Feb. 19, 1935. M. P. FAVRE-BULLE 1,991,839

ELECTRIC TIMEPIECE

Filed July 6, 1932 3 Sheets-Sheet 1

Fig. 1

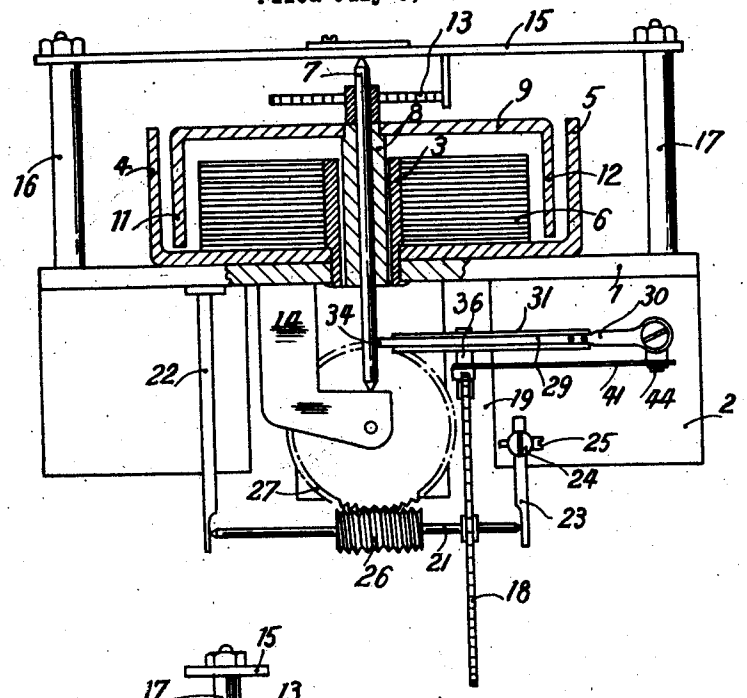


Fig. 2

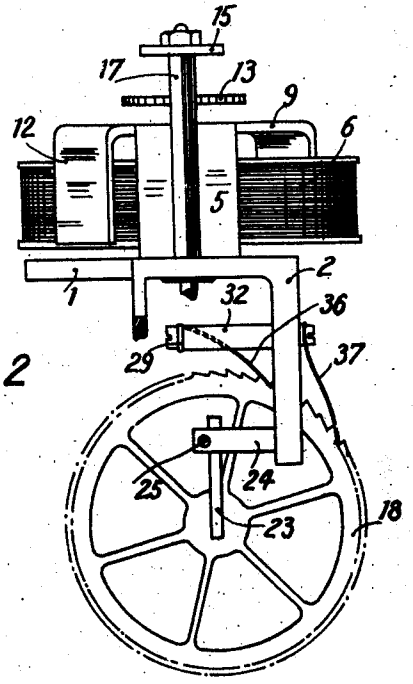
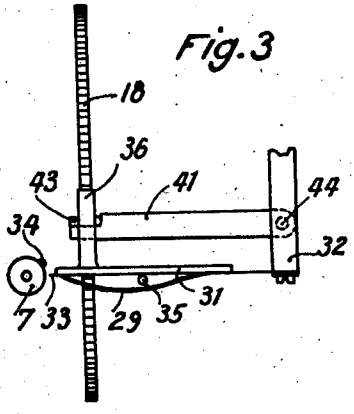


Fig. 3



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ELECTRIC TIMEPIECE

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Fig. 2a.

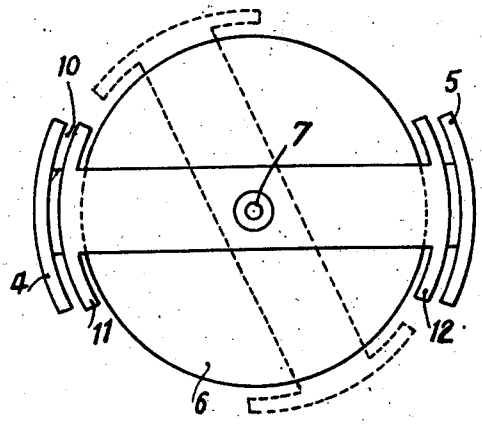
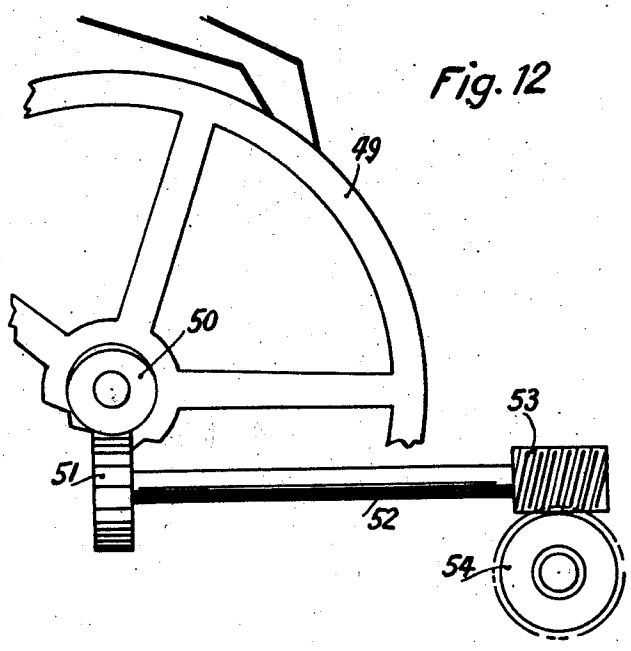


Fig. 12



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ELECTRIC TIMEPIECE

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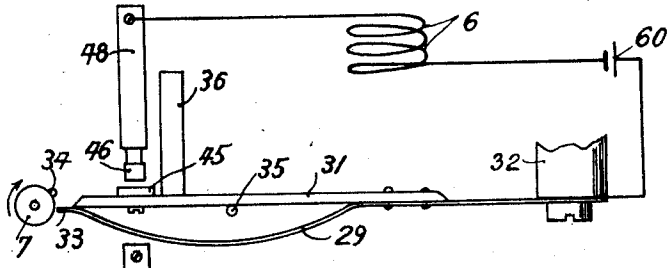


Fig. 4

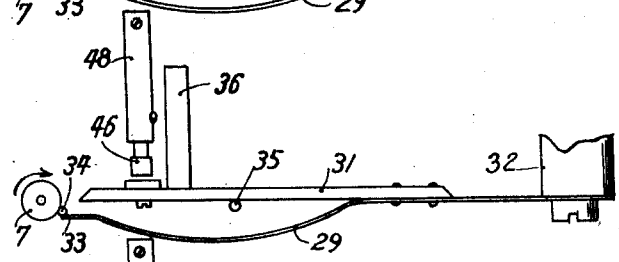


Fig. 5

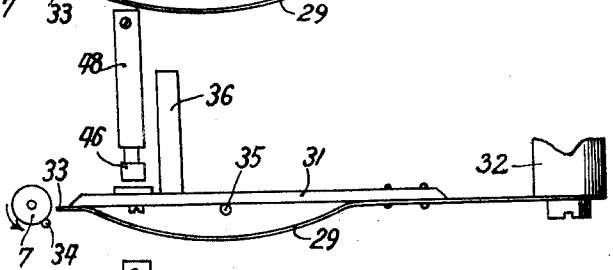


Fig. 6

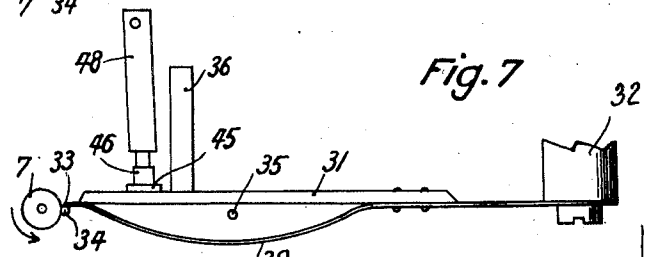


Fig. 7

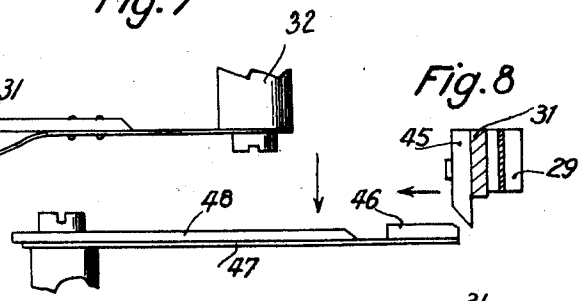


Fig. 8

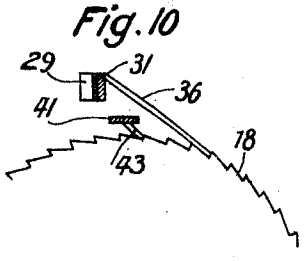


Fig. 10

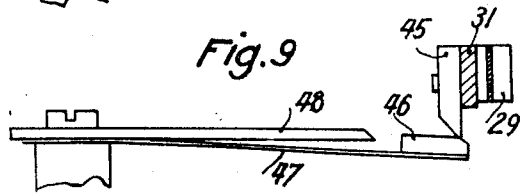


Fig. 9

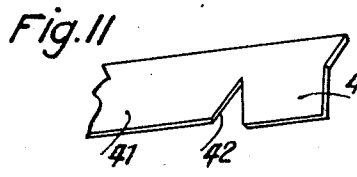


Fig. 11

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Patented Feb. 19, 1935 1,991,839

UNITED STATES PATENT OFFICE

1,991,839

ELECTRIC TIMEPIECE

Maurice Philippe Favre-Bulle, Boulogne-on-the-Seine, France

Application July 6, 1932, Serial No. 621,014
In France July 15, 1931

4 Claims. (Cl. 58—28)

The object of the present invention is to provide an electric time piece, with direct reaction, giving absolute reliability in working together with a simplicity of design not hitherto found in any other system of mechanical or electric time piece.

A further object is also to minimize as far as possible the number of parts required for motion of the mechanism.

A final object is to provide an electro-magnetic system of considerable power with minimum bulk.

A time piece attaining the aforesaid objects has characteristic features which will be apparent from the following description and the accompanying claims.

Examples of clock mechanisms according to the invention are illustrated by way of example in the accompanying drawings, wherein

Fig. 1 is an enlarged section of the mechanism of a clock;

Fig. 2 an end elevation with a slightly different system of counter-clicks used to elucidate the figure;

Fig. 2*a* is a plan view of the principal parts of the electric motor system;

Fig. 3 is a plan view of an intermediary member transmitting motion from the balance-shaft to the ratchet wheel performing a function analogous to that of an escapement wheel;

Figs. 4, 5, 6 and 7 are explanatory drawings, also in plan, showing the operation of the device shown in Fig. 3;

Figs. 8 and 9 show in elevation, and on a larger scale, the way in which the contact is formed by means of the intermediary member.

Fig. 10 is a transverse section of this intermediary member and of the counter-click which co-operates with the ratchet wheel, the counter-click being similar to that shown in Fig. 1.

Fig. 11 shows in perspective the formation of the extremity of this counter-click.

Fig. 12 is a partial plan view of an alternative form of the transmission mechanism.

According to the invention, the electro-magnetic system which acts both as motor and regulator consists of the following parts which fit one into the other;

(*a*) A coil 6, the magnetic core of which is formed by two barrels 3 and 8, one fixed and the other movable, the barrel 3 being secured in the central hole in the coil, while the barrel 8 is fixed on the balance shaft 7 passing through the center thereof, this shaft 7 thus forming part of the magnetic core.

(*b*) A fixed armature solidly secured to the barrel 3 and comprising two radial arms 4 and 5 bent at right angles at their outer ends so as to leave a space 10 in form of the arc of a circle between them and the circumference of the coil 6 (Figs. 1 and 2*a*).

(*c*) A movable armature formed by the balance and consisting of two radial arms 11 and 12 of increased size at their ends and turned down at right angles to project into the space 10.

The assembly of the fixed parts of this electro-magnetic system is fixed to the frame by the lower part of the barrel 3 being suitably cut and inserted in the wing 1 of this frame after the fashion of an eyelet. The frame as shown in Fig. 2 is L-shaped which gives numerous advantages from the point of view of having the varied parts of the mechanism in two different planes.

It is to be noted that employment of the barrel 3 for two objects both simplifies the construction and also has the advantage of making it easy to regulate by rotation with mild friction, the orientation of the arms of the stator in relation to those of the movable armature.

The balance (movable armature) is riveted upon the soft iron barrel 8 secured to the balance shaft 7. As usual the balance is continually drawn towards the position of equilibrium by a spiral spring 13 the use and adjustment of which is well known.

The balance shaft 7 is provided with a little lug 34 formed by a ruby, but which can also consist simply of the bevelled end of a little steel pin tightly fitted in a hole in the shaft.

Clearly the arrangement described is a first part of a clock escapement. This escapement, like all free escapements which can be regulated like a chronometer, comprises an intermediate, vibrating member.

In accordance with the invention the intermediate member is of special design, a kind of spring-click analogous with that used in marine chronometers, but in this case having new functions and with a particular form of construction which makes it quite different from the known arrangement.

This click (Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9) is in fact intended to transmit, while transforming it, the alternating circular motion of the balance to the escapement wheel and at the same time open and close the electric circuit of the apparatus.

The particular construction of this click is simple and economical. It consists of plate 29 reinforced by plate 31, this latter plate being rigid whereas plate 29 itself is necessarily flexible.

Plate 29 is fixed at one end on a pillar 32, fixed to the vertical wing 2 of the frame by means of a screw, for example, and plate 31 is fixed to plate 29 near the commencement of the curve into which the latter is formed (Fig. 3). At the other end of the curve the two parts are independent, and, owing to the flexibility of plate 29, the end of this plate tends to rest upon plate 31, but extends slightly beyond it as indicated at 33. The end 33 is in the path of a lug 34 on the balance shaft 7. At rest, the rear end of plate 29 draws plate 31 against a fixed stop 35. Plate 31 carries a projection 36 which is vertical to it and which forms a click, the free end of which engages in the teeth of the ratchet wheel 18. In order to give this click 36 sufficient length, it is preferable to extend it into the slot 19 of the frame (Fig. 1), the said click thus engaging wheel 18 on the other side of this slot 19.

As in all clicks of this kind there is a counter-click. On Figs. 1, 2, 3, 10 and 11 this counter-click is formed in a special way. It consists of a steel plate 41, the plane of which, instead of being the same as in known devices and parallel to that of wheel 18, is vertical to the plane of this wheel. On its extremity (see in particular Fig. 11) this plate is cut at 42, and tongue 43, thus formed, is turned down in a suitable manner. Obviously, regulation of this counter-click can be made extremely easy by making it turn on screw 44 (Fig. 3) which fixes the counter-click to pillar 32.

Of course, this counter-click could be made in a different way. Thus in Fig. 2 it simply consists of strip 37 fixed to the frame and engaging the escapement wheel 18 at a tangent.

The manner in which the vibrations of the intermediate member cause the opening and closing of the electric circuit to excite coil 6 of the apparatus will now be described. Towards the end of the intermediate member (Figs. 8 and 9) there is, on the rigid strip 31, a silver plate 45, the lower part of which is cut to a bevel. This plate forms one of the contact members, the other of which also consists of a silver plate 46 fitted on the end of a flexible strip 47 supported by a sole piece 48, which precisely determines its position.

The other end of strip 47 and sole 48 is fixed to the frame. When, owing to vibration of rigid plate 31, this said rigid plate moves from right to left (see Figs. 8 and 9) bevel plate 45 comes into contact with plate 46 and makes strip 47 bend until the apex of the bevel has crossed the edge of plate 46. After this the point of the bevel slides on the surface of plate 46 without producing any appreciable extra bending of plate 47. Thus contact is made with perfect reliability and, of course, interruption of the circuit occurs suddenly under the spring action as soon as the intermediary member returns to its position of rest. In this construction the silver plate 45 brushes the surface of plate 46, thus automatically cleaning the engaging surfaces and consequently giving an excellent electric contact.

The ratchet wheel 18, which is comparatively very large and provided with numerous teeth, is on a plane perpendicular to the vertical plane of wing 2 of the frame in which there is a slot 19 (Fig. 1) to allow the passage of the wheel. This wheel is keyed on a shaft 21 ending in two points and this method of mounting on points is to be recommended because wheel 18, which is big, turns very slowly and consequently there is no danger of the points being worn away.

The points of shaft 21 fit into blind holes made in two rods 22 and 23 suitably secured at their other ends. One of these rods at least (23 in the case of Fig. 1) fits into a hole made in a pillar 24 fixed to the vertical wing 2 of the frame. Pillar 24 is cleft as far as this perforation and the sides of the cleft can be drawn together by means of a screw 25. Nothing can be easier than this mounting, as by turning rod 23 a little on itself shaft 21 can be fitted into place, while the height of this end of the shaft is adjustable by moving rod 23 upwards or downwards.

Shaft 21 of the ratchet wheel carries a worm 26 which meshes with a worm wheel 27 keyed on the shaft carrying the hands. Thus the transmission from the ratchet wheel to the hands is reduced to a minimum number of parts.

Before describing the operation of this construction, it will be well to observe that the electro-magnetic system of this clock, in addition to the advantages enumerated, also has that of realizing polarizations of the movable armatures, that is to say, of the balance, inversely to that of the stator, so that with a very slight consumption of current it is possible to obtain particularly strong reactions, provided the current passes through the coil when the balance is at a point close to the fixed armature as indicated in Figs. 2 and 2*a* (in dotted lines on the latter figure).

The working of the arrangement is as follows:—When balance 9 vibrates in the direction of the arrow in Fig. 4, lug 34 on shaft 7 of this balance comes into contact (as shown in Fig. 5) with the end 33 of plate 29 which it moves away from plate 31, which cannot be drawn away owing to the existence of stop 35. Lug 34 then releases the end 33 of plate 29 which returns to rest on plate 31. The balance continues its course and then vibrates in the other direction (Fig. 6). Lug 34 then comes into contact with end 33 of plate 39 but this time, the end 33 being supported by plate 31 and the movement of this plate being free in this direction, this plate 31 will be moved (Fig. 7) as well as click 36 forming part of this plate, and the click makes the wheel 18 move forward by one tooth. At the same time contact 45 closes the circuit of the apparatus, as can be clearly seen in Fig. 7. At this moment owing to adjustment of the working parts the balance will be close to the stator as shown in Figs. 2 and 2*a* (by the dotted line of this latter figure), and it will be suddenly drawn by polar parts 4 and 5, but almost immediately lug 34 will escape from end 33 of plate 29 (Fig. 4), and this plate will then return to a position of rest, thus breaking the current suddenly as previously indicated. The balance then describes a supplementary arc, then, drawn back by the spiral spring 13 it vibrates in the other direction and the above operations recommence.

The diagram of electrical connections is shown in Fig. 4, showing in particular the coil 6 of the electro-magnet fed from the source of current 60, this coil 6 being connected on the one hand with the contact of sole 48 and, on the other, with the frame, for example, to pillar 32.

It is very important to point out that in portable time pieces the transmission mechanism always consists of a number of wheels and pinions, whereas in the invention this transmission consists of only one wheel (27) keyed on the spindle of the minute hand.

Of course, in the construction just described a very special position for the escapement wheel is intended to produce this last mentioned simplification and at the same time allow of the balance

being placed in a horizontal position which as we know is of great importance for accuracy of time keeping. But, of course, if in order to reduce, for instance, the dimensions of mechanism it were desirable to place all the parts on a plate on a single plane, something would need to be added to the mechanism such as either a bevel gear or an additional worm.

The diagram of Fig. 12 shows an arrangement of this kind in which the escape wheel 49 drives, by means of a worm 50, a worm wheel 51 which in turn drives wheel 54 which is keyed on the minute shaft or another transmitting member. A similar arrangement is thus realized without great complication.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In an electric time piece; an electro-motor system comprising a coil, controlling means controlled by said system for closing the circuit of said coil at regular time intervals, a stator having poles, a first staff constituting the core of said coil, a balance having poles and fixed to said first staff, said balance constituting the movable armature of the motor within the stator poles of which the poles of the balance may be displaced, a spring for oscillating said first staff, a transmission mechanism controlled by said first staff, and a second staff carrying the hands and governed by the transmission mechanism.

2. In an electric time piece; an electro-motor system; a first balance staff worked by the electro-motor system; a transmission mechanism comprising a ratchet wheel worked by the first balance staff; a third staff deriving its rotary motion from the transmission mechanism, said mechanism comprising a click system worked by the first staff and said ratchet wheel being worked by the click system and keyed on the third staff; an adjustable support for the third staff, said support consisting of two rods, one of which is secured to the frame while the other is fitted so as to slide in a fixed support; a transmission mechanism worked by the third staff; and a second staff carrying the hands and worked by the last mentioned transmission mechanism.

3. In an electric time piece; an electro-motor system; a balance staff worked by the electro-motor system; a transmission mechanism comprising a ratchet wheel worked by the first balance staff; a third staff rotated by the transmission mechanism, said mechanism comprising a click system controlled by the first staff, said wheel being worked by the click system and keyed on the third staff; an adjustable support for the third staff, said support consisting of two rods one of which is fixed to the frame, the other being fitted so as to slide and rotate in a fixed support; a transmission mechanism worked by the third staff, and a second staff carrying the hands and worked by the last mentioned transmission mechanism.

4. In an electric time piece; an electric-motor system, comprising a coil, controlling means controlled by said system for closing the circuit of said coil at regular time intervals, a stator passing through said coil and provided with radial arms bent at right angles and constituting poles; a first staff passing through the stator and forming the core of the coil; a balance secured on said staff and having arms the two ends of which constitute poles and are turned down at right angles to fit between the raised edges of the fixed armature and the coil; a spring for oscillating said first staff, a transmission mechanism controlled by the staff of the balance; and a second staff carrying the hands and governed by the transmission mechanism.

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