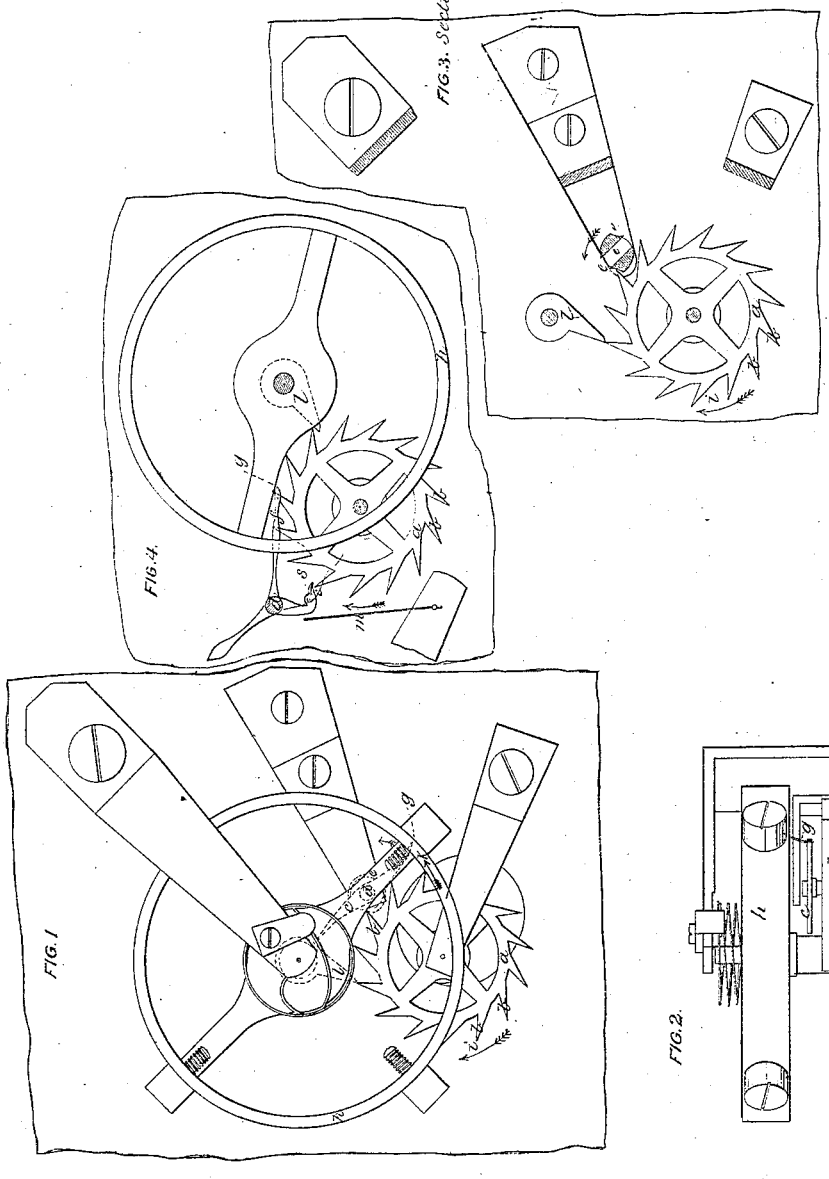
V. Girod.

Chronometer Escapement.

No. 5,963. Patented Dec. 12, 1848.



UNITED STATES PATENT OFFICE.

VICTOR GIROUD, OF NEW YORK, N. Y.

ESCAPEMENT FOR CHRONOMETERS.

Specification of Letters Patent No. 5,963, dated December 12, 1848.

To all whom it may concern:

Be it known that I, VICTOR GIROUD, of the city, county, and State of New York, have invented new and useful Improvements in Scapements of Chronometers and other Kinds of Timepieces, and that the following is a full, clear, and exact description of the principle or character which distinguishes them from all other things before known and of the manner of making, constructing, and using the same, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is a plan of my improved scapement; Fig. 2, an elevation; and Fig. 3, a horizontal section thereof taken at the line (X X) of Fig. 2; and Fig. 4, a plan of a modification of a part of my improvements; Fig. 5, perspective view of the detent.

The same letters indicate like parts in all the figures.

In all time pieces—such as chronometers and watches in which the moving force is a spring—the irregularity of motion arises from the fact that the impelling force, the main spring, is a constantly diminishing force between the periods of winding, while the resistance to be overcome by this varying force—such as the friction of the pivots and cog wheels and the scapement—is a constant force. From this it follows that when the spring is at its full tension and its force is maximum, it overcomes the resistance with greater ease than when nearly run down and its force is minimum, and hence the motion of the chronometer or watch must be faster when the spring is at its maximum force than when at its minimum.

By means of what is known as the fusee the varying force of the spring is made to exert an approximately regular force on the movement by winding the chain, which forms the connection between the barrel of the main spring and the movement, onto a cone that the leverage of this connection may gradually increase in the inverse ratio of the decreasing tension of the spring; but this can only be made to approximate, for the slightest variation in the texture of the metal of the spring will vary the ratio. As the fusee can only be made to approximate, the motion of a time piece can only be made to approximate to regularity of motion, so long as the resistance is a constant force. Many of the scapements heretofore known, such as the duplex and lever or anchor give the impulses to the balance for the liberation of the scape wheel by the rubbing of angular surfaces, and in many of these, as in the duplex—recognized as the best—this rubbing or slipping action is given at a very short distance from the axis of motion of the verge; hence, the resistance of the whole scapement must be a constant force. In the detached scapement of Arnold, and others, this great friction between the impelling and the impelled parts of the scapement—which is recognized as objectionable—is in a great measure obviated by making the detent that holds and liberates the scape wheel separate from the verge of the balance and at rest during nearly the whole time, of the repose of the scape wheel. But this advantage over the duplex scapement is entirely neutralized by a serious defect. The detent is attached to a spring which throws it in place, and the tension of which must be overcome at every beat by the balance which receives its impulse from the scape wheel, and as the tension of the spring that holds the detent exerts a constant force and the scape wheel gives a constantly decreasing impulse to the balance by reason of the constantly decreasing tension of the main spring, an escapement thus made must be irregular in its motions.

The resistance due to the scapement is much the greater part of the whole resistance, and therefore any scapement that will present a varying resistance proportionate, or nearly proportionate to the impelling force must approximate to a regular movement much more nearly than one that presents a constant or nearly constant resistance. It is with a view to accomplish this important result that I have made my invention, the principle of the first part of which consists, in giving a back movement to the scape wheel by the vibration of a detached detent in liberating the tooth of the wheel, the detent being vibrated at the required time by the balance which is impelled at every beat by the scape wheel. By this means the balance which receives all its impulses from the scape wheel, will move with a force varying with the force that operates the scape wheel, and as the balance operates the detent to effect the scapement and the detent can only do this by moving back the scape wheel a short distance, it follows that the resistance to this back movement must be in proportion to the impelling force, and

that therefore the resistance must always vary in the ratio of the impelling force. As an example, let it be imagined that the scape wheel, when the main spring is at its maximum force, gives at each beat an impulse to the balance represented by 10, and that to effect the scape the detent must move back the scape wheel a short distance and to do this the balance must exert a force on the detached detent represented by 2, it follows that when the spring has run down to its minimum force and the scape wheel impels the balance with a force represented by 5 that the resistance of the scape wheel to being moved back by the detent to effect the scape will be reduced one-half and that therefore the balance will only have to exert a force represented by 1 which bears the same ratio to the impulse given to it represented by 5 as the resistance 2 bears to the impelling force 10, and therefore the resistance and the impelling force being so arranged as always to bear the same relations, the irregular movements of time pieces, arising from the causes pointed out, is removed.

The principle of the second part of my invention consists, in making the detached detent to rotate by an intermitting motion by making it with two or more faces of repose and a recess for escapement for each detent face so arranged, relatively to the scape wheel and balance, that when struck by the balance the scape wheel shall be forced back for a short distance to carry the tooth from the face against which it rests during the repose, into one of the recesses that the wheel may make its scapement and at the same time bear against one face of the recess and give a semi-revolution to the detent that the next tooth of the scape wheel may be arrested on the next detent face and there retained while the balance continues and completes its vibration, each face of the detent being cam-formed and so located relatively to the scape wheel that while a tooth of the scape wheel rests on the face neither will rotate unless a sufficient force be applied to a pallet or arm of the detent to force back the tooth of the scape wheel to make it enter the recess.

In the accompanying drawings, Figs. 1, 2, and 3, (*a*) represents the scape wheel made in manner similar to the scape wheel of the well known anchor or the detached scapements; the teeth (*b*) of this wheel act in succession on a detached or independent detent (*c*) which is on an arbor (*d*) that turns on pivots. This detent is formed by cutting two faces (*e*, *e*) into the periphery of a small cylinder to form two concave cam-like faces against which the teeth of the scapement wheel rest during the repose between the beats. A square hole (*e'*) see Fig. 5 is made through the detent and at right angles with its axis, the vertical faces of the said hole constituting what may be called pallets against which the teeth of the scape wheel act in succession, when liberated, to turn the detent. The two cam-like faces (*e*, *e*) are made on opposite sides of this hole, and each is formed by making a slight cavity in the periphery of a cylinder, in the form of a segment of a circle the axis of which is beyond the periphery of the cylinder, so that when the scape wheel is at rest the point of a tooth rests in one of these cavities, but when one of the arms (*f*) of the detent is struck by a pin or pallet (*g*) on the under face of the balance (*h*) to turn it in the direction of the arrow, this curved face acts on the tooth of the scape wheel to force it back in a direction the reverse of the arrow (*i*) which indicates the direction of the impelling force, and so soon as the point of the tooth passes over the edge of the face (*e*) it (the tooth) enters the hole (*e'*) which permits it to scape, and in moving around under the action of the main spring bears against the face of this hole and turns the detent around until the next tooth falls against the other cam like face (*e*) to form the repose, the semi-diameter of the scape wheel (*a*) and the detent being greater than the distance between their axes they must rest in that position until the detent is vibrated sufficiently to throw back the tooth of the scape wheel that it may enter the hole, this being the only means by which the scapement can be effected. The deepest part of the cam like faces of the detent should be very near the edges of the hole that a very slight motion of the detent and a very short back movement of the scape wheel may effect the liberation.

The balance, as stated before, is provided with a pin or pallet (*g*) projecting from its underface, which when moving in the direction of the arrow (*k*) strikes one of the arms of the detent to effect the detachment, and just as this takes place a pallet (*l*) on the verge of the balance is in a position to be struck by a tooth of the scape wheel to give the impulse by which the balance is operated. And the better to adjust the relative positions of the arms of the detent and the pin or pallet on the balance by which they are struck, these two arms are made in one piece and fitted with a ground joint on the verge of the detent so that it can be turned thereon to any position required to adjust the parts. The centers of motion of the three parts of the scapement consisting of the scape wheel, the detent, and the balance, should always bear such relations to one another as to effect the intended purpose as described and represented. The pin or pallet (*g*) on the under face of the balance may be made of a thin piece of wire bent in the direction of the arrow that when

the balance makes its back or retrograde vibration it may bend with facility to pass the arms of the detent without moving it to any essential extent, but the same thing can also be effected by making it strike near the extremity of the arm.

The hole in the detent to receive the teeth of the scape wheel instead of being made through the cylinder may be simply recesses of sufficient depth to admit of the passage of the teeth and the rotation of the detent and scape wheel; but by cutting it entirely through the cylinder, the faces, which answer the purpose of pallets, can be made with more facility and accuracy than by simply cutting out a cavity. In either form however the hole or cavities form a good reservoir of oil from which the teeth take their supply every time they strike into the recess.

The first part of my invention can be applied without the second part by simply making the detent in the manner represented in Fig. 4 where corresponding parts are indicated by the same letters as in Figs. 1, 2, and 3 already described. But the detent instead of being made to rotate, simply vibrates on a fulcrum pin. It is made somewhat in the form of a half anchor, and the face (*c*) of it, against which the teeth of the scape wheel rest during the repose, is so formed relatively to the position of its axis of motion and the other parts that when the pallet or pin of the balance strikes the arm (*f*) to effect the disengagement it shall force back the scape wheel. To effect this it will be seen by reference to Fig. 4 that the dotted line (*s*) is concentric with the axis of the detent and that the face (*c*) runs out of this circle to the point so that this cannot vibrate to liberate the tooth of the scape wheel without forcing back the scape wheel, and therefore in doing this the force of the main spring which actuates the scape wheel in the direction of the arrow must be overcome, so that resistance to effect the liberation must always, as in the first example, bear the same ratio to the impelling force.

When the detent is thrown out to liberate the scape wheel, it is carried beyond the point of scapement and strikes against a small spring (*m*) which drives it back to its place in time to catch the next tooth of the scape wheel and hold it during the repose; but this spring must be so located that the detent will not come in contact with it so long as the arm (*f*) is being acted upon by the balance, or else it would present a constant resistance to the vibrations of the balance and thus defeat in part the essential object of the first part of my invention. It will be obvious from the foregoing that the rotating detent can be made in accordance with the first and second parts of my invention with more than two faces and recesses although I prefer to make it with two as best adapted to effective action.

The amount of friction on the rubbing parts of my improved scapement is very small, for the action of the detent on the teeth to effect the disengagement is very slight, and then the action of the teeth on the recesses of the detent to rotate it is very slight from the fact that the detent is independent and carries only its own weight.

Having thus pointed out the leading defects of the most important scapements heretofore produced, and the principles of my improvements, and shown the advantages thereof, as well as the different applications which I have contemplated, what I claim as my invention and desire to secure by Letters Patent is,

1. The detached or independent detent, formed substantially as herein described, to give a back movement to the scapewheel in detaching the scapement, when combined with the scape wheel and balance, substantially as herein described, whereby the impulse given to the balance by the scape wheel operates the detached detent which in effecting the detachment has to force back the scape wheel, thus making the amount of resistance of the scapement proportionate to the impelling force of the movement, substantially as described.

2. And I also claim making the detached detent with two or more faces of repose against which the teeth of the scape wheel rest and corresponding recesses of scapement, substantially as described when combined with the scape wheel and balance, whereby the detent in its operations rotates by an intermitting motion, as described thus avoiding the back motion due to a reciprocating detent.

VICTOR GIROUD.

Witnesses:
P. ANSELIN,
JOHN CLARK.