No. 617,852. Patented Jan. 17, 1899.

# A. R. COLBURN.

## BALANCE ESCAPEMENT.

(Application filed Mar. 15, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

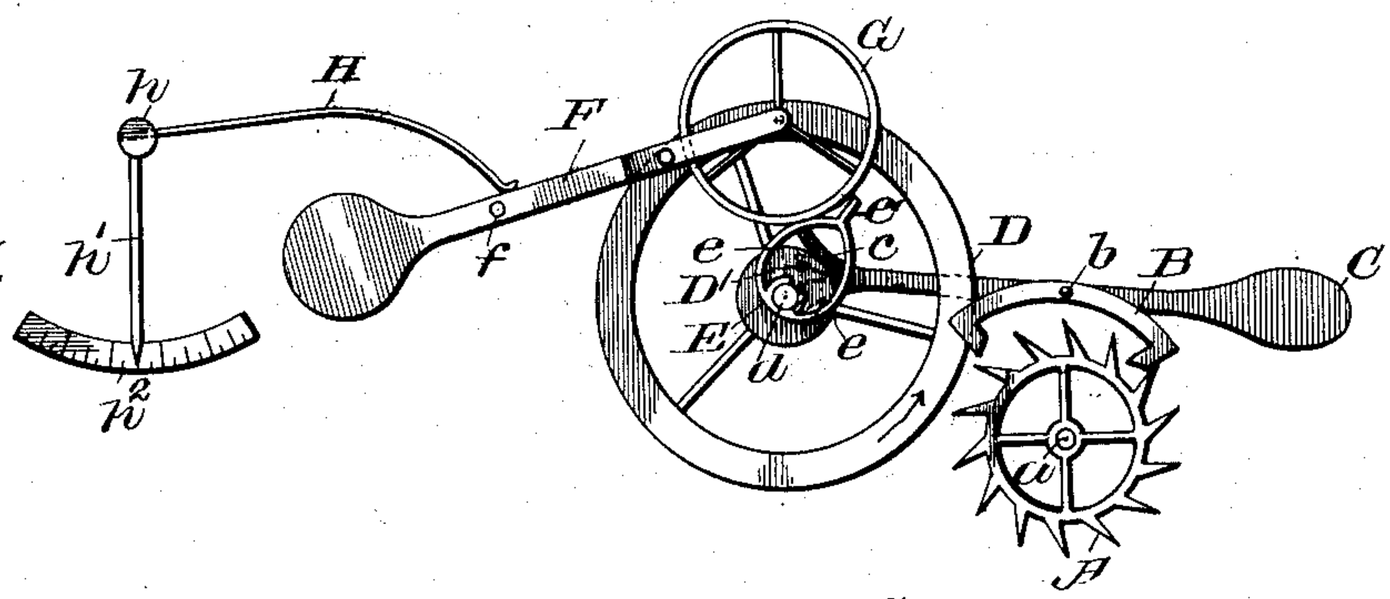



Fig. 2.

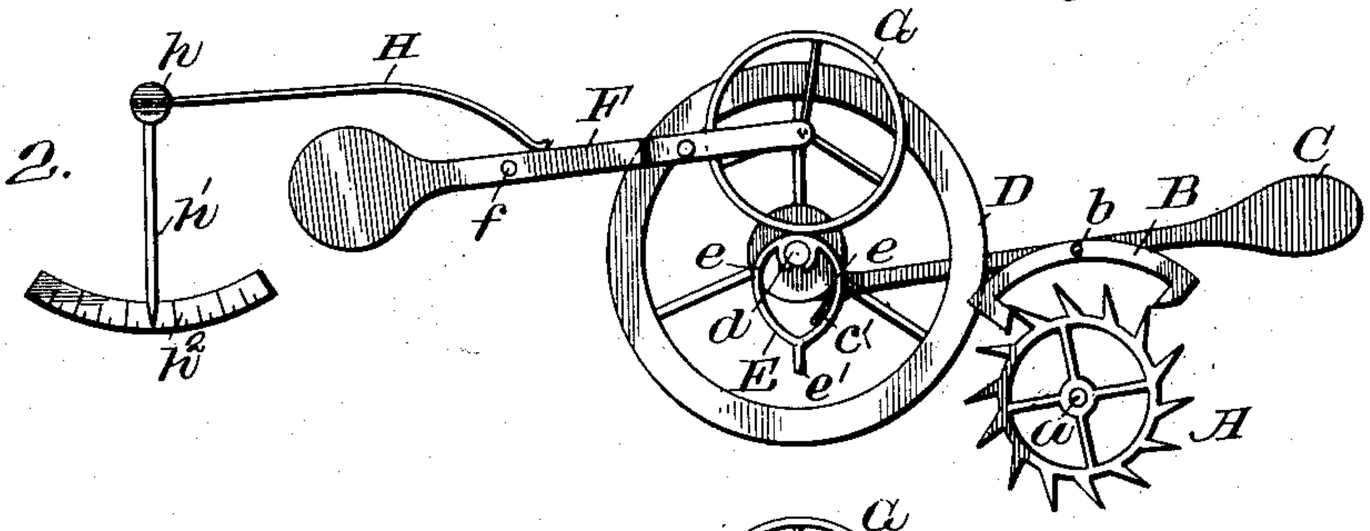



Fig. 3.

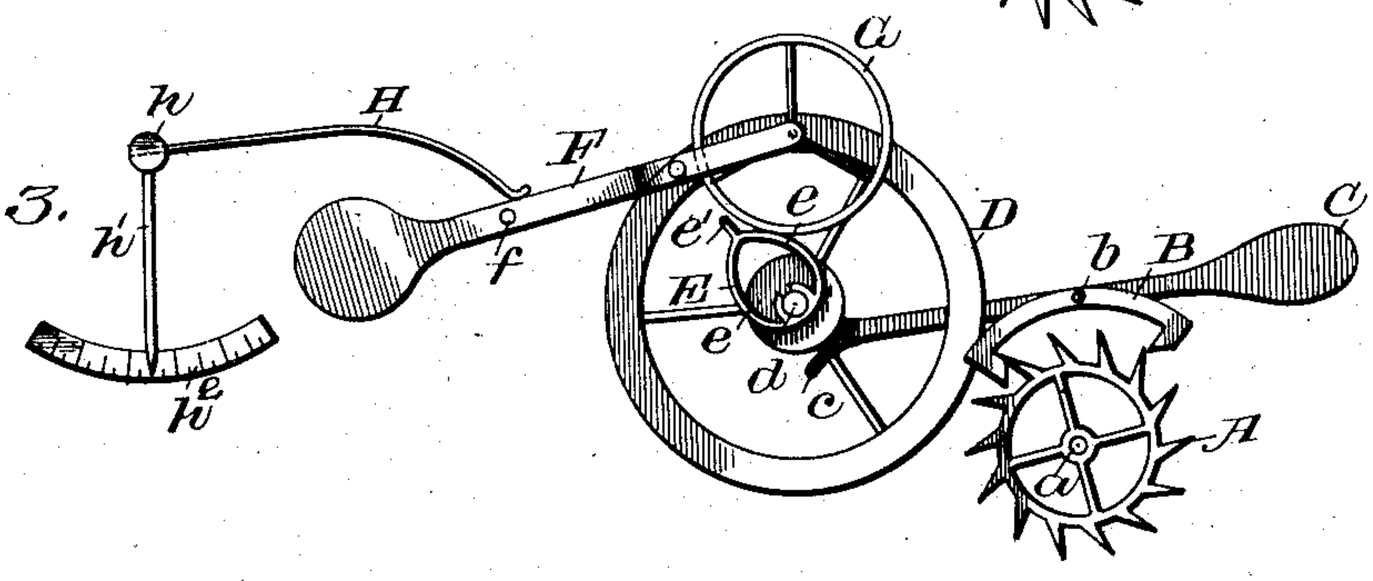



Fig. 4.

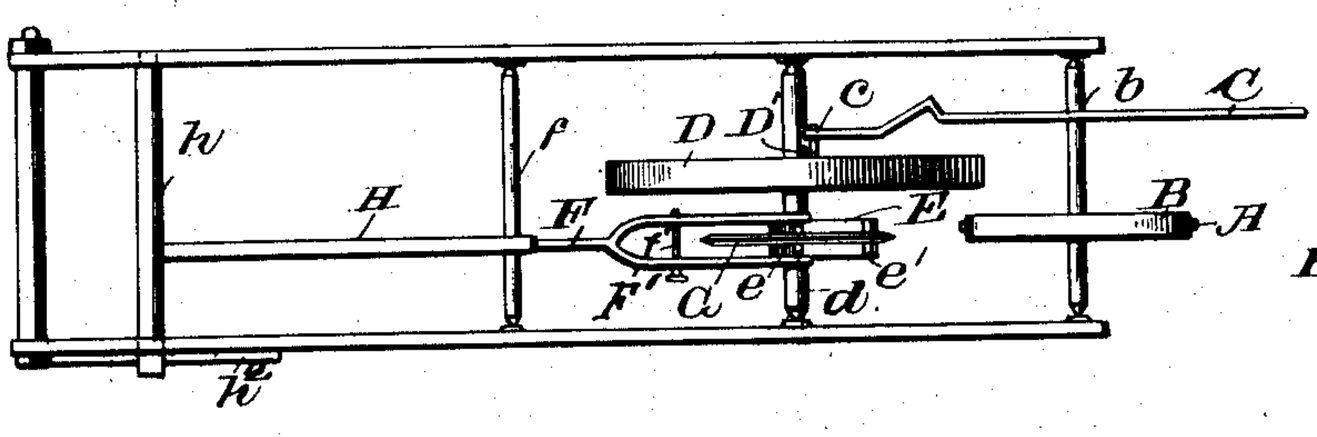
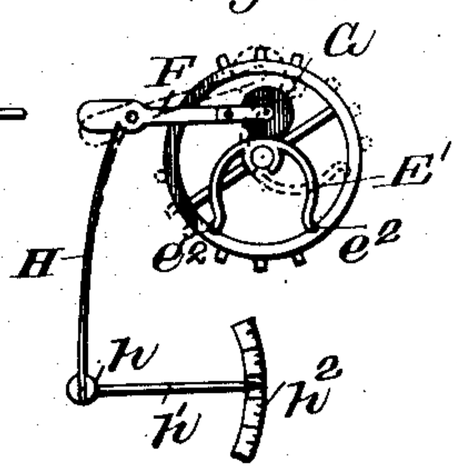



Fig. 5.




WITNESSES

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## BALANCE ESCAPEMENT.

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(No Model.) 2 Sheets—Sheet 2.

Fig. 6.

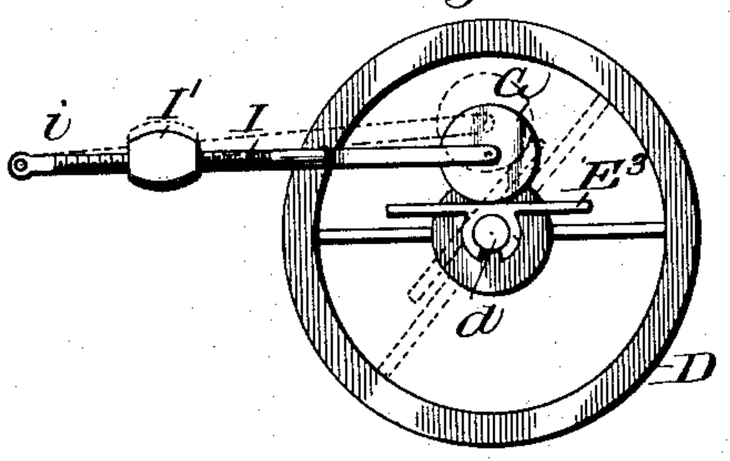



Fig. 7.

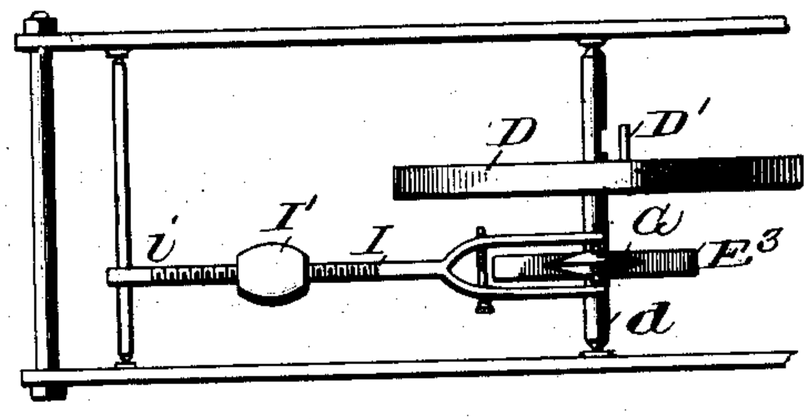



Fig. 8.

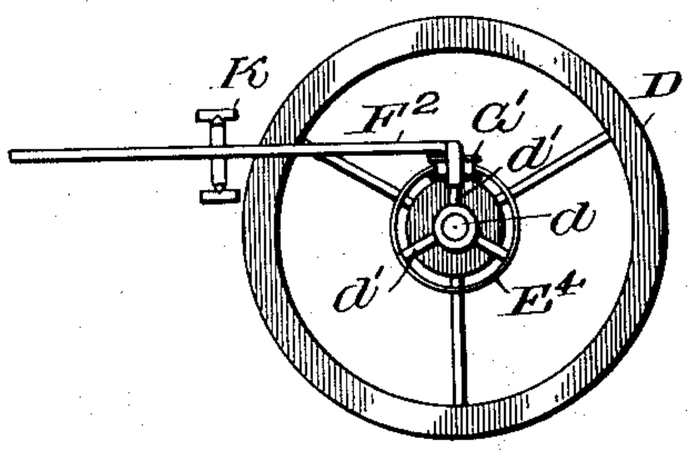



Fig. 9.

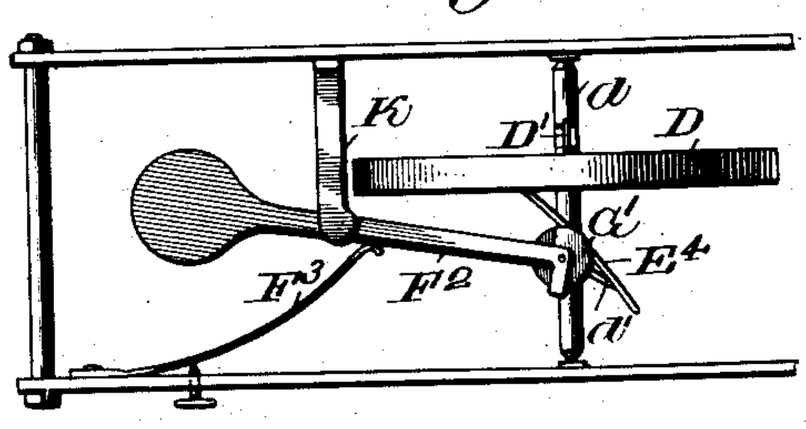
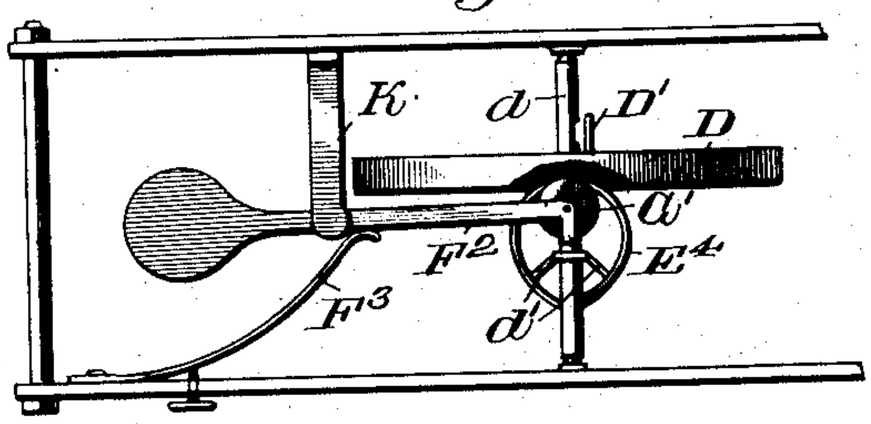



Fig. 10.



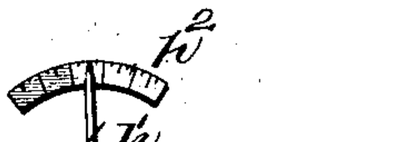




Fig. 11.

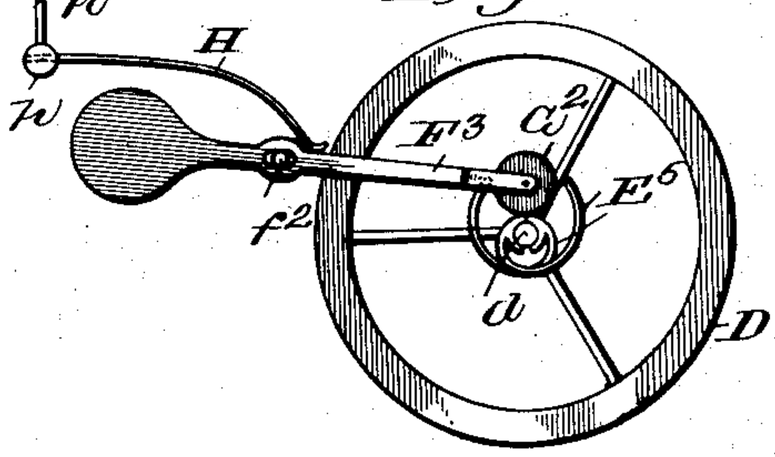
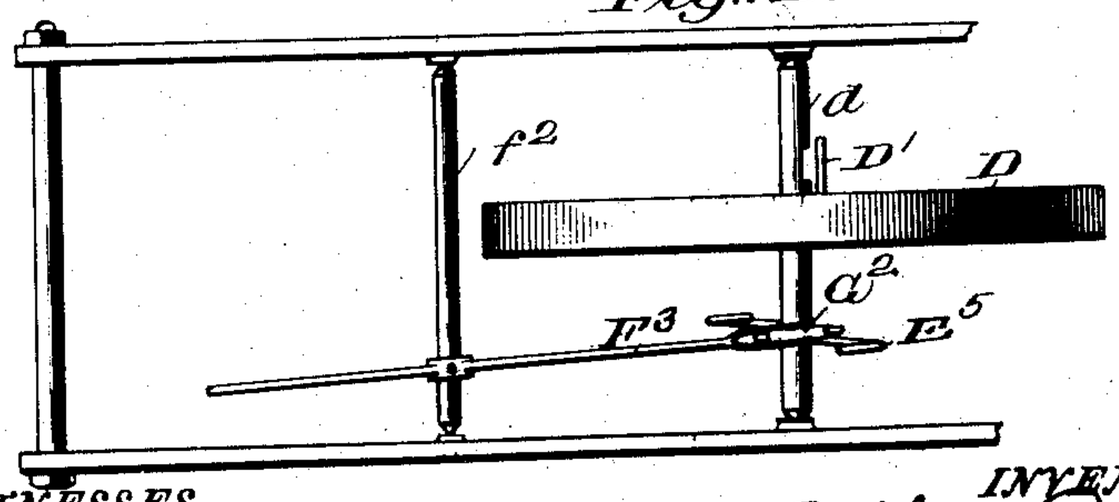



Fig. 12.

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# UNITED STATES PATENT OFFICE.

ARTHUR R. COLBURN, OF WASHINGTON, DISTRICT OF COLUMBIA.

## BALANCE-ESCAPEMENT.

SPECIFICATION forming part of Letters Patent No. 617,852, dated January 17, 1899.

Application filed March 15, 1898. Serial No. 673,933. (No model.)

*To all whom it may concern:*

Be it known that I, ARTHUR R. COLBURN, of Washington, in the District of Columbia, have invented certain new and useful Improvements in Governing and Regulating Mechanisms for Clocks, &c.; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

This invention is an improvement in the governing and regulating mechanism of clocks, watches, &c.; and its object is to provide an efficient substitute for hair-springs which will insure a perfectly isochronous movement of the escapement mechanism, will be susceptible of the nicest adjustment, so that the beats may be made to occur at any interval desired between very fast and very slow, thus enabling the timepiece to be perfectly regulated, and which is free from delicate or complicated mechanism.

The invention is also applicable for controlling the escapement mechanism of any machinery, and I do not intend to limit myself to timepieces.

The essentials of the invention are summarized in the claims appended to the following description, and in the accompanying drawings I have illustrated various mechanisms embodying my invention, which are described hereinafter with reference to the accompanying drawings in which—

Figures 1, 2, and 3 are detail side elevations of an improved escapement controlling and regulating mechanism especially adapted for clocks or watches, the several figures indicating the different positions of the parts in one beat of the balance-wheel. Fig. 4 is a top plan view of the mechanism shown in Figs. 1 to 3 in a conventional frame. Fig. 5 is a side view of a modification of the device more especially adapted for watch-movements. Figs. 6 and 7 are respectively side and top views of a modification of the device especially designed for clocks or stationary mechanisms. Fig. 8 is a side view, and Figs. 9 and 10 are top views, of another modification of the invention. Figs. 11 and 12 are respectively side and top views of a modification of the invention by which the extent of oscillation of the balance-wheel is increased.

A designates an ordinary escape-wheel mounted on a shaft *a*, and B is the anchor, controlling the movements of said wheel, mounted upon a shaft *b*, upon which shaft is fixed the counterpoise anchor-lever C, having a fork *c* on its inner end adapted to engage a pin D′ on a balance-wheel D, fixed on a shaft *d*, as shown. This much of the mechanism is substantially like the well-known escapement mechanism of clocks and watches.

Beside balance-wheel D, either fixed thereto or, as shown, fixed to its shaft *d*, is a cam device E.

As shown in Figs. 1 to 10 of the drawings, the cam devices are of such shape that the balance-wheel will only make a partial revolution at each movement, which is all that is ordinarily necessary or desirable; but in Figs. 11 and 12 I show a modification of the cam device by which the balance-wheel is allowed to make nearly two revolutions at each movement.

The cam device shown in Figs. 1 to 4 is oval or pear-shaped, its broad end being attached to the shaft or axis of the balance-wheel and its opposite sides *e e* being similarly, but oppositely, curved on convolute lines toward the periphery of the wheel and meeting in a stem *e′*. This cam device operates in conjunction with an oscillating lever F, which is preferably equipoised upon a suitable support *f*, with one end pressing lightly upon the surface of the cam device E. In order to obviate or lessen friction between the lever and cam device, I preferably provide the inner end of the lever F with a friction roller or wheel G, which is adapted to roll upon the surface of the cam device. As shown, the inner end of lever F is bifurcated, and the shaft of roller G is made needle-pointed and engages suitable bearings in the bifurcations F′ of the lever, and a screw *f′* is tapped through the bifurcations so as to adjust the journal-bearings of roller G. The roller G is kept in contact with cam device E under more or less pressure by means of adjustable springs or weights. As shown in Fig. 1, a leaf-spring H, attached to a rock-shaft *h*, presses upon lever F, so as to hold roller G in contact with the cam device. The rock-shaft *h* may be adjusted by means of an arm *h′*, which moves over a graduated scale

$h^2$, so that the pressure of the spring can be adjusted with the greatest nicety. According to the greater or lesser pressure of the roller upon the cam device the oscillations of the balance-wheel D, and consequently of the anchor B, will be faster or slower; but the oscillations will always be equal in time, or isochronous, whether regulated to occur rapidly or slowly. Fig. 1 shows the balance-wheel at the end of a locking stroke of the anchor and ready to begin an impact stroke in the direction of the arrow. Fig. 2 shows the position of the parts at the middle of an oscillation or stroke in either direction. It also represents the position of the parts when the mechanism is in its normal position, not in operation, and unaffected by the driving power. Fig. 3 shows the position of the parts at the end of an impact stroke or beginning of a locking stroke. The shaft *a* of the escapement is of course connected to a driving mechanism—such as power springs, weights, &c.—by gearing, as usual, this driving mechanism and connection not being indicated in the drawings because not forming part of present invention and being obvious to those familiar with this class of mechanism. The stem *e'* at the outermost part of cam device E will contact with roller G and prevent too great an oscillation of the balance-wheel from any cause.

In Fig. 5 I have indicated the balance-wheel of an ordinary watch, and as shown in said figure the cam device E' has a larger spiral curve in conjunction with a smaller roller-wheel G, and the termini $e^2$ of the cam device E' are bent outward, so as to prevent undue oscillation of the balance-wheel. The roller G and lever F in this case are substantially like those already described, but the spring H presses against the outer end of lever F. The rock-shaft *h*, lever *h'*, and scale $h^2$ are also substantially the same as in Fig. 1.

In Figs. 6 and 7 the cam device is a simple plate $E^3$, fastened to the balance-wheel or its shaft and projecting diametrically and equally on both sides of the axis of the wheel. The lever F and roller G of Fig. 1 may be employed with this cam device; but instead of lever F, I have shown a lever I, fulcrumed at its outer end *i* and carrying a roller G on its inner end, which is pressed upon the cam device $E^3$. This lever I is to lie normally in a horizontal position, and it is provided with an adjustable weight-nut I', engaging a threaded part of the lever, so that the weight may be adjusted toward or from the roller, and consequently increase or diminish the pressure upon the cam device $E^3$, the weight having in this instance precisely the same function as the spring H.

It will be observed that in the normal or inactive position, as shown in Fig. 2, the point of contact between the roller-wheel G and the cam device E and the axis of the balance-wheel, roller, and cam device are all in line. As the balance-wheel oscillates said point of contact between the roller and cam device is moved away from said line and also farther away from the axis of the balance-wheel, and the greater the oscillation the greater the distance that this point of contact is so removed. This removal can be regulated as desired by the degree of curvature of said cam device and the size of the roller, and the resistance of the roller to the movement of the cam device increases proportionately to the extent of removal of the point of contact. When the balance-wheel stops at the end of one stroke, the roller tends to return the cam device to normal position, and the point of contact shifts back toward the axis of the balance-wheel and produces a like oscillation to the other side.

In Figs. 8 to 11 the cam device is shown as composed of an oval frame $E^4$, encircling the shaft *d* and secured thereto by arms *d'* in such manner that the periphery of the cam device is equidistant from the axis *d*, but inclines away from the balance-wheel. Pressing laterally against this cam device $E^4$ is a roller G' on the end of a lever $F^2$, which is pressed against the cam device and toward the balance-wheel D by means of a spring $F^3$. The lever $F^2$ can be fulcrumed in a bracket K, attached to the casing of the mechanism, as indicated in the drawings. Fig. 10 shows this cam device at its dead-center, the roller G' then pressing against that part of the cam device nearest the wheel D. Fig. 9 shows the parts after the balance-wheel has made a half stroke to the left, and it will be observed that the roller G' has been moved laterally away from the face of the balance-wheel, thereby tensioning the spring, and this roller pressing against the cam device will tend to return the balance-wheel to its normal position. The operation of this device will be readily understood from the drawings and is the same in principle as those already described.

In Figs. 11 and 12 is shown another form of cam device, which in this case consists of a double convolute curved wire strip $E^5$, attached at its center to the shaft *d* and its extremities then bent in opposite directions in convolute spirals, the cam device extending almost entirely twice around the shaft. Upon this cam device $E^5$ presses a roller $G^2$, pivoted on the end of a lever $F^3$, which is pivoted on the rock-shaft $f^2$ in such manner as to allow the roller $G^2$ to move laterally and follow the sinuosities of the cam device. The operation of this mechanism is substantially like that shown in the other figures; but the balance-wheel D in this case will make almost two revolutions to each beat while the roller G is traveling from one extremity of the cam device to the other.

It is obvious that various other modifications may be made in the invention, and therefore I do not limit myself to the particular form herein shown and described except as referred to in the claims.

When the balance-wheel oscillates, the cam device is moved against the resistance of the lever F, which resistance increases in proportion to the extent of oscillation of the balance-wheel, and when the balance-wheel stops the lever and cam device tend to force it back until the roller reaches the center of the cam device; but the momentum of the balance-wheel, augmented by the power applied to shaft *a*, causes the balance-wheel to oscillate so far in both directions as to move the cam device past its dead-center, thus causing the roller to first descend or move inward upon the cam device toward the axis of the balance-wheel and then to move outward upon the cam device, thus proportionately increasing the resistance to the oscillation of the wheel. Thus the cam device and lever alternately tend to impel and to retard the motion of the balance-wheel and act substantially on the same principle and for the same purpose as do the hair-springs of watch-movements.

The several cam devices shown in the drawings are merely various developments of the same idea, the termini of each cam device being equidistant from the axis of the balance-wheel and each part thereof similarly but oppositely and symmetrically formed.

Fig. 6 shows the cam device as perfectly straight. Fig. 5 shows the cam device somewhat curved, and Fig. 1 shows a still greater curvature of the cam device. I do not consider my invention limited to any precise form of the cam device, but each must have the essential feature or effect, to wit, that the surface of the cam device upon which the roller G runs must be such that when the balance-wheel oscillates the roller G is caused to move to and from the axis of the balance-wheel. The shape of the cam device would therefore be determined by the desired extent of oscillation of the balance-wheel, the size of the roller-wheel, the weight of the balance-wheel, the power which the escapement is to control, and the pressure of the levers against the cam device.

The journals of all the shafts and wheels are shown needle-pointed, and in any case they should be such as will produce the least friction in the movements of the parts.

The advantages of this construction are the isochronous oscillations of the balance-wheel, the extreme nicety with which the number of oscillations of the balance-wheel in a given time can be regulated, the non-susceptibility of the parts to disarrangement by magnetism or variations of temperature or from shocks or jars, its simplicity of construction, and its adaptability to various timepieces.

The regulating mechanism—to wit, the oscillating balance wheel or shaft, the cam device, and pressure-lever—may also be useful in other machines to insure isochronous movements of parts.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In regulating and governing mechanisms substantially as described, the combination of a balance wheel or shaft, with a cam device fixedly connected to said wheel and a pressure device bearing upon said cam device to regulate the oscillations thereof, for the purpose and substantially as described.

2. The combination with the balance-wheel and its oscillating shaft of an escapement mechanism, of a cam device fixedly connected to said shaft, and a presser engaging said cam device, substantially as described.

3. The combination of the escape-wheel, the anchor, the anchor-lever and balance-wheel; with a cam device fixedly connected to said balance-wheel, and a pressure device engaging said cam device, substantially as and for the purpose described.

4. The combination with the balance-wheel or like part, of an escapement mechanism, of a cam device connected to said wheel, a pivoted lever bearing upon the cam device, and means for adjusting the pressure of the lever upon the cam device.

5. The combination with the oscillating balance-wheel of an escapement mechanism, of the cam device connected to said balance-wheel shaft, a pivoted lever having a roller on its end bearing upon said cam device, and means for adjusting the pressure of the lever upon the cam device, substantially as described.

6. The combination in an escapement mechanism, of the escape-wheel, anchor, anchor-lever, and the oscillating device engaging the anchor-lever; with a cam device connected to said device, and a pressure device bearing upon said cam device.

7. The combination in an escapement mechanism, of the escape-wheel, the anchor, its lever, and the balance-wheel and oscillating shaft for moving the escapement-lever; with a cam device upon said shaft, a pivoted lever engaging said cam device, and means for regulating the pressure of the lever upon said cam device.

8. In an escapement mechanism, the combination of the escape-wheel, the anchor, an anchor-lever, and a balance-wheel and pin for oscillating said lever; with a cam device attached to said balance-wheel, a pivoted lever bearing upon said cam device, and means substantially as described for adjusting the pressure of said lever upon the cam device.

9. In an escapement mechanism, the combination of the escape-wheel, the anchor, an anchor-lever and a balance-wheel and pin for oscillating said anchor-lever; with a cam device attached to said balance-wheel, a pivoted lever having a roller on its inner end bearing upon said cam device, and means substantially as described for adjusting the pressure of said lever and its roller upon the cam device.

10. The combination of the escape-wheel, its anchor, the anchor-lever and the oscillating pin and wheel for operating said an-

chor-lever; with the cam device connected to said balance-wheel, said cam device having its central or inner portion attached to the shaft or axis of the wheel and opposite portions extending equally and similarly from said shaft; and a pivoted lever bearing upon said cam device, and means for adjusting the pressure of said lever upon said cam device, for the purpose and substantially as described.

11. The combination of the escape-wheel, its anchor, the anchor-lever, the oscillating pin and balance-wheel for operating said anchor-lever; and the cam device connected to said balance-wheel having its central or inner portion at the axis of the wheel and its opposite portions extending equally and similarly from said axis; with a pivoted lever having a bifurcated end, a roller journaled in the bifurcated end of said lever and bearing upon said cam device, and the adjustable spring pressing upon said lever, for the purpose and substantially as described.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

ARTHUR R. COLBURN.

In presence of—

JAMES R. MANSFIELD,

AUTHUR E. DONLEY.