H. S. SINES.

TIME SWITCH.

APPLICATION FILED MAY 29, 1915.

1,300,498.

Patented Apr. 15, 1919.

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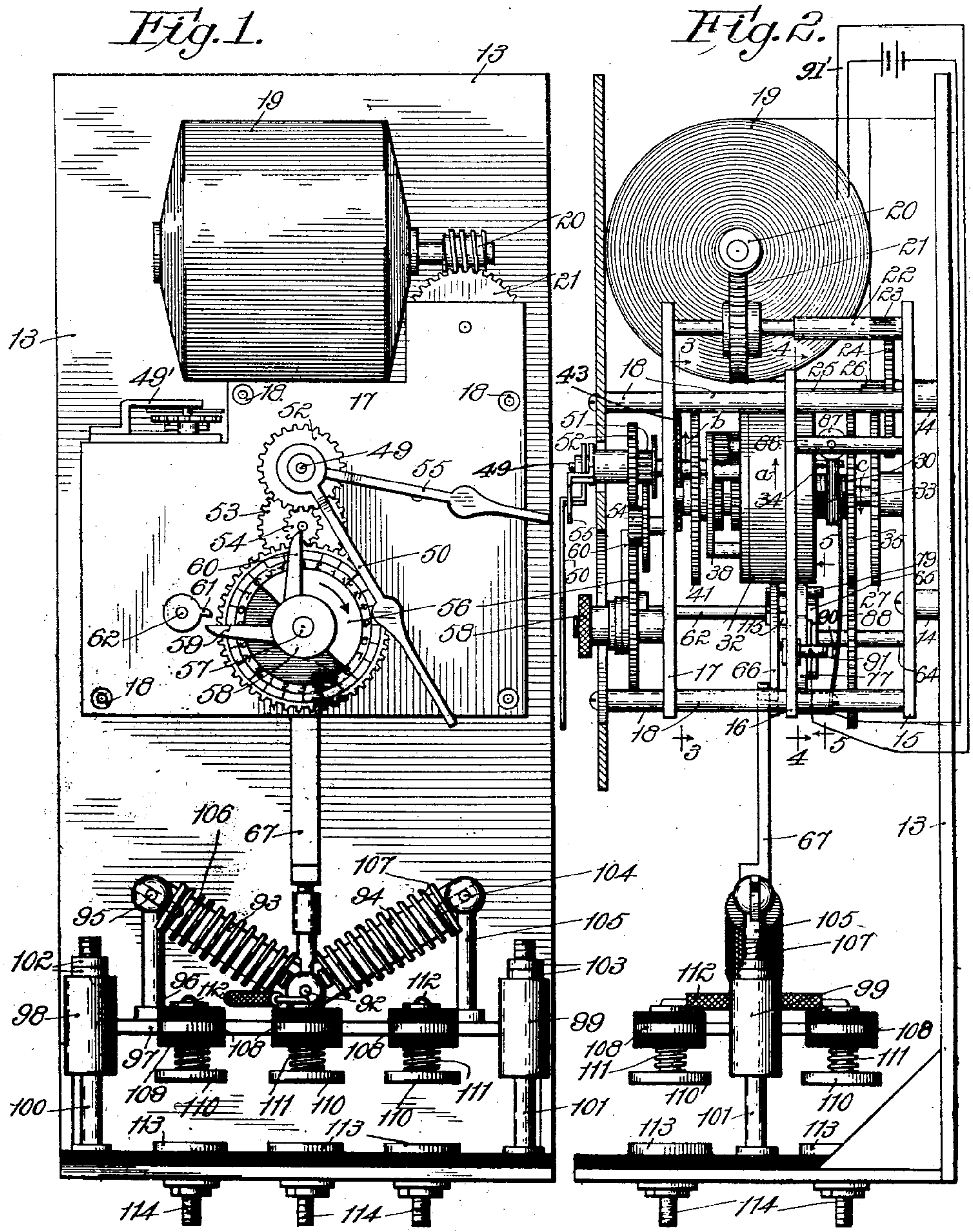

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5 SHEETS—SHEET 2.

Fig. 3.

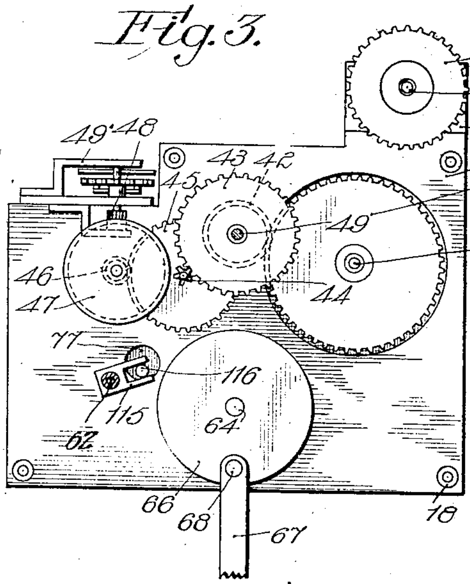


Fig. 4.

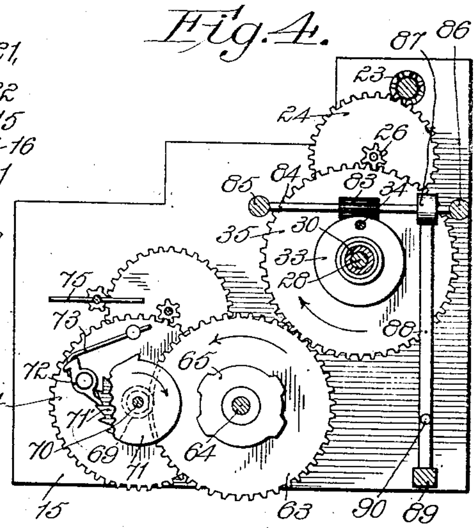


Fig. 5.

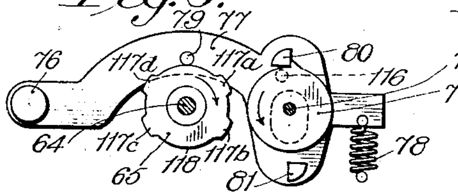


Fig. 11.

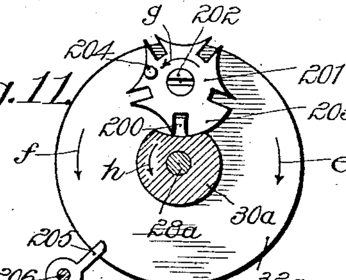
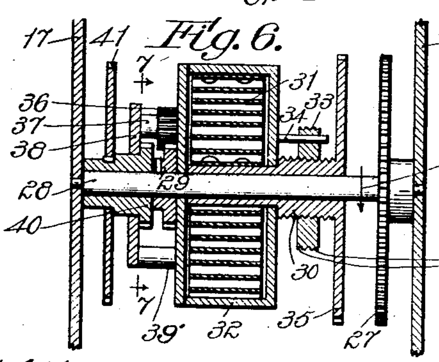


Fig. 6.



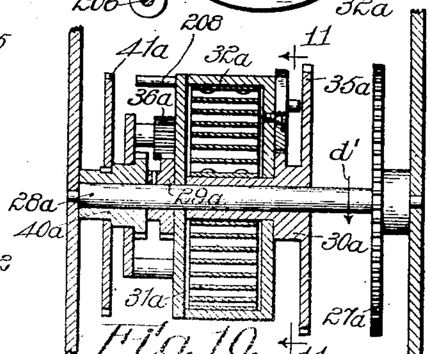


Fig. 10.

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5 SHEETS—SHEET 3.

Fig. 7.

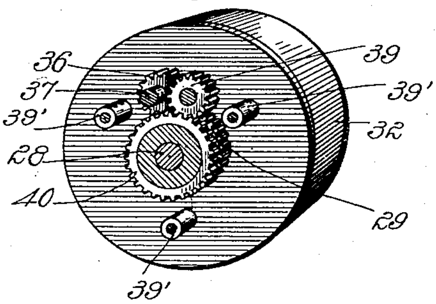


Fig. 12.

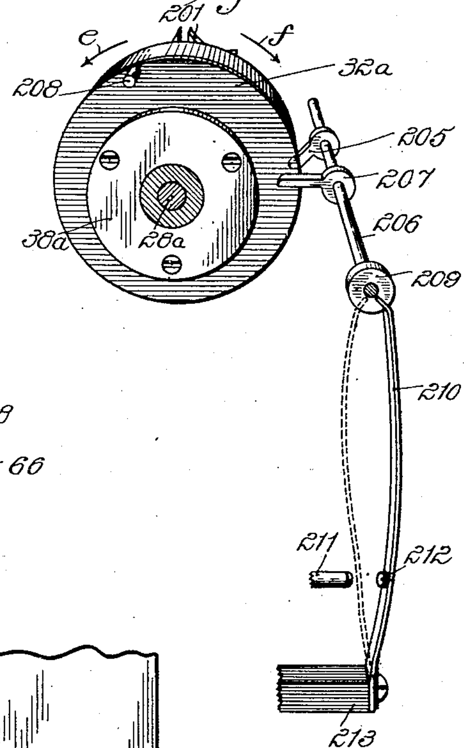


Fig. 8.

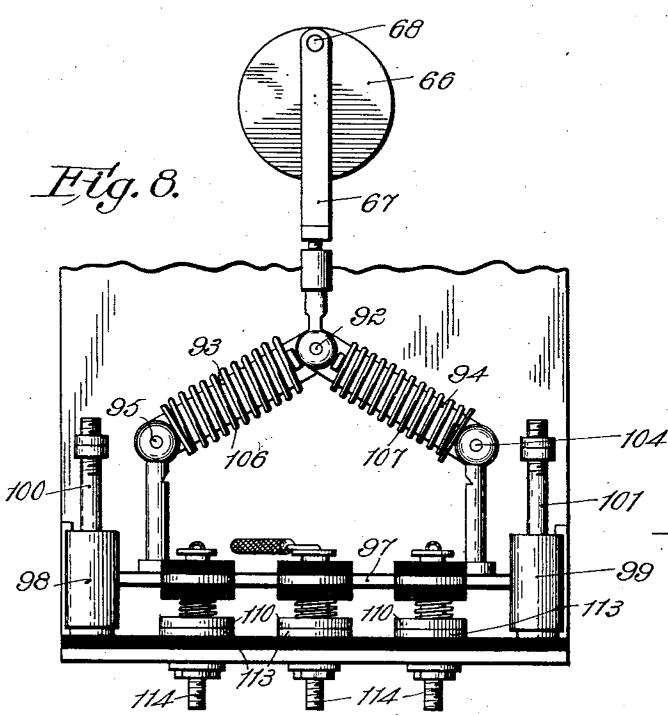
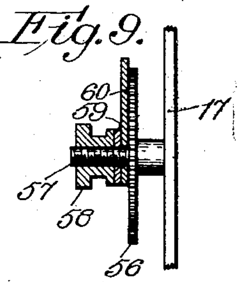


Fig. 9.



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5 SHEETS—SHEET 4.

Fig. 13

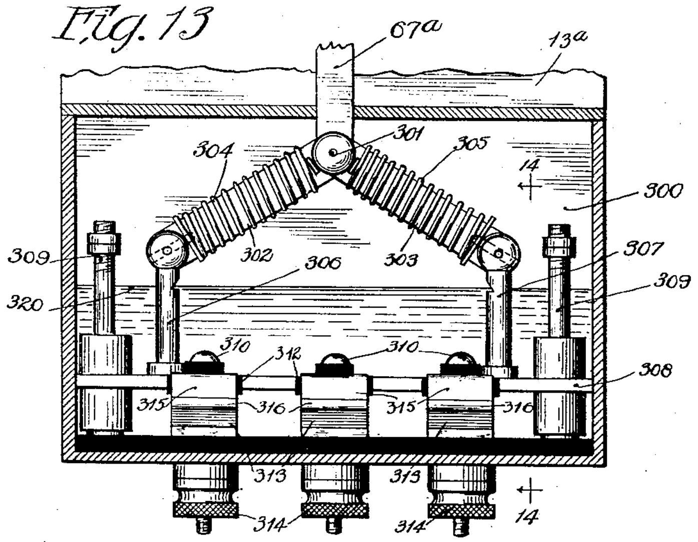
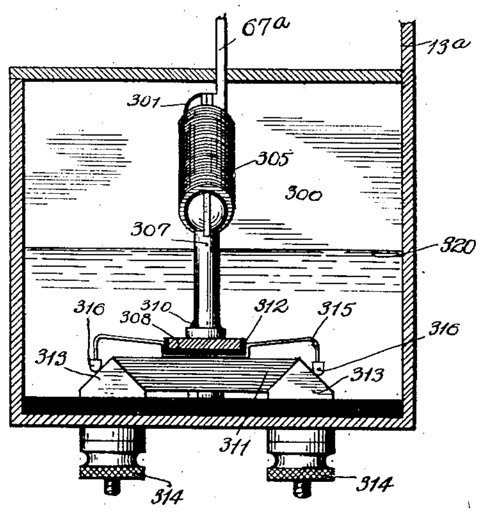


Fig. 14



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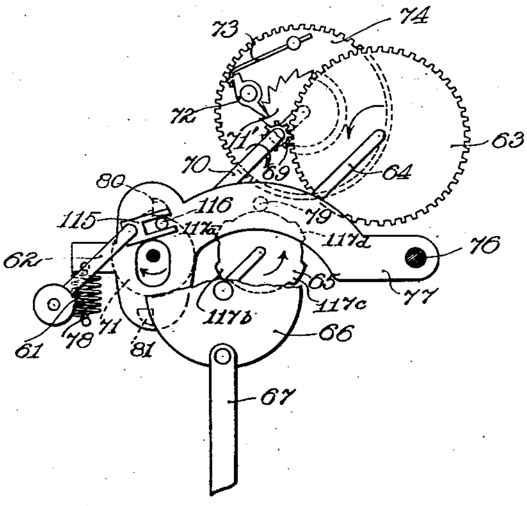
5 SHEETS—SHEET 5.

Fig. 15



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TIME-SWITCH.

1,300,498. Specification of Letters Patent. Patented Apr. 15, 1919.

Application filed May 29, 1915. Serial No. 31,120.

To all whom it may concern:

Be it known that I, HAROLD S. SINES, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Time-Switches, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to time switches, and particularly to that class of switches wherein a main spring is employed, suitable mechnism such as an electric motor being connected with the spring to wind the same when the spring is unwound in operating the clock and switch mechanism.

The device incorporated in this application is an improvement of the device disclosed in my co-pending application, Serial No. 3,021, filed January 19, 1915. In this prior application the means for operating the switch mechanism and the clock mechanism comprised two main springs connected so that when one is wound by the electric motor, the other one will likewise be wound if the same is in unwound condition when the electric motor is caused to operate. In the present invention I employ a single coiled spring to take the place of the above-mentioned pair of springs for operating both the clock mechanism and the switch mechanism. A decided advantage is obtained by employing one spring instead of two, in that when the spring is unwound, due to either the operation of the clock mechanism or the switch mechanism, the electric motor will be caused to operate and thus to again wind the spring. In a device where a pair of springs is employed the electric motor is controlled wholly by the position of one spring. Thus if the other spring is caused to unwind considerably faster than the first spring, said other spring may unwind to a position such as to be inoperative before the electric motor is caused to again wind the same. Thus by combining both springs into one, and connecting the clock mechanism to one end thereof, and the switch mechanism to the other, I overcome the difficulties encountered in connection with the two-spring arrangement.

In winding the main spring after it has been unwound to a predetermined position, it is desirable, if not necessary, to arrange the connections between the clock mechanism, the switch mechanism and the main spring so that when the main spring is being wound by the motor, tension will not be taken from the clock mechanism or the switch mechanism. If, therefore, the switch mechanism is intended to operate while the electric motor is winding the main spring, the switch mechanism can operate regardless of whether or not the main spring is being wound.

To provide means for causing at all times a tension to be placed upon the clock mechanism and the switch mechanism I provide differential gears between the main spring and the clock mechanism, causing an effective connection to be made between the main spring and the clock mechanism whether the electric motor is operating or not, as will hereinafter be described.

Mechanism is also provided whereby the main spring is permitted to unwind for a period of from fifteen to eighteen hours if the electric motor is not operated to wind the spring when the circuit controlling it is closed. As soon as the electric circuit, or motor, is again in condition to operate, the main spring will be rewound to its starting position.

A further object of my invention is the provision of an escapement mechanism whereby the switching devices may be caused at the exact time to operate to control an electric circuit. Suitable means is employed in connection with the escapement mechanism so that the said mechanism may be caused to operate at any desired time to either open or close the electric circuit with which the switching mechanism coöperates.

A still further object of my invention is the provision of a switch connected with the clock-controlled escapement mechanism above referred to. The switch comprises generally a sliding bar upon which are mounted a plurality of loosely mounted terminals adapted when moved to operating position to engage a corresponding number of stationary terminals. These stationary terminals are connected with the electric circuit which is to be controlled by the switch mechanism. Interposed between the sliding bar of the switch mechanism and a rod connected with the clock-controlled escapement, a pair of springs is provided which are arranged to assume positions such that the sliding bar is held either in operating or inoperating position—that is, in a position such that the switch will be closed or opened. As is well known in the art, it is desirable to have switches of this kind operate rapidly so that the circuit is opened or closed at the desired instant. Since the clock mechanism is operated at a comparatively slow rate of speed, means must be provided for moving the switching mechanism into one position or the other comparatively rapidly when the desired time arrives. With this end in view I provide a pair of springs, as above referred to, which are moved slowly either above or below a dead center line. In moving toward the dead center line the springs are compressed and as soon as the line is passed the power stored in the springs quickly moves the sliding bar into the position to close or open the switching mechanism.

For currents of comparatively high amperage I provide a switch constructed substantially like the device mentioned in the above paragraph which is provided with phosphor bronze blades or connectors. This modified construction may be arranged to be submerged in oil, as will more clearly be brought out in the following description:

A still further object of my invention is to produce a switching device in connection with the main spring for closing a circuit to operate the electric motor when the main spring has been unwound to a predetermined position. The spring is in the form of a spring band having one end fixed to the framework of the clock mechanism, the other end being mounted on an oscillating shaft, the length of the spring being greater than the distance interposed between the oscillating shaft and the point at which the spring is mounted on the casing. By means of this arrangement the spring cannot assume a straight line position, and will assume an arc either on one side of a straight line connecting the oscillating shaft and the point at which the spring is mounted to the casing or assume an arc on the other side of said line. The spring carries a contact point arranged to coöperate with a second contact point carried by the clock casing when the spring is moved to one of the above-mentioned positions, thus closing an electric circuit which operates the electric motor. When the spring has been wound, the oscillating shaft above referred to is given a slight turn to cause the spring to assume the other position so as to separate the contact carried by it and the one carried by the casing, thereby interrupting or breaking the electric circuit for the electric motor.

These and further objects of my invention will be more clearly brought out in the following specification, in which reference is made to the accompanying drawings, in which—

Figure 1 is a front elevational view of my invention, the dial plate being removed to more clearly illustrate the mechanism disposed beneath the same;

Fig. 2 is a side elevational view of the device illustrated in Fig. 1, the dial plate being shown in section to illustrate the apertures contained therein for permitting access to the setting devices of the escapement mechanism;

Fig. 3 is a front view of the clock mechanism, the upper plate being removed. This view is taken along the line 3, 3 of Fig. 2 looking in the direction indicated by the arrow;

Fig. 4 is a front view of the clock mechanism, the first and second plates being removed. This view is taken along the line 4, 4 of Fig. 2;

Fig. 5 is a detail view of the escapement mechanism employed for causing the switching mechanism to be operated at the desired time. This view is taken along the line 5, 5 of Fig. 2;

Fig. 6 is an enlarged detail cross-sectional view of the main spring, the differential gears and the mechanism employed for operating the motor switch;

Fig. 7 is a perspective view of the main spring drum and the differential gearing mounted adjacent thereto for facilitating connection between the main spring and the clock mechanism. This view is taken along the line 7, 7 of Fig. 6 looking in the direction indicated by the arrows;

Fig. 8 is a fragmentary front elevational view of the switching mechanism, the mechanism in this view being shown in its closed position;

Fig. 9 is a detail sectional view of the manually-controlled setting devices for causing the escapement mechanism to operate at the desired time;

Fig. 10 is a view similar to Fig. 6 of a modified form of devices for controlling the motor switch;

Fig. 11 is a sectional view taken along the line 11, 11 of Fig. 10 looking in the direction indicated by the arrows;

Fig. 12 is a fragmentary perspective view of the main spring drum used in connection with the device illustrated in Fig. 10, showing the coöperating pawls and switch mechanism for controlling the electric motor for winding the main spring.

Fig. 13 is a fragmentary front elevational view of the modified switch mechanism, some of the parts being broken away to more clearly reveal the construction;

Fig. 14 is a vertical cross sectional view taken along the line 14—14 of Fig. 13, and looking in the direction indicated by the arrows, and

Fig. 15 is a diagrammatic isometric view of the escapement mechanism shown in Fig. 5 and its coöperating mechanism.

Similar characters of reference refer to similar parts throughout the several views.

Referring to Fig. 1, 13 illustrates a supporting plate upon which is mounted by means of studs 14, 14 the plates 15, 16 and 17. These plates are positioned by suitable posts illustrated at 18, 18. Supported by the plate 13 is an electric motor 19 provided with a worm 20 meshing with a worm wheel 21 mounted upon the shaft 22. The shaft 22 is journaled in the plates 15 and 17, as illustrated, and is provided with a pinion at 23 meshing with a gear 24 mounted upon the shaft 25 journaled in the plates 15 and 16. A pinion 26 secured to the gear 24 meshes with a gear 27 mounted upon the main spring shaft 28 most clearly illustrated in Fig. 6. This main spring shaft or spindle is rigidly connected with a gear forming one of the gears of the differential above referred to. Rotatably mounted upon the shaft 28 is a threaded sleeve 30 which is connected to the inner end of the coiled spring 31. This spring 31, as will be hereinafter described, when in wound position serves to operate the clock mechanism and the switching mechanism. The outer end of the spring is connected to the drum 32 as illustrated. The sleeve 30 is provided with external threads, as illustrated, arranged to coöperate with an internally threaded ring 33 provided with a bore into which extends a pin 34 carried by the drum 32. From the description thus far given, it will readily be seen that as the drum 32 is rotated, movement is imparted to the ring 33 which, due to the threads carried by it and the collar 30, will cause the ring to move laterally either away from or toward the drum 32. The collar 30 carries a gear illustrated at 35 which, as will be described, is connected with the main switching devices. Meshing with the gear 29 which is fast on the shaft 28 is a pinion 36 mounted upon a stud 37 carried by the drum 32 and a plate 38 which is spaced from the drum 32 by means of three posts illustrated at 39′, 39′. Meshing with the pinion 36 is a second pinion 39, which in turn coöperates with a gear 40 similar to the gear 29. This gear 40 is loosely mounted on the shaft 28 and is rigidly connected with the gear wheel 41.

The gear wheel 41, as most clearly illustrated in Fig. 3, is connected by means of the train of gearing 42, 43, 44, 45, 46, 47 and 48 with the escapement mechanism illustrated at 49′. 47 illustrates a crown wheel which meshes with the pinion 48, whose axis is disposed at right angles to the axis of the crown wheel 47. The gears 42 and 43 are fixed to the spindle 49 which extends outwardly and has mounted thereon at its outer end the minute hand 50. A pinion 51 is mounted on the spindle 49 and connects with the gear 52 by virtue of the gears 53 and 54, which is connected to the hour hand illustrated at 55. The pinion 54, as illustrated, meshes with the gear 52 and also meshes with a setting gear 56 graduated, as illustrated, into twenty-four hours. This gear is fixed to a shaft rotatably mounted in the frame and, which is threaded, as most clearly illustrated in Fig. 9, to coöperate with the knurled nut 58 adapted when moved to the position illustrated to clamp the fingers 59 and 60. These fingers are loosely mounted upon the shaft 57 so that by loosening the knurled nut 58 the said fingers may be set to any desired position and held there when the nut is caused to clamp the same. Each of the fingers 59 and 60 is arranged when rotated by the gear 56 to engage a trip finger 61 mounted on the shaft 62. This tripping or oscillation of the shaft 62 operates the escapement mechanism to release the main spring to operate the switching devices, as will be presently described.

The gear 35, which is carried by the collar 30, coöperates with a gear 63 fixed upon the shaft 64, which carries a cam 65 between the plates 15 and 16, and a disk 66 between the plates 16 and 17. This disk 66 is connected with a rod 67 by means of the pin 68, said rod extending downwardly as illustrated in Fig. 1 to connect with the sliding bar or plate of the switching device. The gear 63 meshes with a pinion 69 mounted upon the shaft 70, which carries a one-toothed disk 71, positioned immediately adjacent and in the same vertical plane as the cam 65 mounted on the shaft 64. Carried by the pinion 69 is a ratchet wheel 71′ coöperating with the pawl 72 held in operating position by the spring 73. This pawl is mounted upon a gear wheel 74 which is loosely carried by the shaft 70. The gear 74, as illustrated, is connected to a fan 75 by means of suitable gearing. Pivoted to the plate 16 at 76 is the escapement arm 77 held in the position illustrated in Fig. 5 by means of the spring 78 having one end attached to the free end of the arm and its other end attached to the plate 16. The arm 77 is provided with a pin 79 arranged to rest upon the cam wheel 65 and a pair of stops 80 and 81 positioned above and below the one-toothed disk 71. The upper stop 80 is arranged to assume a position in the path of the tooth carried by the disk 71 when the arm is moved to the position illustrated in Fig. 5 and when the arm 77 is moved upwardly, as will be described, the catch 80 is moved out of the path of the tooth carried by the disk and the catch 81 moved upwardly into the path of the same.

The ring 33 is provided with a number of peripheral grooves 82 into which extend the the teeth carried by a pinion 83 mounted upon a shaft 84, which in turn is journaled in the supports 85 and 86 carried between the plates 15 and 16. The shaft 84, as most clearly illustrated in Fig. 4, has rigidly fixed thereon a disk 87 which is connected to a spring switch 88. The lower end of this spring is held by means of a post 89 carried by the plate 16. The length of the spring 88 is greater than the distance interposed between the shaft 84 and the post 89, so that the spring will assume the position of an arc, most clearly illustrated in Figs. 2 and 12, on one side of a straight line connecting the shaft 84 with the post 89. A contact point is mounted at 90 upon the spring 88 and is arranged to coöperate with a second contact point 91 carried by the plate 16. It will readily be seen that as the ring 33 is moved from the drum to the position illustrated in Fig. 2, the gear 83 will be given a counter-clockwise rotation (Fig. 2), which imparts a similar rotation to the disk 87, causing the upper end of the spring 88 to assume a position on the right side of a line connecting the post 89 with the shaft 84. This shifting of the upper end of the spring 88 causes the spring to bulge toward the supporting plate 13, thereby separating the contacts 90 and 91. Now, if the ring 33 is moved from the position illustrated in Fig. 2, to a position near the main spring drum, the gear 83 and thus the disk 87 will be given a rotation in a clockwise direction, thereby shifting the upper end of the spring 89 in a position such that the spring will bulge outwardly to thereby cause the contacts 90 and 91 to coöperate or engage to effect the circuit for controlling or operating the electric motor.

The rod 67, which is connected to the disk 66, extends downwardly and is pivoted at 92 to the arms 93 and 94. The outer end of the rod 93 is provided with a slot where it is pivoted at 95 to a post 96 carried by a plate 97 secured to a pair of collars 98 and 99 slidably mounted upon the posts 100 and 101. Lock nuts are provided at 102 and 103 to limit the upward movement of the collars 98 and 99. The outer end of the arm 94 is similarly provided with a slot and pivoted at 104 to a post 105 carried by the sliding plate 97. Springs 106 and 107 are interposed between the lower end of the rod 67 and the posts 96 and 105. The plate 97 carries a plurality of arms 108, each of which carries an insulating collar 109 provided with a central bore, into which extends a self-adjusting terminal 110. There may be any number of these terminals employed in connection with the switching mechanism. I have illustrated six of such terminals, three positioned in front of the posts 100, 101 and 102, and three in the rear of the same. Interposed between each of the enlarged or lower end of the terminals 110 and its coöperating insulating collar is a spring 111 to normally hold the terminals in the positions illustrated in Figs. 1 and 2. Corresponding terminals may be connected by means of conductors 112. Positioned directly beneath each of the terminals 110 is a stationary terminal 113 mounted upon insulation and terminating at 114 in a binding post to facilitate connection of the circuit which is to be controlled by the switching mechanism.

The operation of the device is as follows:

Let us assume that the main spring is in wound condition. The motor 19 will, therefore, be stationary or in a non-operating condition. The tension placed upon the coiled spring 31 will cause the drum to rotate in the direction indicated by the arrow *a* of Fig. 2, the inner end of the coiled spring 31 being securely held by the collar 30, which is stationary at all times except when the switching device is caused to operate. Since the motor 19 is stationary at this time, the shaft 28, and thus the gear 29 mounted thereon, will also be held stationary, due to the gearing connection between the shaft 28 and the electric motor. Therefore, as the drum 32 is rotated in the direction indicated, motion will be imparted by means of the differential gearing 29, 36, 39 and 40 to the gearing 41 in the direction indicated at *b* in Fig. 2. Since the gear 41 is connected to the clock mechanism and the usual escapement mechanism, the time-indicating devices will be operated in a manner well known in the art.

Now, let us assume that the finger 59 carried by the setting disk 56 is caused to engage the trip finger 61 mounted upon the shaft 62. This tripping of the finger 61 will cause the shaft 62 to oscillate in a counter-clockwise direction, as illustrated in Figs. 1 and 3. The shaft 62 carries a bifurcated arm 115, into which extends a pin 116 carried by the escapement arm 77. As the shaft 62 is therefore oscillated, the pin 116 is lifted, thereby causing the catch 80 to be moved upwardly out of the path of the tooth carried by the disk 71 and the catch 81 to be moved into the path of the same. As the disk 71 is, therefore, released by the catch 80, the gear 35 will be caused to rotate in a direction indicated at *c* in Fig. 2, to cause the gear 63 meshing therewith to move in the direction indicated in Fig. 4. Movement of the gear 63, of course, causes movement of the disk 71 due to the pinion 69 mounted upon the shaft 70, and thus causes the tooth carried by the disk 71 to move 180 degrees about the shaft 70, where it is stopped by the catch 81. The gear 63, and therefore the shaft 64, is allowed a slight rotation, but this rotation is not sufficient to lift the arm 67 any appreciable degree. At any rate, it is not lifted sufficiently to cause the switching mechanism to be operated. As the finger 59 is moved by the disk 56 sufficiently to disengage the trip finger 61, the shaft 62 will be rotated to its normal position due to the spring 78 acting upon the escapement arm 77. This return of the escapement arm 77 to its normal position disengages the catch 81 from the tooth of the disk 71 and permits the disk to continue in its rotation. The gear ratio between the gear 63 and the pinion 69 is one to six, so that the gear 63 will rotate 180 degrees when the pinion rotates three times. As has been described, the cam 65 is provided with four cam surfaces 117^a, 117^b, 117^c and 117^d. Due to the ratio of six to one between the shafts 70 and 64, one rotation of the shaft 70 will cause the cam surface 117^d to coöperate with the pin 79. This coöperation, therefore, of the cam surface and the pin 79 causes the escapement arm 77 to be lifted to cause the catch 80 to be moved out of the path of the tooth carried by the rotating disk 71. When the disk 71 has again completed one revolution, the cam surface 117^c will be brought into engagement with the pin 79 and thus again move the catch 80 away from the disk. After this 180 degrees movement of the shaft 64 has been effected, the point shown at 118 of the cam 65 will be moved adjacent the pin 79 and thus permit the catch 80 to be moved by the spring 78 into the path of the tooth carried by the disk 71.

This movement of the shaft 64 causes the disk 66 and thus the arm 67 to be moved from the position illustrated in Figs. 1 and 2 to the position illustrated in Fig. 8. As the disk 66 is rotated, the arm 67 is moved upwardly, thus causing tension to be placed upon the springs 106 and 107, which is released as soon as the point 92 is moved past the center line—that is a line connecting the points 95 and 104. The springs 106 and 107 will then relax and move the switching plate 97 and the terminals carried thereby to the position illustrated in Fig. 8.

In order to prevent too rapid movement of the disk 66 and thus the arm 67 carried thereby, I provide a fan illustrated at 75, as has been described. Since the rotation of the shaft 70 is suddenly stopped, I have found it advisable to employ mechanism to permit the fan gears to continue in their rotation until the inertia supplied to the gears has been utilized, thus relieving any strain which would be placed upon the mechanism if the fan gearing were suddenly stopped in a manner similar to the disk 71. The gear wheel 74 is, therefore, loosely mounted on the shaft 70 and is arranged to be connected with the ratchet 71′ by the pawl 72. Rotation of the disk 71 in the direction indicated in Fig. 4 will, therefore, cause a rotary motion to be transmitted to the fan 75. As soon as the rotation of the disk 71 is stopped by means of the catch 80 carried by the escapement arm 77, the ratchet wheel 71′ will, of course, also be stopped. The inertia which is taken up by the gear 74 causes the same to continue in its rotation to operate the fan until the inertia has been expended.

After the drum 32 has been unwound a predetermined amount the ring 33 with which it is connected by means of a pin 34 will be rotated a registering amount, and due to the threaded engagement between this ring 33 and the collar 30 the ring will be moved toward the drum 32. Rotation of the gear 35 to operate the switching mechanism will rotate the collar 30 in a direction indicated by the arrow *c* in Fig. 2, and thus move the ring 33 in a direction toward the drum 32. This movement of the ring 33 toward the drum will be transmitted by means of a pinion 83 to the disk 87 which is connected to the spring 88 which carries the contact point 90. After the pinion 83 has been rotated a certain amount the disk 87 will cause the spring 88 to move beyond a line connecting the post 89 and the shaft 84, thereby causing the spring 88 to spring outwardly to effect engagement between the contact points 90 and 91. These contact points form part of the electric circuit 91′ for the motor so that when the same are closed an electric circuit will be provided which causes the electric motor 19 to operate to wind the main spring 31 situated within the drum 32. In this winding operation the gear 27, which is driven from the electric motor, is rotated in a direction indicated by the arrow *d* in Fig. 6. As the gear 27 is securely fixed to the shaft 28 the gear 29 will be caused to rotate in a similar direction. Rotation of the gear 29 is transmitted to the differential pinions 36 and 39. As the gear 39 is rotated there will be a tendency to rotate the gear 40 which carries the gear 41 meshing with or driving the clock train. It will readily be seen, therefore, that a tension is always placed upon the gear 41 to drive the clock train whether the electric motor is operating to wind the main spring or whether it is stationary. The movement of the gear 40 is comparatively slow so that it may be considered as stationary. Therefore, as the gear 39 is rotated the teeth thereof will mesh with the teeth 40 to cause the drum to revolve in a direction opposite to the direction indicated at *a* in Fig. 2, thus winding the main spring 31. As the drum is thus rotated in a reverse direction the ring 33 will likewise be rotated and moved due to the threads carried by the collar 30 away from the drum 32. The rotation of the drum 32 in this reverse direction is continued until the ring 33 travels inwardly a distance sufficient to cause the disk 87 to move the upper end of the spring 88 to a position where the contact points 90 and 91 will be separated. This separation of the contact points will break the electric circuit for the motor 19, and thus cause operation of the same to be interrupted. It will be readily seen, therefore, that tension is always placed upon the gears 35 and 41 whether the motor 19 is operating or whether it is stationary. Due to the gears interposed between the drum 32 and the gear 41, the drum 32 when unwinding is caused to move at one-half the rate of speed at which the gear 41 moves in driving the clock train.

If for any reason the motor is not operated as soon as the contacts 90 and 91 are closed the arrangement of the various parts is such that the drum 32 may continue in its unwinding rotation until the motor is caused to again restore the energy lost by the spring 31.

In Figs. 10, 11, and 12, I have illustrated a modified arrangement to close an electric circuit when the main spring has been unwound a predetermined amount.

Referring to Fig. 10, 27ª illustrates a gear corresponding to the gear 27 shown in Fig. 6, and is connected with the electric motor. Fixed to the gear 27ª is a shaft 28ª pinned to the gear 29ª of the differential gears. One of the differential pinions is illustrated at 36ª, the other one of which, in a manner similar to that illustrated in connection with Fig. 6, meshes with the gear 40ª which carries the gear 41ª connected with the clock train. A drum is shown at 32ª which is connected with the outer end of a coiled spring 31ª having its inner end connected to the collar 30ª forming a part of the gear 35ª. The gear 35ª is connected with the switching mechanism. The collar 30ª, as most clearly shown in Fig. 11, is recessed at its upper portion and there provided with a tooth 200 meshing with a Geneva gear 201 pivoted at 202 to the drum 32ª. This Geneva gear is provided at 203 with an enlarged portion which permits a restricted movement of the gear. Carried by the Geneva gear 201 is a pin 204 extending inwardly, as illustrated in Fig. 10, to engage an arm 305 carried on the shaft 206 running parallel with the shaft 28ª. The shaft 206 extends forwardly and is provided with a second arm 207 which is angularly displaced relative to the arm 205. This arm 207 is arranged to extend inwardly toward the shaft 28ª to be engaged by a pin 208 carried by the outer side of the drum 32ª. A disk 209 is mounted on the shaft 206 and carries a spring 210, which is similar in all respects with the spring 88 illustrated in the preferred embodiment of my invention. A stationary contact is illustrated at 211 and its coöperating contact at 212 mounted on the spring 210. The lower end of the spring is secured to the casing at 213.

The operation of the devices illustrated in Figs. 10 to 12, inclusive, is as follows:

Assuming that the spring 31ª is in wound condition, the drum 32ª will be rotated in the direction indicated by the arrow *e* in Fig. 12 to rotate the gear 41ª and thus the clock train. As the drum 32ª is thus rotated the pin 208 will travel about the shaft 28ª until it reaches the arm 207 extending inwardly from the shaft 206 where it will trip said arm upwardly to close the contact points 211 and 212. As these contact points control the electric motor for rewinding the main spring 31ª the motor will be caused to operate the gear 27ª, and thus effect rewinding of the spring. If now, for some reason, the circuit is not in condition to operate the motor when the contact points 211 and 212 are closed the spring will, of course, not be rewound and the drum will continue in its rotation to unwind the main spring. This unwinding of the spring will continue until the Geneva gear assumes the position illustrated in Fig. 11, where, due to the enlarged portion 203, it will be prevented from further rotation and thus stop the entire mechanism until the electric circuit for controlling the motor is restored. As soon as the electric motor is caused to operate, however, the drum is caused to turn in a direction indicated by the arrow *f* due to its connection, by means of a differential gearing, with the gear 27ª. Each revolution of the drum 32ª in this direction causes the Geneva gear to make one-fifth of a turn in the direction indicated by the arrow *g*, causing the pin 204 to rotate about the pivoted point 202. After the drum has been rotated an amount sufficient to rewind the spring 31ª to its normal condition the pin 204 will assume a position directly in the path of the arm 205, which has been moved into the path of the pin 204 by the engagement of the pin 208 with the arm 207, to cause the arm 205 to be moved downwardly out of the path of the pin 204. This movement of the arm 205 will oscillate the shaft 206 to again bring the arm 207 into operating position and to again separate the contacts 211 and 212 to interrupt the circuit for the electric motor.

When the switching mechanism with which the gear 35ª is connected is operated the collar 30ª will be rotated in a direction indicated at *h*, thereby causing the pin 204 to be set back a certain amount. Each time the gear 35ª is, therefore, caused to operate the pin 204 will be set back this pre-determined amount, and therefore, cause the spring 31^a to be rewound to its normal condition when the electric motor is operated.

Referring to the modification illustrated in Figs. 13 and 14: The casing is illustrated at 13^a carrying an oil tight chamber 300 in which is disposed the switching mechanism. The operating member 67^a is similar in all respects to the operating member 67 illustrated in Fig. 1, and is controlled by the clock mechanism. The lower end of the member 67^a is connected at 301 to arms or links 302 and 303 around which are disposed compression springs 304 and 305. The spring 304 is interposed between the lower end of the rod 67^a and the upper end of the post 306. The spring 305 is interposed between the lower end of the rod 67^a and the upper end of the post 307. The posts 306 and 307 are attached to a sliding bar or plate 308 which has sliding engagement with a pair of guide posts 309. Carried by the bar 308 by means of screws 310—310, is a plurality of connectors or blades 311—311. Each of the connectors 311 is insulated at 312 from the bar 308. Each of the connectors 311 is preferably laminated and made up of phosphor bronze sheets, as most clearly illustrated in Fig. 14. Each of the connectors coöperates with a pair of tapered copper contacts 313—313, the inner faces of which are arranged to be engaged by the faces of the connector. The copper contacts 313 extend downwardly through the casing 13^a and are insulated therefrom. Terminal pieces 314—314 are provided to facilitate connection to the copper contacts.

As most clearly illustrated in Fig. 14, the upper phosphor bronze strips of each blade or connector are slightly larger than the space interposed between the copper contacts at that point. By means of this construction I secure a positive contact between all of the phosphor bronze strips and the contacts.

To prevent sparking between the connector 311 and contacts 313 when the connector is moved to disengage the contacts I provide a spring conductor 315 for each of the connectors. The outer end of each of the springs 315 is provided with a contact piece 316 arranged when the switch is closed to engage the outer face of the copper contacts.

The operation of the device illustrated in Figs. 13 and 14 is as follows:

At the desired instant the operating member 67^a is moved downwardly to cause opening of the switching devices. This downward movement of the member 67^a causes the links 304 and 305 to slide into the upper ends of the posts 306 and 307 due to the slots carried by the links and also causes tension to be placed upon the springs 304 and 305. As soon as the point 301 is moved below a line connecting the points at which the links are pivoted to the posts, the springs 304 and 305 will relax to move the posts, and thus the bar 308, upwardly to break the electric circuit. In breaking the electric circuit the connectors or blades 311 are caused to leave the faces of the copper contacts 313 ahead of the contacts 316 carried by the spring 315, the tension of the spring 315 holding the contacts 316 into engagement with the contacts 313 until the connector 311 has been moved away from the copper contacts. A circuit is completed between the contacts 313 by means of the spring 315 therefor until the connector 313 has been moved to a position where arcing will no longer occur. At 320 I have illustrated oil which may be inserted in the chamber 300 to insulate the various parts.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a clock, the combination of a main spring, time-indicating devices driven thereby, means for winding the spring, and differential gearing interposed between said spring, time-indicating devices and winding means.

2. In a clock, the combination of a main spring, time-indicating devices driven thereby, means for winding the spring comprising an electric motor, electric switching mechanism whose operation depends on the condition of the main spring for controlling the operation of the motor, and differential gearing interposed between said spring, time-indicating devices and motor.

3. In a clock, the combination of a main spring, time-indicating devices driven thereby, means for winding the spring, differential gearing interposed between said spring, time-indicating devices and winding means, and a driven member connected with the end of the spring opposite the time indicating devices.

4. In a clock, the combination of a main spring, time-indicating devices driven thereby, means for winding the spring comprising an electric motor, switching mechanism whose operation depends on the condition of the main spring for controlling the operation of the motor, differential gearing interposed between said spring, time-indicating devices and motor, and a driven member connected with the end of the spring opposite the time indicating devices.

5. In a clock, the combination of a main spring, time-indicating devices driven thereby, means for winding the spring comprising an electric motor, differential gearing interposed between said spring, time-indicating devices and motor, an electric circuit for the motor, a switch disposed in said circuit, and mechanism controlled by the spring for operating the switch.

6. In a clock, the combination of a main

spring, time-indicating devices driven thereby, means for winding the spring comprising an electric motor, differential gearing interposed between said spring, time-indicating devices and motor, an electric circuit for the motor, a switch disposed in said circuit, mechanism controlled by the spring for operating the switch, and a driven member connected with the end of the spring opposite the time-indicating devices.

7. In a clock, the combination of a main spring, time-indicating devices driven thereby, means for winding the spring comprising an electric motor, differential gearing interposed between said spring, time-indicating devices and motor, a driven member connected with the end of the spring opposite the time-indicating devices, an electric circuit for the motor, a switch disposed in said circuit, and mechanism controlled by the spring and the driven member for operating the switch.

8. A self-winding clock comprising a main spring, a drum secured to the outer end of the spring, a driven shaft fixed to the inner end thereof, time-indicating devices, spring-winding means comprising an electric motor, differential gearing interposed between the drum, time-indicating devices and motor, an electric circuit for the motor, a switch disposed in said circuit, and mechanism controlled by the spring for operating the switch.

9. A self-winding clock comprising a main spring, a drum secured to the outer end of the spring, a driven shaft fixed to the inner end thereof, time-indicating devices, spring-winding means comprising an electric motor, differential gearing interposed between the drum, time-indicating devices and motor, an electric circuit for the motor, a switch disposed in said circuit, and mechanism having threaded engagement with the driven shaft and fixed angularly relative to the drum for operating the switch.

10. A self-winding clock comprising a main spring, a drum secured to the outer end of the spring, a driven shaft fixed to the inner end thereof, time-indicating devices, winding means for the spring comprising an electric motor, differential gearing interposed between the drum, time-indicating devices and motor, an electric circuit for the motor, a switch disposed in said circuit, a peripherally grooved ring having threaded engagement with the driven shaft and fixed angularly relative to the drum, and a pinion coöperating with the grooved ring for operating the switch.

11. In a clock, the combination of a main spring, time-indicating devices driven thereby, means for winding the spring comprising an electric motor, differential gearing interposed between said spring, time-indicating devices and motor, an electric circuit for the motor, a switch disposed in said circuit, mechanism controlled by the spring for operating the switch, said switch comprising an oscillating member, a spring strip having one end fixed to the member and the other end fixed to the clock casing, the length of the spring being greater than the distance interposed between its fixed ends, and a contact carried by the strip arranged to engage a stationary contact carried by the clock casing.

12. In a clock, the combination of a main spring, time-indicating devices driven thereby, means for winding the spring comprising an electric motor, switching mechanism whose operation depends on the condition of the main spring for controlling the operation of the motor, differential gearing interposed between said spring, time-indicating devices and motor, said switching mechanism comprising an oscillating member, a spring strip having one end fixed to the member and the other end fixed to the clock casing, the length of the spring being greater than the distance interposed between its fixed ends, and a contact carried by the strip arranged to engage a stationary contact carried by the clock casing.

13. A self-winding clock comprising a main spring, a drum secured to the outer end of the spring, a driven shaft fixed to the inner end thereof, time-indicating devices, means for winding the spring comprising an electric motor, differential gearing interposed between the drum, time-indicating devices and motor, an electric circuit for the motor, a switch disposed in said circuit, a peripherally grooved ring having threaded engagement with the driven shaft and fixed angularly relative to the drum, a pinion coöperating with the grooved ring for operating the switch, said switch comprising an oscillating member, a spring strip having one end fixed to the member and the other end fixed to the clock casing, the length of the spring being greater than the distance interposed between its fixed ends, and a contact carried by the strip arranged to engage a stationary contact carried by the clock casing.

14. A clock comprising a main spring, time-indicating devices connected to one end thereof, a member connected to the other end of the spring and driven thereby, and means for winding the spring without relieving the tension of the spring on either the time-indicating devices or the driven member.

15. A clock comprising a main spring, time-indicating devices connected to one end of the spring, a member connected to the other end thereof and driven thereby, and means for winding the end of the spring connected with the time-indicating devices,

and for placing tension on the time-indicating devices while the main spring is being wound.

16. A clock comprising a main spring, a driven member connected to one end of the spring, a second driven member connected to the other end thereof, and means for winding one end of the spring, and for placing tension on the driven member normally connected with the winding end of the spring while the same is being wound.

17. In a clock the combination of a coil spring, a driven member connected with one end of the spring, differential gearing, a second driven member connected with the other end of the spring through the differential gearing, and means for operating the differential gearing to wind the main spring without relieving tension from either one of the driven members.

18. In a clock the combination of a coil spring, a driven member connected with one end of the spring, differential gearing, a second driven member connected with the other end of the spring through the differential gearing, an electric motor for operating the differential gear to wind the main spring without relieving tension from either one of the driven members, and electric switching mechanism whose operation depends on the condition of the spring for controlling the operation of the motor.

19. A clock comprising a coil spring, a driven member connected with one end thereof, a second driven member connected with the other end thereof, and means for winding the spring without relieving tension on either one of the driven members.

20. A clock comprising a coil spring, a driven member connected at one end of the spring, and means connected at the said end of the spring for winding the same without relieving tension on the driven member.

21. A clock comprising in combination a coil spring, differential gearing, a driven member connected with one end of the spring through the differential gearing, and means for operating the differential gearing to wind the spring without relieving tension on the driven member.

22. In a clock the combination of a coil driving spring, differential gearing connected with one end of the spring for winding the same, and mechanism connected with the differential gearing arranged to receive energy from the differential gearing when the gearing is operated to wind the said spring.

In witness whereof, I hereunto subscribe my name this 19th day of May, A. D. 1915.

HAROLD S. SINES.

Witnesses:
J. VAN BUSKIRK,
S. S. COLE.