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(54) Television signal black level clamping circuit

(57) A method for clamping the black level of a television signal comprises converting the input video signal to a digital input signal and, by means of a measuring circuit, measuring the signal level during a blanking period of the input video signal. The measured signal level is compared with a digital reference level to generate a digital error signal. A correction signal derived from the error signal at correction generator is added to the samples forming the digital input signal with any residue of the truncated addition at each sample being retained for addition with the correction signal to the next sample.

Fig.1

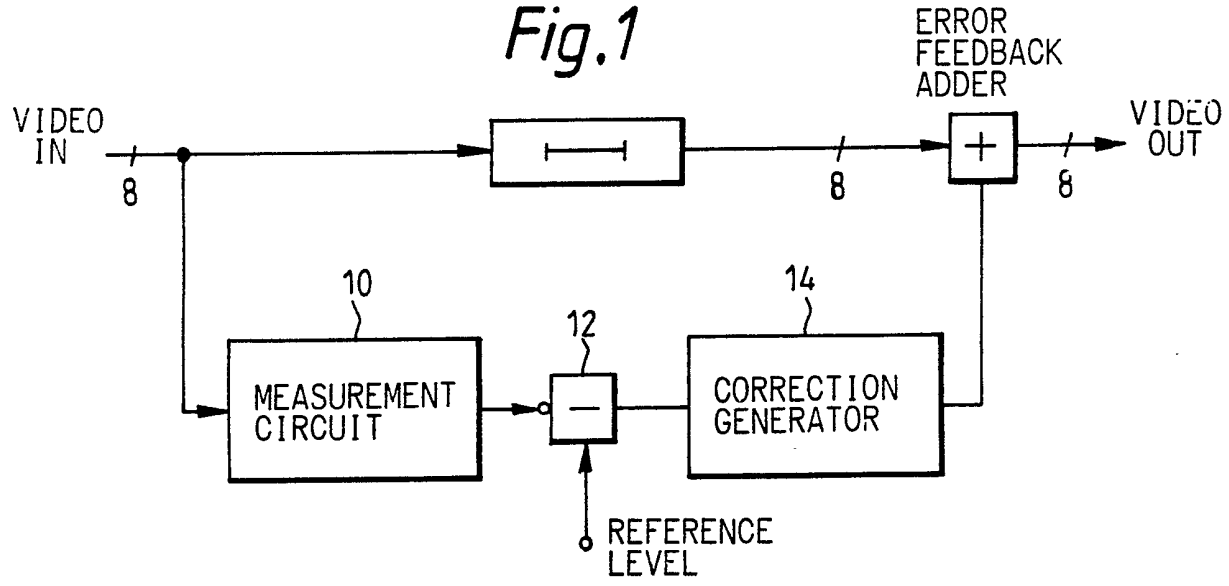

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Fig.1

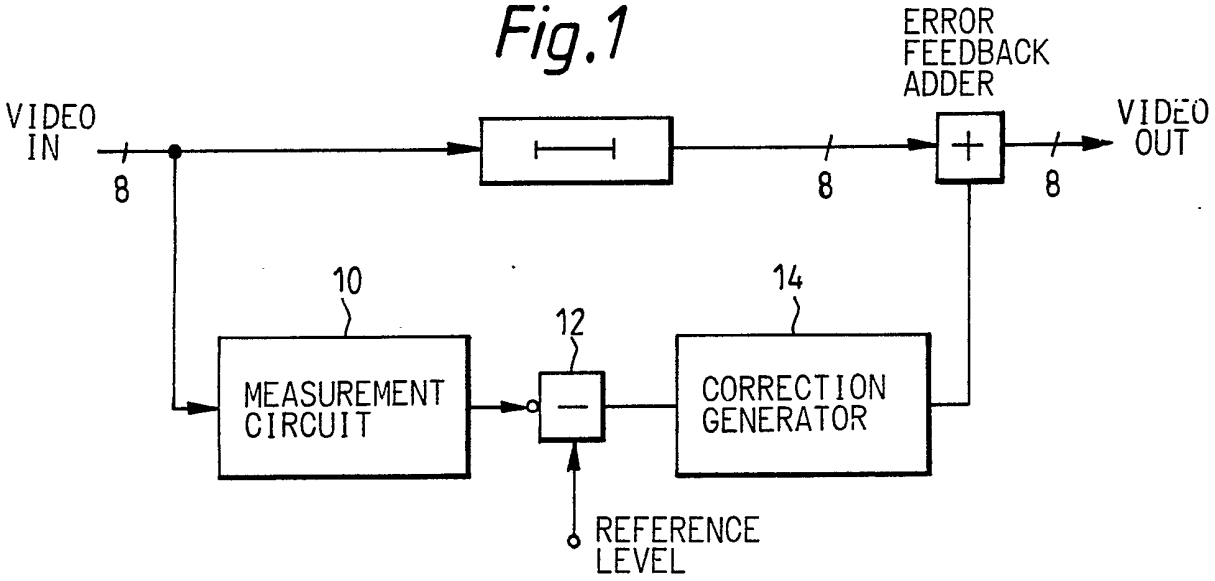


Fig.2(a)

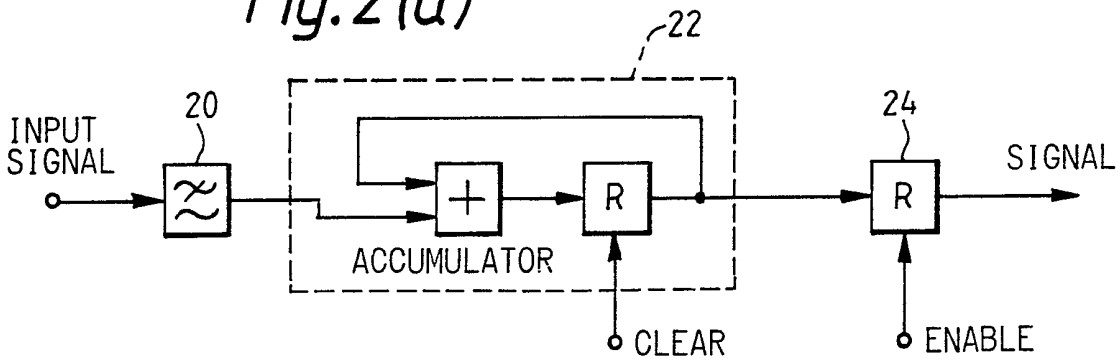


Fig.2(b)

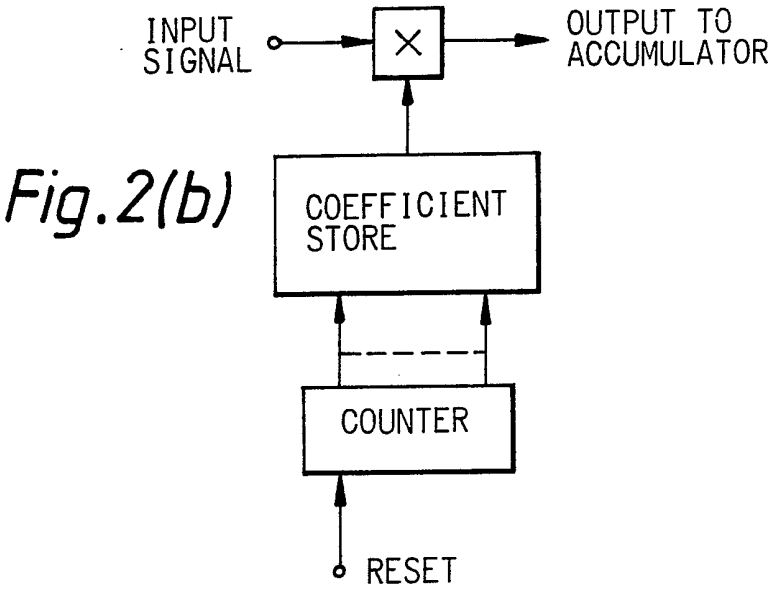


Fig.3(a)

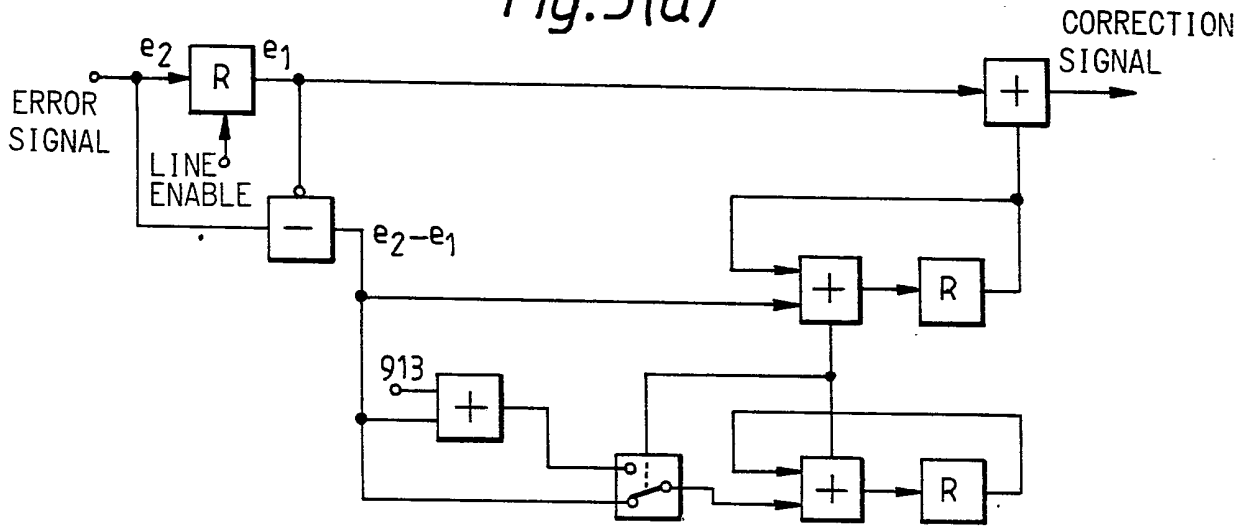


Fig.3(b)

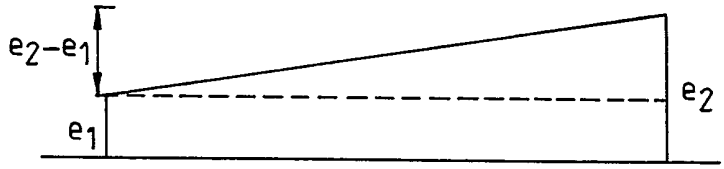
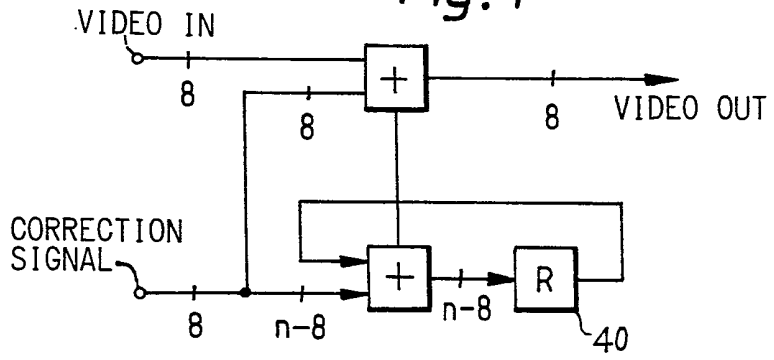


Fig.4



VIDEO SIGNAL PROCESSING

The invention relates to the problem of stabilising the black level of a composite colour television signal after digital encoding at an analogue to digital converter. Although generally applicable, the advantages of the system make it particularly suitable for digital processing where parts of the signal are to be moved from their original positions, such as in a picture scrambling technique in which the lines are shuffled to occur in a different order.

Conventional techniques for television use a clamping pulse generated from the line synchronising pulse to control the d.c. level of the television waveform in the back porch. A feedback circuit is used so that, after a disturbance, such as a change in the average level of the signal, the received level is compared with a reference level and a correction signal applied to gradually correct the error. The feedback technique and the sampled nature of the comparison method dictate that too large a correction cannot be made at one time, because of the stability requirements of the loop. Also, the loop characteristics provide for a degree of noise suppression, by using proportions of the error signal measured on several lines.

Such a technique can be used at the input to an analogue-to-digital converter as a means of ensuring that the signal is accurately located on the signal conversion range of the a-d converter. Nevertheless, this approach is not ideal in that drift or the alignment accuracy of the input circuitry of the converter may still cause the digital coding level corresponding to blanking level to vary.

One approach to stabilising the digital blanking level is to compare the level of the signal during the back porch with a digital reference level. Unfortunately, the quantising steps of the a-d converter are often large compared with the size of the error. According to conventional wisdom, this prevents the correction being made directly in the digital domain, and the signal is added as a contribution to the feedback in the analogue domain before the a-d converter input.

The growing capabilities of digital integrated circuits now make it preferable to place the final black level stabilisation process after the a-d conversion. In this way, we can benefit from the greater accuracy and stability of digital filtering and signal processing techniques to obtain an improved measurement of error and to have greater control over the dynamic characteristics of the correction technique. In this circumstance, we can usefully apply a technique known as error feedback. This is conventionally used to avoid quantising effects, known as 'contouring', in the resulting picture signals when the number of bits has to be reduced at the output of a digital process. The combination of digital measurement and digital correction to the clamping problem is believed to be new. Applying the error feedback technique to the clamping problem allows us to add very small corrections to the average signal level, even though the signal is quantised. The correction can therefore be made as a fixed correction, added equally to all the samples of the line, or as a varying correction intended to compensate for a black level that is changing across the line period.

The main items of such a clamping system are as shown in Figure 1. The incoming analogue video signal would have been first applied to a conventional clamp before analogue-to-digital conversion to ensure that the video signal remained within the coding range. The measuring circuit then determines the average level of the signal during the back porch period by measuring over a number of samples. This averaging process results in more precision than is given directly by the conventional 8-bit quantised signal. The measured value is then compared with the nominal value by subtracting it from the reference level to give an error signal. The error signal could be used directly by adding it to the video signal, appropriately delayed, for each sample in the line. The residue of the truncated addition at each sample would be retained to be added with the correction value at the next sample. By this means, the average correction can have a value much smaller than the quantisation step of the video signal.

The action of one form of measurement circuit is shown in more detail in Figure 2. The input signal must be low-pass filtered and the results accumulated in a register. The register of the accumulator is cleared at the beginning of the clamp period and the following samples added until the end of the clamp period at which point the resulting sum is loaded into the output register and held for one line period. It should be noted that the averaging process itself has a low-pass filtering action, so the filter at the input is not always necessary. Also, when the sampling is locked to a harmonic of the subcarrier frequency, the averaging process has zero response at subcarrier frequency, when the samples from a whole number of subcarrier cycles are added. If further filtering is required this can be provided by the circuit of Figure 2(b), placed in the cicuit of Figure 2(a). Then, when the counter is reset by a line pulse at the beginning of the clamp period, the incoming samples are added in weighted proportions according to the array of stored coefficients.

While the difference signal produced by the comparison process can be used directly for zero-order correction as described above, an improvement is shown in Figure 3. Instead of adding a fixed correction throughout the line period, in this case the measurments from two consecutive lines e_1 and e_2 are used to give a first-order correction through the line. This is achieved by taking the error signal and dividing it by the number of samples in the line (in this case 1135) by adding it to the initial error signal e_1 through a system of ratio counters. The result is that the value of the correction signal is increased from e_1 to e_2 gradually through the line. To do this, it is necessary for the registers of the ratio counter system to be cleared at the beginning of the line.

The correction signal is added to the incoming video using the error feedback adder arrangement shown in Figure 4. Any of the less significant bits of the correction signal not contributing to the video signal in one addition are held in the register R to be included with the correction added to the next sample.

CLAIMS

1. A method of clamping the black level of a television signal, the method comprising converting the input video signal to a digital input signal; measuring the signal level during a blanking period of the input video signal comparing the measured signal level with a digital reference level to generate a digital error signal; adding a correction signal derived from the error signal to the samples forming the digital input signal with any residue of the truncated addition at each sample being retained for addition with the correction signal to the next sample.

2. A method according to claim 1 in which the measured signal level is obtained by a weighted summation of the values of successive samples forming at least part of a line during the blanking period.

3. A method according to claim 1 or 2 in which the correction signal is stored for one line period and the stored signal added to each of the samples forming the line from which the measured signal level has been obtained.

4. A method according to any preceding claim in which digital error signals are derived from each of two consecutive lines of the digital input signal, the correction signal added to the samples forming the first of said lines being dependent on the digital error signal obtained from the next consecutive line as well as the digital error signal derived from that said line.

5. A method according to claim 4 in which the correction signals added to each of the samples forming the first of said lines is scaled in dependence on the difference between the error signal obtained from that line and the error signal obtained from the next consecutive line.

6. A method for clamping the black level of a television signal, the method being substantially as hereinbefore described.

7. Apparatus for use in clamping the black level of a television signal; the apparatus comprising an analogue-to-digital converter for converting an input video signal to a digital input signal; a measuring circuit for measuring the signal level during a blanking period of the input video signal; a digital comparator for comparing the measured signal level with a digital reference level to generate a digital error signal; and an adder for adding to the samples forming the digital input signal a correction signal derived from the digital error signal; the adder including means for retaining any residue of the truncated addition at each sample for addition with the correction signal to the next sample.

8. Apparatus according to claim 7 in which the measuring circuit includes means for averaging the values of successive samples forming at least part of a line during the blanking period.

9. Apparatus according to claim 8 in which the said means for averaging includes an accumulator.

10. Apparatus according to any of claims 7 to 9 in which digital error signals are derived from each of two consecutive lines of the digital input signal, means being provided to derive a correction signal for addition to the samples forming the first of said lines dependent on the digital error signal obtained from the next consecutive line as well as the digital error signal derived from that said line.

11. Apparatus according to claim 10, in which said means include a scaler circuit for scaling the correction signals added to the samples forming the first of said lines in dependence on the difference between the error signal obtained from that line and the error signal derived from the next consecutive line.

12. Apparatus for use in clamping the black level of a television signal, the apparatus being substantially as hereinbefore described with reference to the drawings.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number 9023305.7

Relevant Technical fields

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(ii) Int Cl (Edition 5) HO4N

Search Examiner

J P COULES

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

22.5.91

Documents considered relevant following a search in respect of claims 1-12

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	"NONE"	

SF2(p)

DT6AAP

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

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