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BODY WEARABLE INFORMATION
PROCESSING TERMINAL DEVICE

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(51)

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(52)

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(73)

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(JP)

(57)

ABSTRACT

A function module unit having a memory function is remov-
ably attached on one of wrist bands, while a function module
unit having a sensor function is removably attached to the
other wrist band. On both wrist bands, bus line wires are
embedded along the longitudinal direction. Each of the bus
line wires comprises a Vcc line, a serial data line, a clock
data line, and a ground line. Each of these lines is provided
with a connector member which is exposed on the back
surface of the wrist band at a position corresponding to the
function module unit.

(21)

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(22)

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(30)

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May 17, 2000 (JP) 2000-144500

Petitioner Samsung Ex-1007, 0001

FIG.1A

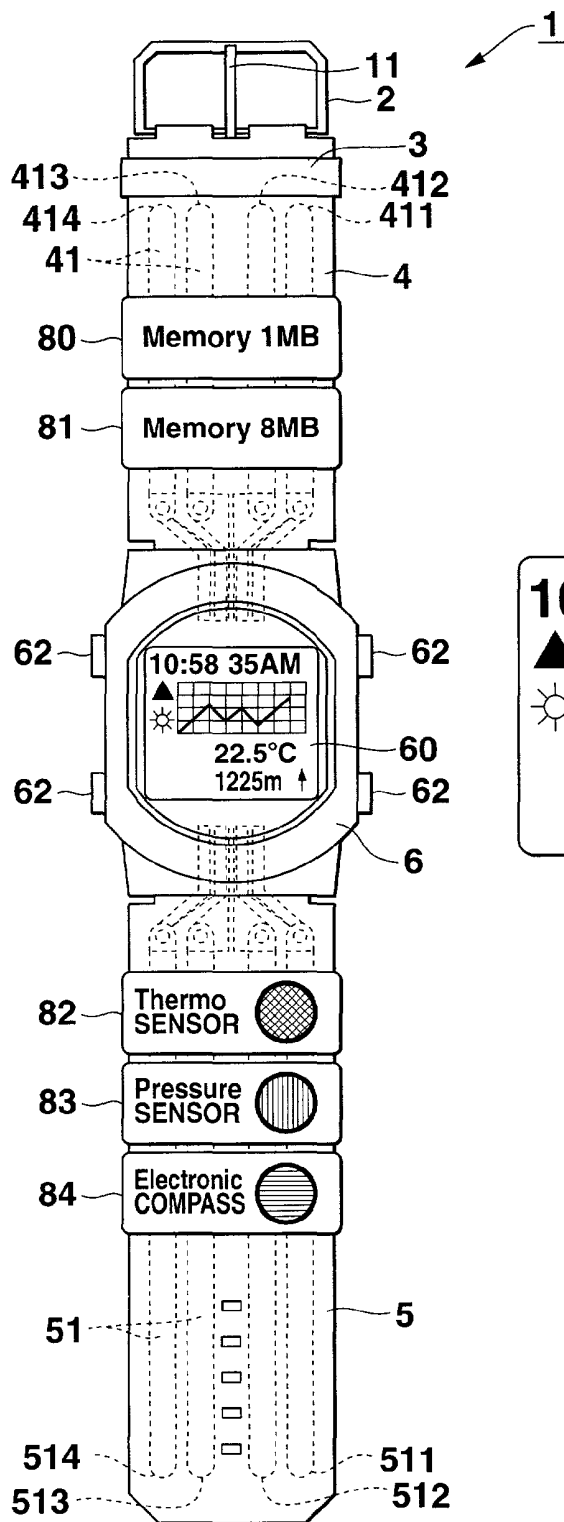


FIG.1B

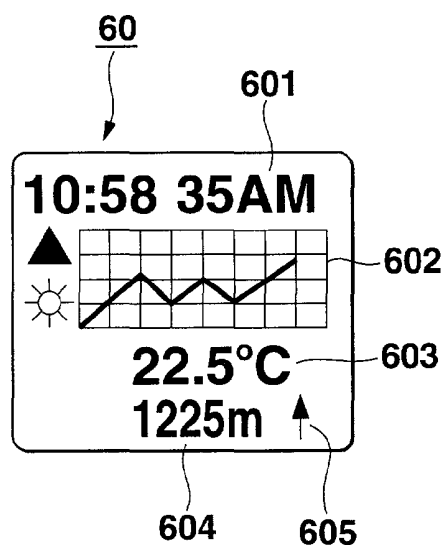


FIG.2

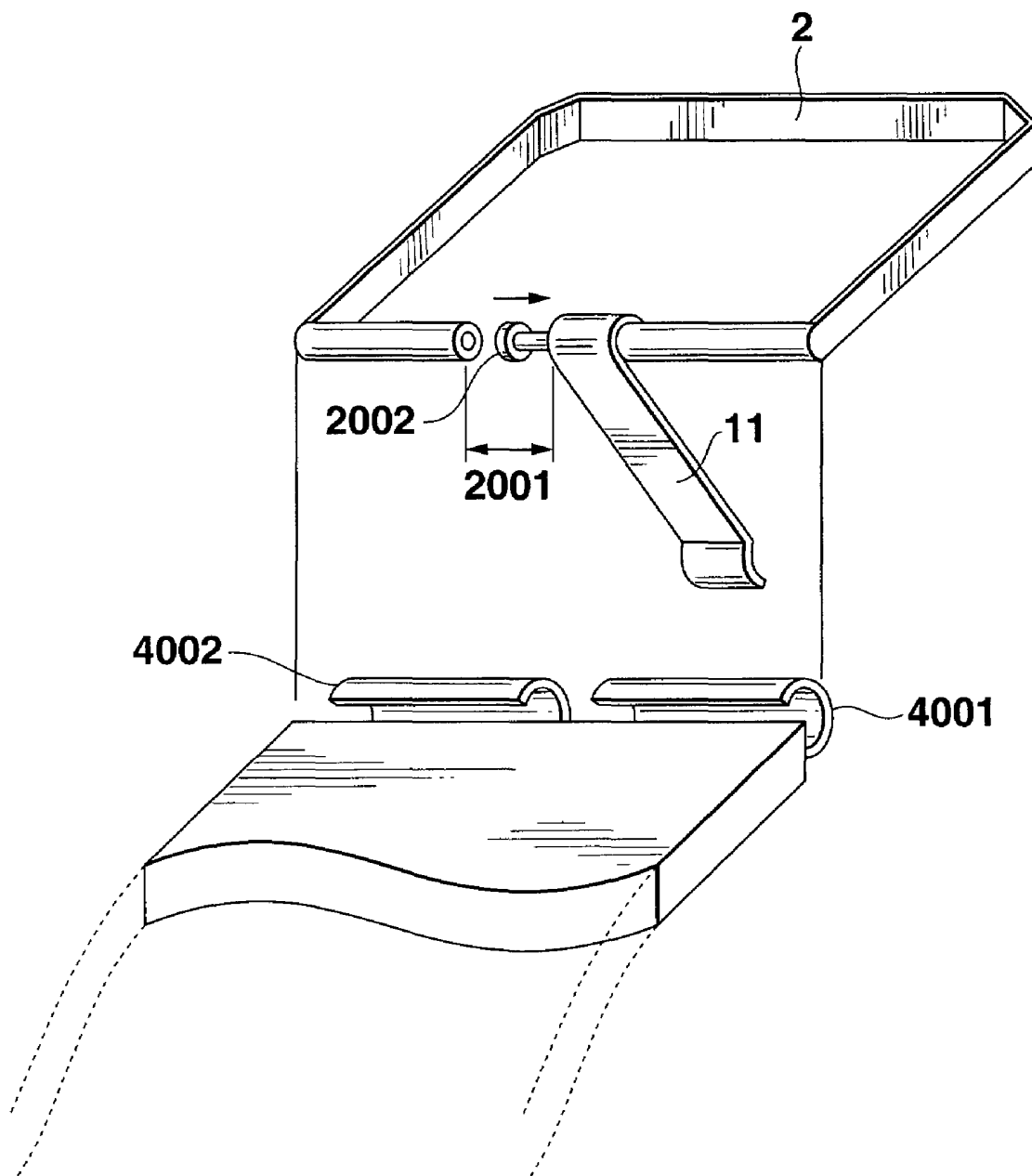


FIG.3

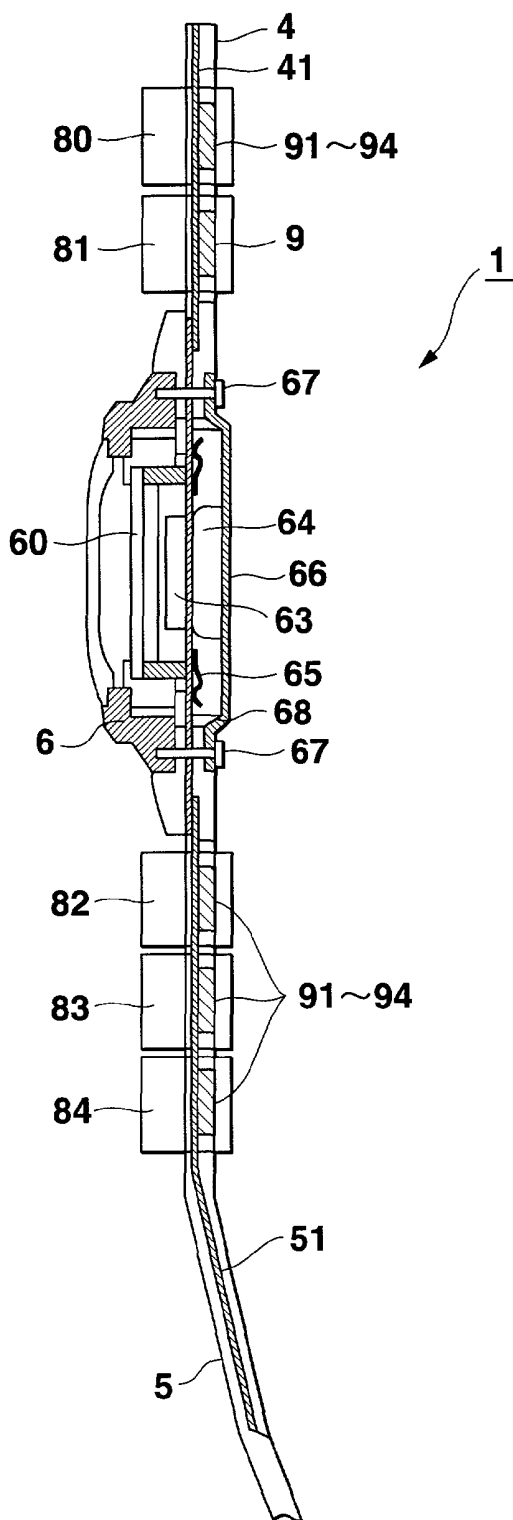


FIG.4

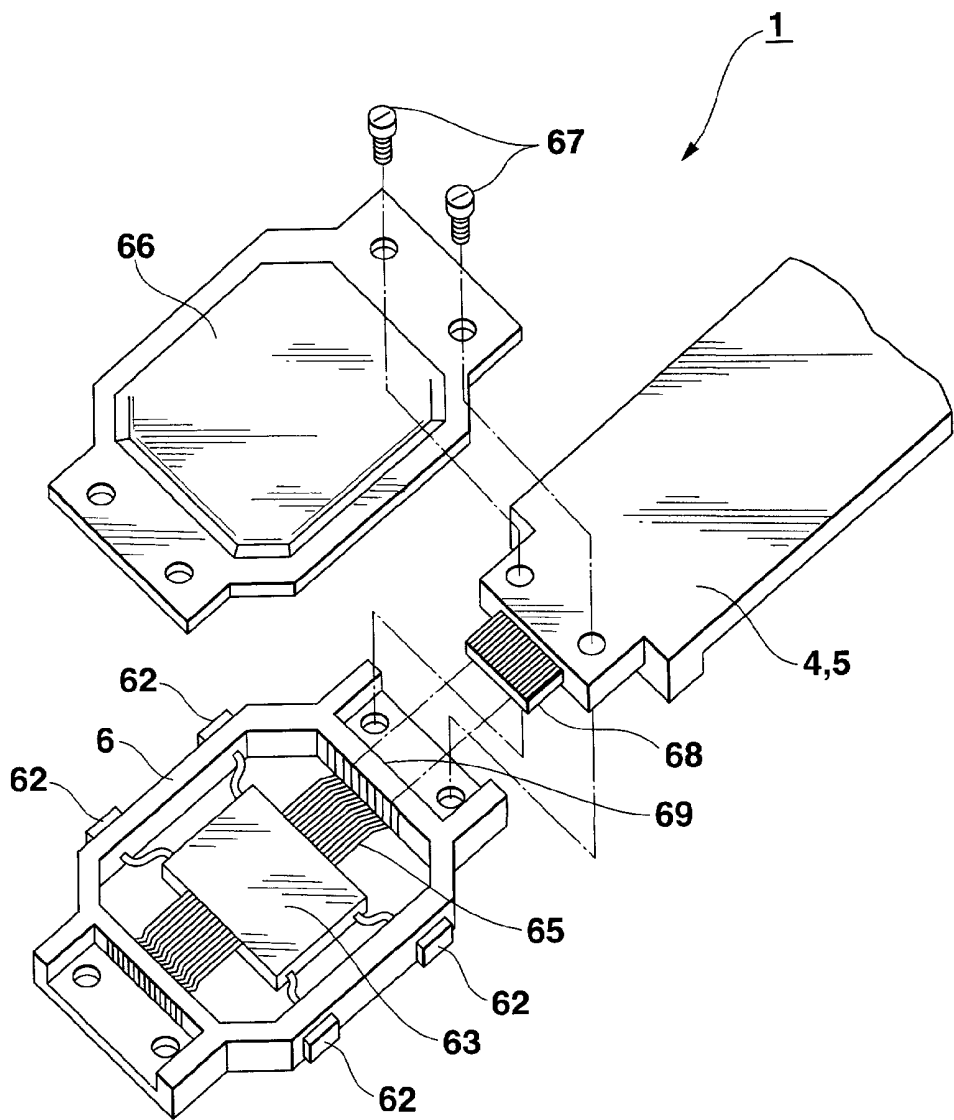


FIG.5A

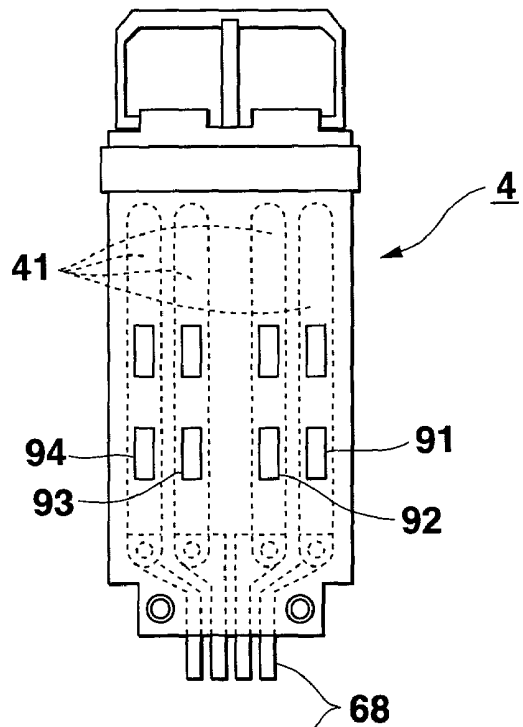
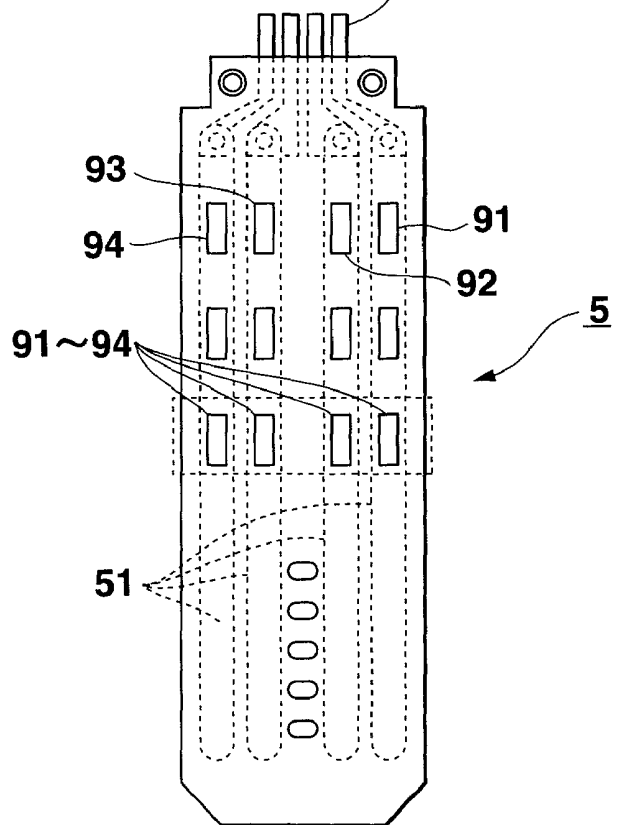


FIG.5B



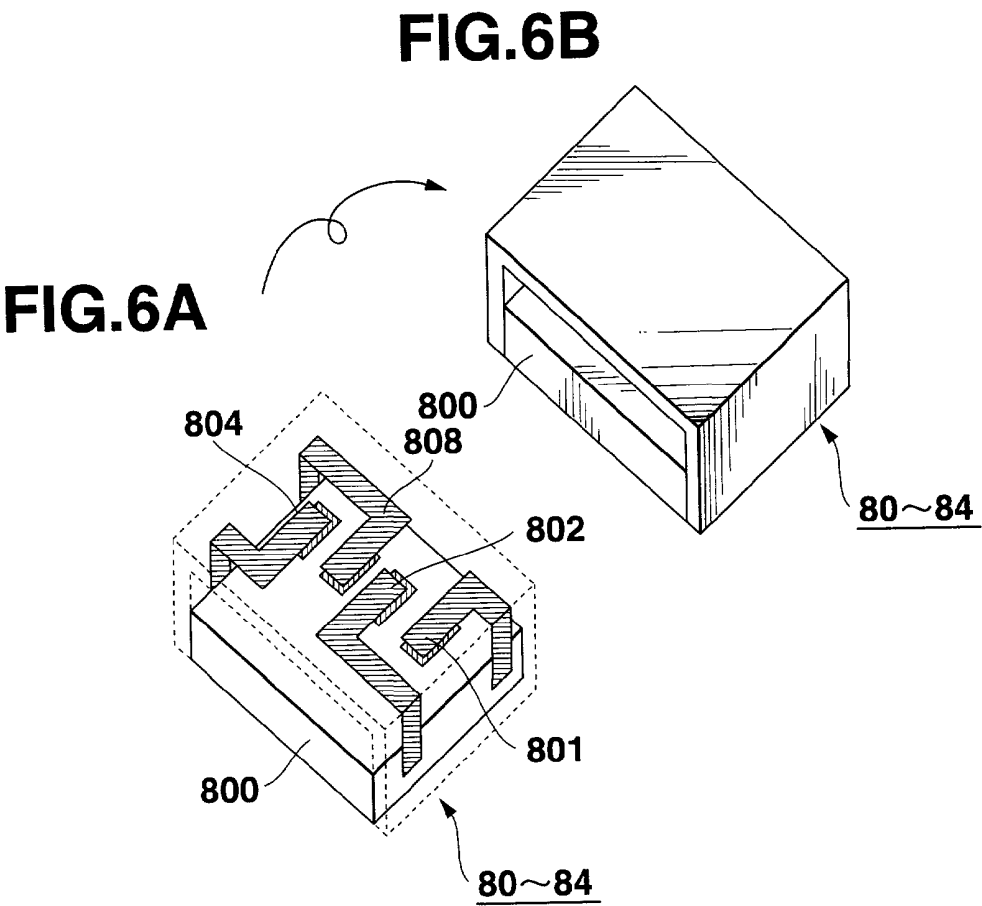
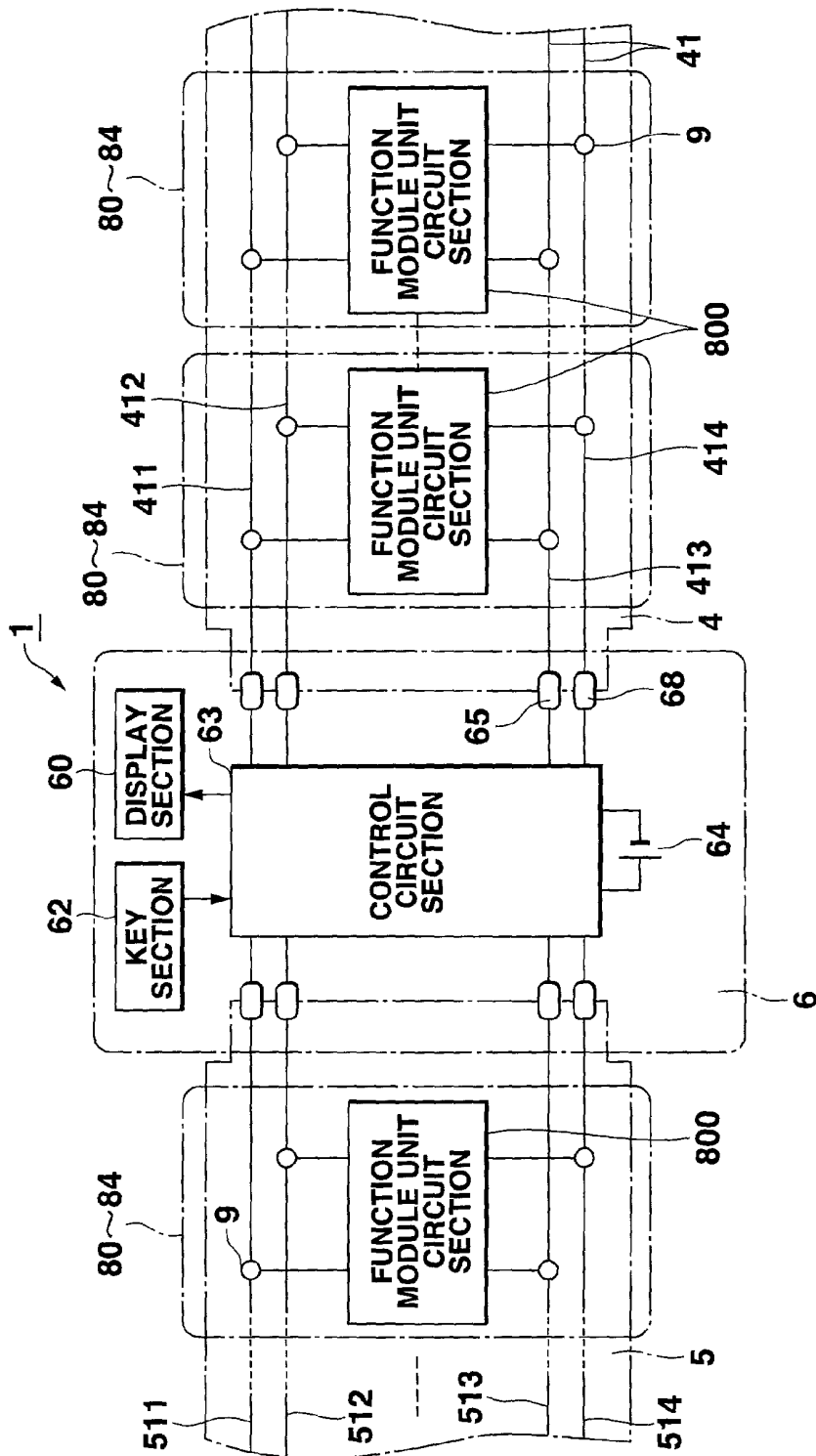


FIG. 7



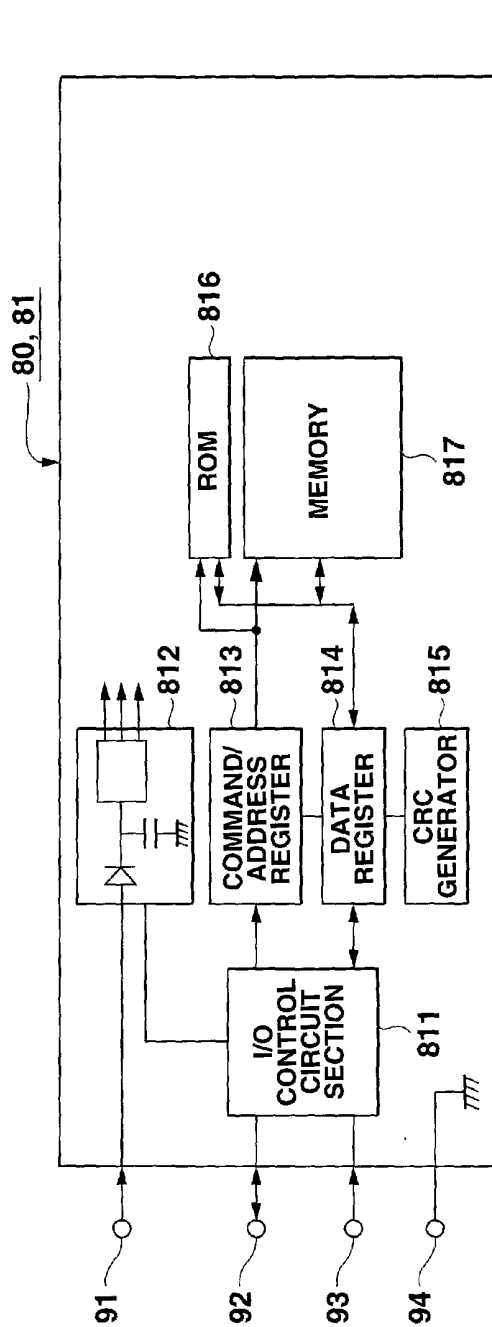


FIG. 9A

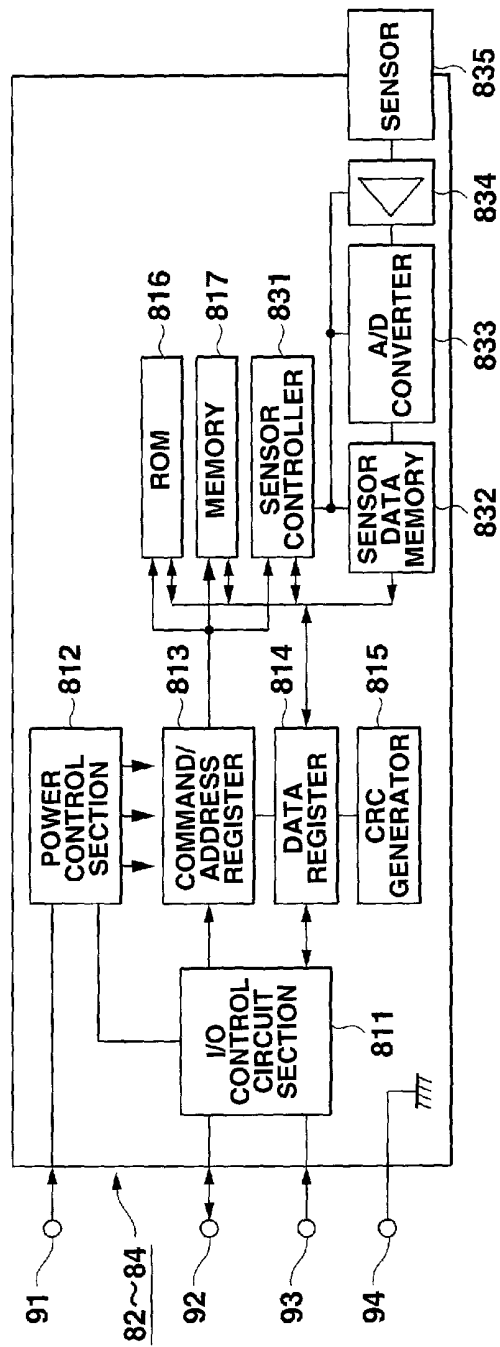


FIG. 9B

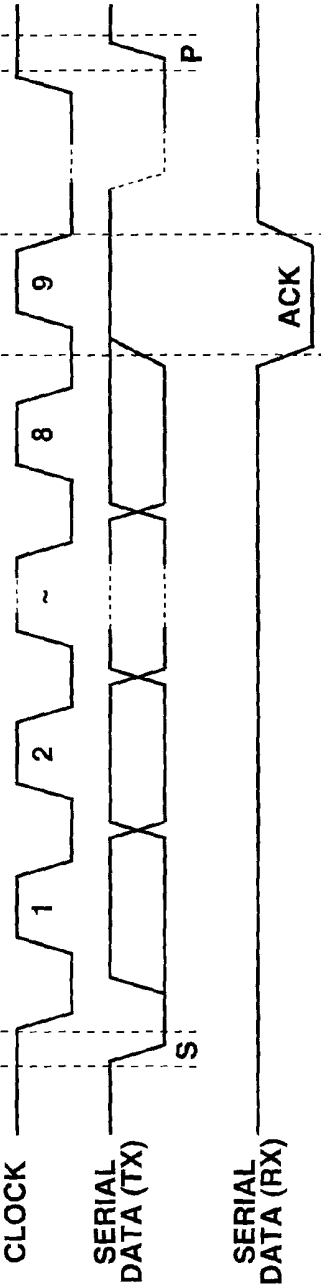


FIG.10A

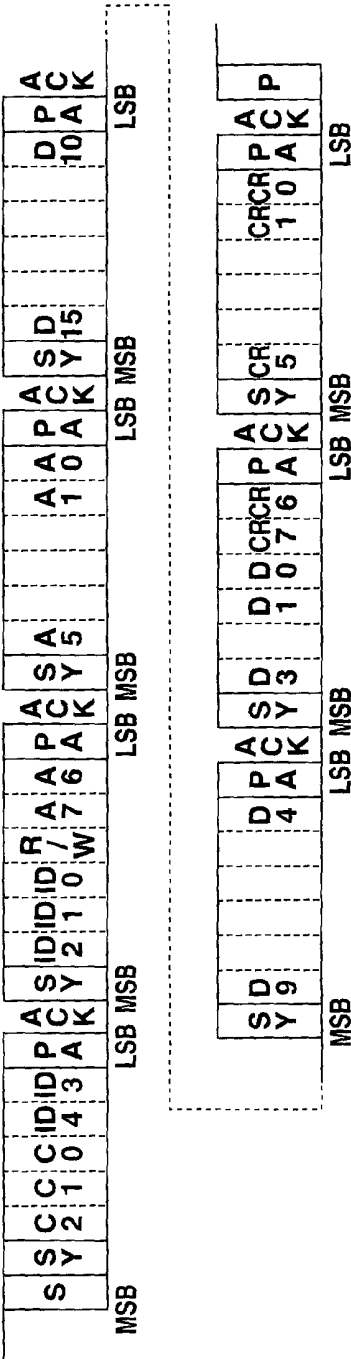


FIG.10B

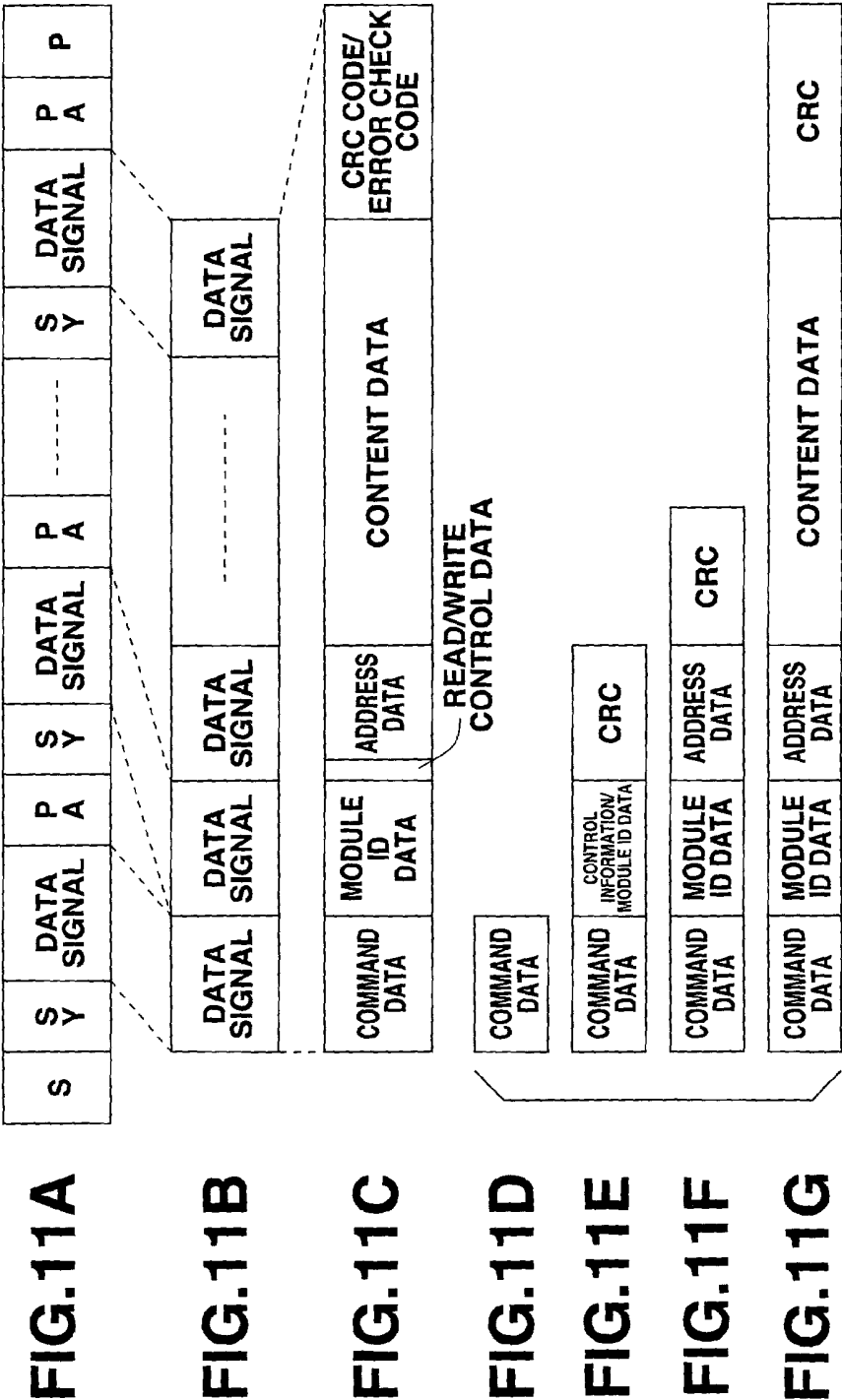


FIG.12A

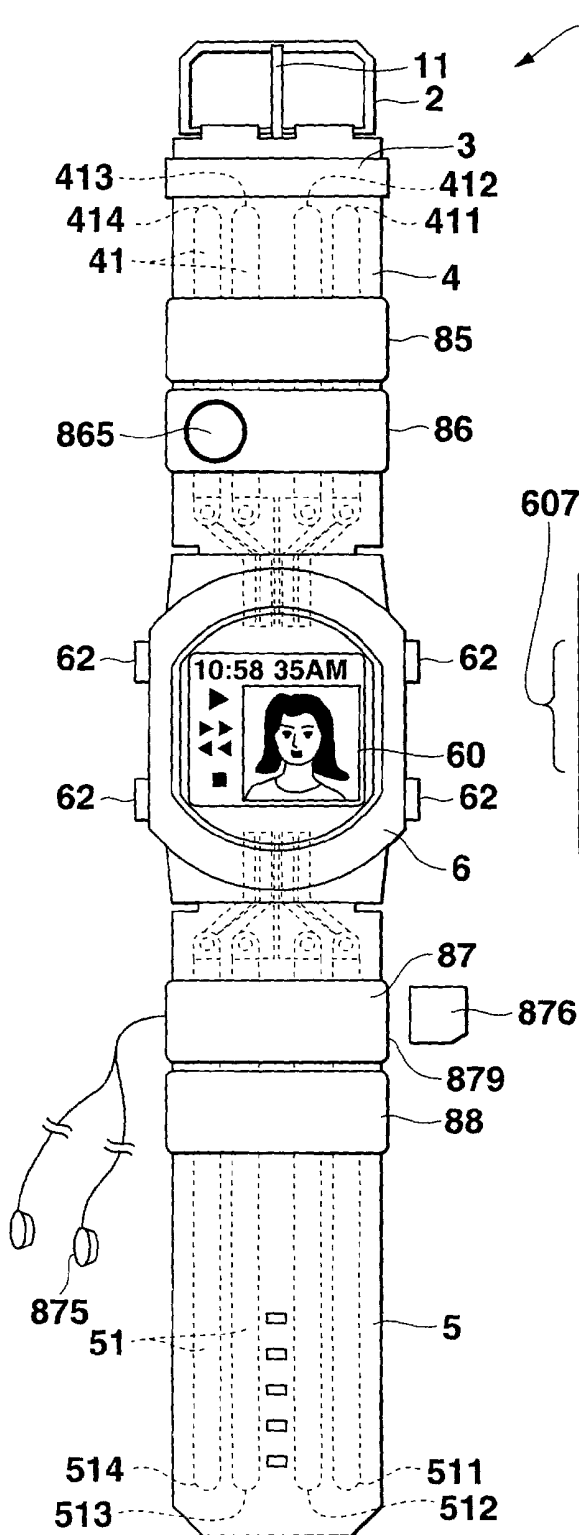
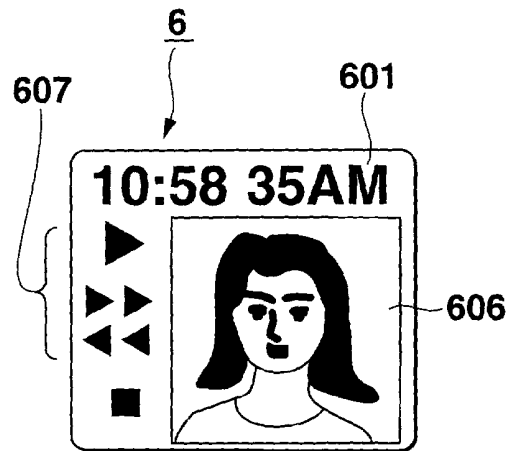


FIG.12B



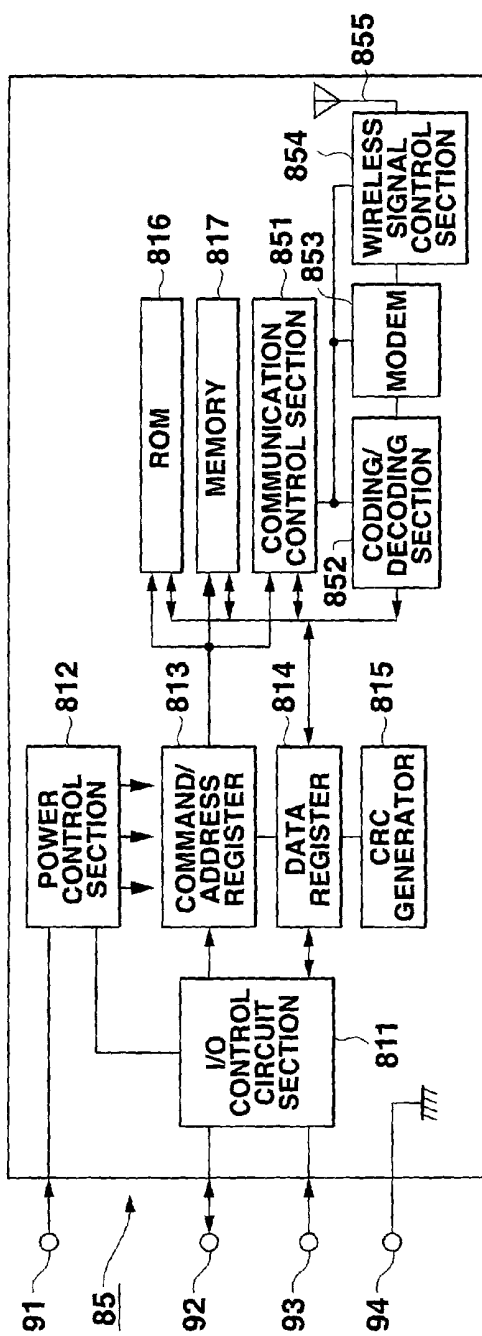


FIG. 13A

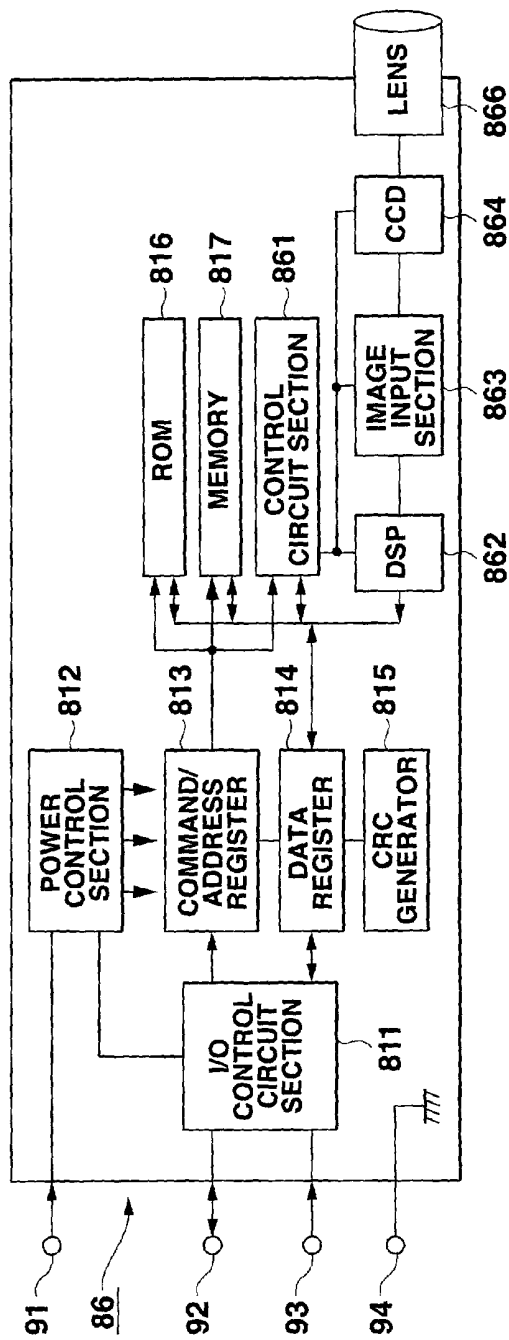


FIG. 13B

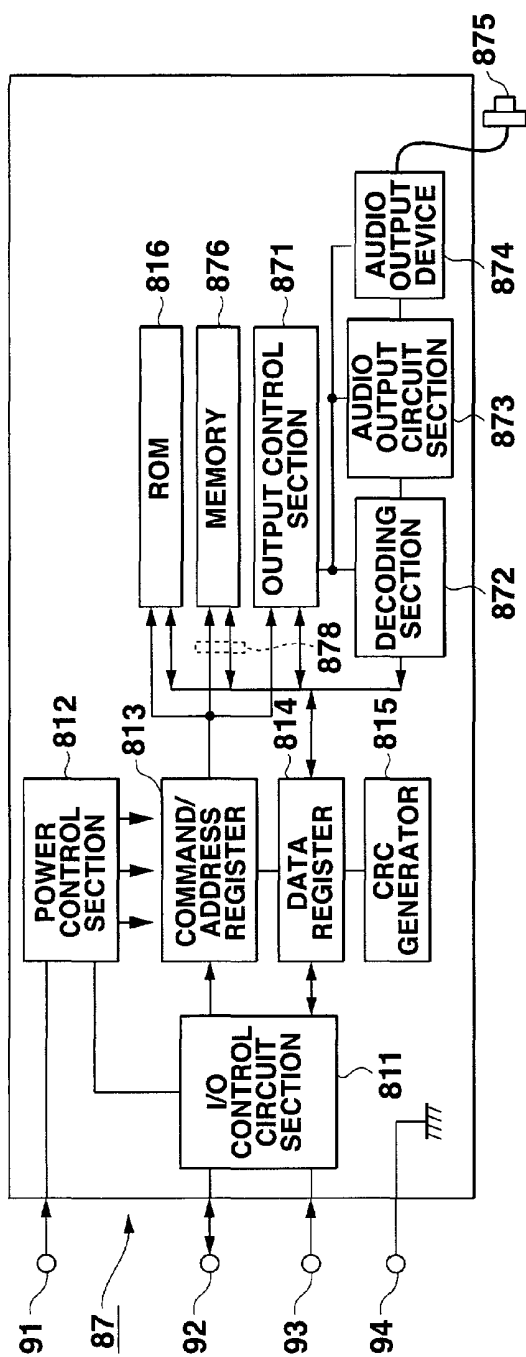


FIG. 14A

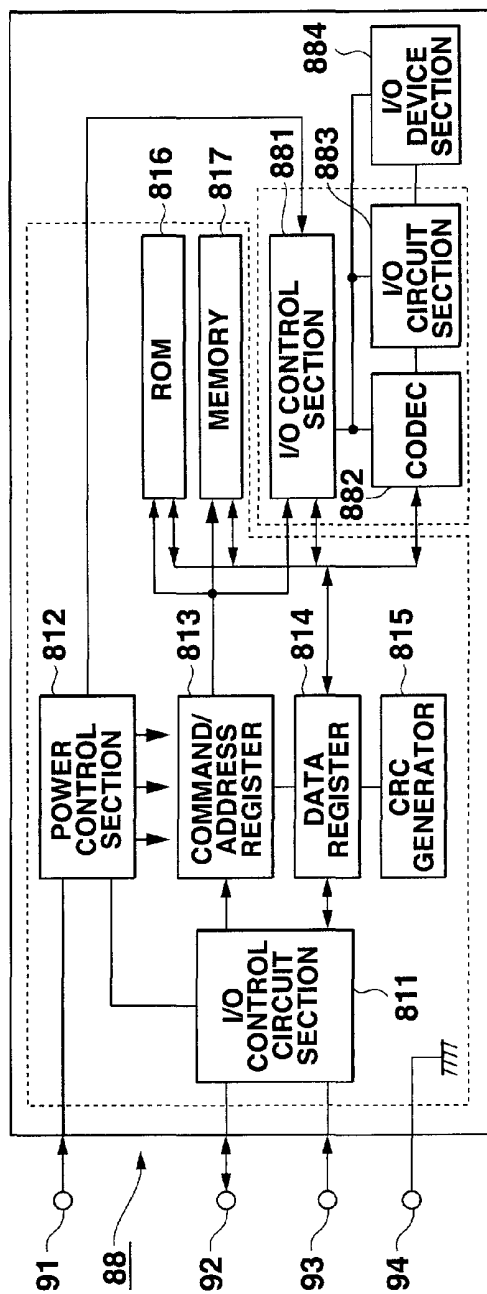


FIG. 14B

FIG.15A

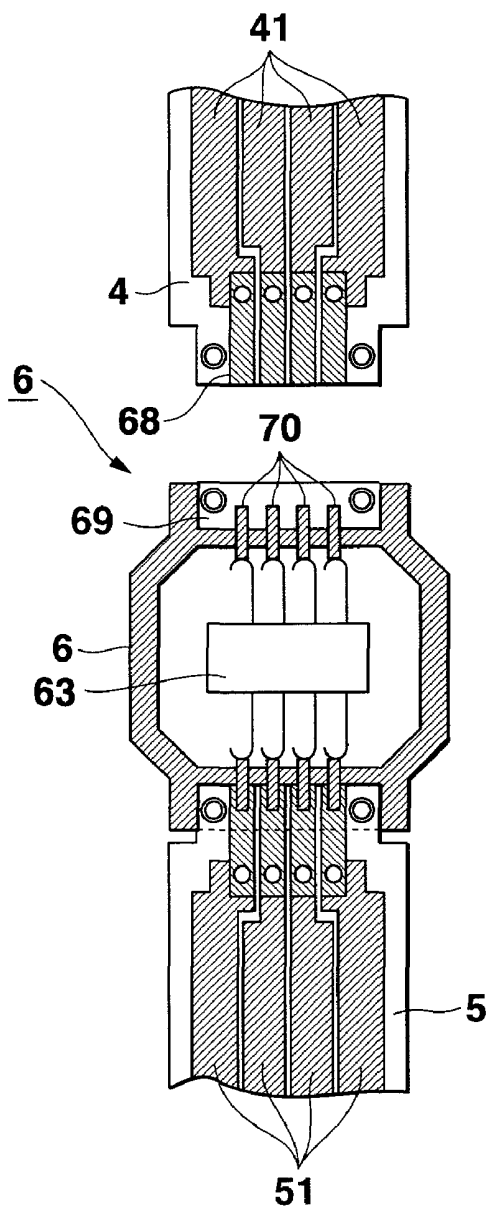


FIG.15B

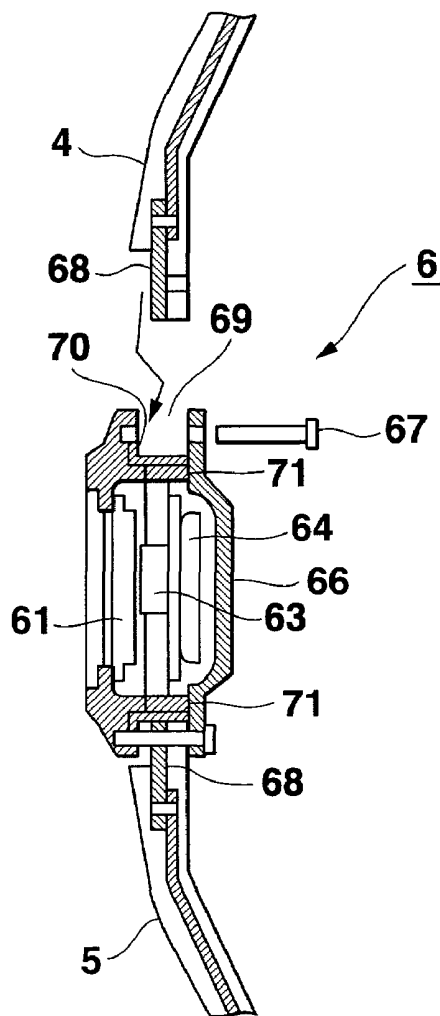


FIG.16

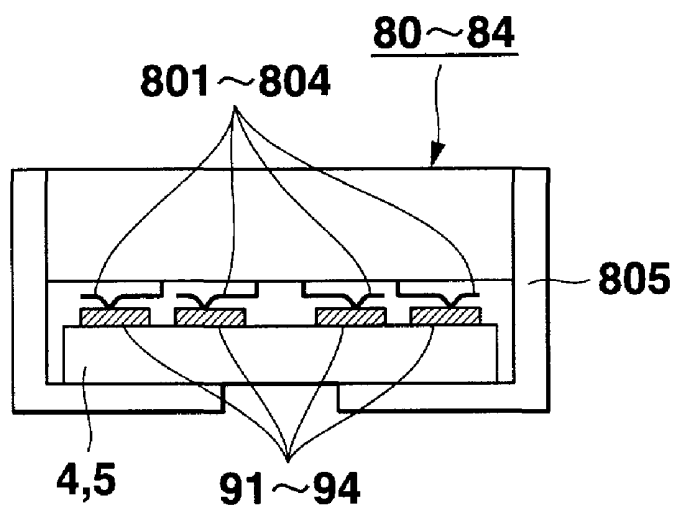


FIG.17

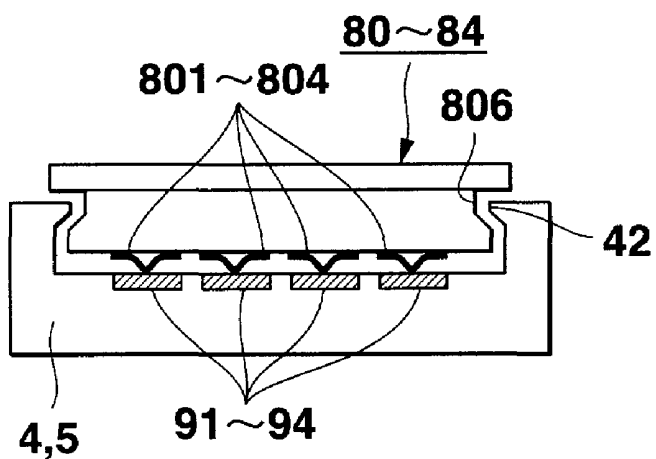


FIG.18A

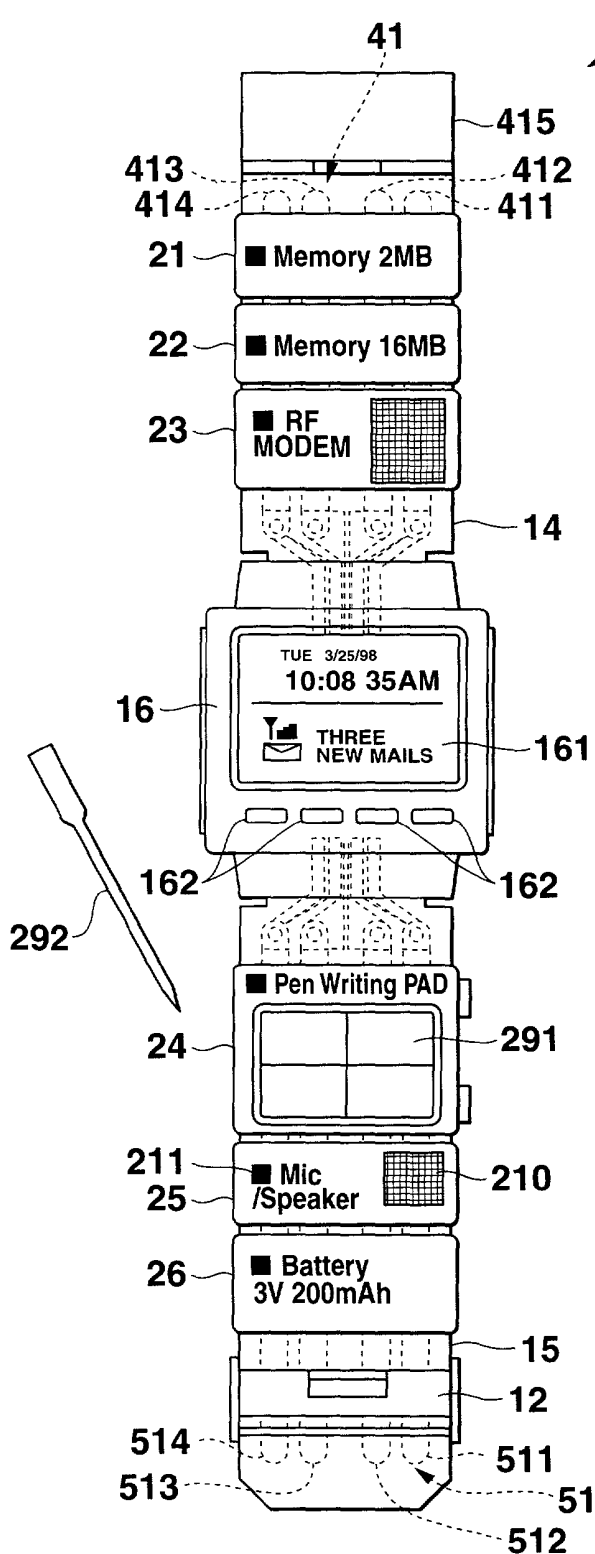


FIG.18B

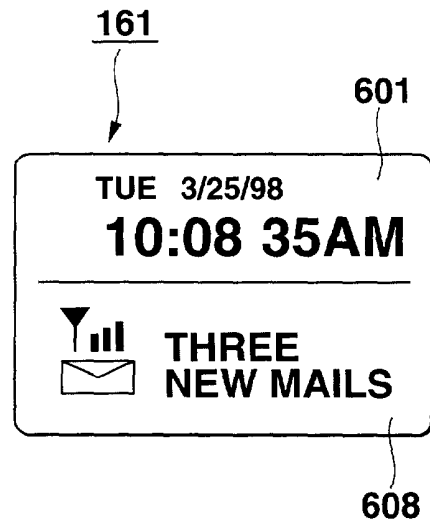
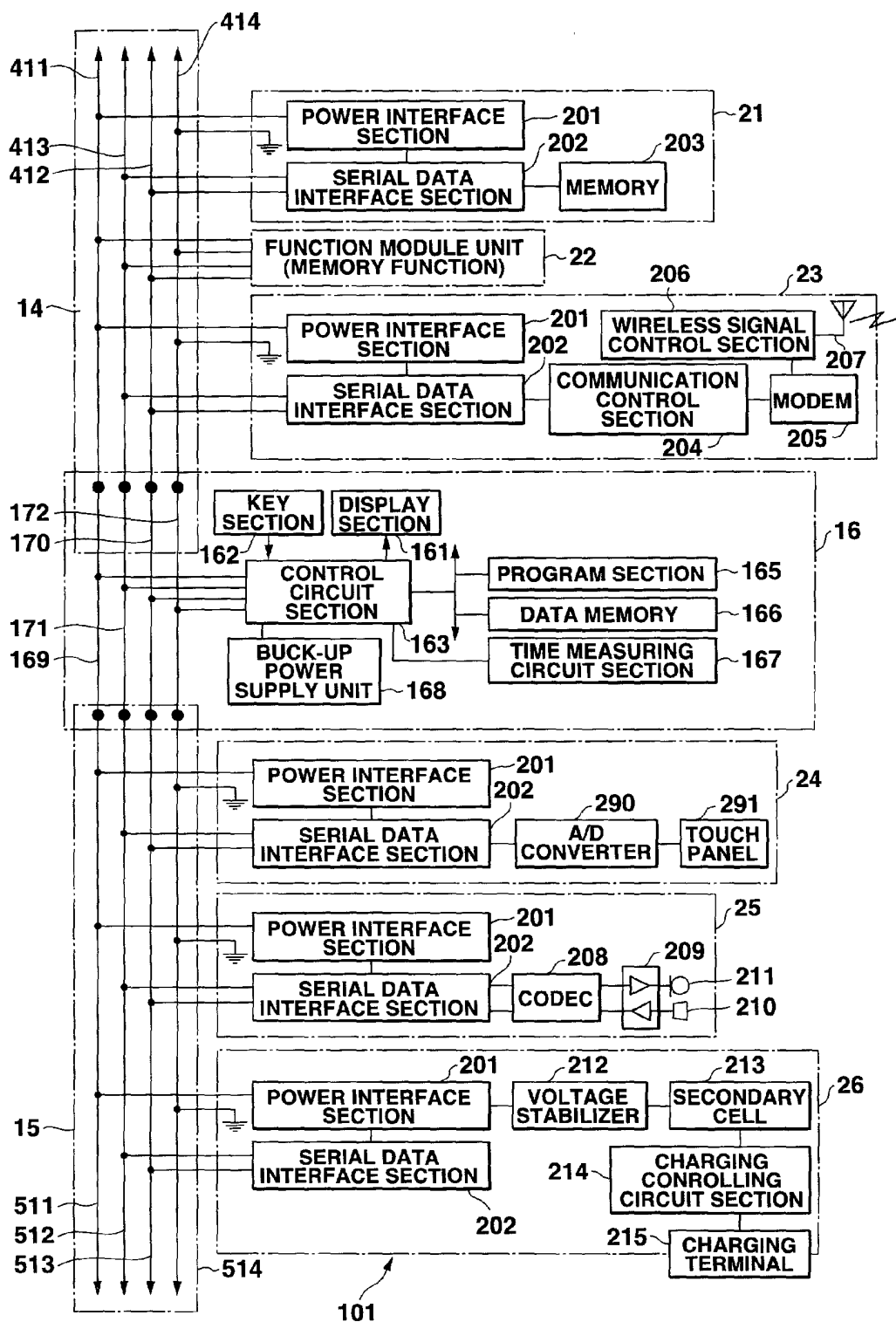


FIG.19



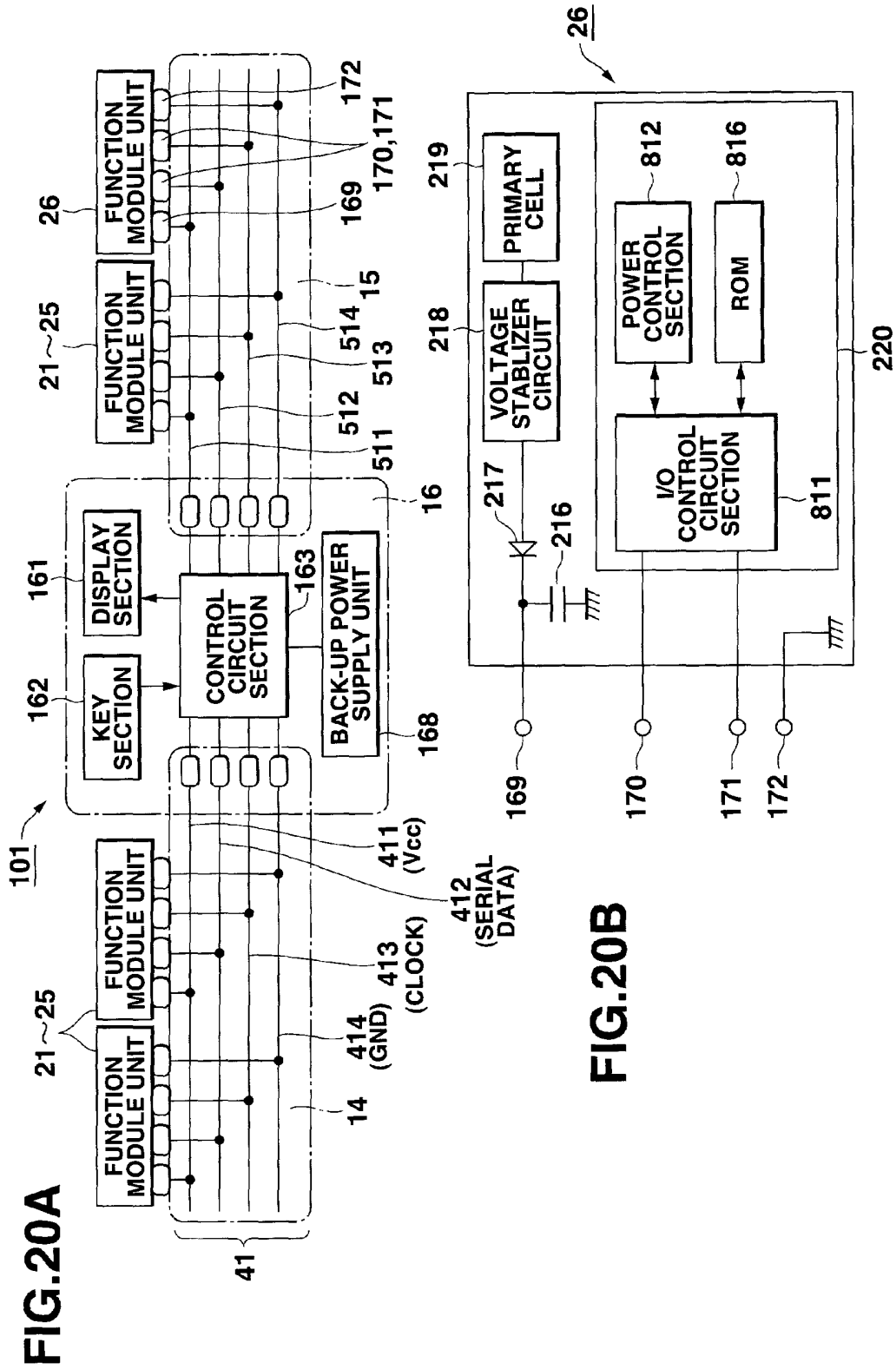


FIG.21

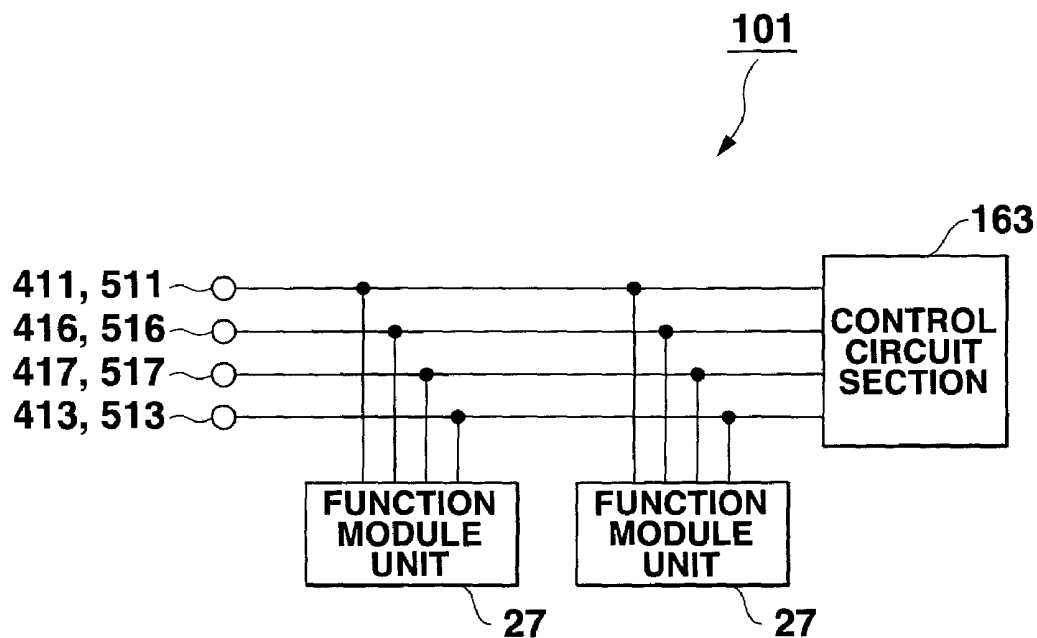


FIG.22A

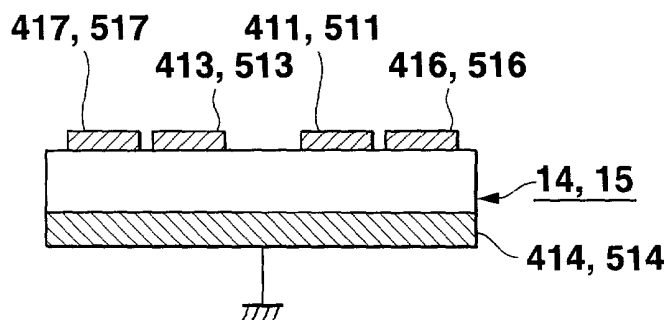


FIG.22B

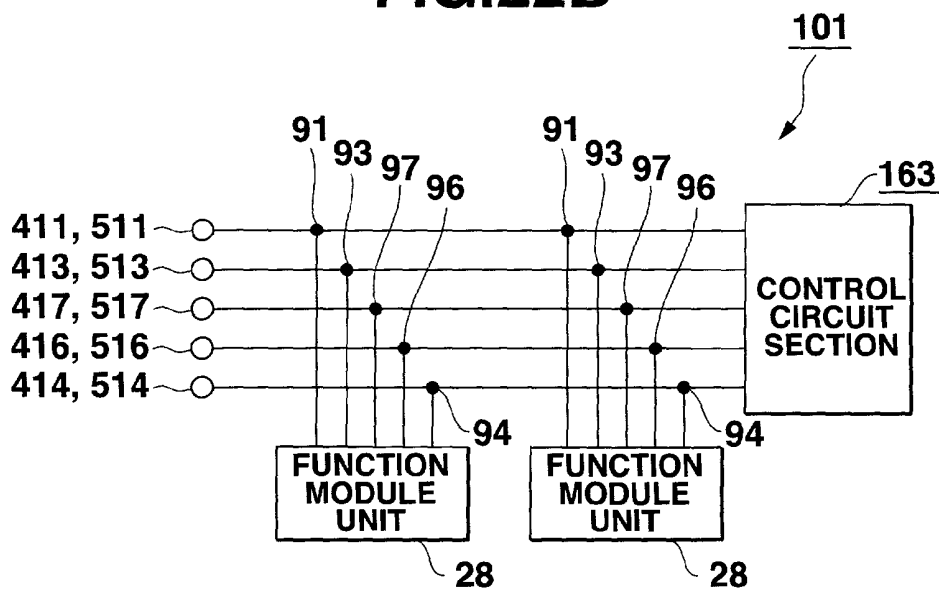


FIG.23

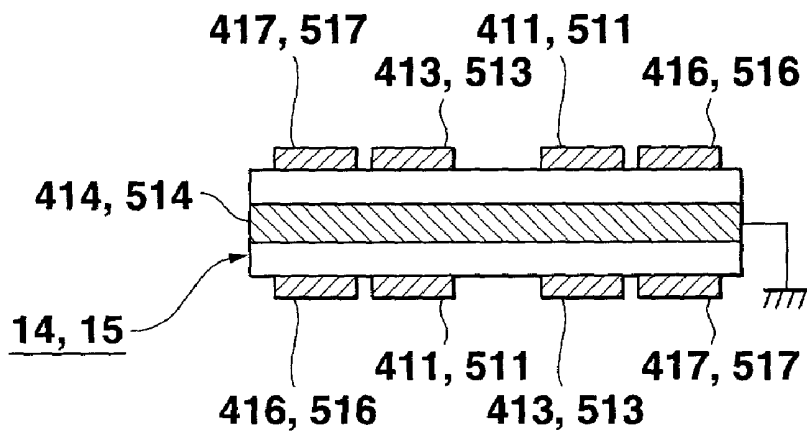


FIG.24

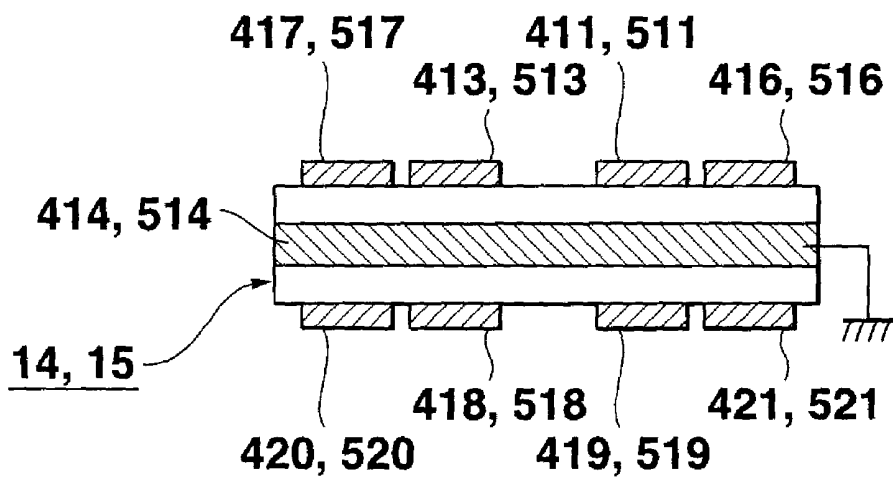


FIG.25A

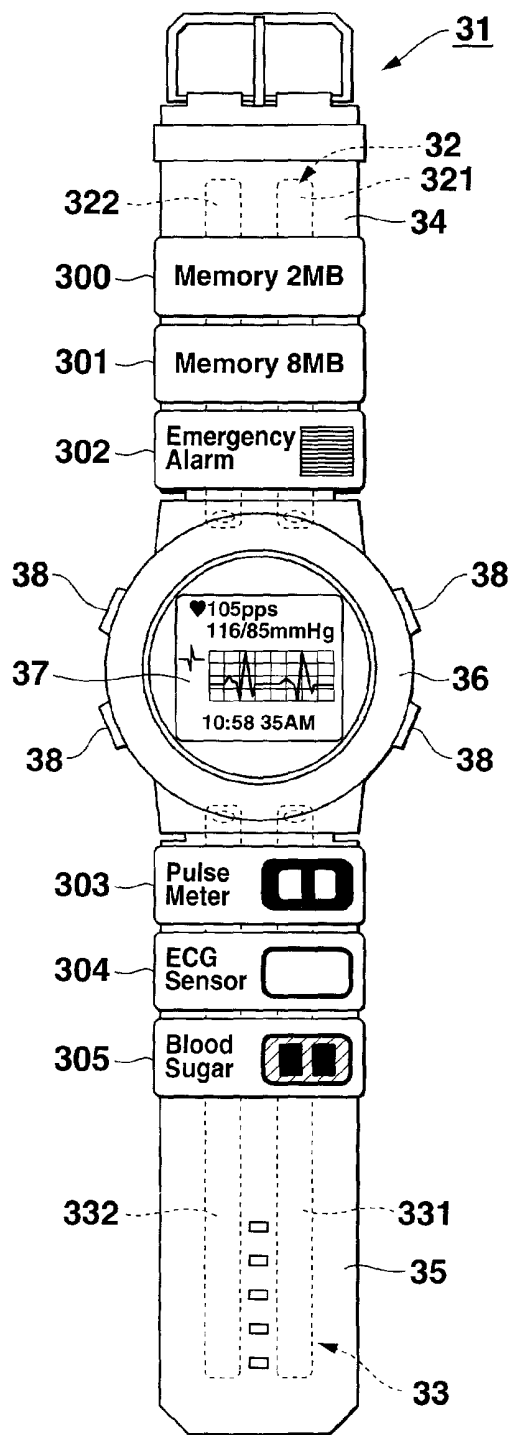


FIG.25B

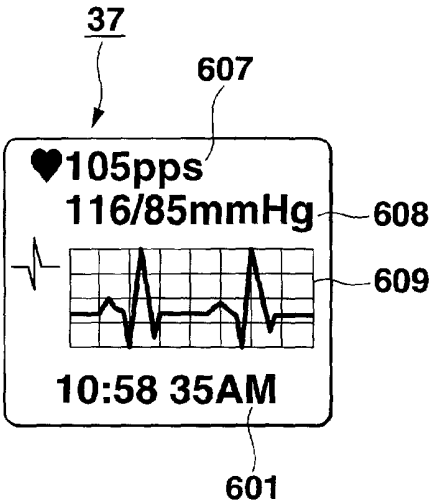


FIG.26

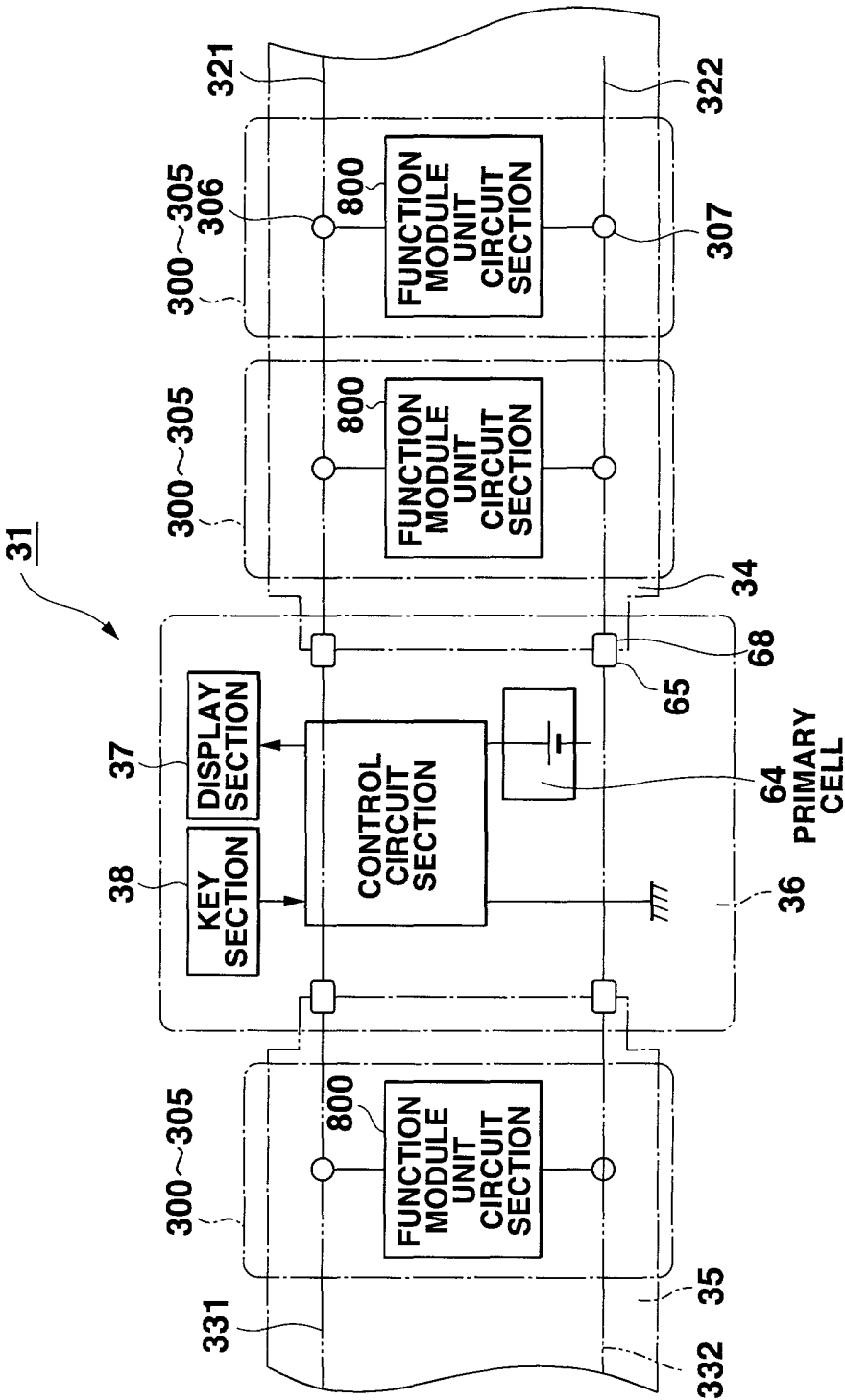


FIG. 27A

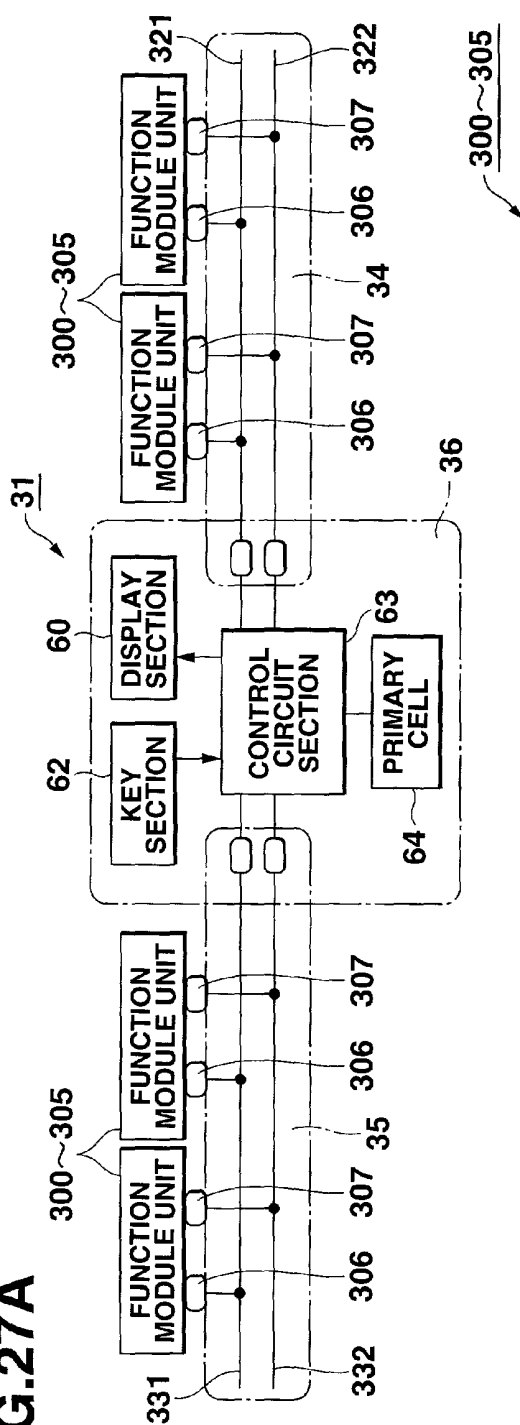


FIG. 27B

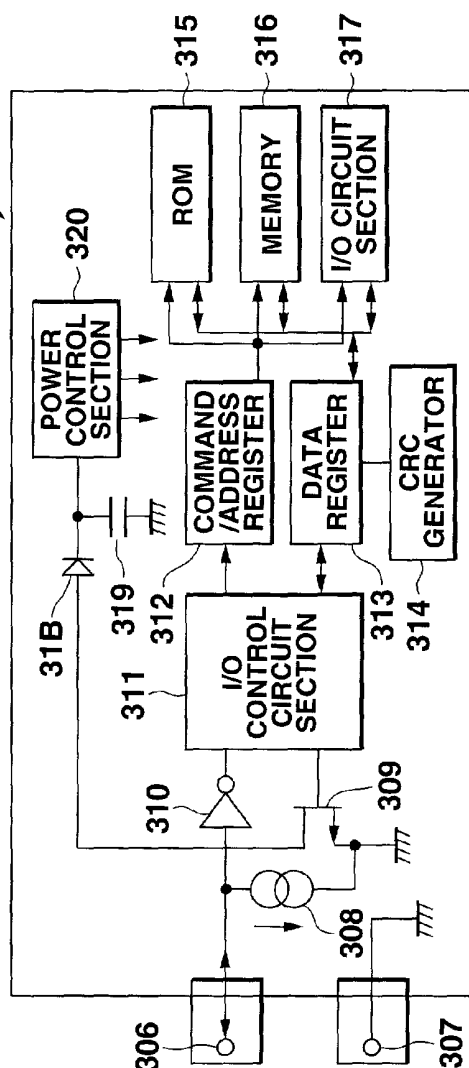


FIG.28

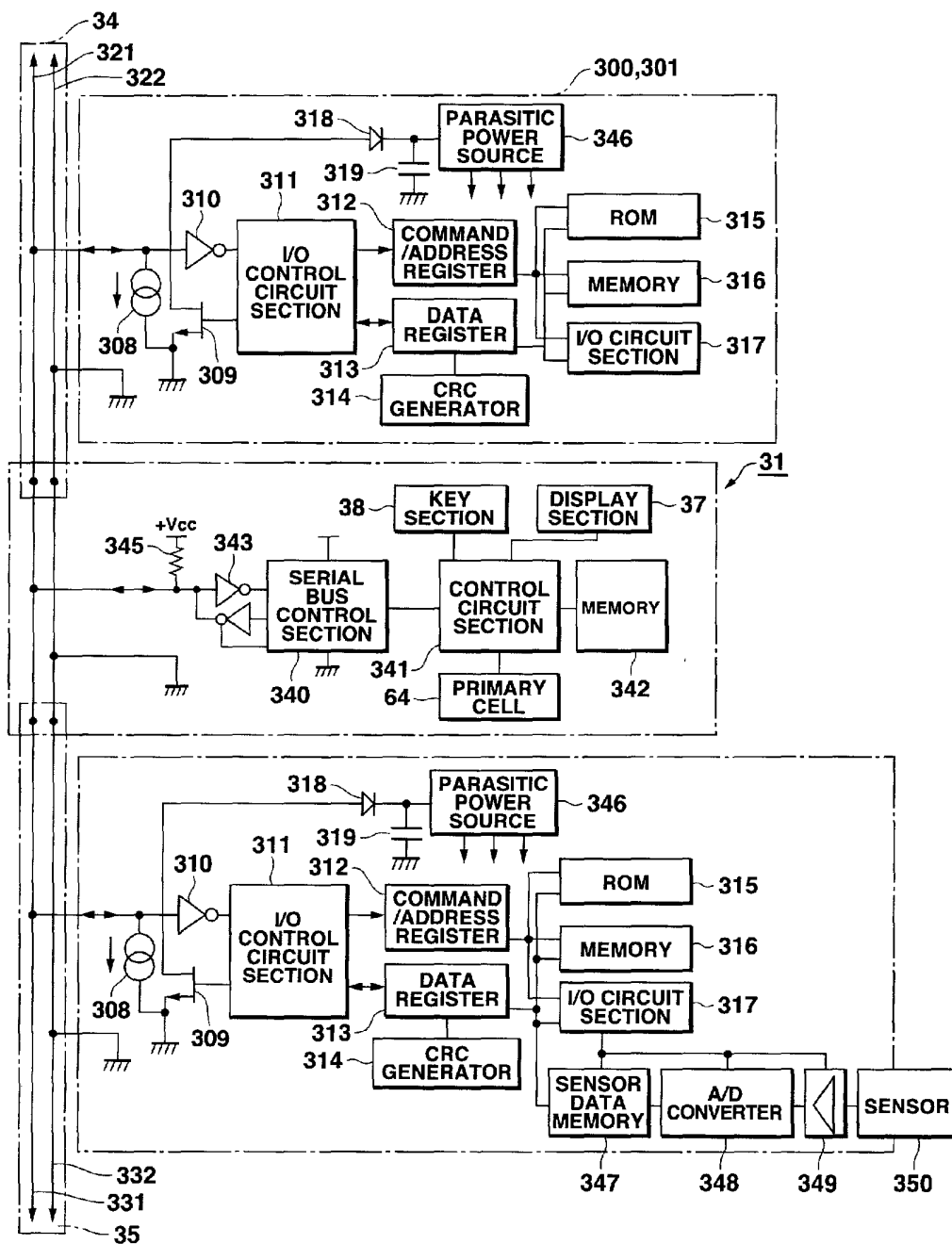


FIG.29A

FIG.29B

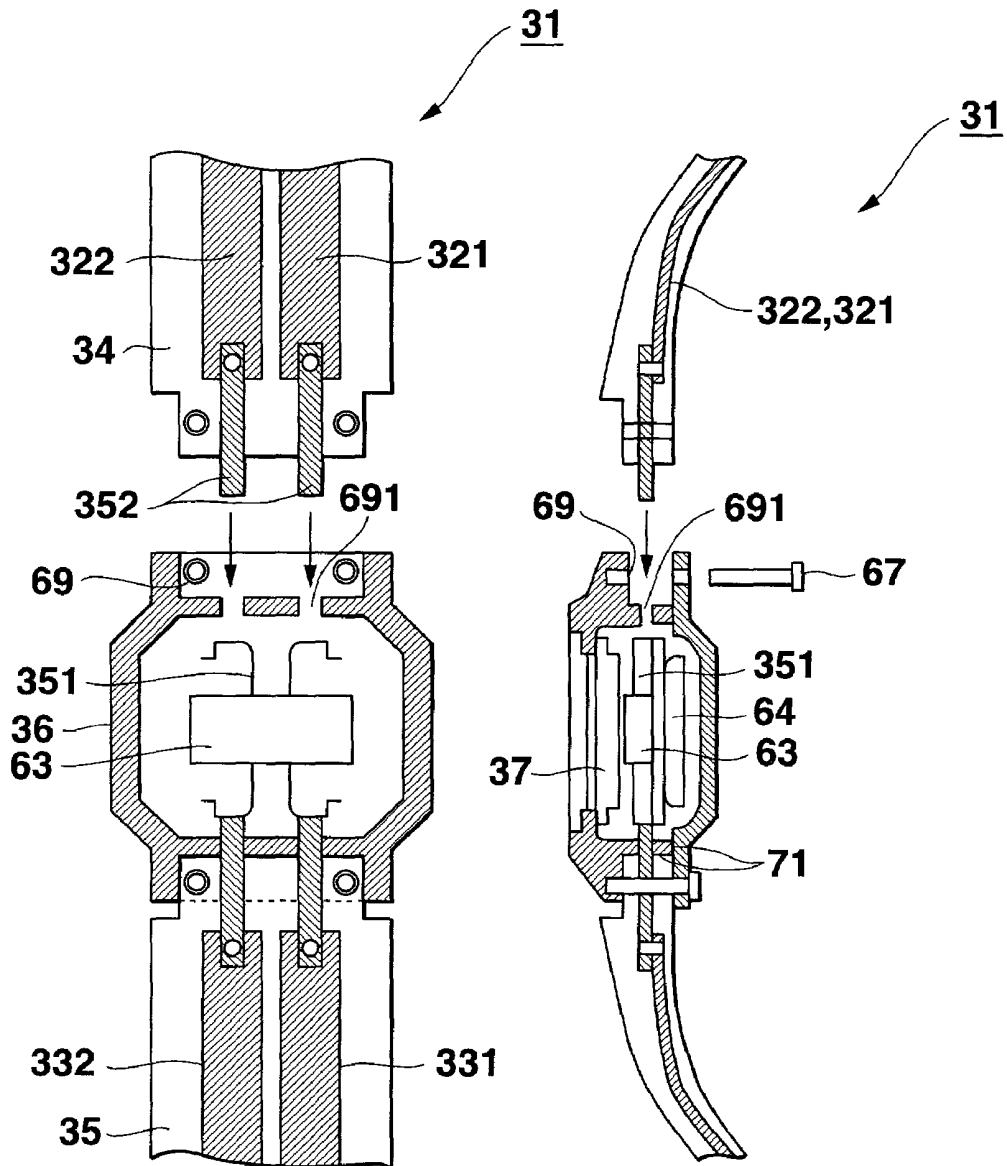


FIG.30A

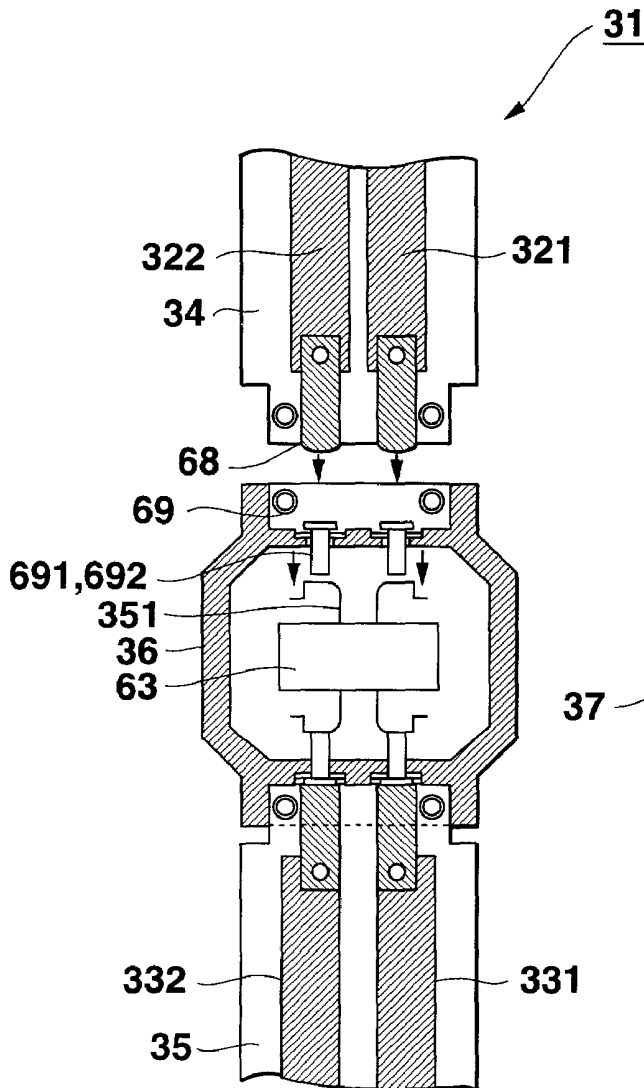


FIG.30B

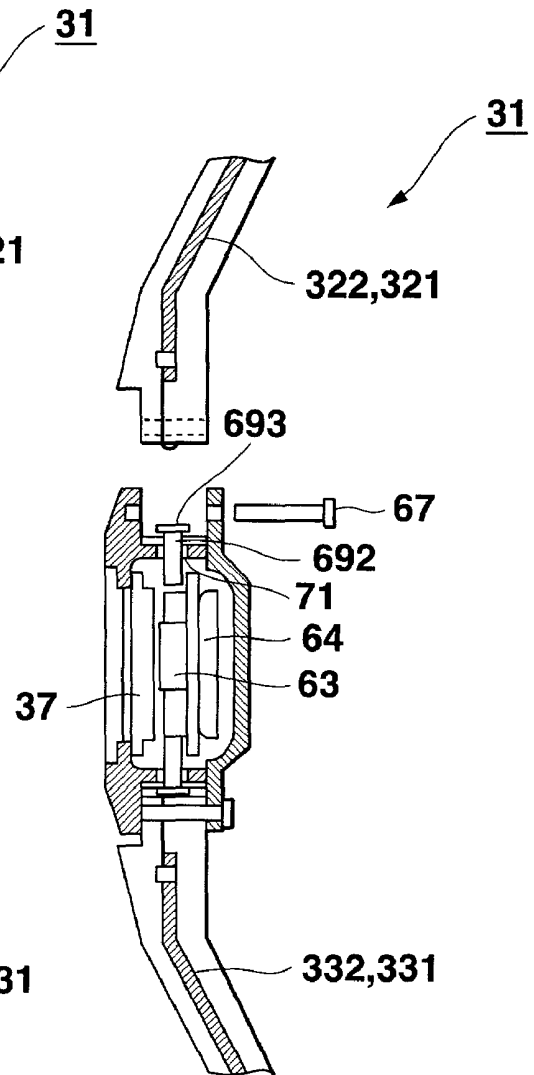


FIG.31A

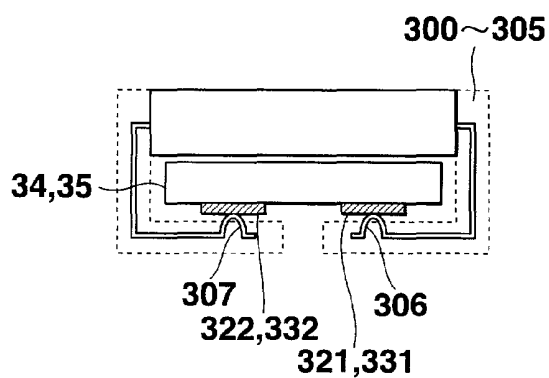


FIG.31B

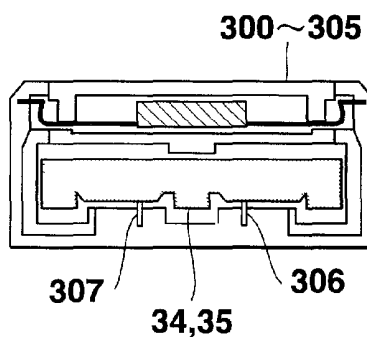


FIG.31C

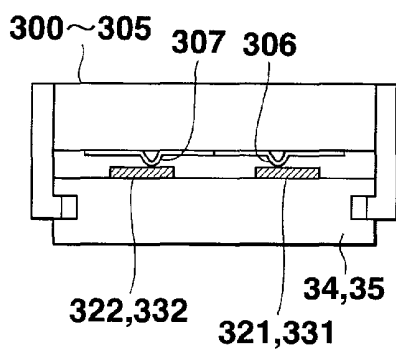


FIG.31D

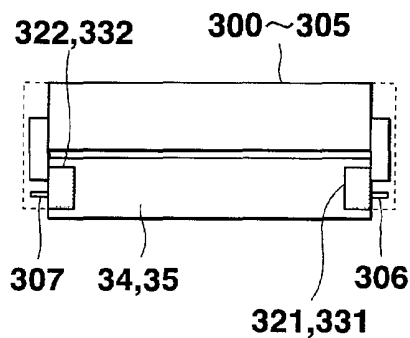


FIG.31E

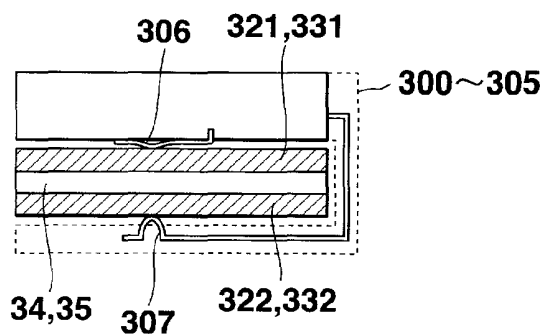


FIG. 32

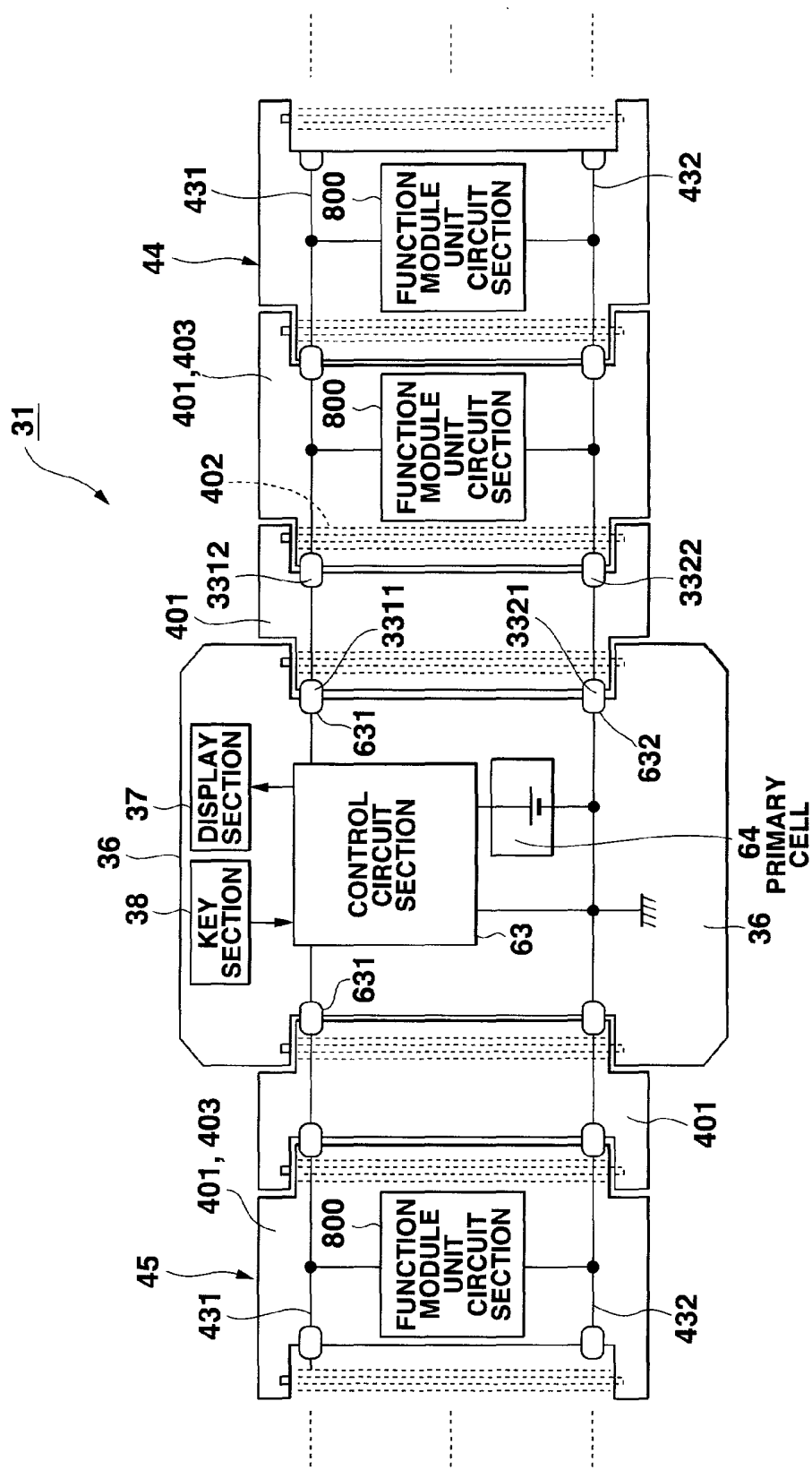


FIG.33

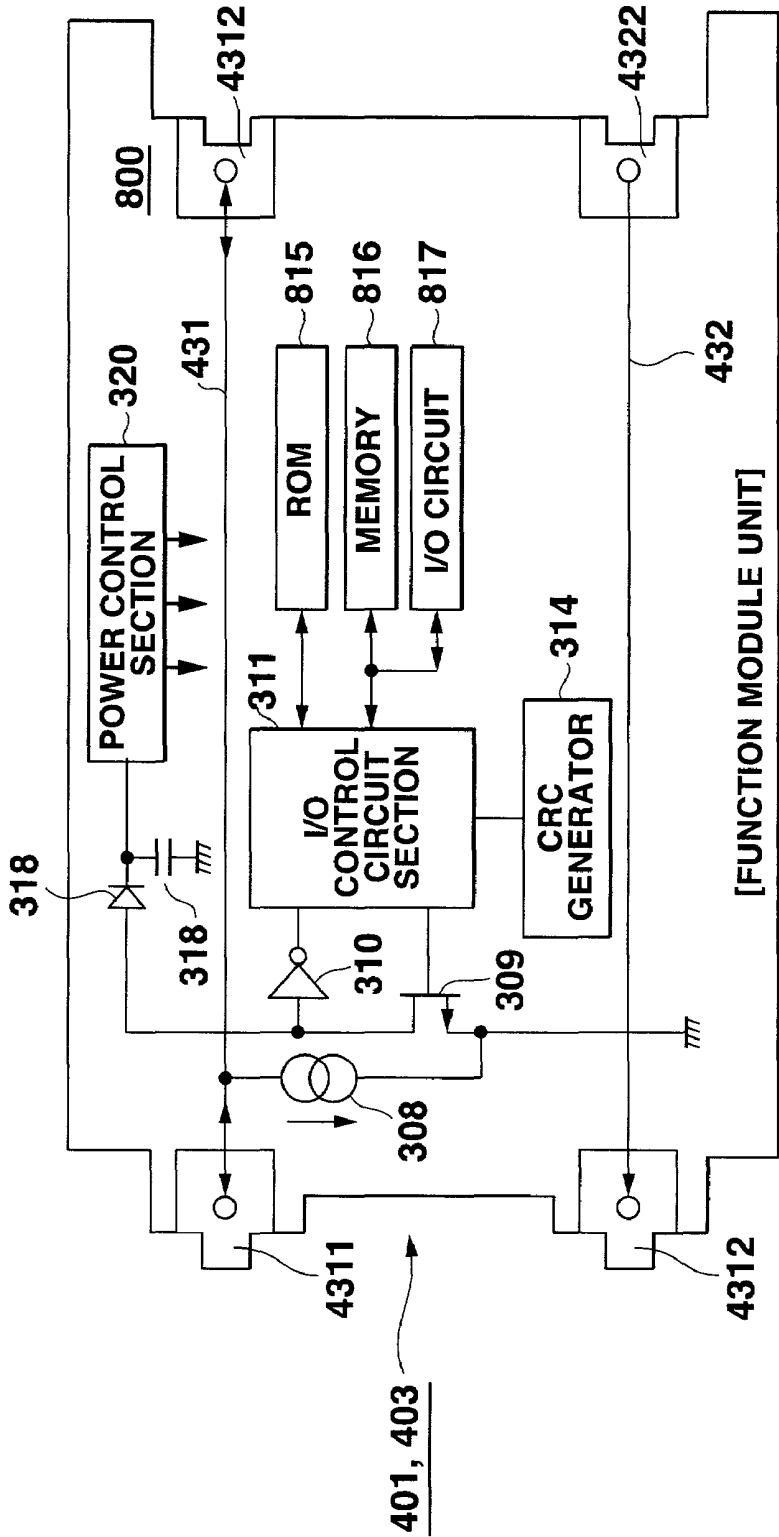


FIG.34A

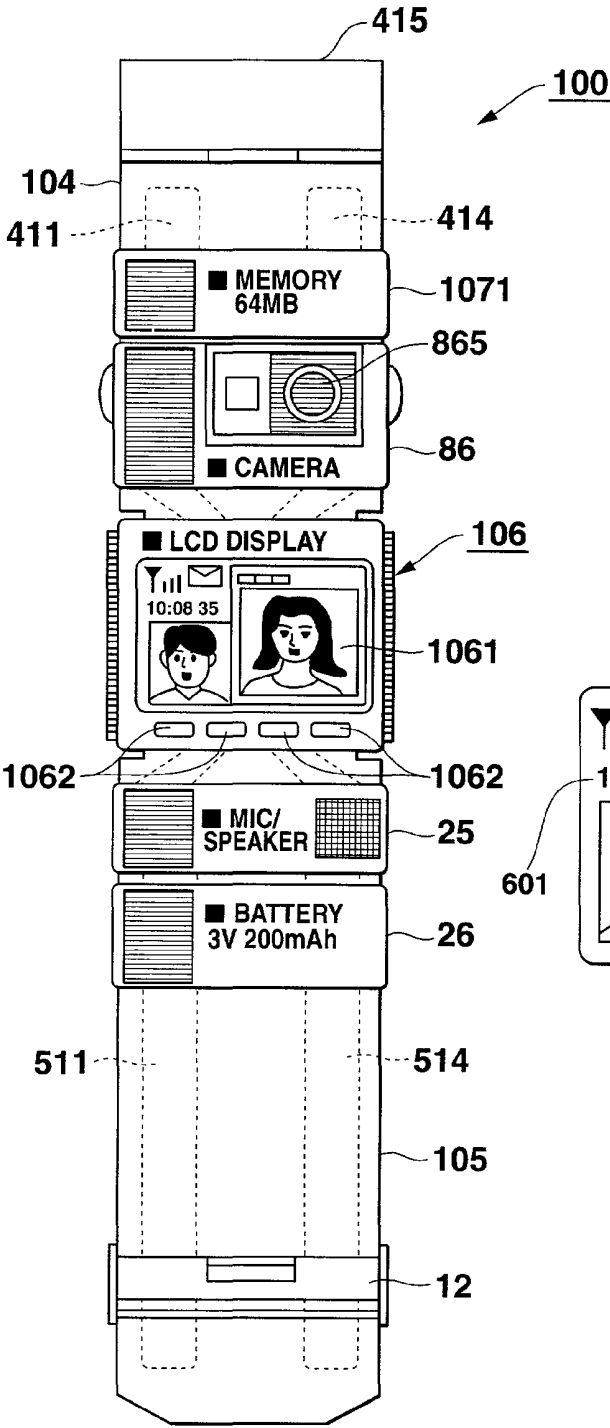


FIG.34B

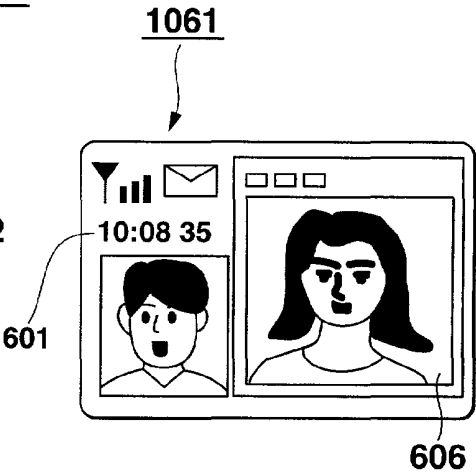
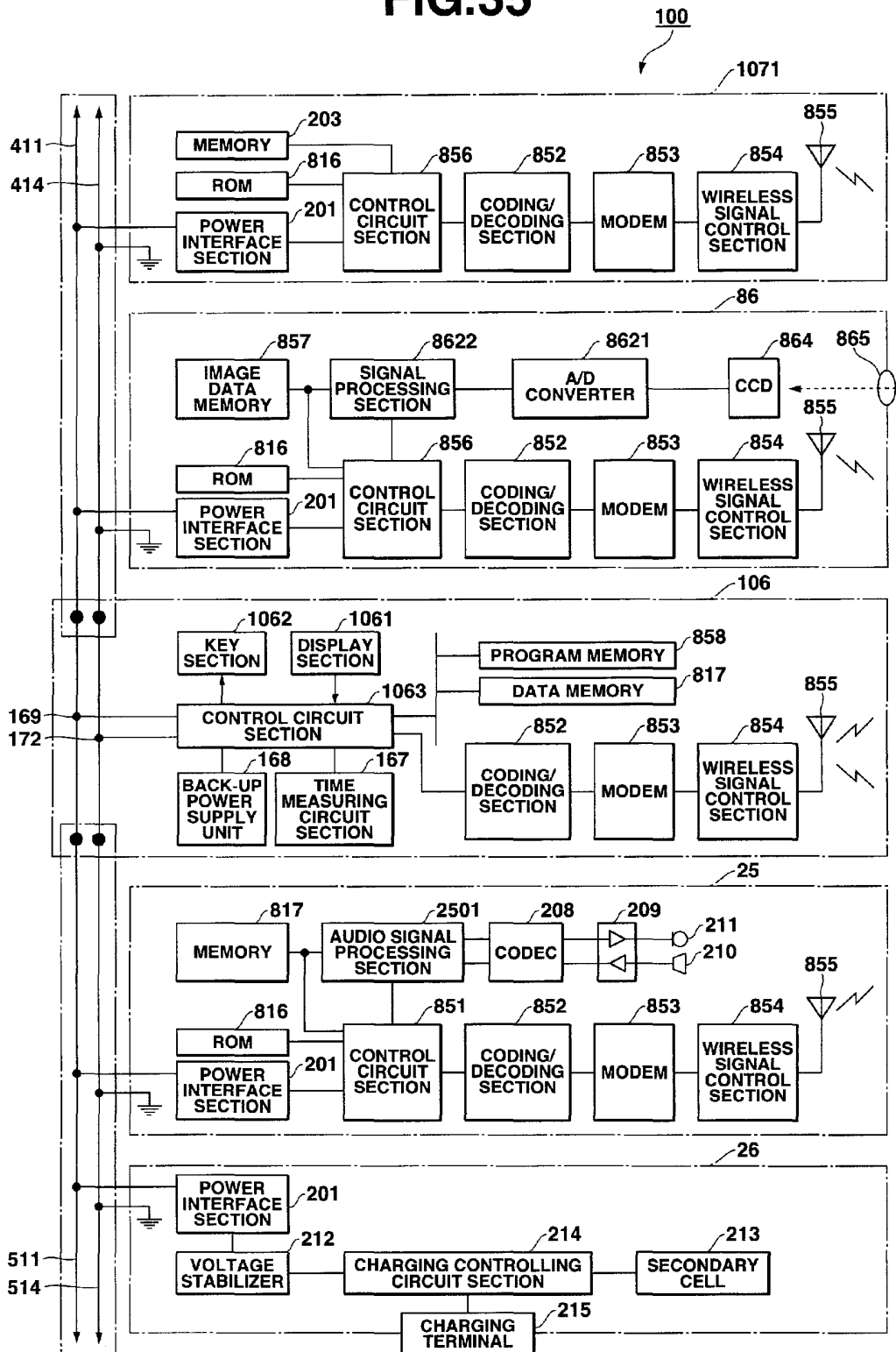


FIG.35



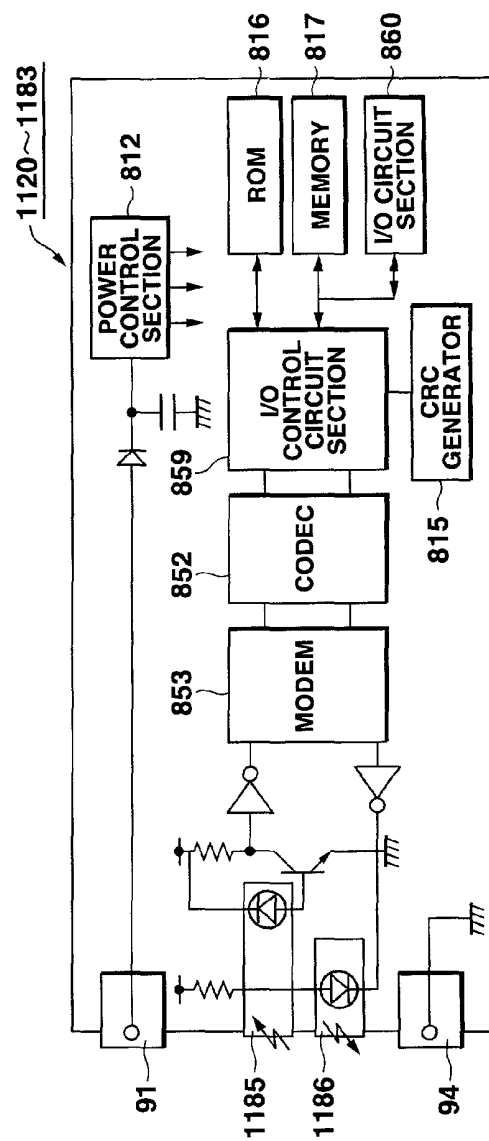
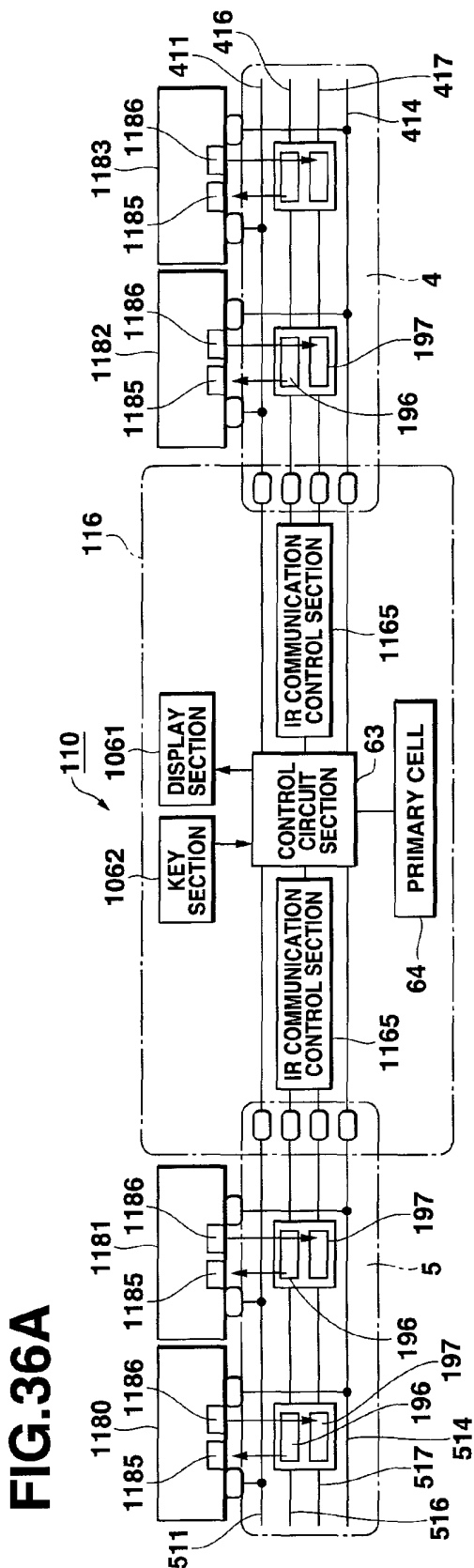


FIG. 36B

FIG.37A

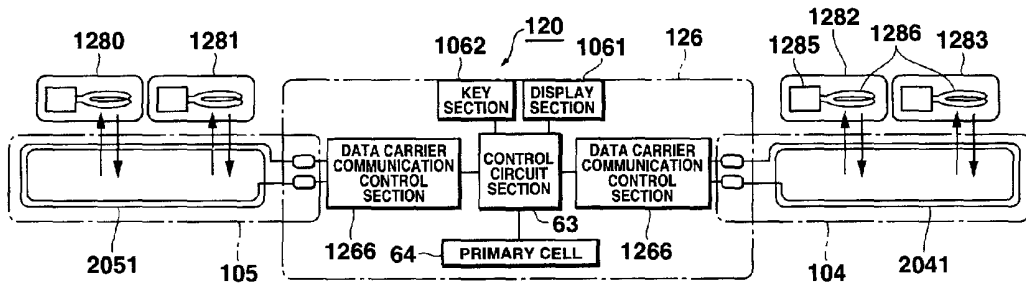


FIG.37B

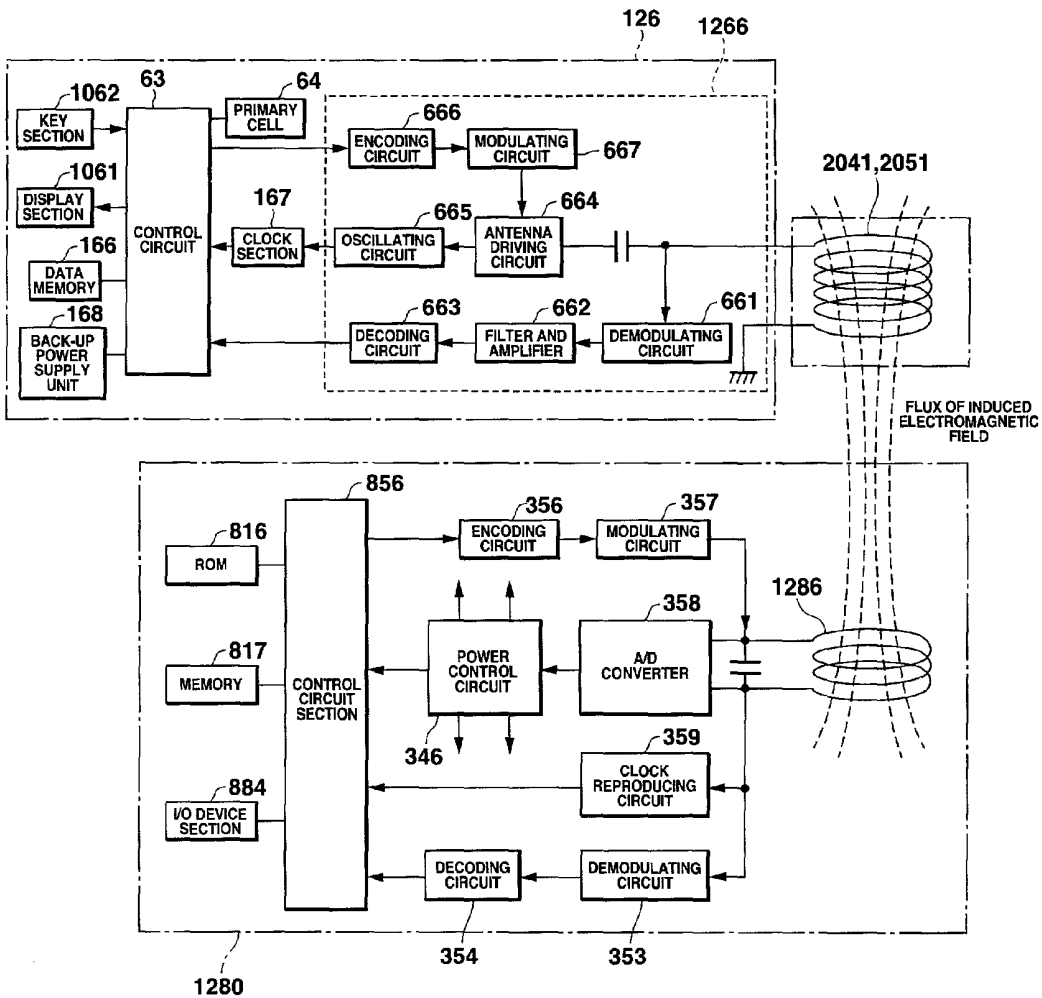
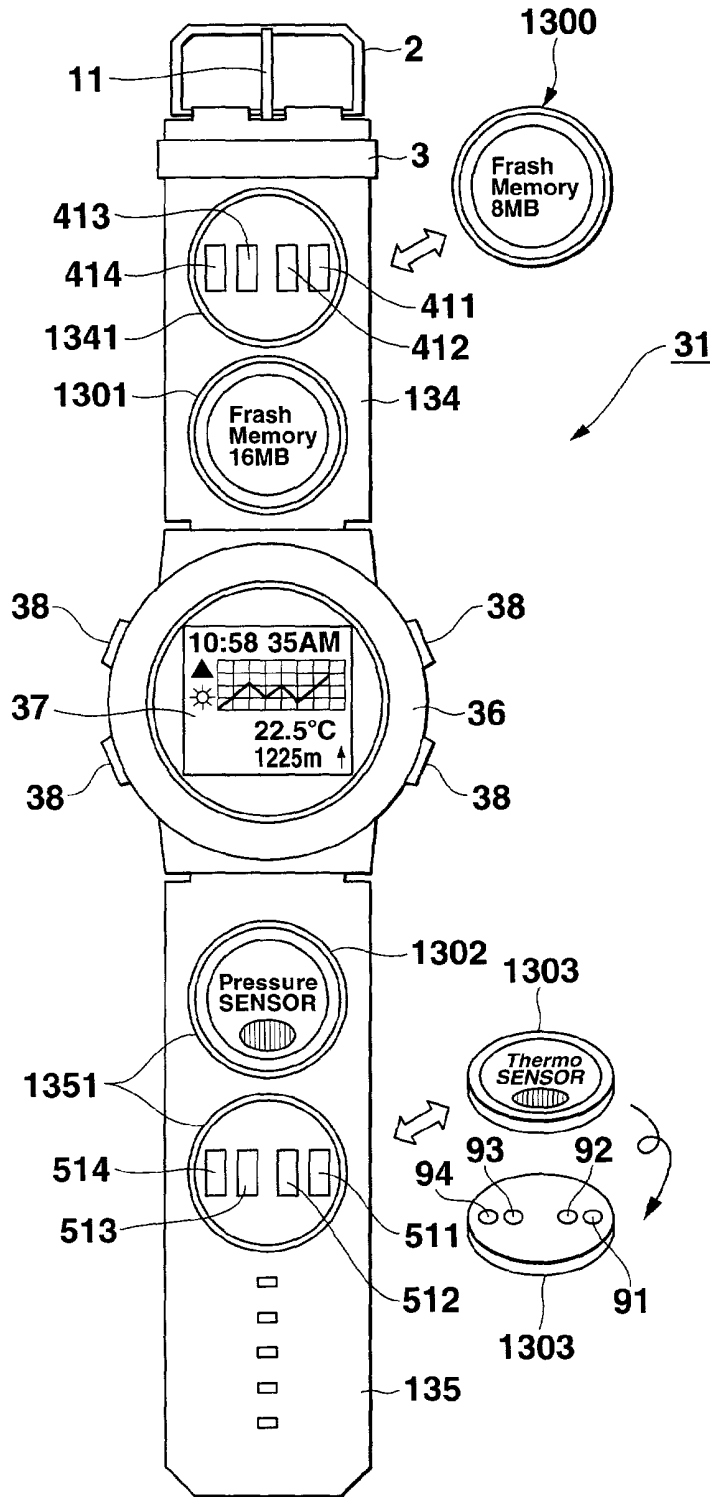


FIG.38



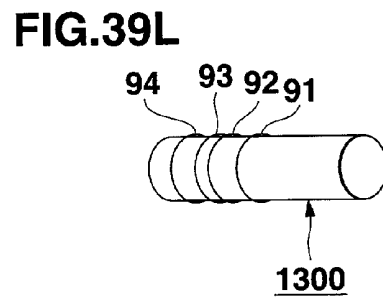
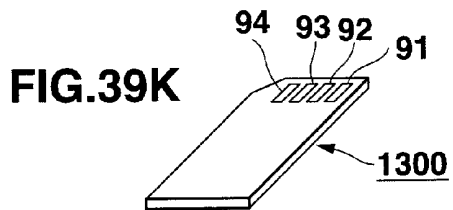
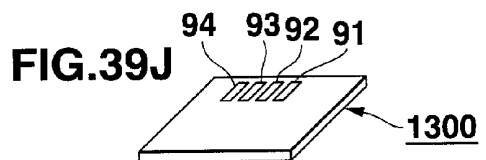
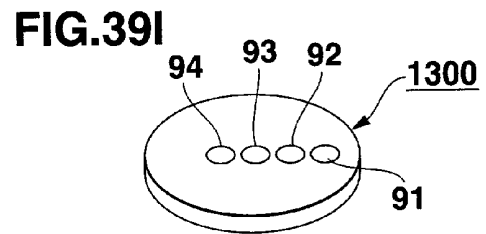
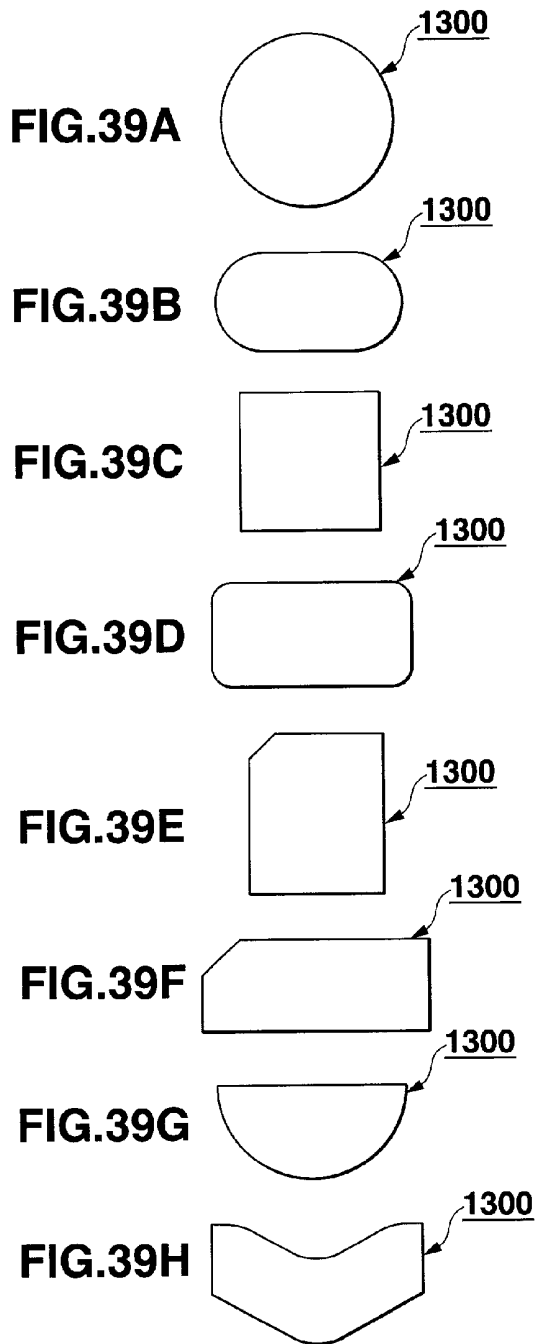
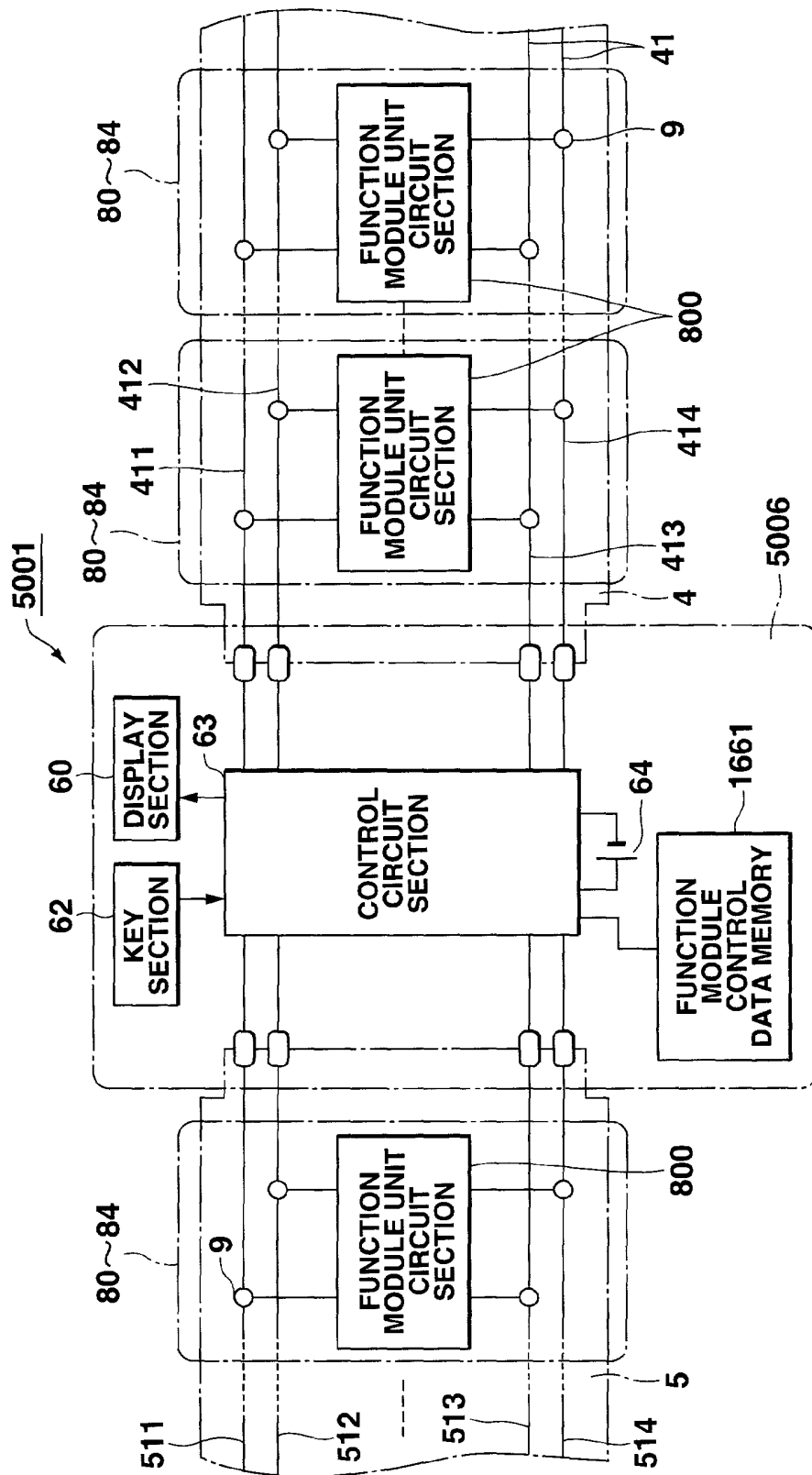


FIG.40



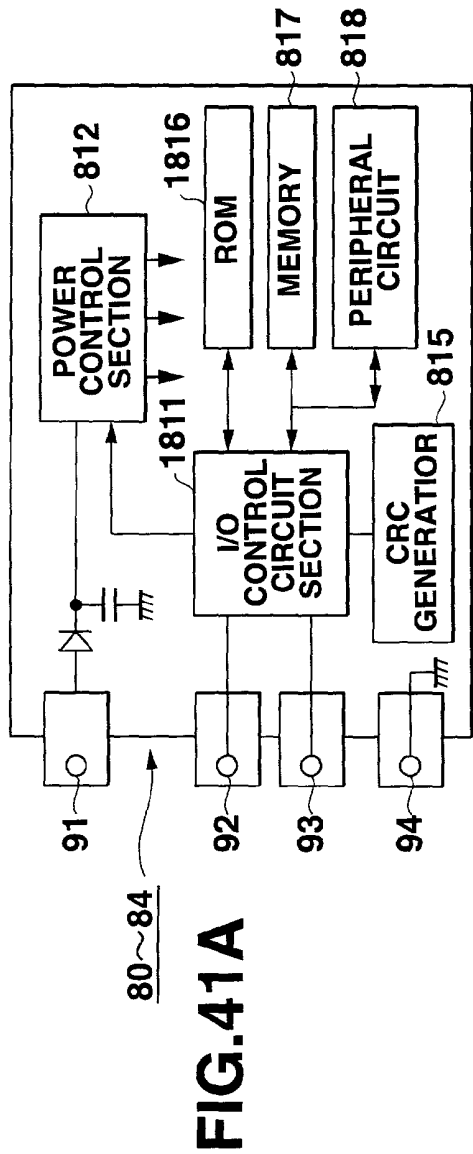


FIG.41B

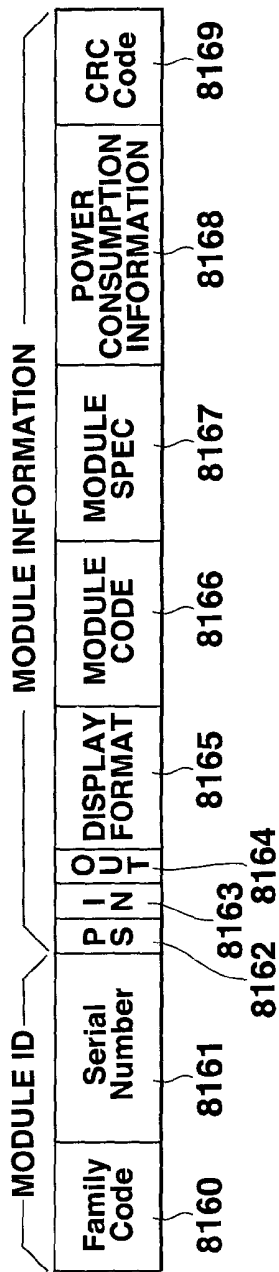


FIG. 42

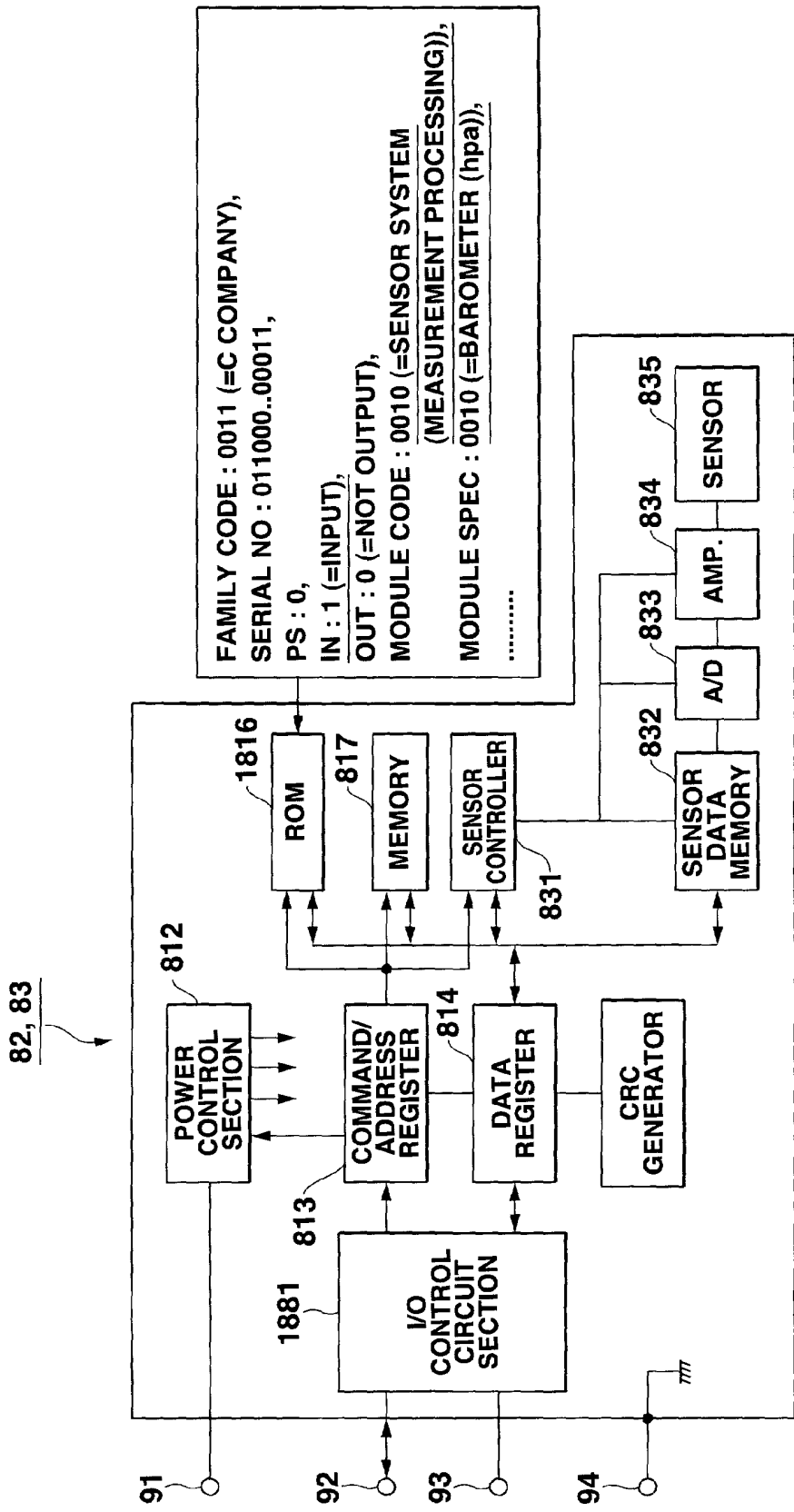


FIG.43

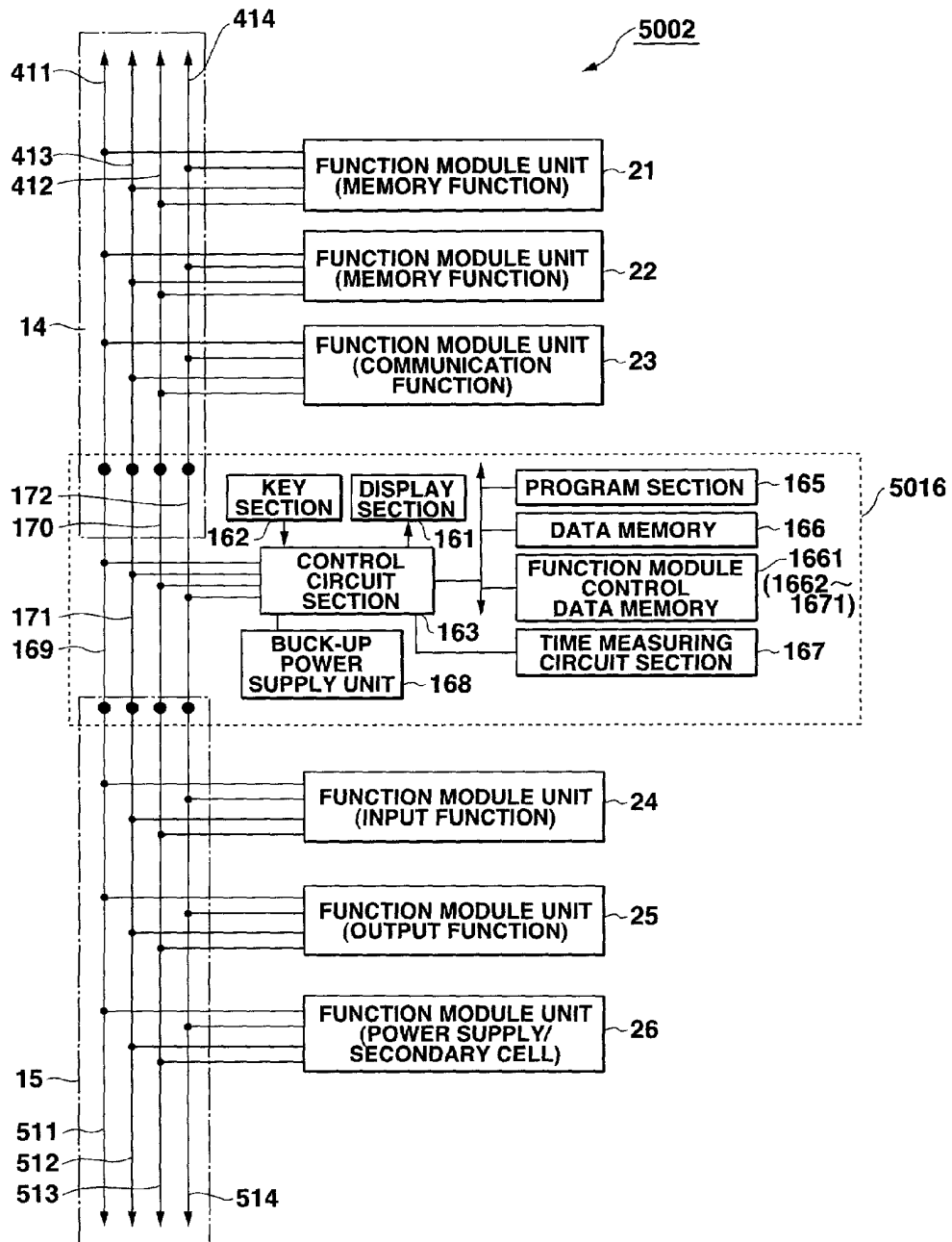


FIG. 44

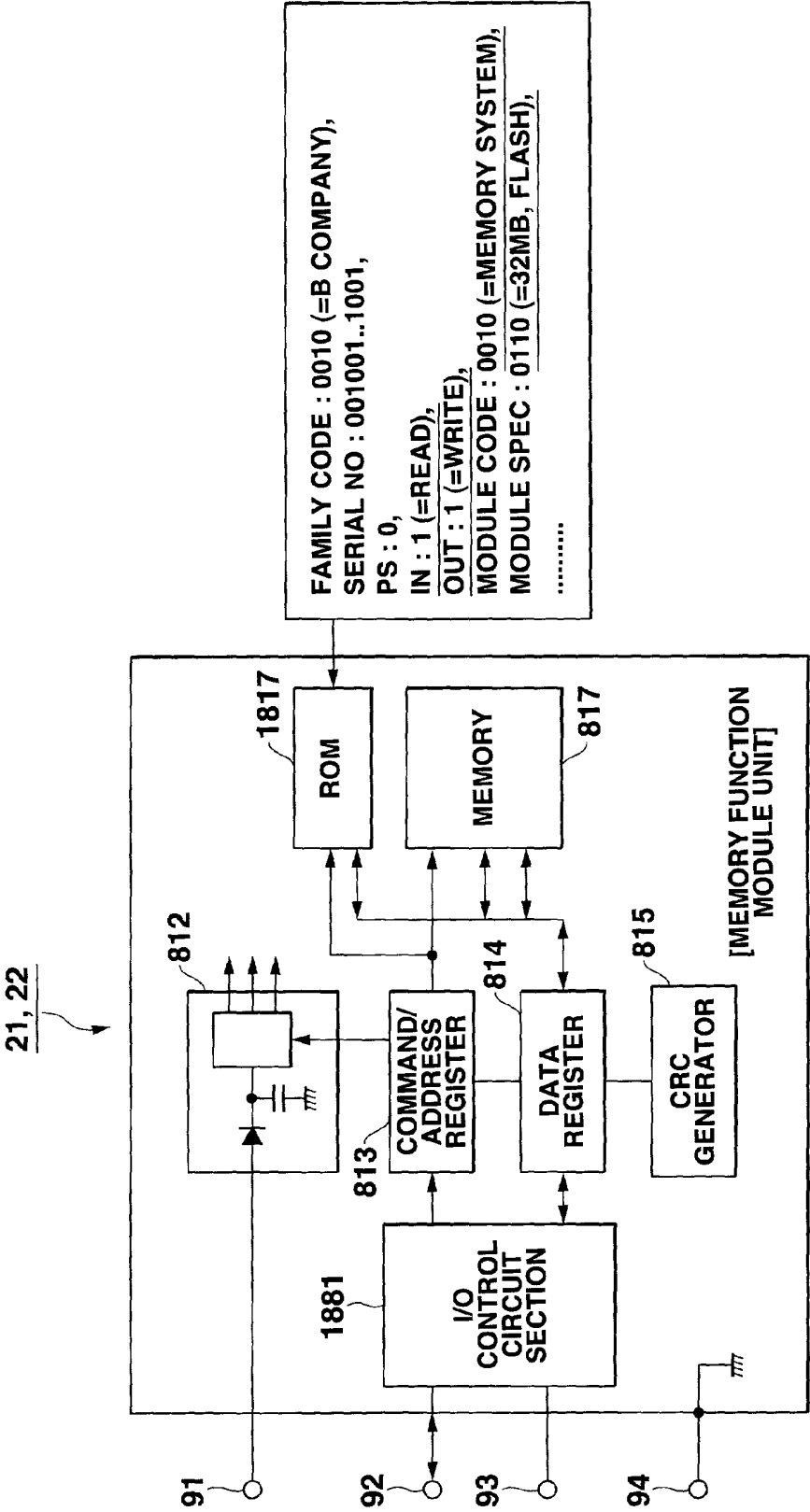


FIG.45

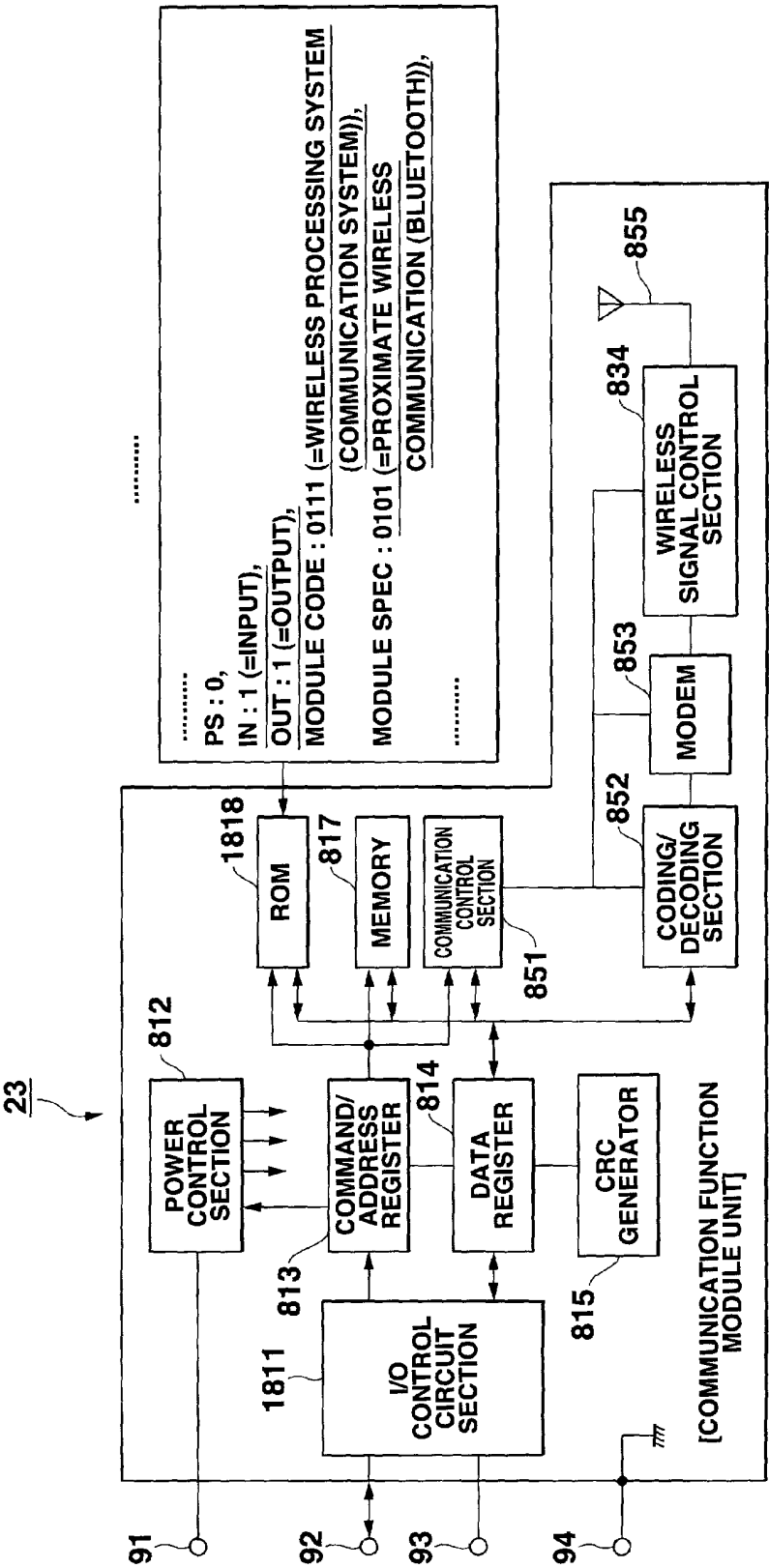


FIG.46

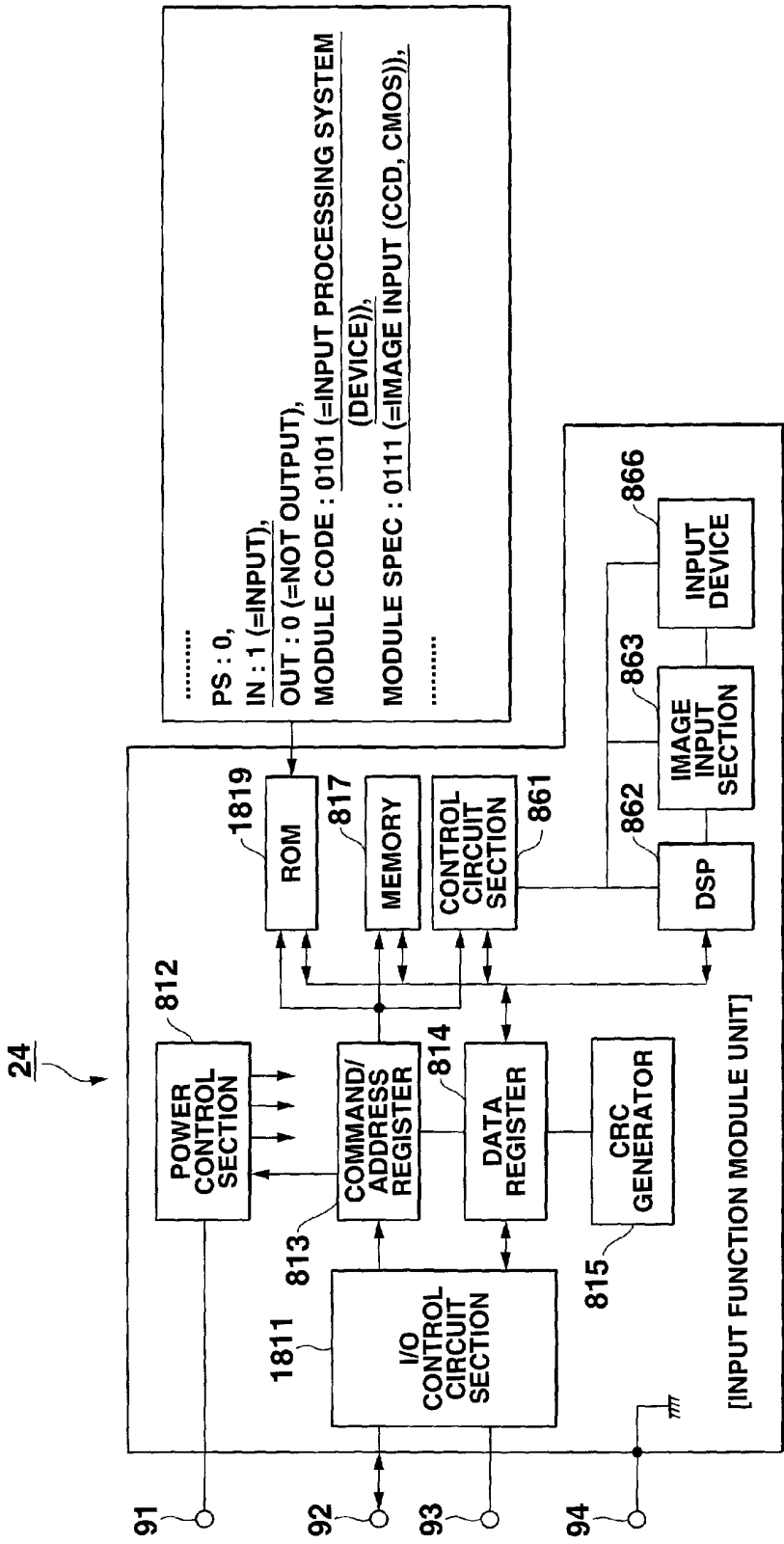


FIG. 47

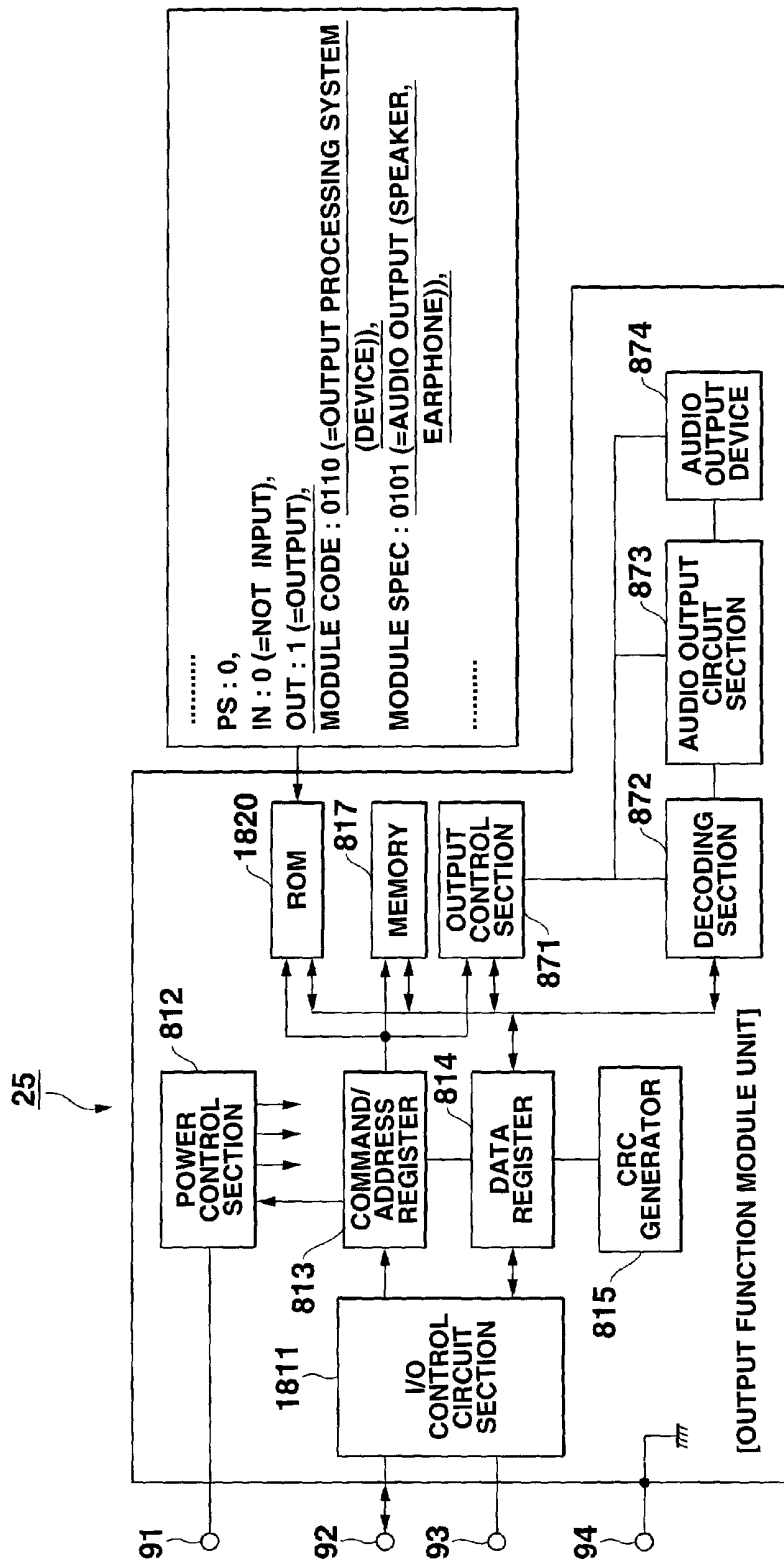


FIG. 48

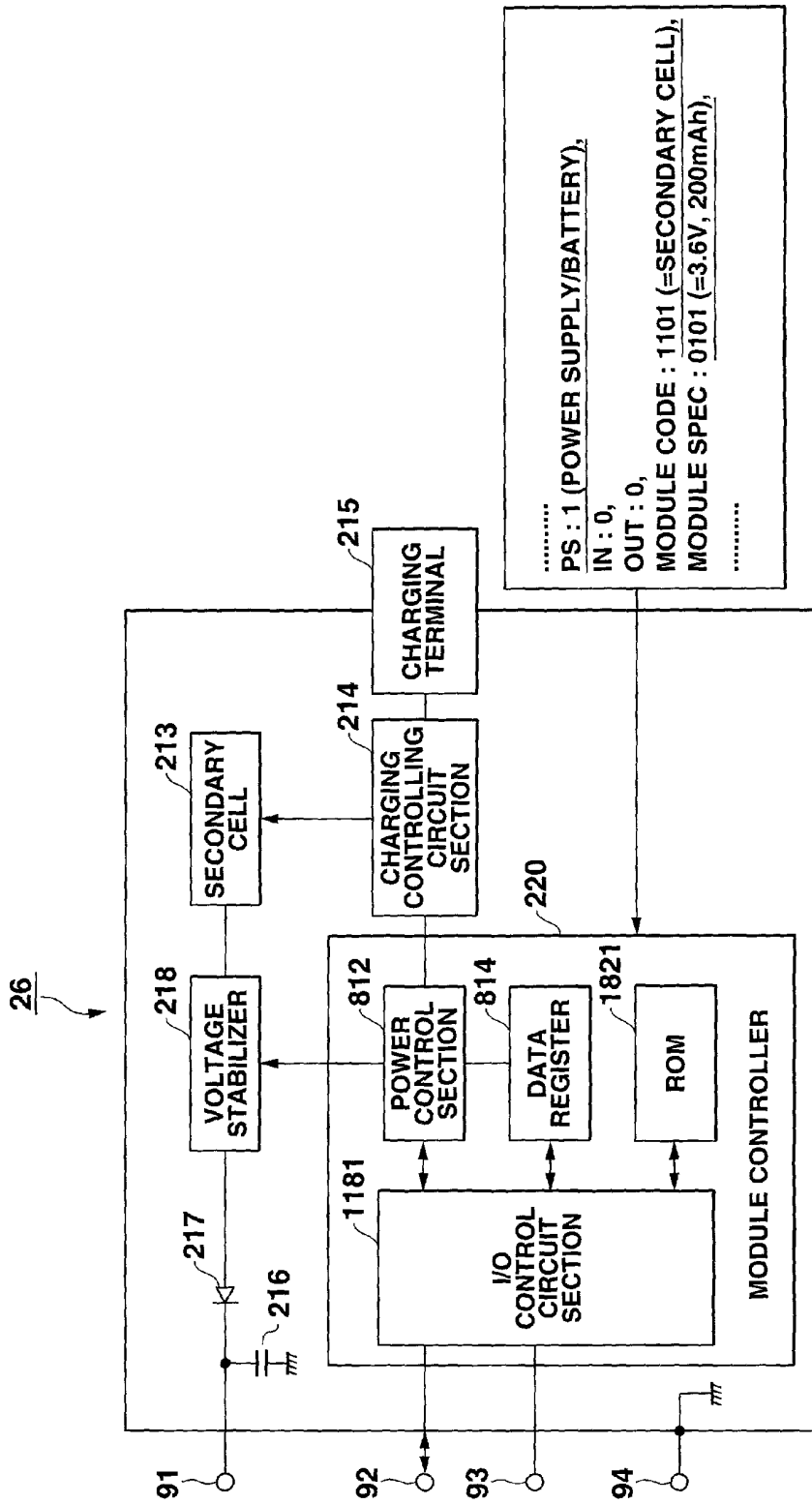


FIG.49

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MODULE ID CODE	MODULE SPECIFICATION CODE	FUNCTION
0000	0000	TIME MEASURING SYSTEM
0000	0001	SURF TIMER
0000	0010	YACHT TIMER
0000	0011	DUAL STOPWATCH
⋮	⋮	⋮
0000	1111	TIME MEASURING SYSTEM RESERVED

FIG.50

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↙

MODULE ID CODE	MODULE SPECIFICATION CODE	FUNCTION
0001	0000	CPU/PROCESSING PROGRAM SYSTEM
0001	0001	SUNRISE/SUNSET CALCULATION
0001	0010	MOON AGE CALCULATION
0001	0011	TIDE CALCULATION
0001	0100	BIORHYTHM
⋮	⋮	⋮
0001	1111	CPU/PROCESSING PROGRAM SYSTEM RESERVED

FIG.51

1664

MODULE ID CODE	MODULE SPECIFICATION CODE	FUNCTION
0010	0000	MEMORY SYSTEM
0010	0001	1MB/SRAM
0010	0010	2MB/SRAM
0010	0011	4MB/SRAM
0010	0100	8MB/SRAM
0010	0101	16MB/FLASH
0010	0110	32MB/FLASH
0010	0111	64MB/FLASH
0010	1111	MEMORY SYSTEM RESERVED

FIG.52

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MODULE ID CODE	MODULE SPECIFICATION CODE	FUNCTION
0011	0000	DATA BANK SYSTEM
0011	0001	ADDRESS BOOK
0011	0010	SCHEDULE BOOK
0011	0011	TO-DO
0011	0100	URL
⋮	⋮	⋮
0011	1111	DATA BANK SYSTEM RESERVED

FIG.53

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↙

MODULE ID CODE	MODULE SPECIFICATION CODE	FUNCTION
0100	0000	SENSOR SYSTEM (MEASUREMENT PROCESSING)
0100	0100	THERMOMETER (°C)
0100	0010	BAROMETER (hPa) —ALTITUDE, DEPTH—
0100	0011	DIRECTION SENSOR (°)
0100	0011	POSITIONING METER (° ' ")
0100	0101	ACCELEROMETER (G)
0100	0110	SPEED METER (km/h)
0100	0111	RADIATION THERMOMETER (°C)
0100	1000	PULSE RATE MEASUREMENT (PULSE/SECOND)
0100	1001	SPHYGMOMANOMETER (mmHg)
0100	1111	SENSOR SYSTEM RESERVED

FIG.54

1667

MODULE ID CODE	MODULE SPECIFICATION CODE	FUNCTION
0101	0000	INPUT PROCESSING SYSTEM (DEVICE)
0101	0001	INPUT VIA CONNECTOR (BINARY DATA)
0101	0010	KEY INPUT (KEYBORD)
0101	0011	2D INPUT (MOUSE, STYLUS PEN, ETC)
0101	0101	AUDIO INPUT (MICROPHONE)
0101	0110	IMAGE INPUT (SCANNER)
0101	0111	IMAGE INPUT (CCD, CMOS)
⋮	⋮	⋮
0101	1111	INPUT PROCESSING SYSTEM RESERVED

FIG.55

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MODULE ID CODE	MODULE SPECIFICATION CODE	FUNCTION
0110	0000	OUTPUT PROCESSING SYSTEM (DEVICE)
0110	0001	OUTPUT VIA CONNECTOR (BINARY DATA)
0110	0010	DISPLAY OUTPUT (MONOCHROME DISPLAY)
⋮	⋮	⋮
0110	0101	AUDIO OUTPUT (SPEAKER, EARPHONE)
0110	0110	PRINT OUTPUT (PRINTER)
0110	0111	VIDEO DISPLAY OUTPUT (COLOR HIGH RESOLUTION DISPLAY)
⋮	⋮	⋮
0110	1111	OUTPUT PROCESSING SYSTEM RESERVED

FIG.56

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MODULE ID CODE	MODULE SPECIFICATION CODE	FUNCTION
0111	0000	WIRELESS PROCESSING SYSTEM (COMMUNICATION SYSTEM)
0111	0001	GENERAL WIRELESS TRANSMISSION (POWER SAVING DIGITAL)
0111	0010	GENERAL WIRELESS RECEPTION (POWER SAVING DIGITAL)
0111	0011	DATA BROADCAST RECEPTION (TUNER)
⋮	⋮	⋮
0111	0101	PROXIMATE WIRELESS COMMUNICATION (BLUETOOTH)
0111	0110	WIRELESS LAN
0111	0111	INFRARED COMMUNICATION
0111	1000	TDMA/EDGE
0111	1001	TDMA/GSM
0111	1010	TDMA/NADC
0111	1011	CDMA/CDMA 2000
0111	1100	CDMA/W-CDMA
⋮	⋮	⋮
0111	1111	WIRELESS PROCESSING SYSTEM RESERVED

FIG.57

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MODULE ID CODE	MODULE SPECIFICATION CODE	FUNCTION
1000	0000	PRIMARY CELL
1000	0001	1.5V, 80mAh
1000	0010	3V, 150mAh
1000	0101	3.6V, 200mAh
1000	0110	4.2V, 250mAh
1000	1111	PRIMARY CELL RESERVED

FIG.58

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MODULE ID CODE	MODULE SPECIFICATION CODE	FUNCTION
1101	0000	SECONDARY CELL
1101	0001	1.5V, 80mAh
1101	0010	3V, 150mAh
1101	0101	3.6V, 200mAh
1101	0110	4.2V, 250mAh
1101	1111	SECONDARY CELL RESERVED

FIG.59

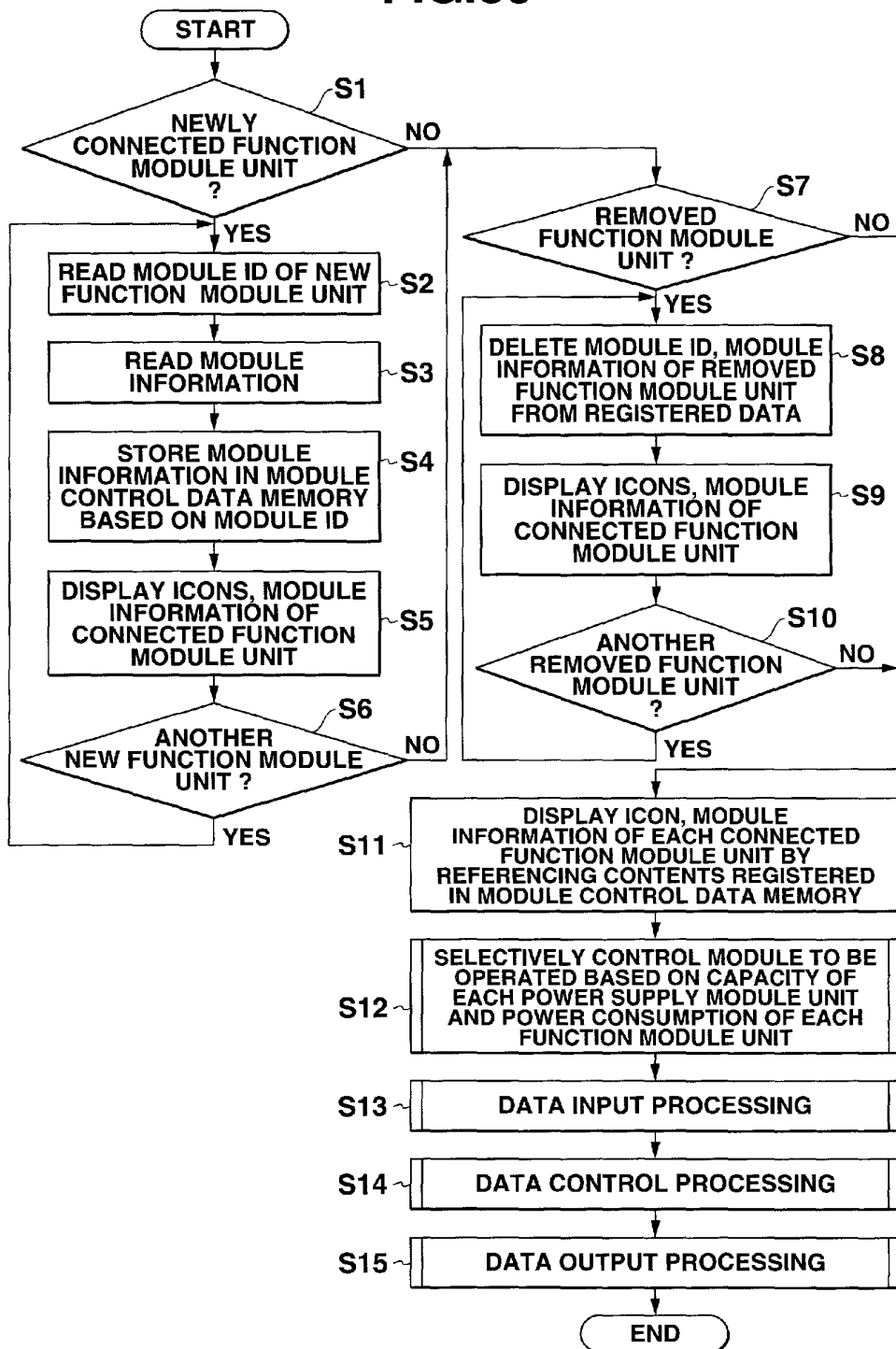


FIG.60

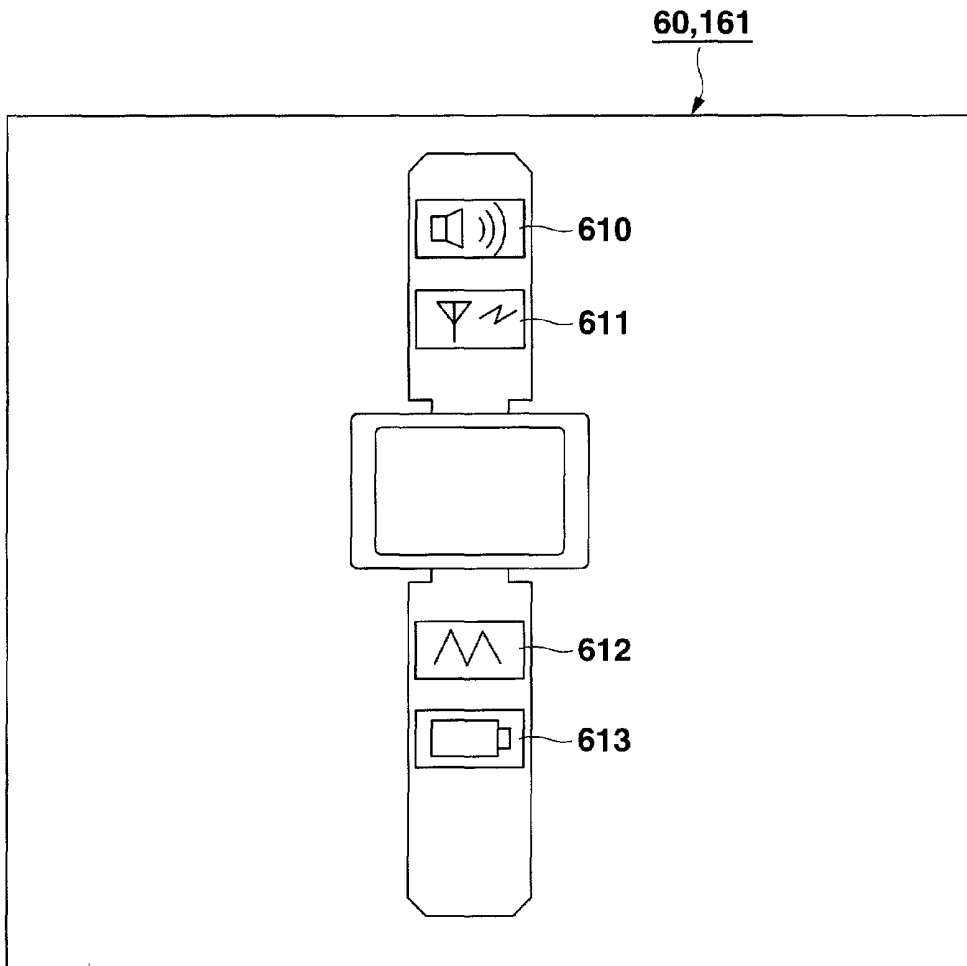


FIG.61

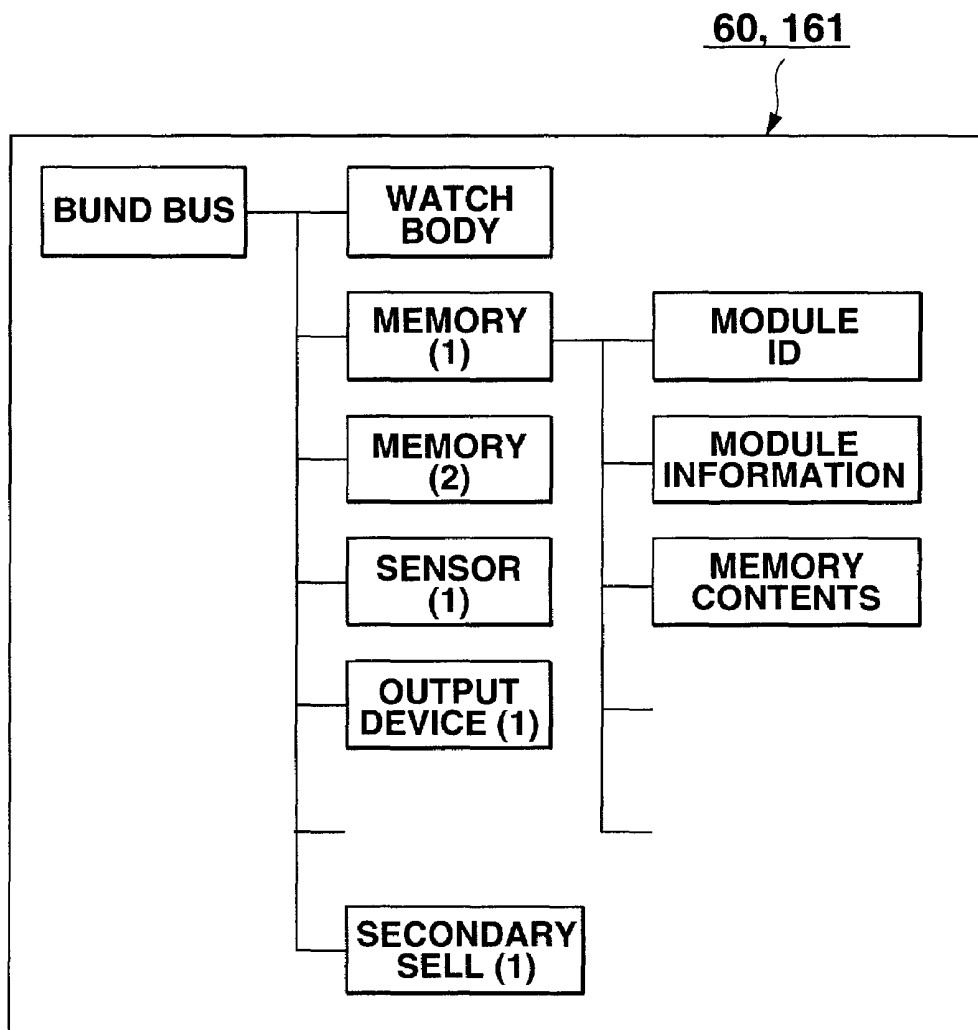


FIG.62

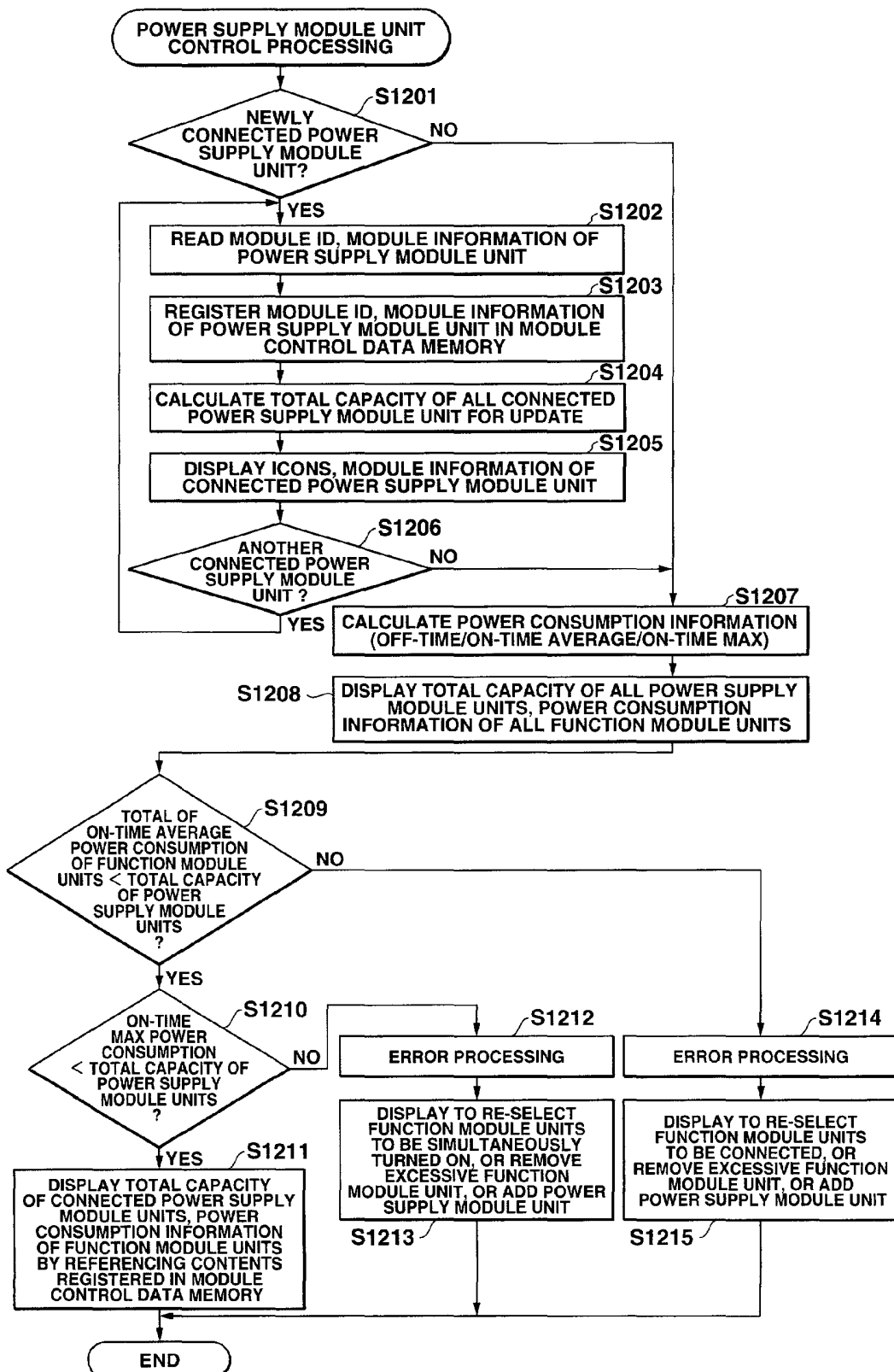


FIG.63

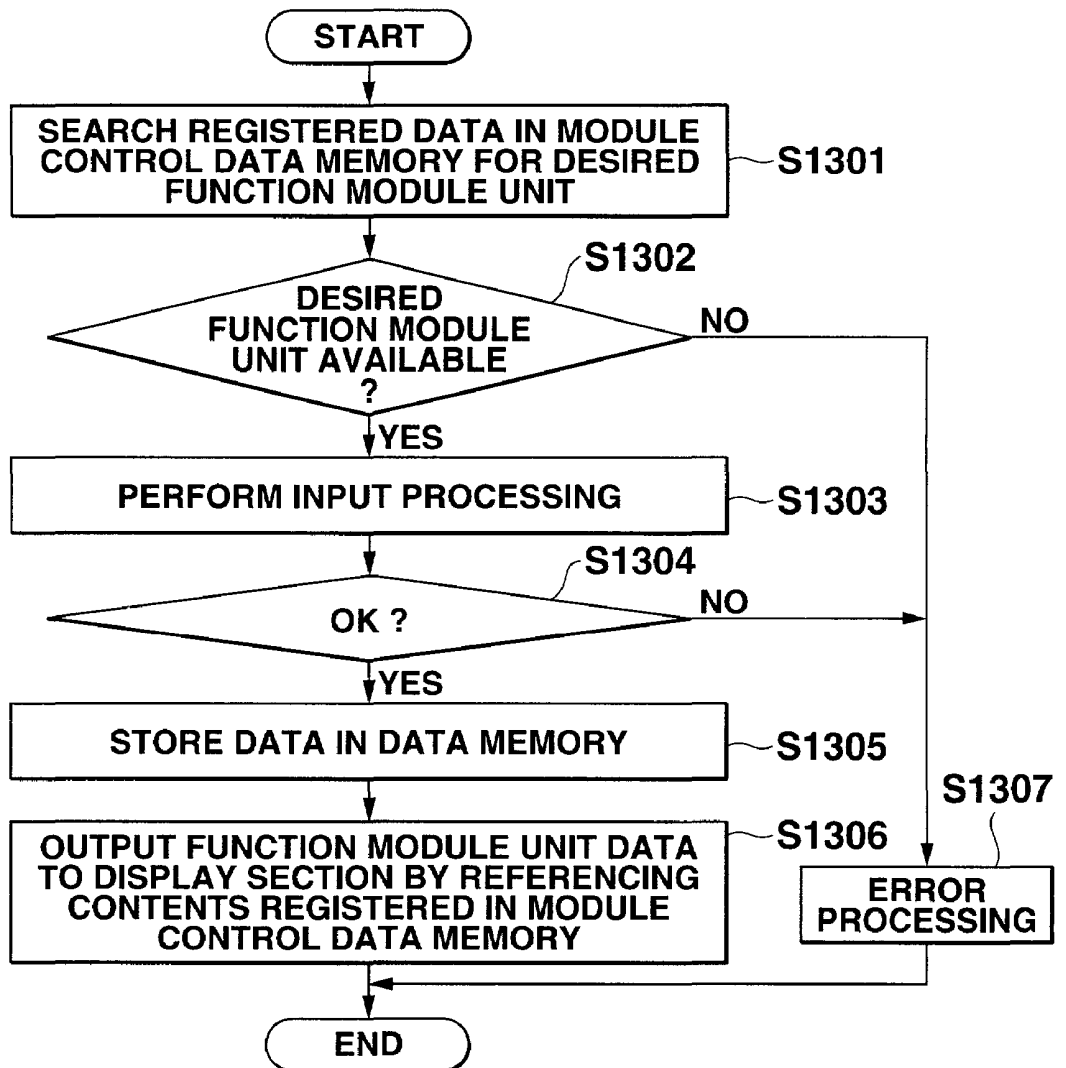


FIG.64

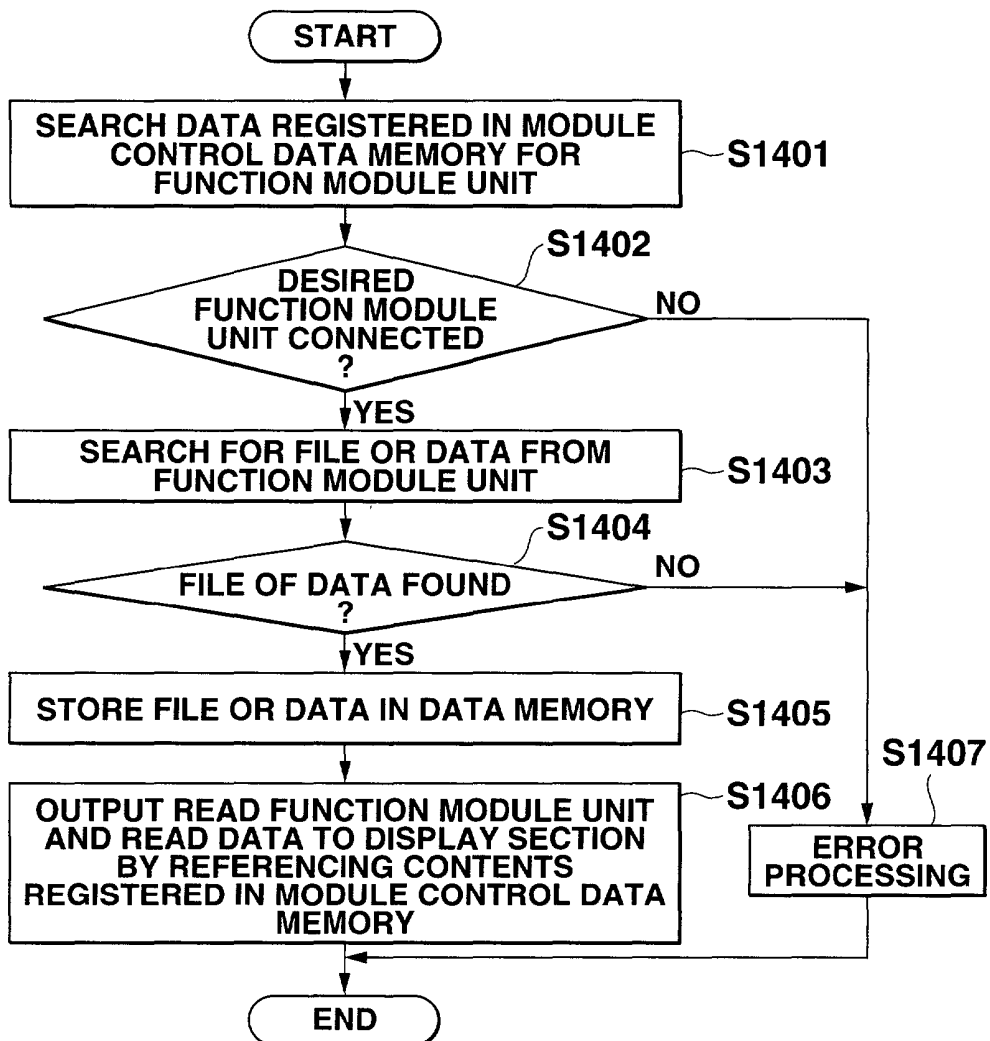


FIG.65

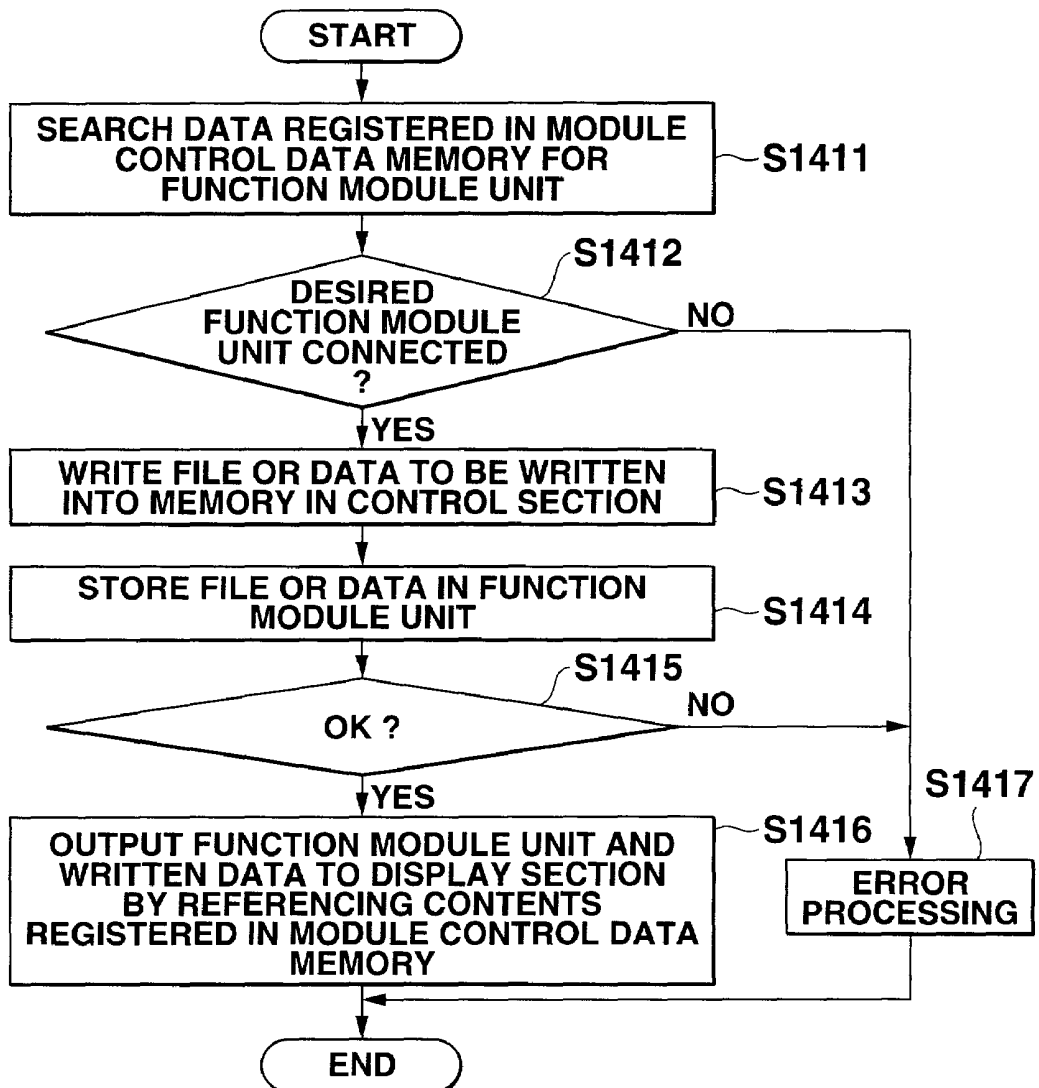


FIG.66

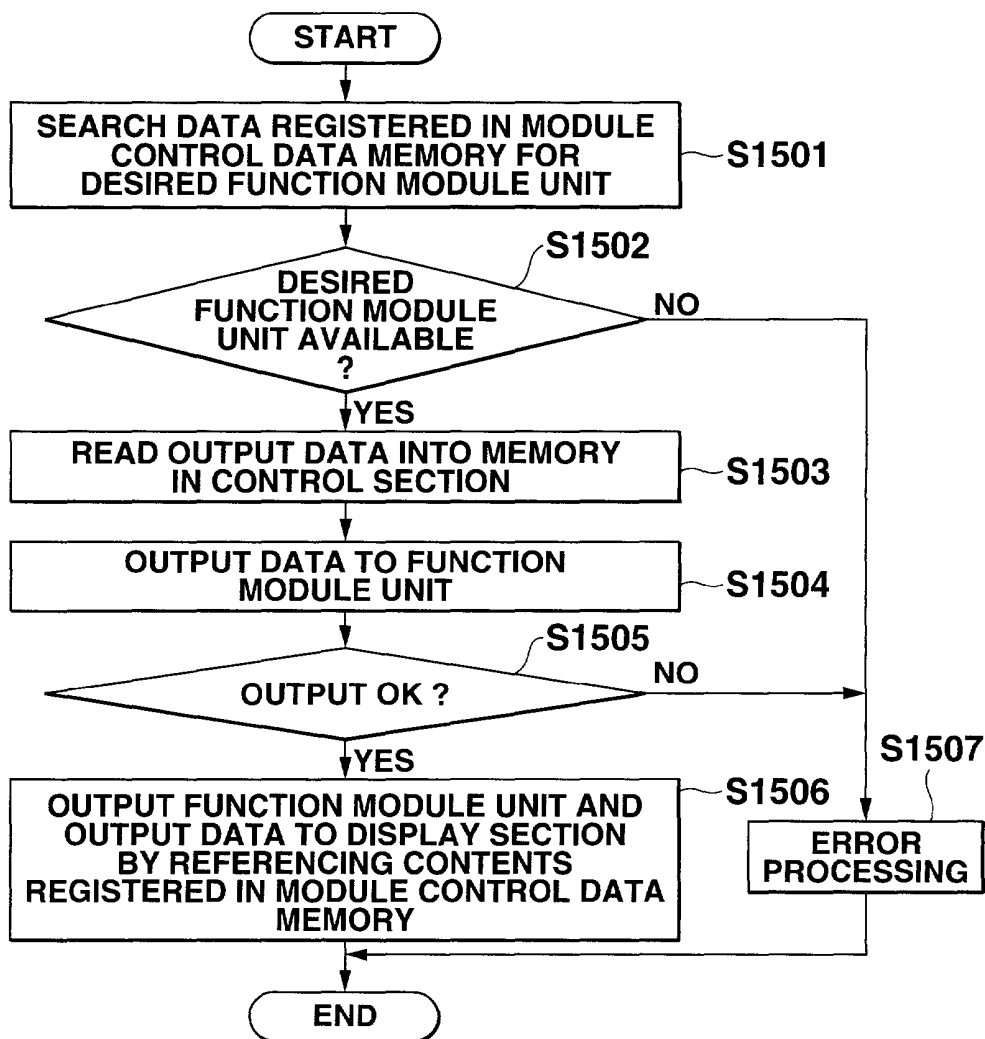
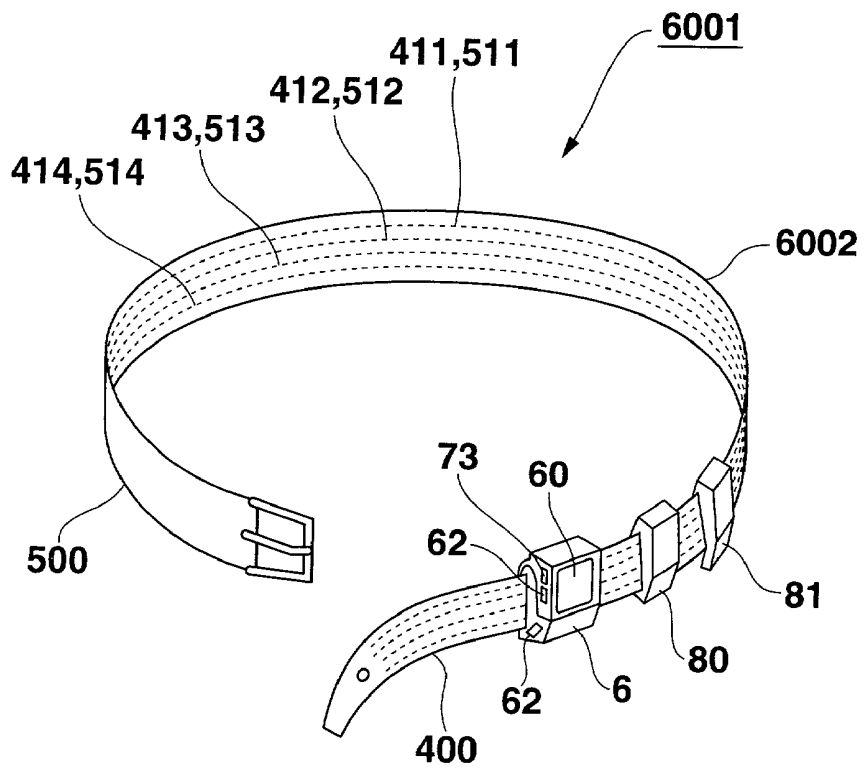


FIG.67



BODY WEARABLE INFORMATION PROCESSING TERMINAL DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon and claims the benefit of priority from the prior Japanese Patent Applications No. 2000-144500, filed May 17, 2000; and No. 2001-106722, filed Apr. 5, 2001, the entire contents of both of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to an information processing terminal device, and more particularly, to an information processing terminal device which is wearable on the body of and operable by a user.

[0004] 2. Description of the Related Art

[0005] Conventionally, wristwatch type information processing terminal devices mountable on the user are available. Such information processing terminal devices contain, in addition to essential components as a watch, circuits for implementing a variety of circuits such as a variety of sensors for measuring a surrounding environment; a memory function for storing input data from the outside; a processor for performing special processing; and so on to previously provide a variety of additional functions, other than a time display function.

[0006] Other than the foregoing configuration, there also exists a case for adding functions by attaching units such as a magnetic compass on a wrist band of a wristwatch.

[0007] When a variety of functional circuits and so on are incorporated in a body case in the manner mentioned above, a built-in control circuit can control circuits which implement a variety of functions and display the results associated with the functions in parallel with the control of a watch circuit.

[0008] However, incorporation of the circuits for implementing a variety of functions in the body case would result in an increased size of the body case, thereby causing an inconvenience when it is worn on a wrist.

[0009] When an additional unit is attached to a wrist band, a control circuit unit contained in the body case cannot control this additional unit. Therefore, each of such additional circuits cannot be controlled using a display section which is originally provided on the body case, so that a display section must be provided on each additional unit.

BRIEF SUMMARY OF THE INVENTION

[0010] Accordingly, the present invention is directed to an apparatus that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

[0011] In accordance with the purpose of the invention, as embodied and broadly described, the invention is directed to a body wearable information processing terminal device which is capable of readily adding a variety of functions in a controllable manner without the need for a body case of a larger size.

[0012] To solve the problem, a body wearable information processing terminal device comprises a case body containing an electronic circuit having a predetermined function, a display section for displaying at least time information, and a band section joined to the case body, removably secured on a human body of a user to make the information processing terminal device wearable, wherein an electronic device is removably mounted on the band section, and the band section has a plurality of connection structures for electrically connecting the electronic device to the electric circuit.

[0013] Additional objects and advantages of the present invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the present invention.

[0014] The objects and advantages of the present invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0015] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate presently preferred embodiments of the present 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 present invention in which:

[0016] FIG. 1A is a diagram illustrating an external appearance of a wristwatch according to a first embodiment of the present invention;

[0017] FIG. 1B is an enlarged view of a display section;

[0018] FIG. 2 is a perspective view illustrating how a buckle member and a center fastening pin are attached in the wristwatch according to the first embodiment;

[0019] FIG. 3 is a cross-sectional view of the wristwatch according to the first embodiment of the present invention;

[0020] FIG. 4 is an exploded perspective view of a main portion of the wristwatch according to the first embodiment of the present invention;

[0021] FIG. 5A is a plan view of a wrist band 4;

[0022] FIG. 5B is a plan view of a wrist band 5;

[0023] FIG. 6A is a perspective view, seen from the back side, of a function module unit (perspective view of internal line wires in the function module unit);

[0024] FIG. 6B is a perspective view of the function module unit, seen from the back side;

[0025] FIG. 7 is a diagram illustrating the circuit configuration of the first embodiment;

[0026] FIG. 8 is a diagram illustrating a connection structure of the first embodiment;

[0027] FIG. 9A is a block diagram illustrating the circuit configuration of a function module unit which has a memory function;

- [0028] FIG. 9B is a block diagram illustrating the circuit configuration of a function module unit which has a sensor function;
- [0029] FIG. 10A is a transmission/reception timing chart of transmission/reception signals in the first embodiment;
- [0030] FIG. 10B shows the structure of serial data carried by transmission/reception signals;
- [0031] FIG. 11A shows the structure of serial data;
- [0032] FIGS. 11B and 11C show the structures of serial data decoded in function module units 80 through 84;
- [0033] FIGS. 11D, 11E, 11F, and 11G show exemplary structures of other serial data;
- [0034] FIG. 12A is a diagram illustrating an external appearance of a wristwatch according to a first modification of the first embodiment;
- [0035] FIG. 12B is an enlarged view of a display section of the wristwatch illustrated in FIG. 12A;
- [0036] FIG. 13A is a block diagram illustrating the circuit configuration of a function module unit which has a communication function;
- [0037] FIG. 13B is a block diagram illustrating the circuit configuration of a function module unit which has an input function;
- [0038] FIG. 14A is a block diagram illustrating the circuit configuration of a function module unit which has an output function;
- [0039] FIG. 14B is a block diagram illustrating the circuit configuration of a function module unit which has an input/output function;
- [0040] FIG. 15A is a sectional plan view of a wristwatch according to a second modification of the first embodiment;
- [0041] FIG. 15B is a sectional side view of the wristwatch illustrated in FIG. 15A;
- [0042] FIG. 16 is a schematic cross-sectional view of a wrist band in a third modification of the first embodiment;
- [0043] FIG. 17 is a schematic cross-sectional view of a wrist band in a fourth modification of the first embodiment;
- [0044] FIG. 18A is a diagram illustrating an external appearance of a wristwatch according to a second embodiment of the present invention;
- [0045] FIG. 18B is an enlarged view of a display section of the wristwatch illustrated in FIG. 18A;
- [0046] FIG. 19 is a block diagram illustrating the circuit diagram of a wristwatch according to the second embodiment;
- [0047] FIG. 20A is a diagram illustrating a connection structure for the circuit configuration in a first modification of the second embodiment;
- [0048] FIG. 20B is a block diagram illustrating the circuit configuration of a function module unit;
- [0049] FIG. 21 is a diagram illustrating a connection structure for the circuit configuration in a second modification of the second embodiment;
- [0050] FIG. 22A is a cross-sectional view of a wrist band in a third modification of the second embodiment;
- [0051] FIG. 22B is a diagram illustrating a connection structure for a serial bus connection of a control circuit section of a body case with respective function module units;
- [0052] FIG. 23 is a cross-sectional view of a wrist band in a fourth modification of the second embodiment;
- [0053] FIG. 24 is a cross-sectional view of a wrist band in another modification of the second embodiment;
- [0054] FIG. 25A is a diagram illustrating an external appearance of a wristwatch according to a third embodiment;
- [0055] FIG. 25B is an enlarged view of a display section of the wristwatch illustrated in FIG. 25A;
- [0056] FIG. 26 is a block diagram illustrating the circuit configuration of a wristwatch according to the third embodiment;
- [0057] FIG. 27A is a diagram illustrating a connection structure for the circuit configuration in the third embodiment;
- [0058] FIG. 27B is a block diagram illustrating the circuit configuration of a function module unit;
- [0059] FIG. 28 is a block diagram illustrating the circuit configuration of a wristwatch according to a first modification of the third embodiment;
- [0060] FIG. 29A is a sectional plan view of a wristwatch according to a second modification of the third embodiment;
- [0061] FIG. 29B is a sectional side view of the wristwatch illustrated in FIG. 29A;
- [0062] FIG. 30A is a sectional plan view of a wristwatch according to a third modification of the third embodiment;
- [0063] FIG. 30B is a sectional side view of the wristwatch illustrated in FIG. 30A;
- [0064] FIGS. 31A, 31B, 31C, 31D, and 31E are cross-sectional views of wrist bands according to a fourth modification of the third embodiment;
- [0065] FIG. 32 is a block diagram illustrating the circuit configuration of a wristwatch according to a fifth modification of the third embodiment;
- [0066] FIG. 33 is a block diagram illustrating the circuit configuration of a function module unit according to a fifth modification of the third embodiment;
- [0067] FIG. 34A is a diagram illustrating an external appearance of a wristwatch according to a fourth embodiment of the present invention;
- [0068] FIG. 34B is an enlarged view of a display section of the wristwatch illustrated in FIG. 34A;
- [0069] FIG. 35 is a block diagram illustrating the circuit configuration of a wristwatch according to a fourth embodiment;
- [0070] FIG. 36A is a diagram illustrating a connection structure for the circuit configuration in a fifth embodiment;

[0071] FIG. 36B is a block diagram illustrating the circuit configuration of a function module unit;

[0072] FIG. 37A is a diagram illustrating a connection structure in a sixth embodiment of the present invention;

[0073] FIG. 37B is a block diagram illustrating the circuit configuration of a function module unit;

[0074] FIG. 38 is a diagram generally illustrating a wristwatch according to a seventh embodiment of the present invention with a function module unit additionally illustrated in a perspective view;

[0075] FIGS. 39A, 39B, 39C, 39D, 39E, 39F, 39G, and 39H are plan views of function module units, respectively, in modifications of the seventh embodiment of the present invention;

[0076] FIGS. 39I, 39J, 39K, and 39L are perspective views of function module units, respectively, in modifications of the seventh embodiment of the present invention;

[0077] FIG. 40 is a block diagram illustrating the circuit configuration of a wristwatch according to an eighth embodiment of the present invention;

[0078] FIG. 41A is a block diagram illustrating the circuit configuration of a function module unit according to the eighth embodiment;

[0079] FIG. 41B is a diagram showing data stored in ROM;

[0080] FIG. 42 is a block diagram illustrating the circuit configuration of a sensor function module unit in the eighth embodiment;

[0081] FIG. 43 is a block diagram illustrating the circuit configuration of a wristwatch according to a modification of the eighth embodiment of the present invention;

[0082] FIG. 44 is a block diagram illustrating the circuit configuration of memory function module units 21 and 22 in the modification of the eighth embodiment;

[0083] FIG. 45 is a block diagram illustrating the circuit configuration of a wireless processing module unit 23 in the modification of the eighth embodiment;

[0084] FIG. 46 is a block diagram illustrating the circuit configuration of an input processing (device) function module unit 24 in the modification of the eighth embodiment;

[0085] FIG. 47 is a block diagram illustrating the circuit configuration of an output processing (device) function module unit 25 in the modification of the eighth embodiment;

[0086] FIG. 48 is a block diagram illustrating the circuit configuration of a power supply module unit 26 in the modification of the eighth embodiment;

[0087] FIG. 49 is a diagram showing contents stored in a time measuring function module table;

[0088] FIG. 50 is a diagram showing contents stored in a CPU/processing program function module table;

[0089] FIG. 51 is a diagram showing contents stored in a memory function module table;

[0090] FIG. 52 is a diagram showing contents stored in a data bank function module table;

[0091] FIG. 53 is a diagram showing contents stored in a sensor function module table;

[0092] FIG. 54 is a diagram showing contents stored in an input processing (device) function module table;

[0093] FIG. 55 is a diagram showing contents stored in an output processing (device) function module table;

[0094] FIG. 56 is a diagram showing contents stored in a wireless processing (communication scheme) function module table;

[0095] FIG. 57 is a diagram showing contents stored in a primary cell function module table;

[0096] FIG. 58 is a diagram showing contents stored in a secondary cell function module table;

[0097] FIG. 59 is a flow chart illustrating a processing routine of the control circuit section;

[0098] FIG. 60 is a diagram showing a display screen of a wristwatch;

[0099] FIG. 61 is a diagram showing a display screen of a wristwatch;

[0100] FIG. 62 is a flow chart illustrating step S12 in FIG. 59 in detail;

[0101] FIG. 63 is a flow chart illustrating step S13 in FIG. 59 in detail;

[0102] FIG. 64 is a flow chart illustrating in detail when data is read from a function module unit having a memory function and stored in a data memory (a read operation) at step S14 in FIG. 59;

[0103] FIG. 65 is a flow chart illustrating in detail when data is read from a data memory and stored in a function module unit having a memory function (a write operation) at step S14 in FIG. 59;

[0104] FIG. 66 is a flow chart illustrating step S15 in FIG. 59 in detail; and

[0105] FIG. 67 is a diagram illustrating an external appearance of an information processing terminal device according to the present invention which is attached to a belt.

DETAILED DESCRIPTION OF THE INVENTION

[0106] A preferred embodiment of an information processing terminal device according to the present invention will now be described with reference to the accompanying drawings.

[0107] First Embodiment

[0108] FIG. 1A generally illustrates a wristwatch as a whole to which the present invention is applied, and FIG. 1B is an enlarged view of a display section 60.

[0109] As illustrated in FIG. 1A, the wristwatch 1 comprises a body case 6; and a pair of wrist bands 4 and 5 made of resin, which are attached to opposing ends of the body case 6 to serve as members for securely wearing the wristwatch 1 on a body (wrist).

[0110] As illustrated in FIG. 2, the wrist band 4 is removably joined to a buckle member 2 by means of a buckle member through hole 4001 and a notch 4002.

[0111] A center fastening pin 11 is inserted from a space 2001 of the buckle member 2 in the direction indicated by the arrow, and then is pivotably fixed to the buckle member 2 by a pin 2002 having a diameter sufficiently larger than that of the center fastening pin 11.

[0112] This structure is provided for facilitating connection or exchange of function module units 80 and 81 by removing the buckle member 2 and the center fastening pin 11.

[0113] The function module units 80 and 81 having a memory function are removably attached to the wrist band 4.

[0114] Attached to the other wrist band 5 are a function module unit 82 having a temperature sensor function; a function module unit 83 having a pressure sensor function; and a function module unit 84 having an electronic direction sensor.

[0115] On the top surface of the body case 6, a display section 60, comprised of LCD, is provided for displaying time information based on control from a control circuit section 63, later described, and information based on the respective functions of the function module units 80 through 84.

[0116] The body case 6 is provided with a plurality of key sections 62 on side surfaces thereof.

[0117] The body case 6 contains the control circuit section 63 and a primary cell (battery) 64 arranged in this order below the display section 60, as illustrated in FIG. 3. The body case 6 is closed by a back case 66.

[0118] As illustrated in FIG. 4, the control circuit section 63 is connected to the plurality of key sections 62 as well as is elastically connected to a connection plug member 68 arranged on the wrist bands 4 and 5 by means of four spring members 65 extending toward the ends at which the wrist bands 4 and 5 are attached.

[0119] A receptacle member 69 is arranged at each of opposing ends of the body case 6.

[0120] As illustrated in FIG. 1A, a band fastening loop member 3, the buckle member 2 and the center fastening pin 11 are attached to an end of the wrist band 4.

[0121] Bus line wires 41 and 51 are embedded in the wrist bands 4 and 5, respectively, in the longitudinal direction.

[0122] Each of the bus line wires 41 and 51 is comprised of a Vcc (power source) line 411, 511; a serial data line 412, 512; a clock data line 413, 513; and a ground (or earth) line 414, 514.

[0123] The respective lines 411 through 514 constituting these bus line wires 41 and 51 are provided with a connector member 91 (for the Vcc line); a connector member 92 (for the serial data line); a connector member 93 (for the clock data line); and a connector member 94 (for the ground line), all of which are exposed on the back surface of the wrist bands 4 and 5 at positions corresponding to the function module units 80 through 84, as illustrated in FIGS. 5A and 5B.

[0124] An end of each of the lines 411 through 514 constituting the bus line wires 41 and 51 is connected to the connection plug member 68 arranged at an end of each of the wrist bands 4 and 5.

[0125] As illustrated in FIG. 3, this connection plug member 68 is inserted into the receptacle member 69 for bringing an end into contact with the spring members 65.

[0126] In this state, the ends of the body case 6 and the ends of the wrist bands 4 and 5 are fastened together by fixing screws 67 for fixing a watch back case 66 to make an electric connection of the body case 6 with the wrist bands 4 and 5.

[0127] As illustrated in FIG. 6A, the function module units 80 through 84 are rectangular parallelepiped in external shape, and enclose circumference of the wrist bands 4 and 5 in direction of width. On one side surface, the function module units 80 through 84 each have a function module unit circuit section 800. In addition, as illustrated in FIG. 6B, the function module units 80 through 84 each have four connector members 801 through 804 on an inner surface opposing the function module unit circuit section 800. These four connector members 801 through 804 are arranged at positions at which they can come into contact with the respective connector members 91 through 94 in a state in which the function module units 80 through 84 are fitted on the wrist bands 4 and 5.

[0128] Therefore, as the function module units 80 through 84 are fitted on the wrist bands 4 and 5, the respective function module built-in circuits 800 of the function module units 80 through 84 are connected to the Vcc lines 411, 511; serial data lines 412, 512; clock data lines 413, 513; and ground lines 414, 514 through the connector members 91 through 94 and 801 through 804, as illustrated in FIGS. 7 and 8, and also connected to the control circuit section 63 within the body case 6 through the connection plug member 68 and the spring member 65.

[0129] As illustrated in FIGS. 7 and 8, the body case 6 contains the control circuit section 63 and the primary cell 64, and the display section 60 and the key sections 62 are positioned along the outer periphery of the body case 6.

[0130] FIG. 9A illustrates the circuit configuration of the function module units 80 and 81, and FIG. 9B illustrates the circuit configuration of the function module units 82 through 84. Each of the function module units 80 through 84 is connected to the Vcc line 411, serial data line 413, clock data line 413 and ground line 414 through the connector members 91 through 94.

[0131] As illustrated in FIG. 9A, the function module units 80 and 81 having a memory function each comprise a power control section 812 connected to the connector member 91, an I/O control circuit section 811 connected to the connector members 92 and 93; a command/address register 813; a data register 814; a CRC (Cyclic Redundancy Check) generator 815; a ROM 816; and a memory 817.

[0132] The ROM 816 stores identification data such as module ID data, serial No. data and so on which are unique to the associated function module unit.

[0133] Similarly, as illustrated in FIG. 9B, the function module units 82 through 84 having a sensor function each comprise a sensor controller 831, a sensor data memory 832,

an A/D converter **833**, an amplifier **834**, and a sensor **835**, as well as an I/O control circuit section **811**, a power control section **812**, a command/address register **813**, a data register **814**, a CRC generator **815**, a ROM **816**, and a memory **817**.

[**0134**] **FIGS. 10A and 10B** show exemplary structures of data communicated between the body case **6** and the function module units **80** through **84**.

[**0135**] As illustrated in a timing chart of **FIG. 10A**, serial data is communicated in accordance with an asynchronous transmission system using a start bit S and a stop bit P, wherein a transmission is started with the start bit S, every eight bits of data are serially transmitted, and the stop bit P is finally transmitted before the transmission is terminated.

[**0136**] On the reception side, as the reception of every eight bits of data is confirmed, an acknowledgement signal ACK is returned to the data transmission side.

[**0137**] In this event, as illustrated in **FIG. 10B**, the serial data transmitted from the control circuit section **63** has the start bit S set at the head, and the stop bit P set at the end, and is comprised of a command data signal (C0 through C2: three bits); a module ID data signal (ID0 through ID4: five bits); a read/write control signal (R/W: one bit); an address data signal (A0 through A7: eight bits); a data signal (D0 through D15: 16 bits) and a CRC code/error check code (CR0 through CR7: eight bits), which are set between a synchronization signal SY and a parity check bit PA in units of eight bits, such that the reception of the acknowledgement signal ACK transmitted from the reception side can be confirmed in units of eight bits.

[**0138**] **FIG. 11A** shows the data structure of serial data which is transmitted from the control circuit section **63** to the function module units **80** through **84** through the connector member **92**. The serial data is comprised of a set of data in predetermined units which is made up of the synchronization signal SY, data signals C, ID, R/W, A, D, CR, and the parity check bit PA.

[**0139**] This serial data is decoded in the function module units **80** through **84**, as shown in **FIG. 11B**.

[**0140**] As shown in **FIG. 1C**, these data signals C, ID, R/W, A, D, CR are comprised of command data, read/write control data, module ID data, address data, data (content data), and CRC code/error check code.

[**0141**] While in this embodiment, the synchronization signal SY is included in the data structure, the acknowledgement signal ACK may be included in the data structure in place of the synchronization signal SY, so that the synchronization signal SY is omitted.

[**0142**] ACK (acknowledgement) data and NAK (negative acknowledgement) data are comprised only of command data, as shown in **FIG. 11D**.

[**0143**] SOF, EOF, initial settings for the function module units **80** through **84**, ON/OFF control, request for attribute information (properties) are comprised of command data, module ID data, and CRC code/error check code, as shown in **FIG. 1E**.

[**0144**] A read command for reading data stored in the memory **817** of the function module units **80** through **84**, and an input command from the function module units **80**

through **84** are comprised of command data, module ID data, address data, and CRC code/error check code, as shown in **FIG. 11F**.

[**0145**] A data write command for writing data into the memory **817** of the function module units **80** through **84**, and an output command to the function module units is comprised of command data, module ID data, address data, data (output content data or data to be written), and CRC code/error check code, as shown in **FIG. 11G**.

[**0146**] Since the serial data is communicated between the body case **6** and the function module units **80** through **84** through the wrist bands in the manner mentioned above, it is not necessary to incorporate a memory or a sensor in the body case **6**.

[**0147**] Also, the results of measurements made by the function module units **82** through **84** can be generated and displayed on the display section **60**.

[**0148**] As illustrated in **FIG. 1B**, a current time **601** measured by the control circuit section **63**; an altitude history **602** and an altitude of a current position generated based on data measured by the function module unit **83**; a temperature **603** generated based on data measured by the function module unit **82**; and a compass direction **605** generated based on data measured by the function module unit **84** are displayed on the display section **60**.

[**0149**] It is therefore possible to readily add a plurality of functions to the wristwatch **1** without the need for increasing the size of the body case and to use the wristwatch **1** as an information processing terminal device which provides a wide variety of functions.

[**0150**] First Modification of First Embodiment

[**0151**] **FIG. 12A** generally illustrates the whole wristwatch according to the first modification of the first embodiment, and **FIG. 12B** is an enlarged view of a display section **60**.

[**0152**] The wristwatch **1** illustrated in **FIG. 12A**, though substantially identical to that illustrated in **FIG. 1A**, differs in the functions of the function module units **85** through **88** and the circuit configuration.

[**0153**] The function module units **85** through **88** have a wireless communication function, an image capturing function, a music replay function, and a touch sensor function with a liquid crystal display, respectively. The function module unit **87** which has the music replay function is provided with a slot **879** for inserting a semiconductor memory chip **876** on which music data is recorded.

[**0154**] The function module unit **85** having the wireless communication function, as illustrated in **FIG. 13A**, comprises an I/O control circuit section **811**, a power control section **812**, a command/address register **813**, a data register **814**, a CRC generator **815**, a ROM **816**, and a memory **817**, as is the case with the function module units **80** through **84**, and also comprises a communication control section **851**, a coding/decoding section **852**, a modem **853**, a wireless signal control section **854**, and an antenna **855**.

[**0155**] Therefore, according to the function module unit **85** having the wireless communication function, data received by the wireless signal control section **854** through

the antenna **855** can be transferred to the body case **6** through the wrist band **4** and displayed on the display section **60**.

[0156] It is also possible to transmit data from the wireless signal control section **854** through the antenna **855** by manipulating the key sections **62** on the body case **6**.

[0157] The function module unit **86** having the image capturing function, as illustrated in **FIG. 13B**, comprises the respective circuit sections from the I/O control circuit section **811** to the memory **817**, and also comprises a control circuit section **861** for image capturing, a coding section **862** including a DSP (Digital Signal Processor), an image input section **863**, an input device (CCD (Charge Coupled Device)) **864**, and a lens **865**.

[0158] Therefore, according to the function module unit **86** having the image capturing function, an image captured by the input device (CCD) **864** through the lens **865** is input to the image input section **863**, and image data processed by the coding section (DSP) **862** can be transferred to the body case **6** by the I/O control circuit section **811** and displayed on the display section **60**.

[0159] It is also possible to input image data from the coding section (DSP) **862** and stored in the memory **817** by manipulating the key sections **62** on the body case **6**.

[0160] The function module unit **87** having the music replay function, as illustrated in **FIG. 14A**, comprises the respective circuit sections from the I/O control circuit section **811** to the ROM **816**, and also comprises a connector **878** for making an electric connection with respective terminals (not shown) of the semiconductor memory chip **876** arranged deep in the slot **879**, an output control section **871**, a decoding section **872**, an audio output circuit section **873**, and an audio output device **874** comprising an ear phone jack to which an ear phone is connected.

[0161] Therefore, according to the function module unit **87** having the music replay function, music data recorded on the semiconductor memory chip **876** can be replayed and listened to by the ear phone by manipulating the key sections **62** on the body case **6**.

[0162] The function module unit **88** having the touch sensor function with a LCD (liquid crystal display), as illustrated in **FIG. 14B**, comprises the respective circuit sections from the I/O control circuit section **811** to the memory **817**, and also comprises an input/output control section **881**, an encoding/decoding section **882**, an input/output circuit section **883**, and an input/output device section **884** comprised of a LCD and a transparent touch panel arranged on the surface of the LCD.

[0163] Therefore, according to the function module unit **88** having the touch sensor function with the LCD, data can be output from or input to the input/output device **884**. In this way, the wristwatch **1** can display the current time **601** measured by the control circuit section **63**; an image **606** captured by the function module unit **86**; and a manipulation icon **607** for manipulating the function module unit **87** on the display section **60**, as illustrated in **FIG. 12B**.

[0164] Second Modification of First Embodiment

[0165] **FIGS. 15A and 15B** illustrate the second modification of the first embodiment. The receptacle member **69** of

the body case **6** is provided with four plate springs **70** connected to the control circuit section **63**.

[0166] Water-proof packing **71** is interposed between the plate springs **70**, back case **66** of the wristwatch **1**, and body case **6**.

[0167] The two wrist bands **4** and **5** are fixed by fixing screws **67** with the connection plug member **68** inserted in the receptacle member **69**.

[0168] With this structure, the connection plug member **68** is elastically connected to the plate springs **70**, causing the bus line wires **41** and **51** to be connected to the control circuit section **63** through the connection plug member **68** and the plate springs **70**. According to this modification, the water-proof packing **71** can prevent a contact failure and so on due to immersion.

[0169] Third Modification of First Embodiment

[0170] **FIG. 16** illustrates a third modification of the first embodiment. The wrist bands **4** and **5** are provided with connector members **91** through **94** protruding from the surfaces thereof.

[0171] On both sides of each function module unit **80** through **84**, attachment members **805** having a substantially L-shape are provided for wrapping the wrist bands **4** and **5**.

[0172] Connector members **801** through **804** are arranged on the bottom surface of each function module unit **80** through **84**, and the connector members **801** through **804** have spring forces for elastic connection with the connector members **91** through **94** on the wrist bands **4** and **5**.

[0173] Therefore, the connector members **801** through **804** can be brought into contact with the connector members **91** through **94** by the spring forces to ensure the conduction therebetween.

[0174] Fourth Modification of First Embodiment

[0175] **FIG. 17** illustrates a fourth modification of the first embodiment, wherein connector members **91** through **94** are arranged in flush with the surfaces of the wrist bands **4** and **5**.

[0176] Each of the wrist bands **4** and **5** is provided on both sides with protrusions **42** which extend outward in directions opposite to each other.

[0177] Each of the function module units **80** through **84** is provided with recesses **806** on both sides for engagement with the protrusions **42**, and connector members **801** through **804** on the lower surface which come in contact with the connector members **91** through **94**.

[0178] Each of the function module units **80** through **84** is mounted on the wrist band **4** or **5** by engaging the recesses **806** to the protrusions **42**, with the connector members **801** through **804** in contact with the connector members **91** through **94**.

[0179] Therefore, even with the function module units **80** through **84** mounted on the wrist bands, the entire thickness of the wrist bands can be reduced, thereby making it possible to carry the watch without discomfort.

[0180] Second Embodiment

[0181] FIG. 18A generally illustrates the whole wristwatch 101 according to the second embodiment of the present invention, and FIG. 18B is an enlarged view of a display section 161.

[0182] As illustrated in FIG. 18A, the wristwatch 101 comprises a body case 16, and a pair of wrist bands 14 and 15 which are attached to opposing ends of the body case 16.

[0183] One wrist band 14 is provided with a fixture 415 at an end for connection with a buckle member 12 of the wrist band 15 to fix both wrist bands 14 and 15.

[0184] Function module units 21 and 22 having a memory function, and a function module unit 23 having a wireless communication function are removably mounted on the wrist band 14, while a function module unit 24 having a hand-written character input function, a function module unit 25 having a speech input/output function, and a power supply module unit 26 are removably mounted on the other wrist band 15.

[0185] The display section 161 comprised of LCD and a plurality of key sections 162 are arranged on the top surface of the body case 16.

[0186] The function module unit 24 is provided with a touch panel 291 and a stylus pen 292 for entering handwritten characters and so on. The function module unit 25 is provided with a speaker 210 and a microphone 211.

[0187] The buckle member 12 is attached to an end of the wrist band 15.

[0188] Bus line wires 41 and 51 are embedded in both wrist bands 14 and 15, respectively, along the longitudinal direction.

[0189] Each of the bus line wires 41 and 51 is comprised of a Vcc line 411, 511; a serial data line 412, 512; a clock signal line 413, 513; and a ground line 414, 514.

[0190] A connection structure for connecting the wrist bands 14 and 15 to the body case 16 is similar to the first embodiment illustrated in FIGS. 3 and 4, and a connection structure for the Vcc line 411, 511, serial data lines 412, 512, clock data lines 413, 513, and ground lines 414, 514 are also similar to the first embodiment illustrated in FIGS. 4, 5A, and 5B.

[0191] As illustrated in FIG. 19, the body case 16 contains a control circuit section 163; a program memory 165 for storing control programs; a data memory 166 for storing arbitrarily generated data; a time measuring circuit section 167 for generating time information; and a back-up power supply unit 168. In addition, the display section 161 and the key sections 162 are arranged along the outer periphery of the body case 16.

[0192] The body case 16 is provided with a power supply (Vcc) connector member 169 for connection with the Vcc lines 411, 511; a serial data connector member 170 for connection with the serial data lines 412, 512; a clock data (Clock) connector member 171 for connection with the clock data lines 413, 513; and a ground (GND) connector member 172 for connection with the ground lines 414, 514.

[0193] The connector members 169 through 172 are connected to the control circuit section 163.

[0194] The function module units 21 and 22 each comprise a power interface section 201, a serial data interface section 202, and a memory 203. The power interface section 201 is connected to the Vcc line 411 and the ground line 414, while the serial data interface section 202 is connected to the serial data line 412 and the clock data line 413.

[0195] The function module unit 23 comprises a power interface section 201 and a serial data interface section 202, which are connected in a similar manner, as well as comprises a communication control section 204, a modem 205, a wireless signal control section 206, and an antenna 207.

[0196] The function module unit 24 comprises a power interface section 201, a serial data interface section 202, an A/D converter 290, and a touch panel 291. The power interface section 201 is connected to the Vcc line 511 and the ground line 514, while the serial data interface section 202 is connected to the serial data line 512 and the clock data line 513.

[0197] The audio input/output module unit 25 comprises a power interface section 201 and a serial data interface section 202, which are connected in a similar manner as in the function module unit 24, as well as comprises an audio codec (CODEC) 208, an amplifying device 209, a speaker 210, and a microphone 211.

[0198] The power supply module unit 26 comprises a power interface section 201 and a serial data interface section 202, which are connected in a similar manner as in the function module unit 24, as well as comprises a voltage stabilizer 212, a secondary cell 213, a charging controlling circuit section 214, and a charging terminal 215.

[0199] In this embodiment configured as described above, the wristwatch 101 can display a current time 601 measured by the time measuring circuit section 167, and an image 606 received by the function module unit 23 on a display section 161, as illustrated in FIG. 18B.

[0200] The secondary cell 213 can be charged by connecting the charging terminal 215 of the power supply module unit 26 to an external power source.

[0201] The power charged in the secondary cell 213 can be supplied to respective circuits in the body case 16 and respective circuits in the function module units by way of the Vcc line 411 (511) and power (Vcc) connector member 169, and the ground line 414 (514) and ground (GND) connector member 172.

[0202] On the contrary, when the voltage supplied by the secondary cell 213 becomes lower than a normal operating voltage, the power from the back-up power supply unit 168 can be supplied to the respective circuits in the function module units 21 through 25 by way of the Vcc line 411 (511) and power (Vcc) connector member 169, and the ground line 414 (514) and ground (GND) connector member 172.

[0203] A speech recognition function provided in the control circuit section 163 may enable the control circuit section 163 to control the wristwatch body 11, function module units 21 through 24 and power supply module unit 26 based on speech information input through the function module unit 25.

[0204] For example, the control circuit section 163 recognizes speech information input through the function mod-

ule unit **25** to control the function module unit **23**, so that the wristwatch **101** may be used as a wireless communication device having the ability of speech recognition.

[0205] First Modification of Second Embodiment

[0206] **FIGS. 20A and 20B** illustrate the first modification of the second embodiment. **FIG. 20A** illustrates a connection structure, and **FIG. 20B** illustrates the circuit configuration of a function module unit.

[0207] The first modification features the use of an exchangeable primary cell.

[0208] The connection structure for connecting the wrist bands **14** and **15** to the body case **16**, and the connection structure for connecting the respective function module units **21** through **26** to the body case **16** are similar to those of the second embodiment.

[0209] A power supply module unit **26** removably contains an exchangeable primary cell **219** which is connected to a power (Vcc) connector member **169** through a voltage stabilizer **218** and a diode **217**. A grounded capacitor **216** is connected between the diode **217** and the power (Vcc) connector member **169**.

[0210] The power supply module unit **26** further comprises a module controller **220** which is comprised of an I/O control circuit section **811**, a power control section **812**, and a ROM **816** which stores information unique to the function module unit such as module ID/serial number or the like.

[0211] The I/O control circuit section **811** is connected to a serial data connector member **107** and a clock data (Clock) connector member **171**.

[0212] In the modification as described above, the power supplied from the primary cell **219** can be stored in the back-up power supply unit **168**, so that even if the power in the primary cell **219** is exhausted, the operation of the module units **21** through **25** can be compensated for by the power from the back-up power supply unit **168** until the primary cell **219** is exchanged.

[0213] Second Modification of Second Embodiment

[0214] **FIG. 21** illustrates the second modification of the second embodiment, and more specifically, the configuration of a serial bus connection of the control circuit section **163** of the body case **16** with each function module unit **27** when a balance (differential) data transmission system is implemented by a two-wire serial bus, instead of the aforementioned asynchronous transmission system.

[0215] The balance differential data transmission system implemented by a two-wire serial bus divides data signal lines into two, instead of using the clock data lines **413** and **513**, and communicates data with the control circuit section **163** through transmission (Tx) lines **416** and **516** and reception (Rx) lines **417** and **517**.

[0216] This permits faster communication of data than the aforementioned asynchronous system.

[0217] Though not shown, the control circuit section **163** and the function module unit **27** are previously provided with a circuit configuration associated with the transmission (Tx) lines **416** and **516** and the reception (Rx) lines **417** and **517**.

[0218] Third Modification of Second Embodiment

[0219] **FIGS. 22A and 22B** illustrate a third modification of the second embodiment. **FIG. 22A** is a cross-sectional view of the wrist bands **14** and **15**, and **FIG. 22B** illustrates a connection structure for a serial connection of the control circuit section **163** of the body case **16** with each function module unit **28**.

[0220] In **FIG. 22A**, the wrist bands **14** and **15** comprise, on their front sides, Vcc lines **411** and **511**, clock data lines **413** and **513**, and transmission (Tx) lines **416** and **516** and reception (Rx) lines **417** and **517** from the control circuit section **163**, and comprises ground lines **414** and **514** on their entire back sides.

[0221] This causes the ground lines **414** and **514** to come into contact with a human body (wrist) for grounding. The function module section **28** in turn comprises a connector member (for the Vcc line) **91**; a connector member (for the clock data line) **93**; a connector member (for the ground line) **94**; a connector member (for the transmission (Tx) line) **96**; and a connection member (for the reception (Rx) line) **97**.

[0222] Therefore, in addition to the advantage of the second modification of the second embodiment, since the clock signal can also be transmitted to the function module units, not only data can be more smoothly transmitted and received, but also a good solution is provided for possible problems related to the grounding.

[0223] Though not shown, the control circuit section **163** and the function module unit **28** are previously provided with a circuit configuration associated with the transmission (Tx) lines **416** and **516** and the reception (Rx) lines **417** and **517**.

[0224] Fourth Modification of Second Embodiment

[0225] **FIG. 23** illustrates the fourth modification of the second embodiment, and specifically is a cross-sectional view of the wrist bands **14** and **15**.

[0226] The wrist bands **14** and **15** additionally comprise clock data lines **413** and **513**, respectively, in the aforementioned balance differential data transmission system.

[0227] The wrist bands **14** and **15** comprise, on both sides thereof, Vcc lines **411** and **511**; clock data lines **413**, **513**; transmission (Tx) lines **416** and **516** and reception (Rx) lines **417** and **517** from the control circuit section **163**; and ground lines **414** and **514**, respectively. These lines are made of an electrically conductive material having elasticity. The ground lines **414** and **514** are sandwiched by members which form parts of the wrist bands.

[0228] According to the configuration as described, in addition to the advantages provided by the second modification of the second embodiment, function module units **28** can be connected on both front and back sides of the wrist bands **14** and **15**, and the wrist bands become more robust because the ground lines **414** and **514** are sandwiched by the elastic electrically conductive members in portions which are cores of the wrist bands.

[0229] In **FIG. 23**, the function module units **28** are connected on both front and back sides of the wrist bands **14** and **15**. Additionally, as illustrated in **FIG. 24**, the wrist bands **14** and **15** may be further provided, on both front and back sides thereof, with transmission strobe (Tx) lines **418**

and 518; reception strobe (Rxs) lines 419 and 519; and reserve data (Rsv) lines 420, 421, 520, and 521, in addition to the Vcc lines 411 and 511; clock data lines 413 and 513; transmission (Tx) lines 416 and 516 and reception (Rx) lines 419 and 519, and the ground lines 414 and 514 may be made of an electrically conductive material having elasticity.

[0230] With the configuration as described, a large amount of information can be smoothly transmitted between the control circuit section 163 and the function module units 28.

[0231] In terms of the transmission system, data transmission can be performed in accordance with half duplex transmission or full duplex transmission.

[0232] It should be understood that the routing of the respective signal lines on the wrist bands is not limited to the foregoing embodiments or modifications, but may be arbitrarily modified in accordance with members which form parts of the wrist bands, and the usability of particular users.

[0233] Third Embodiment

[0234] FIGS. 25A and 25B illustrate external appearances of a wristwatch 31 according to the third embodiment of the present invention. FIG. 25A generally illustrates the wristwatch 31, and FIG. 25B is an enlarged view of a display section 37.

[0235] As illustrated in FIG. 25A, the wristwatch 31 employs a common line for a serial data line and a Vcc line routed to wrist bands 34 and 35, so that the wristwatch 31 only incorporates this line and a ground line.

[0236] The wristwatch 31 according to this embodiment comprises a body case 36, and a pair of wrist bands 34 and 35 attached to opposing ends of the body case 36.

[0237] Function module units 300 and 301 having a memory function, and a function module unit 302 having an emergency alarm wireless transmission function are removably attached to one wrist band 34, while a function module unit 303 having a heart rate sensing function, a function module unit 304 having an electrocardiograph sensing function, and a function module unit 305 having a glucose sensing function are removably attached to the other wrist band 35.

[0238] A display section 37 comprised of LCD is arranged on the top surface of the body case 36, and a plurality of key sections 38 are arranged on side surfaces of the same.

[0239] Each of bus line wires 32 and 33 is comprised of a serial data line 321, 331 and a ground (GND) line 322, 332. In this embodiment, the serial data lines 321 and 331 also serve as Vcc lines in addition to as input/output lines for such data as serial data, address data and command data.

[0240] As illustrated in FIG. 26, a function module unit circuit section 800 contained in each of the function module units 300 through 305 is connected to the serial data lines 321 and 331 through a data connector member 306, and also connected to the ground lines 322 and 332 through a ground connector member 307.

[0241] The body case 36 is provided therein with a control circuit section 63, and a primary cell 64 for supplying power to the control circuit section 63. The display section 37 and the key sections 38 are arranged along the outer periphery of the body case 36.

[0242] Each of the function module units 300 through 305 has a data connector member 306 connected to an I/O control circuit section 311 by way of a current source 308, an FET (Field-Effect Transistor) 309, and an inverter 310, and also connected to a power control section 320 through a diode 318, as shown in FIGS. 27A and 27B. A grounded capacitor 319 is arranged between the diode 318 and the power control section 320.

[0243] The I/O control circuit section 311 is connected to a command/address register 312 and a data register 313, and the data register 313 is connected to a CRC generator 314.

[0244] The command/address register 312 and the data register 313 are connected to a ROM 315 which stores information unique to an associated function module section such as module ID/serial number or the like, a memory 316, and an I/O circuit section 317.

[0245] In this embodiment configured as described above, the serial data lines 321 and 331 supply the power in a manner similar to the Vcc lines 411 and 511 in the first embodiment.

[0246] Therefore, the function module units 300 through 305 enter a charging state when they do not communicate data with the control circuit section 63. Data, when communicated between any of the function module units 300 through 305 and the control circuit section 63, is communicated in the form of a signal such as Morse codes which are a combination of time intervals of negative pulses.

[0247] More specifically, a reset pulse of a fixed duration is transmitted from the control circuit section 63 of the body case 36 to the function module units 300 through 305 to notify them of the start of data communication, and the function module units 300 through 305, upon receipt of the reset pulse, transmit an acknowledgement signal (ACK) back to the control circuit section 63.

[0248] Upon receipt of the acknowledge signal (ACK), the control circuit section 63 transmits a command, a module ID and an address signal, when data is transmitted, in sequence, and then transmits again the reset signal as a communication end code.

[0249] Thus, the function module units 300 through 305 can be controlled only by routing two bus line wires comprised of the serial data line 321, 331 and the ground (GND) line 322, 332. As a result, the wristwatch 31 can display information generated based on a variety of vital information data detected from the user by the function module units 303 through 305, as illustrated in FIG. 25B.

[0250] In FIG. 25B, the display section 37 displays a current time 601 measured by the control circuit section 63; heart rate 608; maximum/minimum blood pressures 608; and pulsation trend 609. These measurement results may be stored in the function module units 300 and 301 that have a memory function.

[0251] If an abnormal value is detected in any of a variety of vital information data, or if a certain data exceeds a predetermined fixed value, the function module unit 302 that has the emergency alarm wireless communication function can automatically send an urgent alarm to a destination or an emergency center which may be previously stored in the memory.

[0252] Accordingly, the wristwatch 31 can be utilized as a measuring monitor for a variety of vital information data in applications such as medical health management, in-house nursing care, security and so on.

[0253] First Modification of Third Embodiment

[0254] FIG. 28 illustrates the first modification of the third embodiment of the present invention, in which the function module units 300 through 305 each comprise a parasitic power source circuit section comprised of a capacitor.

[0255] A body case 36 contains a serial bus control section 340, a control circuit section 341, and a memory 342, as well as a display section 37, key sections 38, and a primary cell 64, similar to the foregoing embodiment.

[0256] The serial bus control section 340 is connected to serial data lines 321 and 331 through inverters 343 and 344, respectively. A resistor 345 having one end connected to a power supply (+Vcc) has the other end connected between the serial data line 321 and the inverter 343.

[0257] Function module units 300 and 301, which have a memory function, each comprise a parasitic power source 346 comprised of a capacitor, in place of the power control section 320, as well as comprises the respective sections from the source of current 308 to the I/O circuit 317, similarly to the function module units illustrated in FIGS. 27A and 27B.

[0258] The function module units 303 through 305, which have a sensor function, each comprise a sensor data memory 347, an A/D converter 348, an amplifying device 349, and a sensor 350, as well as the respective sections from the source of current 308 to the I/O circuit 317 and the parasitic power source 346 in a similar manner as in FIGS. 27A and 27B.

[0259] In this modification, the power from the primary cell 64 in the body case 36 is supplied to the respective function module units 300, 301, 303 through 305 through the Vcc line 411, and charged in the parasitic power source 346.

[0260] Thus, the respective function module units 300, 301, 303 through 305 can operate with the power from the parasitic power source 346, and similarly to the foregoing, can also communicate data with the body case 36 through a signal comprised of a combination of time intervals of negative direction pulses.

[0261] Second Modification of Third Embodiment

[0262] FIGS. 29A and 29B illustrate the second modification of the third embodiment. FIG. 29A is a sectional plan view, and FIG. 29B is a sectional side view.

[0263] A body case 36 is provided with receptacle members 69 each having a pair of through holes 691.

[0264] A control circuit section 63 arranged in the body case 36 is provided with body connector members 351, each comprised of a pair of plate springs, at opposing ends of the control circuit section 63.

[0265] On the other hand, both wrist bands 34 and 35 are provided with connector plugs 352 at their respective ends for connection with serial data lines 321 and 331 and ground lines 322 and 332, respectively.

[0266] Water-proof packing 71 is interposed over the inner peripheral surfaces of the through holes 691, body case 36 and watch back case 66.

[0267] With the connector plugs 352 inserted in the through holes 691 of the receptacle members 69, the ends of both wrist bands 34 and 35 are fixed to bus connecting receptacle members 69 with fixing screws 67.

[0268] This causes the connector plugs 352 to elastically come into contact with the body connector members 351, so that the serial data lines 321 and 331 and the ground lines 322 and 332 are connected to the control circuit section 63 through the connector plugs 352 and the body connector members 351.

[0269] According to this modification, the water-proof packing 71 can prevent a contact failure and so on due to immersion.

[0270] Third Modification of Third Embodiment

[0271] FIGS. 30A and 30B illustrate the third modification of the third embodiment. FIG. 30A is a sectional plan view, and FIG. 30B is a sectional side view.

[0272] In each of the through holes 691 formed through receptacle members 69, a coil spring 692 is fitted. Also, a push button type terminal 693 of substantially T-shape in cross-section is fitted in the coil spring 692.

[0273] Both wrist bands 34 and 35 are fixed to the receptacle members 69 with fixing screws 67 with connection plugs pressed onto the heads of the push button type terminals 693.

[0274] This causes the coil springs 692 to contract, and also causes the push button type terminals 693 to elastically come into contact with the body connector members 351 to make connection of serial data lines 321 and 331 and ground lines 322 and 332 to the control circuit section 63 through the push button type terminals 693 and the body connector members 351.

[0275] According to this modification, since the contact state is maintained with spring forces of the body connector members 351 and spring forces of the coil springs 692, the wristwatch 31 is resistant to a shock, and can properly maintain the contact state.

[0276] Fourth Modification of Third Embodiment

[0277] FIGS. 31A through 31E illustrate the fourth modification of the third embodiment. In FIG. 31A, serial data lines 321 and 331 and ground lines 322 and 332 are routed on the back side of wrist bands 34 and 35, and function module units 300 through 305, which have a substantially inverted C-shape in cross section, wrap the wrist bands 34 and 35, respectively.

[0278] Connector members 306 and 307 are arranged at locations at which the function module unit gets in contact with the serial data lines 321 and 331 and the ground lines 322 and 332.

[0279] Therefore, with the employment of the connection structure as described above, the function module units 300 through 305 are held on the wrist bands 34 and 35 without fail, and a secure conduction can be provided through contacts of the serial data lines 321 and 331 and the ground lines 322 and 332 with the connector members 306 and 307.

[0280] In FIG. 31B, function module units 300 through 305 are each constructed to surround the periphery of wrist bands 34 and 35. In addition, portions of the connector members 306 and 307, which come in contact with the serial data lines 321 and 331 and the ground lines 322 and 332, have spring forces.

[0281] Thus, as compared with the structure illustrated in FIG. 31A, more secure holding and conduction can be provided.

[0282] In addition, it is contemplated that the serial data lines 321 and 331 and the ground lines 322 and 332 are routed on the front side of the wrist bands 34 and 35, and the function module units 300 through 305 are held on side surfaces of the wrist bands 34 and 35 (FIG. 31C); the data lines 321 and 331 and the ground lines 322 and 332 are routed on side surfaces of the wrist bands 34 and 35, and the function module units 300 through 305 are held by the side surfaces as well (FIG. 31D); and the data lines 321 and 331 are routed on the entire front side of the wrist bands 34 and 35, while the ground lines 322 and 332 are routed on the entire back side of the wrist bands 34 and 35, and the function module units 300 through 305, formed in an inverted C-shape, are fitted thereon (FIG. 31E).

[0283] Therefore, with the employment of the connection structure as described above, the function module units 300 through 305 can be held on the wrist bands 34 and 35 without fail, and a secure conduction can be provided through contacts of the serial data lines 321 and 331 and the ground lines 322 and 332 with the connector members 306 and 307 of the function module units 300 through 305.

[0284] Fifth Modification of Third Embodiment

[0285] FIG. 32 illustrates the fifth modification of the third embodiment of the present invention, wherein a function module unit is built in a block which forms part of a wrist band.

[0286] A body case 36 is similar in circuit configuration to that illustrated in FIG. 26, and comprises a display section 37, key sections 62, a control circuit section 63, and a primary cell 64.

[0287] The body case 36 is provided at both ends with a serial data terminal 631 connected to the control circuit section 63, and a ground terminal 632 connected to the control circuit section 63 and the primary cell 64 as well as to the ground.

[0288] Wrist bands 44 and 45, connected to both ends of the body case 36, are each comprised of a plurality of blocks which are removably joined in sequence by spring rods 402. A function module unit 403 is comprised of the block 401 and a function module unit circuit section 800 arranged in the block 401.

[0289] The function module unit 403 integrally formed with the block 401 is provided with a serial data line (Serial Data) 431 and a ground line 432, as illustrated in FIG. 33.

[0290] The serial data line (Serial Data) 431 is connected at two ends to a serial data male terminal 4311 and a serial data female terminal 4312, arranged at both ends of the block 401, respectively. The ground line 432 is connected at two ends to a ground male terminal 4321 and a ground female terminal 4322, respectively.

[0291] The serial data line 431 is connected to an I/O control circuit section 311 through a current source 308, an FET 309 and an inverter 310, and also connected to a power control section 320 through a diode 318. A grounded capacitor 319 is arranged between the diode 318 and the power control section 320.

[0292] The I/O control circuit section 311 is connected to a CRC generator 314, a ROM 315 which stores information unique to the associated function module unit such as module ID/serial number or the like, a memory 316, and an I/O circuit 317.

[0293] The ground line 432 is connected to the current source 308 and the FET 309 as well as to the ground.

[0294] A block 401 which is not provided with the function module unit circuit section 800, i.e., a block 401 which does not serve as the function module unit 403 is provided only with a serial data line 431 and a ground line 432; a serial data male terminal 4311 and a serial data female terminal 4312; and a ground male terminal 4321 and a ground female terminal 4322.

[0295] As the block 401 at one end is connected to the body case 36 by a spring rod 402, the serial data male terminal 4311 and the ground male terminal 4321 of the block 401 are brought into contact with the serial data terminal 631 and the ground terminal 632 of the body case 36.

[0296] Then, as blocks 401 are sequentially connected by spring rods 402, the serial data male terminal 4311 and the ground male terminal 4321 of the subsequent block 401 are brought into contact with the serial data female terminal 4312 and the ground female terminal 4322 of the preceding block 401.

[0297] This results in the formation of connection between the serial data lines 431 and the ground lines 431 routed on the respective blocks 401 as well as the formation of connection with the body case 36.

[0298] Thus, in this modification, the function module units 403 can be controlled only by routing two bus line wires, i.e., the serial data line 431 and the ground line 432, on the wrist bands 44 and 45, as is the case with the third embodiment.

[0299] In addition, in this modification, since the blocks 401 themselves, which make up the wrist bands 44 and 45, serve as function module units 403, the function module units themselves do not protrude from the wrist bands 44 and 45, so that the user can carry the wristwatch 31 as if the user carries an ordinary watch.

[0300] Fourth Embodiment

[0301] In the first through third embodiments, the bus line wires are routed on the wrist bands, such that the wristwatch body is electrically connected directly to respective function modules through the bus line wires. Alternatively, data may be communicated between the watch body and function module units mounted on the wrist bands through a proximate wireless communication scheme such as Bluetooth.

[0302] In the following, a fourth embodiment of the present invention in which the foregoing scheme is applied will be described in detail with reference to the drawings. FIGS. 34A and 34B illustrate external appearances of a

wristwatch **100** according to the fourth embodiment of the present invention. **FIG. 34A** generally illustrates the wristwatch **100**, and **FIG. 34B** is an enlarged view of a display section **1061**.

[0303] In describing the figures, the configuration previously described in the first through third embodiments is basically identical in the fourth embodiment as well, so that description thereon is omitted.

[0304] As illustrated in **FIG. 34A**, the wristwatch **100** according to the fourth embodiment of the present invention comprises a body case **106**, and a pair of resin-made wrist bands **104** and **105** attached to opposing ends of the body case **106**.

[0305] A function module unit **1071** having a memory function and a function module unit **86** having an image capturing function are removably attached to one wrist band **104**, while a function module unit **25** having an audio input/output function and a power supply module unit **26** are removably attached to the other wrist band **105**.

[0306] The display section **1061** comprised of LCD and a plurality of key sections **1062** are arranged on the top surface of the body case **106**.

[0307] On both wrist bands **104** and **105**, Vcc lines **411** and **511** and ground lines **414** and **514** are routed in the longitudinal direction as bus line wires, respectively. The structure for connecting the wrist bands **104** and **105** to the body case **16** is similar to that of the third embodiment illustrated in **FIGS. 29A, 29B, 30A and 30B**.

[0308] As illustrated in **FIG. 35**, the body case **106** contains a control circuit section **1063**; a program memory **858** for storing control programs; a data memory **817** for storing data; a time measuring circuit section **167** for generating time information; and a back-up power supply unit **168**. Also, the display section **1061** and the key sections **1062** are arranged along the outer periphery of the body case **106**.

[0309] The body case **106** further comprises power (Vcc) connector members **169** for connection with the Vcc lines **411** and **511** of both wrist bands **104** and **105**; and ground (GND) connector members **172** for connection with the ground lines **414** and **514** of the wrist bands **104** and **105**.

[0310] The function module unit **1071** comprises a power interface section **201**; a ROM **816** which stores information unique to the associated function module unit such as module ID/serial number or the like; and a memory **203**.

[0311] The power interface section **201** is connected to the Vcc line **411** and the ground line **414**.

[0312] These power interface section **201**, ROM **816** and memory **203** are sequentially connected to a coding/decoding section **852**, a modem **853**, a wireless signal control section **854**, and an antenna **855**.

[0313] The function module unit **86** having the image capturing function similarly comprises a power interface section **201** and a ROM **816** which stores information unique to the associated function module unit such as module ID/serial number or the like, as well as an image data memory **857**, a control circuit section **856**, a coding/decoding section **852**, a modem **853**, a wireless signal control section **854**, and an antenna **855**.

[0314] The function module unit **86** further comprises a signal processing section **8622**, an A/D converter **8621**, an input device **864** comprised of CCD, and a lens **865**.

[0315] The function module unit **25** comprises a power interface section **201** and a ROM **816** which stores information unique to the function module unit **25** such as module ID/serial number or the like, connected in a similar manner, as well as an audio signal processing section **2501**, a codec **208**, an amplifying device **209**, a speaker **210** and a microphone **211**. The audio input/output function module unit **25** further comprises a control circuit section **861**, a coding/decoding section **852**, a modem **853**, a wireless signal control section **854**, and an antenna **855**.

[0316] The power supply module unit **26** comprises a power interface section **201** connected in a similar manner, a voltage stabilizer **212**, a charging controlling circuit section **214**, a charging terminal **215** and a secondary cell **213**.

[0317] In the fourth embodiment configured as described above, as the charging terminal **215** of the power supply module unit **26** is connected to an external power source, the secondary cell **213** can be charged.

[0318] The power charged in the secondary cell **213** can be supplied to the body case **106**, function module unit **1071**, function module unit **86** having the image capturing function, and function module unit **25** by way of the Vcc lines **411** and **511** and power (Vcc) connector member **169**, and the ground lines **414** and **514** and ground (GND) connector member **172**.

[0319] As illustrated in **FIG. 34B**, the wristwatch **100** can display a current time **601** measured by the control circuit section **167**, and an image **610** input by the function module unit **86** on the display section **1061**.

[0320] When the voltage supplied by the secondary cell **213** becomes lower than a normal operating voltage, the power from the back-up power supply unit **168** can be supplied to the respective function module units **1071**, **86**, and **25** by way of the Vcc lines **411** and **511** and power (Vcc) connector member **169**, and the ground lines **414** and **514** and ground (GND) connector member **172**.

[0321] Fifth Embodiment

[0322] In the first through third embodiments, the bus line wires are routed on the wrist bands, such that the wristwatch body is electrically connected to respective function module units through the bus line wires. Alternatively, the connection between the watch body and function module units mounted on the wrist bands may be made through infrared communications.

[0323] In the following, a fifth embodiment of the present invention in which the infrared communication as mentioned is applied will be described in detail with reference to the drawings. In describing the figures, the configuration previously described in the first through third embodiments is basically identical in the fifth embodiment as well, so that description thereon is omitted.

[0324] As illustrated in **FIG. 36A**, a body case **116** of a wristwatch **110** contains a control circuit section **63**, a power supply **64**, and an Ir communication control section **1165** for infrared-based data communications. Also, similarly to the

fourth embodiment, a display section **1061** and key sections **1062** are arranged along the outer periphery of the body case **116**.

[0325] Wrist bands **4** and **5** comprise bus line wires similar to those in the third modification of the second embodiment; a light emitting section **196** having an infrared light emitting device in place of the connector member (for the (TX) line) **96** at a position opposite to an infrared input section **1185** of each function module unit **1180** through **1184**; and a light receiving section **197** having an infrared receiving device in place of the connector member (for the (Rx) line) **97** at a position opposite to an infrared output section **1186**.

[0326] Each of the module units **1180** through **1183** is connected to the Vcc lines **411** and **511** and to the ground lines **414** and **515**, and has the light receiving section **1185** opposing the light emitting section **196** of the wrist bands **4** and **5** and the light emitting section **1186** opposing the light receiving section **197** of the wrist bands **4** and **5**.

[0327] As illustrated in FIG. 36B, the function module unit **1180** comprises connector members **91** and **94**, light receiving section **1185** and light emitting section **1186**, as well as a power control section **812**, a modem **853**, a coding/decoding section **852**, an I/O control circuit section **859**, a ROM **816**, a memory **817**, an I/O circuit and so on **860** for controlling data communications with a variety of devices such as sensor devices for acquiring surrounding environment and vital information, an imaging device, an audio input/output device, and so on.

[0328] Therefore, according to these function module units **1180** through **1183**, data communications with the body case **116** through infrared communication can be made through the light receiving section **1185** and the light emitting section **1186** in the function module unit and the light emitting section and the light receiving section **197** in the wrist bands **4** and **5**.

[0329] Sixth Embodiment

[0330] FIGS. 37A and 37B illustrate a sixth embodiment of the present invention, wherein an induced electromagnetic field generated by electromagnetic induction is used to communicate data between antenna coils in wrist bands and an antenna coil built in each module unit.

[0331] As illustrated in FIG. 37A, a body case **126** of a wristwatch **120** contains a control circuit section **63** and a power supply **64**. Similarly to the fourth embodiment, a display section **1061** and key sections **1062** are arranged along the outer periphery of the body case **126**. The control circuit section **63** is connected to antenna coils **2041** and **2051** arranged in wrist bands **4** and **5**, respectively, through a data carrier communication control section **1266**.

[0332] As illustrated in FIG. 37B, the data carrier communication section **1266** comprises a demodulating circuit **661**, a filter and amplifier circuit **662**, a decoding circuit **663**, an antenna driving circuit **664**, an oscillating circuit **665**, a modulating circuit **667**, and an encoding circuit **666**.

[0333] The decoding circuit **663** and the encoding circuit **666** are connected to the control circuit section **63**, while the oscillating circuit **665** is connected to the control circuit section **63** through a time measuring circuit section **167** for generating time information.

[0334] The control circuit section **63** is connected to the key sections **1062** and the display section **1061**, as well as to a data memory **166** and a back-up power supply unit **168**.

[0335] On the other hand, function module units **1280** through **1283** are removably mounted to wrist bands **104** and **105** by appropriate mounting means.

[0336] Each of the module units **1280** through **1284** comprises a module antenna **1286**, a demodulating circuit **353**, a decoding circuit **354**, a clock recovering circuit **359**, an A/D converter **358** which additionally provides a rectifying function, a parasitic power source **346**, an encoding circuit **356**, a modulating circuit **357**, a control circuit section **856**, a ROM **816**, a memory **817**, and an input/output device **884**.

[0337] Therefore, according to the sixth embodiment, the electromagnetic induction between the antenna coil **2041** (**2051**) on the wrist band side and the module antenna coil **1286** in each of the function module units **1280** through **1283** enables data to be communicated between the control circuit section **63** and each of the function module units **1280** through **1283** as well as enables the power of the primary cell **64** to be supplied to each of the function module units **1280** through **1283** without contact, thereby making it possible to eliminate wired bus line and accordingly simplify the wiring structure.

[0338] Seventh Embodiment

[0339] FIG. 38 illustrates the seventh embodiment of the present invention, wherein function module units are made in a coin shape so that they are removably fitted in wrist bands.

[0340] In the following, the seventh embodiment of the present invention will be described with reference to FIG. 38. In describing the figures, the configuration previously described in the first through third embodiments is basically identical in the seventh embodiment as well, so that description thereon is omitted.

[0341] Wrist bands **134** and **135** joined to both ends of a body case **36** are formed with a plurality of function module unit fitting holes **1341** and **1351** which are circular in shape, when seen on a plan view, and in which function module units **1300** through **1303** can be removably fitted.

[0342] On the bottom of each module unit fitting hole **1341**, **1351**, portions of a Vcc line **511**, a serial data line **512**, a clock data line **513**, and a ground line **514** are exposed.

[0343] On the other hand, each of the function module units **1300** through **1303** is provided on the bottom with connector members **91** through **94** at positions corresponding to the exposed portions of the respective lines **511** through **514**.

[0344] Therefore, according to the seventh embodiment, functions can be readily added by fitting the function module units **1300** through **1302** into the module unit fitting holes **1341** and **1351** as required.

[0345] Modification of Seventh Embodiment

[0346] In the foregoing seventh embodiment, while the function module unit **1300** is made circular in shape, when seen on a plan view, the function module unit **1300** may be made in any appropriate shape, not limited to the circular shape (FIG. 39A) on a plan view, such as oval (FIG. 39B),

square (FIG. 39C), rectangle with curved corners (FIG. 39D), rectangle with a particular corner cut away (FIGS. 39E and 39F), semicircle (FIG. 39G), wedge shape (FIG. 39H), and so on.

[0347] Also, in terms of the positions at which the connector members 91 through 94 are formed, they may be aligned along a base line (FIG. 39I), or placed along one side of the function module unit (FIGS. 39J and 39K). When the function module 1300 is cylindrical, the connector members 91 through 94 may be formed on its peripheral surface (FIG. 39L).

[0348] Eighth Embodiment

[0349] An eighth embodiment describes control processing in detail in the first embodiment when data is communicated between the control circuit section 63 contained in a body case 5006 (6) and each of the function module units 80 through 84. In describing figures, since the configuration previously described in the first embodiment is basically identical, description thereon is omitted.

[0350] As illustrated in FIG. 40, in the eighth embodiment, the body case 5006 of a wristwatch 5001 contains a function module unit control data memory 1661, later described, in addition to the configuration described in the first embodiment.

[0351] FIG. 41A illustrates the circuit configuration of each function module unit 80 through 84. In describing the figure, since components previously described in the first embodiment are basically identical in configuration, they are omitted in the following description.

[0352] An I/O control circuit section 1811 is connected to connector members 92 and 93 for reading, storing or searching data on a ROM 1816 and a memory 817 as well as data on peripheral circuits such as an I/O circuit, a communication circuit and so on in accordance with a received command. The I/O control circuit section 1811 manages the power in a power control section 812.

[0353] The ROM 1816 stores a manufacturer/series code (Family Code) 8160 indicative of the manufacturer which has manufactured an associated function module unit, and a model number or the like in the manufacturer; a product serial number (Serial No.) 8161; a power supply/primary cell module bit (PS) 8162 for setting whether or not the associated function module unit includes a power supply module unit or a power supply with 1-bit data (flag) information; an input (data readable) module bit (IN) 8163 for setting whether or not the associated function module unit can read data from the outside with 1-bit data (flag) information; an output (data writable) module bit (OUT) 8164 for setting whether or not the associated function module unit can write data to the outside; display format setting data (DF) 8165; a module type code (Module Code) 8166; a module specification code (Module Spec) 8167; power consumption information data 8168 (PCI: Power Consumption Information); and an error check (CRC cyclic correction code) 8169.

[0354] Among these data stored in the ROM 1816, the module type code (Module Code) 8166 and the module specification code (Module Spec) 8167 are defined in each table stored in the function module unit control data memory 1661.

[0355] The display format setting data (DF) 8165 is data for defining a display format when items related to an associated function module unit is displayed on a display section 60 of the wristwatch 5001. The power consumption information data (PCI) 8168 is data related to power consumption required for an associated function module unit to normally operate (power consumption when the function module unit is off; average power consumption when on; maximum power consumption when on; and so on).

[0356] The module type code (Module Code) 8166 is a code indicative of the type of an associated function module unit, while the module specification code (Module Spec) 8167 is a code indicative of specifications of the associated function module unit.

[0357] The module type code 8166 and the module specification code 8167 will be described later in greater detail.

[0358] When these data and codes are communicated between the respective function module units and the watch body, the data structure conforms to those shown in FIGS. 10A and 10B, 11A through 11G. Each of the data and codes, however, is modified.

[0359] FIG. 42 is a block diagram illustrating in detail the circuit configuration of function module units 82 and 83 as an example.

[0360] The ROM 1816 of the function module units 82 and 83 stores information from the manufacturer/series code 8160 of the function module unit to the error check (CRC cyclic correction code) 8169 shown in FIG. 41B.

[0361] In the information 8160 through 8169, the code type code 8166 for the function module unit 82 and 83 is defined as "Module Code=0100 (=sensor system (measurement processing))" on the right side of FIG. 42. The module specification code 8167 for the function module unit 83 is defined as "Module Spec=0010 (barometer (hPa))".

[0362] Modification of Eighth Embodiment

[0363] FIG. 43 illustrates a modification in the eighth embodiment of the present invention, which describes control processing in detail in the second embodiment when data is communicated between the control circuit section 163 contained in a body case 5016 (6) and each of the function module units 21 through 26. In describing figures, since the configuration previously described in the second embodiment is basically identical, description thereon is omitted.

[0364] In the modification of the eighth embodiment, as illustrated in FIG. 43, the body case 5016 of a wristwatch 5002 contains a function module unit control data memory 1661, later described, in addition to the configuration previously described in the first embodiment.

[0365] The function modules 21 through 26 are each connected to Vcc lines 411 and 511; serial data lines 412 and 512; clock data lines 413 and 513; and ground lines 414 and 514.

[0366] FIG. 44 is a block diagram illustrating in detail the circuit configuration of the function module units 21 and 22. In describing the figure, since components previously described in the second embodiment are basically identical in configuration, they are omitted in the following description.

[0367] A ROM 1817 stores information from the manufacturer/series code 8160 of the function module unit to the error check (CRC cyclic correction code) 8169, which are similar to those shown in FIG. 41B. Among the information 8160 through 8169, the module type code 8166 of the function module unit 21 and 22, which has a memory function, is defined as "Module Code=0010 (=memory system)". Also, the module specification code 8167 of the function module unit 21 is defined as "Module Spec=0110 (32 MB/Flash(memory device))".

[0368] FIG. 45 is a block diagram illustrating in detail the circuit configuration of the function module unit 23. Since components previously described in the second embodiment are basically identical in configuration, they are omitted in the following description.

[0369] A ROM 1818 stores information from the manufacturer/series code 8160 of the function module unit to the error check (CRC cyclic correction code) 8169, which are similar to those shown in FIG. 41B.

[0370] Among the information 8160 through 8169, the module type code 8166 of the function module unit 23 is defined as "Module Code=0111 (=wireless processing system (communication system))".

[0371] The module specification code 8167 of the function module unit 23 is defined as "Module Spec=0101 (=proximate wireless communication (Bluetooth))".

[0372] FIG. 46 is a block diagram illustrating in detail the circuit configuration of the function module unit 24. Since components previously described in the second embodiment are basically identical in configuration, they are omitted in the following description.

[0373] A ROM 1819 stores information from the manufacturer/series code 8160 of the function module unit to the error check (CRC cyclic correction code) 8169, which are similar to those shown in FIG. 41B.

[0374] Among the information 8160 through 8169, the module type code 8166 of the function module unit 24 is defined as "Module Code=0101 (=input processing system (device))".

[0375] The module specification code 8167 of the function module unit 24 is defined as "Module Spec=0111 (=image input (CCD, CMOS))".

[0376] FIG. 47 is a circuit diagram illustrating in detail the circuit configuration of the function module unit 25. Since components previously described in the second embodiment are basically identical in configuration, they are omitted in the following description.

[0377] A ROM 1820 stores information from the manufacturer/series code 8160 of the function module unit to the error check (CRC cyclic correction code) 8169, which are similar to those shown in FIG. 41B.

[0378] Among the information 8160 through 8169, the module type code 8166 of the function module unit 25 is defined as "Module Code=0110 (=output processing system (device))".

[0379] The module specification code 8167 of the function module unit 25 is defined as "Module Spec=0101 (=audio output (speaker, earphone))".

[0380] FIG. 48 is a circuit diagram illustrating in detail the circuit configuration of the function module unit 26. Since components previously described in the second embodiment are basically identical in configuration, they are omitted in the following description.

[0381] A ROM 1821 stores information from the manufacturer/series code 8160 of the function module unit to the error check (CRC cyclic correction code) 8169, which are similar to those shown in FIG. 41B.

[0382] Among the information 8160 through 8169, the module type code 8166 of the function module unit 26 is defined as "Module Code=1101 (=secondary cell)".

[0383] The module specification code 8167 of the function module unit 26 is defined as "Module Spec=0101 (=3.6V, 200 mAh)".

[0384] FIGS. 49 through 58 show tables 1662 through 1671 which are stored in the module unit control data memories 1661 of the respective wristwatches 5001 and 5002.

[0385] Each of the tables 1662 through 1671 stores a module identification code, a module specification code and a function in correspondence.

[0386] FIG. 49 shows a time measuring function module table 1662 in which the module identification code is set to "0000" commonly for all time measuring function module units such as a surf timer, a yacht timer, . . . , and so on in correspondence.

[0387] The module specification code differs from one function module unit to another depending on the function.

[0388] Therefore, the control circuit sections 63 and 163 of the wristwatches 5001 and 5002 can determine whether or not a function module unit fitted on and connected to the wrist bands 4 and 5 provides a time measuring function, and which specifications, when it provides the time measuring function, by referencing this time measuring function module table 1662.

[0389] FIG. 50 shows a CPU/processing program function module table 1663 in which the module identification code is set to "0001" commonly for all CPU/processing program function module units such as sunrise/sunset calculation, moon age calculation, and so on in correspondence.

[0390] The module specification code differs from one function module unit to another depending on the function. Therefore, the control circuit sections 63 and 163 of the wristwatches 5001 and 5002 can determine whether or not a function module unit fitted on and connected to the wrist bands 4 and 5 provides a CPU/processing function, and which specifications, when it provides the CPU/processing function, by referencing this CPU/processing program function module table 1663.

[0391] FIG. 51 shows a memory function module table 1664 in which the module identification code is set to "0010" commonly for all memory module units such as 1 MB/SRAM, 2 MB/SRAM, . . . and so on in correspondence.

[0392] The module specification code differs from one function module unit to another depending on the memory capacity and hardware specifications of a particular function module unit.

[0393] Therefore, the control circuit sections 63 and 163 of the wristwatches 5001 and 5002 can determine, by referencing this memory function module table 1664, whether or not a function module unit fitted on and connected to the wrist bands 4 and 5 provides a memory function, and how man capacity and in which hardware the function module unit is configured, when it provides the memory function, based on the module specification code.

[0394] FIG. 52 shows a data bank function module table 1665 in which the module identification code is set to "0011" commonly for all data bank module units such as an address book, a schedule book, . . . and so on in correspondence.

[0395] The module specification code differs from one function module unit to another depending on the function.

[0396] Therefore, the control circuit sections 63 and 163 of the wristwatches 5001 and 5002 can determine, by referencing this data bank function module table 1665, whether or not a function module unit fitted on and connected to the wrist bands 4 and 5 provides a data bank function, and which specifications, when it provides the data bank function, based on the module specification code.

[0397] FIG. 53 shows a sensor function module table 1667 in which the module identification code is set to "0100" commonly for all data bank module units such as a thermometer, a barometer, . . . and so on in correspondence.

[0398] The module specification code differs from one function module unit to another depending on the function.

[0399] Therefore, the control circuit sections 63 and 163 of the wristwatches 5001 and 5002 can determine by referencing this sensor function module table 1666, whether or not a function module unit fitted on and connected to the wrist bands 4 and 5 provides a sensor function, and which specifications, when it provides the sensor function, based on the module specification code.

[0400] FIG. 54 shows an input processing system (device) function module table 1667 in which the module identification code is set to "0101" commonly for all input processing function module units such as input through via a connector (binary data), key input (keyboard), . . . and so on in correspondence.

[0401] The module specification code differs from one function module unit to another depending on the function.

[0402] Therefore, the control circuit sections 63 and 163 of the wristwatches 5001 and 5002 can determine by referencing this input processing system (device) function module table 1667, whether or not a function module unit fitted on and connected to the wrist bands 4 and 5 comprises an input device, and which specifications, when it comprises an input device, based on the module specification code.

[0403] FIG. 55 shows an output processing system (device) function module table 1668 in which the module identification code is set to "0110" commonly for all output processing function module units such as output through via a connector (binary), display output (monochrome display), . . . and so on in correspondence.

[0404] The module specification code differs from one function module unit to another depending on the function.

[0405] Therefore, the control circuit sections 63 and 163 of the wristwatches 5001 and 5002 can determine by referencing this output processing system (device) function module table 1668, whether or not a function module unit fitted on and connected to the wrist bands 4 and 5 comprises an output device, and which specifications, when it comprises an output device, based on the module specification code.

[0406] FIG. 56 shows a wireless processing system (communication system) function module table 1669 in which the module identification code is set to "0111" commonly for all output processing function module units such as general wireless communication, general wireless reception, . . . and so on in correspondence.

[0407] The module specification code differs from one function module unit to another depending on the function.

[0408] Therefore, the control circuit sections 63 and 163 of the wristwatches 5001 and 5002 can determine by referencing this wireless processing system (communication system) function module table 1669, whether or not a function module unit fitted on and connected to the wrist bands 4 and 5 provides a wireless processing function, and which specifications, when it provides the wireless processing function, based on the module specification code.

[0409] FIGS. 57 and 58 show a primary cell function module table 1670 and a secondary cell function module table 1671 in which the module identification code is set to "1000" (for the primary cell) or "1101" (for the secondary cell) commonly for all power supply module units such as 1.5V, 80 mAh; 3V, 150 mAh; and so on in correspondence.

[0410] The module specification code differs from one function module unit to another depending on the capabilities of the function module unit.

[0411] Therefore, the control circuit sections 63 and 163 of the wristwatches 5001 and 5002 can determine by referencing the primary cell and secondary cell function module tables 1670 and 1671, whether or not a function module unit fitted on and connected to the wrist bands 4 and 5 comprises a power supply, and which function is provided thereby, when it comprises a power supply, based on the module specification code.

[0412] In the eighth embodiment and modifications thereto configured as described above, the control circuit section 63 or 163 of each wristwatch 5001 or 5002 first executes processing in accordance with a flow chart illustrated in FIG. 59 based on the processing programs stored therein.

[0413] It is determined whether or not there is a newly connected function module unit fitted in the wrist band 4 or 5 (step S1).

[0414] If there is a newly connected function module unit, the control circuit section 63 or 163 reads the module ID (manufacturer/series code 8160, product serial number 8161) from among the information 8160 through 8169 stored in the ROM 816, 1816 through 1821 of the function module unit to determine whether or not the function module unit is supported by the wristwatch 5001 or 5002 (step S2). Then, the control circuit section 63 or 163 reads the subsequent module information (power supply/primary cell module bit (PS) 8162, input (data readable) module bit (IN) 8163, output (data writable) module bit (OUT) 8164,

display format setting data (DF) **8165**, module type code (Module Code) **8166**, module specification code (Module Spec) **8167**, power consumption information data **8168** (PCI: Power Consumption Information), and error check (CRC cyclic correction code) **8169** (step **S3**).

[**0415**] In correspondence to the module ID read at step the control circuit section **63** or **163** registers the module information read at step **S3** in the module control data memory **1661** (step **S4**).

[**0416**] The control circuit section **63** or **163** then displays icons representative of the connected function module units and the module information of the same on the display section **60** or **161** (step **S5**).

[**0417**] The processing at step **S5** causes the display section **60** or **161** of the wristwatch **5001** or **5002** to display the icons and module information of the connected function module units as illustrated in **FIG. 60**, or to display the module information in a tree form as illustrated in **FIG. 61** (in **FIG. 60**, **610** designates an audio output icon representative of an output processing (device) function module unit; **611** an icon representative of a wireless processing (communication system) function module unit; **612** an icon representative of a memory function module unit; and **613** an icon representative of a power supply module unit).

[**0418**] It is determined whether or not there is another newly connected function module unit (step **S6**), and the processing from step **S2** to step **S5** is repeated for a newly connected function module unit, if any.

[**0419**] Then, when the processing from step **S2** to step **S5** has been completed for all of newly connected function module units, or when the result at the determination at step **S1** shows that there is no newly connected function module unit, it is determined, contrary to the above, whether or not there is any function module unit which has been removed from the wrist band **4** or **5** (step **S7**).

[**0420**] If there is a function module unit which has been removed, the control circuit section **63** or **163** deletes the module ID and module information of the removed function module unit registered in the module control data memory **1661** at the foregoing step **S4** from the registered data (step **S8**).

[**0421**] Then, the control circuit section **63** or **163** displays icons and module information of connected function module units on the display section **60** or **161** (step **S9**). It is determined whether or not there is another function module unit removed from the wrist band **4** or **5** (step **S10**), and the processing at steps **S8** and **S9** is repeated for all of removed function module units.

[**0422**] When the processing at steps **S8** and **S9** has been completed for all of the removed function module units, or when the result of the determination at step **S7** shows that there is no removed function module unit, the control circuit section **63** or **163** displays icons and module information of the respective function module units connected to the wrist band **4** or **5** on the display section **60** or **161** by referencing the contents registered in the module control data memory **1661** (step **S11**).

[**0423**] The control circuit section **63** or **163** reads the contents registered in the module control data memory **1661** and selectively controls a function module unit to be oper-

ated from the capacity of a connected power supply module unit and the power consumption information data **8168** of the respective function module units (step **S12**).

[**0424**] As a result, if an input processing (device) function module unit, for example, has been operated, the control circuit section **63** or **163** processes data entered by the user in response to arbitrary manipulations of the user (step **S13**).

[**0425**] When the operated function module unit is a function module unit other than the input processing (device) function module unit and the output processing (device) function module unit for which processing is performed at the next step **S15**, data is processed in accordance with the function and specifications of the function module unit (step **S14**).

[**0426**] When the operated function module unit is an output processing (device) function module unit, the control circuit section **63** or **163** outputs data which is instructed by the user through arbitrary manipulations (step **S15**).

[**0427**] **FIG. 62** is a flow chart illustrating in detail a routine of the processing at step **S12** for selecting a function module to be operated.

[**0428**] It is first determined whether or not there is a newly connected power supply module unit fitted on the wrist band **4** or **5** (step **S1201**). If there is a newly connected power supply module, the control circuit section **63** or **163** reads a module ID stored in the ROM **816** of the power supply module unit, and reads subsequent module information (step **S1202**).

[**0429**] The read module ID and module information are registered in the module control data memory **1661** (step **S1203**).

[**0430**] The control circuit section **63** or **163** calculates the total capacity of all power supply module units connected to the wrist bands, and updates the value of the total capacity so far stored in the module control data memory **1661** (step **S1204**).

[**0431**] The control circuit section **63** or **163** displays icons representative of connected power supply module units and module information of the same on the display section **60** or **161** (step **S1205**). It is determined whether or not there is another newly connected power supply module unit (step **S1206**), and the processing from step **S1202** to step **S1205** is repeated to all of newly connected power supply module units.

[**0432**] When the processing from step **S1202** to step **S1205** has been completed or when the result of the determination at step **S1201** shows that there is no newly connected power supply module unit, the control circuit section **63** or **163** calculates off-time power consumption, average on-time power consumption, and maximum on-time power consumption from power consumption information data of all connected function module units except for the power supply module units (step **S1207**).

[**0433**] Then, the control circuit section **63** or **163** displays the total capacity of all the connected power module units and the power consumption information of all the function module units on the display section **60** or **161** (step **S1208**).

[**0434**] It is determined whether or not a total of on-time average power consumption of all the function module units

except for the power supply module units is less than the total capacity of all the connected power supply module units (step S1209).

[0435] If the determination at step S1209 is NO, i.e., if the total of on-time average power consumption of the connected function module units is equal to or more than the total capacity of all the power supply modules, the control circuit section 63 or 163 performs error processing (step S1214).

[0436] Associated with the error processing, the control circuit section 63 or 163 displays re-selection of function module units to be connected, or removal of excessive function module units, or addition of power supply module units on the display section 60 or 161 (step S1215).

[0437] On the other hand, if the determination at step S1209 is YES, i.e., if the total of on-time average power consumption of all the connected function module unit is less than the total capacity of all the power supply module units, it is determined whether or not the total of on-time maximum power consumption of all function module units except for the power supply module units is less than the total capacity of all the connected power supply module units (step S1210).

[0438] If the determination at step S1210 is NO, i.e., if the total of on-time maximum power consumption is equal to or more than the total capacity of all the connected power supply module units, the control circuit section 63 or 163 performs error processing (step S1212).

[0439] Associated with the error processing, the control circuit section 63 or 163 displays on the display section 60 or 161 to re-select function module units to be simultaneously driven, or remove excessive function module units, or add power supply module units (step S1213).

[0440] If the determinations at step S1209 and at step S1210 are both YES, i.e., if the total of on-time average power consumption of the connected function module units is less than the total capacity of the power supply module units, and if the total of on-time maximum power consumption of the connected function module units is less than the total capacity of the power supply module units, the control circuit section 63 or 163 performs processing at step S1211.

[0441] Specifically, the control circuit section 63 or 163 displays the total capacity of the connected power supply module units, and the power consumption of the connected function module units by referencing the contents registered in the module control data memory 1661.

[0442] FIG. 63 is a flow chart illustrating in detail a routine of the data input processing at step S13 in FIG. 59.

[0443] In response to manipulations of the user on the key sections 62 or 162, the control circuit section 63 or 163 searches data registered in the module control data memory 1661 for a desired input processing (device) function module unit (step S1301).

[0444] It is determined from the result of the search whether or not the desired input processing (device) function module is available (step S1302), and the control circuit section 63 or 163 performs error processing if not (step S1307), followed by termination of the input processing routine.

[0445] If the desired function module unit is available, this function module unit performs data input processing of the user through arbitrary manipulations (step S1303).

[0446] It is determined whether or not the data input has been successfully performed (step S1304), and the control circuit section 63 or 163 performs the error processing if not successfully performed (step S1307), followed by termination of the input processing routine.

[0447] If the result of the determination at step S1304 shows that the data input has been successfully performed, the control circuit section 63 or 163 stores the input data in the data memory 166 within the control section (control circuit section 63 or 163) (step S1305).

[0448] Then, the control circuit section 63 or 163 displays the function module unit which has performed the input processing and associated data on the display section 60 or 161 by referencing the contents registered in the module control data memory 1661 (step S1306).

[0449] FIG. 64 is a flow chart illustrating in detail a routine of the data control processing at step S14 in FIG. 59 when data is read from a function module unit having a memory function and stored in the data memory 166 of the control circuit section 63 or 163.

[0450] In response to manipulations on the key sections 62 or 162, the control circuit section 63 or 163 searches data registered in the module control data memory 1661 for a function module unit which has a memory function (step S1401).

[0451] It is determined from the result of the search whether or not a function module unit having a memory function is connected to the wrist band 4 or 5 (step S1402), and the control circuit section 63 or 163 performs error processing if not (step S1407), followed by termination of this routine.

[0452] If a function module unit having a memory function is connected, it is determined whether or not a file or data specified by the user through predetermined manipulations is stored in the function module unit (step S1403).

[0453] It is determined whether or not a desired file or data is found (step S1404), and the control circuit section 63 or 163 performs the error processing (step S1407), followed by termination of this routine.

[0454] If the result of the determination at step S1404 shows that the desired file or data is found, the file or data is stored in the data memory 166 of the control circuit section 63 or 163 (step S1405).

[0455] The control circuit section 63 or 163 displays the function module unit and the read file or data on the display section 60 or 161 by referencing the contents registered in the module control data memory 1661 (step S1406).

[0456] FIG. 65 is a flow chart illustrating in detail a routine of the processing at step S14 in FIG. 59 when data is written from the data memory 166 of the control circuit section 63 or 163 to a function module unit having a memory function, reverse to the processing routine in FIG. 64.

[0457] In response to predetermined manipulations by the user on the key sections 62 or 162, the control circuit section

63 or **163** searches data registered in the module control data memory **1661** for a function module unit having a memory function (step **S1411**).

[**0458**] It is determined from the result of the search whether or not a function module unit having a memory function is connected to the wrist band **4** or **5** (step **S1412**), and the control circuit section **63** or **163** performs error processing if not (step **S1417**), followed by termination of this processing routine.

[**0459**] If a function module unit having a memory function is connected, a file or data specified by the user through predetermined manipulations is first temporarily read into a memory within the control circuit section **63** or **163** (step **S1413**).

[**0460**] Then, the control circuit section **63** or **163** stores the file or data in the memory function module unit (step **S1414**).

[**0461**] It is determined whether or not the storage has been successfully performed (step **S1415**), and the control circuit section **63** or **163** performs the error processing if not performed successfully (step **S1417**), followed by termination of the processing routine.

[**0462**] If the storage has been successfully performed, the control circuit section **63** or **163** displays the function module unit in which the file or data has been stored, and the file or data on the display unit **60** or **161** by referencing the contents registered in the module control data memory **1661** (step **S1416**).

[**0463**] **FIG. 66** is a flow chart illustrating in detail a routine of the data output processing at step **S15** in **FIG. 59**.

[**0464**] In response to manipulations on the key sections **62** or **162**, the control circuit section **63** or **163** searches data registered in the module control data memory **1661** for a function module unit having an output processing (device) function (step **S1501**).

[**0465**] It is determined from the result of the search whether or not a function module unit having an output processing (device) function is available (step **S1502**), and the control processing section **63** or **163** performs error processing if not (step **S1507**), followed by termination of the function module unit output processing routine.

[**0466**] If a function module unit having an output processing (device) function is available, data to be output from the function module unit is first read into a memory within the control section (control circuit section **63** or **163**) (step **S1503**).

[**0467**] This data is output to the function module unit (step **S1504**).

[**0468**] It is determined whether or not the output has been successfully performed (step **S1505**), and the control circuit section **63** or **163** performs the error processing if not (step **S1507**), followed by termination of the function module unit output processing routine.

[**0469**] If the output has been successfully performed, the control circuit section **63** or **163** displays the function module unit to which the data has been output, and the data on the display section **60** or **161** by referencing the contents registered in the module control data memory **1661** (step **S1506**).

[**0470**] Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the present invention in its broader aspects is not limited to the specific details, representative devices, and illustrated examples shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents. While the foregoing embodiments have been described for a wristwatch worn on a wrist of the user taken as an example of a body wearable information processing terminal device, the present invention is not limited to the wristwatch, but may be applied to any information processing terminal device.

[**0471**] For example, as illustrated in **FIG. 67**, the information processing terminal device may be designed to have the bus line wires **411**, **412**, **413**, **414** (**511**, **512**, **513**, **514**) routed on a belt **6002** wound around the waist of the user, and the body case **6** provided with a movable shaft **73** for pivoting the display section **60**, such that the display section **60** can be rotated upward by 90 degrees, when the user mounts the information processing terminal device, to allow the user to look down the display section **60**.

[**0472**] In this case, respective function module units **80** and **81** can be removably mounted to the belt **6002** and can be applied as a wearable computer which can readily extend functions.

What is claimed is:

1. A body wearable information processing terminal device comprising:

a case body which contains an electronic circuit having a predetermined function;

a display section configured to display at least time information;

a band section which is joined to said case body and removably secured on a human body of a user; and

an electronic device which is removably mounted on said band section,

wherein said band section comprises a connection structure configured to electrically connecting said electronic device to said electric circuit.

2. The information processing terminal device according to claim 1, wherein said connection structure is electrically connected to said band section by a fixing member configured to fix a case cover sealing said case body.

3. The information processing terminal device according to claim 2, wherein said connection structure comprises a spring member and said case body and said band section are pressed by said spring member to be in contact with each other.

4. The information processing terminal device according to claim 3, further comprising a water-proof structure near said spring member which prevents water from introducing into said case body from said connection structure.

5. The information processing terminal device according to claim 1, wherein said band section comprises a connector member which is electrically and directly connected to said electronic device; and

said electronic device comprises a connector which is directly connected to said connector member, and a fixing structure which is fixed to said band section.

6. The information processing terminal device according to claim 5, wherein said electronic device comprises an identification information memory configured to store identification information of the information processing terminal device, and said information processing terminal device further comprising:

- a function information memory configured to store function information corresponding to the identification information;
- a receiver configured to receive the identification information transmitted from said electronic device;
- a search unit configured search for relevant function information from said function information memory with the identification information received by said receiver used as a search condition; and
- a controller configured to control said electronic circuit based on a result of search made by said search unit.

7. The information processing terminal device according to claim 6, further comprising a first display controller configured to display contents of control made by said controller on said display section.

8. The information processing terminal device according to claim 6, wherein a plurality of electronic devices are able to be removably mounted on said band section, and said controller comprises:

- a first determining unit configured to determine based on the identification information whether a connected electronic device has a function of supplying power to said electronic circuit and other connected electronic devices;

an information acquiring unit configured to acquire information related to a power to be supplied and information on power consumed by at least the other connected electronic devices when said first determining unit determines that the connected electronic device has the function of supplying power;

- a second determining unit configured to determine whether or not the other connected electronic devices can normally operate based on the information acquired by said information acquiring unit; and

an informing unit configured to inform a result of determination made by said second determining unit.

9. The information processing terminal device according to claim 1, wherein said band section comprises a plurality of block members which comprise a function possessed by said electronic device.

10. The information processing terminal device according to claim 1, wherein said electronic device comprises a memory configured to store at least a variety of information to be calculated by said electronic circuit.

11. The information processing terminal device according to claim 1, wherein said electronic device comprises a sensor configured to detect surrounding environmental information, and said information processing terminal device further comprising:

an environmental information receiver configured to receive the surrounding environmental information from said electronic device; and

- a second display controller configured to display the surrounding environmental information received by said environmental information receiver on said display section.

12. The information processing terminal device according to claim 1, wherein said electronic device comprises a wireless communication unit, and said information processing terminal device further comprising:

- an acquiring unit configured to acquire contents communicated by said wireless communication unit; and
- a third display controller configured to display the contents acquired by said acquiring unit on said display section.

13. The information processing terminal device according to claim 12, wherein said electronic device comprises an audio information input/output unit, and said information processing terminal device further comprising:

- a converter configured to convert audio information input by said audio information input/output unit to communication contents; and

- a communication contents output unit configured to output the communication contents converted by said converter to said wireless communication unit.

14. The information processing terminal device according to claim 13, wherein said audio information input/output unit converts the communication contents converted by said converter to an audio signal.

15. The information processing terminal device according to claim 1, wherein said electronic device comprises an image capturing device, and said information processing terminal device further comprising:

- a fourth display controller configured to display the image captured by said image capturing device on said display section.

16. The information processing terminal device according to claim 1, wherein said electronic device comprises an audio information output unit, and said information processing terminal device further comprising:

- a user operable device; and

- an audio information controller configured to control said audio information output unit based on an operation of said user operable device.

17. The information processing terminal device according to claim 1, wherein a plurality of electronic devices are able to be removably mounted on said band section, and each of said electronic devices comprises an information output unit configured to output information stored in other electronic devices.

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