No. 653,713. Patented July 17, 1900.

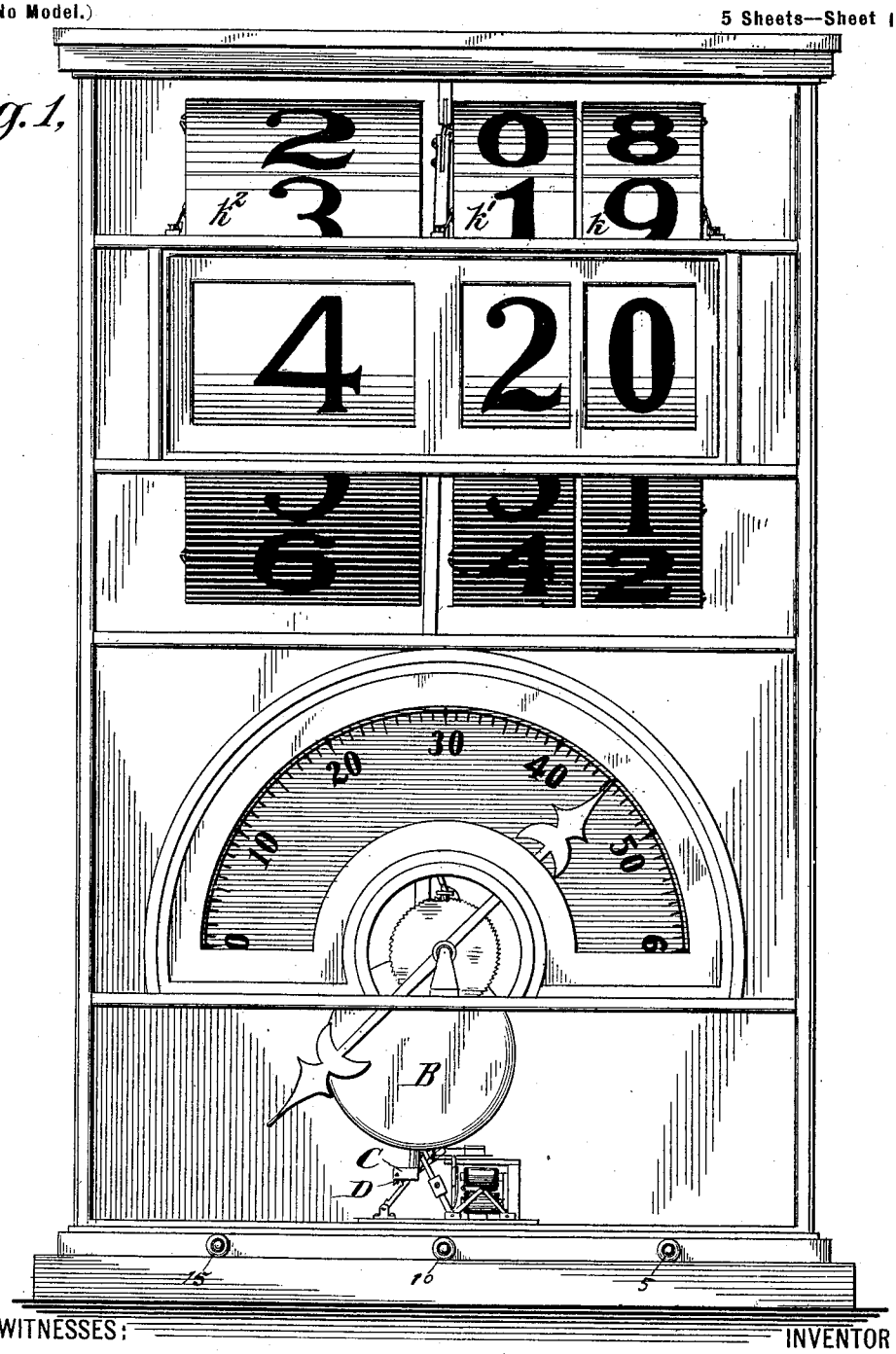
S. P. THRASHER.

ELECTRIC CLOCK.

(Application filed Jan. 14, 1899.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.



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No. 653,713. Patented July 17, 1900.

S. P. THRASHER.

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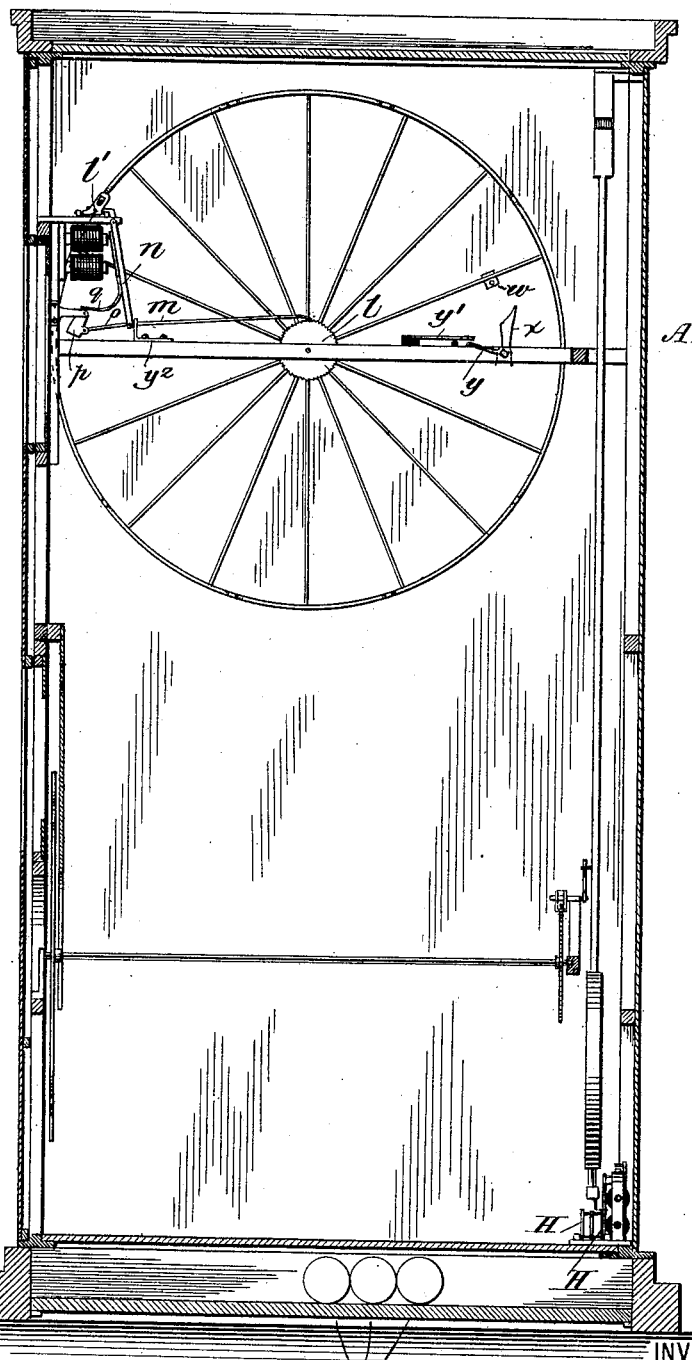
(No Model.) 5 Sheets—Sheet 2.

Fig. 2,



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ELECTRIC CLOCK.

(Application filed Jan. 14, 1899.)

(No Model.) 5 Sheets—Sheet 3.

Fig. 11.

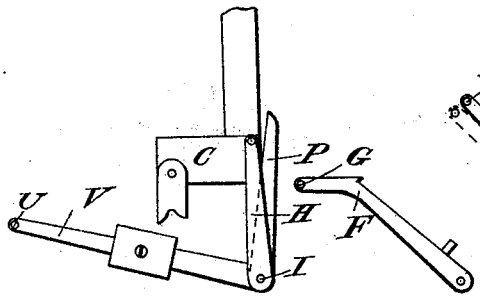


Fig. 10.

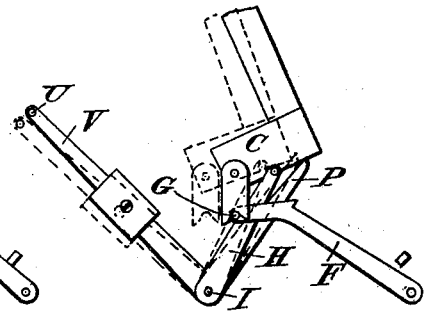
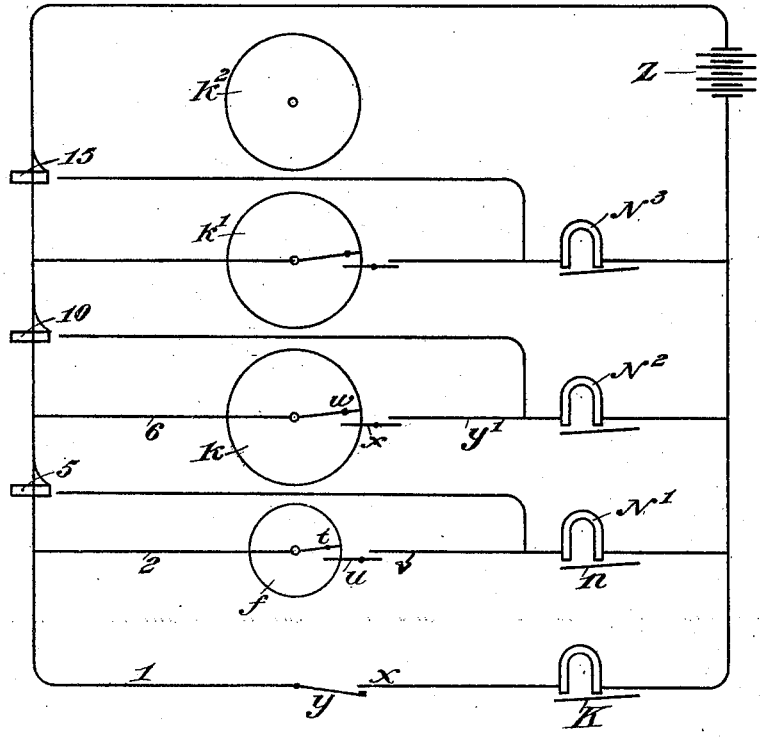


Fig. 3.



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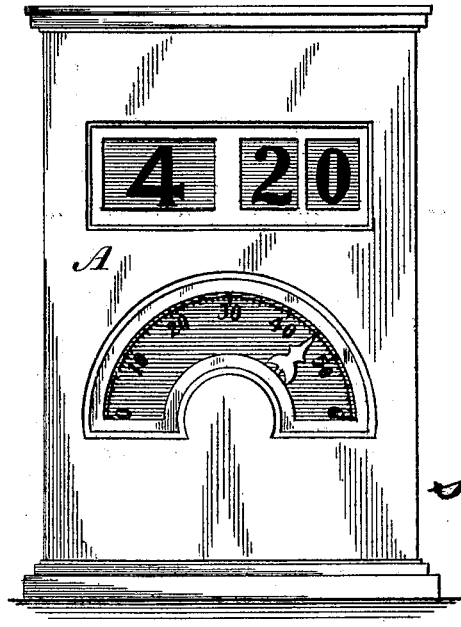
ELECTRIC CLOCK.

(Application filed Jan. 14, 1899.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 4,



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ELECTRIC CLOCK.

(Application filed Jan. 14, 1899.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 5,

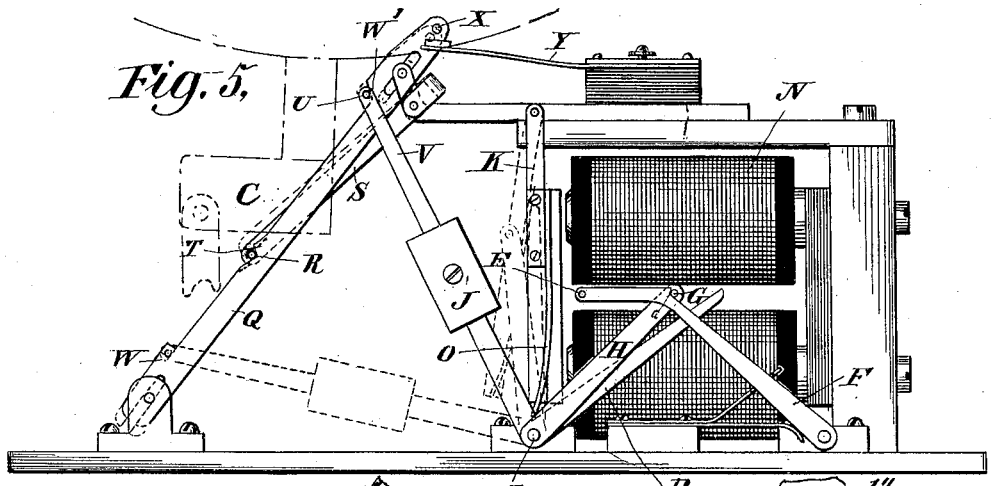

Fig. 6,

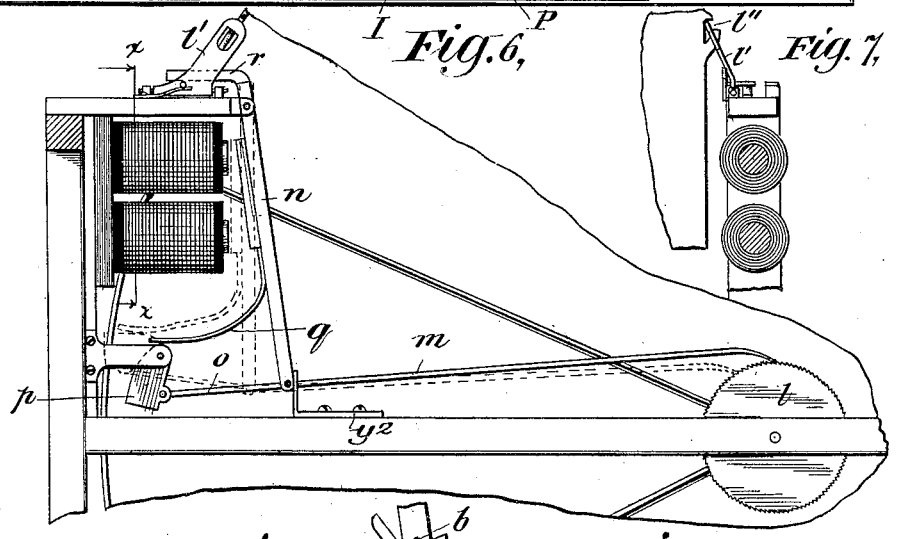

Fig. 7,

Fig. 8,

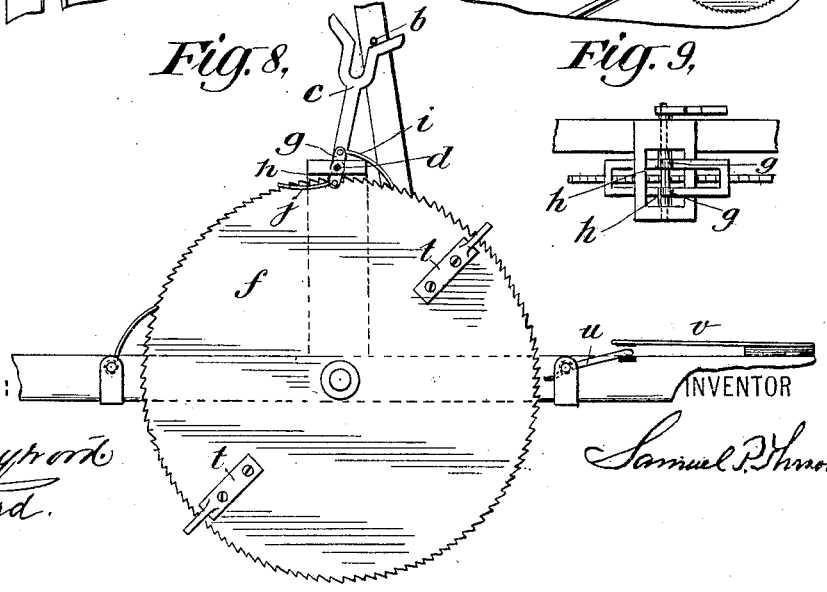

Fig. 9,

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UNITED STATES PATENT OFFICE.

SAMUEL P. THRASHER, OF NEW HAVEN, CONNECTICUT.

ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 653,713, dated July 17, 1900.

Application filed January 14, 1899. Serial No. 702,155. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL P. THRASHER, a citizen of the United States, and a resident of New Haven, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Time-Indicating Devices, of which the following is a specification.

My invention relates to an improvement in time-keeping devices, and has special reference to indicating time by figures upon rotating drums and upon a seconds-dial; and it consists in the construction and relative arrangement of the parts hereinafter described, and pointed out in the claims.

Figure 1 is a front view of my device with the door of the case removed. Fig. 2 is a side view of the same with the right side of the case removed. Fig. 3 is a diagrammatic view of the electrical connections. Fig. 4 is a front view of the timepiece. Fig. 5 is a detail of the impulse mechanism. Fig. 6 is a detail of the drum-operating mechanism. Fig. 7 is a section on the line *x x* of Fig. 6. Fig. 8 is a view of the seconds mechanism. Fig. 9 is a plan view of the pawls of the seconds mechanism. Figs. 10 and 11 are detached views showing the positions of parts of the device at successive moments.

Like letters of reference indicate like parts throughout the several figures.

A is a case for the clock-movement.

D is a pendulum having, preferably, a broad foot C. The pendulum in this embodiment is not provided with a device to give it an impulse at each swing. Consequently the length of the arc of vibration of the pendulum will decrease, and the pendulum would finally stop if an impulse were not given to it in some way. To give this impulse to the pendulum after the length of the arc of vibration thereof has decreased to a certain point, I have provided a weight which will be automatically released by the pendulum, allowing it to fall and give an impulse on the side of the pendulum, thereby increasing the length of its arc of vibration, and, further, in this embodiment I provide means to draw back the weight into its former position ready to give a new impulse. When a blow is given to the side of the pendulum to increase its swing, the regularity of the swing will be slightly interfered with, and to obviate this I have in this embodiment provided a construction in which the falling of the weight does not give a blow directly to the side of the pendulum, but the force of the fall is directed first against the pendulum in the direction of its length, in this embodiment against the bottom of the foot C, attached to the pendulum, which will not interfere with the swing of the pendulum, and the influence of the weight is gradually, although of course swiftly, changed to an impulse against the side of the pendulum. The consequence of this is that impulse is given without practically any interference with the swing of the pendulum, which is of importance in such a delicate mechanism as a clock.

In the present embodiment of my invention I have provided a magnet N, suitably supported and energized by an electric circuit. (Shown diagrammatically in Fig. 3.)

Pivoted at I is an arm V, carrying an adjustable weight J. Connected to this arm, so as to move therewith, are two other arms P and H. The arm H carries a pin G, which is engaged by a catch on the pivot-lever X to keep the weight in its normal raised position. This normal position of the weight is with the arm V raised in a position approaching the vertical, so that when the weight starts to fall it will move comparatively slowly at first and increase its dynamic effect as the arm V approaches the horizontal. This will give a corresponding motion to the arm P, which transmits the impulse of the fall of the weight to the pendulum. The object of this is to transmit a comparatively-slight force to the pendulum at first and gradually increase this force, so that the swing will not be disarranged. The foot C of the pendulum is provided with a swinging trip, as shown in dotted lines, which as the pendulum swings back and forth will freely pass over a pin E in the end of the arm F. When the length of the arc of vibration decreases to a certain point, the swinging trip will not quite pass over the pin E, but the jaws of this trip will receive the pin E between them, and as the pendulum starts back the pendulum will force the arm F downward, as shown in Fig. 10, releasing the catch on the arm F from engagement with pin E and allowing the weight to drop. This will

raise arm P, and as the foot C of the pendulum is in the path of the end of this arm the arm will strike against the bottom of it, as shown in Fig. 10, thereby expending its force against the pendulum in the direction of its length, on account of which the blow will not disarrange the swinging of the pendulum, and as the pendulum swings further along the end of the arm the end of the arm will reach the corner of the foot C, and the arm will then travel around the corner of the foot and contact with the side of the foot as the pendulum swings farther, as shown in Fig. 11, and the impulse given by the fall of the weight will then be given to the side of the pendulum to increase its swing without any blow or other sudden shock against the side. In this way the action will be gradual and the full force of the fall of the weight will be transmitted to the side of the pendulum just as the foot of the pendulum swings away from the end of the arm P. The weight and arm are then in the position shown in dotted lines in Fig. 5. To return the parts to their normal position, I have provided a movable armature K, preferably pivoted at one end, and which armature in this embodiment carries a curved face O, which I designate a "cam-face." When the weight drops and the arm P is raised, it preferably strikes against this cam-face of the armature and pushes it back into the position shown in dotted lines in Fig. 5, the cam-face resting against the arm P, toward or at the end of said arm.

Q is preferably an inclined sliding contact-bar held normally in its upper position by means of a holding-pin R in the bar S bearing against the lower side of a V-shaped lug T, formed on the said bar Q, as shown. When an impulse is given to the pendulum, the weight J descends and a pin U in the outer end of the gravity-arm V strikes the shoulder W of the said bar and, dislodging the pin U, forces the bar downward and causes a contact-pin X to engage its wiper Y and close the electric circuit through the magnet N. This will attract the armature K, and as the cam-face O rests against the lever P the cam-face will roll along the lever P and shift this point of contact along toward the fulcrum I as the weight is raised. When the weight is in its position, (shown in dotted lines in Fig. 5,) the force necessary to be applied to it to raise it from that position into the position shown in full lines will decrease as the weight rises. Consequently the force applied to the lever II must be greater at first than is necessary as the weight continues to rise. The armature K also is at its farthest point away from the magnet. Consequently the influence of the magnet upon it will be the least at that point, and the pull upon the armature will increase as the armature approaches the magnet. To attain greater leverage therefor, the point of contact with the arm P is at or toward its end, and as the necessity for power decreases as the weight is raised and the pull of the magnet on the other end of the armature at the same time increases the shifting of the point of contact of the cam-face O of the arm P toward the fulcrum I shortens the effective leverage and varies the force applied through the arm inversely as the force of the magnet applied to the armature. By "inversely" I do not mean that the ratio must be exact; but what I do mean is that as the pull of the magnet increases the effect through the lever P decreases. The weight is then forthwith raised by force of the magnet to its highest point, the impulse-bar G having entered its holding-notch *a* in the holding-lever F and the pin U of the gravity-arm V having engaged the upper shoulder W′ of the sliding contact-bar and forced the bar upward and broken the circuit, the pin R having again fallen into its normal position against the lug T. In like manner the operation of the several parts is repeated at each impulse given to the pendulum.

In the present embodiment the magnet N′, Fig. 6, attracts the armature *n* and raises the weight *p*, and when this weight is released the drum is moved. I therefore may denominate these parts as together constituting an electric motor for moving the drum. When the switch is closed, the circuit passes through the coils of the magnet M′, thereby energizing the same and moving in this embodiment both the parts *n* and *p*; but they are at that time unconnected with the drum, because the pawl *m* is then idly sliding over the teeth on the ratchet-wheel *l*. When the weight *p* falls, the end of *m* engages a tooth on the wheel *l*, thus connecting the weight P with the drum, and thereby rotating said drum.

A stud *b*, borne upon the pendulum-rod, engages a lever *c* and imparts to its shaft *d* an oscillating motion. This shaft is disposed close to the periphery of the seconds ratchet-wheel *f*, as shown, and is provided with vertical arms *g g* and *h h*, the former of which carrying a pushing-pawl *i* and the latter a pulling-pawl *j*, by which the said ratchet-wheel is actuated at each swing of the pendulum, and uniform motion is imparted to the seconds-pointers as they in turn traverse over the dial.

In the present construction the drums are each provided with an electromagnet for operating the same, respectively, as hereinafter explained.

Secured, preferably, to the shaft of each drum is a fine-toothed ratchet-wheel, as *l*, and upon the rim of each drum are arranged locking or holding notches *l″ l′*, which are engaged by a spring-actuated holding-pawl *l′*. The notches on the rims correspond in number to the figures or divisions on their respective drums, but need have no definite relation to the number of teeth on the ratchet-wheels. N′ is a second magnet in an electric circuit, as shown in Fig. 3. *n* is an armature for this magnet, pivoted to the frame, as shown. *m*

is a rod constituting a pawl pivoted to the free end of lever n. o is a second rod also pivoted to lever n and further pivoted at its other end to a weight p. This weight is pivoted to a projection from the frame and has a cam-surface, as shown. q is a curved spring preferably carried by the armature, resting against the cam-face on this weight. When the wheel f is rotated far enough for the contacts uv to make a connection through the magnet N', as shown in Figs. 3 and 8, the magnet will be energized and the armature n drawn toward it. This will draw back the pivoted pawl m and raise the weight into the position shown in dotted lines, the curved spring q advancing along the curved face of the weight p, as shown. As the armature is attracted, the bent arm r at its top will be raised from the position shown in Fig. 7 and will bend aside the spring-pawl l', releasing the drum and allowing it to revolve. The pawl m being meanwhile drawn to the position shown in dotted lines in Fig. 6 and the circuit through the magnet having been broken, the weight p starts to fall from its substantially horizontal position. The spring q bears upon this weight at this moment at a point comparatively remote from the pivot of the weight, and as the weight falls its point of contact is shifted toward the pivot of the weight, thereby decreasing the effect of the spring upon the weight. When the weight is in its horizontal position (shown in dotted lines) its force to throw the armature n and pivot-pawl m toward the right is greater than when it approaches the point shown in full lines. This decrease of the effect of the spring q and of the force of the fall of the weight I provide because a relatively-greater force should be used to overcome the inertia of the drum in starting the same than after its inertia has been overcome. Upon being released by the magnet the weight, having at this point its greatest effective gravity and its greatest leverage, in addition to the recoil force of the spring acting upon it, exerts its maximum power in starting the drum in its rotation, and as the weight continues in its descent the power decreases in a ratio well calculated to prevent undue acceleration and secure substantially-uniform velocity in the rotation of the drum.

By providing the ratchet-wheel l with fine teeth immediate engagement of the pawl m with one of the ratchet-teeth upon the breaking of the electric circuit is assured, and adjustment of the ratchet-wheel upon the shaft of the drum with relation to the stop-notches on the rim is rendered unnecessary. As a means of regulating the velocity of the drums, I have provided the actuating mechanism of each with an adjustable stop y^2 to limit and control the movement of the pawl m, as may be required.

Secured at the upper end of the armature is the spring-releasing arm, as r, which is adapted to disengage a holding-pawl l' from one of the locking-notches l^2 on its drum whenever the armature is drawn toward the magnet, so that the drum may be free to turn upon the next release of the weight by the magnet, and as the armature recedes from the magnet with the rotation of the drum the releasing-arm r, now moving in an opposite direction, allows the stop or holding pawl l' to spring back against the rim of the drum and enter the next-succeeding notch.

To insure positive locking and holding, I have formed the stop-pawl l' with its end slotted, as shown, and the said notches on the drums with double-inclined sides and one of the points elongated, as shown in Fig. 7. The stop-pawl l' will be thus invariably engaged by the elongated point while gliding over the rim and forced by the inclined sides to the bottom of the notch.

The arrangement and operation of the drums are as follows: Upon the seconds ratchet-wheel are contact-fingers $t\,t$, one of which each minute engages a pivoted contact-lever u and forces its upper end against a wiper v, thereby closing the electric circuit of the magnet of the first drum k and causing the change of the units-figure to take place. At each complete revolution of this drum a contact-finger, as w, secured to the drum, engages a pivoted arm x at the proper time and brings the arm y, secured to its shaft, into contact with the wiper y'. This closes the circuit of the tens-of-minutes drum k' and effects the change of the tens-of-minutes figure. In like manner two similar contact-fingers on the tens-of-minutes drum (the figures on this drum being duplicated) in their turn engage the wiper and cause the rotation and change of figures of the hour-drum k^2 to take place by thus closing the circuit of its actuating-magnet.

It is obvious that many changes might be made in the construction and relative arrangement of the parts herein shown and described and yet be within the spirit and scope of my invention.

What I claim as new, and desire to secure by Letters Patent, is—

1. In combination, a swinging pendulum, a weight, and a portion moved longitudinally of said pendulum by the fall of said weight and adapted to contact with said pendulum to transmit the force of the fall of said weight to the side of said pendulum with a gradually-increasing effect, a separable catch to hold said weight from falling during the normal swings of said pendulum, and means operated by said pendulum to automatically separate the parts of said catch and release said weight when the length of the arc of vibration of said pendulum diminishes to a certain point.

2. In combination, a swinging pendulum, a weight, an arm moved upward against said pendulum by the fall of said weight to transmit an impulse in the direction of the length of said pendulum and adapted to contact with

said pendulum to transmit the force of the fall of said weight to the side of said pendulum, a separable catch to hold said weight, and means operated by said pendulum to automatically separate the parts of said catch and release said weight when the length of the arc of vibration of said pendulum diminishes to a certain point.

3. In combination a swinging pendulum, a weight, an arm moved upward, by the fall of said weight, against said pendulum to transmit an impulse in a direction of the length of said pendulum and adapted to continue in contact with said pendulum as said pendulum moves away to transmit the force of the fall of said weight to the side of said pendulum, a separable catch to hold said weight, and means operated by said pendulum to automatically separate the parts of said catch and release said weight when the length of the arc of vibration of said pendulum diminishes to a certain point.

4. In combination a swinging pendulum, a pivoted arm carrying a weight, means to hold said arm and weight above the pivot of said arm and in a position approaching the vertical, a portion moved against the side of said pendulum by the fall of said weight to give an impulse thereto and means operated by said pendulum to automatically release said weight as the length of the arc of vibration of said pendulum decreases to a certain point and allow said arm to fall toward a horizontal position, thereby transmitting the gradually-increasing effect of the fall of said weight to said pendulum.

5. In combination, a swinging pendulum, a pivoted arm carrying a weight, means to hold said arm and weight above the pivot of said arm and in a position approaching the vertical, a second arm moved against the bottom and then gradually against the side of said pendulum by the fall of said weight to give an impulse thereto, and means operated by the said pendulum to automatically release said weight as the length of the arc of vibration of said pendulum decreases to a certain point and allow said weighted arm to fall toward a horizontal position, thereby transmitting a gradually-increasing effect of the fall of said weight to said pendulum.

6. In combination, a swinging pendulum, a weight, means to transmit the force of the fall of said weight against said pendulum, first in the direction of its length and then gradually against the side thereof, means to hold said weight and means operated by said pendulum to automatically release said weight and allow the same to expend its force against said pendulum as the length of the arc of vibration of said pendulum decreases to a certain point.

7. In combination a swinging pendulum, a weight, means to transmit the force of the fall of said weight against said pendulum first in the direction of its length and then gradually against the side thereof during the swinging of said pendulum in one direction, means to hold said weight, and means operated by said pendulum to automatically release said weight and allow the same to expend its force against said pendulum as the length of the arc of vibration of said pendulum decreases to a certain point.

8. In combination, a swinging pendulum, a weight carried by an arm, and a second arm moved by the fall of said weight to transmit the force of the fall of said weight against said pendulum first in the direction of its length and then gradually against the side thereof, a separable catch to hold said weight, and means carried by said pendulum to separate said catch and release said weight and allow the same to expend its force against said pendulum as the length of the arc of vibration of said pendulum decreases to a certain point.

9. In combination, a swinging pendulum, a weight adapted to fall and transmit the force thereof to the side of said pendulum, a normally-open electric circuit, an electromagnet in said circuit, means to hold said weight from falling during the normal swings of said pendulum and adapted to be automatically released by said pendulum when the length of the arc of vibration thereof decreases to a certain point, and means operated by the movement of said weight to close said circuit and energize said magnet and thereby raise said weight.

10. In combination, a swinging pendulum, a weight adapted to fall and transmit the force thereof to the side of said pendulum, a normally-open electric circuit, an electromagnet in said circuit, means to hold said weight from falling and adapted to be automatically released by said pendulum when the length of the arc of vibration thereof decreases to a certain point, a lever moved by the fall of said weight, a cam moved by said magnet when energized and adapted to tilt said lever and decrease the effect of said cam through said lever as the effect of said magnet upon said cam increases, and means operated by the movement of said weight to close said circuit and energize said magnet and thereby raise said weight.

11. In combination, a swinging pendulum, a weight adapted to fall and transmit the force thereof to the side of said pendulum, a normally-open electric circuit, an electromagnet in said circuit, said magnet having a pivoted armature, said armature having a cam-face, a catch to hold said weight from falling and adapted to be automatically released by said pendulum when the length of the arc of vibration thereof decreases to a certain point, a pivoted lever to return said weight, said cam-face on said arm resting against said lever at a point on the same and adapted to move said lever and shift the point of contact therewith toward the pivot of said lever as the same continues to move to decrease the effect of said armature upon said weight as

the effect of said magnet upon said armature increases.

12. In a time-indicating device in combination, a movable time-indicator, a ratchet connected with the same, a pawl to engage said ratchet, a weight pivoted and adapted to automatically exert a decreasing force to move said pawl in one direction thereby moving said time-indicator, said weight having a cam-face, a spring to engage said cam-face to add its force to the effect of said weight and decrease said force after the time-indicator starts to move, and means to retract said pawl and raise said weight for another operation.

13. In a time-indicating device in combination, a movable time-indicator, a ratchet connected with the same, a pawl to engage said ratchet, a weight pivoted and adapted to automatically exert a decreasing force to move said pawl in one direction thereby moving said time-indicator, said weight having a cam-face, a spring to engage said cam-face to add its force to the effect of said weight and decrease said force after the time-indicator starts to move, and a magnet to retract said pawl and raise said weight for another operation.

14. In a time-indicating device in combination, a movable time-indicator having a ratchet, a spring-actuated pawl having a slot therein engaging the said ratchet to prevent the rotation of said time-indicator in either direction, an electric circuit, a magnet in said circuit, a pivoted armature for said magnet carrying at one end a projection adapted to raise said pawl out of engagement with said ratchet, and automatic means to close said circuit and energize said magnet and move said time-indicator.

15. In combination, a movable time-indicator, means to intermittently rotate the same, a ratchet-stop on said indicator embracing a depression having a projection at one side thereof, a spring-pawl having an aperture therein adapted to drop over said projection and enter said depression thereby locking said indicator from movement in either direction, and means to automatically release said pawl from engagement therewith.

16. In a time-indicating device in combination, a swinging pendulum, a weight adapted to fall and transmit some of its power to the side of said pendulum, automatic means operated by said pendulum to release said weight when the arc of vibration of said pendulum decreases to a certain point, a normally-open electric circuit, a magnet in said circuit, a normally-open switch including a movable portion having a stop thereon and a part moved by the fall of said weight to strike said stop and move said arm and close said circuit thereby energizing said magnet and drawing said weight back to its normal position.

17. In a time-indicating device in combination, a pivoted rotating drum provided with a series of stop-notches, a relatively-stationary stop adapted to engage said notches successively, a fine-toothed ratchet-wheel connected with said drum to move the same, the number of teeth on said ratchet-wheel being greatly in excess of the number of stop-notches on said drum.

18. A drum provided with a series of stop-notches l'', l'' and a slotted locking-pawl l' adapted to engage with said notches.

19. In a time-indicating device in combination, a rotating drum provided with a ratchet-wheel, a pawl connected therewith, an electric circuit, an electromagnet in said circuit, means to close the circuit through said magnet to move said armature in one direction, and a weight raised by the movement of said armature said weight being connected with said pawl and adapted to fall and move said pawl in an opposite direction, said weight having a cam-face, and a leaf-spring pressing upon said cam-face.

20. In a time-indicating device in combination, a rotating drum, actuating mechanism therefor, a pivoted weight p, and a checking and recoil spring q, substantially as described.

21. In combination, a swinging pendulum, means to give an impulse thereto, and a portion moved longitudinally of said pendulum by said impelling means and adapted to contact with said pendulum to transmit the force of the impulse to the side of said pendulum with a gradually-increasing effect, a separable catch to hold said impelling means from operating against said pendulum during the normal swings of said pendulum, and means operated by said pendulum to automatically separate the parts of said catch and allow said impelling means to operate when the length of the arc of vibration of said pendulum diminishes to a certain point.

22. In a time-indicating device in combination, a pivoted weight p, a magnet, an armature for said magnet and a spring q carried by said armature and resting against said weight, substantially as described.

23. In combination, an electric circuit, an electromagnet in said circuit, an armature n, a movable time-indicator, a ratchet-wheel l to move the same, a carrying-pawl m and a stop y^2.

24. In a time-indicating device in combination, a movable time-indicator provided with locking-notches l'', l'', a slotted pawl l' and a releasing-arm r secured to the armature of an electromagnet.

25. In a time-indicating device in combination, an electric circuit, a switch, and an electromagnet in said circuit, a movable armature for said magnet, a pivoted lever, a connection from said armature contacting with said lever at a distance from its pivot, one of said contacting parts having a cam-face, means to automatically close said switch and circuit and energize said magnet, thereby moving said armature, connection and lever and shifting the point of contact with said lever toward the pivot thereof as the influence of said magnet on said armature increases, a ro-

tating time-indicator carrying time-numerals thereon, a ratchet connected with same, a reciprocating pawl-carrier, a pawl carried thereby and adapted to engage said ratchet, means to retract said carrier, and a connection between said carrier and lever whereby said shifting of the point of contact on said lever decreases the effect which said lever has on said carrier.

26. In a time-indicating device in combination, a plurality of independently-rotatable numeral-carrying time-indicators, a clock-movement, a normally-open electric circuit, a motor in said circuit adapted to be connected with one of said rotatable time-indicators to move the latter, a switch moved by said clock-movement at regular intervals to close said circuit thereby energizing said motor and moving a part of said motor, said part of said motor being at that time unconnected with said time-indicator, and means operated by the further motion of said clock-movement to connect said part of said motor with said time-indicator to rotate the latter.

27. In a time-indicating device in combination, a plurality of independently-rotatable numeral-carrying drums, a clock-movement, a normally-open electric circuit, a motor in said circuit adapted to be connected with one of said rotatable drums to move the latter, a switch moved by said clock-movement at regular intervals to close said circuit thereby energizing said motor and moving a part of said motor, said part of said motor being at that time unconnected with said drum, and means operated by the further motion of said clock-movement to connect said part of said motor with said drum to rotate the latter.

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Witnesses:
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