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Akamine et al.

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[54] **AUDIO DATA RECORDING SYSTEM FOR RECORDING VOICE DATA AS AN OPTICALLY READABLE CODE ON A RECORDING MEDIUM FOR RECORDING STILL IMAGE DATA PHOTOGRAPHED BY A CAMERA**

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[73] Assignee: **Olympus Optical Co., Ltd.**, Tokyo, Japan

[21] Appl. No.: **09/172,740**

[22] Filed: **Oct. 14, 1998**

Related U.S. Patent Documents

Reissue of:

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Filed: **Dec. 16, 1994**

[30] **Foreign Application Priority Data**

Dec. 22, 1993 [JP] Japan 5-325366

[51] **Int. Cl.**[7] **G11B 13/00**

[52] **U.S. Cl.** **369/14**; 396/315; 348/232; 382/239

[58] **Field of Search** 369/14, 15, 13; 396/315, 312; 358/335, 342; 360/10.1, 32; 355/218; 382/239, 250, 251, 232; 348/232

[56] **References Cited**

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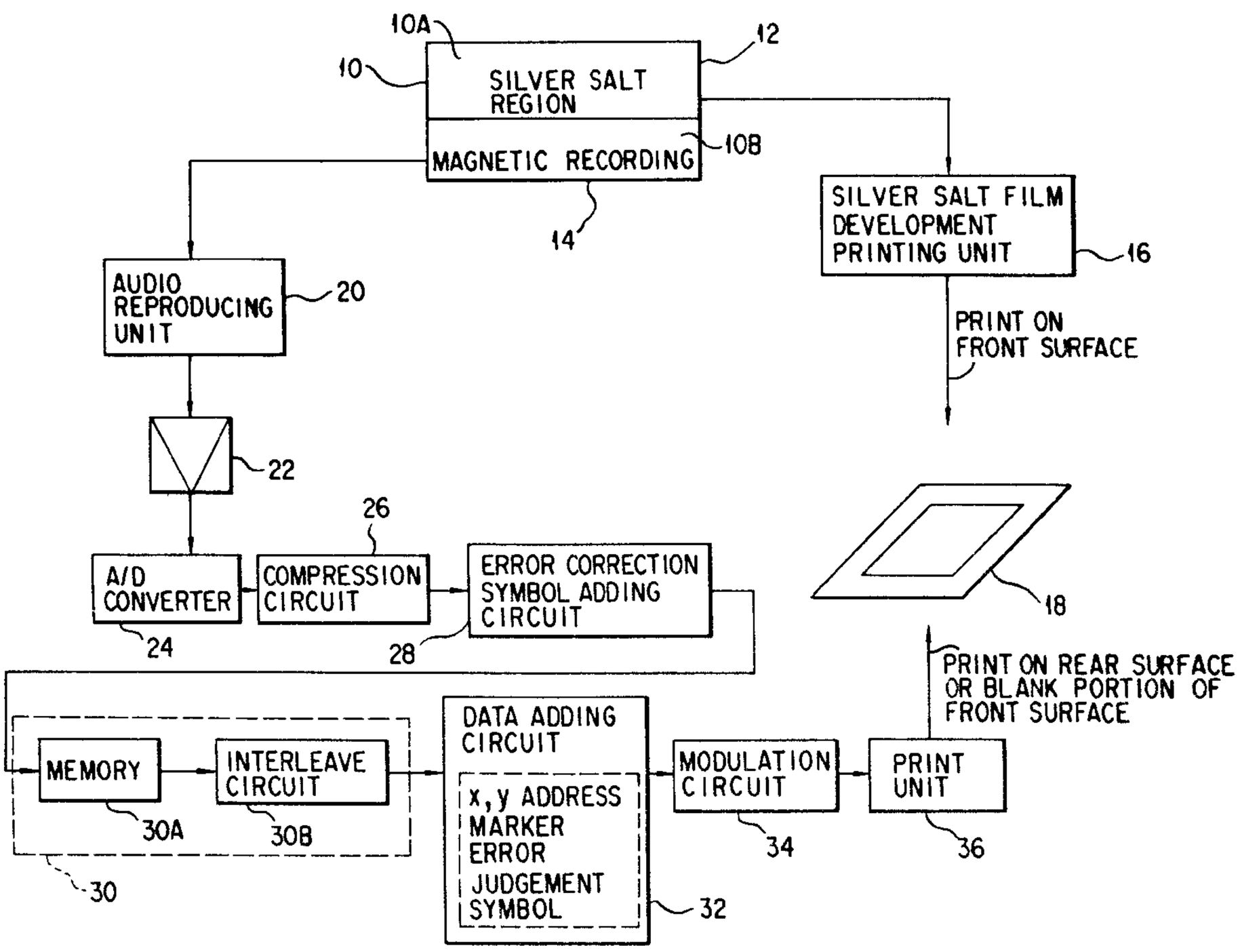
Primary Examiner—Ali Neyzari
Attorney, Agent, or Firm—Frishauf, Holtz, Goodman, Langer & Chick, P.C.

[57] **ABSTRACT**

An audio data recording/reproduction system including an independent, portable camera for respectively recording still image data on a silver salt region of a film and audio data on a magnetic recording region of the film. A silver salt film developing/printing device is provided for developing the still image data recorded in the silver salt region of the film, and for printing the developed still image data on a front surface of a photographic paper as visible data. A conversion device is provided for reproducing the audio data recorded in the magnetic recording region of the film, and for converting the reproduced audio data into an optically readable code. And a recording device is provided for printing the optically readable code produced by the conversion device on a rear surface or a blank section of the front surface of the photographic paper.

55 Claims, 6 Drawing Sheets



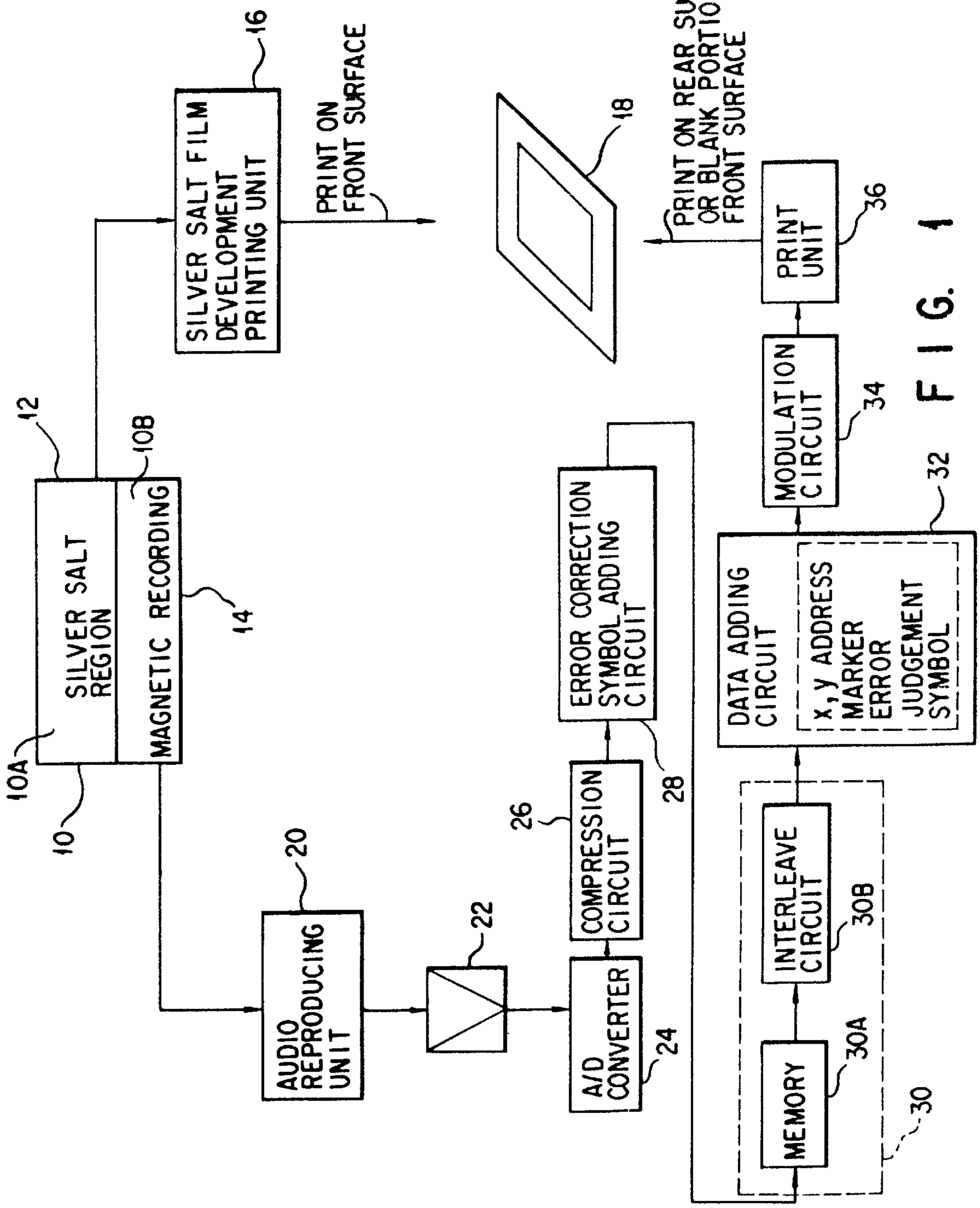

SILVER SALT REGION
MAGNETIC RECORDING
SILVER SALT FILM DEVELOPMENT PRINTING UNIT
PRINT ON FRONT SURFACE
PRINT ON REAR SURFACE OR BLANK PORTION OF FRONT SURFACE
AUDIO REPRODUCING UNIT
A/D CONVERTER
COMPRESSION CIRCUIT
ERROR CORRECTION SYMBOL ADDING CIRCUIT
MODULATION CIRCUIT
PRINT UNIT
DATA ADDING CIRCUIT
x, y ADDRESS MARKER ERROR JUDGEMENT SYMBOL
INTERLEAVE CIRCUIT
MEMORY
10
10A
12
14
16
18
20
22
24
26
28
30
30A
30B
32
34
36
108

FIG. 1

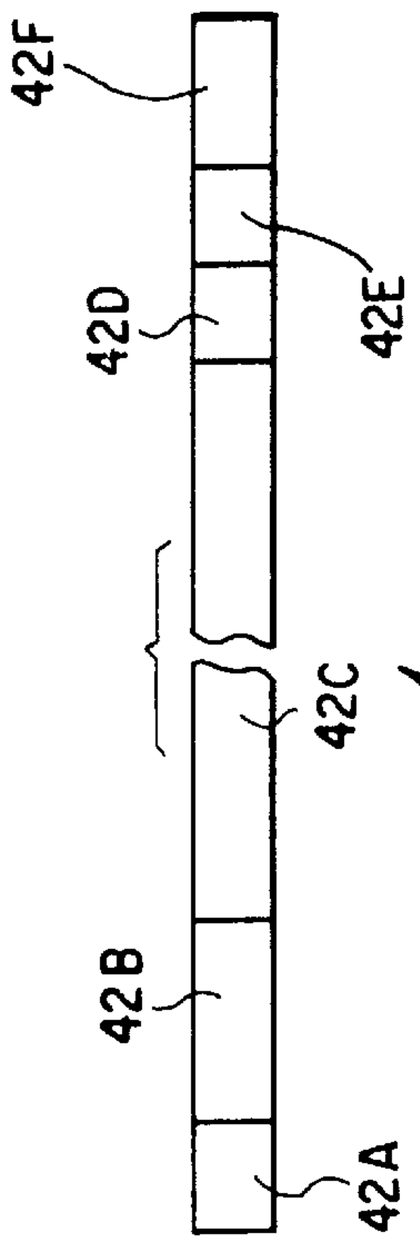


FIG. 2D

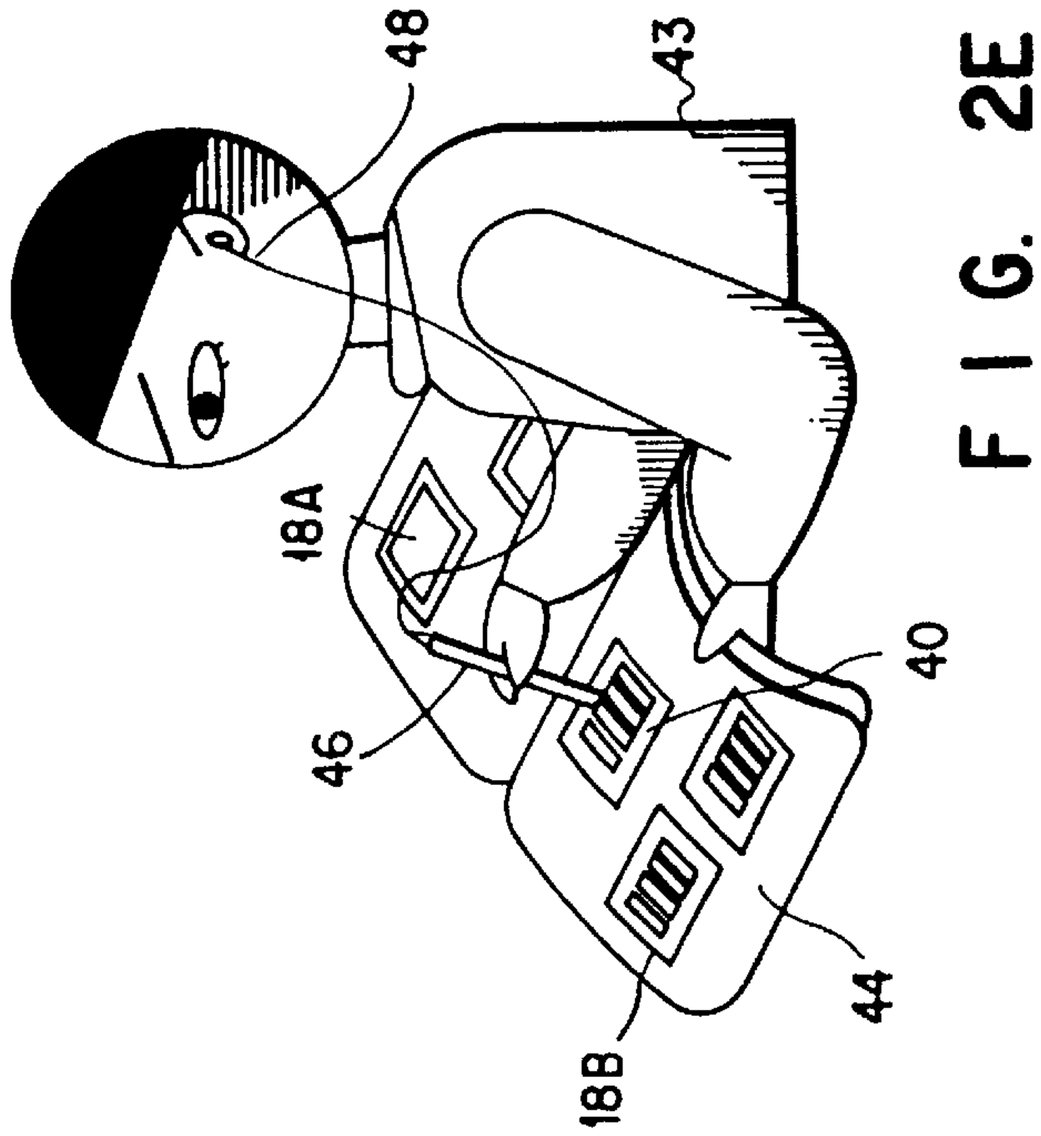


FIG. 2E

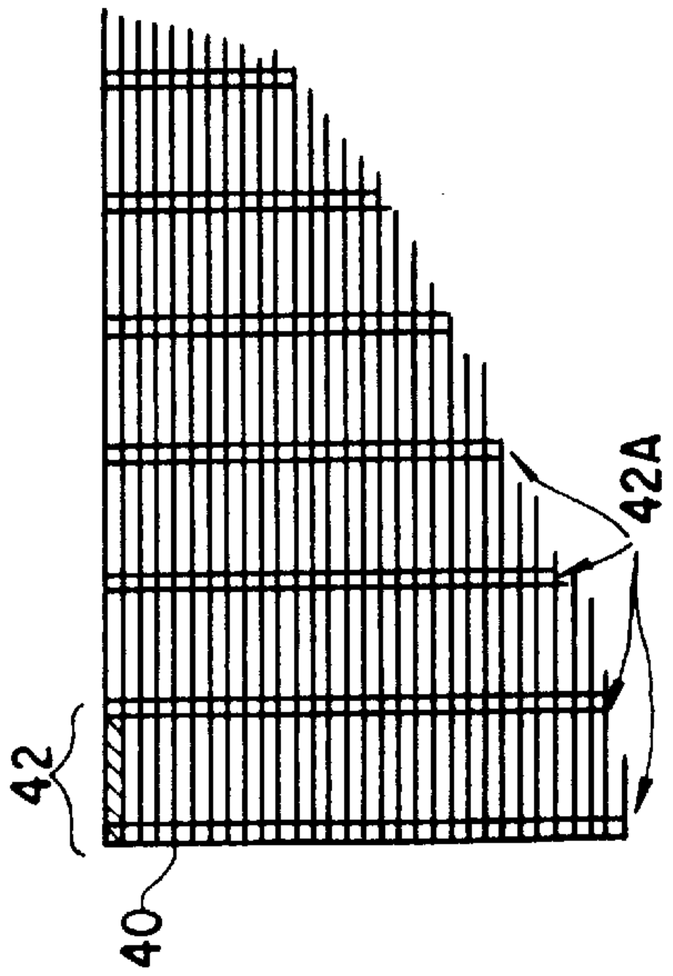


FIG. 2C

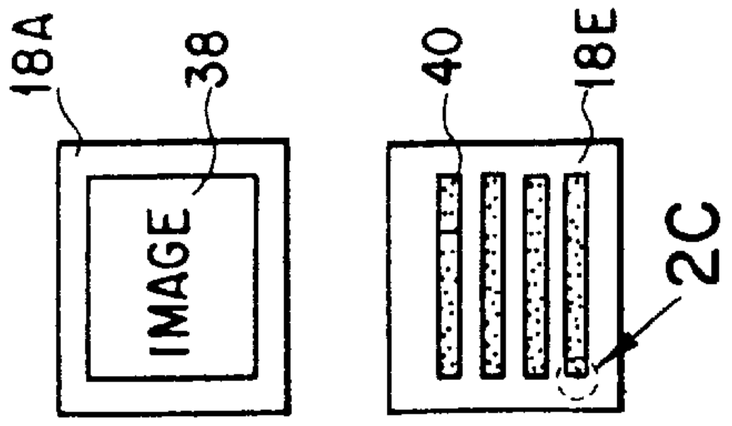


FIG. 2A

FIG. 2B

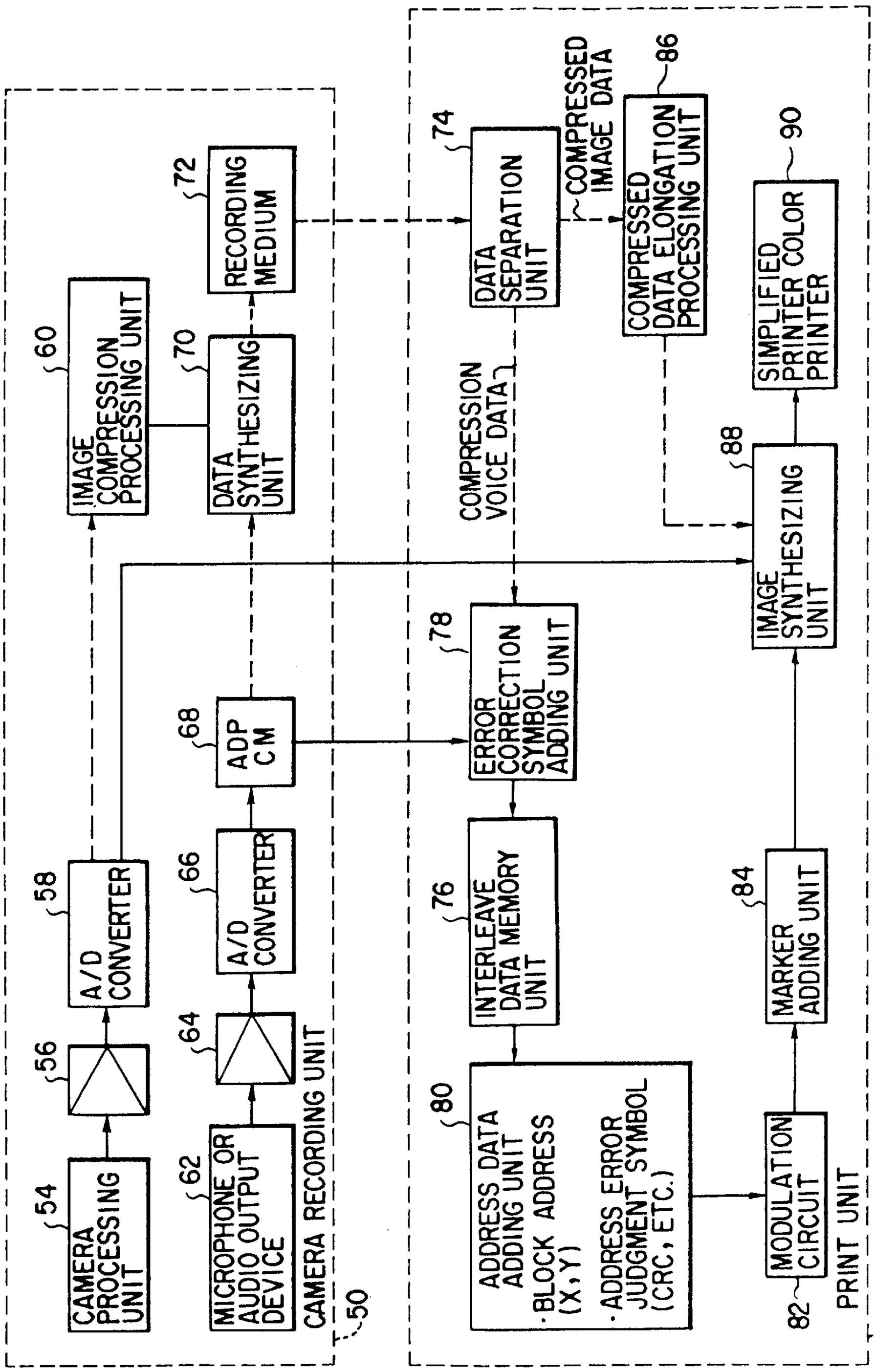

CAMERA RECORDING UNIT
50
CAMERA PROCESSING UNIT
54
56
A/D CONVERTER
58
IMAGE COMPRESSION PROCESSING UNIT
60
MICROPHONE OR AUDIO OUTPUT DEVICE
62
64
A/D CONVERTER
66
ADP CM
68
DATA SYNTHESIZING UNIT
70
RECORDING MEDIUM
72
DATA SEPARATION UNIT
74
INTERLEAVE DATA MEMORY UNIT
76
ERROR CORRECTION SYMBOL ADDING UNIT
78
ADDRESS DATA ADDING UNIT
80
·BLOCK ADDRESS (X, Y)
·ADDRESS ERROR JUDGMENT SYMBOL (CRC, ETC.)
MODULATION CIRCUIT
82
MARKER ADDING UNIT
84
IMAGE SYNTHESIZING UNIT
88
SIMPLIFIED PRINTER COLOR PRINTER
90
COMPRESSED DATA ELONGATION PROCESSING UNIT
86
COMPRESSED IMAGE DATA
COMPRESSION VOICE DATA
PRINT UNIT
52

FIG. 3

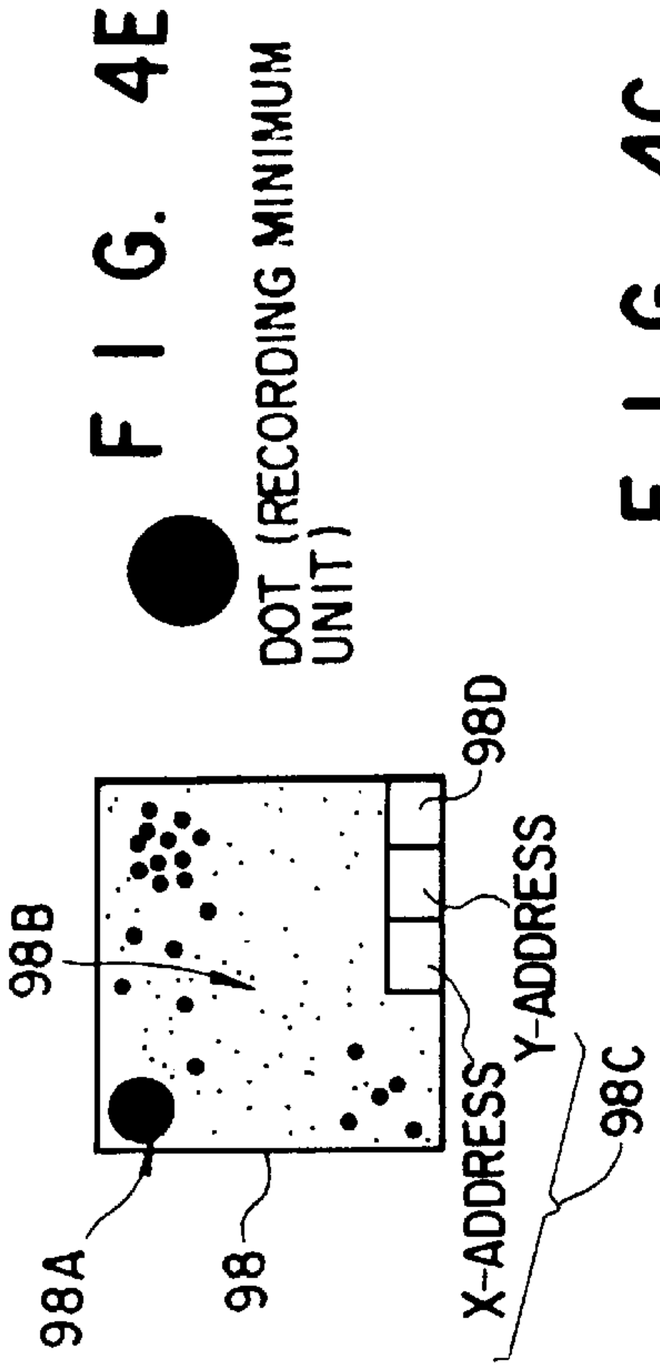


FIG. 4E

FIG. 4A

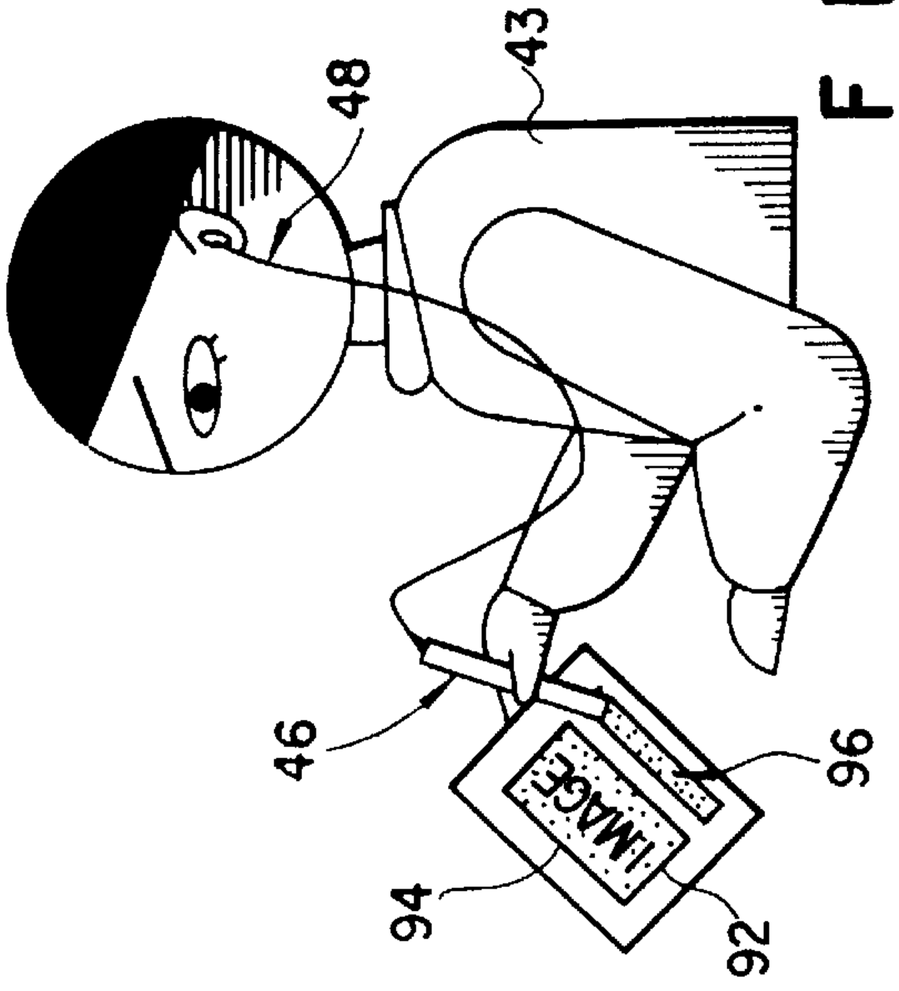


FIG. 4C

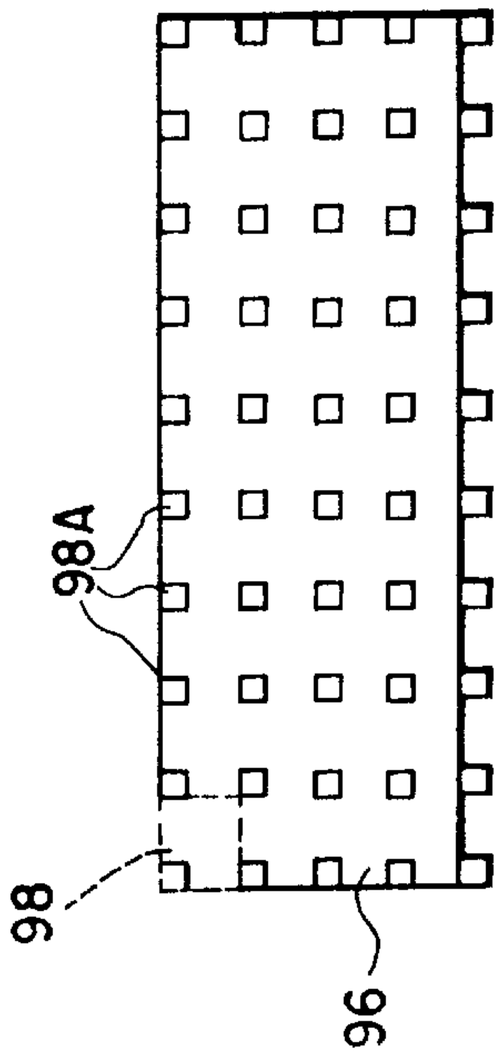


FIG. 4B

FIG. 4D

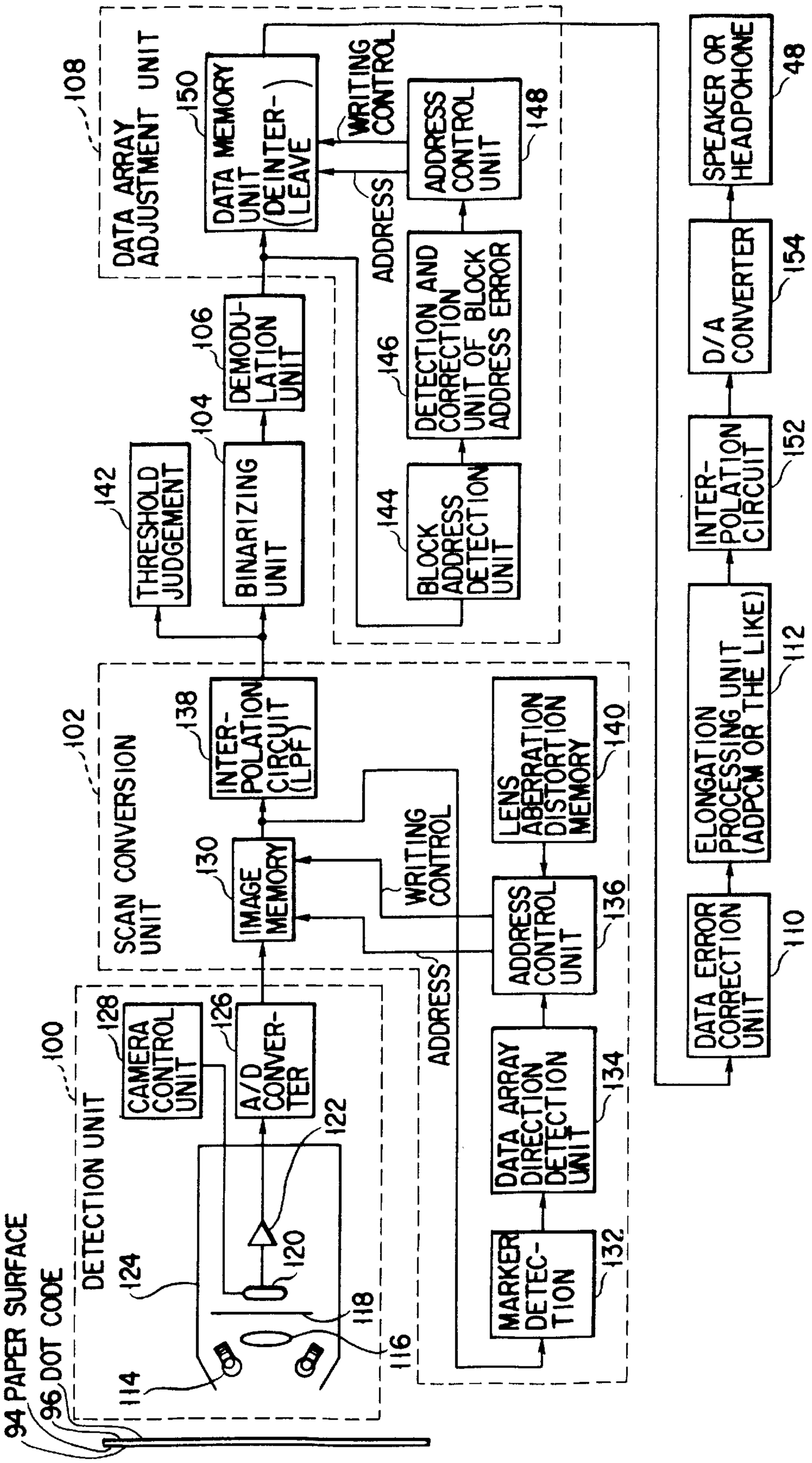

94 PAPER SURFACE
96 DOT CODE
100 DETECTION UNIT
114
116
118
120
122
124
126 A/D CONVERTER
128 CAMERA CONTROL UNIT
102 SCAN CONVERSION UNIT
130 IMAGE MEMORY
138 INTERPOLATION CIRCUIT (LPF)
WRITING CONTROL
ADDRESS
132 MARKER DETECTION
134 DATA ARRAY DIRECTION DETECTION UNIT
136 ADDRESS CONTROL UNIT
140 LENS ABERRATION DISTORTION MEMORY
110 DATA ERROR CORRECTION UNIT
112 ELONGATION PROCESSING UNIT (ADPCM OR THE LIKE)
152 INTERPOLATION CIRCUIT
154 D/A CONVERTER
48 SPEAKER OR HEADPHONE
108 DATA ARRAY ADJUSTMENT UNIT
150 DATA MEMORY UNIT (DEINTERLEAVE)
WRITING CONTROL
ADDRESS
148 ADDRESS CONTROL UNIT
146 DETECTION AND CORRECTION UNIT OF BLOCK ADDRESS ERROR
144 BLOCK ADDRESS DETECTION UNIT
106 DEMODULATION UNIT
104 BINARIZING UNIT
142 THRESHOLD JUDGEMENT

FIG. 5

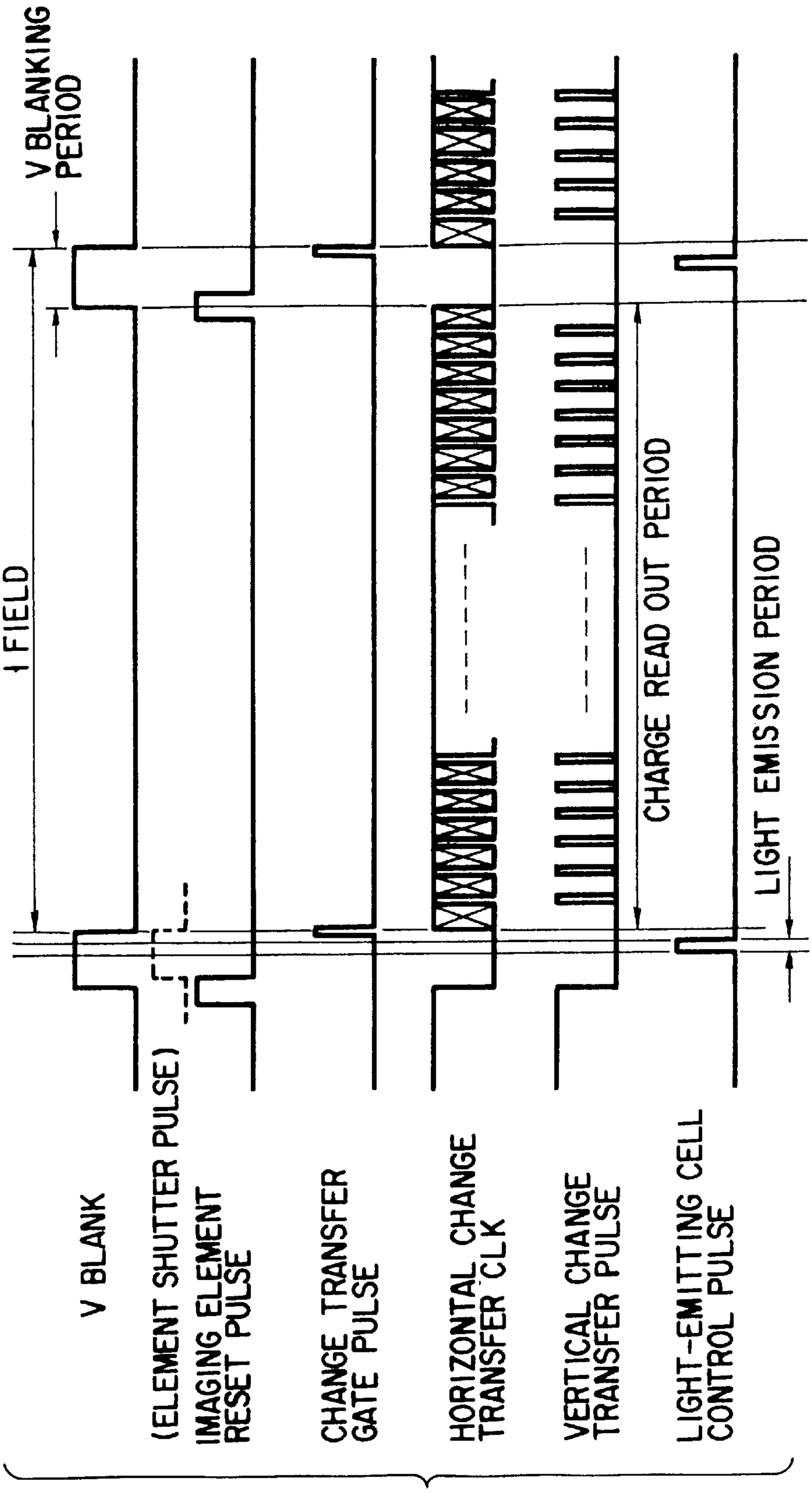

V BLANK
(ELEMENT SHUTTER PULSE)
IMAGING ELEMENT RESET PULSE
CHANGE TRANSFER GATE PULSE
HORIZONTAL CHANGE TRANSFER CLK
VERTICAL CHANGE TRANSFER PULSE
LIGHT-EMITTING CELL CONTROL PULSE
1 FIELD
V BLANKING PERIOD
CHARGE READ OUT PERIOD
LIGHT EMISSION PERIOD

FIG. 6

AUDIO DATA RECORDING SYSTEM FOR RECORDING VOICE DATA AS AN OPTICALLY READABLE CODE ON A RECORDING MEDIUM FOR RECORDING STILL IMAGE DATA PHOTOGRAPHED BY A CAMERA

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an audio data recording/reproduction system which records and reproduces audio data such as voice data. More specifically, the present invention relates to the recording/reproduction of audio data in an optically readable format.

2. Description of the Related Art

Conventionally, various types of media for recording voice data, music data and the like are known. Such known media include a magnetic tape and an optical disk.

However, with these media, the unit cost cannot be reduced very much even if a great amount of copies are prepared, and a large area is required to store such media.

In the case where a medium on which voice is recorded has to be delivered to a person in a remote place, much time and labor can be required.

In order to solve such a problem, there has been proposed a technique in which audio data is recorded on a sheet of paper in the form of image data which can be transmitted by facsimile and copied in large numbers.

An example of such technique is disclosed in, for example, Jap. Pat. Appln. KOKAI Publication No. 60-244145, and according to this publication, audio data is converted into image data by converting some audio data into an optical code.

Further, the following audio data recording/reproduction system and a recording medium used therefor, have been proposed in International Application PCT/JP93/01377 of the assignee of the present application. According to this document, from a recording medium on which multi media information including audio data such as voice, video data obtained from a video camera or the like and digital code data or the like is recorded in the form of optically readable dot code, the dot code is optically read, and a portion to be converted back to the multi media information is stored in a portable box. Thus, the multi media information can be reproduced from the recording medium regardless of place or number of reproductions, making it possible to use a recording medium on which the multi media information including audio data is recorded for a long time.

Further, recently, there has been known an image/voice recording device which uses a recording medium having a recording memory region on a silver salt film, capable of recording image data on a silver salt region and recording audio data on a magnetic recording region. In the conventional system which uses such an image/audio recording device, the image data recorded on the silver salt film is printed on the surface of a photographic paper, and the audio data is stored in another recording medium as a magnetic recording medium.

However, in the printing system in which image data recorded on a silver salt film is printed on the surface of photographic paper and audio data is stored on a magnetic recording medium, each photograph and each magnetic recording medium are separated from each other, and the reproduction of the audio data on the magnetic recording medium and the maintenance of the medium are time-and-labor consuming after adhering each photograph on an album or the like. Further, the audio data on the magnetic recording media are deteriorated as the number of times of reading is increased, and as a result, the audio data are degraded along with time.

SUMMARY OF THE INVENTION

The present invention has been proposed in consideration of the above-described circumstances, and an object thereof is to provide an audio data recording/reproduction system capable of maintaining both audio data and an image, and preventing a degradation of the audio data with time.

Another object of the present invention is to provide an audio data recording/reproduction system using an electronic camera, capable of maintaining both audio data and an image, and preventing a degradation of the audio data with time.

In order to achieve one of the above-described objects, there is provided an audio data recording/reproduction system comprising: image formation means for forming image data recorded on a first recording medium capable of magnetic recording of audio data, on a second recording medium as visualized data, while recording the image data; conversion means for converting the audio data recorded on the first recording medium into an optically readable code; and recording means for printing out the optically readable code converted by the conversion means in an image data unformed region of the second recording medium.

In order to achieve the other of the abovedescribed objects, there is provided an audio data recording/reproduction system comprising: image pick-up means for obtaining image data; input means for inputting audio data; an electronic still camera for recording the image data and the audio data on a first recording medium; image formation means for forming the image data recorded on the first recording medium, or the image data from the image pick-up means on a second recording medium as visualized data; conversion means for converting the audio data recorded on the first recording medium or the audio data from the input means into an optically readable code; and recording means for printing out the optically readable code converted by the conversion means in an image data unformed region of the second recording medium.

More specifically, according to an audio data recording/reproduction system of the present invention, the image formation means forms image data recorded on the first recording medium on which audio data can be magnetically recorded, on a sheet as the second recording medium, i.e., printing out the image data on photographic paper, together with the recording of image data on, for example, a silver salt film having a magnetic recording region. Meanwhile, the audio data magnetically recorded on the first recording medium is converted into an optically readable code by the conversion means, and the optical readable code is printed out in a region of the above paper in which the image data is not printed, for example, the rear surface.

According to another audio data recording/reproduction system, the electronic camera having the imaging means for obtaining image data and the first recording medium for recording the image data obtained by the imaging means, is provided with input means for inputting audio data such that

the audio data can be recorded on the first recording medium. The image data recorded on the first recording medium by the image formation means is formed on a sheet serving as the second recording medium. At the same time, the audio data recorded on the first recording means is converted into an optically readable code by the conversion means, and the optically readable code is printed out in a region of the sheet serving as the second recording medium, in which the image data is not formed by the recording means.

The optically readable code printed on the sheet is optically read by the reproduction means, and is reproduced as the original audio data.

Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be leaned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate presently preferred embodiments of the invention and, together with the general description given above and the detailed description of the preferred embodiments given below, serve to explain the principles of the invention.

FIG. **1** is a block diagram showing the structure of the first embodiment;

FIGS. **2**A, **2**B, **2**C and **2**D are diagrams illustrating the recording results in the first embodiment, with FIG. **2**C showing an enlarged view of the small circled portion in FIG. **2**B, and FIG. **2**D showing a part of FIG. **2**C;

FIG. **2**E is a diagram showing a scene in which the read out of data is carried out with the first embodiment;

FIG. **3** is a block diagram showing the structure of the second embodiment;

FIGS. **4**A, **4**B and **4**C are diagrams illustrating the recording results in the second embodiment, with FIG. **4**B showing an enlarged view of the small circled portion in FIG. **4**A, and FIG. **4**C showing a part of FIG. **4**B;

FIG. **4**D is a diagram showing a scene in which the read out of data is carried out with the second embodiment;

FIG. **4**E shows an enlarged view of a dot, which is a minimum recording unit;

FIG. **5** is a block diagram showing the structure of a pen-type data reproduction device used in the present invention; and

FIG. **6** is a timing chart of the light emission of the pen-type data reproduction device shown in FIG. **5**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the presently preferred embodiments of the invention as illustrated in the accompanying drawings, in which like reference characters designate like or corresponding parts throughout the several drawings.

Embodiments of the present invention will now be described with reference to accompanying drawings.

First Embodiment

FIG. **1** is a diagram showing the structure of the first embodiment of the present invention.

Still image data **12** is recorded in a silver salt region **10**A of a silver salt film **10** having a magnetic recording region, which is the first recording medium, and audio data **14** around (before and after) the time of imaging is recorded in a magnetic recording region **10**B, both by a conventional camera capable of magnetic recording.

In an audio data recording reproduction system of this embodiment, the still image data **12** is read out from the silver salt region **10**A of the silver salt film **10** having the magnetic recording region and printed on the front surface of a photographic paper **18** by a conventional silver salt film development/printing device **16**.

When the still image data **12** is printed, an audio reproducing unit **20** reproduces magnetically recorded audio data **14** from the magnetic recording region **10**B of the silver salt film **10** having the magnetic recording region. The audio data **14** reproduced by the audio reproducing unit **20** is amplified by a preamplifier **22**, and converted into a digital signal by an analog/digital (A/D) converter **24**. The digitized audio signal is subjected to data compression by a compression circuit **26**, and then an error correction symbol is added to the signal by an error correction symbol adding circuit **28**.

After that, the signal is subjected to interleaving by a memory circuit **30**. In the interleaving, the data array is two-dimensionally dispersed in advance in accordance with a certain regulation. However, a burst-like contamination or damage of paper, that is, an error itself, is also dispersed, and the error correction and the interpolation of data cannot be easily carried out when the data is set back to the original array by the reproducing device. In the actual interleaving operation, data recorded in a memory **30**A is appropriately read out and output by an interleave circuit **30**B.

To each block of the output data of the interleave circuit **30**B, a marker as a reference for synchronizing and positioning, an x address and a y address, which indicate a two-dimensional address of each block, and an error judgment symbol are added by a data adding circuit **32** in accordance with a predetermined recording format, which will be described in detail later. After that, the output data is demodulated by a demodulation circuit **34** for the purpose of recording. The result is printed on the rear surface or blank portion of the front surface of the photographic paper **18** by a print unit **36**.

The printing is carried out in the formats such as illustrated in FIGS. **2**A and **2**B, on the front surface **18**A and the rear surface **18**B of the photographic paper **18**. More specifically, an image **38** is printed on the front surface **18**A of the photographic paper **18**, and digitized audio data is printed on the rear surface **18**B of the photographic paper **18** as recording data **40**. The recording data **40** consists of a plurality of blocks **42** as shown in FIG. **2**C. Each block **42** includes a marker **42**A, an error correction symbol **42**B, audio data **42**C, x address data **42**D, y address data **42**E and an error judgment symbol **42**F as shown in FIG. **2**D. The marker **42**A has a pattern which is not usually output in recording modulation, such as used in DAT (digital audio tape recorder). The error correction symbol **42**B is used for correcting an error in the audio data **42**C. The x and y address data **42**D and **42**E indicate the position of the block **42**. The error judgment symbol **42**F are used for error judgment of the x and y address.

The recording data **40** having the above-described format is printed on a sheet of paper by the print unit **36** in such a manner that data of "1" is presented by the presence of a black dot and data of "0" is presented by the absence of a black dot as in, for example, bar code.

FIG. **2**E illustrates a scene in which a user **43** is reading out the audio recording data **40** recorded on the rear surface **18**B of the photographic paper **18** shown in FIG. **2**B with a pen-type reproduction device **46**, while the photographic paper is contained in an album **44** of such a transparent bag that both the front surface **18**A and the rear surface **18**B can be seen. As the recording data **40** is scanned by the pen-type reproduction device **46** shown in FIG. **2**E, the recording data **40** is detected, and converted into sounds, which can be heard by the user **43** with an audio output device **48** such as an ear phone. The details of the pen-type reproduction device **46** will be described later.

The recording data **40** such as audio data may not be printed on the rear surface **18**B of the photographic paper **18**; but may be printed in an area of the front surface **18**A, wherein no image data is formed.

Second Embodiment

In the first embodiment, the silver salt film **10** having the magnetic recording region **10**B is used as a recording medium. However, even with a type in which both audio data and image data are magnetically recorded by an electronic camera or the like, the image data may be recorded on the front surface of a print sheet and the audio data, after converting it into an optically readable code, may be printed on the rear surface thereof, or in an image data unformed region of the front surface, when the data are actually printed out in accordance with the audio data recording/reproduction system.

Such a case will now be described as the second embodiment of the present invention.

FIG. **3** is a block structure diagram showing an audio data recording/reproduction system consisting of a camera recording unit **50** including an interface with a microphone or an audio output device, and capable of recording audio data, together with image data, on a recording medium such as a memory card, and a print unit **52** capable of printing out the audio data, together with the image data, by a printer or the like. The camera recording unit **50** and the print unit **52** are separably connected to each other. The image recording unit **50** can be used as an electronic camera by itself; however it may be constructed as an integrated unit.

First, the case where the camera recording unit **50** and the print unit **52** are separable from each other will be described.

Image data input by the camera processing unit **54** is amplified by a preamplifier **56** and A/D-converted by an A/D converter **58**, and then supplied to an image compression processing unit **60** as indicated by the broken line in the figure. In the image compression processing unit **60**, a simple data compression may be carried out in accordance with a natural image compression standard such as JPEG (joint photographic coding experts group). However, it is also a possibility that an optimum data compression process is carried out in the following manner. That is, for example, an image area judgment and separation circuit which functions based on the mode of identified image area separation, using a neural network such as disclosed in U.S. Ser. No. 08/123,533 of the assignee of the present invention, is provided so as to identify if inputted image data is a digitized image such as a handwritten character or a graph, or a multivalued image such as a natural image, and separating the data into these categories. Then, the binary image data is subjected to the binary compression such as MR (modified READ)/MH (modified Hoffman)/MMR (modified modified READ), and the multivalued image data is subjected to the compression based on the compressing function for still image, such as JPEG.

In the meantime, the audio data is input from the microphone or the audio output device **62** around the time of, or after the picking up of image data, and the audio data is amplified by the preamplifier **64** and converted into digital data by the A/D converter **66**. Then, the data is supplied to an ADPCM (adaptive differential pulse code modulation) circuit **68**. The ADPCM circuit **68** modulates the input digital audio data based on the adaptive differential PCM, so as to compress the data. The audio data compressed by the ADPCM circuit **68** is supplied to a data synthesizing unit **70** as indicated by the broken line in the figure.

In the data synthesizing unit **70**, the audio data compressed by the ADPCM circuit **68** and the image data compressed by an image compression processing unit **60** are synthesized into a data format which can be separated by a data separation unit **74**, described later, and the synthesized format is stored in a first recording medium **72** such as a memory card.

The recording medium **72** such as a memory card, in which the audio data around the time of, or after the shooting of image is stored together with the image data by the camera recording unit **50**, is treated by the data separation unit **74** in the print unit **52** such that the compressed image data and the compressed image data are separated from the predetermined format, and the compressed audio data is input to a data memory unit **76**, after error correction symbols are added by an error correction symbol adding unit **78** as indicated by the broken line in FIG. **3**. In the data memory unit **76**, data items are recorded, and then the data items are subjected to an interleaving process. In the interleaving process, a continuous data array is dispersed to positions appropriately away from each other in order to enhance the correctability by reducing errors as much as possible when the data is actually recorded as a dot code and the dot code is reproduced, for example, suppressing a block error due to noise or the like, as much as possible. More specifically, a burst error is reduced to the level of a bit error so as to decrease the degree of danger by the interleaving process.

To the interleaved data, the address of the block and an address error identification judgment symbol (CRC) are added, and the result is input to a modulation circuit **82**. In the modulation circuit **82**, for example, 8-bit data is converted into data having another bit number, for example, 10-bit data by 8–10 modulation. In the case of, for example, the 8–10 modulation, there are 1024 possible combinations; however 8 of 10 bits, that is, 256 combinations are selected for assignment.

After that, a marker is formed in a marker adding unit **84** by using a data array which is not included in the 256 data arrays assigned by the modulation circuit **82**, and the marker is added to the data. It is possible that the modulation is carried out after the addition of the marker. However, if the marker is added after the modulation, the marker is also modulated, and therefore the marker becomes very difficult to be identified as a marker. By adding the marker after the modulation, the just-mentioned problem can be avoided.

The compressed image data separated by the data separation unit **74** is supplied to an image elongation processing unit **86** as indicated by the broken line in the figure, and subjected to the elongation process which corresponds to the process of the image compression processing unit **60**, thus restoring the original image. The restored image is supplied to an image synthesizing unit **88** as indicated by a broken line in the figure.

The image data restored by the image elongation processing unit **86** and the marker-added data from the marker

adding unit **84** are synthesized by the image synthesizing unit **88**. The synthesized data is printed as a dot code **96** along with an image **94** on a sheet **92** as a second recording medium, which is, for example, heat sensitive paper or photographic paper, sheet paper, tape, or resin film, by a simple printer or a color printer **90** as can be seen in FIG. **4**A.

Next, the case where the camera recording unit **50** and a print unit **52** in FIG. **3** are connected to each other will be described.

Image data input from the camera processing unit **54** is amplified by the preamplifier **56** and A/D-converted by the A/D converter **58**, and then supplied to the image synthesizing unit **88** as indicated by the solid line in the figure.

In the meantime, the audio data is input from the **10** microphone or the audio output device **62** around the time of, or after the picking up of image data, and the audio data is supplied to the preamplifier **64**, the A/D converter **66**, and the ADPCM circuit **68** and is then input into the error correction symbol adding unit of the print unit **52**, as indicated by the solid line. The data is, as described before, subjected to the addition of error correction code, the interleaving process, the addition of error identification judgment symbol for the address of a block, or address itself (cyclic redundancy code: CRC or the like), the modulation, and the addition of a marker, respectively, by the error correction symbol adding unit **78**, the interleave data memory unit **76**, the address data adding unit **80**, the modulation circuit **82** and the marker adding unit **84**, and then the data is supplied to the image synthesizing unit **88**.

In the image synthesizing unit **88**, the image data input from the A/D converter **58** of the camera recording unit **50** and the marker-added data from the marker adding unit **84** are synthesized, and the synthesized data is printed as the dot code **96** along with the image **94** on the sheet **92** as the second recording medium, which is, for example, heat sensitive paper or photographic paper, sheet paper, tape, or resin film, by the simple printer and the color printer **90** as can be seen in FIG. **4**A.

The concept of the dot code in this embodiment will now be described with reference to FIGS. **4**B, **4**C and **4**E. According to the data format of the dot code of this embodiment, one block **98** consists of a marker **98**A, a data area **98**B in which actual data is input, a block address **98**C of the block **98** and address error detection and correction data **98**D. A number of blocks **98** each having the just-mentioned constitution are two-dimensionally arranged in horizontal and vertical direction, and collected as the form of the dot code **96**.

FIG. **4**D illustrates a scene in which a user **43** is scanning the dot code **96** formed in an image data unformed region on the sheet **92** with the pen-type reproducing device **46**, thus reproducing the data through the audio output device **48** such as earphone.

The structure of the pen-type reproducing apparatus **46** is discussed in International Patent Application PCT/JP93/01377 of the assignee of the present application in detail; however the structure will be briefly described with reference to FIG. **5** for reference.

The pen-type reproducing device comprises a detection unit **100** for reading out a dot code printed on a sheet **92**, a scan-conversion unit **102** for identifying image data supplied from the detection unit **100** as a dot code and performing normalization; a binarization processing unit **104** for binarizing multivalued data, a demodulation unit **106**, a data array adjusting unit **108** for adjusting a data array, a data error correction unit **110** for correcting a read-our error and a data error at the time of reproduction, an elongation processing unit **112** with respect to the data compression process in the ADPCM circuit **68**, the audio output device **48**, and the like.

In the detection unit **100**, the dot code on the sheet **92** is lit up by the light source **114**, and the reflection light is guided through an image forming system **116** such as a lens and a space filter for removing moire or the like. Then, the reflection light is detected as an image signal by a camera unit **120** such as a charge coupled device (CCD) or a charge modulating device (CMD) which converts optical data into an electric signal, and the detected signal is amplified and output by the preamplifier **122**. The light source **114**, the image forming system **116**, the space filter **118**, the camera unit **120** and the preamplifier **122** are enclosed in an external light shut off unit **124** designed for avoiding turbulence with respect to the external light. The image signal amplified by the preamplifier **122** is converted into digital data by the A/D converter **126**, and then supplied to the next stage, i.e. the scan-conversion unit **102**.

The camera unit **120** is controlled by the camera control unit **128**. For example, in the case where a CCD of the interline transfer type is used as the camera unit **120**, the camera control unit **128** outputs, as a control signal for the camera unit, a vertical (V) blanking signal for vertical synchronism, an imaging element reset pulse signal for resetting a data charge, a charge transfer gate pulse signal for transferring a charge accumulated in charge transfer accumulating units two-dimensionally arranged, to a plurality of vertical shift registers, a horizontal charge transfer clock (CLK) signal which is a transfer clock signal of a horizontal shift register for transferring the charge in the horizontal direction and outputting it to outside, a vertical charge transfer pulse signal for transferring the charges of the vertical shift registers in the vertical direction and send them to the horizontal shift resister and the like. The timings for these signals are shown in FIG. **6**.

The camera control unit **128** applies a light-emitting cell control pulse for timing the light emission of the light source **114**, in accordance with the timings.

FIG. **6** shows, basically, a conceptual timing chart for one field. The image data is read out between a V blanking and another V blanking on the one field. The light source **114** is turned on not continuously, but pulsewise, and the following pulse lighting is carried out in synchronous with the unit field. In this case, the timing is controlled such that the exposure is carried out during a v blanking period, that is, while no image charge is output, thus avoiding a clock noise which is generated by the pulse lighting, from entering a signal output. More specifically, the light-emitting cell control pulse is a very fine digital clock pulse generated by applying an instantaneous electrical power, and therefore it is necessary to avoid the noise caused by the application of the power from entering an analog image signal. In order to achieve this, the light source is turned on pulsewise during a V blanking. Thus, the signal to noise (S/N) ratio is improved. By turning the light source pulsewise, the time of light emission is shortened, and therefore the influence of out-of-focus by a manual operation error and a transfer error can be removed. Consequently, a high-speed scanning can be performed.

In the case where some turbulence such as external light enters the inside the external light shut off unit **124** as the reproducing device **46** inclines, the image signal is reset by outputting a reset pulse once immediately before turning on the light source **114** during a v blanking period so as to

suppress the S/N degradation to the lowest level, and light is emitted immediately after that. Further, the reading of data is carried out immediately after that.

The scan-conversion unit **102** will now be described with reference to, one again, FIG. **5**. The scanconversion **102** identifies the image data supplied from the detection unit **100** as a dot code, and carries out the normalization in the following manner. That is, the image data from the detection unit **100** is stored in the image memory **130**, and then, the data is read out from the memory to send it to the marker detection unit **132**. In the marker detection unit **132**, the marker of each block is detected. The data arrangement direction detection unit **134** detects the arrangement direction of the data, such as the rotating direction or inclining direction, by using the marker. The address control unit **136** reads out the image data from the image memory **130** so as to correct the data based on the results of the above detection, and supplies the data to the interpolation circuit **138**. At the same time, lens aberration data is read out from the memory **140** in which the data used for correcting lens aberration distortion in the image forming optical system **116** of the detection unit **100**, and the correction of the lens is also carried out. The interpolation circuit **138** interpolates the image data so as to convert it into data having the original dot code pattern.

The output of the interpolation circuit **138** is applied to the binarizing unit **104**. As can be understood from FIG. **4**C, the dot code **96** has black and white patterns, and is basically digital data. The dot code is digitalized by the binarizing unit **140**. During the digitization, the threshold judgment circuit **142** is used to carry out appropriate judgments of the threshold for accurate digitization, in consideration of influences of a turbulence, signal amplification and the like. Then, the data, which was modulated by the modulation circuit **82** as described with reference to FIG. **3**, is demodulated by the demodulation unit **106**, and the data is input to the data array adjusting unit **108**.

In the data array adjusting unit **108**, the block address of the two-dimensional blocks described before, is detected by the block address detection unit **144**. After that, the error detection and correction of the block address is carried out by the block address error detection and correction unit **146**. Then, the data is stored in the data memory **150** in the unit of block by the address control unit **148**.

Since the data items are stored in the units of block address, they can be stored efficiently even if some data is left out or added in the middle of a series.

Next, the data read out from the data memory **150** is subjected to the data correction in the data error correction unit **110**. The output from this error correction unit **108** is then subjected to the elongation process in the elongation processing unit **112**, in reply to the data compression by the ADPCM circuit **68** shown in FIG. **8**. Further, the output data is interpolated by the data interpolation circuit **152**, and this interpolation is correctable. The output data from the data interpolation circuit **152** is converted into an analog signal by the (digital/analog) D/A converter **154**, and output to the audio output device **48** such as a speaker, a headphone or an earphone.

As described above, according to the present invention, an audio data recording/reproduction system capable of handling both audio data and an image, and capable of preserving the audio data DO as not to be degraded with time, can be provided.

Further, according to the present invention, an audio data recording/reproduction system using an electronic camera, capable of handling audio data and an image, and capable of preserving the audio data DO as not to be degraded along with time, can be provided. More specifically, image data recorded on a silver salt film is printed on the surface of a photographic paper, and at the same time, audio data recorded in a magnetic recording region of the silver film is printed on the rear surface of the photographic paper or in a blank area of the surface, in an optically readable form. Therefore, even if the photograph is already stuck on an album, the audio data which is associated with the photograph can be easily reproduced a pen-type reproduction device. Thus, the photograph and its sound can be preserved along with each other, and therefore maintenance is facilitated. Further, since the audio data as recording data is optically read out, the data is not deteriorated regardless of how many times it is read out, and is not degraded with time. Furthermore, the rear surface or the like of a photographic paper is a blank area which is not conventionally used for any purpose, and therefore, with the technique of the present invention for adding audio data to the conventional image data, the usability of photography can be expanded.

Moreover, according to the present invention, the audio data recording function can be added to an electronic camera, and with such a device, a recorded image is printed on a print-out sheet and audio data recorded on a memory card is printed out on the rear surface of the sheet or a blank area of the front surface as an optically readable dot code. Thus, the same effect as described above can be obtained. Further, with the technique of the present invention, a memory card can be used for recording audio and image data and both types of data can be recorded and printed on a sheet, expanding the utility of the card and sheet, and audio data memo can be easily added to image data at low cost even in the case where a black-and-white image only is printed out using a heat sensitive paper.

Additional embodiments of the present invention will be apparent to those skilled in the art from consideration of the specification and practice of the present invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with the true scope of the present invention being indicated by the following claims.

What is claimed is:

1. An audio data recording/reproduction system comprising:

an independent, portable camera for respectively recording still image data on a silver salt region of a film and audio data on a magnetic recording region of said film;

a silver salt film developing/printing device for developing said still image data recorded in said silver salt region of said film, and for printing said developed still image data on a front surface of a photographic paper as visible data;

conversion means for **[**reproducing**]** *converting* said audio data recorded in said magnetic recording region of said film, **[**and for converting said reproduced audio data**]** into an optically readable *two-dimensional* code *comprising a plurality of blocks*; and

a recording device for printing said optically readable *two-dimensional* code produced by said conversion means on a rear surface or a **[**blank**]** *predetermined* section of said front surface of said photographic paper.

2. An audio data recording/reproduction system according to claim **1**, further comprising reproduction means for optically reading out said optically readable *two-dimensional* code printed by said recording device on said photographic paper, and for reproducing corresponding original audio data therefrom.

3. An audio data recording/reproduction system according to claim 1, wherein said conversion means comprises:

magnetic recording/reproduction means for reproducing said audio data magnetically recorded on said magnetic recording region of said film;

A/D conversion means for converting said audio data reproduced by said magnetic recording/reproduction means into a digital signal;

compression means for compressing said digital signal produced by said A/D conversion means;

error correction symbol adding means for adding an error correction symbol to said digital signal compressed by said compression means;

memory means for interleaving said digital signal to which said error correction symbol has been added by said error correction symbol adding means;

data adding means for adding predetermined data to said digital signal interleaved by said memory means; and

modulation means for modulating said digital signal to which said predetermined data has been added by said data adding means, for recording thereof.

4. An audio data recording/reproduction system according to claim 3, wherein said data adding means includes:

means for adding [a two-dimensional] block [address marker] *addresses* to respective blocks of said digital signal interleaved by said memory means[, said two-dimensional address marker serving as a reference for synchronizing and positioning said blocks of said digital signal interleaved by said memory means]; and

means for adding an error judgment signal *for said block address* to said digital signal interleaved by said memory means[in accordance with a predetermined recording format].

5. An audio data recording/reproduction system according to claim 1, wherein said recording device prints said optically readable *two-dimensional* code as a dot code constructed by two-dimensionally arranging a plurality of dots.

6. An audio data recording/reproduction system according to claim 2, wherein said reproducing means includes a pen-type reproduction device for scanning said optically readable *two-dimensional* code and converting said optically readable code into an audio signal.

7. An audio data recording/reproduction system comprising:

an independent, portable electronic still camera including image pick-up means for obtaining image data, input means for inputting audio data, and a first recording medium for recording said image data obtained by said image pick-up means and said audio data input by said input means;

a printer for printing one of said image data recorded on said first recording medium and said image data obtained by said image pick-up means on a second recording medium as visualized data; and

conversion means for converting one of said audio data recorded on said first recording medium and said audio data input by said input means into an optically readable *two-dimensional* code *comprising a plurality of blocks*;

wherein said printer prints said optically readable code produced by said conversion means in a *predetermined* region of said second recording medium in which image data has not been printed.

8. An audio data recording/reproduction system according to claim 7, further comprising reproduction means for optically reading out said optical readable *two-dimensional* code recorded on said second recording medium so as to reproduce corresponding original audio data.

9. An audio data recording/reproduction system according to claim 7, wherein said image pick-up means comprises:

a camera unit for inputting an image signal;

an A/D converter for converting said image signal input by said camera unit into a digital signal; and

a compression unit for compressing said [image] digital *image* signal produced by said A/D converter.

10. An audio data recording/reproduction system according to claim [9] *7*, wherein said input means comprises:

an input unit for inputting an audio signal;

an A/D converter for converting said image signal input by said input unit into a digital signal; and

a compression unit for compressing said audio digital signal produced by said A/D converter.

11. An audio data recording/reproduction system according to claim [10] *7*, wherein said electronic still camera includes a data synthesizing unit for synthesizing compressed image data produced by said compression unit of said image pick-up means and compressed audio data produced by said compression unit of said input means.

12. An audio data recording/reproduction system according to claim 11, wherein synthesized image data and audio data produced by said data synthesizing unit are recorded on said first recording medium.

13. An audio data recording/reproduction system according to claim 12, wherein said first recording medium includes a memory card.

14. An audio data recording/reproduction system according to claim [12] *7*, wherein said conversion means comprises:

[a data memory unit for storing one of said audio data produced by said compression unit of said input means and said audio data recorded in said first recording means, and for interleaving said stored audio data;]

an error correction symbol adding unit for adding an error correction symbol to said [interleaved] audio data *from one of a compression unit included in said input means and said first recording medium;*

a data memory unit for recording said audio data to which the error correction symbol is added by said error correction symbol adding unit, and for interleaving said recorded audio data;

an address data adding unit for adding respective *block* address data to respective blocks of said audio data [to which said error correction symbol has been added] *which is interleaved by said data memory unit*, and for adding an address error judgment symbol to said audio data [to which said error correction symbol has been added] *which is interleaved by said data memory unit*;

[a conversion circuit for converting] *a modulating circuit for modulating* said audio data to which said *block* address data and said address error judgment symbol [have been into data of another bit number] *are* added *by said address data adding unit, for recording*; and

a marker adding unit for adding a marker to said *modulated* audio data[of another bit number].

15. An audio data recording/reproduction system according to claim [17] *7*, further comprising synthesizing means for synthesizing one of said image data recorded on said first recording medium and said image data obtained by said image pick-up means with said optically readable *two-dimensional* code produced by said conversion means, and

wherein a synthesized output from said synthesizing means is recorded on said second recording medium by said printer.

16. An audio data recording/reproduction system according to claim **7**, wherein said printer includes a simple printer and a color printer.

17. An audio data recording/reproduction system according to claim **7**, wherein said second recording medium comprises one of a heat sensitive paper, photographic paper, photographic sheet, photographic tape, and resin film.

18. An audio data recording/reproduction system according to claim **15**, further comprising:

data separation means for separating said audio data recorded on said first recording means and said image data recorded on said first recording means from each other; and

elongation means for elongating said image data separated by said data separation means to form elongated, uncompressed data, and for supplying said elongated, uncompressed data to said synthesizing means.

19. An audio data recording/reproduction system comprising:

digital image data obtaining means for obtaining an imaged picture as digital image data;

digital audio data obtaining means for obtaining an input voice as digital audio data;

a memory for recording digital image data obtained by said digital image data obtaining means and digital audio data obtained by said digital audio data obtaining means;

conversion means for converting said digital audio data recorded in said memory or audio data from said digital audio data obtaining means into an optically readable two-dimensional code comprising a plurality of blocks; and

recording means for forming image data recorded in said memory or image data from said digital image data obtaining means as visualized data on a recording medium, and printing/recording an optically readable two-dimensional code converted by said conversion means on said recording medium.

20. An audio data recording/reproducing system according to claim 19, wherein said recording means prints/records said optically readable two-dimensional code on a region in said recording medium where image data is not formed.

21. A recording method of recording an image and a voice on the same recording medium comprising the steps of:

obtaining image data by image a picture;

obtaining audio data by inputting a voice;

converting audio data obtained in said audio data obtaining step into an optically readable two-dimensional code comprising a plurality of blocks; and

forming image data obtained in said image data obtaining step on a recording medium as visualized data, and printing/recording an optically readable two-dimensional code converted in said converting step on said recording medium.

22. A method according to claim 21 wherein:

said image data obtaining step records a picture imaged by a camera using a silver salt film having a silver salt region and a magnetic recording region in said silver salt region of said silver salt film as a still image;

said audio data obtaining step records a voice inputted to said camera on said magnetic recording region of said silver salt film as audio data;

said converting step converts said audio data recorded in said magnetic recording region into said two-dimensional code; and

said recording step records a still image recorded on said silver salt region on a front surface of a photographic paper, and printing/recording said optically readable two-dimensional code on a predetermined section on which a still image recorded on a rear surface or a front surface of said photographic paper is not recorded.

23. A method according to claim 21 wherein:

said image data obtaining step obtains a still image imaged by an electronic still camera as digital image data and recording the still image in a memory installed in said electronic still camera;

said converting step converts said digital audio data recorded in said memory into an optically readable two-dimensional code comprising a plurality of blocks; and

said recording step records said digital image data recorded in said memory on a front surface of a recording medium, and prints/records said optically readable two-dimensional code on a predetermined section on which a still image recorded on a rear surface or a front surface of said recording medium is not recorded.

24. An audio data recording/reproduction system according to claim 1, wherein said plurality of blocks of said optically readable two-dimensional code are arranged in two dimensions.

25. An audio data recording/reproduction system according to claim 24, wherein each of said plurality of blocks has a two-dimensional block addresses.

26. An audio data recording/reproduction system according to claim 25, wherein each said two-dimensional block address includes an address error judgment symbol.

27. An audio data recording/reproduction system according to claim 1, wherein each of said plurality of blocks includes a marker.

28. An audio data recording/reproduction system according to claim 1, wherein each of said plurality of blocks has a data area comprising a plurality of dots arranged according to said audio data.

29. An audio data recording/reproduction system according to claim 28, wherein said plurality of dots are arranged in two dimensions according to a predetermined format.

30. An audio data recording/reproduction system according to claim 1, wherein said optically readable two-dimensional code is produced by subjecting individually said plurality of blocks to conversion processing.

31. An audio data recording/reproduction system according to claim 1, wherein said plurality of blocks of said optically readable two-dimensional code are arranged in two dimensions, each of said plurality of blocks having a two-dimensional block address, a marker, and a data area comprising a plurality of dots arranged according to said audio data.

32. An audio data recording/reproduction system according to claim 7, wherein said plurality of blocks of said optically readable two-dimensional code are arranged in two dimensions.

33. An audio data recording/reproduction system according to claim 32, wherein each of said plurality of blocks has a two-dimensional block address.

34. An audio data recording/reproduction system according to claim 33, wherein each said two-dimensional block address includes an address error judgment symbol.

35. An audio data recording/reproduction system according to claim 7, wherein each of said plurality of blocks includes a marker.

36. An audio data recording/reproduction system according to claim 7, wherein each of said plurality of blocks has

a data area comprising a plurality of dots arranged according to audio data.

37. An audio data recording/reproduction system according to claim 36, wherein said plurality of dots are arranged according to a predetermined format.

38. An audio data recording/reproduction system according to claim 1, wherein said optically readable two-dimensional code is produced by subjecting individually said plurality of blocks to conversion processing.

39. An audio data recording/reproduction system according to claim 7, wherein said plurality of blocks of said optically readable two-dimensional code are arranged in two dimensions, each of said plurality of blocks having a two-dimensional block address, a marker, and a data area comprising a plurality of dots arranged according to said audio data.

40. An audio data recording/reproduction system according to claim 19, wherein said plurality of blocks of said optically readable two-dimensional code are arranged in two dimensions.

41. An audio data recording/reproduction system according to claim 40, wherein each of said plurality of blocks has a two-dimensional block address.

42. An audio data recording/reproduction system according to claim 41, wherein each said two-dimensional block address includes an address error judgment symbol.

43. An audio data recording/reproduction system according to claim 19, wherein each of said plurality of blocks includes a marker.

44. An audio data recording/reproduction system according to claim 19, wherein each of said plurality of blocks has a data area comprising a plurality of dots arranged according to audio data.

45. An audio data recording/reproduction system according to claim 44, wherein said plurality of dots are arranged in two dimensions according to a predetermined format.

46. An audio data recording/reproduction system according to claim 19, wherein said optically readable two-dimensional code is produced by subjecting individually said plurality of blocks to conversion processing.

47. An audio data recording/reproduction system according to claim 19, wherein said plurality of blocks of said optically readable two-dimensional code are arranged in two dimensions, each of said plurality of blocks having a two-dimensional block address, a marker, and a data area comprising a plurality of dots arranged according to said audio data.

48. An audio data recording/reproduction system according to claim 21, wherein said plurality of blocks of said optically readable two-dimensional code are arranged in two dimensions.

49. An audio data recording/reproduction system according to claim 48, wherein each of said plurality of blocks has a two-dimensional block address.

50. An audio data recording/reproduction system according to claim 49, wherein each said two-dimensional block address includes an address error judgment symbol.

51. An audio data recording/reproduction system according to claim 21, wherein each of said plurality of blocks includes a marker.

52. An audio data recording/reproduction system according to claim 21, wherein each of said plurality of blocks has a data area comprising a plurality of dots arranged according to said audio data.

53. An audio data recording/reproduction system according to claim 52, wherein said plurality of dots are arranged in two dimensions according to a predetermined format.

54. An audio data recording/reproduction system according to claim 21, wherein said optically readable two-dimensional code is produced by subjecting individually said plurality of blocks to conversion processing.

55. An audio data recording/reproduction system according to claim 21, wherein said plurality of blocks of said optically readable two-dimensional code are arranged in two dimensions, each of said plurality of blocks having a two-dimensional block address, a marker, and a data area comprising a plurality of dots arranged according to said audio data.

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