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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : H04L 12/40 | A3

(11) International Publication Number: WO 94/17615

(43) International Publication Date: 4 August 1994 (04.08.94)

(21) International Application Number: PCT/US94/00822

(22) International Filing Date: 24 January 1994 (24.01.94)

(30) Priority Data:
08/008,200 25 January 1993 (25.01.93) US

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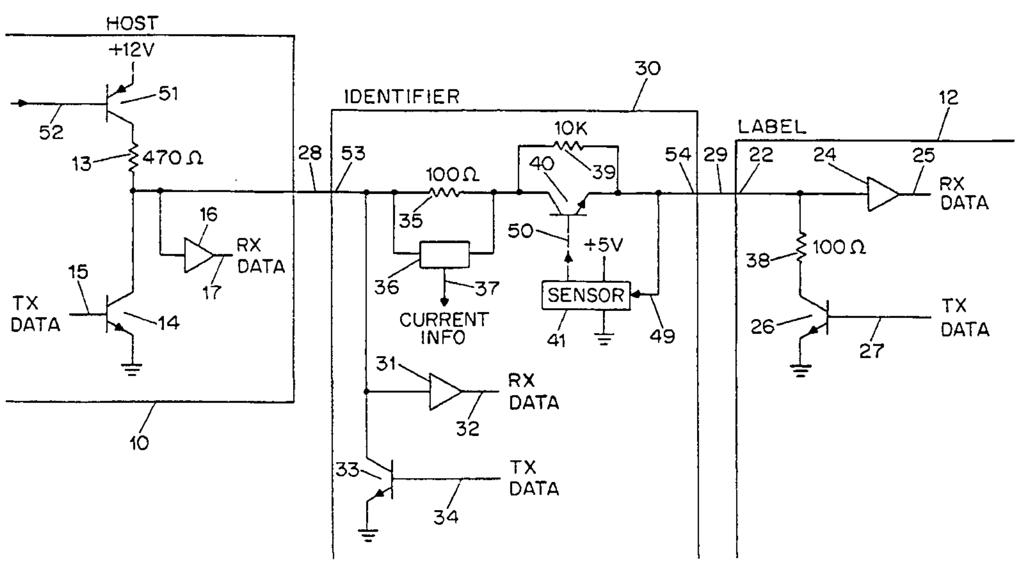
(81) Designated States: CA, JP, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(88) Date of publication of the international search report: 27 October 1994 (27.10.94)

(54) Title: ELECTRONIC PRICE DISPLAY SYSTEM WITH DATA BUS ISOLATION



(57) Abstract

An electronic price display system having electronic price displays (12) on a serial data bus (11) protects against shorts on the data line (28) of the bus by providing identifier modules (30) at many locations in the bus. Each identifier has a data bus isolator including a switch (40) selectively connecting and disconnecting first and second data terminals, and a current threshold sensor (35, 36) operatively coupled with the switch. The threshold is selected so that with actuation of the serial line driver and with a first impedance at the data line of the associated second bus (29) the switch conducts, and that with actuation of the serial line driver and with a second, lower impedance at the data line of the associated second bus (29) the switch (40) does not conduct. Advantageously the isolator shares circuitry with a current detector (35, 36) that permits the identifier (30) to monitor data transmissions on the data bus. Optionally the system is set up so that a pull-up resistor (13) on the data line is provided only when messages are to be propagated but not continuously.

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INTERNATIONAL SEARCH REPORT

Intern ;al Application No
PCT/US 94/00822

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 H04L12/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB,A,2 077 076 (VDO) 9 December 1981 see the whole document	1,2
A	GB,A,2 194 867 (MITSUBISHI) 16 March 1988 see abstract	1,2
A	US,A,4 912 724 (NORTHERN TELECOM) 27 March 1990 see column 2, line 65 - column 3, line 8; figure 2	4-6
P,A	WO,A,93 05475 (ELECTRONIC RETAILING SYSTEMS) 18 March 1993 cited in the application see page 5, column 24 - page 14, column 35	1,3,4

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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2

Date of the actual completion of the international search	Date of mailing of the international search report
27 May 1994	20.09.94

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	MIKKELSEN, C

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern al Application No
PCT/US 94/00822

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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WO-A-9305475	18-03-93	AU-A-	2556892	05-04-93
		EP-A-	0603267	29-06-94

on those rails.

A power line short tends to be quite easily detected since the current flow is large enough and constant enough to trigger a relatively unsophisticated device such as a PTC resistor. The PTC resistor approach is not, however, workable to provide corresponding protection to the data line, for several reasons. First, the current flow on the data line may be quite small for long periods of time, such as times when the data line is quiescent (i.e. not carrying data messages). Second, the current flow when data is being passed is not constant, but varies with the binary values of the serial data. Finally, even when there is a short, it is a short carrying current provided not by a large five-volt power supply, but by a rather different source namely a line driver. The five-volt supply carries current to each of several tens of thousands of labels, each of which presents some power load; in contrast, the line driver is driving data receiver loads that may be of higher impedance than the power loads.

For all these reasons it is desirable to have a sophisticated arrangement for disconnecting the data line of a rail in the event of a short, thereby isolating that line of the data bus. It is also desirable that the arrangement be low in component count, taking advantage of circuit elements already present in the identifier for other purposes.

Disclosure of Invention

An electronic price display system having electronic price displays on a serial data bus protects against shorts on the data line of the bus by providing identifier modules at many locations in the bus. Each identifier has a data bus isolator including a switch selectively connecting and disconnecting first and second data terminals, and a current threshold sensor operatively coupled with the switch. The threshold is selected so that with actuation of the serial line driver and with a first impedance at the data line of the associated second bus the switch conducts, and that with actuation of the serial line driver and with a second, lower impedance at the data line of the associated second bus the switch does not conduct. Advantageously the isolator shares circuitry with a current detector that permits the identifier to monitor data transmissions on the data bus. Advantageously the system is set up so that a pull-up resistor on the data line is provided only when messages are to be propagated but not continuously.

Brief Description of Drawings

The invention will be described with respect to a drawing of several figures, of which:

Fig. 1 shows in functional block diagram form the generalized case of a host with a line driver driving a bus, with a display label on the bus;

Fig. 2 shows in functional block diagram form the architecture of the system showing the host and the nodes (identifiers) in communication with a multiplicity of labels;

Fig. 3 shows in schematic form the line driver and line receiver circuitry of the host, a node, and a label;

Fig. 4 shows in schematic form the line driver and line receiver circuitry of Fig. 3 but with added features of the invention, namely the selectively asserted pull-up resistor and the over-current sensor on the data line; and

Fig. 5 shows in schematic form the over-current sensor of Fig. 4 in component detail.

Where possible, like elements in the figures have been denoted with like reference numerals.

Best Mode of Carrying Out the Invention

In Fig. 1 there is shown a generalized host 10 driving a bus 11, on which are located a multiplicity of labels 12, of which only one is shown for clarity. Bus 11 is composed of power line 19, data line 18, and ground line 20. The host provides a pull-up resistor 13, typically 470 Ω, tending to pull the data line to +12 volts. The host drives the line by selectively asserting TX data line 15, which drives transistor 14 and selectively grounds the data line. The resulting voltage swings are detected by comparator 24, yielding RX data line 25.

Although not all electronic price display systems would call for bidirectional communication, the system of Fig. 1 provides this with a line driver 26 controlled by TX data line 27. The data are received by comparator 16, yielding RX data line 17. It will be appreciated that unless protocols provide otherwise, collisions could occur on data line 18 due to overlapping assertions of TX lines 27 of multiple labels, or due to overlapping assertions of TX lines 27 and 15. Preferably protocols are employed such that a label issues a message only if addressed by the host in a previous message. Protocols providing this result are described, for example, in copending U.S. appl. no. 7/757,675.

As described above, in the simple case of Fig. 1 the data bus propagates metallically to every label and to the central computer; in this arrangement everything is in parallel with everything else. Desirably, however, as shown in Fig. 2 the system uses nodes 30, also called identifiers, which define branching points in a tree-structured data bus. In this way, a message from the central computer or host 10 passes along what may be termed a first data bus 28 to a node 30, and from there to a label 12 along what may be termed a second data bus 29. Typically each four-foot section of shelf in the store receives its own identifier 30. For clarity in Fig. 2, the power and ground lines of the buses are not shown. Several ways to provide an arrangement such as is shown in Fig. 2 are described in copending U.S. appl. no. 7/757,260.

Fig. 3 shows in more detail the line drivers and line receivers along the data path from the host 10 to a particular one of the labels 12. For clarity, only one identifier 30 and only one label 12 are shown, but it should be understood that a plurality of other identifiers 30 (typically many hundreds of them) and a multiplicity of other labels 12 (typically many tens of thousands of them) make up the rest of the system, and those skilled in the art will appreciate that the presence of the other identifiers 30 and labels 12 imposes many demands on what might otherwise seem to be a simple line driver/line receiver design exercise.

Identifier 30 defines two data buses 28 and 29, distinct from the single data bus 18 depicted in Fig. 1. First data terminal 53 couples to data bus 28 and second data terminal 54 couples to data bus 29. The identifier 30 has a comparator 31 that is much like the comparators 16 and 24 discussed above, and it provides an RX data signal 32 for the comparator. The identifier 30 has a driver 33 that is much like the drivers 14 and 26 discussed above, and it is driven by a TX data signal.

Host 10, identifier 30, and label 12 each have a processor executing a suitable stored program. The processors each receive the RX data from respective comparators, and each provide TX data to respective driver transistors. The processors are omitted for clarity in Fig. 3, as are the memory devices, input devices, and output devices associated therewith.

When the host 10 issues a message via line 28 seeking a response from one of the multiplicity of labels 12, and when the response is received, it is desirable that the host 10 be able to determine whether the responding label 12 was located where expected. As described in copending U.S. appl. no. 7/757,675, it is advantageous to provide a resistor 35 in series between data lines 28 and 29. A voltage sensor 36 provides a signal 37 indicative of the flow of current on a particular one of the plurality of data lines 29. In this way, a particular one of the identifiers 30 may detect that its respective data line 29 was the one on which a label 12 responded, and if requested the identifier may drive the line 28 (via its driver 33) to provide information regarding the identity of the particular identifier 30 to the host 10. In this way the identifier 30 appends a message to the message sent by the label 12, for this reason identifier 30 is also referred to as an "appender".

In the simple design of Figs. 1, 2, or 3, the central computer or host 10 provides a pull-up resistor 13 from the data line to the power source, and the pull-up resistor is provided continuously. As mentioned above, the host 10 communicates messages by selectively grounding the data line by driver 14, and labels 12 read the data by noting the voltage on the data line as a function of time. But this design has the drawback in that there is always current flowing in the data line since the data receivers 24 have some non-infinite resistance. This can lead to unwanted electroplating in the data line contacts, especially in the presence of moisture.

A more complex design that attempts to minimize this problem is shown in Fig. 4. A switch 51 is controlled by a control line 52. Under control of the processor of the host (omitted for clarity in Fig. 4) the transistor 51 is switched on only when needed, that is, only when a message is to be sent to labels, or when it is anticipated a message may be sent by a label back to the host. In that way, current in lines 28 and 29 is kept to a minimum, and electroplating problems, if any, are minimized.

It will be appreciated that the system of Fig. 2 or 3 can be disrupted, however, if line 29 happens to be shorted, say, to ground. The same problem arises if line 18 of the system of Fig. 1 is shorted to ground. To provide a measure of fault tolerance to the system of Fig. 3, additional circuitry is provided as shown in Fig. 4. A transistor switch 40 is in series with the data lines 28 and 29, lying between first and second data terminals 53 and 54 (and in series with the current sensor 35, 36). The sensor 41 detects the voltage via input 49, which is the voltage defined for example by resistors 13, 35, and 39 and by the impedance of comparator 24. The voltage detected will be quite different (and lower) if, for example, the data line 29 has been grounded. Sensor 41 has an output 50 that drives switch 40, preferably a bipolar transistor. When the line 29 is "healthy", e.g. is not shorted, the sensor 41 turns on transistor 40 and the data signals from line 28 propagate to line 29. When the line 29 is shorted, the transistor 40 is off, and the shorted condition of the particular line 29 does not affect the plurality of other lines 29. It will be noted that the resistor 35 is thus put to double duty, providing a voltage drop (with one set of thresholds) for current sensing and providing a voltage drop (with a different set of thresholds) for sensing a data line short.

A typical sequence of events for sending a message, then, is that the host turns on transistor 51, establishing the pull-up voltage (here, +12VDC) in line 28. Assuming no short in the line 29, then the sensor 41 turns on, causing transistor 40 to turn on. This establishes the pull-up voltage in line 29. Receivers 31 and 24 are able to detect bits of a message generated by selective actuation of transistor 14.

Stated another way, the data bus for this design will normally be at 0 volts when no messages are being sent. When messages are to be sent or received, the host asserts the +12VDC bias through the pull-up resistor on the data bus for several milliseconds, as appropriate, before the transmission. Communication is effected by the host, the label, or the identifier (also called the locator module) pulling the data line to ground. The only pull-up resistor on the line is that provided by the host.

Preferably, as described in the above-mentioned copending U.S. appl. no. 7/757,675, the protocol for messages to be exchanged between the host 10 and one or another of the labels 12 defines windows of time during which a label 12 may generate a message. According to the protocol, a label 12 will generate a message only immediately after receiving one of a predetermined set of possible messages from the host. Thus, if the host 10 is sending a message not in that set (i.e. a message for which no reply is expected) then the host will turn off transistor 51 shortly after having finished sent its message. On the other hand, if the host 10 is sending a message in that set, then it keeps the pull-up resistor in place (keeping line 52 asserted) until after the expiration of a time interval defined by the expected duration of the message from the label 12 and an appended message from an appender, as applicable.

Provision of transistor 51 and its control arrangements, rather than simply providing a pull-up resistor at all times, offers certain advantages. As mentioned above, it can reduce electroplating effects in contacts at lines 28 and 29. Although in the system embodied here the power consumption savings are not great, it will be appreciated that in some systems, especially those with many more receivers 32, 24 or with receivers of lower impedance, the power savings would be greater. The active and repetitive exercising of the sensors 41 and switches 40 improves the likelihood that failures there and in lines 29 will be detected early on.

Fig. 5 shows the circuitry of sensor 41 in schematic detail. Between communications, the data bus is at ground, and a short to ground on a rail has no effect. When a message is to occur, the controller applies the +12VDC bias via transistor 51 as mentioned above in connection with Fig. 4, to the data line through the pull-up resistor 13. This voltage passes through resistors 35, 39, and 42 (the latter shown in Fig. 5) through line 49. This turns on transistor 43 and in turn transistor 46, and provides a bias of 3.4V via line 50 to the base of transistor 40 (shown in Fig. 4). This is sufficient to keep transistor 40 turned on, now passing the +12V through the collector-emitter of transistor 40 (in parallel with resistor 39) to the rail data bus 29 and any labels 12 connected thereto. Communications to and from the labels 12 passes through transistor 40, and the 100-Ω resistor 35 in series at the identifier module 30 can still sense the direction of the message and function as described in the above-mentioned copending U.S. appl. no. 7/757,675.

In the event that the rail data line 29 is shorted to ground, the base-emitted junction of transistor 43 is back-biased through resistor 42, turning off the three transistors 43, 46, and 40. Transistor 40 then isolates the shorted rail from the rest of the host data bus 28 and from the rail data buses 29 connected to identifiers 30 other than the one connected to the shorted rail data line. Resistor 39 is selected to be high enough so that operation of the data bus 28 is not adversely affected by the short in one of the data lines 29.

It is instructive to consider the effect of the data bus isolation circuit of Fig. 5 and of resistor 39 and transistor 40 (also called a rail disconnect logic circuit) in the instance of shorts that are not metallic short circuits. Such shorts could be, for example, moisture or other non-zero-resistance effects. For example, with the isolation circuit in place the bus 29 will not operate with a 100-Ω short to ground, but will operate with a 1000-Ω short. The transition point will vary with the length of bus 28 and with actual current loads in the cables, but is in the neighborhood of 700 to 800 Ω. Resistor 39 is chosen to provide enough current to turn on transistor 43 when the resistance of the short is higher than, say, 1000 Ω. Below this selected threshold, the data bus is isolated. Selection of resistor 39 is thus a design parameter that controls the rail disconnect logic threshold point. Although not shown in Fig. 4, optionally a line from the sensor 41 may be provided as an input to the processor of the identifier 30, and the identifier may be programmed to provide the value of that input back to the host 10 in response to a message from the host.

In one embodiment of the invention, there is a single host 10 identified as the central computer of the price display system. In such an embodiment, wiring runs from the central computer to the nodes or identifiers 30, and thence to the labels 12, as shown in Fig. 2. In another embodiment, however, each gondola has a gondola controller which fills the role of the host 10 in Fig. 2. In that embodiment, the gondola controllers all communicate with a store central computer by a wired link or by a wireless (e.g. UHF radio) link. It will be appreciated that either embodiment presents the issue of protecting a data line against widespread problems due to shorts, and that the location of the driver driving that line (including transistor 14 in Fig. 2) defines the host 10 as discussed herein; if that driver is in a gondola controller, then the gondola controller is the host as described herein.

In the above-mentioned U.S. Appl. No. 7/757,259, it is described that in order to determine whether or not the various electronic pricing displays and their associated rails are operating properly, a message is sent to a first display to evoke a response. If no response is evoked, a second message is sent to a second electronic pricing display which is powered through the same power limiting device as the first display. If a second response is not evoked, a message is sent to a human operator indicative of a possible limiting of the power by the power limiting device.

A corresponding method is usable when the present invention is employed. Messages are sent from time to time to each of the labels 12 in the system, requesting responses therefrom. If for a particular label 12 no response is evoked, then there is the possibility that the explanation is due to (1) a power line short in the rail powering the label, (2) a data line isolation in the data line connecting to the rail, or (3) a broken or missing label. To resolve among these competing explanations (and of course other explanations are also possible) the host 10 would send a message to a second label 12 that is shown on the central computer's records as being on the same rail as the inexplicably silent first label 12. If a response is not evoked, the likely explanation is that the entire rail is not working, and test queries to the remaining labels 12 on that rail will be further indicative of that explanation. If a response is evoked for the second label 12 (and for other labels 12 on that rail) then the likely explanation is a defect in the label 12 or its absence. If the above-mentioned optional data line from sensor 41 is employed to provide a discrete output to the processor of the identifier 30, then it is possible further to determine whether the loss of an entire rail is due to a power short or a data short, by making use of the value of that discrete output. Another possible way that the two explanations of loss of a rail may be resolved is if the PTC resistor described in the above-mentioned U.S. Appl. No. 7/757,259 powers not only the labels 12 on a rail but also the processor of the associated identifier 30. In such a configuration, the host, after finding that all labels 12 on a rail have failed to answer, could then attempt to elicit an answer from the controller of the identifier 30. Absence of a response would suggest that a power short is the explanation.

Those skilled in the art will appreciate that while the line driver and receiver voltage level definitions are set up with a pull-up resistor to +12VDC and with collector-emitter conduction paths to ground, the invention could be employed equally well with other voltages levels for the two states of the line. For example, the resistor could go to ground, with the data-driving transistor going to +12VDC. The data line could transition between two voltages, namely the power or ground level carried on other conductors of the bus. But it is simple and preferable to use +12VDC and the ground level of the bus as the data defining levels.

Those skilled in the art will also appreciate that while the transistors 51, 14, 40, 34, and 26 herein are shown as bipolar (NPN or PNP) transistors, nothing about the invention requires this. FET transistors could be employed, for example, if lower voltage drops were deemed important. It will also be appreciated that while the preferred embodiment uses a single-line bidirectional serial channel, parallel buses could be employed, or single-direction serial lines could be used. The driver and fault isolation aspects of the invention could be applied equally well to such systems.

Claims

We claim:

1. An electronic price display system comprising:

a host (10) with a line driver (14,15);

a first bus (11) having a data line (28), the bus electrically connected to the host, and the data line receiving data from the line driver;

a plurality of identifier modules (30) each electrically connected with the first bus, each identifier module having a first data terminal (53) and a second data terminal (54), and each identifier module having a power supply, each identifier module further comprising a data bus isolator connecting the first data terminal and second data terminal thereof;

each data bus isolator comprising a switch (40) selectively connecting and disconnecting the first data terminal and the second data terminal, and a current threshold sensor (35,39,41,49) operatively coupled with the switch, the threshold selected so that with actuation of the line driver and with a first impedance at the data line of the associated second bus (29) the switch conducts, and that with actuation of the line driver and with a second, lower impedance at the data line of the associated second bus the switch does not conduct;

a plurality of second buses corresponding to the identifier modules (30), each second bus having a data line (29) and a power line, the data line receiving data from the second data terminal (54) of the corresponding identifier module (30), and the power line receiving power from the power supply of the corresponding identifier module (30); and

a multiplicity of electronic price displays (12) each electrically connected with one of the second buses, each display having a data receiver(24), the data receiver receiving data from the data line (29) of the one of the second buses, the display receiving power from the power line of the one of the second buses.

2. The system of claim 1 wherein the switch comprises a bipolar transistor (40) having a collector, an emitter, and a base, the collector of which is electrically connected with one of the first data terminal and second data terminal and the emitter of which is electrically connected with the other of the first data terminal and second data terminal.

3. The system of claim 1 or 2 wherein the current threshold sensor comprises a resistor (35) between the first data terminal and the switch and a comparator (41) sensing voltage at a point (49) between the switch and the second data terminal, the operative coupling of the current threshold sensor and the switch comprising coupling of the comparator output (50) with the switch.

4. The system of claims 1, 2, or 3 wherein the host has a pull-up impedance (13) between the data line (28) and the power line, and sends data by selectively grounding (14) its data line; wherein each display device (12) sends messages by selectively grounding (26) its data line; and wherein each identifier module (30) further comprises first means (35,36) for detecting current flow through the impedence (13), whereby the identifier module connected with the display device sending one of the messages detects the message from the display device by monitoring the detected current flow.

5. The system of claims 1, 2, 3, or 4 wherein the host line driver comprises first and second switch means, the first switch means (51) connecting the data line to a first voltage level through a first predetermined impedance (13), and the second switch means (14) connecting the data line to a second voltage level through a second, smaller impedance;

the host (10) further comprising control means actuating the first switch means for the duration of a sending a message comprising bits from the host to an electronic price display and for the duration of any reply therefrom, and actuating the second switch means selectively for sending the bits thereof.

6. The system of claim 5 wherein the second voltage level is substantially a ground level, and the first voltage level is substantially the voltage level of the power line.

7. An electronic price display system comprising:

a host (10) with a host line driver (51,13,14) and a line receiver (16);

a first bus (11) having a data line (28), the bus electrically connected to the host, the data line receiving data from the line driver, the data line electrically coupled to the line receiver;

a multiplicity of electronic price displays (12);

the host line driver comprising first and second switch means, the first switch means (51) connecting the data line to a first voltage level through a first predetermined impedance (13), and the second switch means (14) connecting the data line to a second voltage level through a second, smaller impedance;

the host further comprising control means actuating the first switch means (51) for the duration of a sending a message comprising bits from the host to an electronic price display (12) and for the duration of any reply therefrom, and actuating the second switch means (14) selectively for sending the bits thereof;

a plurality of second buses operatively coupled to the first bus (11), each second bus having a data line (29) and a power line, the data line of each second bus (29) operatively coupled with the data line of the first bus (28); and

each electronic price display electrically connected with one of the second buses, each display having a data receiver (24) and a label line driver (26,38), the data receiver receiving data from the data line of the one of the second buses, the display receiving power from the power line of the one of the second buses, and the label line driver comprising a third switch means (26) connecting the data line to the second voltage level.

8. The system of claim 7 wherein is further provided:

a plurality of identifier modules (30) each electrically connected with the first bus (11), each identifier module having a first data terminal (53) and a second data terminal (54), and each identifier module having a power supply, each identifier module further comprising a data bus isolator connecting the first data terminal and second data terminal thereof;

each data bus isolator comprising a fourth switch (40) selectively connecting and disconnecting the first data terminal and the second data terminal, and a current threshold sensor (41) operatively coupled with the fourth switch, the threshold selected so that with actuation of the line driver and with a first impedance at the data line of the associated second bus the fourth switch conducts, and that with actuation of the line driver and with a second, lower impedance at the data line of the associated second bus the fourth switch does not conduct.

9. The system of claim 8 wherein the fourth switch (40) comprises a bipolar transistor having a collector, an emitter, and a base, the collector of which is electrically connected with one of the first data terminal and second data terminal and the emitter of which is electrically connected with the other of the first data terminal and second data terminal.

10. The system of claims 8 or 9 wherein the current threshold sensor comprises a resistor (35) between the first data terminal and the fourth switch and a comparator (41) sensing voltage at a point between the fourth switch and the second data terminal, the operative coupling of the current threshold sensor and the fourth switch comprising coupling of the comparator output (50) with the fourth switch.

11. The system of claims 8, 9, or 10 wherein:

the first predetermined impedance of the host line driver comprises a pull-up resistor (13) between the data line and a voltage level substantially that of the power line;

the first switch means comprising a transistor (51);

the second switch means comprises a transistor (14) and the second impedance associated therewith is substantially only the impedance of the transistor;

the second voltage level substantially comprises a ground level,

and wherein each identifier module further comprises first means for detecting current flow through the predetermined resistance, whereby the identifier module connected with the display device sending one of the messages detects the message from the display device (12) by monitoring the detected current flow.

12. A method for use in an electronic price display system comprising a host (10) with a host line driver and a line receiver (16), a first bus (11) having a data line (28), the bus electrically connected to the host, the data line receiving data from the line driver, the data line electrically coupled to the line receiver, and a multiplicity of electronic price displays (12); the host line driver comprising first and second switch means, the first switch means (51) connecting the data line to a first voltage level through a first predetermined impedance (13), and the second switch means (14) connecting the data line to a second voltage level through a second, smaller impedance; the host further comprising control means actuating the first switch means for the duration of a sending a message comprising bits from the host to an electronic price display and for the duration of any reply therefrom, and actuating the second switch means selectively for sending the bits thereof; the system further comprising a plurality of second buses operatively coupled to the first bus, each second bus having a data line (29) and a power line, the data line of each second bus (29) operatively coupled with the data line of the first bus (28); each electronic price display (12) electrically connected with one of the second buses, each display having a data receiver (24) and a label line driver, the data receiver receiving data from the data line of the one of the second buses, the display receiving

power from the power line of the one of the second buses, and the label line driver comprising a third switch means (26) connecting the data line to the second voltage level; the method comprising the steps of:

actuating the first switch means (51), whereby the first voltage level is presented to the data line through the first predetermined impedance (13);

actuating the second switch means (14) selectively to transmit the bits of a message from the host;

after the bits of the message from the host have been transmitted, continuing to actuate the first switch means (51) for the duration of any response from a label (12); and

turning off the first switch means (51).

13. A price display system substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

14. An identifier substantially as hereinbefore described with reference to and as illustrated in Figure 4 of the accompanying drawings.

15. A host substantially as hereinbefore described with reference to and as illustrated in Figure 4 of the accompanying drawings.

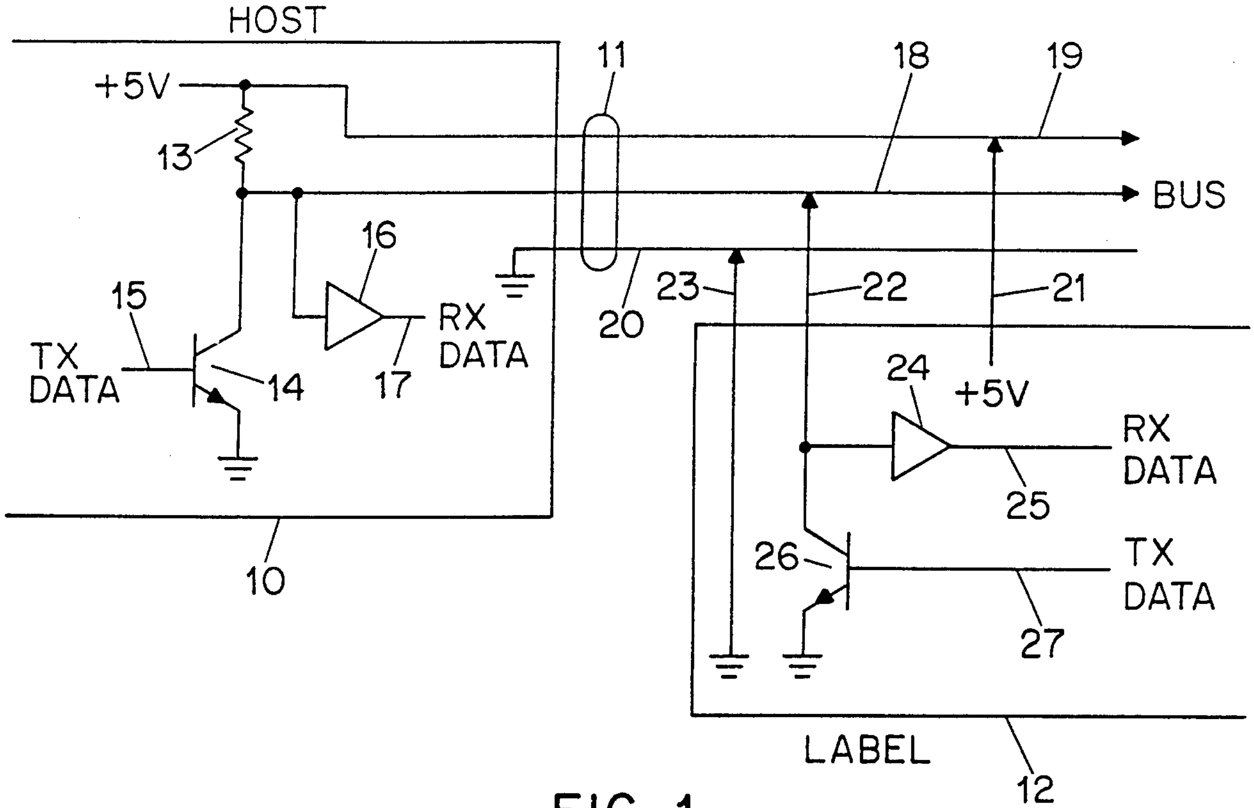
HOST
+5V
13
15
TX
DATA
14
16
RX
DATA
17
10
11
18
19
BUS
20
23
22
21
24
+5V
RX
DATA
25
26
TX
DATA
27
LABEL
12

FIG. 1

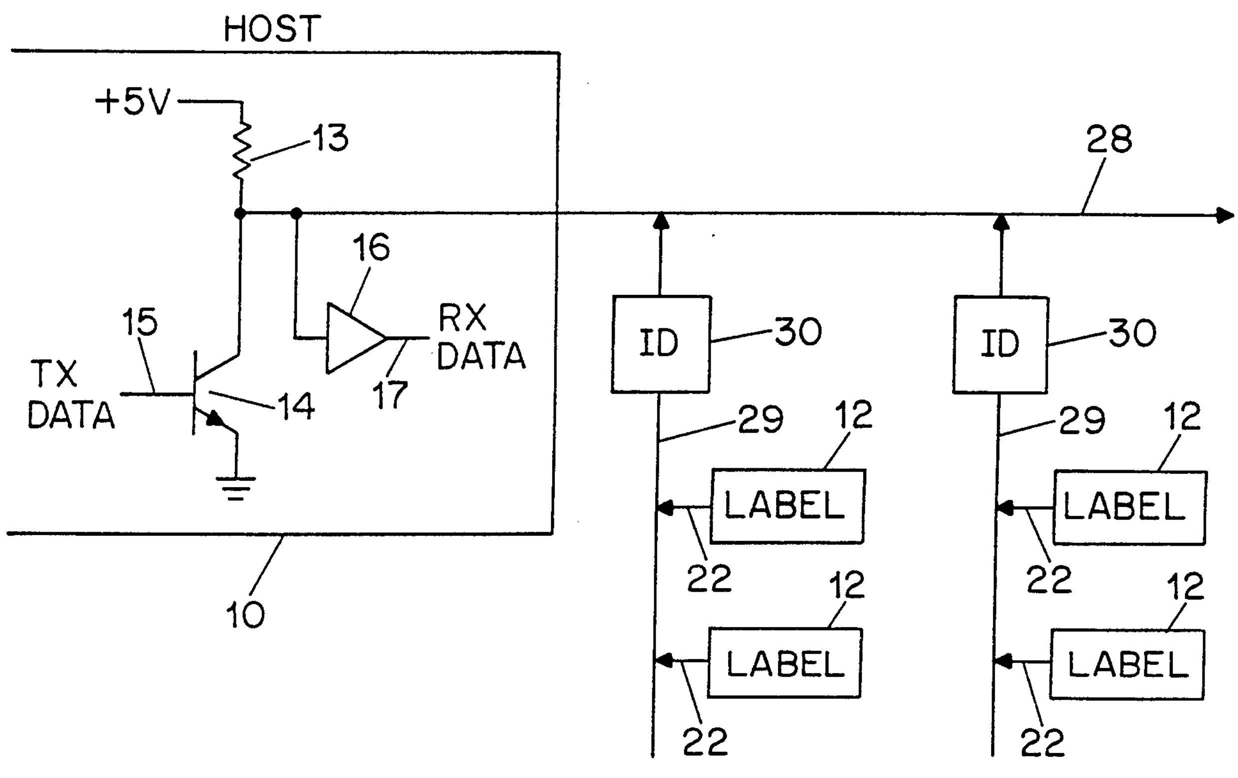
HOST
+5V
13
15
TX
DATA
14
16
RX
DATA
17
10
28
ID
30
29
12
LABEL
22

FIG. 2

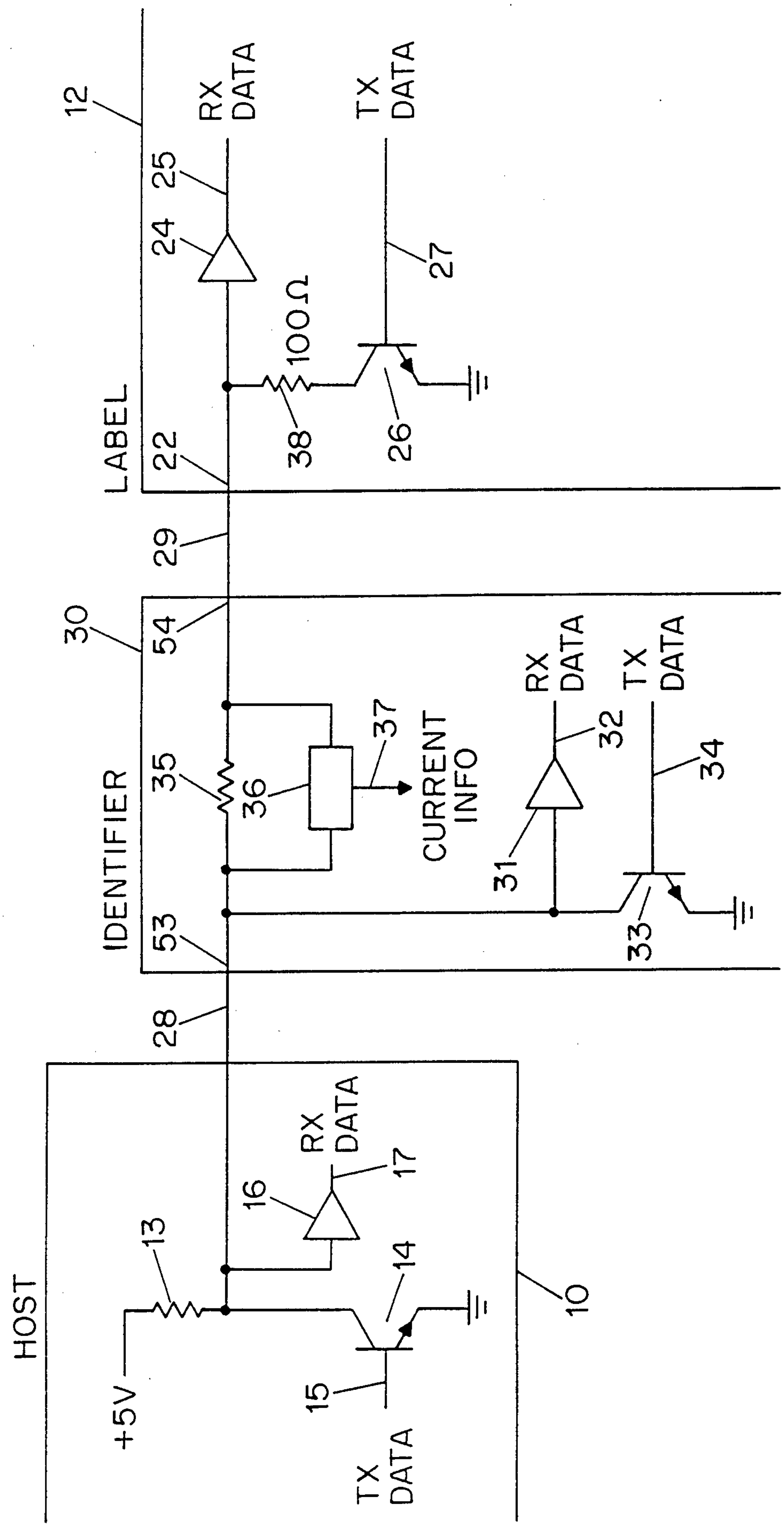
HOST
+5V
13
14
15
TX DATA
16
RX DATA
17
10
28
IDENTIFIER
53
35
36
37
CURRENT INFO
31
RX DATA
32
TX DATA
33
34
30
54
29
LABEL
22
38
100Ω
26
24
25
RX DATA
TX DATA
27
12

FIG. 3

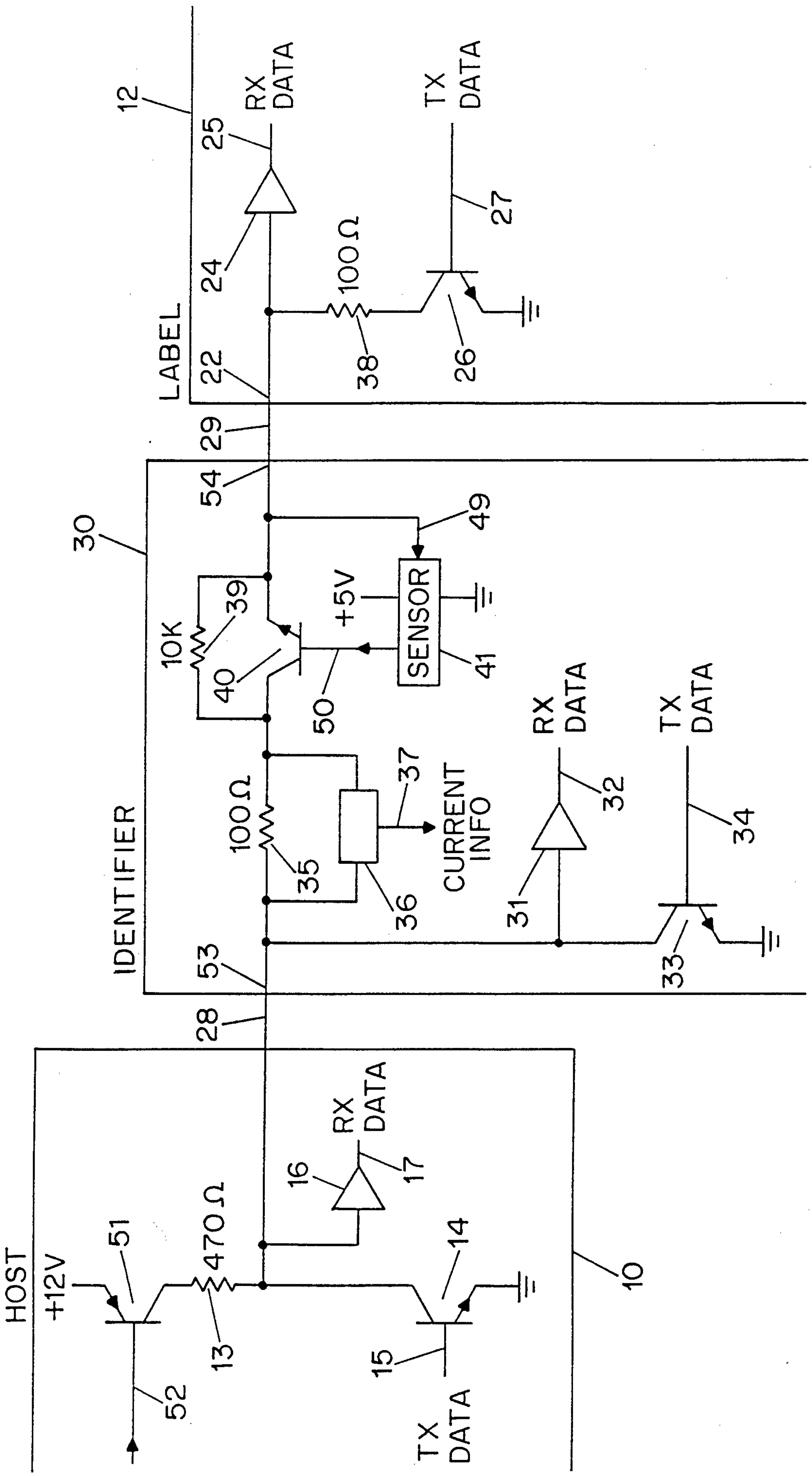
HOST
+12V
51
52
470Ω
13
RX DATA
16
17
14
15
TX DATA
10
28
53
IDENTIFIER
100Ω
35
36
37
CURRENT INFO
31
RX DATA
32
33
TX DATA
34
10K
39
40
50
+5V
SENSOR
41
49
30
54
29
22
LABEL
12
RX DATA
25
24
100Ω
38
26
27
TX DATA

FIG. 4

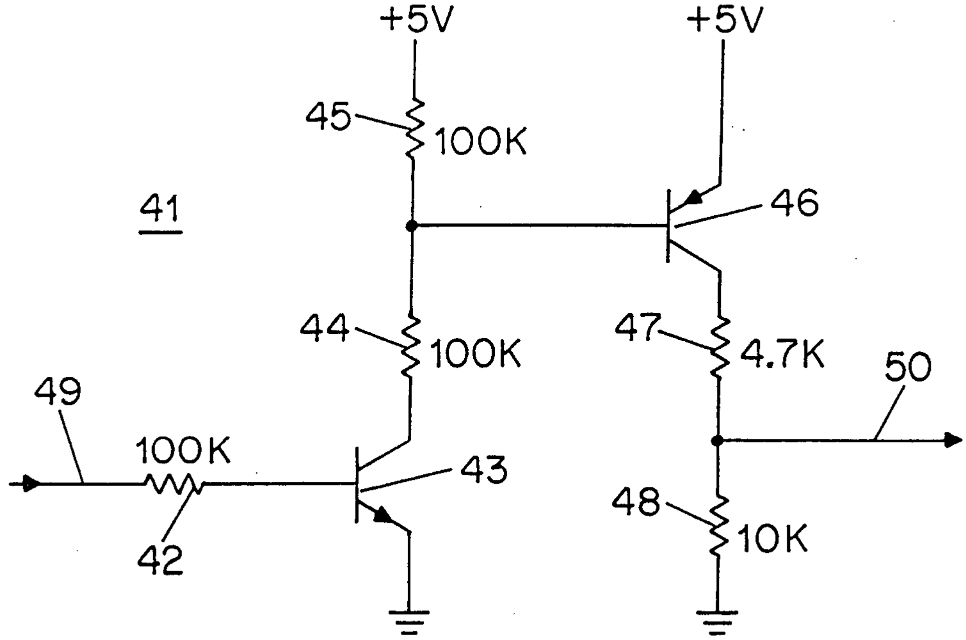

FIG. 5