

HORIZONTAL AND VERTICAL IMAGE DETAIL
PROCESSING OF A COLOR TELEVISION SIGNAL

(44)

5 This invention concerns apparatus for enhancing color television signal vertical detail picture information, in a television signal processing system also including apparatus for enhancing horizontal picture detail information.

10 In a color television system such as the system developed in the United States, the luminance and chrominance components of a color television signal are disposed within the video frequency spectrum in frequency interleaved relation, with the luminance components primarily occurring at integral multiples of the horizontal
15 line scanning frequency and the chrominance components primarily occurring at odd multiples of one-half the line scanning frequency. Current color television receiver designs often employ a comb filter for separating the frequency interleaved luminance and chrominance components
20 of the video signal. Examples of comb filters suitable for this purpose are shown in U. S. Patent No. 4,143,397 - D. D. Holmes and in U. S. Patent No. 4,096,516 - D. H. Pritchard.

25 A combed luminance signal which appears at the luminance output of the comb filter has been subjected to a "combing" effect over its entire band. The combing action over the high frequency band portion which is shared with chrominance signal components has the desired effect of deleting chrominance signal components. Extension of this
30 combing action into the low frequency band portion which is not shared with the chrominance signal components, however, is not needed to effect the desired removal of chrominance signal components, and serves only to unnecessarily delete luminance signal components. Components in the
35 lower end of this unshared band which are subject to such deletion are representative of "vertical detail" luminance information. Preservation of the vertical detail information is desirable to avoid loss of vertical resolution

in the luminance content of a displayed image.

One arrangement for preserving the vertical
5 detail information employs a low-pass, vertical detail
filter for selectively extracting the vertical detail
signal information from the comb filter output that also
contains combed chrominance signal. The extracted vertical
detail signal is then combined with combed luminance
10 signals from the comb filter. The combined signal includes
a "combed" high frequency portion (occupying a band of
frequencies above the cut-off frequency of the vertical
detail filter) from which chrominance signal components
have been removed, and an uncombed (i.e., "flat") low
15 frequency portion in which all luminance signal components
have been preserved. In many color television receivers
the luminance signal is afterwards processed by a
horizontal peaking network to improve the horizontal image
detail of an image to be reproduced by the receiver.

20 An improvement in vertical image detail can be
accomplished by suitably processing the extracted vertical
detail signal. A signal processing arrangement suitable
for this purpose is described in U. S. Patent No. 4,245,237
titled "Controllable Non-Linear Processing Of Video
25 Signals". In this system, the extracted vertical detail
signal is non-linearly processed to provide a desired
amplitude response with respect to selected ranges of
vertical detail signal amplitude levels. This vertical
detail signal processing system also includes a filter for
30 low-pass filtering the non-linearly processed vertical
detail signal. This reduces certain unwanted visible
effects of the non-linear signal processing which may
otherwise appear in a displayed image as potentially
objectionable serrations along the edge of a displayed
35 diagonal or similar image pattern.

In accordance with the principles of the present
invention there is disclosed herein an arrangement of a
luminance signal horizontal detail signal processor and a

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1 non-linear vertical detail signal processor wherein unwanted
interaction between processed horizontal and vertical detail
5 signals is minimized, so that undesirable transient
responses in the luminance signal are avoided. In addition,
the signal processing characteristics of the horizontal
signal processor facilitate the design of the filter
response for a low pass filter utilized to filter output
10 signals from the vertical detail signal non-linear processor.

Apparatus according to the present invention is
included in a color television receiver for processing a
television signal containing image representative luminance
and chrominance components disposed within the frequency
15 spectrum of the television signal in frequency interleaved
relation. The receiver includes a comb filter with first
and second outputs. A combed luminance appears at the
first comb filter output. At the second comb filter
output there appears a combed signal including signal
20 frequencies representative of luminance vertical image
detail information absent from the combed luminance signal
at the first output. A frequency selective network
coupled to the second comb filter output selectively
passes the signal frequencies corresponding to vertical
25 detail information, exclusive of signal frequencies
occupying the band of chrominance signal frequencies, to
thereby derive a vertical detail component from the second
comb filter output. A restored luminance signal is produced
by combining combed luminance signals from the first comb
30 filter output with a given magnitude of the vertical detail
component. A first signal translating network responds
to the restored luminance signal for peaking horizontal
image detail information of the restored luminance signal,
to provide a horizontally peaked luminance signal at an
35 output. A second signal translating network responds to
the vertical detail component for developing a vertical
detail peaking component at an output. Output signals from
the first and second translating networks are combined to

produce a horizontally and vertically peaked luminance signal, which is then supplied to a luminance signal utilization network.

In an embodiment of the invention, the second translating network includes a filter for removing signal frequencies greater than the vertical detail signal frequencies from output signals of the second translating network, the first translating network includes a delay network for determining the peaking characteristics of output signals from the first translating network, and signal delays exhibited by the first and second translating networks are substantially equal.

In the drawing:

FIGURE 1 shows a block diagram of a portion of a color television receiver including signal processing apparatus according to the present invention;

FIGURE 2 shows a schematic circuit diagram of signal processing apparatus according to the present invention; and

FIGURES 3-6 depict signal transfer responses which are useful in understanding the operation of the signal processing apparatus shown in FIGURES 1 and 2.

In FIGURE 1, a source of composite color video signals 10 including luminance and chrominance components supplies video signals to an input of a comb filter 15 of known configuration, such as a comb filter employing charge coupled devices (CCD's) as shown in U. S. Patent No. 4,096,516. The luminance and chrominance components are arranged within the video signal frequency spectrum in frequency interleaved relation. The luminance component has a relatively wide bandwidth (extending from D.C. or zero frequency to about four megahertz for NTSC). The upper frequency range of the luminance component is shared with the chrominance component, which comprises a subcarrier signal of 3.58 MHz. which is amplitude and phase modulated with color information. The amplitude versus frequency

response of comb filter 15 with respect to luminance combining action exhibits a peak amplitude

5 response at integral multiples of the horizontal line scanning frequency (approximately 15,734 Hz.) extending from D.C. or zero frequency, and an amplitude null at odd multiples of one-half the line scanning frequency, including the 3.58 MHz. chrominance subcarrier frequency. The
10 amplitude versus frequency response of comb filter 15 with respect to chrominance combining action exhibits a peak amplitude response at odd multiples of one-half the line frequency including 3.58 MHz., and an amplitude null at integral multiples of the line frequency.

15 A "combed" luminance signal (Y) from a first output of comb filter 15 is coupled via a low-pass filter 22 to an input of a signal combining network 30. Filter 22 is arranged to pass all luminance signals below a cut-off frequency of approximately 4 MHz., and serves to remove
20 noise and clock frequency components of switching signals associated with the switching operation of comb filter 15 when of a CCD type comb filter.

A second output of comb filter 15 is applied to a chrominance signal processing unit 64 for generating R-Y,
25 B-Y and G-Y color difference signals, and to an input of a low-pass vertical detail filter 35. Unit 64 includes a suitable filter for passing only those signal frequencies from comb filter 15 which occupy the band of chrominance signal frequencies. Filter 35 exhibits a cut-off
30 frequency of approximately 1.0 MHz., and selectively passes those signal frequencies present in the second signal output of comb filter 15 which lie below this cut-off frequency. Signal frequencies in this region represent vertical detail luminance information which is absent from
35 the combed luminance signal and which must be restored to the luminance signal to avoid loss of vertical resolution in the luminance content of a displayed image. Such vertical detail restoration is accomplished by combining

an appropriate amount of the vertical detail signal from filter 35, with the filtered combed luminance signal from filter 22, in combining network 30. In this regard it is noted that the vertical detail signals from the output of filter 35 exhibit a linear amplitude transfer (gain) response "A" of the form shown in FIGURE 3 for both positive (+) and negative (-) signal polarities. The restored luminance signal from the output of combiner 30 is inverted by unit 32, subjected to horizontal detail processing by means of a horizontal peaking control network 40, and afterwards applied to an input of a signal combining network 42.

Vertical detail signals from filter 35 also are supplied to a non-linear vertical detail signal processing circuit 50 including a non-linear signal processor 52 and a signal combiner 54, for imparting different amounts of signal gain to vertical detail signals within three predetermined ranges of signal amplitude as will be discussed. Processed signals from network 50 are supplied to another input of combiner 42, where they are summed with the signals from horizontal peaker 40.

The output signal from combiner 42 corresponds to a reconstituted luminance component of the video signal with the vertical detail information thereof restored, and controllably enhanced (peaked) and pared (attenuated) as will be discussed in connection with FIGURE 2. The reconstituted luminance component is afterwards applied to a luminance signal processing unit 58. An amplified luminance signal Y from unit 58 and the color difference signals from chrominance unit 64 are combined in a matrix 68, for providing R, B, and G color image representative output signals. These signals are then suitably coupled to image intensity control electrodes of a color kinescope 70.

FIGURE 2 shows circuit details of the horizontal and vertical detail signal processing networks of FIGURE 1.

In FIGURE 2, restored combed luminance signals

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are applied to peaking network 40 from the output of coupling network 30 via signal inverter 32, a coupling capacitor 75, and a resistor network 78. Peaking network 40 includes a delay line 85, differentially connected transistors 87 and 88, a current source 89 for providing operating currents for transistors 87 and 88, and a transistor 90, arranged as shown. In this example delay line 85 operates in a reflective mode and provides a signal delay of approximately 140 nanoseconds. Peaked luminance output signals from network 40 appear at the interconnected collector electrodes of transistors 88 and 90, and are applied to combiner 42. The peaked luminance signals exhibit an increased amplitude transition slope with associated "preshoots" and "overshoots" V_{p1} and V_{p2} for improved horizontal definition and sharpness of a reproduced image. In this example, the bandwidth of network 40 encompasses the zero Hertz to 4.0 MHz. luminance signal bandwidth, with maximum signal peaking being produced at 3.5 MHz. The amount of luminance signal horizontal peaking can be controlled by controlling the level of current available from current source 89. Additional details of peaking network 40 are disclosed in copending British Patent Application 8210796 (RCA 75655) filed with this application and corresponding to U.S. Patent Application Serial No. 255,982 of W. E. Harlan titled "Self-Limiting Video Signal Peaking Circuit," filed April 20, 1981.

Linear vertical detail signals from vertical detail filter 35 (FIGURE 1), exhibiting a linear amplitude transfer response "A" as shown in FIGURE 3, are coupled via a network 92 to a base input of an amplifier transistor 95 included in non-linear signal processor 52. An amplitude responsive switched feedback network 98 is coupled from the collector electrode to the base electrode of transistor 95. The vertical detail signals are translated with a non-linear amplitude transfer (gain) function by non-linear processor 52, as described in detail in U.S. Patent No. 4,295,160, of W. A. Lagoni, entitled "Signal Processing Circuit Having a Non-Linear Transfer Function".

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Briefly, non-linear processor 52 provides a non-linear composite amplitude transfer function as shown in FIGURE 4. This imparts different amounts of signal gain to signals having small, moderate and large amplitudes within three ranges respectively designated as I, II, and III in accordance with a transfer function "B" shown in FIGURE 4, for both positive (+) and negative (-) signal polarities. Processed vertical detail signals with response "B" are coupled from an output of network 52 via a capacitor 100. Small amplitude vertical detail signals in region I are translated by network 52 with a given fixed gain of approximately two. Small amplitude excursions of moderate amplitude detail signals are also processed with the given fixed gain, while the peak amplitude excursions of moderate amplitude signals are amplified with a gain of approximately three in region II. In region III the peak amplitude excursions of large amplitude signals subject to paring (amplitude reduction) are translated with less than the given fixed gain. Small amplitude excursions of large amplitude signals are processed with the given fixed gain, and moderate amplitude excursions are amplified as mentioned above for region II.

25 The non-linearly processed signals from processor 52 are coupled via a low-pass vertical peaking filter 101 comprising a resistor 102, an inductor 104, a resistor 106, and a capacitor 108, to a base input of a transistor 110. These signals are combined at the base of transistor 110 with a predetermined amount of linear vertical detail signals from vertical detail filter 35. The latter signals are coupled to the base of transistor 110 via a low-pass filter 112 comprising a resistor 115, an inductor 116, resistor 106 and capacitor 108. Transistor 110 operates as an inverting feedback summing amplifier transistor, and the base electrode of transistor 110 represents a "virtual ground" summing point. Transistor 110 also acts as an active filter device in conjunction with

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low-pass filters 101 and 112, as will be described in greater detail subsequently.

5 A non-linear amplitude transfer function "C" is associated with signals developed at the collector output of transistor 110, as shown in FIGURE 5. Specifically, the characteristics of transfer function C, and the level of signals appearing at the collector of transistor 110,
10 are determined by the ratio of the impedance presented by resistor 106 to the impedance presented by resistor 102, and by the ratio of the impedance presented by resistor 106 to the impedance presented by resistor 115. These impedance ratios are selected so that small amplitude excursions of
15 signals from network 52, after processing in region I of transfer function B (FIGURE 4), substantially cancel with small amplitude excursions of signals linearly translated via resistor 115, when signals coupled via resistors 102 and 115 are combined in transistor 110.
20 That is, the linear signal transfer slope in region I of response B and the linear transfer slope associated with response A for signals coupled via resistor 115 mutually cancel in region I so as to produce non-linear transfer function C (FIGURE 5) at the collector of transistor 110.

25 The detail signal developed at the collector output of transistor 110 is coupled via a variable gain control resistance 125 to an input of combiner 42, where the non-linearly processed detail signal from network 50 is summed with the linearly translated luminance signal
30 from horizontal peaking network 40. In this example the signal from peaking network 40 also exhibits a linear (gain) transfer response "A" as shown in FIGURE 3. Accordingly, a reconstituted luminance signal appearing at the output of combiner 42 exhibits an amplitude transfer
35 response "D" as shown in FIGURE 6. With reference to response "D", it is noted that the signal gain imparted to signals in regions II and III can be varied in accordance with the setting of variable resistance 125, without

disrupting the fixed signal gain in region I, as described in detail in U. S. Patent No. 4,245,237.

5 With regard to the output signal from combiner 42, it is noted that the restoration gain produced in restoration region I for low level vertical detail signals (e.g., signal amplitudes of about five percent of maximum expected amplitude) is such that low level vertical
10 detail signals along with noise and other undesired components are processed without enhancement in region I. The peak amplitude of vertical detail signals of moderate amplitude (e.g., signal amplitudes between five percent and forty percent of maximum expected amplitude)
15 are processed within enhancement region II to thereby emphasize the vertical detail information and picture definition in this region. The peak amplitude of relatively large amplitude vertical detail signals (e.g., between about forty percent of maximum expected amplitude and
20 maximum amplitude) corresponding to high contrast images such as lettering, for example, are processed within region III to attenuate or pare the large amplitude excursions, which can be large enough to cause excessive contrast and kinescope "blooming" which would otherwise
25 distort or obscure picture detail.

In region I, low level vertical detail signal information has been restored in an amount sufficient to preserve normal low level vertical resolution in the luminance content of a displayed image. The amount of
30 restoration gain in region I preferably corresponds to that amount of signal gain which, in a given system, is required to restore small amplitude excursions of the vertical detail component to the luminance signal so that an ultimately reconstituted luminance signal exhibits an
35 essentially "flat" amplitude response with respect to small amplitude vertical detail signals. The magnitude of the restoration gain is a function of various factors, including the signal translating characteristics of networks coupled

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1 between the outputs of comb filter 15 and luminance processor 58 which processes ultimately reconstituted
5 luminance signals, and the relative magnitudes of the signals appearing at the outputs of comb filter 15, for example. The choice of the restoration gain for region I also involves considerations of what results are acceptable in a given video signal processing system. For example,
10 if the restoration gain is insufficient, significant combing effects (i.e., signal peaks and nulls at different frequencies) will appear in the vertical detail frequency region, resulting in less low level vertical detail information. Thus the slope of the amplitude transfer
15 characteristic in region I corresponds to the amount of signal gain necessary to produce a desired response (i.e., a flat luminance response) without introducing unacceptable side effects.

It is noted that in the system as so far described,
20 horizontal peaking is accomplished in a first signal processing path including horizontal peaking network 40, and vertical detail signal processing including peaking is accomplished in a second signal processing path including processor network 50, independent of the horizontal peaking
25 path. Thus the nonlinearly processed vertical detail signals, which are combined in network 42 with signals from horizontal peaker 40, are not subjected to the process of horizontal peaking. This manner of luminance signal processing avoids the introduction of unwanted luminance
30 signal transient responses which would otherwise be produced if the nonlinearly processed vertical detail signals were afterwards subjected to horizontal peaking. Such unwanted transient responses would otherwise be produced due to the different signal processing bandwidths
35 associated with the horizontal and vertical detail signal processing networks. In this example the signal bandwidth of the vertical detail signal processing path extends from zero hertz to approximately 1.0 MHz., while the horizontal

peaking signal processing path including network 40 encompasses the significantly wider 4.0 MHz. luminance signal bandwidth as mentioned earlier.

It is also noted that the non-linear operation of vertical detail signal processor 50 sometimes produces rapid amplitude gain transitions of processed signals. Such rapid transitions, which appear as amplitude discontinuities in the time domain, desirably assist to provide a well defined boundary between the operating range wherein vertical detail signals are not peaked, and the operating range wherein detail signals are peaked. However, the discontinuities associated with such rapid transitions can produce an objectionable visible effect upon a displayed image. Specifically, manifestations of the discontinuities appear as serrations or "stairsteps" (i.e., a form of ripple) along the edges of a displayed diagonal or similar image pattern. The image serrations may also be attributable to the content of a received television signal, in which case the serrations may be magnified in effect by the non-linear signal processing operation of network 50. Additional information concerning this phenomenon is found in U. S. Patent No. 4,223,340 of J. P. Bingham and W. A. Lagoni.

In the arrangement of FIGURE 2, the visible impact of these image serrations is reduced to an acceptable minimum by means of low-pass vertical peaking filter 101, including elements 102, 104, 106 and 108, coupled to the output of nonlinear processor circuit 52. This filter serves to smooth or average out the serrations by filtering out high frequency components such as unwanted harmonics and distortion components associated with the rapid signal amplitude transitions attributable to the operation of non-linear processor 52.

The design of vertical peaking filter 101 is facilitated by the manner in which the combed luminance signal processing path including horizontal peaker 40 is

1 arranged relative to the vertical detail signal processing
path including non-linear processor 52 and filter 101, as
5 follows.

Proper operation of the signal processing arrange-
ment of FIGURE 2 requires that signals coupled via the path
including horizontal processor 40, and signals coupled via
the vertical detail signal path including vertical
10 processor 52, arrive at combiner 42 in time coincidence
so that the reconstituted luminance signal output from
combiner 42 exhibits proper amplitude and phase characteris-
tics. This time coincidence is achieved by the signal
delay imparted by delay line 85 in the horizontal processor
15 path, in conjunction with the signal delay associated with
vertical peaking filter 101 in the vertical processor
signal path. In this example the signal delays associated
with delay line 85 and vertical peaking filter 101 are
substantially equal.

20 The amount of delay associated with delay line
85 corresponds to the amount of delay (approximately 140
nanoseconds in this example) which is required to
determine a desired horizontal peaking response for signals
processed by network 40. This amount of delay is
25 sufficiently large so that the corresponding amount of
signal (equalizing) delay that is required in the
vertical signal processing path including filter 101 is
large enough to permit vertical peaking filter 101 to be
designed for effective performance relative to desired
30 filtering characteristics. That is, filter 101 is permitted
to exhibit a large enough delay so that filter 101 can be
designed to exhibit a sufficiently low cut-off frequency
of approximately 1.0 MHz. with good rejection of frequencies
above 1.0 MHz., as well as a good group phase delay response.
35 Low-pass filter 112 is included to provide signal delay
and bandwidth matching for the linear vertical detail
signals summed at the base of transistor 110, relative to
the signal delay and bandwidth associated with the

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nonlinearly processed signals from processor 52 and filter 101.

5 Thus the disclosed arrangement of delay line 85 in horizontal processor 40, relative to vertical processor 52 and vertical peaking filter 101, assists to facilitate the design of an effective vertical peaking filter and provides signal delay equalization, in addition to
10 determining the peaking characteristic of signals processed by horizontal peaker 40 and avoiding the transient response problem noted previously.

 Other arrangements of the vertical detail signal processing network are also possible, consistent with the
15 principles of the present invention. Illustratively, vertical detail signal processing circuit 50 could be replaced by the non-linear signal processor shown in FIGURE 3 of previously mentioned U.S. Patent Number 4,295,160. In this case also it
20 remains desirable to filter the non-linearly processed output signals by means of a filter corresponding to vertical peaking filter 101, for the reasons mentioned previously. The vertical detail signal processing arrangement shown by FIGURE 2 herein is advantageous,
25 however, since it permits gain control via adjustable resistor 125 of moderate and large amplitude detail signals in regions II and III, without affecting the fixed gain desired for small amplitude vertical detail signals in region I.

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CLAIMS:

1. Video signal processing apparatus in a television receiver system for processing a video signal containing image representative luminance and chrominance components disposed within a frequency spectrum of said video signal in frequency interleaved relation, said system including comb filter means for providing at a first output a combed luminance signal with amplitude peaks at integral multiples of an image line scanning frequency and amplitude nulls at odd multiples of one-half said line frequency, and for providing at a second output a combed signal with amplitude peaks at odd multiples of one-half said line frequency and amplitude nulls at integral multiples of said line frequency, and wherein signals provided at said second output include signal frequencies representative of luminance vertical image detail information absent from said combed luminance signal at said first output, said apparatus comprising:
- means coupled to said second output of said comb filter means for selectively passing said signal frequencies corresponding to vertical detail information, exclusive of signal frequencies occupying the band of chrominance signal frequencies, to thereby derive a vertical detail component from said second output of said comb filter means;
 - first means for combining combed luminance signals from said first output of said comb filter means with a given magnitude of said vertical detail component to produce a restored luminance signal;
 - first signal translating means responsive to said restored luminance signal for peaking horizontal image detail information of said restored luminance signal, to provide a horizontally peaked luminance signal at an output;
 - second signal translating means responsive to said vertical detail component for developing a vertical detail peaking component at an output;



5 second means for combining signal outputs from
said first and second signal translating means to produce
a horizontally and vertically peaked luminance signal at
an output; and

luminance signal utilization means for receiving
10 output signals from said second combining means.

2. Apparatus according to Claim 1, wherein said
second translating means includes

15 low-pass filter means for removing signals
occupying a band of frequencies above said vertical
detail signal frequencies from output signals of said second
translating means.

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3. Apparatus according to Claim 2, wherein
said low-pass filter means attenuates signals
occupying the band of chrominance signal frequencies.

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4. Apparatus according to Claim 2, wherein
said first translating means includes signal
delay means for determining the peaking characteristics
30 of output signals from said first translating means;
and wherein

said signal delays exhibited by said first and
second translating means are substantially equal.

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5. Apparatus according to Claim 4, wherein
said low-pass filter means exhibits a signal delay
substantially equal to the signal delay exhibited by said
signal delay means.

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6. Video signal processing apparatus in a television receiver system for processing a video signal containing image representative luminance and chrominance components disposed within a frequency spectrum of said video signal in frequency interleaved relation, said system including comb filter means for providing at a first output a combed luminance signal with amplitude peaks at integral multiples of an image line scanning frequency and amplitude nulls at odd multiples of one-half said line frequency, and for providing at a second output a combed signal with amplitude peaks at odd multiples of one-half of said line frequency and amplitude nulls at integral multiples of said line frequency, and wherein signals provided at said second output include signal frequencies representative of luminance vertical image detail information absent from said combed luminance signal at said first output, said apparatus comprising:

means coupled to said second output of said comb filter means for selectively passing said signal frequencies corresponding to vertical detail information, exclusive of signal frequencies occupying the band of chrominance signal frequencies, to thereby derive a vertical detail component from said second output of said comb filter means;

first means for combining combed luminance signals from said first output of said comb filter means with a given magnitude of said vertical detail component to produce a restored luminance signal;

first signal translating means responsive to said restored luminance signal for peaking horizontal image detail information of said restored luminance signal to provide a horizontally peaked luminance signal at an output;

second signal translating means for linearly translating said vertical detail component with a first gain greater than zero;



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5 third signal translating means responsive to said
vertical detail component and comprising non-linear
processor means having a non-linear signal transfer function
for translating small amplitude excursions of said
vertical detail component with a second gain greater than
10 zero in a first region, and for translating moderate
amplitude excursions of said vertical detail component
with a third gain greater than said second gain in a second
region;

 second means for combining signal outputs from
15 said second and third signal translating means to
substantially cancel small amplitude excursions of said
vertical detail component;

 third means for combining signal outputs from
said second combining means and said first signal translating
20 means; and

 luminance signal utilization means for receiving
output signals from said third combining means.

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7. Apparatus according to Claim 6, wherein
said third signal translating means includes low-
pass filter means for removing signals occupying the band
of frequencies above said vertical detail frequencies
30 from output signals of said third translating means.

8. Apparatus according to Claim 7, wherein
said second signal translating means includes
35 signal delay means exhibiting a signal delay substantially
equal to a signal delay exhibited by said third signal
translating means.

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9. Apparatus according to Claim 8, wherein
said signal delay means included in said second
5 signal translating means comprises a low-pass filter.

10. Apparatus according to Claim 7, wherein
said first signal translating means includes
10 signal delay means for determining the peaking characteristics
of output signals provided by said first signal translating
means; and wherein
signal delays exhibited by said first and third
signal translating means are substantially equal.

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11. Apparatus according to Claim 10, wherein
said signal delay means exhibits a signal delay
substantially equal in magnitude to a signal delay exhibited
20 by said low-pass filter means.

12. Apparatus according to Claim 10, wherein
said low-pass filter means attenuates signals
25 occupying the band of chrominance signal frequencies.

13. Apparatus according to Claim 6, and further
comprising
30 a variable impedance coupled to said second
combining means for varying the magnitude of output signals
from said second combining means.

14. Video signal processing apparatus
35 substantially as hereinbefore described with reference
to Figures 1 to 6.

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