(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 483 829 A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 91118565.0

(51) Int. Cl.[5]: G09G 3/32

(22) Date of filing: 30.10.91

(30) Priority: 31.10.90 JP 296602/90
29.11.90 JP 325826/90

(43) Date of publication of application:
06.05.92 Bulletin 92/19

(84) Designated Contracting States:
DE FR GB

(71) Applicant: Oki Electric Industry Co., Ltd.
7-12, Toranomon 1-chome Minato-ku
Tokyo(JP)

(72) Inventor: Sato, Masashi, c/o Oki Electric
Industry Co., Ltd
7-12, Toranomon 1-chome
Minato-ku, Tokyo(JP)

(74) Representative: Betten & Resch
Reichenbachstrasse 19
W-8000 München 5(DE)

(54) Control circuit for operating panel.

(57) A control circuit for an operating panel in a printing apparatus or the like is provided with indicator devices and switches, and is adapted for lighting the indicator elements and sensing switching conditions of the switches on the basis of a control signal transmitted from a control unit. The control circuit is provided with a serial-to-parallel converter (2 in FIG. 2; 11 in FIG. 5) having input terminals (DATA, CLK) and output terminals (O_1-O_{16}) for converting a serial signal transmitted from the control unit (4, 5 in FIG. 2; 13 in FIG. 5) into a parallel signal. The output terminals (O_1 - O_{16}) of the serial-to-parallel converter are connected with the indicator elements (LED 1 - LED 16), which are put to the ground at the other ends thereof, and some output terminals (O_9 - O_{16}) of the serial-to-parallel converter are further connected with the switches (SW 1 - SW 8).

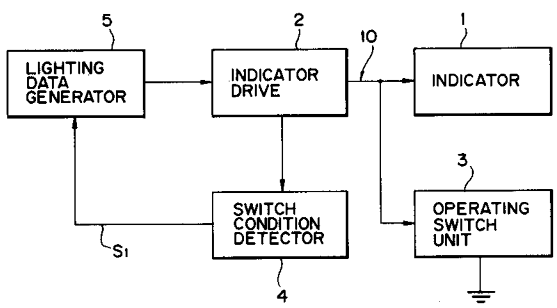


FIG.1

EP 0 483 829 A2

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a control circuit for an operating panel or operation console and the like, and more particularly to one preferably used in a circuit for controlling a turn-on operation of a display or indicatior device such as LED (Light Emitting Diode) provided on an operating or indicator panel in a printing apparatus and the like.

Description of the Prior Art

Generally, an operating panel in a printing apparatus and the like is provided with a control circuit having a display or indicator unit for informing an operator of an operational state of the function and operating switches, which are controlled by a control unit.

FIG. 9 is an elevational view of a conventional operating panel by way of example. In the figure, there are shown a plurality of light emitting diodes designated by LED_1 - LED_{16} as display means and a plurality of operating or control switches designated by SW_1 - SW_8. Those elements LED_1 - LED_{16} and SW_1 -SW_8 are disposed on a printed circuit board 2 and attached to the back surface of an operating panel 1. When the printing apparatus is in operation, light emitting diodes LED_1 - LED_{16} serve to indicate, when lighting, functions which are now in turn-on state.

FIG. 10 is a diagram of a conventional control circuit by way of example. A control circuit 3 comprises driver electronics 4 for driving LED_1 -LED_{16}, current control resistors R_1 - R_{16} each for determining luminance of the associated light emitting diode, switches SW_1 - SW_8 and pull-up resistors R_{17} -R_{24}. The control circuit 3 is controlled by a central processor unit (CPU) 5. The driver 4 is provided with output terminals O_1 - O_{16} each connected in series to associated one of the elements LED_1 - LED_{16} to which the resistors R_1 - R_{16} are connected in series, respectively. The resistors R_1 - R_{16} are put to the ground at the other ends thereof by a common connection. Input terminals I_1 - I_{16} of the driver 4 are connected through terminals T_1 - T_{16} provided on a printed circuit board 2 to ports P_1 - P_{16} of CPU 5, respectively. Likewise, ports P_{17} - P_{24} of CPU 5 are connected through terminals T_{17} - T_{24} to one terminals of SW_1 - SW_8, respectively. The SW_1 - SW_8 are put to the ground at the other ends thereof. Further, the one terminals of the SW_1 - SW_8 are connected to associated one terminals of the pull-up resistors R_{17} - R_{24}, respectively, which are grounded at the other terminals thereof. Here, there are terminals, not shown, for power supply and ground.

Central processor unit 5 outputs a signal of level "1" through ports P_1 - P_{16} to a light emitting diode corresponding to function which is now in turn-on state, so that the driver 4 is driven to light that light emitting diode. When depression of switches SW_1 - SW_8 is sensed, ports P_{17} - P_{24} of CPU 5 are detected to determine depression of swithces SW_1 - SW_8 by discriminating whether or not the port corresponding to the depressed switch is now in level "0".

According to the conventional control circuit as mentioned above, however, there are required the ports of the central processor unit on individual switches SW's and individual LED's. Consequently, when the ports of the CPU are desired to be used for the other purpose, there is such an inconvenience that the remaining ports are few and thus limited in use for the other purpose.

Further, the conventional control circuit has been associated with the following drawbacks. There are required wirings for connection of the switches SW_1 - SW_8 and the associated ports. Thus, the number of wirings for connection is increased, thereby enlarging the required area of the printed circuit board.

The number of terminals in the terminal unit of the printed circuit board needs the sum of the number of LED's and the number of operating switches. Thus, the number of circuit connection patterns provided on the printed circuit board also requires the associated number of terminals, thereby enlarging the area of the printed circuit board.

Furthermore, according to the conventional control circuit, if the number of LED's exceeds the number of address lines of the CPU, or the number of operating switches exceeds the number of data lines of the CPU, there is such a problem that it needs to provide an additional LSI chip or electronics for an I/O port.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a control circuit permitting the same signal wire to be used in both the control of turn on and off of the indicator element such as a light emitting diode and the detection of depression of the switch element.

It is another object of the present invention to reduce the number of ports of a CPU to be used by permitting the same signal wire to be used in both the control of turn on and off of the indicator element such as an LED and the detection of depression of the switch element in order to solve such a problem that the ports of the CPU are required on individual switch elements and individual indicator elements.

According to the present invention, there is provided an indicator control circuit for controlling a drive operation of a lighting indicator unit provided with a plurality of indicator elements each adapted to indicate an operating condition of an electronic apparatus. The indicator control circuit comprises an indicator element driver unit provided with ports the number of which corresponds to that of the plurality of indicator elements, each of the ports being connected by a signal line to associated one of the plurality of indicator elements to supply a driving signal to the associated indicator element; an operating switch unit comprising a plurality of operating switches each of which is connected to associated one of the ports of the indicator element driver unit through associated one of the signal lines for connecting the ports and the indicator elements on a common basis; a switch condition detector for providing such a control that while the indicator element driver unit drives the indicator elements, the driving operation is stopped for a moment and at that time potential of each of the ports of the indicator element driver unit, to which the switches are connected, is sensed, so that turn-on/turn-off states of the switches are detected and turn-on/turn-off information representative of the turn-on/turn-off states of the switches is outputted; and a lighting data generator for generating data for lighting operation of the respective indicator elements on the basis of the turn-on/turn-off information of the switches outputted from the switch condition detector.

Further, the present invention provides a control circuit having a plurality of indicator elements and a plurality of switches, for lighting the indicator elements and sensing switching conditions of the switches on the basis of a control signal transmitted from a control unit. The control circuit is provided with a serial-to-parallel converter having input terminals and output terminals for converting a serial signal transmitted from the control unit into a parallel signal. The output terminals of the serial-to-parallel converter are connected with the plurality of indicator elements, which are put to a reference potential at other ends thereof, and some output terminals of the serial-to-parallel converter are further connected with the plurality of switches, to which a switch condition sensor is connected at other ends thereof on a common basis, while the switch condition sensor is put to the reference potential at another end thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the present invention will become more apparent from the consideration of the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a schematic diagram showing a functional structure of an indicator control circuit according to an embodiment of the present invention;

FIG. 2 is a schematic diagram used for the description of a wiring state of the indicator control circuit according to the embodiment of the present invention;

FIG. 3 is a time chart useful for understanding an operation of lighting of LED's in the embodiment;

FIG. 4 is a time chart useful for understanding a operation of sensing the switches in the embodiment;

FIG. 5 is a schematic diagram showing a control circuit according to another embodiment of the present invention;

FIG. 6 is a diagram showing an example of the structure of the serial signal in the embodiment;

FIG. 7 is a diagram showing a relation between input and output of the driver during a period of time of SW sense data output in the embodiment;

FIG. 8 is a time chart according to the embodiment shown in FIG. 1;

FIG. 9 is an elevational view of a conventional operating panel by way of example; and

FIG. 10 is a diagram of a conventional control circuit for an operating panel by way of example.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a diagram schematically showing a functional structure of an indicator control circuit according to an embodiment of the present invention. FIG. 2 is a diagram useful for understanding a wiring state of the indicator control circuit according to the embodiment of the present invention.

As apparent from FIGS. 1 and 2, the indicator or display control circuit according to the embodiment basically comprises an indicator unit 1, an indicator driver circuit or electronics 2, an operating or control switch unit 3, a switch condition detector 4 and a lighting data generator 5. It is noted that actually the switch condition detector 4 and the lighting data generator 5 are constructed into program sequences stored in a central processor system, which will be described later.

The indicator or display unit 1 is provided for indicating an operating condition of an electronic apparatus and the like such as a printer. As indicator or display devices for informing the operating conditions of the apparatus, there are disposed a plurality of light emitting diodes LED 1 - LED 16.

The light emitting diodes LED 1 - LED 16 are driven by the indicator driver circuit 2. Thus, in order to enable the light emitting diodes LED 1 - LED 16 to light, the indicator driver circuit 2 is provided with ports O_{16} - O_1 the number of which corresponds to that of the light emitting diodes LED 1 - LED 16. Each of the ports O_{16} - O_1 is connected by a signal line 10 to associated one of the light emitting diodes LED 1- LED 16 to supply a driving signal to the associated LED.

According to the present embodiment, the signal lines 10 for connecting the ports O_{16} - O_1 and diodes LED 1 - LED 16 are used on a common basis in such a manner that a plurality of operating switches SW 1 - SW 8 are connected to the ports O_1 - O_8 of the indicator lamp driver circuit 2, respectively. The operating switches SW 1 - SW 8 are provided on the operating or control switch unit 3 to produce associated command signals for controlling operation of the apparatus. The switches SW 1 - SW 8 are put to the ground as a reference potential through diodes D 1 - D 8 at the other terminals thereof. Consequently, if any of the switches SW 1 - SW 8 is closed or turned on, the port O, to which the closed switch SW is connected, goes down in its potential to low level "L". Thus, sensing of the potential of the port O makes it possible to detect turn-on/turn-off states of the switches SW 1 - SW 8. The diodes D 1 - D 8 are provided for the purpose of protection of driver electronics, advantageously implemented in a single integrated circuit chip, constructing the indicator driver circuit 2 from short-circuiting in its output in case of simultaneous depression of plural switches SW's.

According to the present embodiment, the switch condition detector 4 provides such a control that while the indicator driver circuit 2 drives light emitting diode LED 1 - LED 16 to light, the driving operation is ceased for a moment, and at that time potential on each of the ports of the indicator driver circuit 2 to which the switches SW1 - SW 8 are connected is sensed, so that turn-on/turn-off states of the switches SW 1 - SW 8 are detected and a switch condition detection signal S_1 is outputted to indicate the sensed condition.

The switch condition detection signal S_1 from the switch condition detector 4, which includes information representing turn-on/turn-off states of the switches SW 1 - SW 8, is applied to the lighting data generator 5. The lighting data generator 5 generates data for lighting operation of the respective LED 1 - LED 16 on the basis of the given information.

The indicator driver circuit 2, or the driver electronics 2, is provided with a means for converting a serial input to a parallel output, which has 16 bits of parallel output, in accordance with the present embodiment. Between the respective LED 1 - LED 16 and the ground, there are provided current control resistors R1- R16 each for determining luminance of associated one of the light emitting diodes LED 1 - LED 16.

As shown in FIG. 2, an input portion of the driver electronics 2 is provided with a serial data input terminal DATA and a serial clock input terminal CLK, to which a serial data signal S_2 and a serial clock signal S_3 are applied from the lighting data generator 5, respectively.

Next, methods of lighting the light emitting doides and sensing the switches SW's according to the present embodiment will be described hereinafter. FIG. 3 is a time chart useful for understanding a method of lighting the light emitting diodes. First, the lighting data generator 5 sends the serial data signal S_2 (hexadicimal data (B153)H, for example) in synchronism with the serial clock signal S_3. The data is changed at the leading edge of the serial clock signal. The serial data signal S_2 is shifted through a shift register, not shown and provided within the driver IC 2, and has been set to the ports O_1 - O_{16} after the serial clock signal S_3 is terminated, so that the light emitting diode or diodes corresponding to the conditions of the serial data signal S_2 are driven to light.

Thus, while light emitting diodes LED 1 - LED 16 are driven to light, the switching states of the switches SW 1 - SW 8 are sensed by the switch condition detector 4. FIG. 4 is a time chart used for describing how the switches SW 1-SW 8 are sensed. First, the lighting data generator 5 sends data (8000)H in synchronism with the serial clock signal S_3, the data being changed at the leading edge of the serial clock signal. The data to be latched is changed in response to a depressed condition of the switch, for example, changed to (0000)H if none of the switches is depressed, and (8000)H if the switch SW 8 is depressed. At the same time, signals SW - DATA are latched in synchronism with the serial clock signal S_3 at the trailing edge of the serial clock signal. The signal SW - DATA becomes "1", only at a timing wherein a switch is depressed and a port of the driver electronics 2 outputs "1".

In FIG. 4, encircled numeral 1 designates a state of the signal SW - DATA in a case where none of the switches SW 1 - SW 8 is depressed. In that state, the latched data is given by "0000". The encircled numeral 2 is directed to a state of the signal SW - DATA in a case where only the switch SW 8 is depressed. In the state, the data is given by data (8000)H. The encircled numeral 3 shows a state of the signal SW - DATA in a case where only the switch SW 6 is depressed. In the state, the data is given by data (2000)H. The encircled number 4 designates a state of the signal SW - DATA in a case where both the switches SW 8 and SW 4 are depressed. In the state, the data is given by data (8800)H. Those data are detected by the switch condition detector 4 and supplied to the lighting data generator 5 so as to be latched. The lighting data generator 5 determines, based on the latched data, which switch has been depressed, and immediately sets the light emitting diode on the basis of condition of the depressed switch. Thus, data other than the data to be displayed essentially is displayed on the light emitting diode while sensing of the switch SW is performed. However, a time required for sensing of the switch SW is considerably shorter in the order of 50 μ sec, for example, than a period of time during which the light emitting diode starts to light. Consequently, there is provided after-image by the serial data signal S_2 before and after sensing of the switch SW, and thus operators feel neither incoherency nor confusion, even if data other than the data to be displayed essentially is displayed on the light emitting diode while detecting of the switch SW is performed.

As stated above, according to the embodiment of the present invention, the display control circuit is so arranged that the ports of the indicator driver circuit and the signal lines for connecting the ports and the indicator devices are used on a common basis in such a manner that a plurality of operating switches are connected to the ports of the indicator drive, and the switch condition detector provides such a control that while the indicator driver circuit drives the indicator devices to light, the lighting operation is stopped for a moment, and at that time potential on each of the ports of the indicator driver circuit to which the switches are connected, respectively is sensed, so that turn-on/turn-off states of the switches are detected. Thus, it is possible to use the same signal wire for both the control of turn-on/turn-off of the indicator devices and the sensing of a depression of the switch. Consequently, it is possible to avoid necessity for providing the ports on each individual switch and each individual indicator devices, thereby utilize the remaining ports for the other purpose. Further, it is possible to reduce the number of wirings for connection of the respective switches and the associated ports, thereby reducing the area of the printed circuit board required for the wiring and thus contributing to miniaturization of the circuit.

FIG. 5 is a diagram showing a control circuit according to an alternative embodiment of the present invention. As apparent from FIG. 5, the control circuit 10 according to the alternative embodiment comprises driver electronics 11, advantageously inplemented in an integrated circuit chip and provided with serial inputs and 16 bits of parallel outputs, an light emitting diodes LED 1 - LED 16 as display or indicator means and current control resistors R1- R16 each for determining luminance of the associated light emitting diode, a plurality of operating or control switches SW 1 - SW 8, and a plurality of diodes D 1 - D 8 provided for the purpose of protection of the driver electronics 11 from short-circuiting in its output in case of a simultaneous depression of plural switches SW's and an additional resistor R 25. Those elements are mounted on a printed circuit board 12. The control circuit 10 is further under the control of CPU 13. Input terminals DATA and CLK of the driver electronics 11 are connected through terminals T_1 and T_2 of the printed circuit board 12 with ports P_1 and P_2 of CPU 13, respectively. Output terminals O_1 - O_{16} of the driver electronics 11 are connected with LED 1 - LED 16, respectively, to which the resistors R1-R16 are connected in series, respectively. The resistors R1-R16 are put to a reference potential, the ground, for example, through a common line at the other ends thereof. The output terminals O_9 - O_{16} are further connected with the operating switches SW 1 - SW 8, respectively, to which the diodes D 1 - D 8 are connected in series, respectively. The diodes D1 - D8 are connected to the resistor R 25 as a switch condition sensing means at the other ends thereof on a common basis. The resistance R 25 is also put to the ground at its other end. The one end of the resistance R 25 is connected through a terminal T_3 of the printed circuit board 12 to port P_3 of CPU 13. The driver electronics 11, which includes a shifter, not shown, adapted for storing 16 bits of serial signals, serves to sequentially store in the shifter the 16 bits of serial signals supplied from CPU 13 in synchronism with serial clock signals also supplied from CPU 13 and to output those signals from the output terminals O_1 - O_{16} in the form of parallel signals. Signal SW-DATA is output from the control circuit 10 to CPU 13 when CPU 13 senses the switches SW 1 - S W 8.

FIG. 6 is a diagram showing exemplarily a structure of the serial signal. The exemplified serial signal comprises LED data for turn-on and off of light emitting diodes LED 1 - LED 16 and SW sense data for sense of switches SW 1 - SW 8, and is repeatedly transmitted at 20-30 m sec of cycle time from CPU 13 to the control circuit 10. During a period of time of LED data output, a light emitting diode corresponding to a function which is now in condition of turn-on is lighted. During a period of time of SW sense data output, level "1" of data is transmitted to the output terminals O_9 - O_{16} of the driver electronics 11 in order, and at that time, if the operating switch, to which the level "1" of data is transmitted, has been depressed, level "1" of SW-DATA signal is output to CPU 13, so that CPU 13 may sense the depressed operating switch. The SW sense data begins at the state "0080H" and terminates at the state (0001)H.

FIG. 7 is a diagram showing a relation between input and output of the driver electronics 11 during a period of time of SW sense data output. The SW sense data (0080)H on a hexadicimal notation is given with bainary data "0000000010000000" on a binary notation basis, which indicates that the output terminal O_9 of the driver electronics 11 takes its binary state "1" in the output level and the other terminals are of binary state "0" in the output level. That is, if the operating switch SW 1 has been depressed, the SW-DATA signal becomes banary "1" in level and CPU 13 senses the fact that the operating switch SW 1 has been depressed. Likewise, CPU 13 may sense the condition of depression of the operating switches SW 2 - SW 8.

FIG. 8 is a time chart according to the present embodiment. Parts (A), (B), (C) and (D) of FIG. 8 show serial data, driver output, depression condition of SW 2 and SW-DATA signal, respectively. The operation will be described hereinafter referring to the figure. At time T_1, if the driver electronics 11 shown in FIG. 5 receives, on DATA input terminal, LED data (FFFF)H transmitted from CPU 13, the driver electronics 11 including a shifter, not shown, serves to sequentially store in the shifter data in synchronism with serial clock signals also supplied from CPU 13. At time T_2, the LED data (FFFF)H have been stored in its entirety in the shifter and are output in parallel from the output terminals O_1 - O_{16}. At time T_3, the operating switch SW 2 is depressed. While depression of the operating switch SW 2 enables SW-DATA signal to become binary "1" in level, CPU 13 does not yet sense the operating switches SW 1 - SW 8. At time T_4, the SW sense data (0080)H as the serial signal are entered to the driver electronics 11. At time T_5, the SW sense data (0080)H have been stored in its entirety in the shifter and are output in parallel from the output terminals O_1 - O_{16} as shown in part (A) of FIG. 7. At that time, CPU 13 is able to sense the condition of switch SW 1 by means of sensing of SW-DATA signal in level binary "1" or "0". According to the embodiment of FIG. 8, since switch SW 1 is not depressed, SW-DATA signal is binary "0" in level. Thus, CPU 13 senses that switch SW 1 is not depressed. At time T_6, SW sense data (0040)H in the form of the serial signal is entered to the driver IC 11. At time T_7, the SW sense data (0040)-H have been stored in its entirety in the shifter and are output in parallel from the output terminals O_1 - O_{16} as shown in part (B) of FIG. 7. At that time, since switch SW 2 is in its depressed condition, the current flows through the output terminal O_{10} and then SW-DATA signal becomes binary "1" in level. Thus, CPU 13 senses that switch SW 2 is in its depressed condition. Likewise, switches SW 3 - SW 8 are sensed. At time T_8 when 20-30 m sec lapsed from time T_1, LED data (FFFF)H is again entered, and light emitting diodes LED 1 - LED 16 are lighted.

The illustrative embodiments include a light emitting diode as the display or indicator means. It should be noted, however, that an incandescent lamp may also be used as the display means for a light emitting diode since the sufficient current required for the incandescent lamp is supplied by the driver.

Further, according to the present embodiments, there is shown the resistance as a switch condition sensing means. It should also be noted, however, that any sort of device may be used which is adapted for sensing current or voltage on a switch to be detected. For example, there may be so arranged that a small size of electromagnet, instead of the resistance, is provided, and a reed switch between the both ends of which a predetermined voltage is applied is disposed near the electromagnet, wherein a voltage is detected when the electromagnet is operated, so that terminals of the reed switch make contact with each other.

As stated above, according to the embodiments of the present invention, the number of signal wires between the CPU and the printed circuit board is remarkably reduced, and thus it is possible to reduce the number of circuit connection patterns provided on the circuit board, thereby minimizing the area of the printed circuit board.

Further, according to the embodiments of the present invention, even if the number of display means or switches is increased, the number of ports of the CPU to be used is not increased. Thus, it is possible to avoid such a requirement that an additional CPU or LSI chip for an I/O port, which are expensive, are provided.

Furthermore, according to the embodiments of the present invention, it is possible to use the remaining ports of the CPU or the ports released from necessity according to the present invention, for the other purposes, such as for ports for other signal data.

Claims

1. An indicator control circuit for controlling a drive operation of a lighting indicator unit including a plurality of indicator devices each

adapted to indicate an operating condition of an electronic apparatus,

CHARACTERIZED IN THAT

said indicator control circuit comprises:

an indicator driver unit (2) provided with ports (O_{16} - O_1) the number of which corresponds to that of the plurality of indicator devices (LED 1 - LED 16), each of the ports being connected by a signal line (10) to associated one of the plurality of indicator devices (LED 1 - LED 16) to supply a driving signal to the associated indicator device;

an operating switch unit (3) comprising a plurality of operating switches (SW 1 - SW 8) each of which is connected to associated one of the ports (O_8 -O_1) of the indicator driver unit (2) through associated one of the signal lines (10) for connecting the ports (O_8 - O_1) and the indicator devices (LED 9 - LED 16) on a common basis;

a switch condition detection means (4) for providing such a control that while the indicator driver unit (2) drives the indicator devices (LED 1 - LED 16), the driving operation is stopped for a moment and at that time potential of each of the ports of the indicator driver unit (2), to which the switches (SW1 - SW 8) are connected, is sensed, so that turn-on/turn-off states of the switches (SW 1 - SW 8) are detected and turn-on/turn-off information representative of the turn-on/turn-off states of the switches (SW 1 - SW8) is outputted; and

a lighting data generating means (5) for generating data for lighting operation of the respective indicator devices (LED 1 - LED 16) on the basis of the turn-on/turn-off information of the switches (SW 1 - SW 8) outputted from said switch condition detection means (4).

2. A control circuit according to claim 1, CHARACTERIZED IN THAT said indicator driver unit (2) is constructed into an integrated circuit.

3. A control circuit according to claim 1, CHARACTERIZED IN THAT said indicator driver unit (2) includes a means for converting a serial input to a parallel output.

4. A control circuit according to claim 2, CHARACTERIZED IN THAT said indicator driver unit (2) includes a means for converting a serial input to a parallel output.

5. A control circuit according to claim 1, CHARACTERIZED IN THAT the operating switches (SW 1 - SW 8) are provided on said operating switch unit (3) to generate command signals for controlling operation of the apparatus.

6. A control circuit according to claim 1, CHARACTERIZED IN THAT the operating switches (SW 1 - SW 8) are put to a reference potential through diodes (D 1 - D 8) at other ends thereof.

7. A control circuit according to claim 1, CHARACTERIZED IN THAT the indicator devices (LED 1 - LED 16) are light emitting diodes.

8. A control circuit according to claim 1, CHARACTERIZED IN THAT the indicator devices (LED 1 - LED 16) are lamps.

9. A control circuit according to claim 1, CHARACTERIZED IN THAT at least said lighting indicator unit (1), said indicator driver unit (2) and said operating switch unit (3) are disposed on a single printed circuit board.

10. An indicator control circuit provided with a plurality of indcator devices and a plurality of switches, for lighting the indicator devices and sensing switching conditions of the switches on the basis of a control signal transmitted from a control unit,

CHARACTERIZED IN THAT

said control circuit is provided with a serial-to-parallel conversion means (11) having input terminals (DATA, CLK) and output terminals (O_1-O_{16}) for converting a serial signal transmitted from the control unit (13) into a parallel signal, and

the output terminals (O_1 - O_{16}) of said serial-to-parallel conversion means (11) are connected with said plurality of indicator devices (LED 1 - LED 16), which are put to a reference potential at other ends thereof, and some output terminals (O_9 - O_{16}) of said serial-to-parallel conversion means (11) are further connected with said plurality of switches (SW 1 - SW 8), to which a switch condition sensing means (R 25) is connected at other ends thereof on a common basis, while said switch condition sensing means (R 25) is put to the reference potential at another end thereof.

11. A control circuit according to claim 10, CHARACTERIZED IN THAT said serial-to-parallel conversion means (11) is constructed into an integrated circuit.

12. A control circuit according to claim 10, CHARACTERIZED IN THAT at least said indicator devices (LED 1- LED 16), said switches (SW 1 - SW 8) and said serial-to-parallel conversion means (11) are disposed on a single printed circuit board.

13. A control circuit according to claim 12, CHARACTERIZED IN THAT said serial-to-parallel conversion means (11) has an input terminal (DATA) to receive a serial signal from a port (P_1) of said control unit (13) through a terminal (T_1) of the printed circuit board.

14. A control circuit according to claim 12, CHARACTERIZED IN THAT said switch condition sensing means (R25) transmits switch condition sensing information (SW-DATA signal) representative of a sensed condition of the switches through a terminal (T_3) of the printed circuit board to a port (P_3) of said control unit (13).

15. A control circuit according to claim 10, CHARACTERIZED IN THAT said switch condition sensing means is a resistance (R25).

16. A control circuit according to claim 10, CHARACTERIZED IN THAT said switch condition sensing means (R25) is a sensor comprising an electromagnet and a reed switch.

17. A control circuit according to claim 10, CHARACTERIZED IN THAT the indicator devices (LED 1 - LED 16) are light emitting diodes.

18. A control circuit according to claim 10, CHARACTERIZED IN THAT the indicator devices (LED 1 - LED 16) are incandescent lamps.

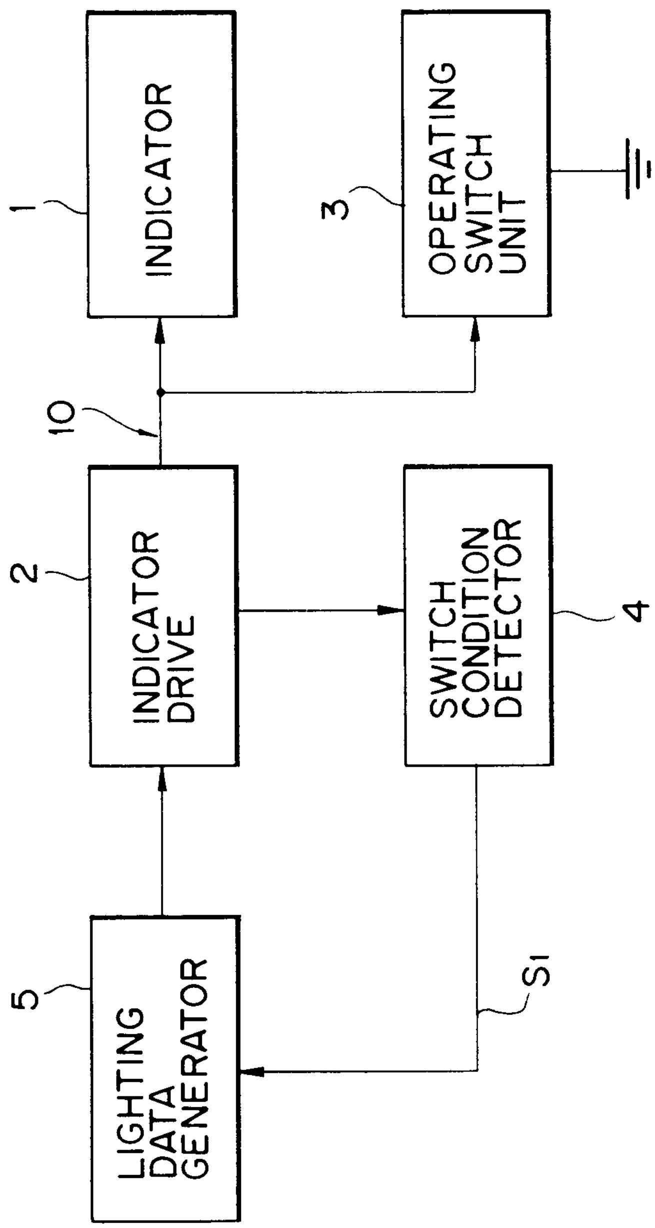
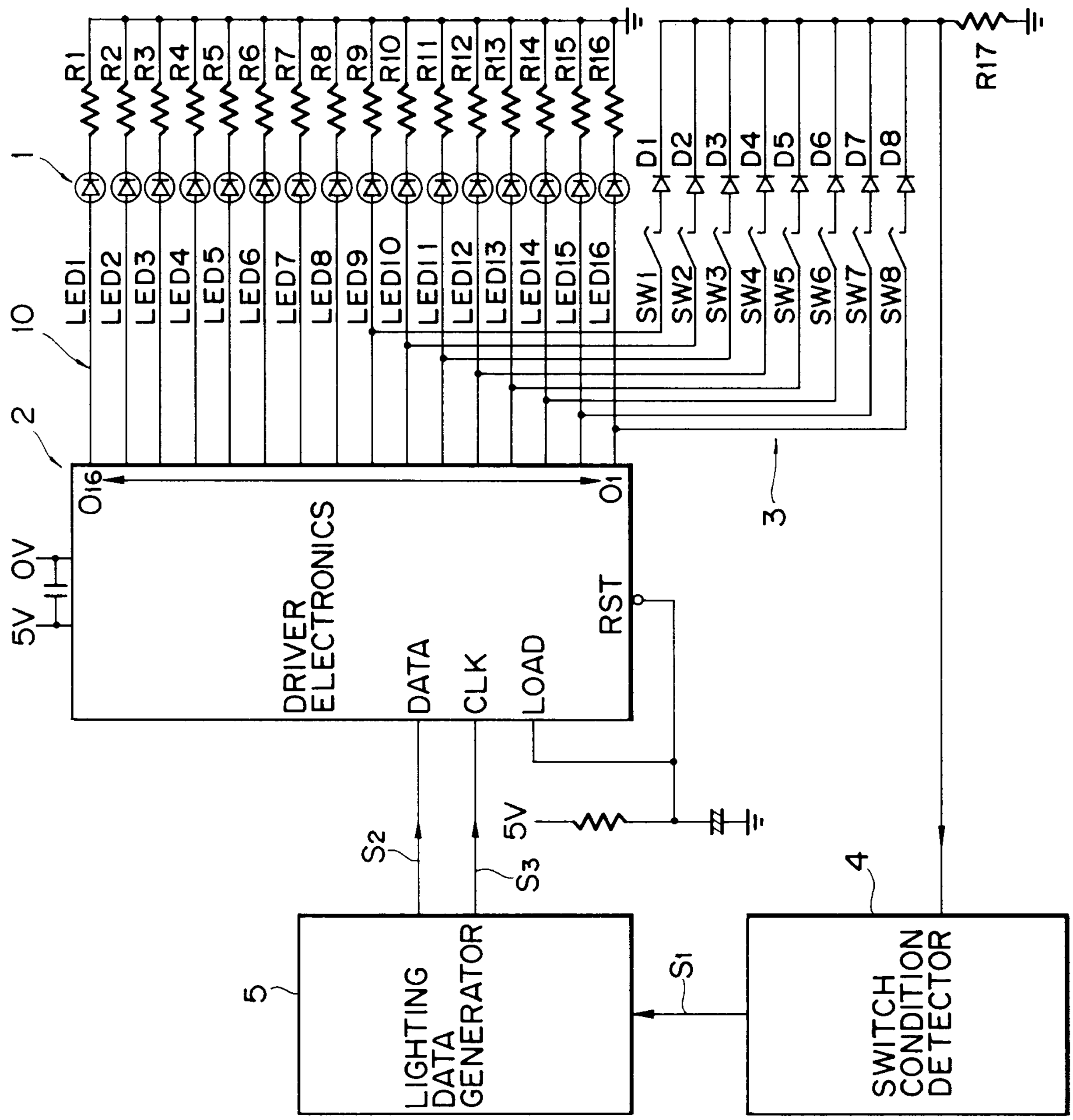

INDICATOR
1
OPERATING SWITCH UNIT
3
10
INDICATOR DRIVE
2
SWITCH CONDITION DETECTOR
4
LIGHTING DATA GENERATOR
5
S1

FIG.1



1
10
2
LED1
LED2
LED3
LED4
LED5
LED6
LED7
LED8
LED9
LED10
LED11
LED12
LED13
LED14
LED15
LED16
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
D1
D2
D3
D4
D5
D6
D7
D8
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
3
5V
0V
O16
O1
DRIVER ELECTRONICS
DATA
CLK
LOAD
RST
5V
S2
S3
S1
4
5
LIGHTING DATA GENERATOR
SWITCH CONDITION DETECTOR

FIG.2

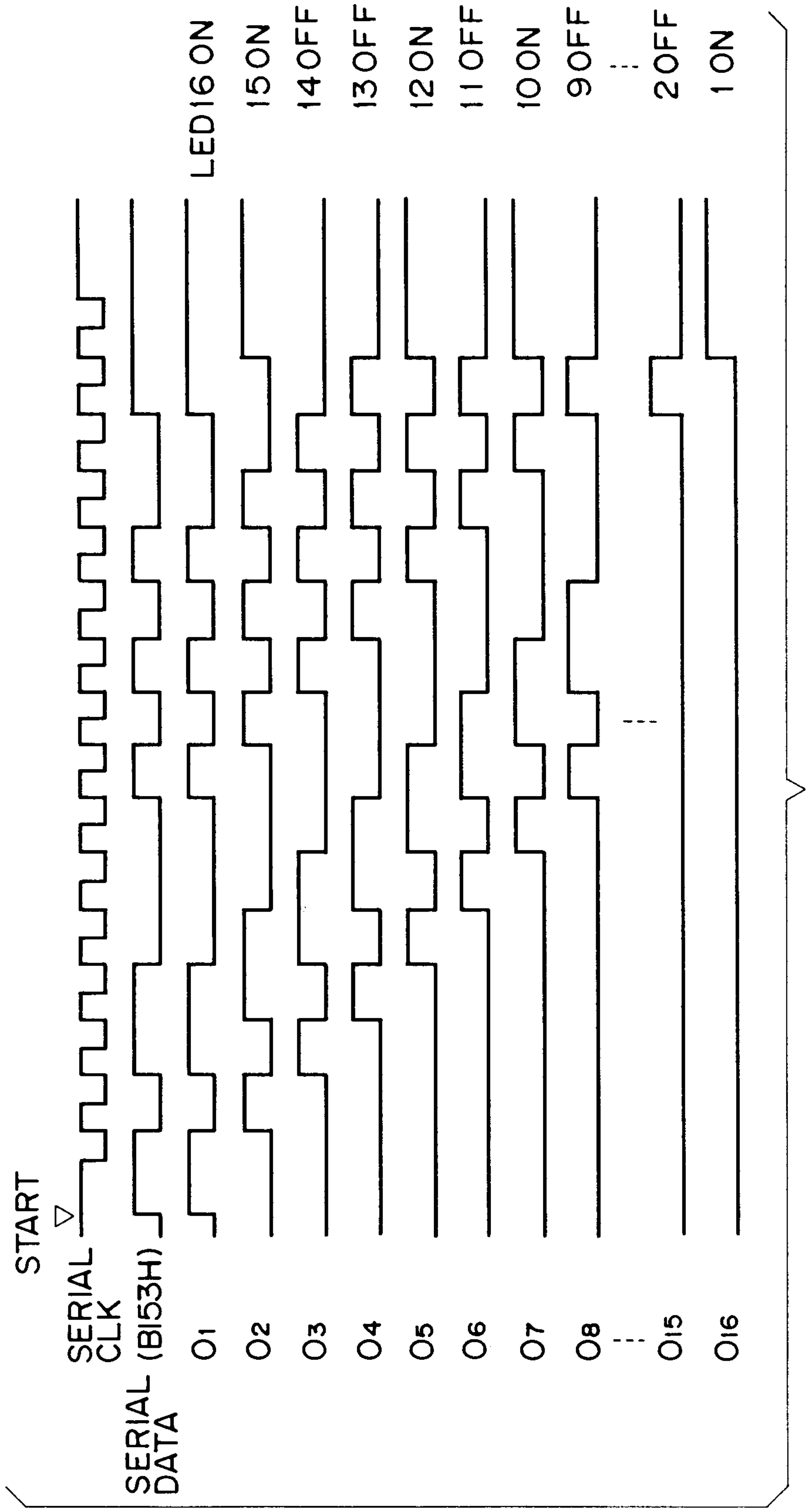

START
SERIAL CLK
SERIAL DATA (B153H)
O1
O2
O3
O4
O5
O6
O7
O8
O15
O16
LED16 ON
15 ON
14 OFF
13 OFF
12 ON
11 OFF
10 ON
9 OFF
2 OFF
1 ON

FIG.3

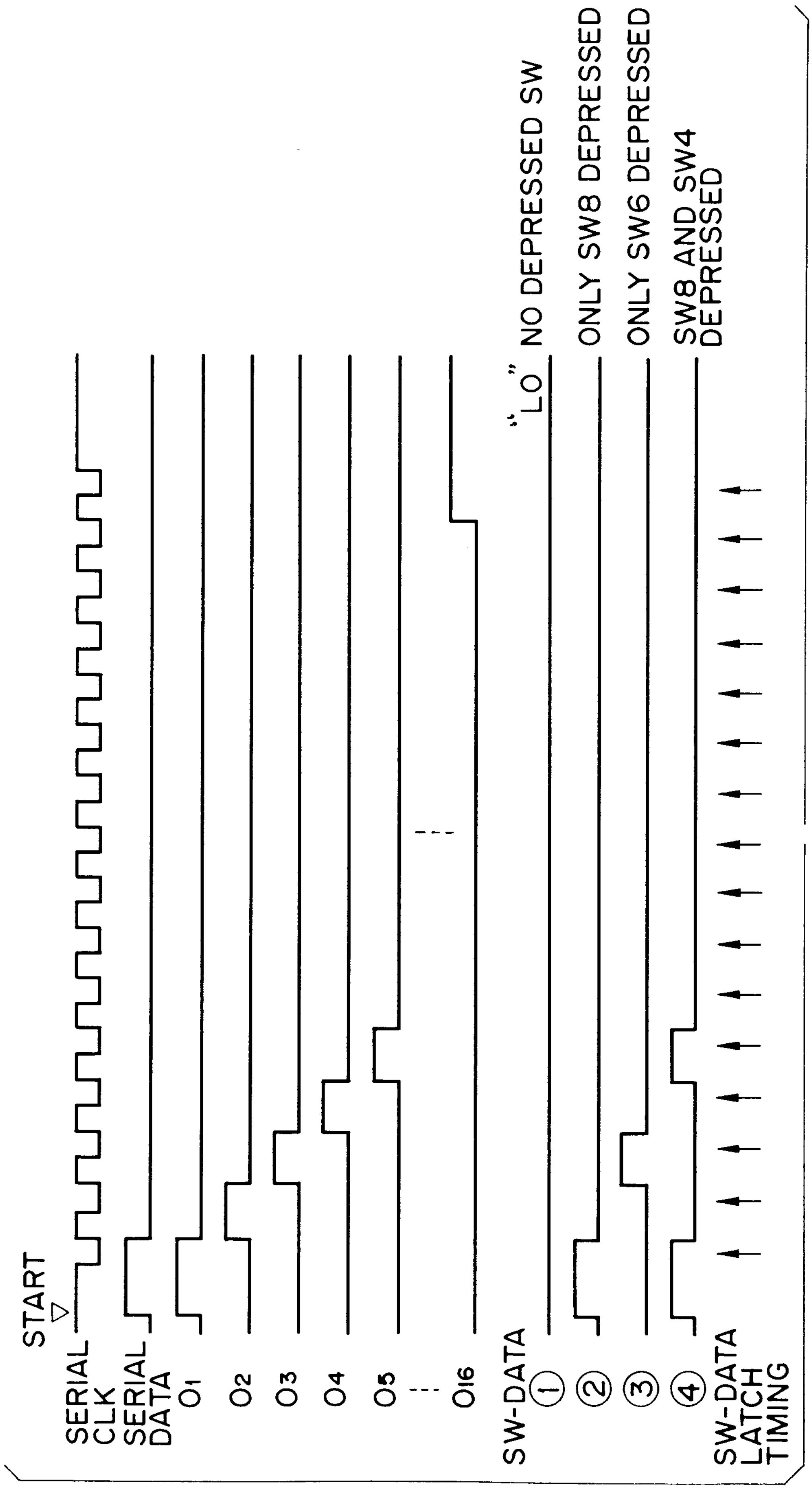

START
SERIAL CLK
SERIAL DATA
O1
O2
O3
O4
O5
O16
SW-DATA
①
②
③
④
"LO"
NO DEPRESSED SW
ONLY SW8 DEPRESSED
ONLY SW6 DEPRESSED
SW8 AND SW4 DEPRESSED
SW-DATA LATCH TIMING

FIG. 4

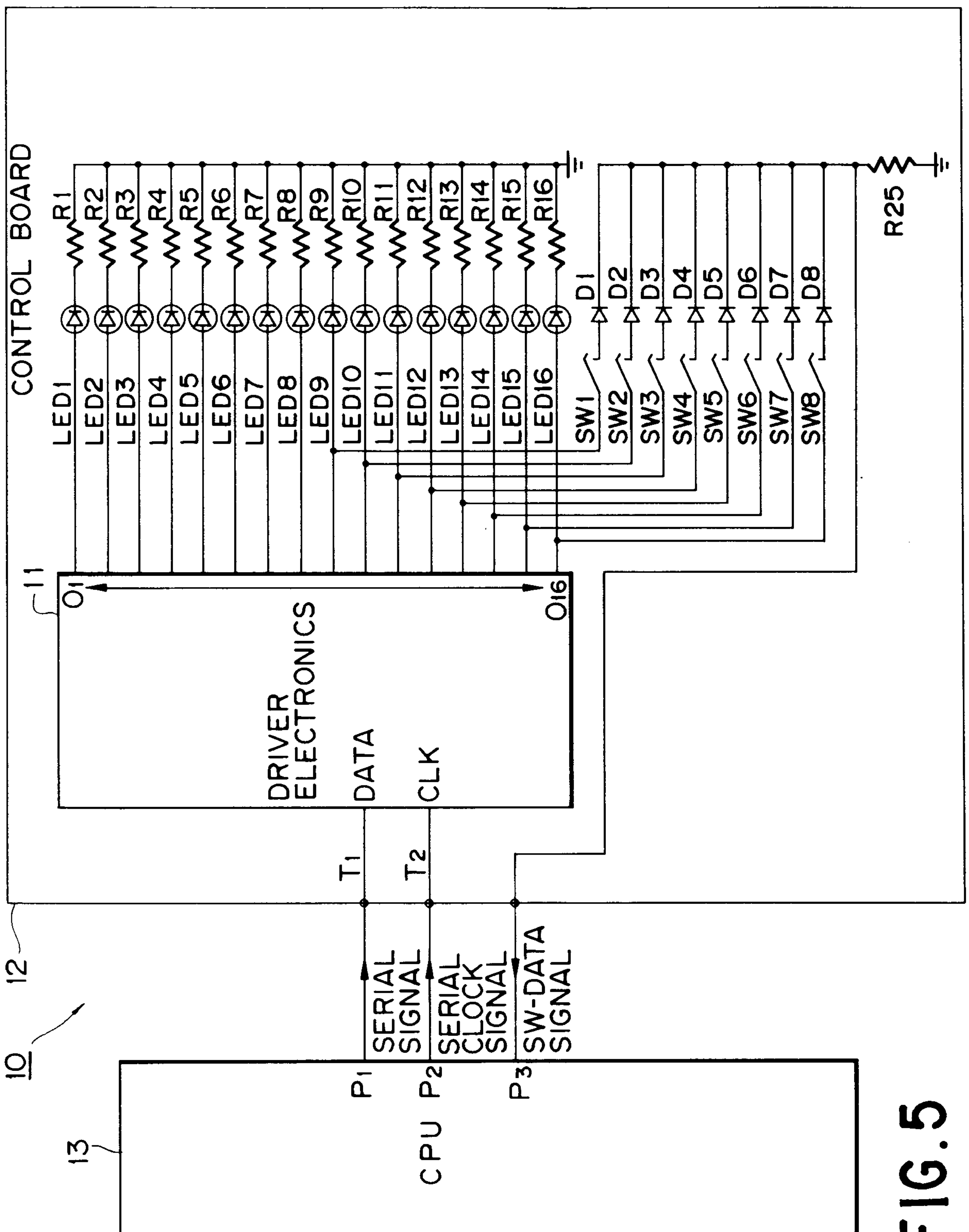

CONTROL BOARD
R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14 R15 R16
R25
D1 D2 D3 D4 D5 D6 D7 D8
LED1 LED2 LED3 LED4 LED5 LED6 LED7 LED8 LED9 LED10 LED11 LED12 LED13 LED14 LED15 LED16
SW1 SW2 SW3 SW4 SW5 SW6 SW7 SW8
11
O1
O16
DRIVER ELECTRONICS
DATA
CLK
T1
T2
12
10
SERIAL SIGNAL
SERIAL CLOCK SIGNAL
SW-DATA SIGNAL
P1 P2 P3
13
CPU

FIG.5

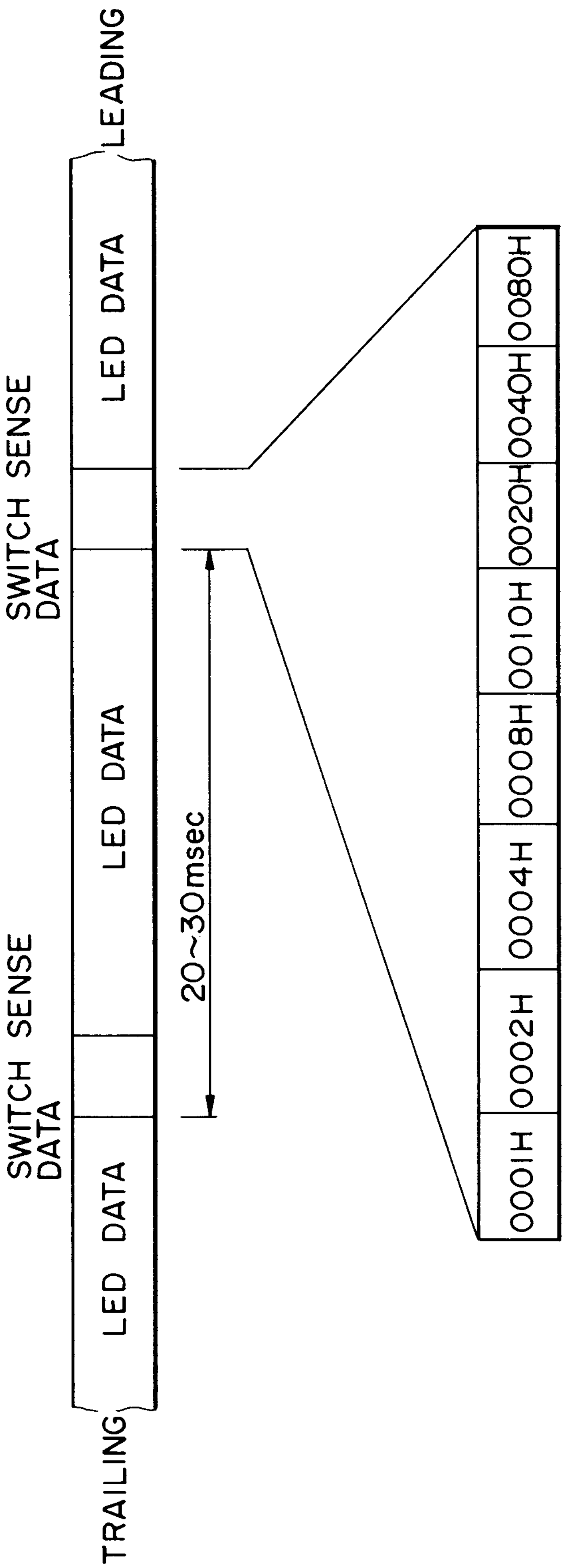

LEADING
LED DATA
SWITCH SENSE DATA
LED DATA
20~30msec
SWITCH SENSE DATA
LED DATA
TRAILING
0080H
0040H
0020H
0010H
0008H
0004H
0002H
0001H

FIG.6

	INPUT (16CLOCKS)	OUTPUT																
		O16	O15	O14	O13	O12	O11	O10	O9	O8	O7	O6	O5	O4	O3	O2	O1	
(A)	0080H	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	SW1 SENSE
(B)	0040H	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	SW2 SENSE
(C)	0020H	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	SW3 SENSE
(D)	0010H	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	SW4 SENSE
(E)	0008H	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	SW5 SENSE
(F)	0004H	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	SW6 SENSE
(G)	0002H	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	SW7 SENSE
(H)	0001H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	SW8 SENSE

FIG.7

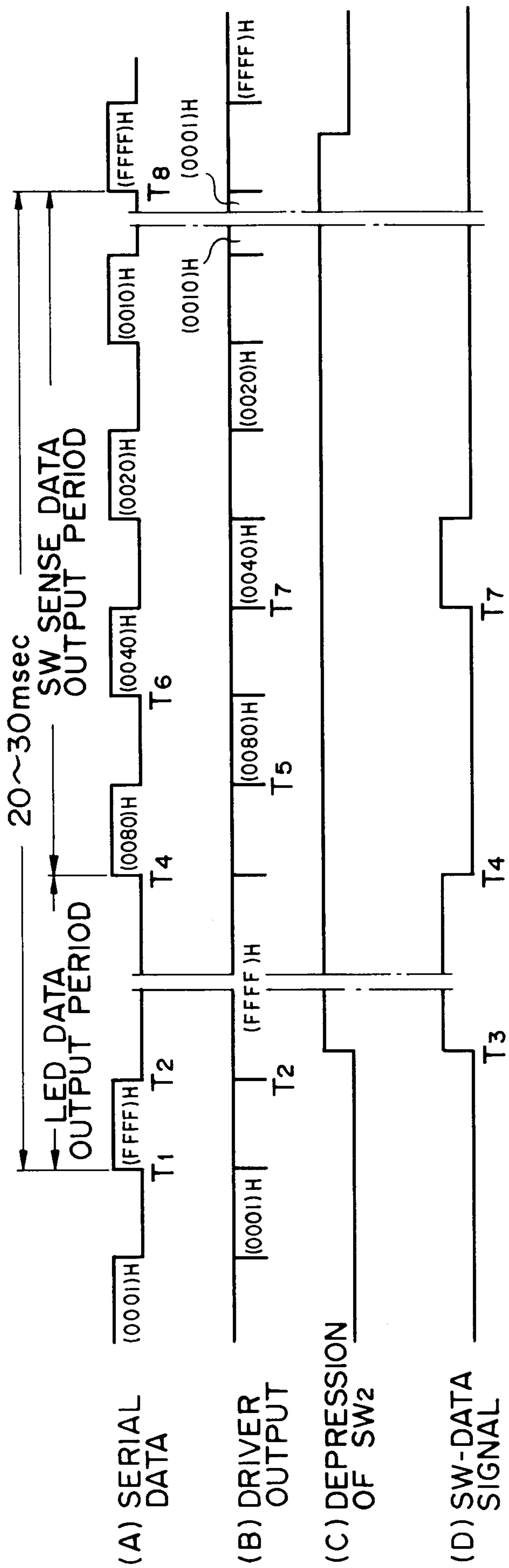

(A) SERIAL DATA
(B) DRIVER OUTPUT
(C) DEPRESSION OF SW2
(D) SW-DATA SIGNAL
20~30msec
LED DATA OUTPUT PERIOD
SW SENSE DATA OUTPUT PERIOD
(0001)H
(FFFF)H
(0080)H
(0040)H
(0020)H
(0010)H
(0001)H
(FFFF)H
(0001)H
(FFFF)H
(0080)H
(0040)H
(0020)H
(0010)H
(0001)H
(FFFF)H
T1
T2
T3
T4
T5
T6
T7
T8

FIG.8

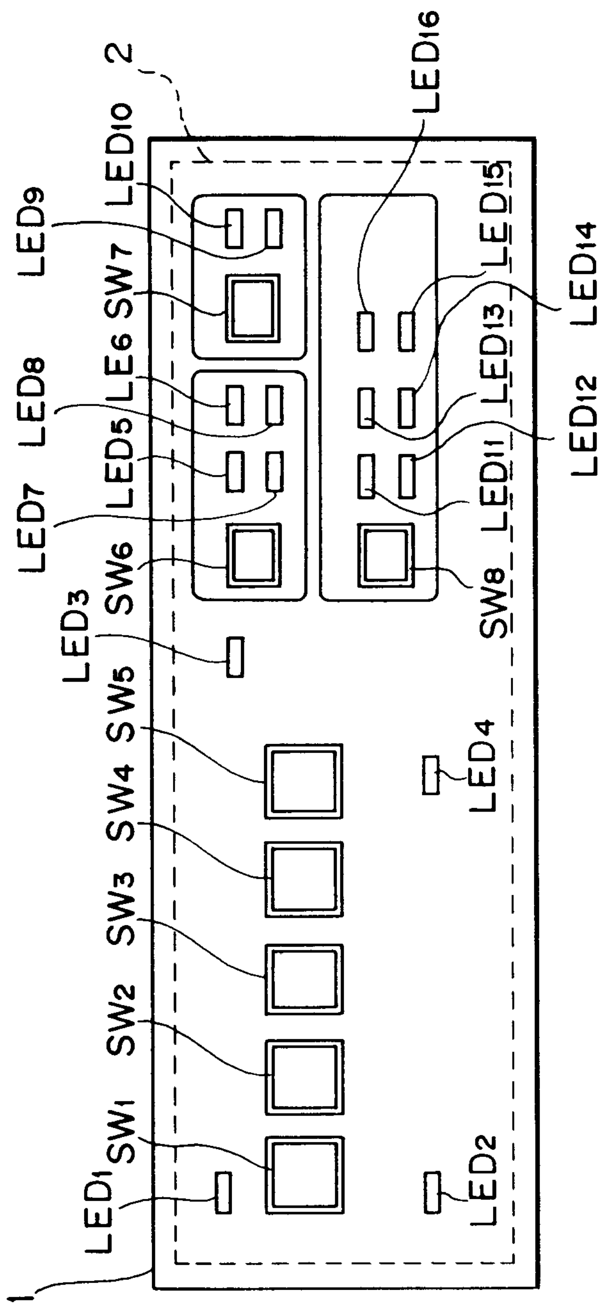
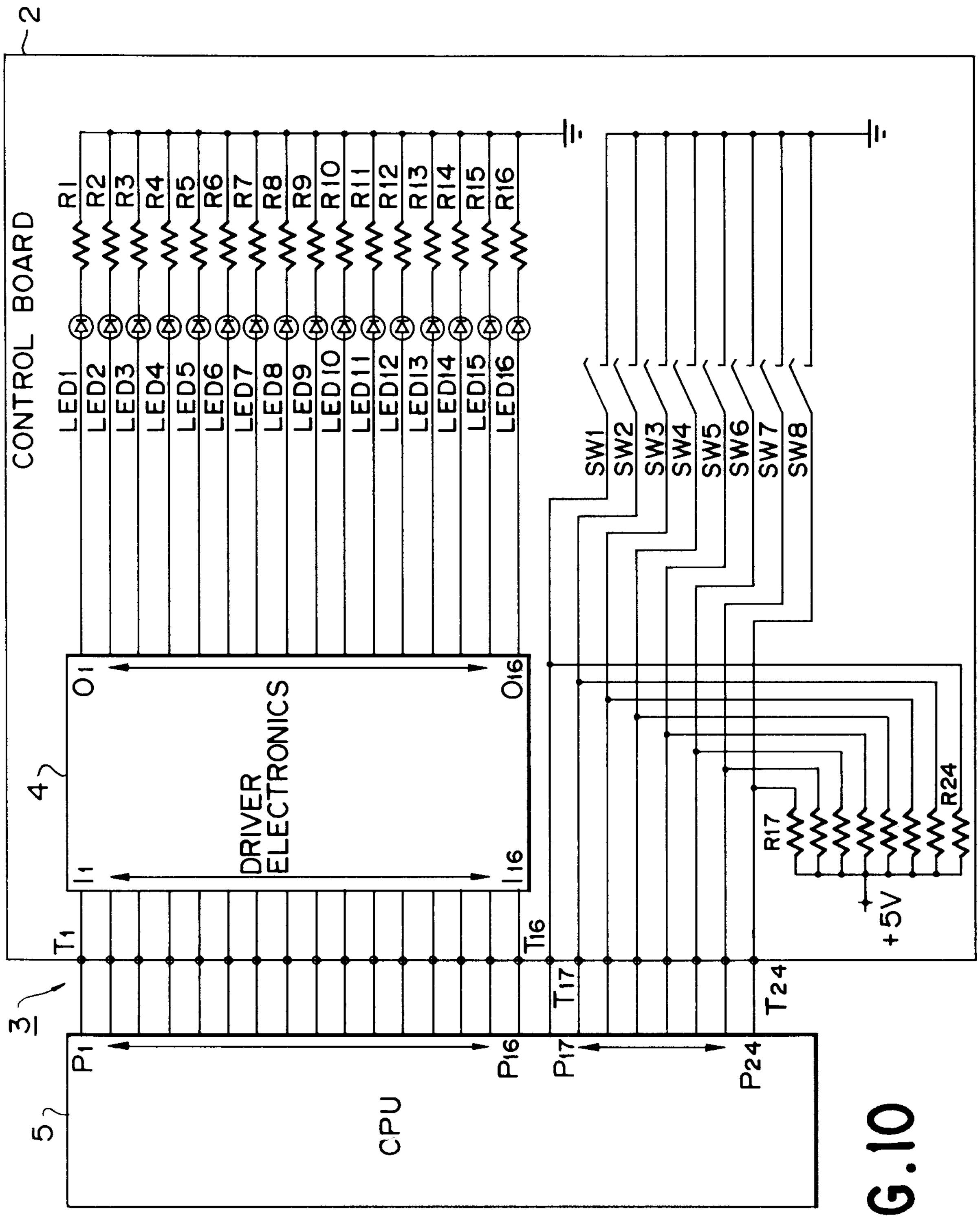

1
2
LED1
LED2
LED3
LED4
LED5
LE6
LED7
LED8
LED9
LED10
LED11
LED12
LED13
LED14
LED15
LED16
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8

FIG.9



2
CONTROL BOARD
LED1
LED2
LED3
LED4
LED5
LED6
LED7
LED8
LED9
LED10
LED11
LED12
LED13
LED14
LED15
LED16
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
4
DRIVER
ELECTRONICS
O1
O16
I1
I16
R17
R24
+5V
T1
T16
T17
T24
3
P1
P16
P17
P24
5
CPU

FIG.10