled recombination circuit selects alternately one and the other of said modes each for the duration of a complete picture.

The signal controlled recombination circuit may comprise a summing means and a two-position switch.

When applied to a PAL system, the invention can ensure that under all circumstances the line-sequential alternation of the PAL-phase in the chrominance signal at the output terminal is maintained. When the same recorded television picture is scanned twice in succession, switching the signal controlled recombination circuit to its second mode during the second scan will ensure that during said second scan the read-out chrominance signal does not directly become available at the output terminal, it being replaced by a chrominance signal which has been delayed by one line period.

As said delayed chrominance signal then always has the opposite PAL-phase compared with that of the undelayed chrominance signal, the line-sequential alternation of the PAL-phase is thus maintained in a substantially correct manner.

It is true that during said second scan the reproduced luminance signal and chrominance signal no longer correctly match in respect of time, because the chrominance signal has been delayed by one line period. However, in the reproduced picture this generally has substantially no effect, because it will only play a part in the case of sharp horizontal transitions.

A first embodiment of the apparatus according to the invention is characterized in that the two-position switch has a first input which is coupled to the second filter, a second input which is coupled to the delay means and a common output, whilst the summing means comprises a first input which is coupled to the first filter, second input which is coupled to the output of the two-position switch and an output which is coupled to the output terminal.

A second embodiment of the apparatus

according to the invention is characterized in that the summing means comprises a first input which is coupled to the first filter, a second input which is coupled to the delay means, and an output, whilst the two-position switch has a first input which is coupled to the input terminal, a second input which is coupled to the output of the summing means, and an output which is coupled to the output terminal. Said second embodiment is to be preferred in the case of systems in which the colour television signal which is recorded on the record carrier consists of a composite signal which has been derived directly from a standard colour television signal without separating the luminance and the chrominance signal. For such a coding of the colour television signal on the record carier care is to be taken that also during reproduction said colour televisision signal is not interfered with in so far as this is possible. In the case of the previously described second embodiment this requirement is met in that during normal reproduction, when the two-position switch occupies the first position, said composite signal is transferred unmodified and a separation and recombination of the chrominance and luminance signal is effected only in the case of modified reproducing speeds.

The invention will be described in more detail by way of example with reference to the accompanying diagrammatic drawings, in which

Fig. 1 shows a part of a spiral track on a disc,

Fig. 2 shows the sequence of lines with the associated PAL-phase during scanning of such a track, and

Figs. 3, 4 and 5 show three examples of the correction circuit which may be employed in read apparatus according to the invention.

Fig. 1 shows a spiral track S on a disc which rotates about a centre M with a direction of rotation v. Said track is scanned by means of a scanning unit which ensures that scanning spot E keeps on track. The read system as a whole, and the servo systems required for it, have been described in the aforesaid Patent Specification 1,429,882 and are not relevant to the principle of the present invention, so that they will not be discussed any further.

It is assumed that exactly one television picture is recorded in each track, *i.e.* a picture P_1 starting with line 1 at the radius vector R and terminating with line 625 at the same radius vector R (European standard). This means that a stationary picture can be obtained very simply by each time having the scanning spot E make a jump D as soon as the radius vector R coincides with said scanning spot E, so that always the same track is scanned.

However, in respect of the chrominance signal this presents a problem, which will be further discussed with reference to Figs. 2a and 2b. In these Figures the spiral track of Fig. 1 has, as it were, been unrolled. Fig. 2a shows the situation in which the scanning spot E continuously follows the spiral track, so that the recorded colour television signal is reproduced at normal speed. Consequently, the television pictures P_1, P_2, P_3 etc. are reproduced successively.

When considering the chrominance signal contained in the recorded colour television signal, if it is required to display the read-out colour television signal in a PAL reproducing apparatus, said chrominance signal will already exhibit the characteristics typical of the PAL standard. This means that the polarity of the colour component (R-Y) will change with every line, which is generally denoted by a line-alternating PAL phase. In Fig. 2a a line with positive PAL phase is shown shaded and it is assumed that line 1 of picture P_1 starts with said positive PAL phase. It is then obvious that line 625 of said picture P_1 will also have a positive PAL phase. Line 1 of the next recorded picture P_2, in contradistinction to line 1 of picture P_1, has the negative PAL phase and line 1 of picture P_3 again the positive PAL phase. From the Figure it is evident that the line-sequential alternation of the PAL phase is maintained from picture to picture, which of coursce is essential for the reproducing apparatus, which responds to these phase alterations so as to reproduce the correct colour picture.

Fig. 2b shows the situation in the case that a stationary picture is obtained by repetitively scanning the same recorded picture P_1, The Figure clearly shows that said line-sequential PAL phase alternation is then disturbed at the start and end of each scan, because the reproduced odd lines of each picture then again have the positive PAL-phase. Thus, the phase of said line-sequential PAL phase alternation does not change as it should from picture to picture. A comparison with Fig. 2a reveals that during the second reproduction of picture P_1 (which corresponds to the reproduction of picture P_2 in Fig. 2a) the PAL-phase of corresponding lines is always opposite in these two cases.

In the reproducing apparatus said phase jump at picture frequency in the PAL phase alternation results in that the electronic circuitry, which responds to this PAL phase alternation, must lock in again

to said changing PAL phase alternation after every picture change, which gives rise to the colour in the reproduced picture being very distorted.

In order to prevent this, the decoding device converts the signal which has been read with the aid of the scanning unit into a standard colour television signal and consequently comprises a correction circuit of which a first embodiment is shown in Fig. 3.

This correction circuit comprises an input terminal 1 to which a colour television signal is applied which has been derived from the signal read from the record. This colour signal applied to the input terminal 1 may have any arbitrary coding, depending on the coding of the signal recorded on the record and the standard colour television signal which is ultimately required. For simplicity it is assumed hereinafter that the colour signal applied to the input terminal is a standard PAL colour signal, but it is emphasised once more that any other coding of the applied colour television signal is permissible.

From this standard PAL colour television signal applied to the input terminal 1 the luminance signal Y is extracted with the aid of a low-pass filter 2, with for example 3-MHz bandwidth. With the aid of band-pass filter 4 the chrominance signal F is extracted, said filter 4 being preceded by a delay element 3 in order to compensate for the delay caused by the low-pass filter 2. Said chrominance signal F is applied both to a first input 10 of a two-position switch 9 and to a delay means 5, which delays said chrominance signal by substantially one line period, *i.e.* approximately 64 μsecs. Said delay means 5 may simply comprise an ultrasonic glass delay line as normally employed in PAL reproducing equipment. The delayed chrominance signal F′ is applied to a second input 11 of the switch 9 *via* an amplifier 6, which may be a variable gain amplifier, which compensates for the attenuation caused by the delay line and which also ensures that the phase of the chrominance signal F′ is correct.

Said switch 9 forms part of a recombination circuit 7 which also includes a summing means 13, having a first input 14 to which the extracted luminance signal Y is applied and a second input 15 which is connected to the master contact of the switch 9. Said switch 9 is controlled by a command device 17, which also controls the sequence in which the information on the record is scanned. Finally, the output 16 of the summing means 13 constitutes the output terminal 8 of the correction circuit.

The operation of this correction circuit is as follows. The switch 9 is normally in the position shown. The summing means 13 then receives the luminance signal Y at its input 14 and the chrominance signal F at the input 15. Consequently, the colour television signal originally applied to input terminal 1 will appear at the output terminal 8.

Assume that the picture P_1 recorded in track S has been scanned with the switch 9 in this position. The alternating PAL-phase of the colour television signal obtained at the output terminal 8 (see Fig. 2c) then fully corresponds to that shown in Fig. 2a (normal reproduction). If the recorded programme is to be reproduced at the normal speed, it is obvious that the switch 9 remains in the position shown.

However, if for example a sationary picture is required, the scanning spot E should perform a jump D after every revolution of the record (see Fig. 1). For this purpose a command signal should be supplied to the servo system which controls the radial position of said scanning spot E as described in the aforesaid Patent Specification 1,429,882. This command signal for the servo system is supplied by the command device 17, which by the detection of the field synchronizing pulses of the read-out colour television signal ensures that the command pulse for the servo system appears during the frame flyback period.

However, this command device 17, simultaneously with the command pulse for the servo system, also supplies a control pulse for the switch 9 so that said switch changes over and input 11 is connected to master contact 12. This means that for the second picture period P'_1 during which the recorded picture P_1 is being read for the second time, the combination of the luminance signal Y and the chrominance signal F′ delayed by one line period becomes available at the output 8 of the correction circuit as a colour television signal. Owing to this one-line-period delay of the chrominance signal, a one-line-period shift of the pattern of the PAL phase alternations is achieved. It is evident from Fig. 2c that the change of the PAL phase which is now obtained in the picture P_1' is in synchronism with that which appears during normal reproduction (Fig. 2a).

The only modification which persists concerns the first line of this reproduced picture P_1', which has the same PAL phase as line 625, so that upon the picture change from P_1 to P_1' three successive lines 625, 1 and 2 will have the same PAL-phase. However, this is of no importance because these 3 lines periods appear during the

picture change, the frame flyback period, so that this disturbance is not visible. Moreover, no information about the PAL phase is available in the colour television signal for a number of lines during this flyback period (no colour burst), so that this brief disturbance of the rhythm of the PAL phase alternation does not present any problem.

On the next command and control pulse from the command device circuit 17 at the beginning of the third scan of the picture P_1 switch 9 is reset to the shown position. Fig. 2c shows that picture P_1'' is then again fully identical to picture P_1 and also has the correct PAL phase immediately after the transition.

Apparatus in accordance with the present invention thus ensures that when a stationary picture is displayed the rhythm of the PAL phase alternation (apart from a perfectly permissible brief disturbance during the frame flyback) is not affected. During the second reproduction (P_1') of the recorded picture P_1 the time relationship between the luminance signal and the chrominance signal is no longer entirely correct, because the chrominance signal has been delayed by one line period. However, generally this does not result in a serious visible disturbance in the reproduced picture, because this shift of the chrominance signal can only play a part in the case of sharp horizontal transitions in the colour.

What has been described hereinbefore for obtaining a stationary picture is equally valid for any other modified display speed. Whenever the command device applies a command pulse to the servo system, for performing a radial jump of the scanning spot by one track pitch or an odd number of track pitches, the switch 9 also receives a control pulse so that its position is changed. Thus the rhythm of the PAL-phase alternation in the colour television signal at the output terminal 8 is automatically maintained correct.

In order to ensure that during normal reproduction of the recorded colour television signal the time relationship of the luminance and chrominance signals is correct, it is very desirable to design the switch 9 so that it has a preferred position in which the input 10 is coupled to the master contact 12. This ensures that, after termination of a period of display at modified speed, said switch automatically assumes said preferred position, irrespective of the position occupied at the end of said period. Depending on the reproducing speeds which are required, this automatic reset to the preferred position is to be performed with a specific time constant when displaying a stationary picture, it is of course possible to ensure in a simple manner that automatic changeover to the normal reproducing speed is not effected until said two-position switch has assumed a first position.

Fig. 4 shows a second embodiment of the correction circuit, in which corresponding elements are denoted by the same reference numerals as in Fig. 3. The input terminal 1 is directly coupled *via* a delay element 3' to the input 10 of the switch 9 of the recombination circuit 7. This input terminal 1 is also connected to the low-pass filter 2 (so that the luminance signal Y is extracted) and *via* a delay element 3 to the band-pass filter 4 (so that the chrominance signal F is extracted). Said chrominance signal F is delayed by one line period by the delay means 5 and it is applied *via* the amplifier 6 to the input 15 of the summing means 13. The input 14 of means 13 is coupled to the low-pass filter 2. The output 16 of the summing means 13 is connected to the input 11 of the switch 9, the master contact 12 of said switch being connected to the output terminal 8 of the correction circuit 7.

The figure clearly shows that in the shown position of the switch 9 the colour television signal at the input terminal 1 is applied directly, *i.e.* without any processing, to the output terminal 8. When the switch 9 assumes the other position, the colour television signal at the output terminal 8 is composed of the luminance signal Y and the chrominance signal F delayed by one line period, fully in accordance with what has been described with reference to Fig. 3.

The embodiment of Fig. 4 is of special interest for records in which the recorded colour television signal has been coded in such manner that a standard colour television signal can be derived from it without separation of the luminance and chrominance signals. In this respect composite systems are considered first of all, in which a complete standard colour television signal is frequency-modulated on an FM carrier wave and is recorded on the record. The complete standard colour television signal can be recovered during reading by frequency demodulation. As the colour television signal applied to terminal 1 normally becomes directly available at the output terminal 8 *via* the switch 9, optimum use is made of said composite signal during normal reproduction in the embodiment shown in Fig. 4. The separation and recombination of the two signal components is then effected only in the case of reproduction at modified reproducing speeds.

Fig. 5 finally shows a modification of the embodiment of Fig. 4. Now the band-

pass filter 4 is not connected to the input terminal 1 via a delay element 3 but is coupled to the delay element 3' in the circuit between the input terminal 1 and input 10 of the switch 9. The two delay elements 3 and 3' of Fig. 4 both serve to compensate for the delay of the low-pass filter 2, so that in fact one common delay element suffices. Moreover, the variable amplifier 6, which essentially serves to compensate for losses caused by the delay means, can be made simply adjustable both with respect to gain and phase, so that possible minor differences between various circuits can be corrected.

Furthermore, it is to be noted that the band-pass filter 4 may essentially form part of the delay means 5. The glass delay line generally used for such delay means already exhibits a band-pass characteristic, and this can be adapted to the pass-band requirements of the colour television circuit so that no separate band-pass filter is needed. The filters which are used may take the form of comb filters. Finally, it is to be noted that the switch 9 preferably takes the form of a generally known electronic switching circuit.

WHAT WE CLAIM IS:

1. An apparatus for reading a record of disc form on which in substantially parallel tracks a colour television signal is recorded, the chrominance signal of which shows a line sequential alternating pattern, the apparatus being provided with a scanning unit for scanning the record, a decoding device for converting the signal read from the record carrier into a standard colour television signal, and a command device for selectively repeating the scanning of predetermined picture of the television signal recorded on the record, characterized in that the decoding device is provided with a correction circuit which comprises an input terminal for receiving a colour television signal derived from the read-outs signal, a first filter for extracting the luminance signal contained in said derived colour television signal, a second filter for extracting the chrominance signal contained in said derived colour television signal, delay means in series with said second filter for delaying the extracted chrominance signal by one line interval and a signal controlled recombination circuit switchable in response to signals from the command device into one of two modes such that in the first mode the recombination circuit produces an output signal comprising the sum of a luminance signal, and a chrominance signal both obtained from said derived colour television signal, that in the second mode the recombination circuit produces an output signal comprising the sum of a luminance signal obtained from said derived colour television signal and of said delayed extracted chrominance signal, and that during the repetition of the predetermined picture said signal controlled recombination circuit selects alternately one and the other of said modes each for the duration of a complete picture.

2. Apparatus as claimed in claim 1 wherein said signal controlled recombination circuit comprises a summing means and a two-position switch.

3. Apparatus as claimed in Claim 2, characterized in that the two-position switch has a first input which is coupled to the second filter, a second input which is coupled to the delay means, and a common output, whilst the summing means has a first input which is coupled to the first filter, a second input which is coupled to the output of the two-position switch, and an output which is coupled to the output terminal.

4. Apparatus as claimed in Claim 2, characterized in that the summing means has a first input which is coupled to the first filter, a second input which is coupled to the delay means, and an output, whilst the two-position switch has a first input which is coupled to the input terminal, a second input which is coupled to the output of the summing means, and an output which is coupled to the output terminal.

5. Apparatus as claimed in Claim 4, characterized in that the connection between the input terminal and the first input of the two-position switch includes a time delay element, and the second filter is coupled to the output of said element.

6. Apparatus substantially as described with reference to Figure 3 or Figure 4 or Figure 5 of the accompanying drawings.

R. J. BOXALL,
Chartered Patent Agent,
Berkshire House,
168-173 High Holborn,
London WC1V 7AQ,
Agent for the Applicants.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1979.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

pass filter 4 is not connected to the input terminal 1 via a delay element 3 but is coupled to the delay element 3' in the circuit between the input terminal 1 and input 10 of the switch 9. The two delay elements 3 and 3' of Fig. 4 both serve to compensate for the delay of the low-pass filter 2, so that in fact one common delay element suffices. Moreover, the variable amplifier 6, which essentially serves to compensate for losses caused by the delay means, can be made simply adjustable both with respect to gain and phase, so that possible minor differences between various circuits can be corrected.

Furthermore, it is to be noted that the band-pass filter 4 may essentially form part of the delay means 5. The glass delay line generally used for such delay means already exhibits a band-pass characteristic, and this can be adapted to the pass-band requirements of the colour television circuit so that no separate band-pass filter is needed. The filters which are used may take the form of comb filters. Finally, it is to be noted that the switch 9 preferably takes the form of a generally known electronic switching circuit.

WHAT WE CLAIM IS:

1. An apparatus for reading a record of disc form on which in substantially parallel tracks a colour television signal is recorded, the chrominance signal of which shows a line sequential alternating pattern, the apparatus being provided with a scanning unit for scanning the record, a decoding device for converting the signal read from the record carrier into a standard colour television signal, and a command device for selectively repeating the scanning of predetermined picture of the television signal recorded on the record, characterized in that the decoding device is provided with a correction circuit which comprises an input terminal for receiving a colour television signal derived from the read-outs signal, a first filter for extracting the luminance signal contained in said derived colour television signal, a second filter for extracting the chrominance signal contained in said derived colour television signal, delay means in series with said second filter for delaying the extracted chrominance signal by one line interval and a signal controlled recombination circuit switchable in response to signals from the command device into one of two modes such that in the first mode the recombination circuit produces an output signal comprising the sum of a luminance signal, and a chrominance signal both obtained from said derived colour television signal, that in the second mode the recombination circuit produces an output signal comprising the sum of a luminance signal obtained from said derived colour television signal and of said delayed extracted chrominance signal, and that during the repetition of the predetermined picture said signal controlled recombination circuit selects alternately one and the other of said modes each for the duration of a complete picture.

2. Apparatus as claimed in claim 1 wherein said signal controlled recombination circuit comprises a summing means and a two-position switch.

3. Apparatus as claimed in Claim 2, characterized in that the two-position switch has a first input which is coupled to the second filter, a second input which is coupled to the delay means, and a common output, whilst the summing means has a first input which is coupled to the first filter, a second input which is coupled to the output of the two-position switch, and an output which is coupled to the output terminal.

4. Apparatus as claimed in Claim 2, characterized in that the summing means has a first input which is coupled to the first filter, a second input which is coupled to the delay means, and an output, whilst the two-position switch has a first input which is coupled to the input terminal, a second input which is coupled to the output of the summing means, and an output which is coupled to the output terminal.

5. Apparatus as claimed in Claim 4, characterized in that the connection between the input terminal and the first input of the two-position switch includes a time delay element, and the second filter is coupled to the output of said element.

6. Apparatus substantially as described with reference to Figure 3 or Figure 4 or Figure 5 of the accompanying drawings.

R. J. BOXALL,
Chartered Patent Agent,
Berkshire House,
168-173 High Holborn,
London WC1V 7AQ,
Agent for the Applicants.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1979.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

* C L M S *