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(54) Alignment of a computer controlled television

(57) The image of a computer-controlled television 12 is aligned by feeding back the image displayed on the CRT screen by means of a video camera 16. The control device to feed back the image pattern includes the video camera for converting the image pattern into an electrical composite video signal; and RGB matrix 18 for separating the composite video signal into respective R,G,B components; first, second and third analog-to-digital converters 20, 22, 24 for converting the R,G,B components respectively into corresponding R,G,B digital signals; a pattern recognizor 28 for comparing the R,G,B components with reference values programmed in advance; and a control computer 30 for providing deflection equalizing data to the CCTV 12 to equalize distortion of the image pattern, according to the comparison result of the pattern recognizor 28.
A similar audio alignment process is mentioned.

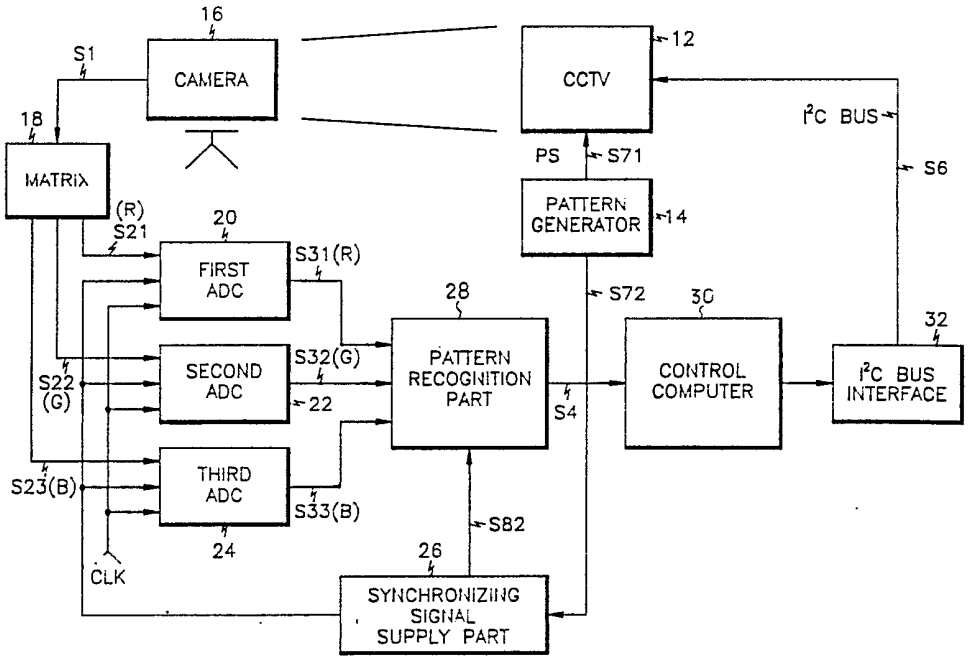

FIG. 1

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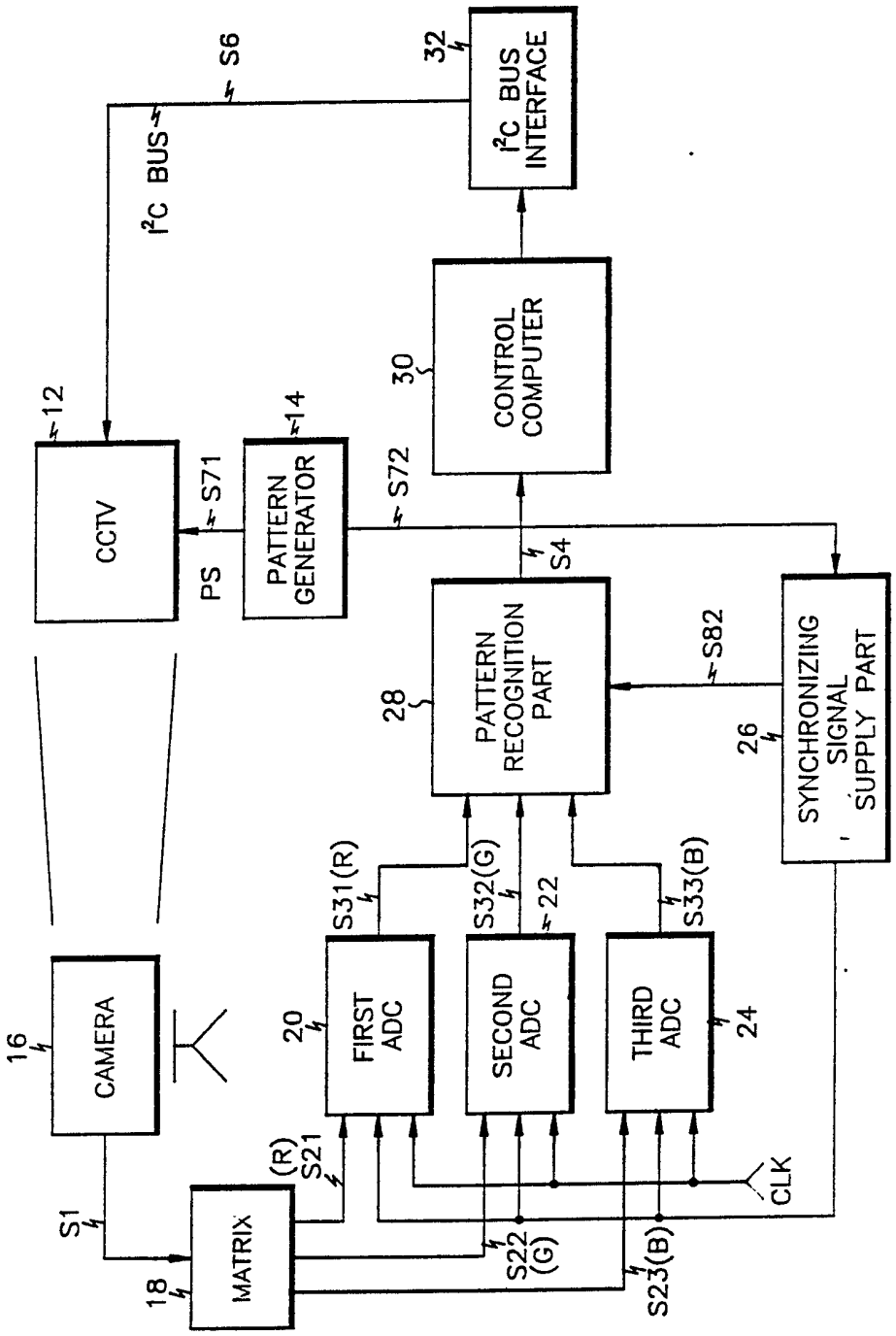
I²C BUS INTERFACE
32
S6
I²C BUS
CONTROL COMPUTER
30
12
CCTV
14
PATTERN GENERATOR
S71
PS
S72
S4
PATTERN RECOGNITION PART
28
S82
SYNCHRONIZING SIGNAL SUPPLY PART
26
S31(R)
S32(G)
22
S33(B)
16
CAMERA
20
FIRST ADC
SECOND ADC
THIRD ADC
24
(R) S21
CLK
S1
18
MATRIX
S22 (G)
S23(B)

FIG. 1

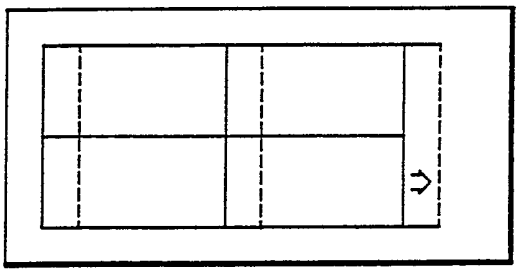

FIG. 2A

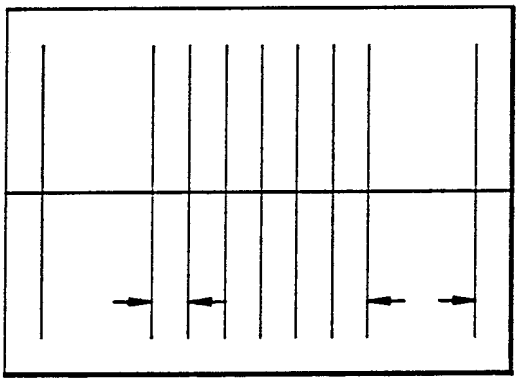

FIG. 2B

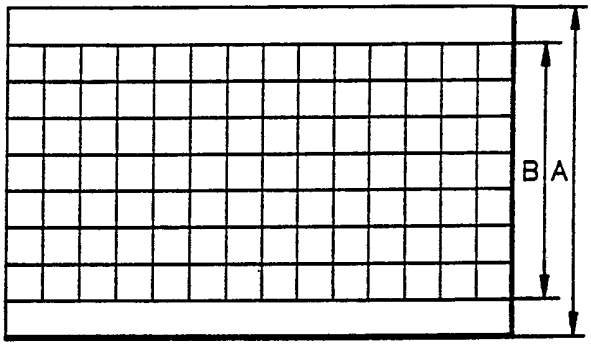

FIG. 2C

ALIGNMENT OF A COMPUTER-CONTROLLED TELEVISION

The present invention relates generally to computer-controlled televisions (hereinafter referred to as CCTVs) and more particularly (although not exclusively) to apparatus for controlling an image pattern thereof.

A known CCTV includes a microcomputer to control precisely the characteristics of geometry alignment of the image pattern displayed on the CRT and the sound characteristics thereof. In the CCTV, a horizontally or vertical distorted (shifted) image pattern and a mal-aligned image pattern can be adjusted by the internal microcomputer, according to a predetermined condition set up in advance.

In a conventional CCTV, once the parameters for controlling the horizontal, vertical and alignment characteristics are set up, it is inconvenient to re-adjust them. Further, it is difficult to confirm that the system keeps controlling the above characteristics according to the parameters previously set up. Therefore, there arises a demand for automatically controlling the parameters.

Preferred embodiments of the present invention aim to provide a device for automatically controlling the geometry characteristics of an image pattern of a CCTV by feeding back the image pattern presently displayed on a screen of the CCTV.

Another aim of preferred embodiments of the present invention is to provide a device for automatically controlling (or aligning) the sound characteristics of a CCTV by feeding back the sound signal.

More generally, according to a first aspect of the present invention, there is provided apparatus for aligning a computer-controlled television (CCTV), the apparatus comprising:

a test signal generator;

monitoring means for monitoring an output of a CCTV which output is generated in response to said test signal;

comparison means for comparing the output monitored by said monitoring means with a reference and outputting a difference signal representing differences resulting from the comparison; and

control signal means for outputting to the monitored CCTV a control signal that represents said difference signal and to which the CCTV can respond to modify signal processing characteristics of the CCTV.

Said test signal may be a signal to generate a video output from the monitored CCTV.

The apparatus may be adapted to align both video and audio signal processing circuits of the monitored CCTV, comprising an audio test signal generator and a video test signal generator.

Said test signal may be a signal to generate an audio ouput from the monitored CCTV.

Said test signal generator (or one of them) may comprise a pattern generator for producing on the monitored CCTV an image pattern containing a synchronous signal.

Said monitoring means may comprise image sensing means for sensing said image pattern on the monitored CCTV

and converting said image pattern into an electrical composite video signal.

Said monitoring means may further comprise means operably connected to said image sensing means, for separating said composite video signal into red, green, and blue components; and

first, second and third converting means for converting said red, green and blue components into red, green and blue digital signals, respectively.

The apparatus may further comprise means operably connected to said pattern generator to receive a synchronous signal from said pattern generator, said synchronous signal being coupled to said respective first, second and third converting means, whereby said first, second and third converting means synchronize with said pattern generator.

Said comparison means may comprise a pattern recognizor for comparing the output of said first, second and third converting means with a reference programmed in advance to control the monitored CCTV, and producing parameters for respective horizontal, vertical and alignment characteristics according to the comparison result.

Said signal means may comprise a control computer for comparing said parameters for respective horizontal, vertical and alignment characteristics with a reference parameter and thereby producing control data according to the comparison result, said control data being coupled, in use, to the monitored CCTV to equalize distortion of said image pattern.

Said first, second and third converting means may be analog-to-digital converters.

The apparatus may further comprise an interface arranged to be operably coupled between said control signal means and the monitored CCTV being monitored so as to convert control data output from said control signal means to a format suitable for controlling said CCTV.

Said monitoring means may comprise a video camera, a charge-coupled device image sensor or an LED light sensor.

The apparatus may be so arranged that, in use, the monitored CCTV responds to said control signal to modify signal processing characteristics of the CCTV until said difference signal becomes less than or equal to a predetermined minimum value.

The invention extends to apparatus as above, in accordance with the first aspect of the invention, in combination with a CCTV connected to be aligned by said apparatus.

In a second aspect, the invention provides a method of aligning a CCTV, comprising the steps of connecting to the CCTV apparatus as above, in accordance with the first aspect of the invention, and modifying signal processing characteristics of the CCTV by use of said apparatus.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 is a system block diagram of a device for automatically controlling the image pattern of a CCTV in an embodiment of the present invention; and

Figures 2A through 2C illustrate examples of mal-aligned image patterns to show features and advantages of the embodiment of Figure 1.

Referring primarily to Figure 1, the illustrated embodiment controls the geometric characteristics of an image pattern and includes a general CCTV set 12, in which a deflection circuit (not shown) controls the horizontal and vertical deflection of the image pattern displayed on the CRT thereof, according to a horizontal and vertical deflection control signal, respectively. The CCTV set 12 displays a picture on the CRT, of which geometric characteristics can be controlled by the deflection circuit as programmed in advance by a user. The image pattern displayed on the CRT of the CCTV set 12 is photographed by a video camera 16, and converted into electrical signal. The electrically converted signal is a composite video signal. Then the composite video signal is delivered to an RGB (Red, Green, Blue) matrix 18 for separating the above composite video signal delivered from the video camera 16 into red, green and blue components.

The separated R, G, B components are respectively provided to a first ADC (Analog-to-Digital Converter) 20 for converting the R component of the analog composite video signal into the R component of a digital video signal, a second ADC 22 for converting the G component of the analog composite video signal into the G component of a digital video signal, and a third ADC 24 for converting the B component of the analog composite video signal into the B component of a digital video signal.

The first, second and third ADC's 20, 22, 24 are provided with image window synchronous signals from a synchronizing signal supply part 26, whereby the output digital video signals of the first through third ADC's 20, 22, 24 are synchronized with the above synchronous signals. The output of the first through third ADC's 20, 22, 24 are then applied to a pattern recognition part 28 to be compared with a reference value. The reference value is set up (programmed) by a user in advance as desired. From the result of the comparison, the pattern recognition part 28 recognizes the geometric characteristics of the image pattern on the CRT screen to produce corresponding parameters of the horizontal, vertical and alignment characteristics by detecting the respective R, G, B component differences.

A control computer 30 compares the geometric characteristics of the pattern recognition part 28 with the reference geometric characteristics to produce a corresponding control data. The control data output from the control computer 30 is delivered via a bus line to a I^2C (Inter-Integrated Circuit) bus interface 32 by which the control data is converted to be suitable for an I^2C bus line S_6.

Referring now to Figures 2A through 2C, there is shown an image pattern which is shifted to the left-hand side on the CRT screen of the CCTV set 12, in Figure 2A. There is shown an image pattern which is mal- aligned horizontally, in Figure 2B. In addition, Figure 2C shows an image pattern in which the vertical image characteristic is reduced.

In operation of the embodiment, if a pattern generator 14 applies to the CCTV set 12 an image pattern

signal S_{71}, the input image pattern will be displayed on the CRT screen of the CCTV set 12. Facing the CRT screen of the CCTV set 12, the video camera 16 takes the picture of the image pattern displayed on the CRT screen and converts the image signal into a composite video signal which is applied to the RGB matrix 18. The composite video signal applied to the RGB matrix 18 is separated into the respective chrominance signals of the R, G, B components and then provided to the first through third ADC's 20, 22, 24. Namely, the R component is provided to the first ADC 20, the G component to the second ADC 22, and the B component to the third ADC 24, respectively.

The first through third ADC's 20, 22, 24 sample the respective R, G, B components at a predetermined sampling frequency (clock: CLK) to convert the chrominance signals into the digital video signals, in which the converted digital video signal is synchronized with the image window synchronous signal applied from the synchronizing signal supply part 26, thereby to produce the synchronized digital video signal to the pattern recognition part 28. In this way, the first through third ADC's 20, 22, 24 generate the parameters of the horizontal, vertical and alignment characteristics for the respective R, G, B components.

On the other hand, the synchronizing signal supply part 26 delays the synchronous signal of the image pattern generated from the pattern generator 14 for a predetermined time and controls the pulse width of the synchronous signal so as to provide the synchronous signal to the first through third ADC's 20, 22, 24. In this case, the delay must be made not only to complement the time taken for the R, G, B separation by the first through

third ADC's 20, 22, 24, but also to have the ADC's synchronize with the pattern generator 14.

In the meanwhile, the pattern recognition part 28 compares the characteristics of the horizontal, vertical and alignment for the respective R, G, B components produced from the first through third ADC's 20, 22, 24 with the reference characteristics programmed in advance as desired, so as to recognize (detect) the distortion characteristics and to generate to the control computer 30 the parameters corresponding to the distortion characteristics.

For example, if the pattern generator 14 generates an image pattern for the CCTV set 12, then the image pattern is to be displayed on the CRT screen of the CCTV 12. In this occasion, if the image pattern displayed on the CRT screen has inferior horizontal, vertical and alignment characteristics because of the mal-adjustment of the CCTV set 12, then the image pattern will be distorted as shown in Figures 2A - 2C.

Accordingly, the respective R, G, B components digitized by the first through third ADC's are distorted correspondingly and the distorted components are provided to the pattern recognition part 28, in which compared with the reference values programmed by the user.

For the image pattern of Figure 2A, the pattern recognition part 28 adds or subtracts (i.e., adjusts) the parameter corresponding to the horizontally-distorted image pattern caused by the inferior horizontal characteristic. Next, for the image pattern of Figure 2B, the parameter corresponding to the alignment characteristic is adjusted by the pattern recognition part

28 to equalize the mal-aligned image pattern. Namely, at the central portion of the image of Figure 2B is compressed while the left and right hand side of the image is spread out. Lastly, for the image pattern of Figure 2C the parameter corresponding to the vertical characteristic is adjusted to an extent by which the image is compressed vertically.

In other words, the pattern recognition part 28 compares with the reference values the parameters of the horizontal, vertical and alignment characteristics for the respective R, G, B components which is the feedback signal to recognize the geometric distortion of the image pattern on the CRT and to provide corresponding parameters to the control computer 30.

Thus, the control computer 30 determines the difference between the input distortion parameters and the reference parameters and provides deflection equalizing data to the I^2C bus interface 32 . The I^2C bus interface 32 converts the deflection equalizing data into I^2C bus data which are provided to the CCTV set 12 as control data.

As a result, when the image pattern displayed on the CRT screen of the CCTV set 12 has a narrow, suppressed horizontal and vertical characteristics, the control computer 30 controls the CCTV set via the I^2C bus interface 32 to complement (equalize) the suppressed characteristics, by applying the control signal to the deflection circuit.

The above described embodiment recognizes the geometric characteristics of the image pattern displayed on the CRT screen of the CCTV set. The recognized

geometric characteristics are compared with the reference characteristics by means of the control computer in order to provide deflection equalizing data for controlling the deflection circuit. Therefore, the embodiment can be used to adjust precisely television sets and monitors during a manufacturing process.

Whilst a preferred embodiment of the invention has been particularly shown and described, it will be understood by those skilled in the art that modifications in detail may be made without departing from the spirit and scope of the invention. For example, the video camera can be substituted by a CCD (Charge Coupled Device) image sensor.

In addition, the embodiment described in this specification only discloses an application for the video signal. However, the sound signal can be automatically controlled by replacing the video camera with a microphone and the first through third ADC's with a single ADC for converting the analog signal sensed by the microphone into a digital signal. Of course, the RGB matrix in this case must be excluded.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination,

except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS:

1. Apparatus for aligning a computer-controlled television (CCTV), the apparatus comprising:

a test signal generator;

monitoring means for monitoring an output of a CCTV which output is generated in response to said test signal;

comparison means for comparing the output monitored by said monitoring means with a reference and outputting a difference signal representing differences resulting from the comparison; and

control signal means for outputting to the monitored CCTV a control signal that represents said difference signal and to which the CCTV can respond to modify signal processing characteristics of the CCTV.

2. Apparatus according to claim 1, wherein said test signal is a signal to generate a video output from the monitored CCTV.

3. Apparatus according to claim 1, adapted to align both video and audio signal processing circuits of the monitored CCTV, and comprising an audio test signal generator and a video test signal generator.

4. Apparatus according to claim 1, wherein said test signal is a signal to generate an audio ouput from the monitored CCTV.

5. Apparatus according to claim 1, 2 or 3, wherein said test signal generator (or one of them) comprises a pattern generator for producing on the monitored CCTV an image pattern containing a synchronous signal.

6. Apparatus according to claim 5, wherein said monitoring means comprises image sensing means for sensing said image pattern on the monitored CCTV and converting said image pattern into an electrical composite video signal.

7. Apparatus according to claim 6, wherein said monitoring means further comprises means operably connected to said image sensing means, for separating said composite video signal into red, green, and blue components; and

first, second and third converting means for converting said red, green and blue components into red, green and blue digital signals, respectively.

8. Apparatus according to claim 5, 6 or 7, further comprising means operably connected to said pattern generator to receive a synchronous signal from said pattern generator, said synchronous signal being coupled to said respective first, second and third converting means, whereby said first, second and third converting means synchronize with said pattern generator.

9. Apparatus according to claim 7 or 8, wherein said comparison means comprises a pattern recognizor for comparing the output of said first, second and third converting means with a reference programmed in advance to control the monitored CCTV, and producing parameters for respective horizontal, vertical and alignment characteristics according to the comparison result.

10. Apparatus according to claim 9, wherein said control signal means comprises a control computer for comparing said parameters for respective horizontal, vertical and alignment characteristics with a reference parameter and

thereby producing control data according to the comparison result, said control data being coupled, in use, to the monitored CCTV to equalize distortion of said image pattern.

11. Apparatus according to any of claims 7 to 10, wherein said first, second and third converting means are analog-to-digital converters.

12. Apparatus according to any of the preceding claims, further comprising an interface arranged to be operably coupled between said control signal means and the monitored CCTV being monitored so as to convert control data output from said control signal means to a format suitable for controlling said CCTV.

13. Apparatus according to any of claims 1 to 3 and 5 to 12, wherein said monitoring means comprises a video camera, a charge-coupled device image sensor or an LED light sensor.

14. Apparatus according to any of the preceding claims, so arranged that, in use, the monitored CCTV responds to said control signal to modify signal processing characteristics of the CCTV until said difference signal becomes less than or equal to a predetermined minimum value.

15. Apparatus for aligning a computer-controlled television (CCTV), the apparatus being substantially as hereinbefore described with reference to the accompanying drawings.

16. Apparatus according to any of the preceding claims, in combination with a CCTV connected to be aligned by said apparatus.

17. A method of aligning a CCTV, comprising the steps of connecting to the CCTV apparatus according to any of the preceding claims, and modifying signal processing characteristics of the CCTV by use of said apparatus.

18. A method of aligning a computer-controlled television (CCTV), the method being substantially as hereinbefore described with reference to the accompanying drawings.

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