PATENT SPECIFICATION (11) 1358551

1358551

(21) Application No. 13859/71 (22) Filed 7 May 1971
(23) Complete Specification filed 1 May 1972
(44) Complete Specification published 3 July 1974
(51) International Classification H04N 9/42
(52) Index at acceptance
H4F D19 D1A1 D1B3 D1B5 D1K3 D1K9 D30B D30H D30Q D30T D30V

(72) Inventor RENE PETER

(19)

(54) SECAM PAL DEMODULATION SYSTEM

(71) We, RCA CORPORATION, a corporation organized under the laws of the State of Delaware, United States of America, of 30 Rockefeller Plaza, City and State of New York, 10020, United States of America, 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:—

This invention relates to a colour television receiver unit able to demodulate "PAL" or "SECAM" transmissions. "SECAM" is a registered trade mark. It is especially advantageous for people living near the frontiers between countries using different ones of the two systems to be able to switch over their receivers to choose either mode of transmission. Such receivers should use as many components as possible common to both modes of reception, to economize on components and space.

It is also advantageous if the owner of a PAL receiver can convert his set to receive SECAM with as little additional circuitry and connecting-in as possible; such a conversion should be applicable to any type of PAL receiver and should influence the PAL components and the normal PAL operations to a negligible extent.

According to the present invention there is provided a PAL/SECAM colour television receiver comprising PAL facilities to process a signal having line scanning and line-by-line phase reversal of one colour signal component and to check the phase of a line-by-line switch-over device, and SECAM receiver facilities to process a signal with two colour components frequency modulated on to subcarriers having different centre frequencies, and to make use of some of the PAL-operational components including a one line scan period's delay line and a local oscillator, said receiver comprising, for the SECAM chroma, frequency demodulator means adapted to deliver demodulated colour signal components in turn line-by-line at an output, an amplitude modulator to apply the demodulated colour signal components in turn on the output of said local oscillator, means to feed said oscillator output to the amplitude modulator through a phase-shifter switched over line-by-line between two 90°-differing phase shifts, and means coupling the thus remodulated colour signal components to said PAL facilities for delivery as separate demodulated colour signal components at respective outputs thereof.

Advantages of the present invention are that the SECAM operation involves demodulation before the usual one line scan's delay line performs a memory function, so that when no blue line is present in the incoming signal, the last blue line is remembered and displayed (and the same for the alternate, red lines), and the colour signals are remodulated on to the normal PAL oscillator output also before the one line scan's delay line, so that this component is used for both functions. By using two 90° apart versions of the phase of the PAL oscillator output for the remodulation for the two subcarriers, the signal fed to the PAL delay line, although by no means identical with a PAL wave, is processed subsequently as though it had originated from a normal PAL transmission. Since the delay line and colour signal commutation on to separate output lines are subsequent to the frequency demodulation, a single line-by-line returned discriminator may be used for demodulating both SECAM colour subcarriers but this feature is not essential to the invention, merely a preferred option by reason of the extra economy given.

Thus the components extra to the normal PAL receiver complement, in order to receive SECAM transmissions, will be few in number. Further features and advantages of the invention will appear from the following description of an embodiment thereof, given by way of example only, in conjunction with the drawings, in which:

Figure 1 shows essential picture signal pro-

[Price 25p]

Price 33p

cessing components for SECAM and PAL working; and

Figure 2 shows the above in more detail, also the changeover switch and identity switch operation.

Referring to Figure 1, the legends 1 and 2 at various points index details relating to two consecutive picture lines of a colour sequence. The details may at some points be relative phase angles for each line against a reference, or may signify at other points which of the two colour signals appears. A SECAM input terminal 3 receives an (R—Y) signal on horizontal line 1 and a (B—Y) signal on line 2 as frequency modulations on separate sub-carriers of frequency 4.406 MHz and 4.25 MHz respectively. The input terminal 3 is connected to a video detector and filter (not shown) which have already selected the two subcarriers from the sound and luminance signals. Such selection, and also such matters as colour zeroing, burst separation and identification are well-known SECAM devices and not further discussed with reference to Figure 1.

The alternating sub-carriers are fed along path 4 to a single discriminator 5 which feeds demodulated R—Y information on line 1 and B—Y information on line 2 along a path 6 to an amplitude modulator 7 from which the colour signals re-appear as amplitude modulations on a locally generated oscillation of also about 4 MHz on a path 8. The centre frequency of the discriminator is tuned back and forth line by line to deal with the two different subcarrier frequencies. This eliminates necessity for two separate discriminators, but it also has the disadvantage at first sight of requiring the usual Secam delay line memory to operate over a wide band, and at a much lower frequency than the input 4 MHz or so. This difficulty is overcome by the re-modulation at 7 of the demodulated chrominance signals from path 6; this solves the delaying problem. Separate discriminators 5 with commoned outputs to 7 may be preferred to save the line by line returning.

The new carrier for the two chrominance signals, (R—Y) on horizontal line 1 and (B—Y) on line 2, is switched in phase line by line between 0° and 90° before being modulated, so that the R—Y signal appearing on path 8 is modulated with 0° carrier phase (as symbolized for line 1), and the (B—Y) signal is modulated with +90° carrier phase.

By this refinement, the original SECAM signal has been converted so that a PAL demodulator will be able to operate on it without any modifications as though the input *were* a PAL signal. In fact the input differs from a true PAL in that (1) each chrominance signal is only present on alternate lines, and (2) the carrier differs from a true PAL subcarrier in having a phase alternation of 90° line by line.

The carrier, which is to be modulated at 7 by the colour signals, arrives at 7 from a local oscillator 9 being the usual PAL oscillator of every PAL receiver over path 11 and, either a 90° phase shifter 12 for line 2, or a 0° phase shift path 13 for line 1, by means of a two-way switch 14 switched over line by line as indicated by the arrows 1 and 2 (under control of the usual identification signal flipflop of PAL and SECAM, not shown). Thus the carrier appearing on path 8 has the phases shown.

Referring again to path 8 as reproduced at the bottom left of Figure 1, the remodulated (R—Y) and (B—Y) signals are fed (on alternate lines) via the usual PAL delay line 15, and directly, to an adder 16 and a subtractor 17. The delay is approximately 64 μs and introduced a carrier phase shift of 180°, to give the modified phase values symbolized.

At the subtraction output path 18, we find

for each line 1:

$$(R—Y)-(-j(B—Y))=(R—Y)+j(B—Y)$$

for each line 2:

$$j(B—Y)-(-(R—Y))=(R—Y)+j(B—Y)$$

Thus the subtractor has matrixed the signals, conversely to the *separating* it does after the delay line for normal PAL signals, and identical phases appear for lines 1 and 2. The signal on path 18 is fed to the normal (B—Y) demodulator 19, being the usual PAL phase discriminator fed with the PAL oscillations via a phase shifter 20 of appropriate value as shown for the two lines to select the B—Y only for demodulation. This appears on output 21 as shown; it should be remembered that for the two lines, only information present on one line, 2, is registered, as usual for SECAM. There is no averaging, which a standard PAL receiver gives to incoming PAL signals.

At the addition output path 19 there appear

For line 1:

$$(R—Y)+(-j(B—Y))=(R—Y)-j(B—Y)$$

for line 2:

$$j(B—Y)+(-(R—Y))=-(R—Y)+j(B—Y)$$

These are carrier signals, and the phases are thus opposed as is shown, just by path 22. A phase inverter 23, again a normal PAL component, is switched between 0° and 180° phase shift value line by line, e.g. using a drive shown as a dashed line 24 from switch 14, and thus inverts the polarities on even lines only, see the symbols by path 25 en route to the R—Y demodulator 26. Thus the phase detector therein, which is also fed over an appropriate (zero) phase shift path 27 from the PAL oscillator 9, selects the R—Y on successive lines, originally present on only the odd line 1 on line 6, to appear at output 28.

The purity of the signals at outputs 28 and 21 depends on maintenance of the correct

phase relations at amplitude modulator 17 and at the two PAL demodulators 19, 26. Since all these are controlled by the same PAL oscillator 9 this condition can be met to the required ± 5° maximum phase error without difficulty. The fact that the PAL oscillator is not rigidly phase-controlled by incoming PAL bursts is of no importance.

It may be noted that the demodulators here are used in SECAM working to separate the R—Y and B—Y signals as in a standard NTSC color receiver; however, with the great advantage that both phase modulator and phase demodulator share the same subcarrier-source (whereas for NTSC the modulator is at the transmitter and the demodulator at the receiver) so that none of the usual sources of phase error and therefore of hue error are present in the system here disclosed.

Figure 2 shows above the SECAM converter circuit and below the ordinary PAL decoder in more detail than in Figure 1. In the SECAM circuit a filter 29 called the "cloche circuit" and a limiter 30 are placed in front of the FM discriminator. The filter 29 compensates for the supplementary amplitude modulation of the subcarrier that is employed in the SECAM system to improve the chroma signal-to-noise ratio (a form of pre-emphasis). The limiter 30 serves for further noise suppression as in all FM systems. Due to the different centre frequencies of the FM carriers for the two difference signals, the zero point of the discriminator 5 is shifted from line to line, in practice by means, such as a diode switch shown at 31 and operative to shunt capacitance partially to ground, or otherwise to switch reactances in the tuning circuits. At the output 6 of this single discriminator, as aforesaid signals R—Y and B—Y are available sequentially on alternate lines. These difference signals are remodulated in the amplitude modulator 7 which is DC connected to the discriminator output in order to maintain the correct black level. The carrier on which the difference signals are amplitude modulated is taken off from the oscillator of the PAL decoder and, as described earlier in this disclosure, is switched sequentially by means 12/13/14 on alternate lines to 0° or 90° phase-angle. Figure 1 should be referred to for the adding and subtracting of the signals appearing before and after delay line 15, this is not shown in Figure 2 and indeed is normal PAL equipment. It is repeated that the matrixing processing of the SECAM-derived signals is different from normal PAL processing.

The line-by-line switching (see 14, 23, 24 Figure 1) is produced for SECAM signals under the control of a flipflop 32 triggered by Secam-mode line flyback pulses 33 and usual for SECAM and usual for PAL, in this embodiment being common to both modes of working. The flipflop also controls the discriminator switch 31. All these operate at one half of line frequency and may be in phase or 180° out of phase since the flipflop 32 is triggered at line frequency, whether operated by SECAM flyback pulses 33, or during PAL working, by PAL flyback pulses 34 again at line frequency. To prevent the out of phase condition prevailing, the flipflop phase is checked for sign as usual for Secam and PAL in a unit 35 which receives SECAM or PAL identification information from "ident" units 36 or 37. These obtain information from the incoming video signal in known manner, either from the regular line frequency swinging burst of PAL, or from the few lines of alternating subcarrier of SECAM repeated during every field flyback interval, in each case under the gating action of flyback pulses 33 or 34. Identification is very well known and no further details are included herein, except to point out that sign checker 35, and flipflop 32 are already in every PAL or SECAM receiver and thus dual mode receiver avoids duplication for the two modes.

Received signals from the video detector stages arrive at the common input terminal 38, and if of Secam type will follow path 4 and so on as aforesaid. PAL signals continue via a path 39 to the usual PAL bandpass filter 40, for the usual PAL treatment. A manual selection switch contact 41 isolates filter 40 when switched to SECAM-working. Another contact 42, closed when switched to SECAM, allows access to the delay line 15 along path 8 for re-modulated SECAM-originating signals from amplitude modulator 7. These must by-pass filter 40, in practice, because they are already delayed by the demodulation and re-modulation, and PAL signals are delayed a similar amount in filter 40. Thus the chroma signals of PAL or SECAM have equalized delays relative to the luminance signal of each. This is a practical engineering matter, and other equalizing techniques may be used. Another contact 43 of the SECAM/PAL selector switch (not itself shown) may isolate the PAL identification circuit 37 when SECAM signals are present.

It will readily be appreciated that any PAL decoder can be driven by the converter, without modifications, and with only a few interconnections. Many parts are used for PAL and SECAM working. Thus an economical means is provided of adding SECAM reception facilities to any PAL receiver. The switchover between PAL and SECAM working modes is very simple.

Furthermore the inputs of the converter for signals *from* the PAL decoder are of relatively high impedance. Therefore no readjustment of the PAL decoder is necessary when the converter is connected, and no perturbation of PAL working is at all likely.

WHAT WE CLAIM IS:—

1. A PAL/SECAM colour television

phase relations at amplitude modulator 17 and at the two PAL demodulators 19, 26. Since all these are controlled by the same PAL oscillator 9 this condition can be met to the required ± 5° maximum phase error without difficulty. The fact that the PAL oscillator is not rigidly phase-controlled by incoming PAL bursts is of no importance.

It may be noted that the demodulators here are used in SECAM working to separate the R—Y and B—Y signals as in a standard NTSC color receiver; however, with the great advantage that both phase modulator and phase demodulator share the same subcarrier-source (whereas for NTSC the modulator is at the transmitter and the demodulator at the receiver) so that none of the usual sources of phase error and therefore of hue error are present in the system here disclosed.

Figure 2 shows above the SECAM converter circuit and below the ordinary PAL decoder in more detail than in Figure 1. In the SECAM circuit a filter 29 called the "cloche circuit" and a limiter 30 are placed in front of the FM discriminator. The filter 29 compensates for the supplementary amplitude modulation of the subcarrier that is employed in the SECAM system to improve the chroma signal-to-noise ratio (a form of pre-emphasis). The limiter 30 serves for further noise suppression as in all FM systems. Due to the different centre frequencies of the FM carriers for the two difference signals, the zero point of the discriminator 5 is shifted from line to line, in practice by means, such as a diode switch shown at 31 and operative to shunt capacitance partially to ground, or otherwise to switch reactances in the tuning circuits. At the output 6 of this single discriminator, as aforesaid signals R—Y and B—Y are available sequentially on alternate lines. These difference signals are remodulated in the amplitude modulator 7 which is DC connected to the discriminator output in order to maintain the correct black level. The carrier on which the difference signals are amplitude modulated is taken off from the oscillator of the PAL decoder and, as described earlier in this disclosure, is switched sequentially by means 12/13/14 on alternate lines to 0° or 90° phase-angle. Figure 1 should be referred to for the adding and subtracting of the signals appearing before and after delay line 15, this is not shown in Figure 2 and indeed is normal PAL equipment. It is repeated that the matrixing processing of the SECAM-derived signals is different from normal PAL processing.

The line-by-line switching (see 14, 23, 24 Figure 1) is produced for SECAM signals under the control of a flipflop 32 triggered by Secam-mode line flyback pulses 33 and usual for SECAM and usual for PAL, in this embodiment being common to both modes of working. The flipflop also controls the discriminator switch 31. All these operate at one half of line frequency and may be in phase or 180° out of phase since the flipflop 32 is triggered at line frequency, whether operated by SECAM flyback pulses 33, or during PAL working, by PAL flyback pulses 34 again at line frequency. To prevent the out of phase condition prevailing, the flipflop phase is checked for sign as usual for Secam and PAL in a unit 35 which receives SECAM or PAL identification information from "ident" units 36 or 37. These obtain information from the incoming video signal in known manner, either from the regular line frequency swinging burst of PAL, or from the few lines of alternating subcarrier of SECAM repeated during every field flyback interval, in each case under the gating action of flyback pulses 33 or 34. Identification is very well known and no further details are included herein, except to point out that sign checker 35, and flipflop 32 are already in every PAL or SECAM receiver and thus dual mode receiver avoids duplication for the two modes.

Received signals from the video detector stages arrive at the common input terminal 38, and if of Secam type will follow path 4 and so on as aforesaid. PAL signals continue via a path 39 to the usual PAL bandpass filter 40, for the usual PAL treatment. A manual selection switch contact 41 isolates filter 40 when switched to SECAM-working. Another contact 42, closed when switched to SECAM, allows access to the delay line 15 along path 8 for re-modulated SECAM-originating signals from amplitude modulator 7. These must by-pass filter 40, in practice, because they are already delayed by the demodulation and re-modulation, and PAL signals are delayed a similar amount in filter 40. Thus the chroma signals of PAL or SECAM have equalized delays relative to the luminance signal of each. This is a practical engineering matter, and other equalizing techniques may be used. Another contact 43 of the SECAM/PAL selector switch (not itself shown) may isolate the PAL identification circuit 37 when SECAM signals are present.

It will readily be appreciated that any PAL decoder can be driven by the converter, without modifications, and with only a few interconnections. Many parts are used for PAL and SECAM working. Thus an economical means is provided of adding SECAM reception facilities to any PAL receiver. The switchover between PAL and SECAM working modes is very simple.

Furthermore the inputs of the converter for signals *from* the PAL decoder are of relatively high impedance. Therefore no readjustment of the PAL decoder is necessary when the converter is connected, and no perturbation of PAL working is at all likely.

WHAT WE CLAIM IS:—

1. A PAL/SECAM colour television

* C L M S *

receiver comprising PAL facilities to process a signal having line scanning and line-by-line phase reversal of one colour signal component and to check the phase of a line-by-line switchover device, and SECAM receiver facilities to process a signal with two colour components frequency modulated on to subcarriers having different centre frequencies, and to make use of some the PAL-operational components including a one line scan period's delay line and a local oscillator, said receiver comprising, for the SECAM chroma, frequency demodulator means adapted to deliver demodulated colour signal components in turn line-by-line at an output, an amplitude modulator to apply the demodulated colour signal components in turn on the output of said local oscillator, means to feed said oscillator output to the amplitude modulator through a phase-shifter switched over line-by-line between two 90°-differing phase shifts, and means coupling the thus remodulated colour signal components to said PAL facilities for delivery as separate demodulated colour signal components at respective outputs thereof.

2. A PAL/SECAM receiver according to claim 1, in which said frequency demodulator means is a single frequency discriminator, having a single output and arranged to be switched over in centre tuning frequency line-by-line, and is operative to demodulate both SECAM colour signal components.

3. A PAL/SECAM receiver according to claim 1 or 2 comprising a common control device controlled by the SECAM or PAL identification processers according to which mode of receiving is selected, to control the phase of said line-by-line switchover device.

4. A PAL/SECAM receiver according to claim 1, 2 or 3 further comprising a PAL/SECAM selection or changeover switch for switching between PAL reception and SECAM reception, which switch controls only three contacts.

5. A PAL/SECAM receiver substantially as hereinbefore described in conjunction with Figure 1 or Figure 2.

6. A PAL/SECAM receiver according to any of claims 1—5 wherein the SECAM receiver facilities have been added to a PAL receiver.

T. I. M. SMITH,
Chartered Patent Agent,
50 Curzon Street,
London, W1Y 8EU.
Agent for the Applicant.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1974.
Published by The Patent Office, 25 Southampton Buildings. London, WC2A 1AY, from which copies may be obtained.

