United States Patent

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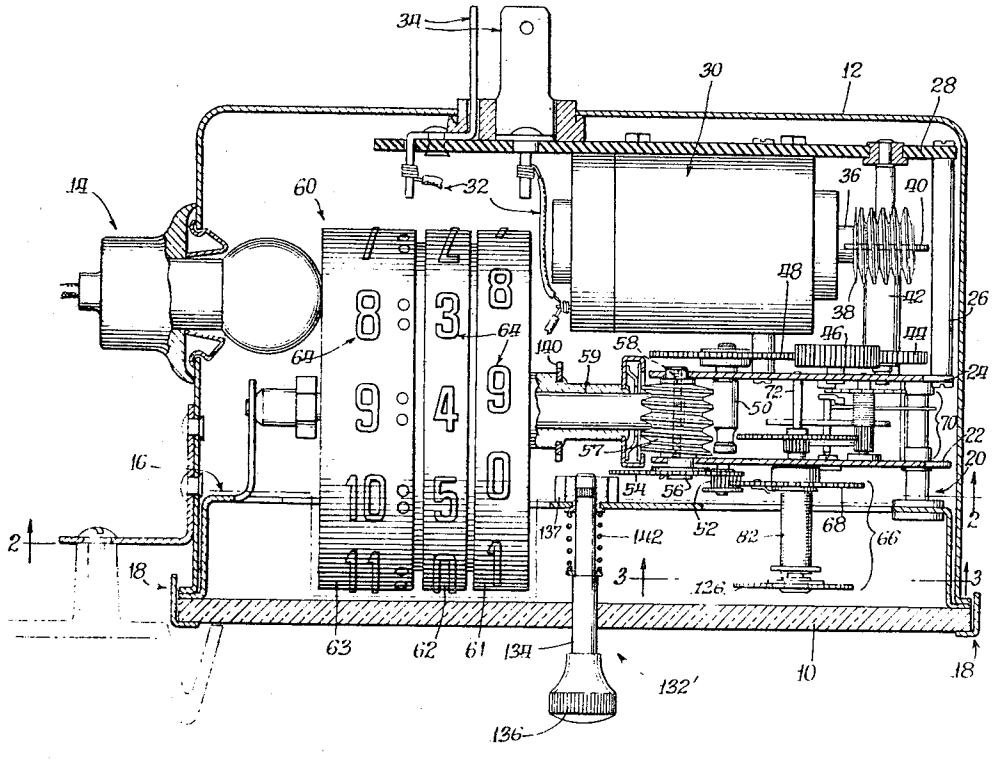
[54] **DIGITAL CLOCK**
12 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **58/24,**
58/33, 58/50, 58/125
[51] **Int. Cl.** **G04c 3/00**
[50] **Field of Search** 58/2, 23,
24, 28, 33, 40, 41, 46; 318/160, 443, 445

[56] **References Cited**
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ABSTRACT: A digital clock having time-indicating drums, the drums remaining stationary between abrupt periodic advancements, the advancements being produced by an electric motor; it includes a coil spring energized by the motor and running constantly; it also includes a mechanical structural contact arrangement triggered by the constant movement of the spring and starting the motor for another cycle.



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SHEET 1 OF 3

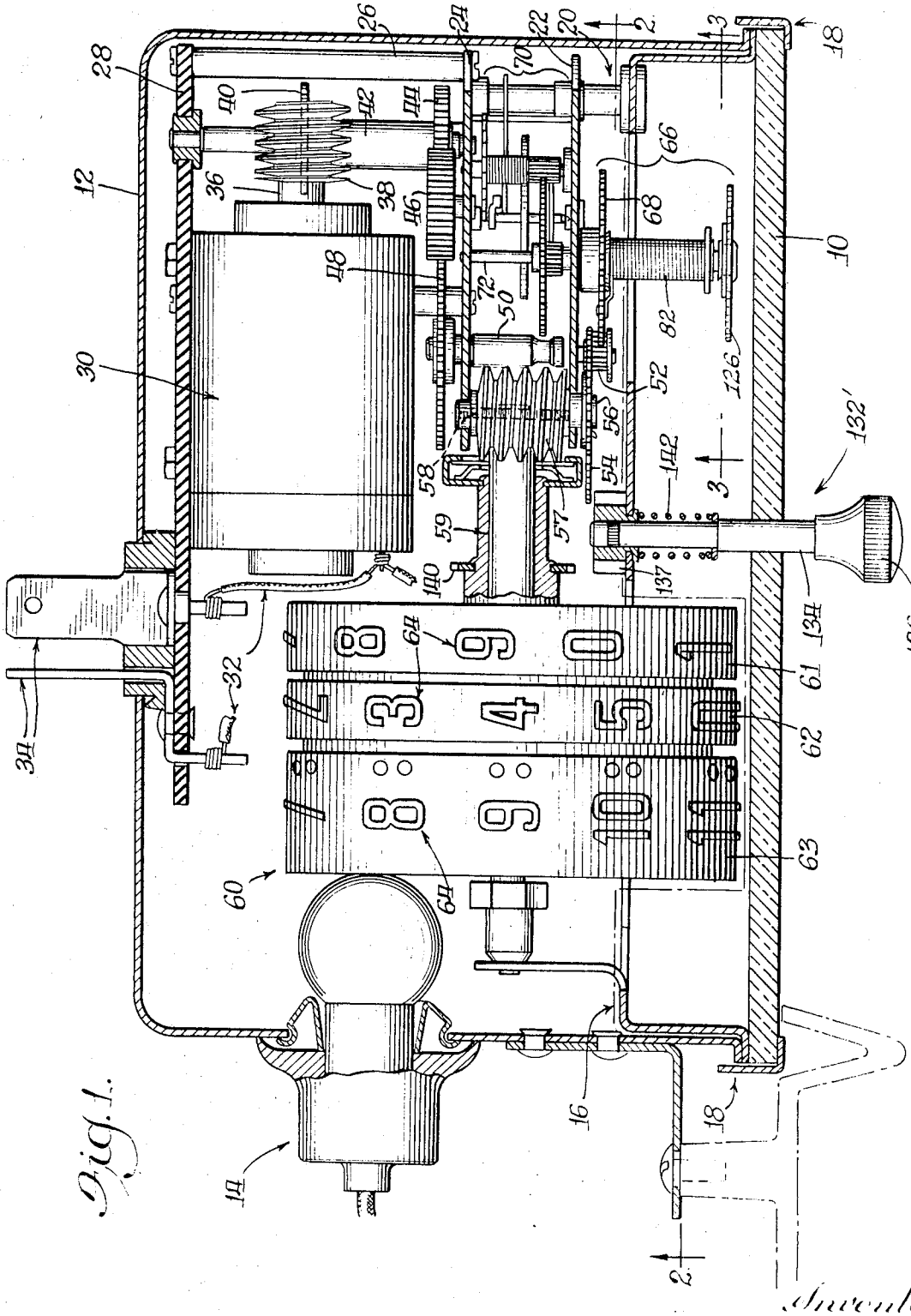


Fig. 1.

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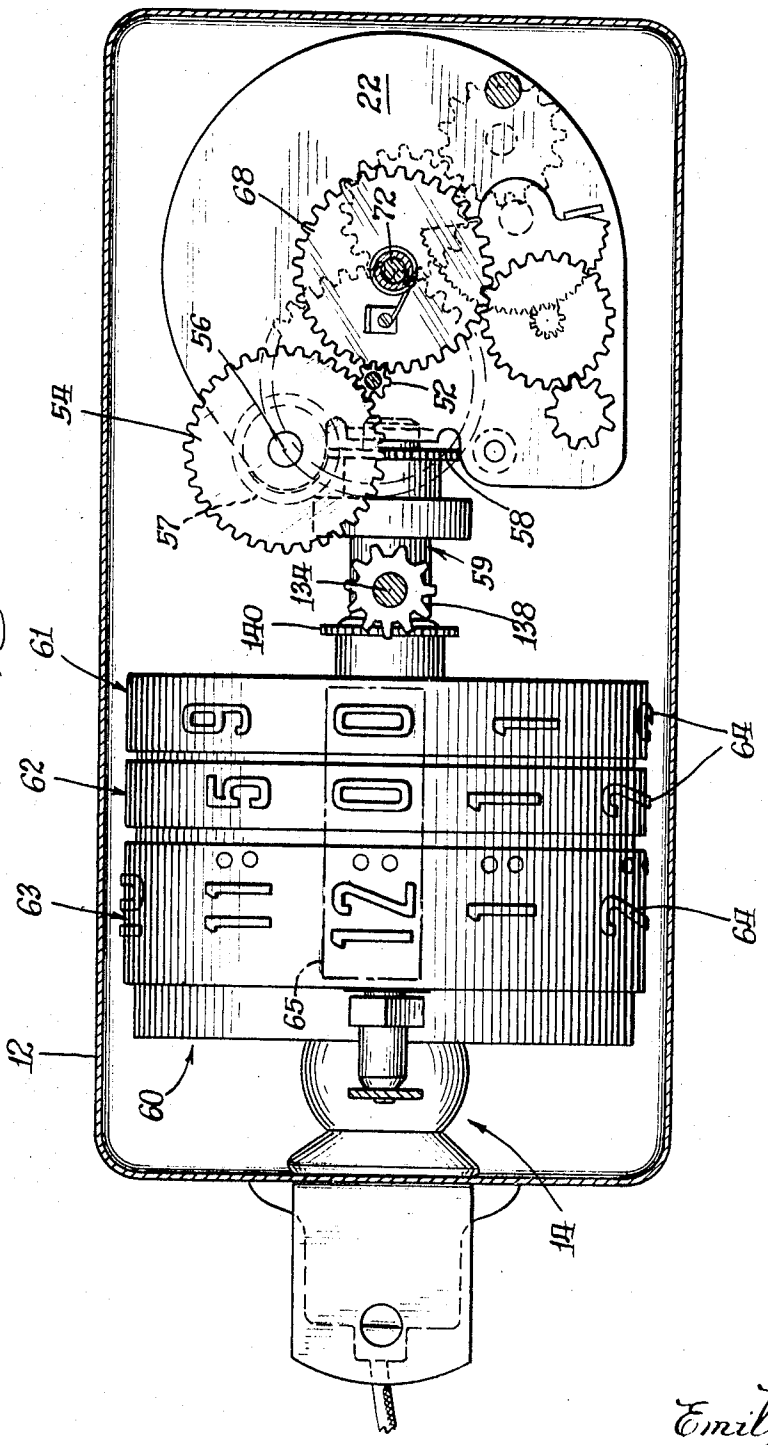


Fig. 2.

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Fig. 4.

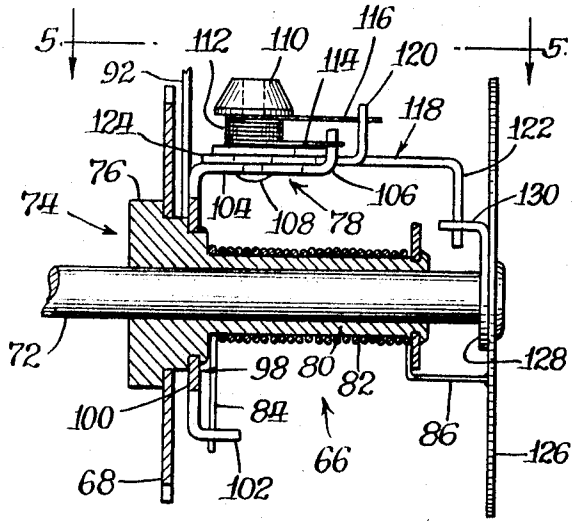


Fig. 5.

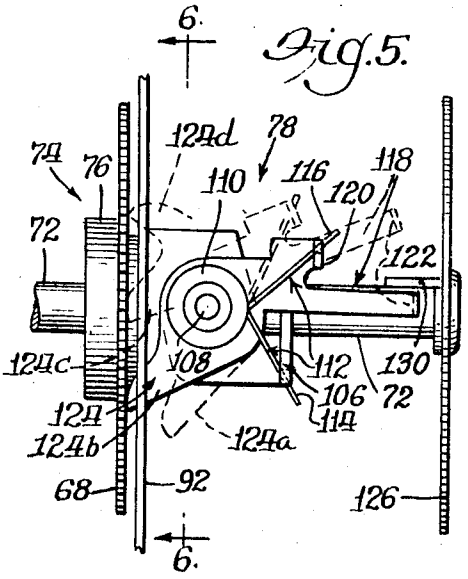


Fig. 3.

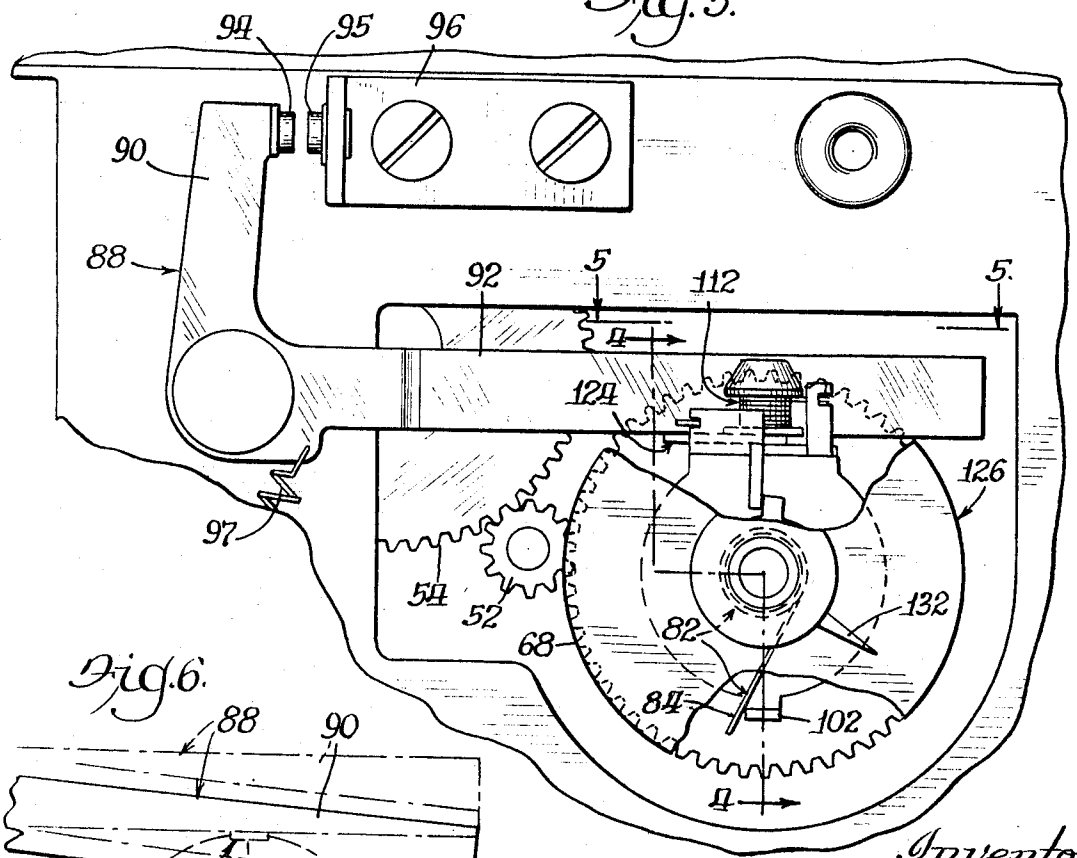
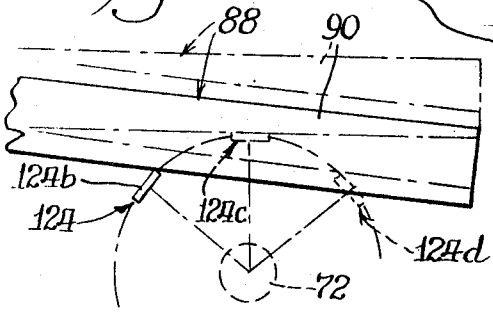


Fig. 6.



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DIGITAL CLOCK

CROSS REFERENCES

Applications of the same inventor, filed of even date herewith:

Ser. No. 7,469, Indexing Drums for Digital Clocks

Ser. No. 7,470, Digital Clock with Second Indicator

OBJECTS OF THE INVENTION

A broad object of the present invention is to provide a digital clock of novel construction and of unusual effectiveness.

Another object is to provide a digital clock having novel construction providing high assurance of prevention of overtravel of the driver or motor, between digital advancements.

A further object is to provide a digital clock in which a minimum amount of power is required for tripping the control mechanism for providing digital advancements, and to initiate movement of the elements that were stationary between digital advancements, easily overcoming the relatively high friction between the various stationary elements.

Another object is to provide a digital clock that is highly shock and vibration resistant and therefore particularly adapted for use in automobiles.

An additional object is to provide a digital clock of the foregoing character utilizing a DC electrical motor and for that reason well adapted for use in automobiles.

Still another object is to provide a digital clock mechanism of the foregoing character which includes a clock driver or motor operative for providing the digital advancements in the time-indicating means, and the incorporation of a continuously operating spring which is wound by the driver and utilized for controlling the operation of the driver to energize it for producing the periodic digital advancements.

A further object is to provide a digital clock mechanism of the foregoing character including time-indicating drums which are periodically advanced and which remain stationary between advancements, and including a novel construction particularly operative for abruptly advancing the time drums so as to utilize a minimum of time in so advancing drums.

A still further object is to provide a digital clock of the foregoing general character which is of extremely simple construction and unusual effectiveness.

IN THE DRAWINGS

FIG. 1 is a view of the clock mechanism of the invention as viewed from the top and showing various elements in elevation, and in section;

FIG. 2 is a front view showing most of the internal parts of the clock and oriented substantially according to line 2–2 of FIG. 1;

FIG. 3 is a view taken substantially at line 3–3 of FIG. 1;

FIG. 4 is a view taken substantially at line 4–4 of FIG. 3;

FIG. 5 is a top view oriented according to line 5–5 of FIG. 3 and line 5–5 of FIG. 4; and

FIG. 6 is a fragmentary and detail view taken at line 6–6 of FIG. 5 and hence oriented according to FIG. 4.

The present invention is closely related to those disclosed in the above identified cross-referenced applications. The clock construction is the same or similar in the three applications and certain of the details of the construction are disclosed in two or all of them, and additionally, the same reference numerals are applied to the common elements uniformly in the three applications.

The present invention is directed toward the novel arrangement of control of digital advancement of the time-indicating drums and continuously moving means for controlling the digital advancing means.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring in detail to the accompany drawings attention is directed first to FIG. 1 which shows a crystal 10 through which the time is viewed. The clock is mounted such as in an automobile. Attached to the crystal is a housing 12 substantially enclosing the operating parts and mounting an interior illuminating lamp 14. Within the housing 12 is a support panel 16 anchored in place with the enclosing housing 12 by the support 10 by a suitable means indicated generally at 18.

Mounted in the panel 16 are a plurality of posts 20 supporting a pair of spaced plates 22, 24 and mounted in the latter plate 24 are another plurality of posts 26 supporting a mounting plate 28.

Mounted on the mounting plate 28 is an electric motor 30 preferably of DC character in keeping with automobile appurtenances, this motor having various conductors, contacts, etc. 32 respectively connected with external contact terminals 34 for connection with a suitable source of current. The motor 30 is utilized for driving a clock mechanism in periodic advancing movements as described hereinbelow.

The motor 30 includes a drive shaft 36 having a worm 38 meshing with a worm gear 40 on a shaft 42 having a gear 44 in mesh with another gear 46 which in turn meshes with a gear 48. The gear 48 is mounted on a shaft 50 having a gear 52 thereon in mesh with another gear 54 on a shaft 56 having a worm 57 in mesh with a gear 58. The gear 58 is mounted on shaft means 59 operatively connected with a digital time-indicating unit 60. This unit 60 need not be described in detail herein by may be and preferably is of the character disclosed in my copending application referred to above, Ser. No. 7,469. Briefly the indicating unit 60 includes a minute drum 61, a ten-minute drum 62 and an hour drum 63, advanced periodically (each minute), the first advancing the second and the second advancing the third, in a generally known manner, by the motor through the gear train identified above. The drums are provided with time indicia 64 exposed through a window 65.

The motor 30 also is operative for driving a power-transmitting or driving unit 66 the details of which are described hereinbelow. This unit 66 includes a gear 68 in mesh with the gear 52 identified above and upon operation of the motor, the gear 68 is driven, actuating the unit 66.

Associated with the unit 66 is an escapement means 70 of suitable and known kind including a shaft 72 which extends into and becomes a part of the unit 66.

Reference is next made to FIGS. 3—5 showing the unit 66 and including the shaft 72 and the gear 68. Upon operation of the motor 30 at each interval referred to above, the gear 68 is rotated one complete revolution, the various gears in the gear train being dimensioned and proportioned to accomplish that purpose. The gear 68 is fixedly mounted on a sleeve member 74 relatively rotatably mounted on the shaft 72. The sleeve member 74 includes a hub portion 76 directly receiving the gear and also receiving a tripping mechanism or release unit 78 to be described in detail hereinbelow. The sleeve member 74 includes an elongated sleeve element 80 on which is a torsion coil spring, or main spring, 82 having radial end elements 84, 86 reactingly engaging elements of the unit 78 as referred to again hereinbelow.

The unit 78 is utilized in controlling the operation of the drive motor 30 in periodic advancements, and for this purpose is directly associated with a lever 88 shown best in FIG. 3. This arm is preferably L-shaped having a first lever 90 and a second arm 92 which is relatively long, this fact being of significance in connection with prevention of over travel in the tripping mechanism. On the arm 90 is a contact 94 cooperable with another contact 95 mounted on a fixed member 96, these contacts being connected with the conductors 32 (FIG. 1) of the motor. The long arm 92 extends into the projection of the gear 68, tangent to a base circle concentric therewith and in position for tripping by the unit 78 as indicated above. The arm 88 is biased in clockwise direction (FIG. 3) by a tension spring

97, toward active position in which the contacts 94, 95 are in engagement.

The unit 78 includes a contact platform or mounting member 98 (FIG. 4) which has a mounting element 100 in the form of a plate directly and fixedly secured to the hub element 76 for rotation therewith. The mounting member 98 at one side includes an axially extending tab 102 engaged by the radial terminal element 84 of the spring 82. The mounting member at the other side includes an axially extending element 104 preferably in the form of a plate having a radially extending terminal tab 106. Fixed in the element 104 is a stud or pin 108 having a head 110 and surrounding the pin is a coil torsion spring 112 having radial end elements 114 and 116. The end element 114 engages the tab 106 while the other end element 116 is provided reaction as explained hereinbelow. The pin is positioned on an axis transverse to the axis of the spring 82.

Pivoted on the pin 108 and mounted on the element 104 is a knockoff arm 118 including an out turned radial tab 120 engageable by the end element 116 of the coil spring 112. The knockoff arm 118 also includes an inturned radial tab 122. The knockoff arm 118 includes an operating finger 124 directly engageable with the contact arm 92 for actuating the latter in a manner more specifically described hereinbelow. The spring 112 biases the knockoff arm 118 (clockwise) toward an advanced position as shown in full lines in FIG. 5, and upon release of the finger it is moved against the spring which thereby yields.

The shaft 72 extends beyond the member 74 and fixedly secured on the extended end thereof is a seconds indicator 126 which may be in the form of a disc as represented, or any other desired form and mounted on this element 126 and carried therewith is a control element 128 having an axially extending knockoff tab 130 engageable with the tab 122 as described below in the operation of the apparatus. The end element 86 of the spring is secured to the disc.

If desired, the clock mechanism may be provided with a manual-setting device indicated at 132' (FIG. 1) which includes a shank 134 having a knob 136 and a pinion 137 adapted for meshing with a gear 140 on the shank 134 means 59. The shaft is biased to inactive position (FIG. 1) by a compression spring 142 in which the pinion 137 is out of mesh with the gear 140 and is manually movable into active position in which that pinion is in mesh with that gear, this specific device being known.

GENERAL OPERATION

In the operation of the clock mechanism a starting position may be assumed as represented in the drawings, in which the contacts 94, 95, (FIG. 3) are open and the motor 30 is stationary. Also the gear 68 is stationary and consequently the sleeve member 74 is also stationary. The coil torsion spring 82 is tensioned at all times, and is held stationary at one end, relative to the member 74, through the terminal element 84, and the other end through the terminal element 86 tends to rotate the disc or seconds indicator 126, and does so as controlled by the escapement mechanism 70, and the timing control is such that the indicator disc 126 makes one revolution per minute.

In the position of the apparatus as shown in the drawings, the finger 124 (FIG. 3—5) is under the lever arm 92 holding it in raised position shown in FIG. 3 in which the contacts 94, 95 are separated. In such position, the motor is stationary; the unit 78 also is stationary, but the seconds indicator member 126 is being constantly advanced by the spring 82. Upon advancement of the latter member, as throughout a full revolution, the knockoff tab 130 encounters the tab 122 and swings the knockoff platform 118 in corresponding direction, which is counterclockwise as viewed in FIG. 5. Upon this happening, the finger 124 is withdrawn from under the arm 92 to the dot-dash line position 124*a* represented in FIG. 5, allowing the arm 92 to drop, or be moved in clockwise direction under the action of the spring 97 (FIG. 3) so that the contacts 94, 95 engage, starting the motor 30. In this action the finger, while moving in an arcuate path, has a large component of movement in direction transverse to the length of the arm 92. The motor upon closure of the contacts, begins to operate and through the train of gears described above, rotates the gear 68, and as best indicated in FIG. 4, carries the unit 78 around substantially a full revolution to a position in which the finger 124 again engages under the arm 92 and raises it or moves it to the open position represented in FIG. 3, opening the contacts 94, 95, and the motor is brought to a stop. The motor while running, in addition to rotating the gear 68, advances the digital indicating unit 60 a corresponding amount, through the described train of gears to that unit. The unit is advanced an incremental amount which in the present instance is a one minute increment, and the motor does not run again until after substantially a full minute. The operation of the motor requires a very small interval of time such for example as 3—4 seconds.

In the advancing operation of the motor 30, the gear 68 upon being correspondingly advanced, tensions the coil torsion spring 82 through the radial terminal element 84 of the spring, this tension being transmitted through the spring and through the other terminal element 86 to the seconds indicator 126. The spring 82 is constantly tensioned as noted, being retensioned every minute by rotation of the unit 78 and this tension is propagated through the spring and exerted on the indicator element 126, the amount of tension being generated at each revolution being dissipated in that direction to the indicator element. The spring 82 is pretensioned in the construction and assembly of the device to the desired amount, and it is of such preselected operational characteristics that its range of operation is such as to provide the great latitude beyond the quantity of tensioning at each revolution of the unit 78, or in other words the tension of the spring is confined within such limits as to advance the second indicator a minute increment without retensioning.

FIGS. and 6 indicate the great range of movement of the finger 124 in its operation of engaging and raising the arm 92. For example position 124*b* indicates the position in which it is just moving under the arm for raising it to its open position. The finger may advance a certain amount such as for example to its full line position by the time the motor stops, but a great latitude is provided so that even if the finger should progress to the position 124*d* it will still be operative for holding the arm in open position. Thus there is great assurance against over travel of the unit 78 because of the wide latitude of possible movement of the finger 124 while still being effective, this movement being for example in the neighborhood of 30°—45° of angular movement. This amount is of course not critical, and the effective angular range may be very wide.

The leading edge of the finger 124 is preferably curved, providing a smooth mechanical action with a minimum of friction in releasing that finger from under the arm 92, this curvature providing effective clearance of the finger from the arm upon swinging of the member 118 in the releasing action. This member is thrown to the dot-dash line position 124*a* of FIG. 5 by the knockoff tab 130 as described above. The element 118 has quite an angular throw as shown, and regardless of a relatively advanced position of the finger relative to the arm 92, it is readily thrown clear of the arm, enabling the latter to lower or move to closed contact position.

Summarizing the action, the unit 78 is rotated one full rotation each minute, this rotation requiring for example 3—4 seconds, and it remains stationary between those advancements. The seconds indicator 126 rotates constantly under the action of the torsion spring 82 and as it reaches a predetermined position in that rotation it actuates the tripping mechanism 78 and the latter then is rotated again, but without interference, with the continuous rotation of the seconds indicator member 126. The arm 118 is provided substantial yielding ability so as to enable considerable extent of advancement of the indicator member 126 to enable the motor 30 to commence operation and continue forward ahead of the ef-

fectiveness of the member **126**, that unit proceeding at a much faster rate and continuing one rotation as indicated above, and the member **126** progressing in its same continuous pattern.

The seconds indicator member **126** and its operation are claimed in applicant's copending application identified above 7,470, its constantly progressing movement serving to indicate seconds while the minutes and hours are represented by the digital time-indicating unit **64**.

I claim

1. Clock mechanism comprising time-indicating means, a normally stationary and cyclically operating electrical motor for driving it, contacts for controlling the motor, a coil spring energized by the motor, a control member carried by the coil spring, and movable into operative association with said contacts, escapement mechanism controlling the coil spring and effecting constant movement of the control member carried thereby, and means actuated by the control member operative for closing the contacts and establishing a new cycle for driving the motor which thereby drives the time-indicating means and energizes the coil spring.

2. Clock mechanism comprising a plurality of normally stationary drums bearing time indications, a driver normally stationary but adapted for periodic operation and movable through a cycle at each operation, means operatively interconnecting the driver and the drums for driving the latter in response to operation of the driver, a constantly tensioned and moving power-transmitting means connected with the driver and tensioned thereby in each cycle of operation, control means for controlling the driver and operated by the power-transmitting means, the control means being operative for effecting energization of the driver throughout a cycle, and the power-transmitting means being operative for again controlling the control means at each of successive periodic intervals.

3. Clock mechanism comprising time-indicating means, an electrical motor for driving the time-indicating means, a gear train operatively interposed between the time-indicating means and motor, contacts for the motor, a pivoted lever carrying the contacts and having an arm element, an arm actuator including a knockoff platform having a finger movable generally in the direction of the length of said arm element, and being engageable therewith in such movement for pivotally swinging the lever for opening said contacts for thereby stopping the motor, a gear train interposed between the motor and said knockoff platform, and continuously moving power-transmitting means for releasing said finger from said arm element to enable said contacts to close, said motor upon being thus energized being operative for again moving through a cycle for advancing the time-indicating means and energizing said continuously moving power-transmitting means.

4. Clock mechanism according to claim **3** wherein said finger is released from the arm in a direction having a large component transverse to the direction of said arm element.

5. Clock mechanism according to claim **3** wherein said actuating finger moves in a circular path and remains in operative engagement with the lever arm throughout a substantial angular portion of its movement.

6. Clock mechanism according to claim **5** wherein said finger rotates about an axis extending generally transverse to the direction of movement of said lever arm.

7. Clock mechanism according to claim **6** wherein the lever arm is so constructed that said arm element moves into the axial projection of the path of the finger, and the finger acts as a cam for swinging the arm element.

8. Clock mechanism according to claim **3** wherein said finger is released from engagement with the lever arm independently of its bodily position along the length of said arm member.

9. Clock mechanism comprising time-indicating means, an electric motor for driving the time-indicating means, a gear train operatively interposed between the time-indicating means and the motor, contacts for controlling the motor, a pivoted lever carrying said contacts, said lever being biased to closed contact position, a release unit mounted for movement and having a stationary position in which it holds the lever in open contact position, a gear train between the motor and the release unit, constantly moving power-transmitting unit movable through a cycle and operative for releasing the release unit at each cycle, whereby to enable the lever to move to closed contact position and energizing the motor, and the motor thereupon being operative for advancing the time-indicating means and said release unit throughout a cycle from said stationary position of the release unit to another such stationary position thereof at the end of said cycle, the lever being held in open contact position by the release unit when the latter is in stationary position, and the lever being in closed contact position throughout the cycle of operation of the motor between stationary positions of the release unit.

10. Clock mechanism according to claim **9** wherein the power-transmitting means includes a spring energized by the motor, and means confining the spring to maintain tension therein between periods of operation of the motor.

11. Clock mechanism according to claim **10** and including escapement mechanism for controlling the movement of the spring throughout a predetermined time interval.

12. Clock mechanism comprising time-indicating means, an electric motor for driving the time-indicating means, a gear train operatively interposed between the time-indicating means and the motor, contacts for controlling the motor, a pivoted lever carrying the contacts and having a relatively long arm element, a driving unit including a driven gear, a gear train between the motor and said driven gear, said driving unit being mounted for rotation about an axis extending generally parallel with the pivot axis of said lever, said driving unit including a release unit, a knockoff platform in the release unit rockable about an axis transverse to the axis of the driving unit, a finger rockably mounted in said release unit, yieldable spring means surrounding the axis of said release unit and biasing the finger to an advanced position, the release unit upon rotation about the driving unit axis carrying said finger into camming engagement with the lever and thereby moving the latter to open contact position, said finger being retractable about the axis of the release unit against the action of said spring, the driving unit also including a coil spring about the axis of the driving unit and the driving unit including a knockoff tab driven by the latter coil spring and movable into operative engagement with said finger for releasing the latter from the lever and thereby enabling the lever to move to closed contact position, and time escapement mechanism controlling the advancing movement of the latter coil spring.