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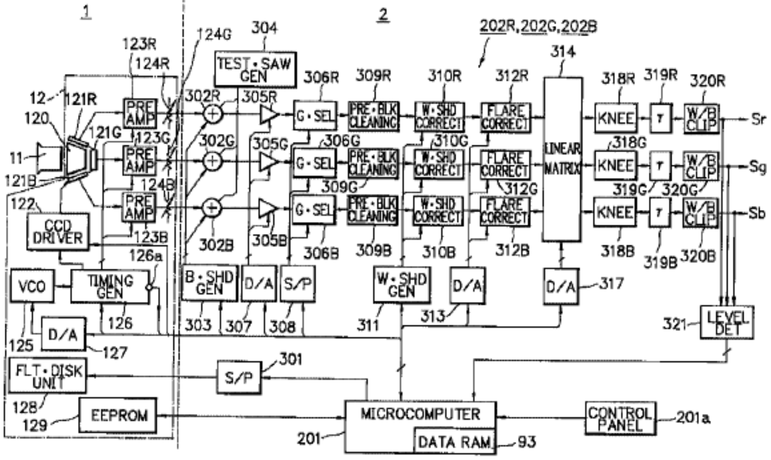
(54) **VIDEO CAMERA AND ITS SETUP METHOD**

(57) A picture pickup block (12) of an optical head body (1) is detachably attached to a camera body (2). The picture pickup block (12) includes an EEPROM (129), which stores data in association with a picture pickup element, such as shading correction data, and setup data for the video camera, including signal-use location data. When the power is turned on, a microcomputer (201) in the camera body (2) reads setup data from the ROM (129), and sets up the video camera by controlling each circuit of the picture pickup block (12) and the camera body (2). For example, based on shading correction data, setup is performed so that a video signal for which shading correction has been performed is output. Also, based on signal-use location data, setup is performed so that a video signal in accordance with the appropriate signal standards of a particular signal-use location is output by controlling a level conversion circuit (206) and a setup level signal adding circuit (207).

FIG. 2



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Description

TECHNICAL FIELD

The present invention relates to a video camera, for which certain adjustment can be eliminated or reduced when the picture pickup block using a picture pickup element must be replaced, and a video signal meeting differing standards depending on the country in which the video signal is to be used or to which the camera is to be shipped, (the signal-use location), can be produced without the need for a number of different circuit boards, and a setup method for the video camera.

BACKGROUND ART

Conventionally, a video camera has been proposed, to the body of which is detachably attached a picture pickup block consisting of a color separation prism, CCD (charge coupled device) solid-state picture pickup element, signal processing circuit, and other devices. When such picture pickup block is replaced, many items must be adjusted on the camera body side to correct for variations in the properties of the CCD solid-state picture pickup element and optical system.

Since many items must be adjusted on the camera body side in connection with the replacement of the picture pickup block, the user cannot simply replace the picture pickup block; special-purpose instruments, jigs, and tools are needed, and work by a specialist is required. Therefore, a camera body is provided with only one picture pickup block, and when a CCD is required or a shift of aspect ratio from 4:3 to 16:9 is needed, for example, the demand for the replacement of only the picture pickup block or the demand for a plurality of picture pickup blocks cannot be satisfied simply.

In the case of a video camera for broadcasting, which is used for photographing an artistic production such as a drama, high picture quality is generally demanded. Therefore, a three tube type video camera using three picture pickup tubes or a three plate type video camera using three solid-state picture pickup elements are typically used.

A system in which a three color separation prism is provided behind the picture pickup lens to separate the light passing through the picture pickup lens into the color component lights of R (red), G (green), and B (blue), is generally used, especially with the three plate type video camera. With this system, since the optical path of each color component light is independent, color correction can be made freely by inserting a trimming filter in each optical path. Therefore, this system has ideal picture pickup characteristics and the capability of obtaining a color image with good color tone. Also, an advantage of this system is that less incident light is absorbed, heightening the light utilization factor, making the production of such a highly sensitive camera relatively easily.

The process in which a composite picture signal is obtained from a picture pickup signal output from the picture pickup elements of R, G, and B is described below. First, the light passing through the picture pickup lens is separated into color component lights of R, G, and B by the three color separation prism, and sent to the picture pickup elements of R, G, and B, respectively. Thereupon, a color image of R, G, and B corresponding to the subject is formed on the picture pickup plane of the picture pickup element for R, G, and B.

Various types of signal processing, such as preamp, clamp, and gamma correction, can be performed on the picture pickup signal obtained by photoelectric transfer at each picture pickup element in order to form the color signals of R, G, and B. From the color signals of R, G, and B, a luminance signal Y, red color difference signal R-Y, and blue color difference signal B-Y are formed in a matrix circuit. Further, from the luminance signal Y and color difference signals R-Y and B-Y, a composite picture signal is formed in a composition circuit (encoder). In the composition circuit, a variety of processing is performed, including processing for adding a synchronizing signal to the luminance signal Y, color modulation processing for obtaining a carrier chrominance signal from the color difference signals R-Y and B-Y, composition processing for obtaining a composite picture signal by compounding the luminance signal Y to which the synchronizing signal is added and the carrier chrominance signal.

The composite picture signal output from the composition circuit is entered into a CCU (camera control unit) at a later stage of processing, for example, through a camera adapter and camera cable connected to the video camera. The CCU controls the adjustment of lens opening, selection of color filter or ND (neutral density) filter, compensation for cable length, correction of contour, gamma correction for each channel, knee characteristics, pedestal level, etc. When a picture pickup tube is used as the picture pickup element, the CCU can also control the adjustment of registration, beam quantity of the picture pickup tube, beam focus, beam alignment, and so on.

Japan, the United States, and Europe have different standards for the composite picture signal. For example, the NTSC standard used in Japan, the NTSC standard (RS170A) used in the United States, and the PAL standard used in Europe, maintain different levels of luminance signal Y and the color difference signals R-Y and B-Y composing the composite picture signal.

The difference in level of the luminance signal Y and the color difference signals R-Y and B-Y composing the composite picture signal, varying depending on the signal-use location are explained below with reference to the attached Table 1, and FIGS. 15, 16A, 16B, 17A, and 17B.

First, the white level (100% level) VW of the luminance signal is 714 mV for the NTSC standard in Japan, 714 mV for the NTSC standard in the United States, and 700 mV for the PAL standard in Europe (see attached Table 1 and FIG. 15). The setup level is 0% of the white level for the NTSC standard in Japan and the PAL standard in Europe (see attached Table 1 and FIG. 16B), and 7.5% of the white level in the NTSC standard in the United States (see attached Table 1 and FIG. 16A). Therefore, the white level of the luminance signal for the NTSC standard used in the United States is 714 mV, but the white level without consideration of setup level is 660.45 mV (= 714 x 0.925 mV).

Next, the difference VP-P between the maximum level and the minimum level at 75% color bar of the color difference signals R-Y and R-Y is 700 mV for analog interface in Japan, 756 mV for analog interface in the United States, and 525 mV for analog interface in Europe (see attached Table 1 and FIGS. 17A and 17B).

In manufacturing video cameras used currently, for example, a circuit board incorporating a matrix circuit with the luminance signal Y and color difference signals R-Y and B-Y at the levels used, for example, in Europe, is mounted, and a number of circuit boards having the appropriate levels for Japan and the United States are delivered as options. That is to say, the levels of the luminance signal and color difference signals are set to one of the standards.

For this reason, when a CCU is externally connected to the camera adapter, the user uses the camera after converting the levels of the luminance signal and color difference signals to the appropriate levels for the country where broadcast is to be delivered by inputting various parameters of CCU. The aforementioned picture pickup block is also replaced with one complying with the appropriate standard. Usually, a sample pulse for AGC (automatic gain control) to detect the attenuation state in the transmission of a composite picture signal, is added to the vertical blanking period of composite picture signal, and the addition of the sample pulse is exclusively performed by the circuit in the camera adapter.

On the other hand, when a VTR (video tape recorder) is externally connected to the camera adapter, the current circuit board is replaced by the circuit board (option) complying with the appropriate standard in the country where the recorded material is to be used (broadcast), and thereafter the composite picture signal is supplied to the VTR. This replacement of circuit board can not be accomplished by a simple change of circuit boards. Since, as described above, the addition of the sample pulse is made by the circuit in the camera adapter, readjustment of signals is also needed. This readjustment takes much time, so that the replacement of the circuit board is very troublesome. Moreover, an inappropriate circuit board may be used, creating the possibility that the level of composite picture signal does not comply with the appropriate standard.

In particular, since the level of the sample pulse added by the camera adapter is uniform, even though the cable length would be ordinarily compensated for the CCU, depending on the type of equipment connected at the processing stage of following the CCU and also depending on the cable length, the level of the signal may be reduced and the sample pulse itself may disappear, making reproduction of the composite picture signal by the AGC impossible. Alternatively, a so-called matrix error due to improper readjustment or the like is also likely to occur.

Accordingly, an object of the present invention is to eliminate or reduce the adjustments necessary on the camera body side when the picture pickup block having a picture pickup element is replaced.

Another object of the present invention is to eliminate the need for replacing or readjusting of circuit boards each time the broadcast signal-use location is changed, thereby enhancing productivity and serviceability.

Still another object of the present invention is to reduce the circuits in the camera adapter, reduce costs, and reduce matrix errors.

DISCLOSURE OF THE INVENTION

According to the present invention, a video camera is comprised of a video camera body with a signal processing means which processes picture pickup signals obtained by picture pickup elements and outputs video signals, and a picture pickup block detachably attached to the video camera body which has the picture pickup elements. The picture pickup block has memory means for storing setup data for setting up the video camera, and the video camera body has a control means for setting up the video camera based on the setup data stored in the memory means. For example, in the signal processing means, the video signals are converted into a signal level determined in accordance with the intended signal-use location at the broadcast, which is one type of the setup data.

Also, according to the present invention, the video camera is comprised of a video camera body with a signal processing means which processes picture pickup signals obtained by picture pickup elements and outputs video signals, and a picture pickup block with the picture pickup elements, which is detachably attached to the video camera body, which also has a memory means for storing setup data for setting up the video camera. The video camera setup method comprises a step of reading the setup data from the memory means when the power is turned on and a step of setting up the picture pickup block and the video camera body based on the setup data read in the first step above.

According to the present invention, the video camera is further comprised of a camera adapter for connecting external equipment. The camera adapter includes an output means for outputting video signals from the video camera body, and a storage means for storing connected equipment information data indicating the type of external equipment. The signal processing means on the video camera body further includes a signal adding means for adding a sample pulse used for detecting an attenuation level due to the transmission of video signals output from the camera adapter based on the connected equipment information data.

Thus, for example, when the power is turned on, setup is automatically performed by controlling each circuit of the picture pickup block and the video camera body based on the setup data, such as shading correction data and signal-use location code, read from the memory means of the picture pickup block. Therefore, adjustments to the camera body side when the picture pickup block is replaced and the reassembly of circuit boards formerly required when the signal-use location was changed can now be eliminated or reduced.

Also, a sample pulse used for detecting an attenuation level due to the transmission of the video signals can be added to the video camera body. Therefore, a circuit for adding a sample pulse by the camera adapter can be eliminated, resulting in a reduction in cost.

In the signal processing means, the signal level of the video signals is converted into a signal level in accordance with the intended broadcast signal-use location based on signal-use location data, which is one of the setup data. Therefore, the need for a readjustment of the signal is eliminated, so that matrix errors caused by improper readjustment, etc., can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 are block diagrams showing an example in which a video camera in accordance with the present invention is applied to a studio camera for broadcasting;

FIG. 3 is a circuit diagram showing a typical configuration of a linear matrix circuit incorporated in the camera body in accordance with the present invention;

FIG. 4 is a circuit diagram showing a typical configuration of a level conversion circuit in accordance with the present invention;

FIG. 5 is a circuit diagram showing a typical configuration of a setup level signal adding circuit incorporated in the camera body in accordance with the present invention;

FIG. 6 is an illustration of a sample pulse in accordance with the present invention;

FIG. 7 is a circuit diagram showing a typical configuration of a sample pulse adding circuit incorporated in the camera body in accordance with the present invention;

FIG. 8 is a circuit diagram showing a typical configuration of a SYNC adding circuit incorporated in the camera body in accordance with the present invention;

FIG. 9 is a block diagram showing the hardware configuration of a microcomputer incorporated in the camera body, together with external equipment and external circuits in accordance with the present invention;

FIG. 10 is a functional block diagram showing the operation of switching processing means in accordance with the present invention;

FIG. 11 is a flowchart showing the operation of the switching processing means in accordance with the present invention;

FIG. 12 is a flowchart showing the operation of the level control data preparing means in accordance with the present invention;

FIG. 13 is a flowchart showing the operation of the sample pulse data preparing means in accordance with the present invention;

FIG. 14 is a flowchart showing the operation of SYNC data preparing means in accordance with the present invention;

FIG. 15 is a waveform diagram showing an example of the horizontal waveform of luminance signal Y;

FIGS. 16A and 16B are waveform diagrams showing a portion of the horizontal waveform of luminance signal Y in order to explain the setup standard; and

FIGS. 17A and 17B are waveform diagrams showing examples of the horizontal waveforms of color difference signals R-Y and B-Y.

BEST MODE FOR CARRYING OUT THE INVENTION

FIG. 1 shows a specific example in which a video camera in accordance with the present invention is applied to a studio camera for broadcasting. The video camera shown in FIG. 1 consists of an optical head body (OHB) 1 and a camera body 2. The optical head body 1 is comprised of a picture pickup lens 11 and a picture pickup block (CCD block) 12 having picture pickup elements. The optical head body 1 is mechanically connected to the camera body 2 by using, for example, four screws, so that when the optical head body 1 is replaced, it can be attached to or detached from the camera body 2 simply by loosening the four screws with a coin. The electrical connection between the picture pickup block 12 of the optical head body 1 and the camera body 2 is made through a connector directly or through a connector and a signal line which include a flexible cable.

As shown in FIG. 2, the picture pickup block 12 has a color separation prism 120 for separating the light output in the picture pickup block 12 through the picture pickup lens 11 into color component lights of R, G, and B, CCD solid-state picture pickup elements 121R, 121G, and 121B in which the color component lights of R, G, and B separated by the color separation prism 120 are input, and a red image, green image, and blue image associated with the subject are formed on a picture pickup plane, respectively, and a CCD driver 122 for driving the picture pickup elements 121R, 121G, and 121B.

The picture pickup block 12 also includes preamp circuits 123R, 123G, and 123B in which the picture pickup signals of R, G, and B output from the picture pickup elements 121R, 121G, and 121B, respectively, are amplified, and already well-known correlation double sampling is conducted for performing certain processing, such as reducing reset noise, and gain adjusting circuits 124R, 124G, and 124B for performing level adjustment of color signals R, G, and B output from the preamp circuits 123R, 123G, and 123B, respectively. The gain adjusting circuits 124R, 124G, and 124B suppress the level difference in color signals caused by variations in sensitivity of the picture pickup elements 121R, 121G, and 121B.

The picture pickup block 12 further includes a voltage control oscillator (VCO) 125 for generating a reference clock, and a timing generator 126 for obtaining various timing signals based on the reference clock output from the voltage control oscillator 125. A necessary timing signal is supplied from the timing generator 126 to each of the aforementioned CCD driver 122 and preamp circuits 123R, 123G, and 123B. Although not shown, necessary timing signals are also supplied from the timing generator 126 to other circuits.

The voltage control oscillator 125 is supplied with VCO offset data from a microcomputer 201, described below, of the camera body 2 via a D/A converter 127, whereby the frequency of reference clock output from the voltage control oscillator 125 is made constant. The CCD driver 122 is supplied with substrate clock voltage Vsub and reset gate clock voltage Vrg, described below, from the microcomputer 201 of the camera body 2, which voltages control the operation of the CCD driver 122. The timing generator 126 is supplied with BLK offset data, described below, from the microcomputer 201 of the camera body 2, which data controls the operation of the timing generator 126.

The timing generator 126 has a terminal 126a for obtaining data showing whether the picture pickup element is of an interline transfer type (IT type) or a frame interline transfer type (FIT type). Since the number of timing signals output from the timing generator 126 differs between the IT type and the FIT type, the data showing whether the picture pickup element is of an IF type or a FIT type is output from the terminal 126a according to the number of timing signals. The data obtained at terminal 126a of the timing generator 126 is supplied to the microcomputer 201 of the camera body 2.

The picture pickup block 12 also has a filter disk unit 128. The filter disk unit 128 switches to an ND filter or CC filter (color conversion filter). The ND filter, which is an optical filter for uniformly decreasing light without selecting waveform in a visible zone, is used, for example, when a decrease in light is desired without changing the diaphragm of the optical system. ND filters of various densities which can decrease light to 1/4, 1/8, 1/16, and so on, are available. The CC filter is used to change the color temperature of illuminating light when a color video camera is used under an illuminating light with a color temperature which does not allow for the optimum color balance. CC filters of various color temperatures such as 4300 K, 6300 K, 8000 K, and so on, are available. The filter disk unit 128 is supplied with a filter switching control signal from the microcomputer 201 of the camera body 2 through a serial/parallel converter (S/P converter) 301, which control signal controls the switching operations of the ND filter and the CC filter.

The picture pickup block 12 also has an EEPROM (electrically erasable and programmable read-only memory) 129 as a reloadable nonvolatile memory. The EEPROM 129 stores, as setup data, white shading data of the picture pickup elements 121R, 121G, and 121B, substrate clock voltage data, reset gate clock voltage data, BLM offset data (temperature characteristics data) of the picture pickup element 121R, 121G, and 121B, offset data of VCO for controlling the voltage control oscillator 125, aspect ratio data showing the aspect ratio of the picture pickup element 121R, 121G, and 121B, signal-use location data showing the signal-use location of the video camera, white offset data for correcting the shift of balance of R, G, and B color signals when the ND filter is inserted, serial number data of the picture pickup block 12, masking data showing the color separation characteristics of the color separation prism 120, ND filter data and CC filter data showing the types of ND filters and CC filters for the filter disk unit 128, color temperature data showing the color temperature of the CC filter, IR filter data showing the thickness of an infrared cut filter, and so on.

For example, as shown in attached Table 2, white shading data (WHT SHADING) for correcting the white shading of the picture pickup elements 121R, 121G, and 121B is stored at address "000-5FF." The reason for storing a lot of white shading data in such a manner is that the correction accuracy is increased by setting many correction points on one screen. Substrate clock voltage data (Vsub data) of the picture pickup elements 121R, 121G, and 121B is stored at addresses "700" to "702." An address "703," VCO offset data for making the frequency of clock output from the voltage control oscillator 125 constant is stored. At address "704," BLK offset data of the picture pickup elements 121R, 121G, and 121B, used for dark correction, is stored. At addresses "705" to "707," the reset gate clock voltage data (Vrg data) for the picture pickup elements 121R, 121G, and 121B is stored. The substrate clock voltage Vsub is a positive

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