

# PATENT SPECIFICATION

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## (54) BROADCAST RECEIVER FUNCTION CONTROL

(71) We, N.V. PHILIPS' GLOEILAMPENFABRIEKEN, a limited liability Company, organised and established under the laws of the Kingdom of the Netherlands, of Emmasingel 29, Eindhoven, the Netherlands, 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 broadcast receiver including a synchronous detection circuit having a first input for an intermediate frequency signal and a second input for a reference signal at the nominal frequency of the intermediate frequency signal, a pass filter tuned to said nominal frequency and included in a signal path to said second input, and a frequency deviation detection circuit having an input coupled to a signal path to said first input for detecting deviations from said nominal frequency of an intermediate frequency signal applied in operation to said first input.

Mullard Technical Communications No. 117, January 1973 pages 223-231 discloses a television receiver of this type in which the output of the frequency deviation detection circuit is used for automatic tuning correction and the output of the synchronous detection circuit is coupled to a function control signal input of the receiver.

The invention provides a broadcast receiver including a synchronous frequency signal and a second input for a reference signal at the nominal detection circuit having a first input for an intermediate frequency of the intermediate frequency signal, a pass filter tuned to said nominal frequency and included in a signal path to said second input, a frequency deviation detection circuit having an output coupled to a signal path to said first input for detecting deviations from said nominal frequency

of an intermediate frequency signal applied in operation to said first input, a rectifier circuit having an input coupled to the output of said frequency deviation detection circuit, and a signal combining circuit having an output coupled to a function control signal input of said receiver for applying a control signal thereto in response to the application of said intermediate frequency signal to the first input of the synchronous detection circuit, said signal combining circuit having a first input coupled to the output of the synchronous detection circuit and a second input coupled to the output of the rectifier circuit and being constructed to combine signals applied in operation to its first and second inputs in such manner that said control signal will be produced for a wider range of frequencies of said intermediate frequency signal than it would be if the coupling from the frequency deviation detection circuit to its second input were absent.

In certain applications the fact that the control signal is produced for a wider range of frequencies of the intermediate frequency signal can be an advantage. It may for example allow the Q-factor of the filter to be chosen higher than would otherwise be possible.

It should be noted that United States Patent Specification 3,696,301 discloses a F.M. receiver in which a combination of signals originating from an amplitude detector and a frequency detector is used for tuning indication. However the combination in this known receiver is such that the frequency range for which the tuning indication function of the receiver becomes operative is reduced.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying diagrammatic drawing, which is a block diagram of a portion of a television receiver.

In the drawing a received television signal

is applied to an input 1 of a high-frequency and mixer circuit 3, in which it is amplified and converted into an intermediate frequency signal which appears at an output 5 whence it is applied to an input 7 of an intermediate frequency amplifier 9.

The amplified intermediate frequency signal appears at an output 11 of the intermediate frequency amplifier 9 and is applied to a first input 13 of a synchronous detection circuit 15 and to a first input 17 of a frequency deviation-detection circuit 19. It is also applied to a pass filter 21 tuned to the nominal intermediate frequency to which the television signal carrier has been converted, the output of this filter being coupled to a reference signal input 23 of the synchronous detection circuit 15 and also through a 90° phase-shifting network 25 to a further input 27 of the frequency deviation detector 19 which operates as a phase detector.

The detected television signal appears at an output 29 of the synchronous detection circuit 15 and is then processed and displayed by means not shown. In addition, this detected (video) signal is applied to a first input 31 of a combining circuit 33 to a second input 35 of which a signal originating from an output 37 of a full-wave rectifier circuit 39 is applied. Circuit 39 has two inputs 41, 43 to which signals are applied which are derived from outputs 45, 47 respectively of the frequency deviation detector 19, these signals being of opposite polarities relative to a reference level.

The signals appearing at the outputs 45 and 47 of the frequency deviation detection circuit 19 are also applied to a signal processing circuit 48 which in turn feeds frequency control signal inputs 49, 51 of an oscillator 53. An output 55 of this oscillator is connected to an oscillator signal input 57 of the high frequency and mixer circuit 3. The output signals of the deviation detection circuit 19 are push-pull video signals the amplitude and polarity of which depend upon how the tuning of the local oscillator 53 and hence the frequency of the IF signal differs from its correct value. The signal processing circuit 48 converts them into d.c. voltages or currents representative of this amplitude and polarity, for example by means of sample and hold circuits which sample at moments when the level of the video signal has a standard value; examples of such moments are those when the sync pulses or the porches are present.

The amplitude of the video signals produced at the output 29 of the synchronous detection circuit 15 varies as a function of how the tuning of the local oscillator differs from its correct value in the manner shown in the drawing near the input 31 of the combination circuit 33; the curve is very narrow

because of the phase characteristic of the filter 21 the Q-factor of which is preferably as high as possible in order to obtain the best possible synchronous detection.

The amplitude and polarity of the video signals appearing at the outputs 45 and 47 of the frequency deviation detection circuit 19 vary as a function of how the tuning of the oscillator 53 differs from its correct value in the manner shown above these outputs 45, 47. The rectifier circuit 39 in effect combines the positive portions of these two curves; the signal appearing at its output 37 is a video signal which is always of positive polarity relative to said reference level and the amplitude of which varies as a function of how the tuning of the oscillator 53 differs from its correct value in the manner shown above the output 37.

The combining circuit 33 preferably operates in such manner that the amplitude of the component of the signal appearing at its output 59 produced by the signal applied to its input 35 is approximately one to two times the amplitude of the component produced by the signal applied to its input 31. Combining circuit 33 may be constructed as an adding circuit, and the signal appearing at its output 59 is a video signal the amplitude of which varies as a function of how the tuning of the oscillator 53 differs from its correct value in the manner shown near this output 59. This curve is wider than that which relates to the signal applied to the input 31, because of the signal applied to the input 35.

The signal appearing at the output 59 of the combination circuit 33 is applied to an input 61 of a detection and amplifier circuit 63 which produces automatic gain control signals for use in the receiver in response thereto, for example by sampling said signal when it has a standard value for example at instants when the synchronization pulses or front or back porches occur, or by peak-detecting the synchronization pulses. The gain control signals appear at two outputs 65, 67 and are supplied to gain control signal inputs 69 and 71 of the high frequency and mixer circuit 3 and the intermediate frequency amplifier 9 respectively.

The automatic gain control of the receiver obtained in this manner operates over a wider range of deviations of the oscillator tuning from its correct value than would have been the case if the signal at the output 37 of rectifier circuit 39 had not been included in the signal applied to the input 61 of circuit 63, which means that there is less likelihood that slight detuning of the receiver will result in overloading of the controlled parts of the receiver.

The signal appearing at the output 59 of the combining circuit 33 is also applied to an input 73 of a synchronization signal separa-

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tion circuit 75 which therefore also operates over a wider range of deviations of the oscillator tuning from its correct value than would have been the case if the input 35 of the combining circuit 33 had been absent.

It will be clear that, as an alternative, the automatic gain control signal or the input to the synchronisation separator may be derived in a conventional manner.

Although the combining circuit 33 has been described as being included in a section of the receiver where video signals are present, i.e. before detection circuits have converted the video signals into d.c. voltages or currents suitable for use as automatic gain control signals, it will be evident that, as an alternative, such detection circuits may be included in the inputs to the combining circuit 33, in which case the combining circuit 33 will operate to combine direct currents or voltages. However, if this is done a greater number of smoothing components will probably be required and it will moreover not be possible then to use the output of the combining circuit to feed the synchronization signal separation circuit.

As previously mentioned, the combining circuit 33 can be constructed as an adding circuit. If one of the input signals thereto has the opposite polarity it can be constructed as a subtracting circuit. It may comprise passive and/or active components and may, if so desired, include one or more threshold circuits. The presence of such threshold circuits will of course affect the shape of the curve shown adjacent the output 59 of the combining circuit 33, as will the amplitude ratio chosen between the signals at the inputs 31 and 35.

The rectifier circuit 39 may be implemented by means of transistors instead of diodes. In any case, if desired, one of the signal paths therein may include attenuation or amplification means to correct the symmetry of, or produce asymmetry in, the characteristic of this circuit.

As an alternative the frequency deviation detection circuit 19 may have only a single output, in which case the signal appearing thereat can be inverted by means of an amplifier and the input signal to the amplifier and the output signal from the amplifier be used to feed the inputs of the full-wave rectifier circuit.

#### WHAT WE CLAIM IS:-

1. A broadcast receiver including a synchronous detection circuit having a first input for an intermediate frequency signal and a second input for a reference signal at the nominal frequency of the intermediate

frequency signal, a pass filter tuned to said nominal frequency and included in a signal path to said second input, a frequency deviation detection circuit having an input coupled to a signal path to said first input for detecting deviations from said nominal frequency of an intermediate frequency signal applied in operation to said first input, a rectifier circuit having an input coupled to the output of said frequency deviation detection circuit, and a signal combining circuit having an output coupled to a function control signal input of said receiver for applying a control signal thereto in response to the application of said intermediate frequency signal to the first input of the synchronous detection circuit, said signal combining circuit having a first input coupled to the output of the synchronous detection circuit and a second input coupled to the output of the rectifier circuit and being constructed to combine signals applied in operation to its first and second inputs in such manner that said control signal will be produced for a wider range of frequencies of said intermediate frequency signal than it would be if the coupling from the frequency deviation detection circuit to its second input were absent.

2. A receiver as claimed in Claim 1, wherein the frequency deviation detection circuit is a phase detection circuit having a further input for a reference signal, said filter being included in a signal path to said further input.

3. A receiver as claimed in Claim 1 or Claim 2, constructed as a television receiver.

4. A television receiver as claimed in Claim 3, wherein the function control signal input is a gain control signal input and the output of the combining circuit is coupled thereto via a detection circuit which is constructed to produce an output which is representative of the output of the combining circuit which occurs at instants when it has a standard value.

5. A television receiver as claimed in Claim 3, wherein the function control signal input is the input of a synchronization signal separation circuit.

6. A television receiver substantially as described herein with reference to the drawing.

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18

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As previously mentioned, the combining circuit 33 can be constructed as an adding circuit. If one of the input signals thereto has the opposite polarity it can be constructed as a subtracting circuit. It may comprise passive and/or active components and may, if so desired, include one or more threshold circuits. The presence of such threshold circuits will of course affect the shape of the curve shown adjacent the output 59 of the combining circuit 33, as will the amplitude ratio chosen between the signals at the inputs 31 and 35.

The rectifier circuit 39 may be implemented by means of transistors instead of diodes. In any case, if desired, one of the signal paths therein may include attenuation or amplification means to correct the symmetry of, or produce asymmetry in, the characteristic of this circuit.

As an alternative the frequency deviation detection circuit 19 may have only a single output, in which case the signal appearing thereat can be inverted by means of an amplifier and the input signal to the amplifier and the output signal from the amplifier be used to feed the inputs of the full-wave rectifier circuit.

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