No. 649,591. Patented May 15, 1900.

S. P. THRASHER.

SECONDARY ELECTRIC CLOCK.

(Application filed July 1, 1898.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1,

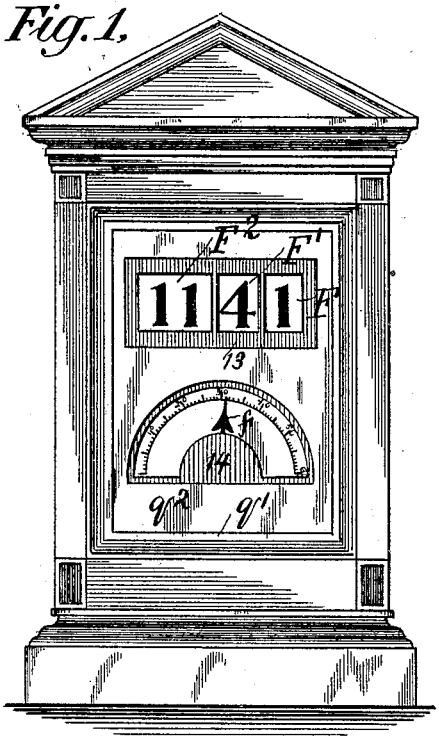


Fig. 6,

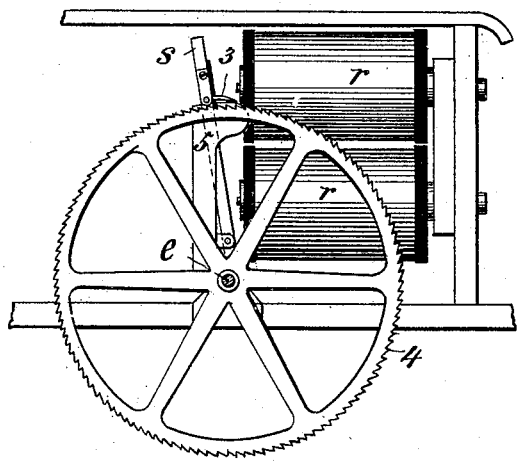


Fig. 5,

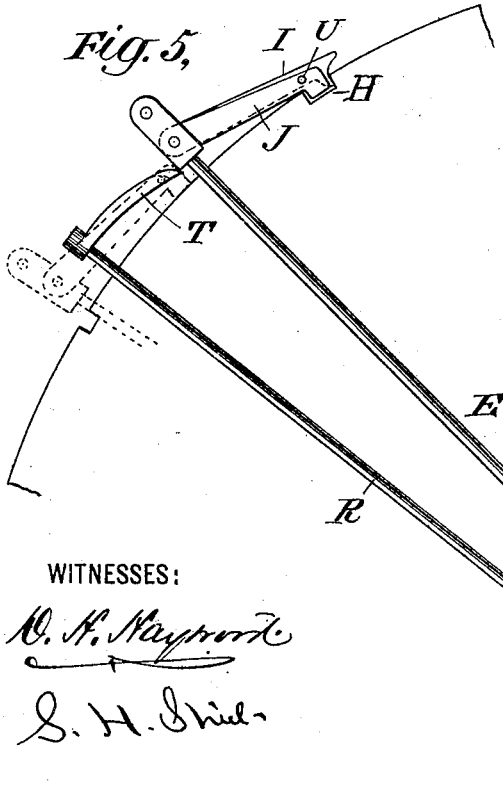


Fig. 7,

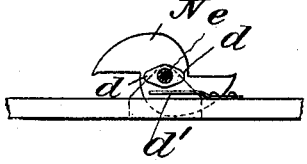
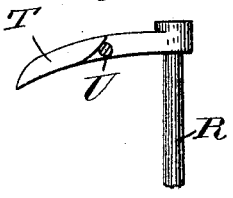


Fig. 9.



WITNESSES:

O. F. Maynard

S. H. Shields

INVENTOR

Samuel P. Thrasher

No. 649,591. Patented May 15, 1900.

S. P. THRASHER.

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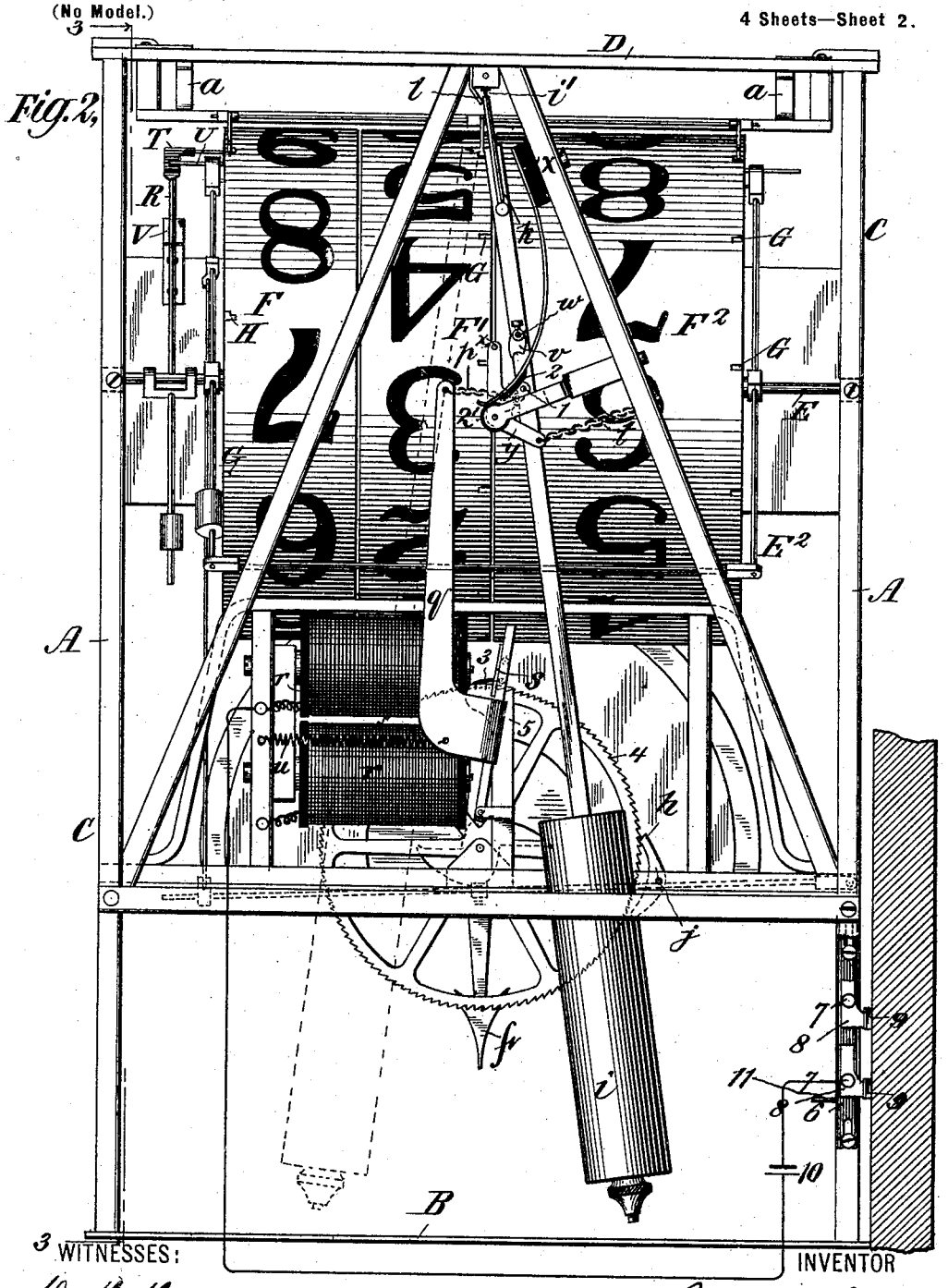
(No Model.) 4 Sheets—Sheet 2.

Fig. 2.



WITNESSES:

O. F. Hayward

S. N. Shield

INVENTOR

Samuel P. Thrasher

No. 649,591. Patented May 15, 1900.

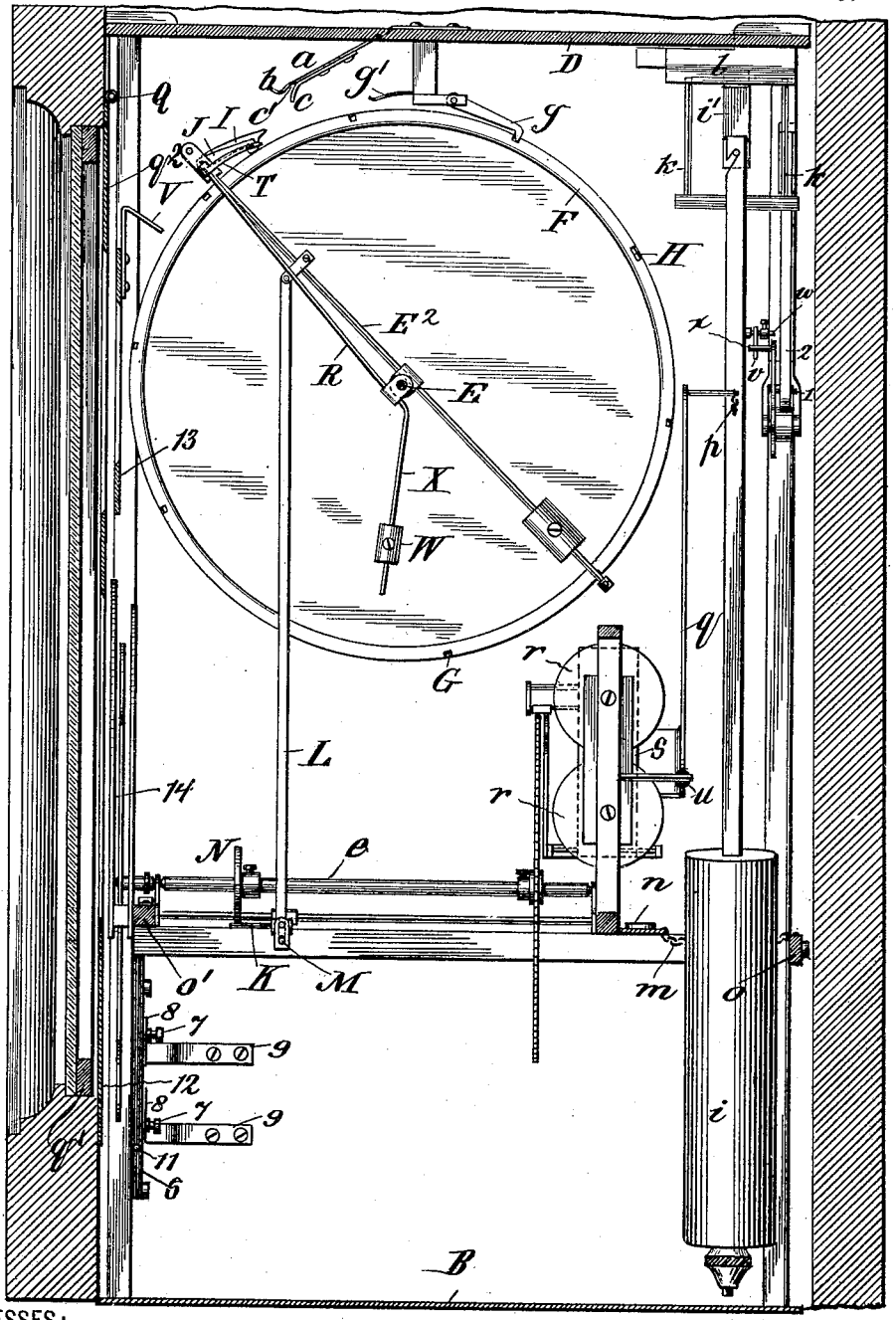
S. P. THRASHER.

SECONDARY ELECTRIC CLOCK.

(Application filed July 1, 1898.)

(No Model.) 4 Sheets—Sheet 3.

Fig. 3,



WITNESSES:

O. N. Kayford.

S. H. Shute

INVENTOR

Samuel P. Thrasher

No. 649,591. Patented May 15, 1900.

S. P. THRASHER.

SECONDARY ELECTRIC CLOCK.

(Application filed July 1, 1898.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 4.

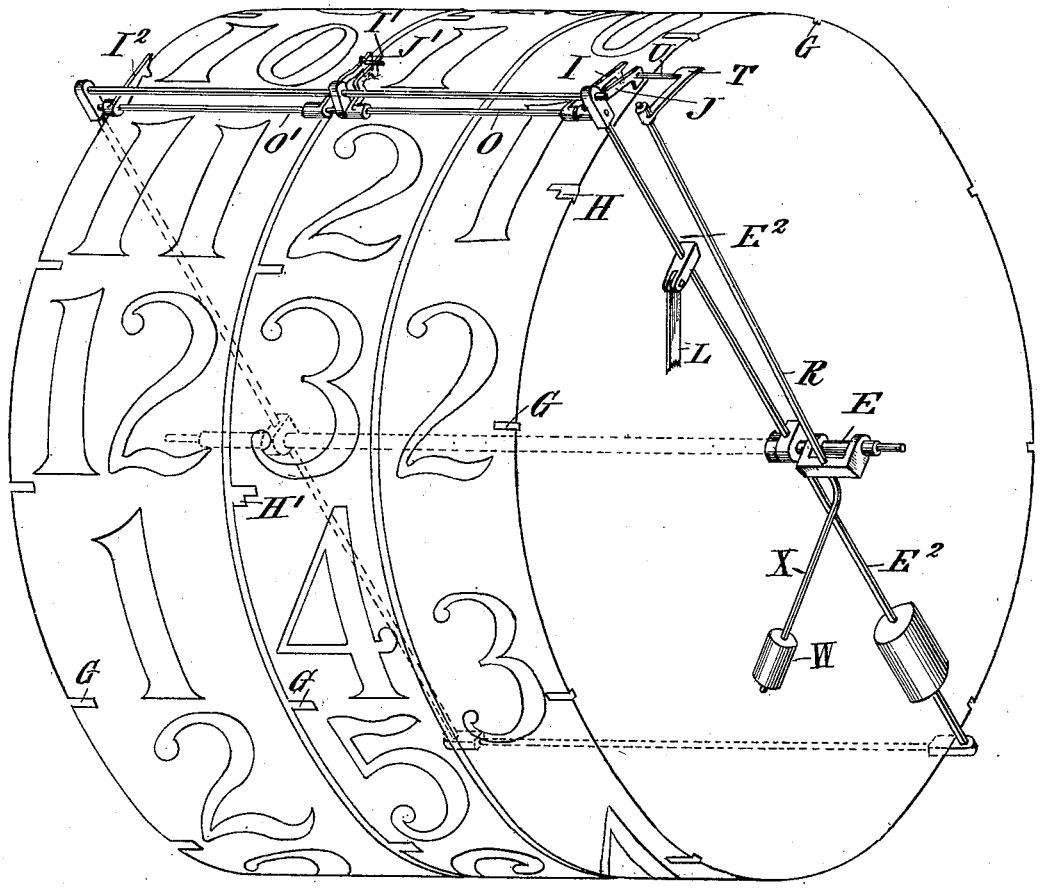
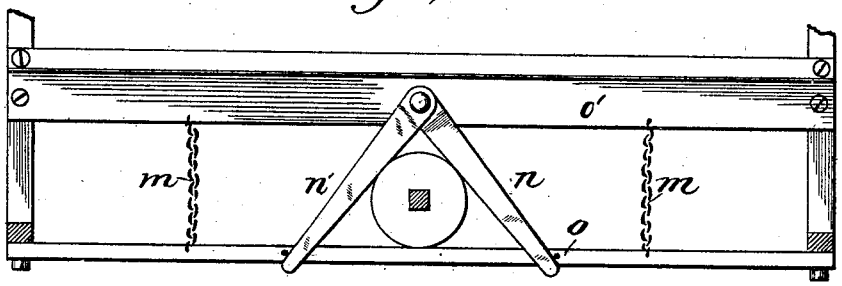


Fig. 8.



WITNESSES:

D. F. Hayward.

S. H. Wait.

INVENTOR

Samuel P. Thrasher

UNITED STATES PATENT OFFICE.

SAMUEL P. THRASHER, OF NEW HAVEN, CONNECTICUT.

SECONDARY ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 649,591, dated May 15, 1900.

Application filed July 1, 1898. Serial No. 684,990. (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 time-indicating devices and is especially adapted to indicate the hour and the minute by figures carried upon rotating drums or spools and the seconds upon a graduated arc, and is particularly adapted to be driven by a pendulum and an electro-magnet; and it consists in the construction and relative arrangement of the parts, as hereinafter described, and pointed out in the claims, reference being had to the accompanying drawings, in which like letters and numerals indicate like parts throughout the several figures.

Figure 1 is a front elevation of my device complete as it appears in operation. Fig. 2 is a rear view of my time-indicating mechanism removed from the case. Fig. 3 is a side view of the same through lines 3 3 of Fig. 2. Fig. 4 is a diagrammatic view. Fig. 5 is a detail view of the upper part of the controller and yoke. Fig. 6 is a detail view of the magnet and seconds-wheel with its carrying-pawl. Fig. 7 is a detail view of the cams, friction-arms, and spring. Fig. 8 is a detail view of pendulum-holding device.

A is the frame of my device, constructed, preferably, with the base-plate B, posts C C, top plate or frame D, &c. Journaled on the shaft E are the time-drums F F′ F², having figures to properly indicate the hours and minutes and being suitably provided with carrying-notches G G and count-notches H H′, which are engaged when the device is in operation by their respective carrying-pawls I I′ I² and count-pawls J J′, borne on the yoke E², which is also preferably journaled on the shaft E. This yoke is connected by pitman L to lever M, which is actuated each minute by successive engagements with the cams N N, and the rotation and checking of the drums is effected in a manner substantially described in a former application of mine and need not be further described here. The construction and arrangement, however, of the carrying and count mechanism, as here shown, constitute a new improvement, which I will now explain.

It will be observed that I have formed certain carrying-notches into count-notches H H′ H′ by widening a portion of each of these notches, so as to be engaged by the carrying and count pawls arranged side by side and substantially of the same length, forming at the same time notches of equal length, giving thereby more leeway to the carrying and idle pawls without increasing the width of the drums. Another advantage of this form of notch will appear later on in the description.

O is a shaft journaled at the upper end of the yoke, and fast thereon is a count-pawl J, adapted to fall into its count-notch H during the revolution of the units-of-minutes drum F, and loosely mounted on the shaft O is a carrying-pawl I, adapted in its forward movement to engage the notches of its drum. Secured to the other end of the shaft O is the carrying-pawl I′, adapted to engage the successive notches in the tens-of-minutes drum at each revolution of the units-of-minutes drum upon the falling of its count-pawl J into the notch H. Arranged substantially in a straight line with the shaft O is a similar shaft O′, provided with the count-pawl J′, adapted to engage the count-notches H′ H′ on the tens-of-minutes drum and the carrying-pawl I², secured at its other end. The count-pawl J′ has a pin which extends laterally over the pawl I′, so that the pawl I′ supports the pawl J′. As clearly shown in Fig. 4, the head on the pawl J′ is of substantially the same width as the head on the pawl J—*i. e.*, it is wider than the narrow notches G in the drums, but narrow enough to drop into the wider part of the notch H′ on the middle drum. It is evident that both pawls I′ and J′ should drop into the notch H′ when they come to it and that the pawl J′ on account of its broad face would not drop into the notches G. This pin extending laterally from the pawl J′ is, in fact, to support the pawls J′ I² slightly out of engagement with the face of the drums, so that there will not be so much friction upon the same. By the arrangement of the shafts and of the several carrying and count pawls thereon as shown and described only two shafts of light weight are required.

R is a controller or governor, which is journaled also on the shaft E. It is provided with an upward and backward extending arm, on which is a laterally-extending bar T, the outward end of which is disposed in the path of a pin U on the count-pawl J. The end of the bar is inclined on its inner surface, as shown in Fig. 9, so as to insure positive locking of the pin U with the bar T when the upwardly-extending arm of the controller is being rotated in the forward direction by the forward movement of the yoke and the carrying-pawl J and also to allow the pin U to drop down and easily free itself from engagement with bar T as the count-pawl J drops into the wider portion of the count-notch H, thereby releasing the controller or governor from engagement with the drums, as shown in Fig. 5. The front part of the bar T is inclined on its outer surface, as shown in Fig. 9, and is adapted to permit the pin U to glide over the same in a backward direction to its normal position behind the bar. The governor is arranged, as shown, with the center of gravity back of its axis and is limited in its backward movement by the stop V. Below the axis and preferably in substantially a perpendicular line when the controller is at rest is a weight W upon the arm X, arranged to be rotated in a backward and upward direction upon the forward rotation of the upper arm of the controller. The object of this controller or governor is to render the movement of the drums more uniform, since a single drum would rotate with greater velocity than when two or three of the drums are carried together. I will now explain its operation. At each forward movement of the yoke when only the units-of-minutes drum is rotated the controller is also rotated by engagement therewith, as shown and described, and at the start it is so arranged and adjusted with reference to opposing gravity as to offer a resistance to the yoke practically equal to the resistance of one or both of the other drums were they being also rotated. When the tens-of-minutes drum only is rotated, the inertia of the drum must be first overcome, and as soon as this inertia is overcome the speed of rotation of the drum will increase. To check this increase of speed is the object of my governor. When the yoke is drawn back so that the pawl I will drop into one of the notches G in the drum and the cam N releases the yoke, the drum will start to turn, and as the pin U is behind the inclined face of the bar T the governor will be carried along with the drum. When the yoke is drawn back so that the pawl drops into the notch, the weight W is preferably hanging directly below the axis of the governor, so that it will be raised only very slightly when the drum and governor start to move because of the inertia of the drum, which must be overcome. When the inertia of the drum is overcome, however, the speed of rotation will increase; but at the same time the weight W will exert more and more of a retarding influence on the drum as the arm X is raised more and more toward a horizontal position. This will considerably retard the speed of the drum. At the same time the weight of the arm E^2 will drop downward, lessening the influence of the weight upon the drum and decreasing the power applied to it.

I will now speak of the operation of my device when two or more drums are actuated by the yoke.

Suppose the yoke is now at the backward limit of its motion and the controller normally at rest on the stop V, with the pin U behind the bar T, with the count-pawl J about to enter its count-notch. It will be seen that as soon as the yoke is released by the sudden falling off of the pin K from one of the cams N N the controller will at first be moved slightly forward, as usual; but instantly the count-pawl J passes to the bottom of its notch H and its pin U drops below the bar T it will be free from the bar T, and instantly the controller will drop back again to its normal position against its stop V, while the yoke will continue to rotate in its forward direction, exerting in this case its entire effective force in rotating two or three drums, as the case may be. Upon the next return of the yoke to its starting-point the pin U will automatically resume its position behind the bar T ready to engage the controller and be governed or controlled thereby throughout the next nine successive changes of the units-of-minutes drum or until the other drum or drums are engaged, as above described. I consider it sufficient to show in this instance my governing device as operatively effecting or limiting the motion of the first drum; but it is my purpose in manufacturing large time-pieces of this character to employ two weights, as W, both of which shall offer resistance to the units-of-minutes drum and only one to be utilized when the units-of-minutes drum and the tens-of-minutes drum are carried forward together, thus securing greater uniformity in the rotation of the drums at every movement of the same. This might be done by substantially duplicating this controller and arranging it on the other end of the shaft E and adapting it to engage the yoke when the count-pawl J′ falls within one of its count-notches on the tens-of-minutes drum, the resistance of each being modified or adapted according to the changed conditions, or, still further, the present governor might be provided with two weights or varying centers of gravity, so as to be properly compensated with reference to the drums and controlled in connection with their rotation.

a is a spring-stop suitably secured to the frame and is formed, preferably, of a flat piece of steel having its outer end *b* curved downwardly and upwardly, as shown. *c* is another piece of spring-steel secured to the same and having its outer end shaped so as to form, in connection with the spring *b*, a yielding shoulder *c′* to receive and gradually

check the yoke by engagement with its top bar. By this means rebound of the yoke is lessened and noise largely overcome. The tendency to rebound is still further overcome by the curving of the outer end *b*, as referred to and shown, the upward curve causing the yoke to lift the spring upon entering the recess and the downward curve forming a partial locking of the yoke against a sudden recoil.

d d are two arms secured to the seconds-shaft *e* and adapted to frictionally engage the spring *d'* and offer resistance to the shaft while the pin K is passing from the highest point of each cam to the lowest. This prevents the ratchet mechanism from imparting undue motion to the seconds-wheel at this point while the cams are disengaged. It also enables me to dispense with the checking mechanism on the ratchet-wheel, as shown in a former application.

The idle pawl *j* is weighted against the wheel, as shown, and provided with an inclined end *h*, which falls gradually over the ends of the teeth of the wheel, and thus prevents backlash and noise when the device is in operation and permits at the same time the backward setting of the seconds-hand when desired, owing to its inclined end *h*.

i is a pendulum provided with the usual flat steel suspension-spring *i'*.

k k are steadying-arms secured to the upper end of the rod and arranged to normally almost touch a guard-piece *l* and when a sudden impulse is given to the pendulum to bear instantly against the guard-piece and prevent abnormal yielding of the spring *i'* in the direction of the impulse, and also serve to steady the pendulum at all times when unduly affected by handling or otherwise.

As a means of guarding against undue vibration, particularly in starting the pendulum, I have arranged the chains *m m*, together with the bars *o o'*. The chains are adapted to conform substantially to the cylindrical or other shape of the pendulum-ball, and the slight elasticity of the chain modifies the sudden stop and also checks a lateral vibration. The bars *o o'* are intended to act merely as guards to prevent the pendulum swinging slightly in either direction if it be given a sudden blow, and chains *m m* are to prevent the pendulum swinging in its proper direction, but with too great an arc of vibration.

To hold the pendulum positively at rest when handling the device, I use the pivoted arms *n n* by moving them to the fixed position, as shown in Fig. 8. These arms and the bar O bear against the pendulum-ball on three sides, and thus practically inclose it as completely as if in a cylindrical bearing, and the arms when returned to their normal position on the bar O' are out of the way, taking up the least possible room.

To the pendulum is attached, preferably, a chain *p*, connecting it with an armature-lever *q*, by means of which the impulse to the pendulum is given by the electromagnet *r*. The "armature-lever," as I term it, I have constructed in the present instance by securing an extension-piece directly to the armature *s* of the magnet; but both might be made in one piece, or an independent lever actuated by the magnet and connected by a chain with the pendulum might be used. The armature-lever is normally drawn toward the poles of the magnet by the retraction-spring *u* and at the extreme of the vibration in this direction is at rest for an instant in its nearest approach to the magnet, the chain having slackened; but the next returning movement of the pendulum forthwith causes tension of the chain and the armature-lever is drawn back. Thus the reciprocation of the armature or armature-lever is caused by the vibrations of the pendulum and in equal times therewith, although the pendulum is at all times free to vibrate and the armature is stopped in each of its alternate vibrations. With this arrangement I am able to impart intermittently or even constantly an impulse to the pendulum through an impulse-lever vibrating with the pendulum, substantially as shown, and to employ the vibrating of the pendulum to operate the contact mechanism either at each alternate vibration or, preferably, at intermittent alternate vibrations, to be determined by the decrease in length of the arc of vibration of the pendulum.

The contact mechanism is as follows: When the device is in operation, a trip-dog *v*, hanging loosely on a stud *w* on the pendulum-rod, is drawn freely in either direction across the laterally-extending pin *x* as the pendulum continues its vibrations until the swinging of the pendulum has fallen off to a predetermined point, when at the next return movement of the pendulum in the direction of the magnet the lower end of the trip-dog having failed to pass wholly over the pin *x* lodges, owing to its V shape, upon the pin and causes the rocker-plate *y* to turn upon its axis and the contact-pin 1 to engage the contact-wiper 2, suitably secured to an insulated piece, and close and hold the electric circuit until the pendulum has ceased to be actuated by the tension of the chain and force of the magnet and has borne the trip-dog *v* again beyond and out of engagement with the pin *x* and allowed the rocker-plate and pin to return to the normal position and break the electric circuit. I have not shown the wiring of some of the parts because the connections would be obvious to any electrician or to any one skilled in this art. The return of the rocker-plate permits the contact-wiper to fall silently upon its cushion 2', while the chain *t* forms a silent stop for the rocker-plate. In the meantime the effective force of the magnet upon the pendulum has been exerted to increase its swing and the next contact in a similar manner cannot take place until the amplitude of the vibrations have shortened to the same point as before. The armature

s is provided with a pawl 3. This pawl rests against the top of a guard 5, which extends just above the teeth in the wheel 4, so as to expose one tooth of the same to the pawl. As the armature and pawl are reciprocated the pawl will slide along the top of the cord, and no matter how far it is reciprocated it will only engage one tooth in the wheel and can therefore only rotate the toothed wheel a distance of one tooth at each reciprocation.

The armature of the magnet is arranged, preferably, to extend upward, as shown, and is disposed with its axis—that is, the pivot on which it turns—substantially concentric with the axis of the seconds-arbor and in a vertical plane passing through the center of oscillation of the pendulum. This facilitates the use of the armature for carrying the actuating-pawl of the seconds-wheel while vibrating in common with the pendulum.

Secured, preferably, to one of the posts C is a sliding insulated bar 6, provided with binding posts or screws 7 7, to which the electric wires within the movement are fastened, each of these binding posts or screws being provided with metallic ear-pieces or projections 8 8.

Secured to the inside of the case are springs 9 9, provided also, respectively, with binding-screws, to which a battery 10, located, preferably, within the base of the case, is connected. To close the circuit, the sliding bar 6 is moved upward by means of the lug 11 or in the opposite direction to break it. When removing the works from the case, the bar becomes disengaged and falls to its lowest position, thereby preventing interference of the parts when the movement is returned to the case.

The arrangement of the figures on the drums and the changes as effected in showing the hours and minutes, and the graduations and pointers of the seconds arc or dial, together with the perforated plates or mats, arranged in front of the drums and seconds-dial, respectively, have been referred to by me in a former application. I have, however, in this device provided the door of the case with a new combination and arrangement of mats to be disposed in front of my time-indicating mechanism when the door is closed and being adapted when the door is opened to expose to view essential portions of my device. This arrangement I will now describe.

q' is a rectangular removable border mat inserted against the rear of the glass in the door, which may be gilded or otherwise finished to embellish the face of my timepiece, and disposed in the rear of the same is a second mat, provided, preferably, with hinges, as Q, by which it is secured to the inside of the door, as shown in Fig. 3, having openings corresponding substantially to the marginal outlines of the mats 13 and 14, secured to the movement. This arrangement facilitates the inspection of the works and at the same time the cleaning of the glass door by first opening this mat on its hinges and then temporarily removing the border mat 12.

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

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

1. In a time-indicating device in combination a pivoted drum, a reciprocating pawl engaging therewith to intermittently rotate the same, a second pivoted drum, automatic means to connect said drums together at a certain point in a revolution of said first drum so that both drums will then rotate together, a governor to regulate the speed of rotation of said first drum, and automatic means to disconnect said governor from said first drum when said two drums are connected together.

2. In a time-indicating device in combination a pivoted drum, a ratchet on said drum and a reciprocating pawl engaging therewith to intermittently rotate the same, a second pivoted drum, automatic means to connect said drums together at a certain point in the revolution of said first drum so that both drums will then rotate together, a governor to regulate the speed of rotation of said first drum consisting of a weight on a pivot-arm and automatic means to disconnect said governor from said first drum when said two drums are connected together.

3. In a time-indicating device in combination a pivoted drum, a ratchet on said drum and a reciprocating pawl engaging therewith to intermittently rotate the same, a second pivoted drum, automatic means to connect said drums together at a certain point in the revolution of said first drum so that both drums will then rotate together, a governor to regulate the speed of rotation of said first drum consisting of a weight on a pivoted arm adapted to be raised to approach a horizontal position to increase the retarding effect of said governor on said drum as said drum continues to move, and automatic means to disconnect said governor from said first drum when said two drums are connected together.

4. In a time-indicating device in combination a pivoted drum, a ratchet on said drum, and a reciprocating pawl engaging therewith to intermittently rotate the same, a second pivoted drum, automatic means, embracing a ratchet on said second drum and a second reciprocating pawl engaging therewith and a count-pawl to hold said second reciprocating pawl out of engagement with the ratchet on said second drum, to connect said drums together at a certain point in the revolution of said first drum so that both drums will then rotate together, a governor to regulate the speed of rotation of said first drum and automatic means to disconnect said governor from said first drum when said two drums are connected together.

5. In a time-indicating device in combina-

tion a pivoted drum, a reciprocating pawl to intermittently rotate the same, a second pivoted drum, automatic means to connect said drums together at a certain point in the revolution of said first drum so that both drums will then rotate together, a carrier for said reciprocating pawl, said carrier provided with an arm having a weight thereon adapted to fall and decrease its influence upon said pawl, a governor to regulate the speed of rotation of said first drum, consisting of a weight on a pivoted arm adapted to be raised to approach a horizontal position to increase the retarding effect of said governor on said drum as said drum continues to move, and automatic means to disconnect said governor from said first drum when said two drums are connected together.

6. In a time-indicating device in combination a rotatable drum, a reciprocating pawl adapted to intermittently rotate the same, a governor therefor embracing a two-armed pivoted lever, a weight on one arm of the same and means to automatically connect the other arm with said drum so as to raise said weight on the movement of said drum.

7. In a time-indicating device in combination, a rotatable time-indicator, a series of stops connected with the same, a reciprocating pawl adapted to engage with said stops and intermittently rotate said time-indicator, a governor therefor embracing a pivoted lever, a weight on said lever, and means to automatically connect said lever with said rotatable time-indicator so that said weight will be raised on the rotation of said indicator.

8. In a time-indicating device in combination, a movable time-indicator, a ratchet connected with the same, a reciprocating pawl engaging therewith to move said time-indicator, a cam connected with said pawl to move said pawl in one direction and release the same and allow it to return in the other direction, a spring-brake and a projection connected with said cam and rotating simultaneously therewith and adapted to come in contact with said spring when said cam has released said pawl to prevent abnormal forward movement of said cam when the retarding influence of the pawl has been removed therefrom.

9. In a time-indicating device in combination, a swinging pendulum, a clock-movement, a normally-open electric circuit, an electromagnet in said circuit, a movable armature for said magnet, a connection between said armature and pendulum whereby said armature is moved in one direction by said pendulum, automatic means independent of said pendulum to move said armature in the other direction while said circuit is still open, a ratchet forming part of said clock-movement, a pivoted pawl reciprocated by the movement of said armature and engaging said ratchet to operate said clock-movement when said armature is moved by said independent automatic means, a switch in said circuit, a pivoted trip operated by said pendulum to automatically close said switch and circuit when the length of the arc of vibration of said pendulum decreases to a certain point, thereby energizing said magnet, moving said armature, and transmitting energy from said magnet to said pendulum to increase the length of its arc of vibration.

10. In a time-indicating device in combination, a swinging pendulum, a clock-movement, a normally-open electric circuit, an electromagnet in said circuit having a pair of poles, a movable armature for said magnet adapted to be moved by said magnet in a plane in which said magnet-poles are located, a connection between said armature and pendulum whereby said armature is moved in one direction by said pendulum, automatic means to move said armature in the other direction while said circuit is still open, a ratchet forming part of said clock-movement, a pivoted pawl reciprocated by the movement of said armature and engaging said ratchet to operate said clock-movement when said armature is moved by said automatic means, a switch in said circuit and a pivoted trip operated by said pendulum to automatically close said switch and circuit when the length of the arc of vibration of said pendulum decreases to a certain point, thereby energizing said magnet, moving said armature, and transmitting energy from said magnet to said pendulum to increase the length of its arc of vibration.

Signed at New Haven, in the county of New Haven and State of Connecticut, this 23d day of June, A. D. 1898.

SAMUEL P. THRASHER.

Witnesses:
JAMES BISHOP,
S. E. LEDYARD.