

(21) Application No **8711841**

(22) Date of filing **19 May 1987**

(30) Priority data

(31) **61/116819**

(32) **21 May 1986**

(33) **JP**

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(51) INT CL⁴

G01R 31/36

(52) Domestic classification (Edition I):

G1U BB

(56) Documents cited

GB A 2043272

EP 0003917

WO 83/00740

GB 1544229

US 4573126

(58) Field of search

G1U

Selected US specifications from IPC sub-class G01R

(54) **Battery level indicators**

(57) A battery level indicator, for use with an electronic apparatus (1), displays on an indicator (7), a real time voltage level detected by a voltage detector (4), when a battery (2) is applying power to the electronic apparatus (1), and displays on the indicator (7) the latest voltage read from a memory (5) when the battery is not applying power to the electronic apparatus, a switch contact (a) being moved accordingly. The memory (5) may be provided by a capacitor or by a microcomputer (Fig. 2 not shown).

FIG. 1

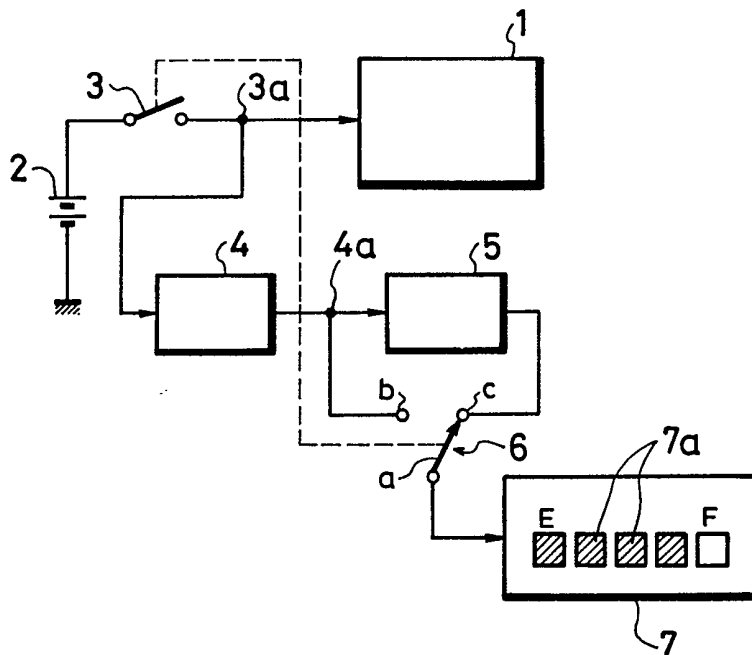


FIG. 1

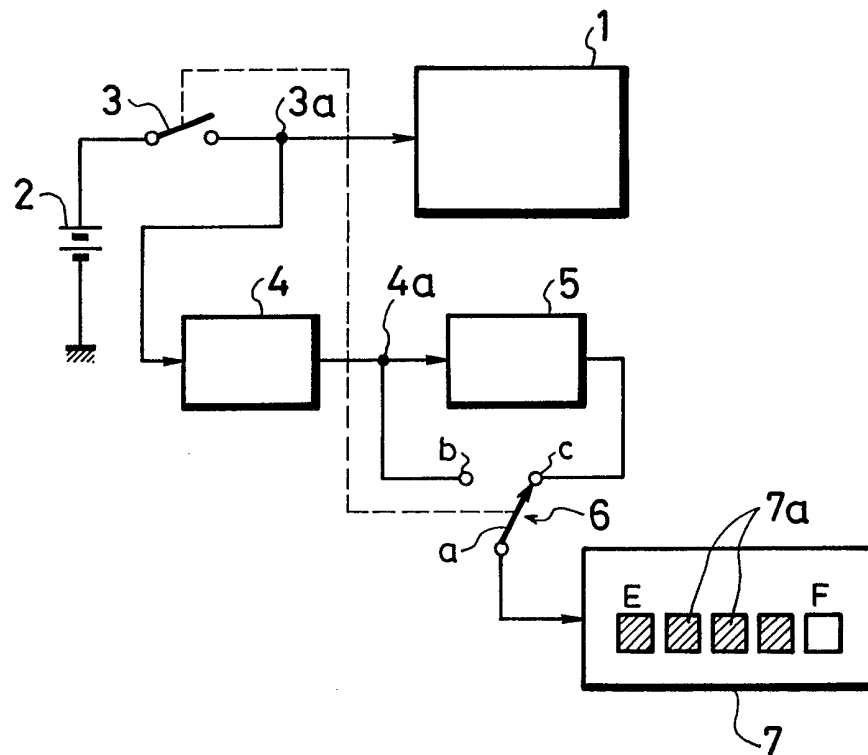


FIG. 2

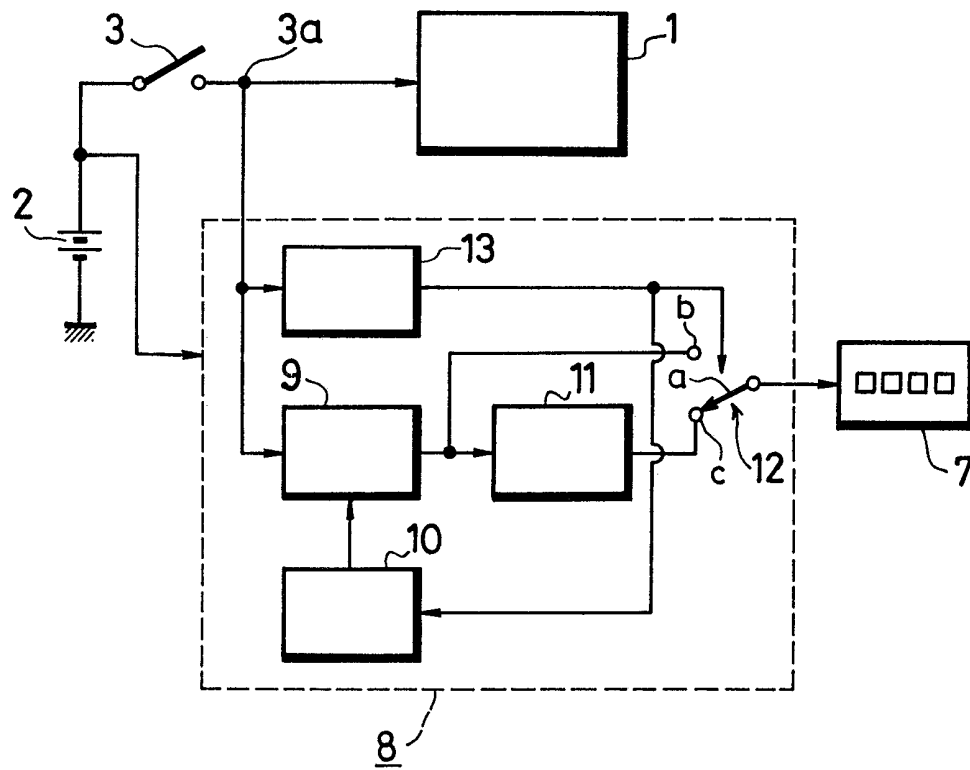
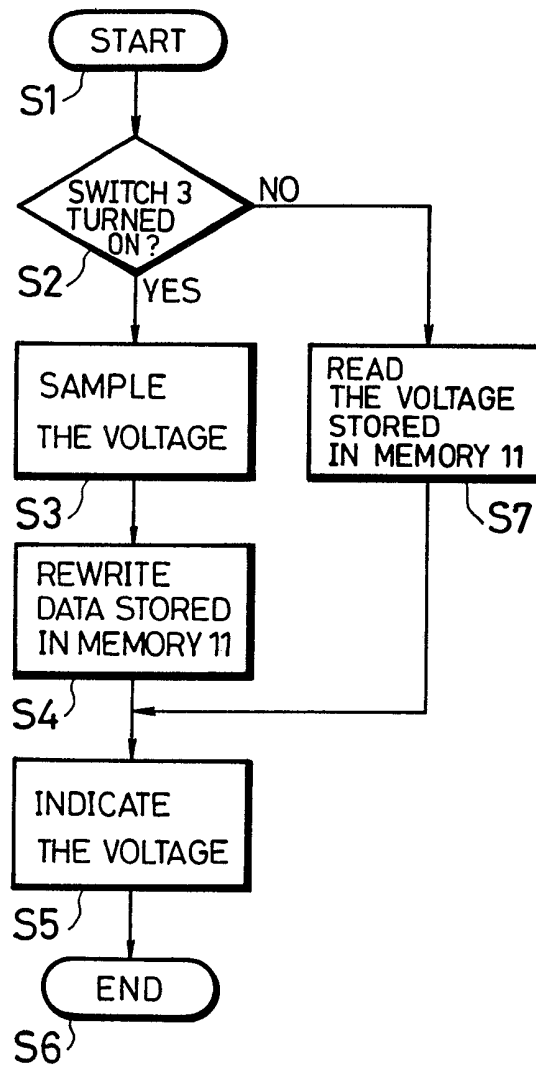


FIG. 3



SPECIFICATION

Battery level indicators

5 This invention relates to battery level indicators for use with electronic apparatus.

A known battery level indicator for use with electronic apparatus is arranged to indicate the voltage level of a battery as it is, without taking into account the effect thereon of its relationship with the electronic apparatus.

When power is being supplied from the battery to the electronic apparatus, the battery level or voltage is decreased, as compared with the open-circuit voltage, due to the voltage drop across its internal resistance. This difference between the battery level when power is being supplied and the open-circuit voltage may be large, especially in the case of an alkaline battery. Accordingly, although the user may judge that the battery is still able to supply enough power on the basis of the indicated battery level when power is not being supplied from the battery to the electronic apparatus, it will often be the case that the remaining power of the battery will not be as adequate as is indicated.

According to one aspect of the invention there is provided a battery level indicator for use with an electronic apparatus, the indicator comprising:

voltage detecting means for detecting the output voltage of a battery which is supplying power to the electronic apparatus;

memory means connected to the voltage detecting means for storing data corresponding to the latest voltage detected by the voltage detecting means;

an indicator for displaying data; and

data supplying means for supplying voltage data from the memory means to the indicator.

According to another aspect of the present invention there is provided a battery level indicator for use with an electronic apparatus or other load, the indicator comprising:

voltage detecting means for detecting a voltage of a battery which is applying power to the electronic apparatus;

memory means for storing data representative of the current or latest voltage detected by said voltage detecting means;

switching means for selecting the voltage detected by the voltage detecting means or the voltage previously read out from the memory means;

an indicator connected to receive a voltage from the switching means; and

data supplying means for supplying voltage data from the memory means through the switching means to the indicator.

The invention will now be further described, by way of illustrative and non-limiting example, with reference to the accompanying drawings, in which like references identify like elements and parts throughout, and in which:

Figure 1 is a block diagram of a battery level indicator embodying the present invention;

Figure 2 is a block diagram of another battery level indicator embodying the present invention; and

Figure 3 is a flow chart to which reference will be made in explaining the operation of the battery level indicator shown in Figure 2.

Figure 1 shows an electronic apparatus main body (electric apparatus proper 1, such as a main body of a video tape recorder (VTR), a radio receiver, a television receiver and so on. A battery 2, which may be a dry cell type of battery, a rechargeable storage battery or the like, is accommodated in the electronic apparatus main body 1. The voltage of the battery 2 is applied through a power supply switch 3 to the electronic apparatus main body 1.

A voltage detecting circuit 4 is arranged to detect a voltage at a junction 3a between the power supply switch 3 and the electronic apparatus main body 1. The voltage detecting circuit 4 is formed of, for example, a resistor of high resistance which is connected between the junction 3a and earth (ground). An output terminal 4a of the voltage detecting circuit 4 is connected to the voltage detector resistor, either at the connection 3a or to a middle point of the resistor. The voltage detecting circuit 4 may thus function as a voltage divider, whereby the voltage supplied to the output terminal 4a has its level adjusted as desired, while remaining proportional to the voltage at the junction 3a.

A memory 5 (for example a condenser memory) is connected to the voltage detecting circuit 4 at its output terminal 4a and stores data which represents the latest voltage of the battery 2 as detected by the voltage detecting circuit 4. The operation of a last condition memory, for example a last channel memory of a television receiver, is well known and therefore will not be described in detail. A memory unit capable of long-term data storage may be used.

A change-over switch 6 has a movable contact *a* and two fixed terminals *b* and *c*: The fixed terminal *b* of the switch 6 is connected to the output terminal 4a of the voltage detecting circuit 4 and the fixed terminal *c* is connected to an output terminal of the memory 5. The movable contact *a* of the switch 6 is connected to an indicator or display unit 7. The indicator 7 may be any of various types of voltage indicator: in the illustrated embodiment it is of a liquid crystal type. The indicator 7 is provided with a plurality of rectangularly-shaped indicating elements 7a aligned in a straight line, which can indicate the voltage level of the battery 2 in correspondence with the number of indicating elements 7a which are activated. In this case, when only the indicating element 7a located at the left-hand end is in the activated or indicating state, the bat-

tery 2 is exhausted and will not be able to supply power any more. On the other hand, when all of the indicating elements 7a from the left-hand end to the right-hand end are in the indicating state, the battery 2 has sufficient residual power to power the electronic apparatus for an extended period.

The change-over switch 6 is ganged with the power supply switch 3 (as shown by a broken line) so that, when the power supply switch 3 is turned on (closed) the switch 6 connects its movable contact *a* to the fixed terminal *b*, and when the power supply switch 3 is turned off (opened) the switch 6 connects its movable contact *a* to the fixed terminal *c*, as shown in Figure 1.

The operation of the battery level indicator of Figure 1 will now be described. When the power supply switch 3 is turned on, the movable contact *a* of the change-over switch 6 is switched to be connected to the fixed terminal *b* to allow the voltage detecting circuit 4 directly to detect the voltage of the battery 2, which is now applying power to the electronic apparatus main body 1, the detected present (real time) voltage being supplied to and indicated by the indicator 7.

When the power supply switch 3 is turned off, the movable contact *a* of the change-over switch 6 is switched to be connected to the fixed terminal *c*. At that time, the voltage read out of the memory 5 (which is the latest voltage supplied from the battery 2 to the electronic apparatus main body 1 just before turning-off of the switch 3) is applied to and indicated by the indicator 7.

Figure 2 shows an electronic apparatus main body (electronic apparatus proper) 1, such as a video tape recorder (VTR), a radio receiver, a television receiver and so on. A battery 2, which may be a dry cell type of battery, a rechargeable storage type or the like, is accommodated in the electronic apparatus main body 1. The voltage from the battery 2 is applied through a power supply switch 3 to the electronic apparatus main body 1 in similar manner to the arrangement shown in Figure 1.

A microcomputer 6 (shown by a broken line block) incorporates various function units such as a voltage sampling means 9, a sampling pulse generating means 10, a memory 11, a switching means or switch 12 and a voltage detector 13 for detecting the presence or absence of a voltage. The microcomputer 8 may be directly supplied with the operating voltage from the battery 2 or with another voltage from a power supply (not shown) that may convert the voltage of the battery 2 to another voltage value, if necessary or desired.

The sampling means 9 is arranged to sample a voltage developed at a junction 3a between the power supply switch 3 and the electronic apparatus main body 1 in response to a sampling pulse supplied thereto from the sampling pulse generating means 10. The

sampling pulse generating means 10 generates sampling pulses on the basis of the detected output from the voltage detector 13 in response to the presence or absence of a voltage at the junction 3a. The pulse generating means 10 is enabled only when the voltage detector 13 is supplied with the voltage developed at the junction 3a, that is only when the switch 3 is closed.

The output voltage from the voltage sampling means 9 is supplied to the memory 11 so that data stored in the memory 11 corresponds to the latest voltage sample from the sampling means 9. The switching means 12 is provided with one movable contact *a* and two fixed terminals *b* and *c*. The sampled voltage from the sampling means 9 is supplied to the fixed terminal *b* of the switching means 12 and the latest sampled voltage read out from the memory 11 is supplied to the other fixed terminal *c* of the switching means 12. The movable contact *a* of the switching means 12 is connected to an indicator 7, which is constructed in the same way as the indicator 7 described with reference to Figure 1.

Switching of the switching means 12 is controlled by the detected output from the voltage detector 13 in the following manner. When a voltage is applied to the junction 3a between the power supply switch 3 and the electronic apparatus main body 1, the switching means 12 connects its movable contact *a* to the fixed terminal *b*, while when no voltage is supplied thereto its movable contact *a* is connected to the other fixed terminal *c*.

The operation of the battery level indicator shown in Figure 2 will now be described with reference to a flow chart shown in Figure 3. Referring to Figure 3, the microcomputer 8 begins execution of processing at a step S1. At the next step S2, it detects whether or not the power supply switch 3 is turned on (closed). When the switch 3 is turned on, the switching means 12 connects its movable contact *a* to the fixed terminal *b* in response to the detected output from the voltage detector 13 and, at the same time, the sampling means 9 samples (step S3) the voltage developed at the junction 3a between the power supply switch 3 and the electronic apparatus main body 1. That is, the sampling means 9 samples the real time voltage supplied from the battery 2 to the electronic apparatus main body 1. The sampled voltage from the sampling means 9 is supplied to the memory 11, and data stored in the memory 11 is rewritten or altered (step S4) to represent or correspond to the latest sampled voltage. At the same time, the sampled voltage is directly supplied to the indicator 7, on which it is indicated (step S5). Then, the processing ends (step S6).

When, on the other hand, the power supply switch 3 is found to be in the open or off condition at the step S2, the switching means

12 is switched by the detected output from the voltage detector 13 such that its movable contact *a* is connected to its fixed terminal *c*. Also, the sampling means 9 is inhibited by the output from the detecting means 13 from sampling the voltage developed at the junction 3a. Then, the latest sampled voltage read out of the memory 11 (step S7), which is the voltage supplied to the electronic apparatus main body 1 just before the power switch 3 was turned off, is supplied to the indicator 7 and the voltage is indicated thereon at the step S5.

According to the embodiments of the present invention described above, the battery level indicator for use with an electronic apparatus can indicate substantially how much power the battery will be able to supply to a specific electronic apparatus connected thereto.

Many modifications and variations could be made to the above-described embodiments of the invention without departing from scope of the invention. For example, in Figure 2, the voltage detector 13 and the switching means 12 can be eliminated and the output of the memory 11 can always be supplied to the indicator 7. In this case, the indicator 7 displays the present (real time) voltage when the switch 3 is in its closed or on condition, and at other times (when the switch 3 is open) the sampling means 9 is not operative to change the data stored in the memory 11, so that the indicator displays the voltage prior to opening of the switch 3.

CLAIMS

1. A battery level indicator for use with an electronic apparatus, the indicator comprising:
 - voltage detecting means for detecting the output voltage of a battery which is supplying power to the electronic apparatus;
 - memory means connected to the voltage detecting means for storing data corresponding to the latest voltage detected by the voltage detecting means;
 - an indicator for displaying data; and
 - data supplying means for supplying voltage data from the memory means to the indicator.
2. A battery level indicator according to claim 1, in which the data supplying means comprises first means for supplying a real time voltage detected by the voltage detecting means when the electronic apparatus is in a power-on state and second means for supplying the voltage data from the memory means when the electronic apparatus is in a power-off state.
3. A battery level indicator according to claim 2, in which said first and second means are constituted by a microcomputer having stored program means for causing new voltage data to be continuously written into the memory means while the electronic apparatus is in its power-on state and for allowing the

memory to retain stored data when the electronic apparatus is in its power-off state, whereby the indicator displays said real time voltage via the memory means when the electronic apparatus is in its power-on state.

4. A battery level indicator substantially as herein described with reference to Figure 1 or Figures 2 and 3 of the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd, Dd 8991685, 1987.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.