July 15, 1969 KIYOAKI KONNO 3,455,103

WINDING-UP DEVICE FOR THE DRIVE SPRING OF AN ELECTRIC CLOCK

Filed June 6, 1967 2 Sheets-Sheet 1

FIG. 1.

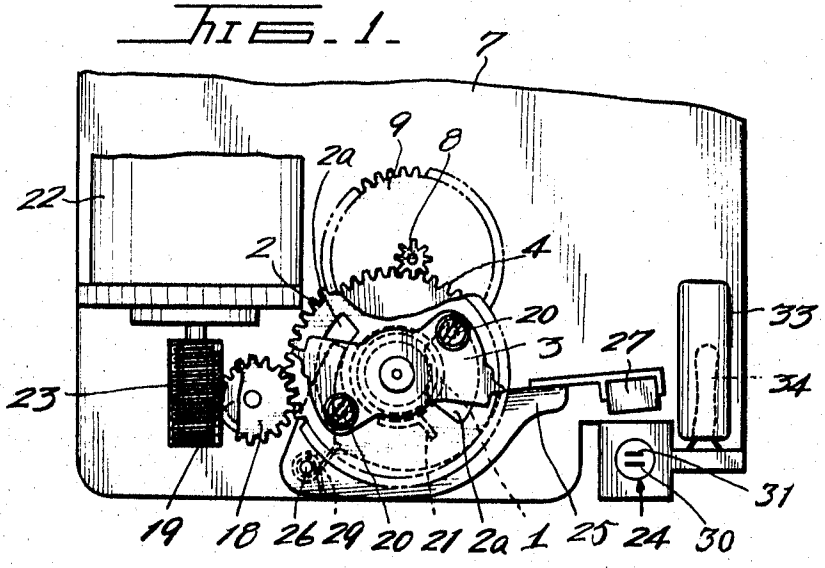
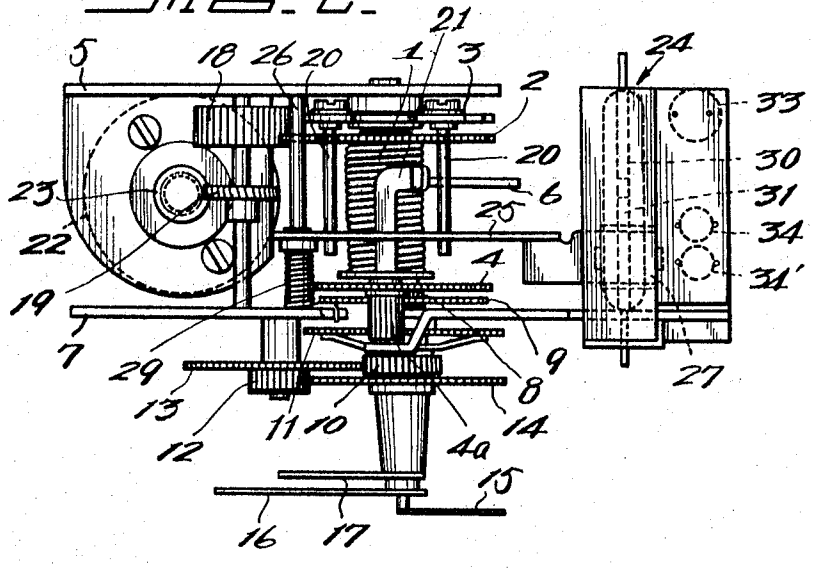


FIG. 2.



July 15, 1969 KIYOAKI KONNO 3,455,103

WINDING-UP DEVICE FOR THE DRIVE SPRING OF AN ELECTRIC CLOCK

Filed June 6, 1967 2 Sheets-Sheet 2

FIG. 3

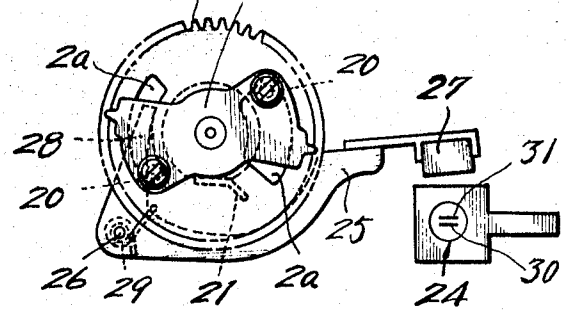


FIG. 4

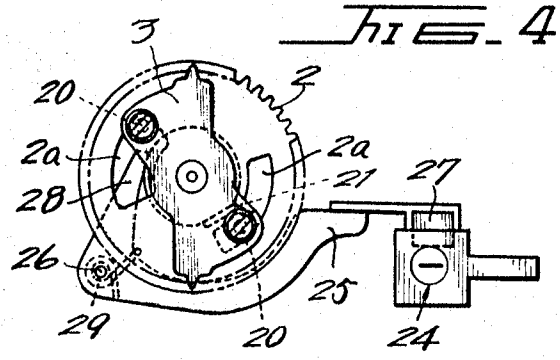


FIG. 5

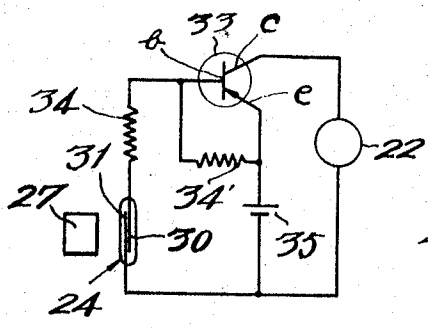
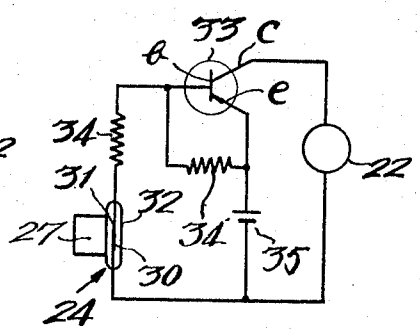


FIG. 6



United States Patent Office 3,455,103
Patented July 15, 1969

3,455,103

WINDING-UP DEVICE FOR THE DRIVE SPRING OF AN ELECTRIC CLOCK

Kiyoaki Konno, Kawsaki-shi, Japan, assignor to Tokyo Tokei Seizo Kabushiki Kaisha, Kawsaki-shi, Kanagawa-ken, Japan

Filed June 6, 1967, Ser. No. 643,863
Claims priority, application Japan, Nov. 30, 1966, 41/78,008
Int. Cl. G04c *1/06*
U.S. Cl. 58—41 4 Claims

ABSTRACT OF THE DISCLOSURE

A winding means for the drive spring of an electric clock having a driving source constituted by a spring adapted to be wound intermittently by an electric motor provided with an electric source defined by a cell, a reed switch inserted in the circuit of a transistor between the emitter and base of the transistor and the reed switch being adapted to be closed or opened by a permanent magnet capable of moving intermittently toward and away from the reed switch.

This invention relates to an electric clock of the type having a helical or spiral spring serving as the drive source therefor with such spring adapted to be intermittently would by a D.C. motor provided with a dry cell as its electric source and more particularly, to a winding device for the drive spring of the main clock mechanism.

It has been known in the art to provide an electric clock in which the main clock mechanism is driven by a helical or spiral spring adapted to be intermittently wound by a D.C. motor having a cell as the electrical source therefor. However, in an electric clock of the type mentioned in which the circuit for operating the main clock mechanism is equipped with an operating switch inserted in series in relationship to the motor which is also in the circuit, since the current from the motor flows directly to the contacts of the switch, the circuit intermittently closes and opens when the contacts are separated and the counter electromotive force generated in the moment of the winding operation of the motor occurs between the contacts thereby resulting in a spark or electric arc discharge which causes wear, deformation and fusing of the contacts and thus constitutes major causes of trouble in the electric clock. To eliminate the above objectionable characteristics, even if the contact pressure to be applied on the contacts is increased to reduce the contact resistance between the contacts if the clock has been in use for a considerable period of time, the leaf spring forming part of the switch will be subject to fatigue due to the repeated closing and opening cycles of the contacts and changes on the contacts in the course of time and as a consequence, mechanical and electrical properties of the switch. Moreover, if the contact pressure to be applied on the switch contacts is increased, the main clock mechanism will be subjected to a great load in a value in excess of a predetermined necessary value and such a great load is not desirable.

Accordingly, a salient object of the present invention is to provide an electric clock having a winding means for the drive mechanism of the main clock mechanism which will overcome the above and other defects existing in the art.

Another object of the present invention is to provide a winding device for the drive spring of an electric clock in which excess current can be prevented from flowing through the switch serving to energize and deenergize the motor so that the switch contacts are protected from the effects of the excess current, thus ensuring a switch having a long life and service.

Another object of the invention is to provide an electric clock in which the main clock mechanism may be free of excess load when the switch operably related to the winding device for the drive spring of the clock is closed and opened.

In accordance with the present invention, by inserting a transistor and reed switch into the circuit of the electric clock for energizing or deenergizing the clock motor, the amperage of the current flowing through the reed switch can be made one-tenth of that of the motor current and moreover, since the counter electromotive force generated in the motor as the switch contacts open have no adverse effect on the switch so that the switch contacts may be protected from the counter electromotive force, thus assuring a long life for the clock and effectively preventing the arising of problems in the clock mechanism.

To accomplish the above and other advantageous objects, the invention provides a winding device for the drive spring of an electric clock having as its drive source, a helical or spiral spring adapted to be wound intermittently by a D.C. motor provided with a cell as its electric source, a sealed-type reed switch inserted in series in the circuit of a transistor between the emitter and base of the transistor on the input side of the transistor, a permanent magnet, movable mounting means supporting said magnet for movement toward and away from said reed switch for effecting closing and opening of the same, means operably related between said mounting means and said drive spring for moving the mounting means and thus the magnet in one direction and additional means for moving said mounting means and thus said magnet in the other direction whereby the base current flowing through the reed switch controls the motor which is inserted in series on the output side or collector circuit of the transistor.

Further objects and advantages of the invention will become more readily apparent to persons skilled in the art from the following detailed specification and annexed drawings and in which drawings:

FIGURE 1 is a fragenentary view in front elevation of the principal portion of a preferred embodiment of the present invention,

FIGURE 2 is a bottom view of the device illustrated in FIGURE 1,

FIGURE 3 is a fragmentary view in front elevation of the principal components of the spring winding mechanism of the device shown in FIGURES 1 and 2 with the reed switch of the mechanism being in its opened condition,

FIGURE 4 is a view similar to FIGURE 3 in which the reed switch is in the closed condition,

FIGURE 5 is a diagrammatic view of the motor electric circuit which corresponds to the condition of the winding mechanism illustrated in FIGURE 3, and

FIGURE 6 is a diagrammatic view of the motor electric circuit which corresponds to the condition of the winding mechanism illustrated in FIGURE 4.

Referring to the embodiment illustrated in the drawings, it can be seen from FIGURE 1 that a conventional helical spring **1** is provided for driving the main clock mechanism of an electric clock. One end of the spring **1** is connected to a drive wheel **2** adapted to rotate together with a drive plate **3** and the drive plate **3** is mounted loosely on a shaft supported by a supporting plate or frame **5** as will later be described in more detail. The other end of the spring **1** is connected to a third wheeel **4** of the conventional clock mechanism and this wheel is adapted to be driven by the spring **1** for driving the main clock mechanism.

The main clock mechanism per se is of conventional type and includes a front plate **6**, the third wheel **4** supported by a back plate **7**, a third pinion **4***a*, a fourth pinion **8**, a fourth wheel **9**, a center pinion **10**, a center wheel **11**,

intermediate or transmission pinion **12**, intermediate or transmission wheel **13**, an hour wheel **14**, a second hand **15**, a minute hand **16** and an hour hand **17**. Inasmuch as the arrangement and structural details of the aforementioned components constituting the main clock mechanism are conventional a detailed explanation thereof is not deemed necessary.

A pair of drive pins **20** secured at one end to the drive plate **3** for rotary movement together with such plate and the free end of the drive pins extend loosely through corresponding sector-shaped through bores or openings **2***a* provided in the drive wheel **2**. A release element **21** is mounted on one side of the third wheel **4** at a position opposite to the drive pins **20** and projects into the path of rotary movement of the drive pins **20**.

The drive wheel **2** is adapted to be driven from a D.C. motor **22** via a wheel **19** which is in engagement with a worm **23** fixedly mounted on the output shaft of the motor **22** and a further wheel **18** mounted on the same shaft as the wheel **19** as clearly illustrated in FIGURE 2. The wheel **18** is in meshing relationship with the drive wheel **2** for driving the wheel **2**.

A sealed-type reed switch **24** for energizing and de-energizing the electric circuit of the motor **22** will be more fully described. An actuating lever **25** is provided for opening or closing the switch **24**. The lever **25** is provided with a shaft or arbor **26** which is supported at its opposite ends on the plates **5** and **7** respectively. A permanent magnet **27** is secured to the tip or forward end of the lever **25** and the opposite or rear end of the lever **25** is shaped to provide a cam portion **28**. A control spring **29** surrounds a cross pin extending laterally of the lever for causing the lever to urge the cam portion **28** to a position in which one of the drive pins **20** may engage the cam portion **28**.

The reed switch **24** is defined by a sealed glass tube **32** in which is disposed a movable contact element **30** of a suitable magnetic material and an opposed and cooperable fixed contact element **31**. The tube **32** is filled with an inert gas, such as nitrogen gas. The switch **24** is inserted in the electric circuit of the motor **22**, together with a transistor **33**, as perhaps best shown in FIGURES 5 and 6. More specifically, the switch **24** is series connected with a current restricting resistance **34** between a dry cell **35** and a base *b* of the transistor **33** and an emitter *e* of the transistor is connected through the cell **35** and motor **22** to collector *c* of such transistor. A second current restricting resistance **34'** is located in the section of the circuit between the base *b* and the emitter *e* of the transistor **33**.

While the operation of the invention is believed to be readily apparent from the foregoing, it may be summarized as follows:

When the lever **25**, which functions to close and open the switch **24**, is caused to swing to the position illustrated in FIGURE 4 due to the action of the spring **29** on the cam portion **28**, the magnet **27** attracts magnetically the movable contact element **30** for causing the movable contact element to contact the opposed fixed contact element **31** whereby current is permitted to flow through the input side of the transistor for rotating the direct current motor **22** connected to the output side of the transistor **33**. The rotary movement of the motor **22** is transmitted via the worm **23** and the coaxial wheels **19** and **18** to the drive wheel **2**. When the drive wheel is rotated as described, the drive pins **20** which project or extend through the bores **2***a* in the wheel **2** are caused to rotate with the drive wheel and consequently the drive plate **3** to which the pins **20** are secured will also rotate in unison with the wheel **2**, thus winding the spring **1** for the main clock mechanism.

As the drive pins **20** continue their rotary movement after having initially engaged the cam portion **28** of the lever **25**, the lever **25** is caused to swing in a counterclockwise direction as shown in FIGURE 3 against the action of the spring **29**. As a consequence, the magnet **27** separates from the switch **24** and as a result, the movable

contact element **30** swingingly separates from the fixed contact element **31** due to its inherent elasticity (see FIGURE 5) for opening the circuit of the motor thereby terminating the motor operation.

When the spring **1** has been wound in the manner described, the force of the thus wound spring will cause the third wheel **4** to rotate to actuate the main clock mechanism. After a predetermined time period from the initiation of the rotary movement of the wheel **4**, the release element **21** engages one of the drive pins **20** and such engaged drive pin is separated from the cam portion **28** and the lever **25** is caused to swing in a clockwise direction to the position illustrated in FIGURE 4. Hence, the magnet **27** approaches the reed switch **24** and the movable contact element **30** is caused to make contact with the fixed contact element **31** thereby closing the input circuit of the transistor. In this fashion, the motor **22** which is connected to the output side of the transistor circuit is again rotated for winding the spring **1**. The above described procedure is repeated at a predetermined time interval and the spring **1** is intermittently wound at the predetermined time interval.

I claim:

1. A winding device for the drive spring of an electric clock of the type having a D.C. motor provided with a cell as its electric source and with the motor being operably related to the drive spring for intermittently winding the spring, comprising a transistor including a base, an emitter and a collector, a circuit for said transistor, a sealed-type reed switch located in said circuit between said emitter and base on the input side of said transistor, said motor being inserted in series in the output side of said circuit, a permanent magnet, movable mounting means supporting said magnet for movement toward and away from said reed switch for effecting closing and opening the same, means operably related between said mounting means and said drive spring for moving said mounting means and thus said magnet in one direction and additional means for moving said mounting means and thus said magnet in the other direction whereby the base current flowing through the reed switch controls said motor.

2. The winding device for the drive spring of an electric clock as claimed in claim **1** and including resistances inserted between the base of said transistor and said reed switch and between the base and the emitter of said transistor, respectively.

3. The winding device for the drive spring of an electric clock as claimed in claim **1** and said reed switch comprising a glass tube, a magnetically actuatable movable contact element within said tube, an opposed fixed contact element within said tube and an inert gas filling said tube, wherein said reed switch functions for closing and opening the circuit of said motor as the permanent magnet moves toward and away from said reed switch.

4. The winding device for the drive spring of an electric clock as claimed in claim **1** and said movable mounting means supporting said magnet comprising an actuating lever, said permanent magnet being carried by said lever, pivot means for said lever, the means operably related between said mounting means and drive spring swinging the lever about the axis of said pivot means in one direction by the action of said drive spring, and the additional means for moving said mounting means and thus said magnet in the other direction comprising a second spring operatively connected with said lever for swinging said lever and the magnet carried thereby about the axis of said pivot means in the other direction.

References Cited

UNITED STATES PATENTS

3,261,935 7/1966 Rogers ..... 58—41

RICHARD B. WILKINSON, Primary Examiner

E. C. SIMMONS, Assistant Examiner