

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO CIRCUIT ARRANGEMENTS FOR COLOUR TELEVISION RECEIVERS

(71) We, EMI LIMITED, a British company of Blyth Road, Hayes, Middlesex, 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 present invention relates to circuit arrangements for colour television receivers, and it relates more particularly to such arrangements for ensuring that a switch provided in a receiver, and adapted to change its condition for successive lines of received information, operates in the correct phase with respect to the variations in the phase construction of the chrominance signals which are characteristic of the PAL system.

According to the invention, there is provided a circuit arrangement for a colour television receiver adapted to receive transmitted information encoded in accordance with the PAL system and including colour burst signals which have one phase in alternate lines and another phase in the intervening lines, said circuit arrangement including a reference oscillator for generating demodulating oscillations for application to respective demodulators for the (R-Y) and (B-Y) components of said information, switchable means for changing through 180° from line to line the phase of the demodulating oscillations fed to the demodulator for said (R-Y) component, control means for ascertaining whether said switchable means is operating in the correct or the incorrect phase in relation to the alternations in phase from line to line of the modulation axis of said (R-Y) component, the control means comprising means for determining the relative phase of a reference oscillation, generated by said reference oscillator, with respect to that of colour burst signals, derived from the received colour burst signals and modified to have the same phase for consecutive lines, said relative phase having one constant

value for consecutive lines when said switchable means is operating in said correct phase and a different constant value for consecutive lines when said switchable means is operating in said incorrect phase, means for generating an error signal in response to said relative phase assuming said different constant value, and means for responding to said error signal to disturb the operation of said switchable means.

In order that the invention may be clearly understood and readily carried into effect, one embodiment thereof will now be described, by way of example only, with reference to the drawings filed with the Provisional Specification, of which:—

Figure 1 shows, in block diagrammatic form, part of a PAL colour television receiver including a circuit arrangement in accordance with one example of the invention, and

Figures 2(a) and 2(b) are vector diagrams which will be used in explaining the operation of the invention.

Reference will also be made to the accompanying drawing, the single figure of which is designated Figure 3 for convenience, and which shows, in block diagrammatic form, an arrangement in accordance with another example of the invention.

Referring now to Figure 1, received chrominance signals are applied to terminal 1. The receiver includes a transit time signal splitting circuit of known kind which incorporates a delay line 2, an adding circuit 3 and a subtracting circuit 4 interconnected in known manner and so arranged that a signal of colour sub-carrier frequency, on which is modulated information indicative of the (B-Y) component of the received chrominance signals is provided by circuit 3 and a signal of similar frequency, but quadrature phase, on which is modulated information indicative of the (R-Y) component of the received chrominance signals

is provided by circuit 4. The signals provided by circuits 3 and 4 are fed to respective demodulators 5 and 6, the former being termed the (B-Y) demodulator and the latter the (R-Y) demodulator.

In order to demodulate the signals applied to the demodulators from circuits 3 and 4, a source of reference oscillations of colour sub-carrier frequency and appropriate phase is required. In this example, the reference oscillations are provided by a crystal oscillator 7 which is driven by colour synchronising signals (commonly called colour bursts) which are transmitted during inter-line periods of the chromatic signals. These colour bursts comprise several cycles of oscillation at the colour sub-carrier frequency, and their phase alternates in successive lines between two values spaced by 90°. The colour bursts are separated from the chrominance signals by means of a burst gate 8, which is opened by pulses 9, derived from the line flyback pulses generated in the scanning circuits of the receiver, when the colour bursts are present. Since their mean phase of the colour bursts is known, the oscillator 7 can be caused to generate oscillations of the phase of the +(B-Y) axis, and these are applied, via a line 10, to the (B-Y) demodulator 5.

As is known, in the PAL system, the phase of the colour subcarrier oscillation which carries the (R-Y) component of the chrominance signal is switched so that it alternates between the phases of the +(R-Y) axis and the -(R-Y) axis on successive lines. Thus in order to correctly demodulate the signals applied from circuit 4 to demodulator 6, it is necessary to change through 180° the phase of the demodulating oscillations applied thereto via line 11. This is achieved by deriving from oscillator 7 oscillations of the phase of the +(R-Y) axis on a line 12 and oscillations of the phase of the -(R-Y) axis on a line 13 and connecting these two lines to line 11 via a switch 14, referred to as the PAL switch, which is caused, by means of the pulses 9, to change its state for alternate lines of the received chrominance signal so that during one set of alternate lines oscillations of the phase of the +(R-Y) axis are applied to the demodulator 6 and during the intervening lines, oscillations of the phase of the -(R-Y) axis are applied to the demodulator 6.

It is known that unless some measures are taken to the contrary, the PAL switch 14 can operate in the wrong phase with regard to the received chrominance signals, and it is an object of this example of the invention to provide means for ensuring the correct phase of operation of the PAL switch.

In accordance with this example of the

invention, a second switch 15 is ganged to operate synchronously with the PAL switch 14. The pole of the second switch is connected to a phase comparator circuit 16 and the two contacts of the switch 15 are connected respectively to the output of the burst gate 8 and to the output of a second burst gate 17. The gate 17 receives the chrominance signals after passage through the delay line 2 and, like gate 8, is operated by the pulses 9 to separate the colour bursts from the chrominance signals.

The phase comparator circuit 16 is also fed with subcarrier frequency oscillations of constant phase derived from the oscillator 7. In this example oscillations of the phase of the +(R-Y) axis are used, but oscillations of other phases may alternatively be used. The output signals from circuit 16 control a gate 18 in the path of the pulses 9 to the switch 14, as will become evident hereinafter.

Understanding of the following description of the operation of the arrangement will be facilitated by reference to the two vector diagrams shown in Figures 2(a) and 2(b). In each case, the vector marked B indicates the phase of the colour sub-carrier which bears the (B-Y) component of the received chrominance signals and the vector marked R indicates the phase of the colour sub-carrier which bears the (R-Y) component of the received chrominance signals. The vector marked S indicates the phase of the colour synchronising signals (or burst) associated with the respective compositions of the chrominance signal. It will be appreciated that the received chrominance signal alternates between the compositions shown in Figures 2(a) and 2(b) for successive lines.

In operation of the arrangement, if on a given line the composition shown in Figure 2(a) is received and if the PAL switch is working in the correct phase, it Since switch 15 is ganged with the PAL switch, it also assumes the condition shown in Figure 1 and thus passes the associated colour burst S to the phase comparator circuit 16. For the subsequent line, the PAL switch changes to its other condition. Switch 15 does likewise and causes the same colour burst S as was previously applied to circuit 16 to be re-applied thereto. This is achieved because the delay line 2 has a delay of one line period. For the next line, switch 14 assumes its original position so switch 15 does likewise and causes a colour burst S of the same phase as that shown in Figure 2(a) to be applied to the comparator circuit 16. This process continues and it will be observed that by means of the switch 15 colour bursts of constant phase (that shown in Figure 2(a)) are applied to the phase comparator circuit 16 for comparison with the constant phase of the +(R-Y) axis. The

burst phase shown in Figure 2(a) leads by 45° the phase of the $+(R-Y)$ axis, so that the circuit 16 produces an output pulse of (say) positive polarity at each comparison.

5 These pulses are rectified and smoothed in a circuit 19 and provide an enabling control signal for the gate 18. The correct operation of the PAL switch 14 is thus maintained.

10 On the other hand, if the PAL switch 14 is operating with the incorrect phase, i.e. if it occupies the position shown in Figure 1 when a chrominance signal of the composition shown in Figure 2(b) is received, the switch 15 will operate so as to feed to the circuit 16 colour burst signals of the phase S shown in Figure 2(b). When the switches 14 and 15 change to their other conditions, colour burst signals of the phase S shown in Figure 2(b) will again be applied to the circuit 16. This situation tends to continue so that successive colour bursts, all of the phase S shown in Figure 2(b) are applied to circuit 16. These colour burst signals are advanced in phase by 135° compared to the $+(R-Y)$ axis and the circuit 16 thus develops a negative pulse at each comparison. The negative pulses, when smoothed, give rise to a disabling signal for the gate 18, thus causing the switches 14 and 15 to be stopped.

With the switch 15 stopped in either of its positions, the bursts fed to circuit 16 alternate in phase from line to line and thus the circuit 16 gives output pulses which are alternatively of positive and negative polarity, giving a net signal of zero when smoothed. The gate 18 is constructed so as to be inhibited only by a negative signal in excess of a threshold amplitude so that, when the zero signal occurs, it is once again enabled to pass the switching pulses 9. Due to time lags caused through the smoothing circuit etc., the arrangement may re-start with switch 14 still in the incorrect phase. However, in this event, the arrangement repeats the stopping of the switch until the correct switching phase obtains.

50 Although the switches 14 and 15 are shown for simplicity as ganged, mechanical switches, it will be appreciated that in practice electronic switches such as, for example, diodes or transistors would be used.

55 It may be advantageous to insert a phase shifting arrangement in the path between switch 15 and circuit 16 or, indeed to connect the burst gate 17 to the output of one or other of the circuits 3 and 4 and to insert a corresponding phase shifting arrangement between burst gate 8 and switch 15.

Referring now to Figure 3, received chrominance signals are applied to a terminal 20. As with the Figure 1 arrange-

ment, the receiver includes a transit time signal splitting circuit of known kind which incorporates a delay line 21, an adding circuit 22 and a subtracting circuit 23 interconnected in known manner and arranged to feed signals of sub-carrier frequency, bearing modulation indicative of the $(B-Y)$ and $(R-Y)$ components respectively, to respective demodulators 24 and 25.

An auxiliary switch 26, which is ganged in operation with the PAL switch 27, receives chrominance signals alternately from opposite ends of the delay line 21 in the transit time signal splitting circuit. The pole of the switch 26 is connected to burst gate 28 which is enabled in known manner (by means of the switching pulses 29) when the colour bursts are present. The colour bursts passed by gate 28 are applied to an oscillator 30 which thus receives bursts which are consistently of one phase, and is arranged to generate oscillations of the sub-carrier frequency which are locked in phase to the phase of the selected bursts. The oscillations provided by the oscillator are applied in parallel to the three phase shifters 31, 32 and 33 which, as indicated in Figure 3, are chosen to give the correct phases of demodulating oscillations provided that bursts of the phase S shown in Figure 2(a) are applied to the oscillator 30. The output oscillations from phase shifter 33 are fed directly to the $B-Y$ demodulator 24 and those from phase shifters 31 and 32 are fed via the PAL switch 27 to the $R-Y$ demodulator 25.

Thus far, it has been established that correct operation will occur if the switch 26 and burst gate 28 pass bursts of the phase S shown in Figure 2(a) to the oscillator 30 and that incorrect operation will occur if bursts of the phase S shown in Figure 2(b) are passed to the oscillator 30. Of course the circuit could alternatively be designed to operate correctly with bursts of the phase S shown in Figure 2(b), this being merely a matter of design choice.

In order to ensure that the correct operation can be made to prevail, or in order to restore correct operation if incorrect operation is occurring, the phase of the output oscillations from phase shifter 33, i.e. those applied as demodulating oscillations to the $B-Y$ demodulator 24, is compared with the phase of the colour bursts associated with the separated $(B-Y)$ component of the chrominance signal derived from the summing circuit 22. Because these latter bursts are formed by adding together the bursts associated with successive lines of chrominance information, their phase is constant and corresponds to the $-(B-Y)$ axis. These bursts are passed to a comparator circuit 34 via a burst gate 35 — which gate could alternatively be placed in the other input

line to the comparator.

When correct operation is occurring, the comparator 34 receives (via burst gate 35) bursts of the constant phase of the $-(B-Y)$ axis at one input and oscillations of the constant phase of the $+(B-Y)$ axis at its other input. The comparator 34 is arranged to produce no output signal under these conditions.

When incorrect operation is occurring, the comparator 34 receives (via burst gate 35) bursts of the constant phase of the $-(B-Y)$ axis at one input and oscillations of the phase of the $+(R-Y)$ axis at its other input. The two input signals therefore are in phase quadrature (as distinct from phase opposition as occurs in the correct operating condition) and the comparator 34 is arranged to provide an output signal under these conditions which can be applied to the switch 26 to give it an extra impulse between two successive ones of the switching pulses 29, so to change its phase of operation relative to the received information. Because of the ganging of the switches 26 and 27, the latter switch will also change its phase of operation. The output signal is applied to the switch 26 via a delay circuit 36 and on OR gate 37, through which gate 37 the switching pulses 29 also pass. The delay circuit 36, for example a monostable circuit, is provided to ensure that when the error signal arrives at the OR gate 37 it is spaced in time from the preceding switching pulse 29 and is effective to cause the switch 26 (and thus also the PAL switch) to change its condition.

WHAT WE CLAIM IS:—

1. A circuit arrangement for a colour television receiver adapted to receive transmitted information encoded in accordance with the PAL system and including colour burst signals which have one phase in alternate lines and another phase in the intervening lines, said circuit arrangement including a reference oscillator for generating demodulating oscillations for application to respective demodulators for the $(R-Y)$ and $(B-Y)$ components of said information, switchable means for changing through 180° from line to line the phase of the demodulating oscillations fed to the demodulator for said $(R-Y)$ component, control means for ascertaining whether said switchable means is operating in the correct or the incorrect phase in relation to the alternations in phase from line to line of the modulation axis of said $(R-Y)$ component the control means comprising means for determining the relative phase of a reference oscillation, generated by said reference oscillator, with respect to that of colour burst signals, derived from the received colour burst signals and modified to have the same

phase for consecutive lines, said relative phase having one constant value for consecutive lines when said switchable means is operating in said correct phase and a different constant value for consecutive lines when said switchable means is operating in said incorrect phase, means for generating an error signal in response to said relative phase assuming said different constant value, and means for responding to said error signal to disturb the operation of said switchable means.

2. An arrangement according to Claim 1 including a delay line, having a delay of one line period of the information, arranged in the path of said received colour burst signals and wherein said modified burst signals are obtained by means including a selector means, synchronised in operation with the switchable means, for coupling colour burst signals derived alternately from a point before and a point after said delay line to said means for determining.

3. An arrangement according to Claim 1 including a transit time signal splitting circuit incorporating a delay line having a delay of one line period of the information, a summing circuit, for adding together successively received lines of information, and a differencing circuit, wherein said modified colour burst signals are obtained by means including said summing circuit and means for coupling the sum of two successively received colour burst signals from said summing circuit to said means for determining.

4. An arrangement according to Claim 3 wherein said modified colour burst signals and said reference oscillation are arranged to be in anti-phase when said switchable means is operating in said correct phase and to be in phase quadrature when the switchable means is operating in said incorrect phase.

5. An arrangement according to Claim 4 wherein said means for determining is arranged to generate said error signal in the form of an additional switching pulse for application to said switchable means when said quadrature phase condition obtains.

6. An arrangement according to any of Claims 3 to 5 wherein a second switchable means is provided, synchronised in operation with said first mentioned switchable means, and arranged to couple to said reference oscillator colour burst signals derived alternately from a point before and a point after said delay line.

7. A circuit arrangement for a colour television signal substantially as herein described with reference to Figure 1 of the drawings filed with the Provisional Specification or to Figure 3 of the accompanying drawing.

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- When correct operation is occurring, the comparator 34 receives (via burst gate 35) bursts of the constant phase of the $-(B-Y)$ axis at one input and oscillations of the constant phase of the $+(B-Y)$ axis at its other input. The comparator 34 is arranged to produce no output signal under these conditions.
- When incorrect operation is occurring, the comparator 34 receives (via burst gate 35) bursts of the constant phase of the $-(B-Y)$ axis at one input and oscillations of the phase of the $+(R-Y)$ axis at its other input. The two input signals therefore are in phase quadrature (as distinct from phase opposition as occurs in the correct operating condition) and the comparator 34 is arranged to provide an output signal under these conditions which can be applied to the switch 26 to give it an extra impulse between two successive ones of the switching pulses 29, so to change its phase of operation relative to the received information. Because of the ganging of the switches 26 and 27, the latter switch will also change its phase of operation. The output signal is applied to the switch 26 via a delay circuit 36 and on OR gate 37, through which gate 37 the switching pulses 29 also pass. The delay circuit 36, for example a monostable circuit, is provided to ensure that when the error signal arrives at the OR gate 37 it is spaced in time from the preceding switching pulse 29 and is effective to cause the switch 26 (and thus also the PAL switch) to change its condition.

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1. A circuit arrangement for a colour television receiver adapted to receive transmitted information encoded in accordance with the PAL system and including colour burst signals which have one phase in alternate lines and another phase in the intervening lines, said circuit arrangement including a reference oscillator for generating demodulating oscillations for application to respective demodulators for the $(R-Y)$ and $(B-Y)$ components of said information, switchable means for changing through 180° from line to line the phase of the demodulating oscillations fed to the demodulator for said $(R-Y)$ component, control means for ascertaining whether said switchable means is operating in the correct or the incorrect phase in relation to the alternations in phase from line to line of the modulation axis of said $(R-Y)$ component the control means comprising means for determining the relative phase of a reference oscillation, generated by said reference oscillator, with respect to that of colour burst signals, derived from the received colour burst signals and modified to have the same

phase for consecutive lines, said relative phase having one constant value for consecutive lines when said switchable means is operating in said correct phase and a different constant value for consecutive lines when said switchable means is operating in said incorrect phase, means for generating an error signal in response to said relative phase assuming said different constant value, and means for responding to said error signal to disturb the operation of said switchable means.

2. An arrangement according to Claim 1 including a delay line, having a delay of one line period of the information, arranged in the path of said received colour burst signals and wherein said modified burst signals are obtained by means including a selector means, synchronised in operation with the switchable means, for coupling colour burst signals derived alternately from a point before and a point after said delay line to said means for determining.

3. An arrangement according to Claim 1 including a transit time signal splitting circuit incorporating a delay line having a delay of one line period of the information, a summing circuit, for adding together successively received lines of information, and a differencing circuit, wherein said modified colour burst signals are obtained by means including said summing circuit and means for coupling the sum of two successively received colour burst signals from said summing circuit to said means for determining.

4. An arrangement according to Claim 3 wherein said modified colour burst signals and said reference oscillation are arranged to be in anti-phase when said switchable means is operating in said correct phase and to be in phase quadrature when the switchable means is operating in said incorrect phase.

5. An arrangement according to Claim 4 wherein said means for determining is arranged to generate said error signal in the form of an additional switching pulse for application to said switchable means when said quadrature phase condition obtains.

6. An arrangement according to any of Claims 3 to 5 wherein a second switchable means is provided, synchronised in operation with said first mentioned switchable means, and arranged to couple to said reference oscillator colour burst signals derived alternately from a point before and a point after said delay line.

7. A circuit arrangement for a colour television signal substantially as herein described with reference to Figure 1 of the drawings filed with the Provisional Specification or to Figure 3 of the accompanying drawing.

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