An in-operation indicating device for a clock comprising a switch being intermittently opened and closed when the clock is running and a light-emitting diode being intermittently put on and off by opening and closing operation of said switch in order to let the user know without fail that the clock is operating.
FIG. 1

FIG. 2

FIG. 3

FIG. 4
FIG. 5

FIG. 6
IN-OPERATION INDICATING DEVICE FOR CLOCKS

BACKGROUND OF THE INVENTION

a. Field of the invention:

The present invention relates to clocks and, more particularly to an in-operation indicating device which can be favourably used for a digital indication type clock.

b. Description of the prior art:

When using an electro-mechanical converting device such as synchronous motor or vibration-rotation converting device such as a tuning fork as the driving power source for a clock, the following method has been adopted to confirm whether the clock is operating or not. That is, a rotary member having wavy stripes on the peripheral surface is mounted to a rotary shaft which turns one revolution per minute and change of those wavy stripes caused by rotation of the rotary member is observed from outside. In this method, however, size of the rotary member and the space for mounting it are limited and, practically, it is impossible to see the change of wavy stripes from a position several-meter distance from the clock. Besides, in this method, it is impossible to see the change at a dark place.

SUMMARY OF THE INVENTION

The principal object of the present invention is to provide an in-operation indicating device for a clock which enables to check easily whether the clock is operating or not even at a dark place and from a comparatively distant position.

Another object of the present invention is to provide said kind of inoperation indicating device which can be housed in a comparatively narrow space and which operates with high reliability.

Still another object of the present invention is to provide said kind of in-operation indicating device wherein a light-emitting diode is used as the in-operation indicating member and which is arranged to make the light-emitting diode emit light of high intensity even with a low source voltage.

These and other objects as well as the attendant advantages of the present invention will become apparent by reading the following detailed description of the embodiments of the invention in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a circuit diagram showing the fundamental theory of the in-operation indicating device according to the present invention;

FIG. 2 shows a front view of the switch mechanism used together with the circuit shown in FIG. 1;

FIG. 3 shows a front view of the switch mechanism different from that shown in FIG. 2; and

FIG. 4 shows a circuit diagram showing an embodiment of the in-operation indicating device according to the present invention but different from that shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1 showing the circuit diagram of the most basic embodiment of the in-operation indicating device according to the present invention, reference symbol

D1 designates a light-emitting diode, reference symbol C1 designates a capacitor with a capacity about 10 μF, reference symbol R1 designates a resistor with a resistance value about 1,000 kΩ, reference symbol SW1 designates a switch which is opened and closed intermittently by a part of a clock device not illustrated and reference symbol E designates a power source battery.

FIG. 2 shows an example of the mechanism to intermittently open and close the switch SW1. In this figure, numeral 1 designates a rotary shaft connected to the drive motor of the clock device not illustrated here. Numeral 2 designates an electro-insulating rotary disk which is mounted to the rotary shaft 2. Numeral 3 designates plurality of electro-conductive foils provided radially on the rotary disk 2 being spaced from each other. Reference symbols a and b designate contact pieces arranged to contact one of conductive foils at the same time. Therefore, when the clock is running, i.e., when the rotary disk 2 is rotating, the switch SW1 is opened and closed intermittently.

FIG. 3 shows an embodiment of the switch mechanism which is different from that shown in FIG. 2. For this embodiment, same numerals and reference symbols are given to those parts which have the same functions as those parts shown in FIG. 2. On the circumference of the insulating rotary disk 2 mounted to the rotary shaft 1, teeth 2a are formed with roots of a suitable width for fitting in the tip of one contact piece (for example, the contact piece a) of the switch SW1. The electro-conductive disk 3 has an outer diameter slightly smaller than the outer diameter of the rotary disk 2 so that the contact piece a can electrically contact the circumference of the conductive disk 3 only when the contact piece a engages in the root between teeth 2a. The central portion of the conductive disk 3 is cut out leaving the tongue portion 3a. The tip of the tongue portion 3a is electrically connected to the rotary shaft 1 and substantially serves as the other contact piece (for example, the contact piece b) of the switch SW1. Therefore, also in this embodiment, the contact piece a intermittently engages in the root of teeth 2a when the rotary disk 2 is rotating, and consequently, the switch SW1 is opened and closed intermittently.

The off-frequency of the switch SW1, is same as the light-emitting frequency of the light-emitting diode D1. Therefore, for one light emission per second, rotating speed of the rotary disk 2 has to be made 1 rpm and 60 copper foils 3 or 60 teeth 2a are required.

The light-emitting diode D1 has a characteristic that the response speed is very high so that it can respond even to a frequency about 1 MHz and emits clear red light of about 6,500 A when a voltage about 1.6 V to 1.7 V is imposed in regular direction. To achieve a light intensity sufficient to confirm light emission from a certain distance in this case, the required current is about 10 mA. On the other hand, in case of a clock for which a battery is used as the power source, the driving current value is about 500 μA on the average in case of 3 V power source because it is necessary to keep the clock in operable condition for one or two years by one or two batteries. Therefore, the current value which can be used for other purpose than to drive the clock (i.e., for the light-emitting diode) is about 100 μA at the maximum. Therefore, in case of an ordinary electric clock for which a battery is used as the power source, a separate battery for the light-emitting diode
is required to make the light-emitting diode $D_2$ emit light satisfactorily. According to the present invention, however, the power source for driving the clock can be used in common to the power source for the light-emitting diode by making the duty cycle short. As the response of the light-emitting diode $D_2$ is very quick, it has been approved as a result of experiments that light emission can be confirmed from a considerably distant position even when the light-emitting time is about 1 msec.

Operation of the device according to the present invention is as described below. That is, when the switch $SW_1$ is closed with the capacitor $C_1$ being under the charged condition, the electric charge of the capacitor $C_1$ is discharged through the light-emitting diode $D_1$ at that moment and the diode $D_2$ emits light for a very short time (about 1 msec). When the switch $SW_1$ is kept in closed condition after the above light emission, current is supplied to the diode $D_1$ from the battery $E$ through the resistor $R_2$. As the resistance of the resistor $R_2$ is large, however, the current which flows through the diode $D_1$ is small and the diode $D_2$ does not emit light. When the switch $SW_1$ is opened after that, the capacitor $C_1$ is charged again through the resistor $R_2$ and its terminal voltage becomes close to the battery voltage $E$ gradually. When the switch $SW_1$ is then closed again, the light-emitting diode $D_1$ emits light at the same moment. In this case, the light-emitting cycle time of the light-emitting diode is decided by the time constant which is decided by the resistor $R_2$ and capacitor $C_1$. The adequate light-emitting cycle time is one to two seconds.

FIG. 4 shows another embodiment in which a transistor $T_1$ is used in order to make the capacity of the capacitor $C_1$ for charging and discharging small. This embodiment is arranged to make the transistor $T_1$ conductive, at the moment when the switch $SW_1$ is turned on, in order to make the light-emitting diode emit light.

In the above embodiments, the switch $SW_1$ is used to detect the motion of the rotary disk. In the present invention, it is also possible to use an electronic switch instead of the switch $SW_1$. FIG. 5 and FIG. 6 show embodiments incorporating an electronic switch.

In case of the embodiment shown in FIG. 5, the capacitor $C_1$ is charged by making the transistor $T_2$ conductive only when a voltage is induced at the pick-up coil $L$ by rotation of the clock driving device (for example, a motor or the like). Besides, discharge from the capacitor $C_1$ is carried out by making the transistor $T_2$ conductive only when a pulse signal is imposed from outside on the input terminals $d$ and $d'$ of the transistor $T_2$. As the signal to be imposed on the input terminals $d$ and $d'$, a pulse signal of 1 to 2 pulses/sec is suitable and can be generated by a signal generating device $S$ such as a multivibrator. When further accuracy is required, said signal generating device can be arranged by a combination of a crystal oscillator and frequency divider. To detect the motor rotation, the pick-up coil $L$ may be positioned near the rotor magnet $M$ of the motor to make it generate an induced voltage. As described in the above, in case of the embodiment shown in FIG. 5, a voltage is intermittently imposed on the base of the transistor $T_2$, when the motor is running, and the transistor $T_2$ becomes conductive. By the collector current of the transistor $T_2$, the capacitor $C_1$ is charged through the resistor $R_2$ and the light-emitting diode $D_2$ emits light only when the input pulse (1 to 2 msec) is given to the base of the transistor $T_3$. In FIG. 5, the resistor $R_1$ is not always required.

The light-emitting diode $D_2$ is arranged to emit light when the capacitor $C_1$ is discharged in cases of the embodiments shown in FIG. 1 and FIG. 5 and when the capacitor $C_2$ is charged in case of the embodiment shown in FIG. 4. In this invention, it is also possible to make the light-emitting diode $D_2$ emit light at both charging and discharging of the capacitor in order to use the power of the capacitor effectively. FIG. 6 shows an embodiment arranged in said way.

In FIG. 6, suitable input pulse is illustrated as imposed on the input terminals $f$ and $f'$ from a signal generator as shown in FIG. 5. When the transistor $T_3$ becomes conductive by these pulses, the capacitor $C_1$ is charged through the passage marked (1) and the light-emitting diode $D_{1x}$ emits light at the same time. When the transistor $T_3$ becomes conductive by said pulses, the charge already charged to the capacitor $C_1$ is discharged through the passage marked (2) and the light-emitting diode $D_{1x}$ emits light.

Claim 1:

1. An in-operation indicating device for a clock comprising a disk member periodically moved by a clock device, a power source battery for driving said clock device, a switch device positioned adjacent to said disk member and operatively coupled thereto for effecting periodically its switching action by the rotation of said disk member, a light-emitting diode connected to said power source battery through said switch device, and a capacitor connected in parallel to a series circuit of said switch device and light-emitting diode and charged by said power source battery when said light-emitting diode is disconnected from said power source battery by said switch device and discharged to make said light-emitting diode emit light for an extremely short time at the moment when said switch device is closed.

2. An in-operation indicating device for a clock according to claim 1, in which said disk member comprises a rotary shaft and said switch device comprises an electro-insulating rotary disk being fixed to said rotary shaft, plurality of electro-conductive foils radially arranged on said rotary disk and a pair of contact pieces capable of contacting electro-conductive foils.

3. An in-operation indicating device for a clock according to claim 1, in which said disk member comprises a rotary shaft and said switch device comprises an electro-insulating rotary disk fixed to said rotary shaft and having plurality of teeth on the peripheral surface, an electro-conductive disk mounted to said rotary disk and electrically connected to said rotary shaft, and a contact piece arranged engageably with said teeth and having a tip portion that contacts the peripheral surface of said electro-conductive disk only when being fitted in the root of said teeth.

4. An in-operation indicating device for a clock comprising a disk member periodically moved by a clock device, a switch device positioned adjacent to said disk member and operable to effect periodically its switching action by the rotation of said disk member, a light-emitting diode connected to said switch device, a transistor having the collector electrode connected to one terminal of said light-emitting diode, a capacitor and resistor connected in parallel between said switch device and the base electrode of said transistor, and a power source battery having one terminal connected between said switch device and the other terminal of
said light-emitting diode and having the other terminal connected to the emitter electrode of said transistor.

5. An in-operation indicating device for a clock comprising a magnet member periodically moved by a clock device, a power source battery for driving said clock device, a switch device including a pick-up coil positioned adjacent to said magnet member for generating an induced voltage in response to motion of said magnet member for effecting periodic switching action by the rotation of said magnet member, said switch device further including a first transistor having a collector electrode connected to one terminal of said light-emitting diode, an emitter electrode connected to one terminal of said power source battery, and a base electrode connected to said pick-up coil, a second transistor having a collector electrode connected to the other terminal of said light-emitting diode, and an emitter electrode connected to the other terminal of said power source battery, a signal generating device connected to the base electrode of said second transistor, and a capacitor connected in parallel to a series circuit of said light-emitting diode and said second transistor.

6. An in-operation indicating device for a clock comprising a magnet member periodically moved by a clock device, a power source battery for driving said clock device, a switch device including a pick-up coil positioned adjacent said magnet member for generating an induced voltage in response to motion of said magnet member for effecting periodic switching action by the rotation of said magnet member, said switch device further including a first transistor having a collector electrode, said first transistor having an emitter electrode connected to one terminal of said power source battery and a base electrode connected to said pick-up coil, a second transistor having an emitter electrode connected to the collector electrode of said first transistor and said second transistor having a collector electrode connected to one terminal of a first light-emitting diode, a second light-emitting diode having one terminal connected to the other terminal of said first light-emitting diode, a third transistor having a collector electrode connected to the other terminal of said second light-emitting diode, and an emitter electrode coupled to the power source battery, a signal generating device having an output coupled to the base electrodes of said second and third transistors, and a capacitor connected between the emitter electrode of said second transistor and the common connection of the other terminal of said first light-emitting diode and the one terminal of said second light-emitting diode.

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