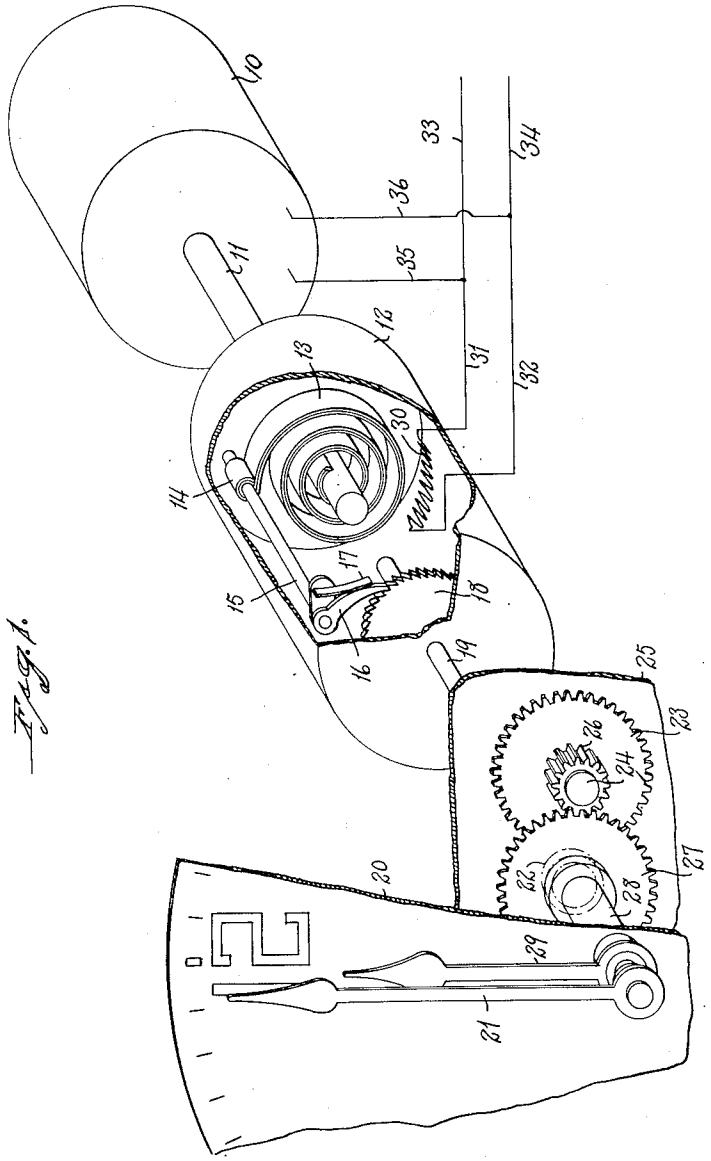
Oct. 17, 1933. D. S. INGRAHAM ET AL 1,931,291

CURRENT INTERRUPTION COMPENSATING MECHANISM FOR ELECTRIC CLOCKS AND THE LIKE

Filed April 30, 1931 2 Sheets-Sheet 1



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Fig. 2.

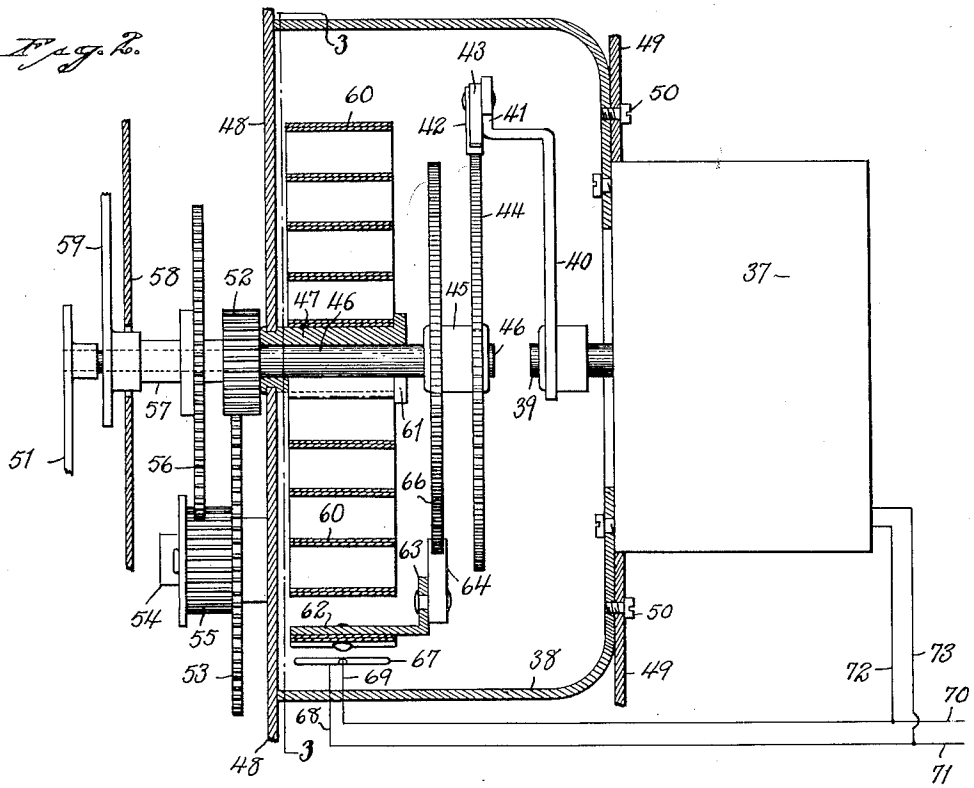
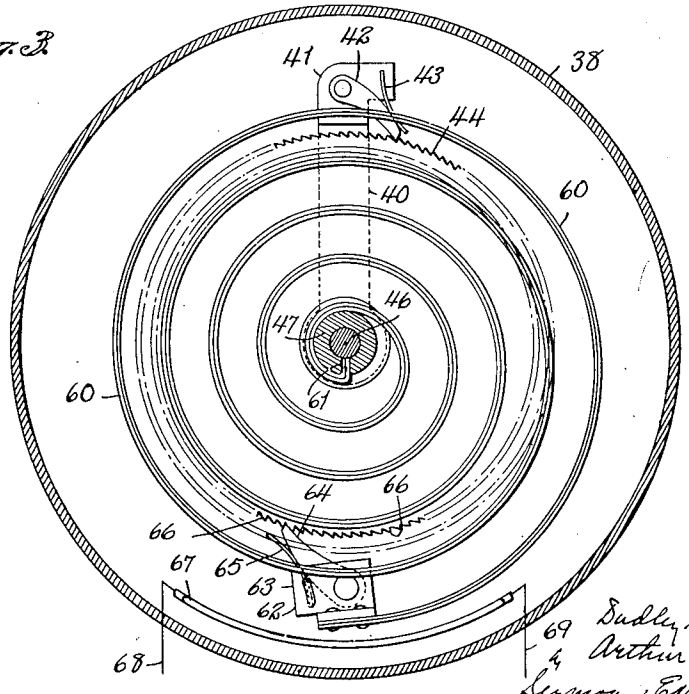


Fig. 3.



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Patented Oct. 17, 1933 1,931,291

UNITED STATES PATENT OFFICE

1,931,291

CURRENT-INTERRUPTION-COMPENSATING MECHANISM FOR ELECTRIC CLOCKS AND THE LIKE

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Application April 30, 1931. Serial No. 533,991

19 Claims. (Cl. 58—26)

This invention relates to an improvement in current-interruption-compensating mechanisms, and particularly to mechanisms of the type referred to for use in connection with so-called synchronous electric clocks and other synchronous electric time-devices, though not so limited.

Our invention, while primarily designed for use in connection with electric clocks as that term is generally understood, its use is not so limited as it is equally useful in connection with a wide variety of other time-devices such as time-switches, time-controlled operating-mechanisms, etc., etc., which do not necessarily indicate the time of day.

While electric clocks and other electric time-devices are more and more coming into use to the gradual displacement of hand-wound types, owing to their capacity for accurate functioning, a very serious drawback to proper and reliable service exists, owing to periodic current-interruptions.

The main object of our present invention is to provide at a low cost for manufacture, simple and reliable means for automatically compensating for the time which would ordinarily be lost by an electric time-device as an incident to an interruption in the current supplied thereto.

With the above and other objects in view as will appear from the following, our invention consists in a current-interruption-compensating mechanism characterized by the combination with a time-member, such as an arbor carrying one or more of the hands of a clock; an electric motor normally effecting the movement of the said time-member; and a thermomotive-member operatively connected to the said time-member for advancing the same, and brought into play by a change in temperature resulting from a change in the current-supply to the said motor.

Our invention further consists in a current-interruption-compensating mechanism characterized as above and having certain other combinations and arrangements of parts as will be hereinafter described and particularly recited in the claims.

In the particular embodiments of our invention presently to be described, we provide for compensating for interruptions in the supply of current to an electric clock by automatically advancing the visual time-indicating hands or pointers thereof, though it will be understood that in other forms of time-devices which do not visually indicate time, the appropriate time-member or members thereof may be automatically advanced to compensate for the time-interval during which the current-supply may be interrupted.

In the accompanying drawings:

Fig. 1 is a broken perspective view of a schematic character illustrating one form which a synchronous electric clock embodying our improved current-interruption-compensating mechanism may assume;

Fig. 2 is a broken view, partly in side elevation and partly in vertical central section, of a synchronous electric clock illustrating another form which our improved current-interruption-compensating mechanism may assume; and

Fig. 3 is a transverse sectional view taken on the line 3—3 of Fig. 2.

The particular synchronous electric clock herein chosen for the illustration of our invention, as shown in Fig. 1 of the drawings, consists of a synchronous electric motor and speed-reducing unit enclosed within an oil-proof housing and generally designated by the numeral 10. This motor and speed-reducing unit may be of any of the well-known forms and requires no detailed illustration or description other than to say that it is provided with a drive-shaft 11 forwardly-projecting from the said unit into a cylindrical casing 12 where its forward end has secured to it the inner convolution of a spirally-wound bimetallic thermomotive or temperature-responsive member 13.

The member 13, above referred to, may be of any approved form and material but is preferably and as shown spirally-wound and of bimetallic character and has its outer end looped to form a knuckle 14 from which forwardly projects a stud 15 carrying a pawl 16. A spring 17 serves to press the nose of the said pawl into engagement with the peripheral teeth of a ratchet-wheel 18 rigidly mounted upon the center or minute-arbor 19 of the clock which projects forwardly through a dial 20 where it is provided with a minute-hand or pointer 21 sweeping over the hour and minute-calibrations on the said dial in the usual manner of clocks.

Immediately to the rear of the dial 20, the arbor 19 has secured to it the usual cannon-pinion 22 meshing into and driving a dial-wheel 23 mounted upon a stud 24 forwardly-offsetting from a movement-plate 25. The said dial-wheel 23 carries a dial-pinion 26 meshing into and driving an hour-wheel 27 carrying a forwardly-projecting sleeve 28 mounted upon the said center-arbor 19 with freedom for rotation with respect thereto and carrying at its forward end

the usual hour-hand 29 located in front of the dial 20 before referred to.

While the arbor 19 and the sleeve 28 each carries and drives a pointer for visually indicating time, it is obvious that either the said arbor or the said sleeve may drive a time-disk or the like for controlling or actuating a switch-mechanism, as hereinbefore referred to. Either the said arbor or the said sleeve or equivalent part may, therefore, be properly termed "time-member," since they discharge a time function such as by propelling pointers or by propelling or controlling a switch or other mechanism at a predetermined time.

Within the casing 12 which is preferably of heat-insulating material and in which is located the thermomotive-member 13, is a heater-element 30 preferably formed of a closely corrugated wire, as shown, and formed of any suitable high-resistance material, the leads 31 and 32 of which are connected to a pair of feed-wires 33 and 34 leading to a suitable source of current-supply in the usual manner of electric clocks. The synchronous motor 10 is provided with a pair of leads 35 and 36 also coupled into the feed-wires 33 and 34 so that current is supplied simultaneously to the same and the heater-element 30 before referred to.

The electrical connections shown are such that the element 30 and the motor 10 are electrically coupled in parallel but it is obvious that any other approved circuit may be arranged, provided only that an interruption in the supply of current to the said motor will correspondingly affect the heater-element 30.

In the normal operation of the clock, the center-arbor 19, and hence the hands 21 and 29, is driven through the intermediary of the thermomotive-member 13, which is maintained at a predetermined degree of expansion by the heat supplied by the heater-element 30.

Now let it be supposed that an interruption has taken place in the supply of current passing through the supply-wires 33 and 34. This interruption will cause the motor to cease running and will further cause the heater-element 30 to cool, thus permitting the thermomotive-member 13 to cool.

The cooling of the thermomotive-member 13 as above described will cause the same to contract and bodily move the ratchet 16 counter-clockwise so that the nose thereof will ratchet back over the peripheral teeth of the ratchet-wheel 18.

The degree to which the ratchet 16 ratchets back over the ratchet-wheel 18 as just above described will depend upon the duration of the current-interruption provided of course, that the latter is not of excessive duration.

Now, upon the resumption of the flow of current to the motor 10 and the heater-element 30, the former will immediately start to drive the hands 21 and 29 at the predetermined synchronous speed, and meanwhile the heater-element 30 will again rise in temperature and in so doing will effect a similar rise in the temperature of the thermomotive-member 13, which will expand and bodily move the ratchet 16 in a clockwise direction, and similarly turn the ratchet-wheel 18 and so move the hands 21 and 29 faster than they are at the time being driven by the motor 10, so that the time lost by the clock during the current-interruption will be substantially compensated for by the more rapid movement of the said hands under the urge of the now-expanding thermomotive-member 13 through which the normal drive of the said hands is effected by the motor, as already referred to.

In the mechanism above described, the loss of time incident to an interruption in the flow of current is compensated for upon the resumption of current-flow by the more-rapid-than-normal movement of the hands 21 and 29 under the urge of the expanding thermomotive-member 13.

Alternative forms of mechanism may be employed in accordance with our invention, such as that shown in Figs. 2 and 3, in which the synchronous-motor-and-speed-reducing unit 37 is mounted upon the rear face of a cup-shaped heat-insulating casing 38 and has its drive-shaft 39 forwardly-projecting thereinto.

Mounted upon the forward end of the drive-shaft 39 is a driving-arm 40 having its outer end 41 forwardly-offset for carrying a driving-pawl 42 normally pressed into engagement by means of a pawl-spring 43 with the peripheral teeth of a ratchet-wheel 44 secured to a hub 45 staked upon the rear end of the center or minute-arbor 46 of the clock.

The center-arbor 46 extends through and bears in a hollow stud 47 rearwardly-projecting from a front movement-plate 48 complementing a rear movement-plate 49 to which latter the casing 38 before referred to is secured by means of screws 50.

The forward end of the center-arbor 46 carries the usual minute-hand or pointer 51 and is provided at a point just forward of the front movement-plate 48 with a cannon-pinion 52 meshing into and driving a dial-wheel 53 mounted with freedom for rotation upon a stud 54 forwardly-projecting from the front movement-plate 48.

The dial-wheel 53 carries the usual dial-pinion 55 meshing into and driving an hour-wheel 56 having a forwardly-projecting sleeve 57 mounted upon the center-arbor 46 with freedom for rotation and carrying at its forward end in front of the dial 58 an hour-hand or pointer 59.

For the purpose of compensating for the time which would be lost by an interruption in the current-supply, I employ a bimetallic spiral thermo-motive-member 60 corresponding to the thermomotive-member 13 before referred to, but having its spiral form extending in a reverse direction so as to have its outer end move in a clockwise direction as it cools, as will be hereinafter described.

The inner end of the thermomtive-member 60 is anchored in a slot 61 in the hollow stud 47 and carries at its outer end an L-shaped plate 62 upon the vertical arm 63 of which is mounted a pawl 64 pressed by means of a spring 65 into engagement with the peripheral teeth of a ratchet-wheel 66 staked upon the hub 45 of the arbor 46 just forward of the ratchet-wheel 44 already described.

Normally, the synchronous motor 37 will effect the turning of the center-arbor 46 and hence the hour and minute-hand 51 and 59 through the intermediary of the driving-arm 40, pawl 42 and ratchet-wheel 44, the ratchet-wheel 66 meanwhile idly turning beneath the pawl 64.

Like the mechanism illustrated in Fig. 1 of the drawings, a heater-element 67 is mounted adjacent the thermomotive-member 60 and normally maintains the same at a predetermined degree of expansion. The said heater-element is mounted within the casing 38 and has its leads 68 and 69 connected to the usual pair of supply-wires 70 and 71, to which latter also are coupled

the leads 72 and 73 of the synchronous motor 37.

Now in the event of a current-interruption, the motor 37 will stop and the heater-element 67 will cool, as will also the thermomotive-member 60. This cooling of the thermomotive-member 60 will cause the same to contract and hence cause its outer end to move clockwise and through the intermediary of the pawl 64 and ratchet-wheel 66 effect the forward or clockwise turning of the center-arbor 46 and minute and hour-hands 51 and 59 respectively.

During the movement of the hands 51 and 59 under the urge of the thermomotive-member 60, as just above described, the ratchet-wheel 44 will turn idly beneath the now stationary driving-pawl 42.

It will be seen from the foregoing that when, owing to a current-interruption, the motor 37 ceases to drive the hands 51 and 59, the thermomotive-member 60, owing to the failure at this time of the supply of heat from the heater-element 67, will contract and thus effect the movement of the said hands during the interval during which the motor 37 is idle, provided, of course, the duration of the current-interruption is not excessively long.

Now, upon a resumption of current flow, the motor 37 will again resume its function of moving the hands 51 and 59 and simultaneously the heater-element 67 will be again energized and correspondingly heat the thermomotive-member 60, so that the latter will expand, with the result that the pawl 64 carried by its outer end will be bodily moved counterclockwise to a predetermined normal position ready to assume the burden of moving the hands 51 and 59 in the event of subsequent current-interruption.

The mechanism shown in Figs. 2 and 3 and described above operates to move the hands 51 and 59 during the interval that the current supply is interrupted, whereas, the structure shown in Fig. 1 effects the movement of the hands not during the time that the current supply is interrupted but acts to move the said hands more rapidly upon a resumption of the current-flow.

In both of the forms herein shown and described, a separate and distinct heater-element, such as 30 and 67, is employed for activating the respective thermomotive-members, we wish to have it understood, however, that while this form is the preferred one, the heat developed by the synchronous motor itself may be utilized for activating the thermomotive-members.

It will, therefore, be understood that the use of the term "heater" as employed herein is intended to include any element of such character as will activate the thermomotive-member, whether that element be separate and distinct from the coil of the motor or other device employed, or one and the same.

It will be understood by those skilled in the art that our invention may assume varied physical forms without departing from our inventive concept, and we, therefore, do not limit ourselves to the specific embodiment herein chosen for illustration, but only as indicated in the appended claims.

We claim:

1. In a device of the class described, the combination with a time-member; of an electric motor normally effecting the movement of the said time-member; a thermomotive-member operatively connected to the said time-member for advancing the same; and electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-member being brought into play by a change in temperature of the said heating-means resulting from a change in the current-supply to the said motor.

2. In a device of the class described, the combination with a time-member; of an electric motor normally effecting the movement of the said time-member; a thermomotive-member operatively connected to the said time-member for advancing the same; and electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-member being brought into play by a rise in temperature of the said heating-means, due to a resumption of the current-supply to the said motor subsequently to an interruption thereof.

3. In a device of the class described, the combination with a time-member; of an electric motor normally effecting the movement of the said time-member; a thermomotive-member operatively connected to the said time-member for advancing the same; and electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-member being brought into play by a fall in temperature of the said heating means due to an interruption in the current-supply to the said motor.

4. In a device of the class described, the combination with a time-member; of an electric motor normally effecting the movement of the said time-member; a thermomotive-member operatively connected by means of a ratchet-mechanism to the said time-member for advancing the same; and electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-member being brought into play by a change in temperature of the said heating-means resulting from a change in the current-supply to the said motor.

5. In a device of the class described, the combination with a time-member; of an electric motor normally effecting the movement of the said time-member; a thermomotive-member operatively connected by means of a ratchet-mechanism to the said time-member for advancing the same; and electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-member being brought into play by a rise in temperature of the said heating-means due to a resumption of the current-supply to the said motor subsequently to an interruption thereof.

6. In a device of the class described, the combination with a time-member; of an electric motor normally effecting the movement of the said time-member; a thermomotive-member operatively connected by means of a ratchet-mechanism to the said time-member for advancing the same; and electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive member being brought into play by a fall in temperature of the said heating-means due to an interruption in the current-supply to the said motor.

7. In a device of the class described, the combination with a time-member; of an electric motor normally effecting the movement of the said time-member; a thermomotive-member interposed between the said motor and the said time-member to transmit the movement of the former to the latter; and electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-

member being activated for moving the said time-member with respect to the said motor by a change in temperature of the said heating-means resulting from a change in the current-supply to the said motor.

8. In a device of the class described, the combination with a time-member; of an electric motor normally effecting the movement of the said time-member; a thermomotive-member interposed between the said motor and the said time-member to transmit the movement of the former to the latter; and electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-member being activated for moving the said time-member with respect to the said motor by a rise in temperature of the said heating-means due to a resumption of the current-supply to the said motor subsequently to an interruption thereof.

9. In a device of the class described, the combination with a time-member; of an electric motor normally effecting the movement of the said time-member; a thermomotive-member interposed between the said motor and the said time-member to transmit the movement of the former to the latter; and electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-member being activated for moving the said time-member with respect to the said motor by a fall in temperature of the said heating-means due to an interruption in the current-supply to the said motor.

10. In a device of the class described, the combination with a time-member; of an electric motor normally effecting the movement of the said time-member; a thermomotive-member and a ratchet-mechanism interposed between the said motor and the said time-member to transmit the movement of the former to the latter; and electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-member being activated for moving the said time-member with respect to the said motor by a change in temperature of the said heating-means resulting from a change in the current-supply to the said motor.

11. In a device of the class described, the combination with a time-member; of an electric motor normally effecting the movement of the said time-member; a thermomotive-member and a ratchet-mechanism interposed between the said motor and the said time-member to transmit the movement of the former to the latter; and electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-member being activated for moving the said time-member with respect to the said motor by a rise in temperature of the said heating-means due to a resumption of the current-supply to the said motor subsequently to an interruption thereof.

12. In a device of the class described, the combination with a time-member; of an electric motor normally effecting the movement of the said time-member; a thermomotive-member and a ratchet-mechanism interposed between the said motor and the said time-member to transmit the movement of the former to the latter; and electric heating-means (which may be the said motor itself) for heating the said thermomotive-member, the said thermomotive-member being activated for moving the said time-member with respect to the said motor by a fall in temperature of the said heating-means due to an interruption in the current-supply to the said motor.

13. In a device of the class described, the combination with a time-member; of an electric motor; a ratchet-mechanism for transmitting the drive of the said motor to the said time-member; a thermomotive-member operatively connected to the said time-member for advancing the same; electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-member being brought into play by a change in temperature of the said heating-means resulting from a change in the current-supply to the said motor; and a second ratchet-mechanism for transmitting the urge of the said thermomotive-member to the said time-member.

14. In a device of the class described, the combination with a time-member; of an electric motor; a ratchet-mechanism for transmitting the drive of the said motor to the said time-member; a thermomotive-member operatively connected to the said time-member for advancing the same; electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-member being brought into play by a rise in temperature of the said heating-means due to a resumption of the current-supply to the said motor subsequently to an interruption thereof; and a second ratchet-mechanism for transmitting the urge of the said thermomotive-member to the said time-member.

15. In a device of the class described, the combination with a time-member; of an electric motor; a ratchet-mechanism for transmitting the drive of the said motor to the said time-member; a thermomotive-member operatively connected to the said time-member for advancing the same; electric heating-means (which may be the said motor itself) for heating the said thermomotive-member; the said thermomotive-member being brought into play by a fall in temperature of the said heating-means due to an interruption in the current-supply to the said motor; and a second ratchet-mechanism for transmitting the urge of the said thermomotive-member to the said time-member.

16. In an electric clock, the combination with the visual time-indicating means thereof; of an electric motor normally effecting the movement of the said time-indicating means; a heater connected into a circuit with the said electric motor so as to be correspondingly affected by the change in the current-supply thereto; and a thermomotive-member operatively connected to the said time-indicating means for advancing the same, and brought into play by a change in temperature resulting from a change in the current-supply to the said motor and to the said heater.

17. In an electric clock, the combination with the visual time-indicating means thereof; of an electric motor normally effecting the movement of the said time-indicating means; a heater connected into a circuit with the said electric motor so as to be correspondingly affected by the change in the current-supply thereto; and a thermomotive-member operatively connected to the said time-indicating means for advancing the same, and brought into play by a rise in temperature due to a resumption of the current-supply to the said motor and the said heater subsequently to an interruption thereof.

18. In an electric clock, the combination with the visual time-indicating means thereof; of an electric motor normally effecting the movement of the said time-indicating means; a heater connected into a circuit with the said electric motor so as to be correspondingly affected by the change in the current-supply thereto; and a thermomotive-member operatively connected to the said time-indicating means for advancing the same, and brought into play by a fall in temperature due to an interruption in the current-supply to the said motor and the said heater.

19. In a device of the class described, the combination with a time-member; of an electric motor for normally driving the said time-member; an electric circuit for the said motor; and temperature-responsive actuating-means including a thermomotive-member operatively connected to the said time-member for supplementing the said motor in moving the said time-member and acting for said purpose in response to changes in current-supply in the said electric circuit.

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