(No Model.)

J. W. NUNAMAKER.

WATCH.

No. 517,882. Patented Apr. 10, 1894.

Fig 2

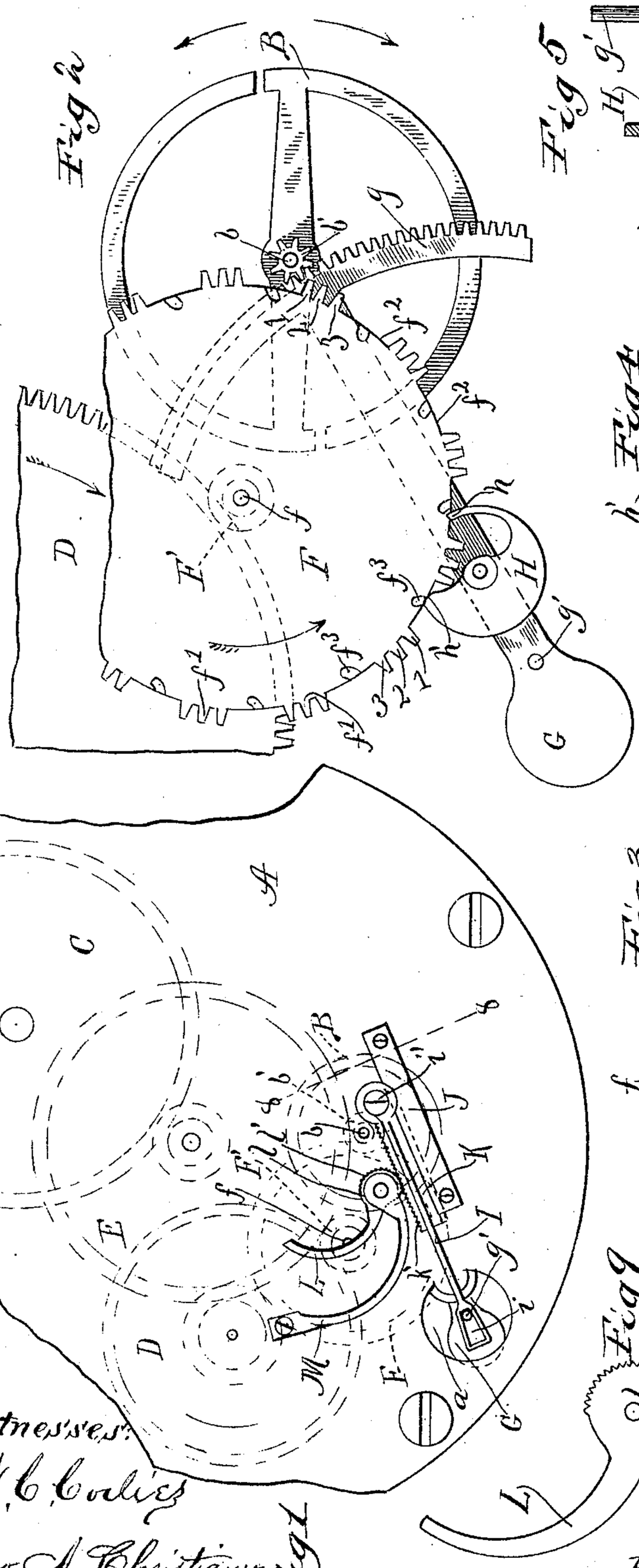

Fig 5

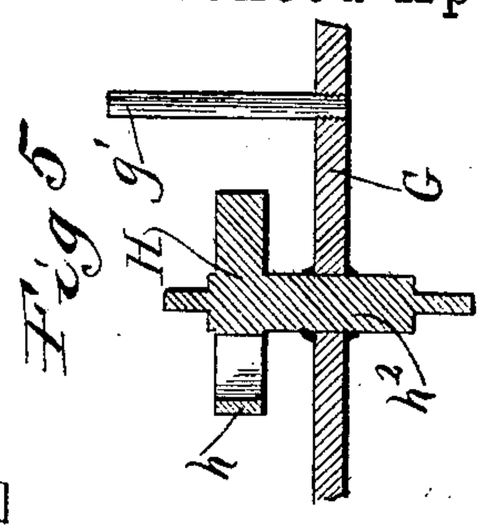

Fig 8

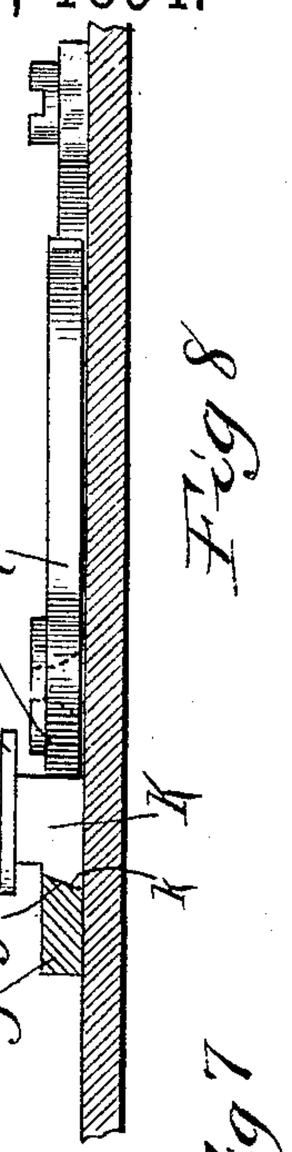

Fig 4

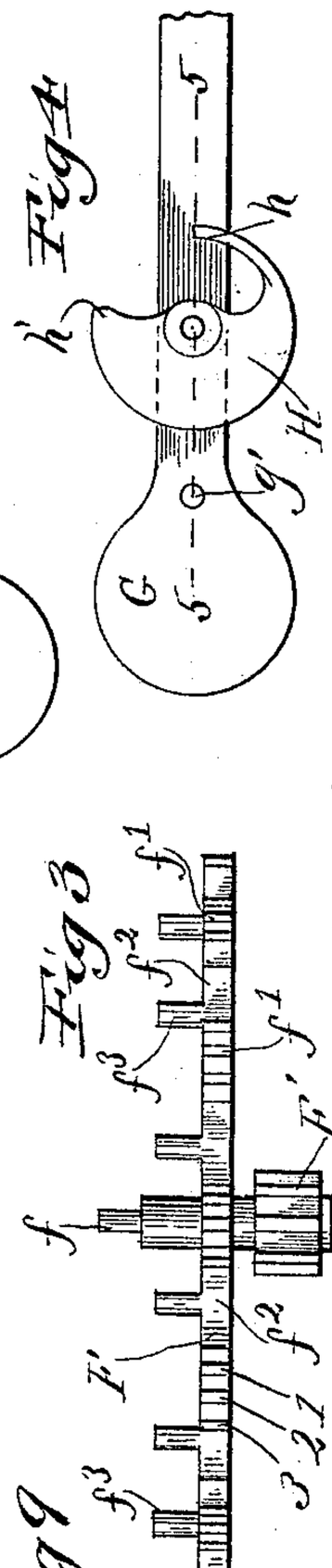

Fig 3

Fig 6

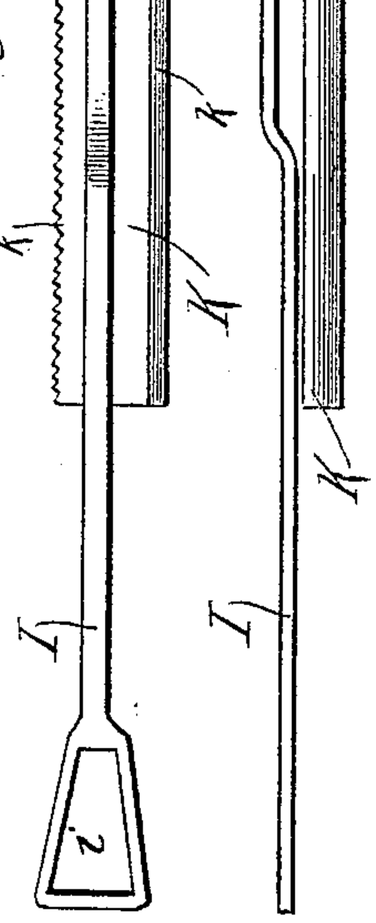

Fig 7

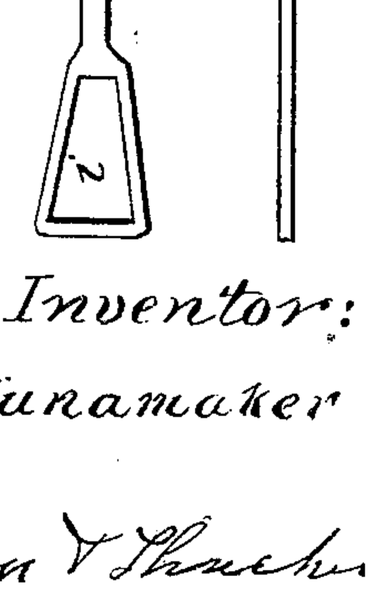

Fig 9

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UNITED STATES PATENT OFFICE.

JOHN W. NUNAMAKER, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-FOURTH TO HARVEY L. HOPKINS, OF SAME PLACE.

WATCH.

SPECIFICATION forming part of Letters Patent No. 517,882, dated April 10, 1894.

Application filed June 20, 1893. Serial No. 478,224. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. NUNAMAKER, 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 Watches, which are fully set forth in the following specification, reference being had to the accompanying drawings, in which—

Figure 1 represents a plan view of the back plate of a watch movement, partly broken away, and with parts connected therewith embodying my invention; Fig. 2, a detail plan of the same with the back plate removed; Fig. 3, an elevation of the escapement wheel; Fig. 4, a detail plan showing the pallets and the end of the rack lever on which they are mounted; Fig. 5, a section of the same taken on the line 5. 5 of Fig. 4; Fig. 6, a detail plan of the rack spring; Fig. 7, an elevation of the same; Fig. 8, a detail section taken on the line 8. 8 of Fig. 1; and Fig. 9, a detail plan of the regulator lever.

In the drawings, Fig. 1 is upon a scale by itself; all the remaining figures are upon the same scale but considerably enlarged from that of Fig. 1.

My invention relates to watches provided with an escapement of the general type known as a "lever-escapement."

The object of the invention is to dispense with the balance spring usually employed with this device and apply the power directly to the balance by an escapement wheel engaging directly with the pinion of the balance wheel.

In the drawings, A represents the back plate of a watch movement, and B, a balance, or balance-wheel, of any ordinary construction, having its arbor, *b*, mounted in the movement plates in the usual way. This balance has no spring, as usual, the ordinary hair-spring being entirely dispensed with. It is, however, provided with a small pinion, *b'*, fixed on the arbor just below the wheel.

The usual main-spring barrel, C, is employed and is connected by train gears, D and E, with a wheel, F, which is fixed on an arbor, *f*, carrying also a pinion, F', with which the train gear, D, engages, thereby connecting this wheel, F, directly with the main-spring gear so that the force of the main spring is conveyed directly to the wheel, F, to impart a rotatory movement thereto. This wheel, F, is the escapement wheel and is of peculiar construction; on its edge or periphery it is provided with cogs or teeth, *f'*, which, however, instead of extending continuously around the periphery of the wheel, are arranged in groups of three with an open or vacant space, f^2, on the wheel periphery between adjacent groups. For convenience in explanation, the teeth of the respective groups are marked in the drawings 1, 2, 3, and as seen in Fig. 2 the length of each open space between the teeth groups is somewhat greater than the space covered by a single group of teeth. This wheel, F, is arranged so that these teeth will engage with the pinion on the arbor of the balance. The wheel is also provided with a series of pins, f^3, mounted on the upper or outer face of the wheel and at its extreme edge, one pin being arranged in each open space between the teeth groups and about the center thereof. These pins are escapement pins or teeth, for they are adapted and intended to be engaged by the pallets; they are shaped according to the form of the pallets used, and in the drawings are shown slightly bent or curved to adapt them to a circular form of pallet.

The escapement lever, G, is, in a general way, of ordinary construction, and at its inner end it carries a segmental rack, *g*, the teeth of which engage with the balance pinion. The anchor, H, is secured to this lever and carries the pallets, *h*—*h'*. In the special construction shown in the drawings, the anchor is fastened to or is in one piece with a post or stem, h^2, which passes through the lever near its outer end, and is fixed therein. This post is journaled at each end in the respective plates so that it becomes the arbor of the lever and, of course, the anchor also, which is fastened to the lever. The anchor, as here shown, is a circular disk, which is cut out on the side next to the escapement wheel and in such a way as to make one of the pallets, *h*, a long circular finger lying in the circumference of the anchor, and adapted to engage the escapement pins or teeth on the front side thereof which is curved as al-

ready stated, this curve being approximately the same as that of the said pallet. The other pallet, *h'*, is merely a kind of blunt point formed by a front face about on a radius of the disk and an outer face on the circumference of the latter, as seen in Fig. 4. A long, straight spring, I, is secured at its inner end to the back plate and extended thence outward over the escapement lever nearly to the outer edge of the plate. At its outer end, which is free, it is provided with an elongated loop, *i*, which is preferably tapered slightly from the outer to the inner end, as seen in Fig. 6. A pin, *g'*, is secured to the lever near its outer end and outside of the anchor, and is arranged to pass up into this slot in the outer end of the spring, as seen in Fig. 1, the plate, A, being cut away to provide an opening, *a*, at this point, which accommodates this arrangement of the pin. The spring is free from the point of its attachment to the plate, as seen in Fig. 7, and so its full elastic force is available. It is obvious that this spring, owing to its connection to the lever described above, will exercise a controlling influence upon the vibrations of the latter, which will be more particularly explained presently. It is also obvious that the length of vibration will depend upon the length of the spring between its fixed point and the contact points of the lever pin in the loop. It is obvious then that the vibrations of the lever may be regulated by regulating this distance, and so it is desirable to provide some means for accomplishing this purpose. In the drawings I have shown one way of doing this, the result being obtained by mounting the spring on the end of a small sliding plate, K, the spring being secured by a screw-bolt, *i'*, to one end of this slide. The slide is provided with a bevel, *k*, on its outer edge which is adapted to fit under the inner beveled edge of a guide strip, J, which is secured to the face of the back plate and has its inner edge, *j*, beveled downward and inward so as to take over the beveled edge of the slide, as seen in Figs. 1 and 8. The inner edge of the slide is toothed or serrated so as to provide a fine rack *k'*. The movement of this slide lengthwise will evidently adjust the distance between the fixed end of the spring and the contact of the lever pin in the spring slot. The device which is shown in the drawings for effecting this adjustment is a small lever, L, constructed with a large circular head, *l*, the circumference of which is provided with teeth, *l'*, adapted to engage with the edge rack of the slide. The engagement is effected by mounting the lever by a pivotal connection to the free end of a spring, M, which is fastened at one end to the back plate and is thence carried toward the slide and bent inward along the latter, as seen in Fig. 1. The arrangement is such that the spring is brought under some tension in adjusting its free end so as to engage the toothed lever with the slide rack, as seen in Fig. 1, and this tension acts not only to keep the lever in engagement with the rack, but also to hold the slide up against its beveled guide so that it will keep its place. By this device the slide which carries the lever spring may be moved lengthwise as may be required to nicely adjust the spring with reference to its connection with the lever as already explained, and the spring support for the adjusting lever effectually holds the slide in its adjusted position.

It will be seen from the above description that, in operation, the balance wheel is driven directly by the engagement with its pinion of the teeth on the escapement wheel, and the latter being driven by a train directly from the main spring, the said main spring also is the power that gives movement to the balance wheel. The engagement of the balance pinion with the rack also imparts a lateral movement to the latter and so causes a vibration of the escapement lever on its pivot, which vibration causes the pallets to engage and disengage the teeth or pins on the escapement wheel, and thereby lock and unlock the latter. This swinging of the escapement lever will, of course, move the pin on the outer end thereof, and the latter being engaged in the slot of the straight spring will, of course, carry the outer end of the spring with it, and the tension of the spring thus produced will immediately return the lever in the opposite direction, when it is free to move by disengagement of one group of teeth on the escapement wheel from the pinion of the balance; the free spaces between the teeth groups provide for this reverse movement of the escapement lever. This long spring then may be called the lever or rack-spring, and its action is to reverse the motion of the lever and so the motion of the balance in each vibration; but it communicates no other power than this, the power being communicated directly to the balance from the main spring, as already explained. The arrangement of the driving teeth on the escapement wheel in groups instead of singly is of considerable advantage. With this construction it is obvious that, if the teeth are arranged in groups of three, as here shown and described, there is a point of contact with the balance pinion on three different centers, or three radial lines as the teeth engage with the pinion in their order of 1—2—3; the action on the balance is, therefore, distributed over a greater space and with greater and more uniform force and with longer duration than if a single tooth was employed for this purpose. The power thus applied in connection with the other devices explained gives a revolution to the balance of two or more turns in each direction, and the result is, therefore, a slow uniform action of the escape device, which is a desideratum in a watch movement. The pallets, as already explained, are concentric, so that their locking is also concentric; and it is obvious from the description above that their only function is

to stop and release the escape wheel; they do not in any way communicate power to the balance. The rack or lever spring is a plain, straight spring, and is, therefore, the cheapest and simplest, and, at the same time, most durable form in which a spring can be made; its action in reversing I have found by actual test to be highly satisfactory, while the adjustment of this spring I have found equally satisfactory in regulating the running of a watch.

It will be evident, I think, to horologists that there may be many changes in the special devices herein shown and described without departing from the main idea of my invention, and I wish to be understood as contemplating such changes and including them in my invention, so long as the mechanism is organized to operate substantially in the manner stated above, with driving teeth, single or in groups, on the escapement wheel.

Having thus described my invention, what I believe to be new, and wish to secure by Letters Patent, is—

1. In an escapement watch, a balance wheel, in combination with an escapement wheel constructed and adapted to apply power directly to the former, a gear-train connecting the escapement wheel with the main-spring drum, an escapement lever provided with a rack-segment engaging with the balance pinion, and a spring connected to said lever to reverse its motion by direct action thereon, substantially as described.

2. In an escapement watch, a balance wheel provided with a pinion on its arbor, in combination with an escapement wheel provided with gear-teeth arranged in groups at equal distances apart on the periphery thereof and adapted to engage with the balance pinion, an escapement lever provided with a rack-segment adapted also to engage with the balance pinion, and a spring having its free end connected to the outer end of the said lever, substantially as described.

3. In an escapement watch, the balance wheel, B, provided with pinions, b', in combination with the escapement wheel, F, having on its periphery teeth, f', arranged in groups of three and with open spaces, f^2, between the respective groups, whereby the balance wheel is moved directly by said groups of teeth successively engaging with the pinion and is permitted to reverse by the open spaces between said groups, substantially as described.

4. In an escapement watch, the balance wheel, B, provided with pinion, b', in combination with the escapement wheel, F, provided with teeth on its periphery adapted to engage with said pinion and separated by open spaces between the teeth sections, the escapement lever, G, provided with rack-segment, g, engaging with the balance pinion and having a pin, g', at its outer end, and the straight spring, I, secured at its inner end and connected at its free end to the pin, g', substantially as described.

5. In an escapement watch, the balance wheel, B, provided with pinion, b', in combination with the escapement wheel, F, having at its periphery groups of teeth, f', and intervening free spaces, f^2, the teeth adapted to engage with the balance pinion, and provided on its face with escapement pins, f^3, set between the respective teeth groups, an escapement lever, G, provided with segmental rack, g, engaging with the balance pinion and having pin, g', at its outer end, an anchor, H, fixed to said lever and having pallets, h—h', adapted to engage the escapement pins to stop the escapement wheel, and a spring, I, secured at one end to an adjustable support and at its free end provided with a loop, i', engaging with the pin, g', on the lever, substantially as described.

6. In an escapement watch, a balance wheel, B, provided with pinions, b', in combination with an escapement wheel, F, adapted to impart motion directly to the balance wheel, the escapement lever, G, provided with rack, g, engaging the balance pinion and provided with pin, g', at its outer end, a slide, K, mounted on the back plate, a spring, I, fastened at one end to this slide and having at its free end a loop, i, engaging said pin, g', and a device for adjusting said slide lengthwise of the spring, substantially as described.

7. In an escapement watch, the balance wheel, B, provided with pinion, b', in combination with the escapement lever, G, provided with rack, g, engaging said pinion and having a pin, g', at its outer end, the slide, K, having toothed edge, k', the spring, I, fastened at one end to said slide and provided at its free end with the loop, i, engaging said pin, g', the guide, J, the adjusting lever, L, having toothed head, l, adapted to engage with the rack on the slide, and the spring, M, on which said lever is mounted, substantially as described.

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