Aug. 10, 1937. F. LOEFFLER 2,089,280

ELECTRIC CLOCK

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Fig. 1.

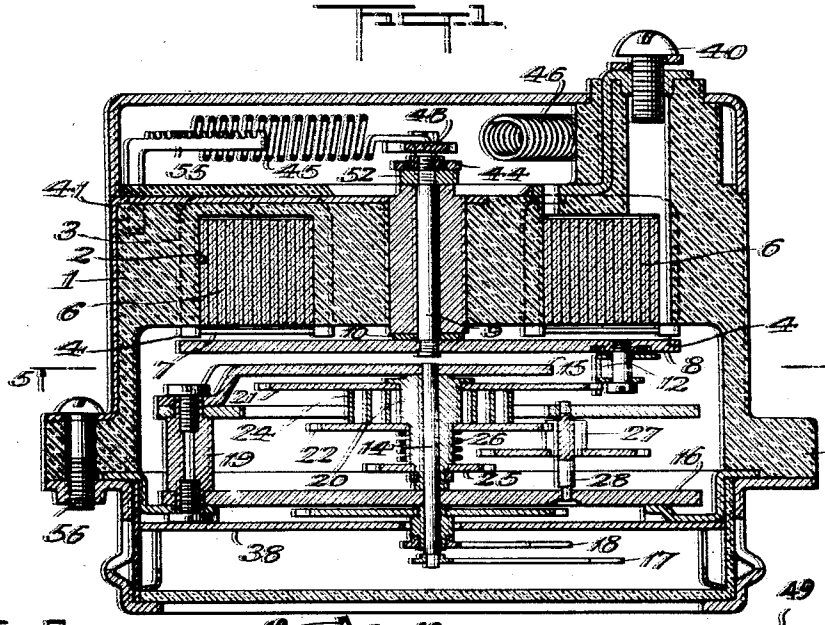


Fig. 6.

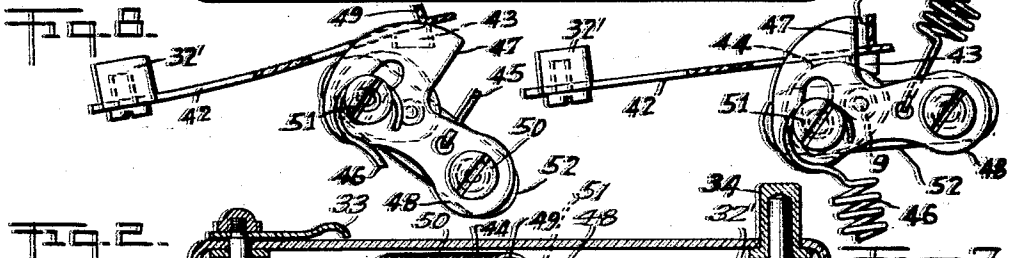


Fig. 7.

Fig. 2.

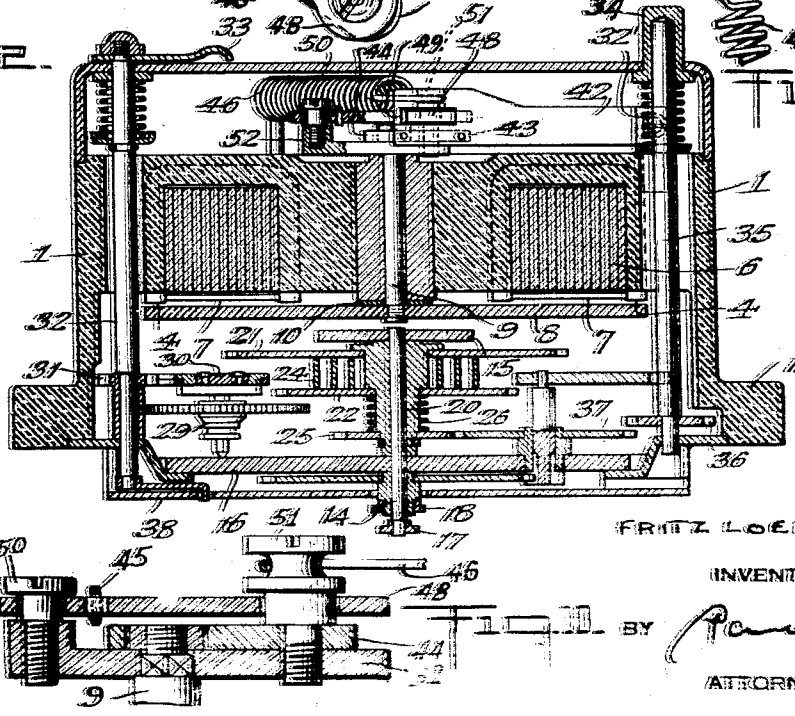


Fig. 10.

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Fig. 3.

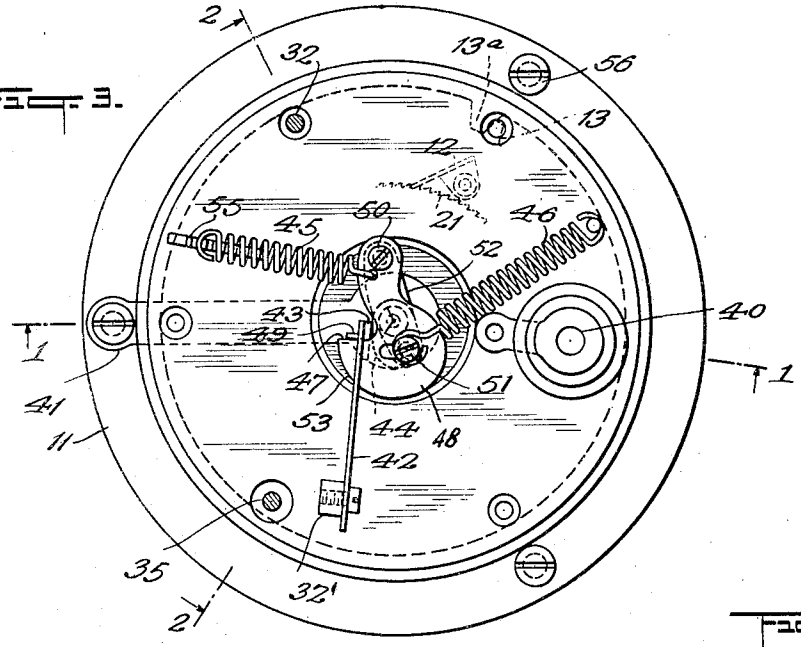


Fig. 4.

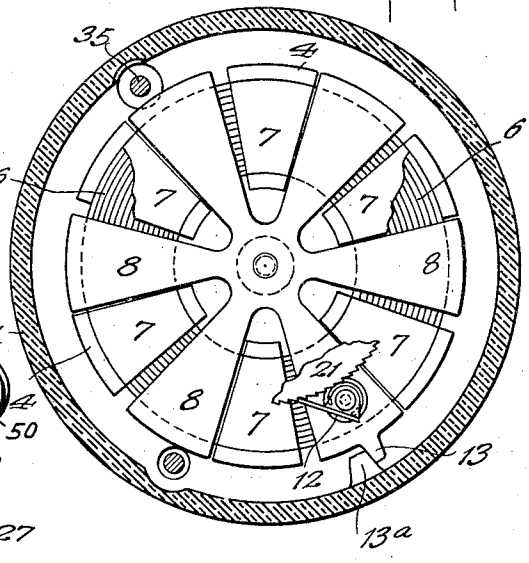


Fig. 5.

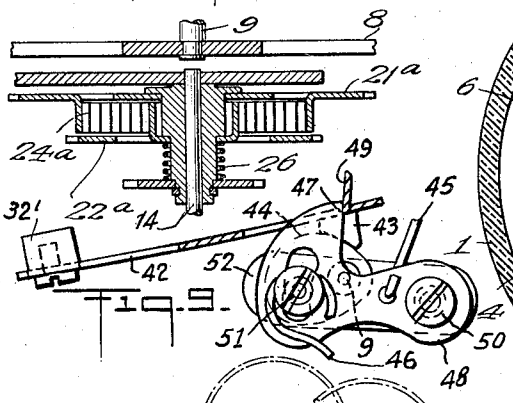
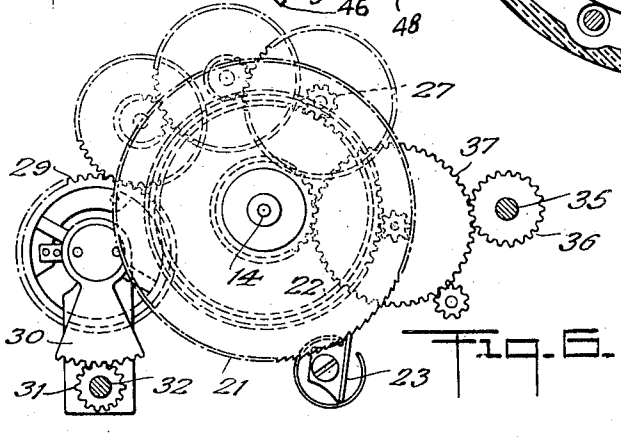


Fig. 6.



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ELECTRIC CLOCK

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Application January 30, 1932, Serial No. 589,788

4 Claims. (Cl. 58—23)

This invention relates to electrically driven clocks of the type wherein the driving motor operates intermittently to store up energy in a spring which serves to drive the clock escapement mechanism and hands.

It is an object of my invention to provide an improved and simple form of electric motor drive of the intermittently operating type which is arranged to apply at all times a substantially smooth and uniform driving torque to the gear trains and escapement mechanism of the clock works.

More specifically, it is an object of my invention to provide a clock driving motor which is very simple in construction and operation and to furnish between the moving element of the clock motor and the drive shaft of the clock works a driving connection of uniform resiliency, which is supplied with small amounts of energy at short intervals of time whereby a uniform driving effect upon the clock works is obtained.

An object of the present invention is the provision of an improved clock motor which is adapted to produce intermittent power impulses of relatively great strength from a small amount of energizing current, and which is adapted to function over a very wide range of voltage.

Another object is the provision of a commutating mechanism or switch, for supplying intermittent electric impulses to a motor, which has few parts, is easy to assemble and in which the contact points are kept clean by wiping action.

A further object is the construction of an electric clock of the intermittent impulse type, using an electric motor to tension a driving spring, wherein the clock escapement and gearing comprise a single time unit, and the driving motor a separate unit, the two units being mounted in axial alignment and having substantially a common center.

Still another object is the provision of an electric clock which is adapted to continue operating for a period of time after the current is turned off, and to continue normal operation when the current is turned on.

In accordance with my invention, the electric clock motor comprises a magnetizing coil, a toothed rotor of magnetic material positioned adjacent to said coil and coaxially therewith, and a plurality of bars or pole pieces of magnetic material are arranged in magnetic relationship with said coil and said rotor. The coil, rotor and pole pieces are held in proper working relationship by any suitable means, such as a frame of non-magnetic material, and a commutating mechanism is provided for intermittently energizing the coil to produce a turning movement of said rotor. This movement of the rotor is opposed by a tension spring that serves to store mechanical energy which is gradually expended in driving the associated time unit. The commutating mechanism preferably consists of a contact cam having a brush spring pressed into engagement therewith, and a lifting finger adapted to be operated, responsive to turning of the rotor, quickly to lift the brush free from the contact cam.

The clock escapement, gears, dial and other parts are assembled in a single unit, to which the electric motor unit is arranged to be attached by screws or other holding means. The motor unit, being entirely separable from the time unit, may be disengaged therefrom without dismantling either individual unit. So repairs may be quickly and easily made; it being merely necessary to remove the holding screws to change the motor unit.

The commutating mechanism or switch is mounted at one side of the motor, preferably the side away from the time unit, so that adjustments and repairs may be effected quickly and easily without separating the two units.

A preferred embodiment of the invention will now be described with reference to the drawings.

In the drawings, Figs. 1 and 2 are cross sections along lines 1—1 and 2—2 of Fig. 3;

Figs. 3 and 4 are top and bottom plan views of the electrical equipment;

Fig. 5 is a modification of Fig. 1;

Fig. 6 is a bottom plan view of the clock mechanism;

Figs. 7, 8 and 9 are enlarged top plan views of the switching mechanism in various positions; and Fig. 10 is a vertical cross section of the switching mechanism.

The electrical elements of the clock are contained within a molding of insulating material 1 provided with a circular groove 2. Six U-shaped elements constituting the magnetic field pieces of the stator are frictionally held within groove 2 equally spaced from one another. The ends 4 constituting the pole faces of magnets 3 project beyond the wall 5 of the molding. The coil 6 of the stator structure is in the form of a toroid and is held within the groove 2 by means of brass or other non-magnetic plates 7 held between the pole pieces 4.

The rotor 8 of the motor is rockably mounted on a bearing shaft 9 centrally provided in the molding 1. The proper spacing of the rotor from

the pole faces is insured by means of a washer 10. The rotor is spider-shaped, having six teeth or bars tapered towards the center. The pole faces 4 of each magnet 3 are of substantially the same width as the width of the spider teeth; that is to say, the outside pole faces are wider than the inside faces.

The clock mechanism is mounted as a separate unit on the shoulder 11 of the molding 1, its only connection with the motor being through a spring-pressed pawl 12 which is pivoted on one of the teeth of the rotor. This rotor tooth is provided also with a projection 13 which is held for movement in one direction by an abutment 13a provided in the molding 1. The clock mechanism is centered around a bearing shaft 14, one end of which has a bearing in an end plate 15, the other end of which projects through another end plate 16 of the clock mechanism and carries the usual minute hand 17 and hour hand 18. The end plates 15 and 16 are spaced from one another by means of uprights 19. Mounted on the shaft within the end plates is a bushing 20 carrying a toothed wheel 21 which is free to rotate with respect to gear wheel 22. The toothed wheel is engaged by the spring-pressed pawl 12 and may be moved thereby in one direction and it is held in its advanced position by means of a second spring-pressed pawl 23 which is mounted on the end plate 15. When, therefore, the rotor 8 is moved it will rotate through the agency of the pawl 12 the toothed wheel 21. Upon the return movement of the rotor to normal, the wheel 21 will be held in its advanced position by means of spring-pressed pawl 23, the pawl 12 riding over the teeth of wheel 21. The gear wheel 22 loosely mounted on bushing 20 below wheel 21 is coupled with the latter through the agency of a light flat spring 24. When the toothed wheel 21 is rotated, it will wind up the spring 24. A third gear wheel 25 is rigidly mounted on the bushing 20 and a spring clutch 26 is provided between 25 and 22. The gear 22 engages with a pinion 27 mounted in an arbor 28 carried in the end plate 16. Through the usual gearing the arbor 28 is connected with the escapement mechanism 29. The latter may be adjusted by means of a geared segment 30 engaging a gear wheel 31 carried by a shaft 32 which projects through the casing and may be rotated from the outside by means of a pointer 33. Similarly, the setting of the hands may be adjusted from outside by means of a knob 34 carried on a shaft 35, the lower end of which is provided with a gear 36 which may be moved into engagement with a gear 37 which is in engagement with the gear 25. The dial of the clock is indicated at 38 and it will be noticed that the structure is so provided that any size dial may be used for the same clock mechanism.

When the electric clock is put into operation, a current of the proper voltage is supplied to it by connecting a source of power to the binding post 40 and to the casing 41. As soon as this circuit is completed, current passes from the binding post 40 through the coil 6, spring 42, brush 43, cam 44, and thence through the shaft 9, and over the metallic parts of the mechanism, to housing 41. The coil 6 being energized, a magnetic field is set up, the lines of flux of which thread through the pole pieces 4, thereby causing them to attract the adjacent teeth of the spider 8 and rotate it in a clockwise direction, as viewed in Fig. 3, bringing the teeth more nearly into line with the pole pieces. As the rotor 8 turns against the tension of springs 45 and 46, flat face 47 of hook 48 of insulating material engages with the cam surface 49 of spring 42, and prevents the hook from turning around shaft 9 as a center. The hook 48 is movably mounted by means of pivot screws 50 and 51 on arm 52 which is fastened to shaft 9. At the beginning of the rotation the flat face 47 of hook 48 engages the flat cam surface 49 of the spring 42 and prevents the rotation of the hook with the arm 52 around shaft 9. The other ends of springs 45 and 46 are attached to the molded part 1 in the manner indicated in Fig. 1 wherein a rack 55 is provided with a number of teeth projecting within the convolutions of the spring. The spring 45 may be hooked on any tooth of rack 55 to vary its tension without interfering with the flexibility of the rest of the spring. The other end of spring 45 is fastened to hook 48 and that of spring 46 to screw 51. The latter screws into arm 52 and has a shoulder which passes through hook 48 and limits the oscillation thereof in one direction. The result is that the end of the hook adjacent the flat face 47 remains substantially stationary because it is held by cam portion 49, while the other end rotates with shaft 9, arm 52 and the screw 50. The arm 52 displaces the pivot screw 51 in the longitudinal slot of hook 48 until it reaches its end position. On the other hand, the motion of the hook 48 with respect to the arm 52 and pivot screw 50, is a counter-clockwise rocking motion, as viewed in Fig. 3. As the rotation of the spider 8 and arm 52 continues, the contact cam 44, which is connected through arm 52 with shaft 9, gradually forces the spring 42 upwardly. In this position the brush 43 is still in contact with the cam 44 so that current still flows through the winding 6, but the cam portion 49 of the spring is about to slide over the outer end of flat face 47 and around the arcuate portion 53 of the hook. When this point is reached, the hook, which has been held back against the tension of spring 45 by the cam portion 49 striking flat face 47, is quickly snapped ahead, thereby lifting the brush 43 from the engagement with the contact cam 44 and breaking the circuit through coil 6. During this rotational movement of the spider 8, the pawl 12 slides over the teeth of ratchet wheel 21 and as soon as the coil 6 is deenergized, by opening of the contacts 43 and 44, the rotor 8 returns to its original position under the influence of tension springs 45 and 46, the ratchet wheel 21 being carried with it by action of the pawl 12 engaging with the teeth of the wheel. The spring 24 is made relatively weak with respect to the two springs 45 and 46, so that the rotor or spider is permitted to return to its original position against the tension of spring 24. Just as this original position is reached, the contact spring 42 snaps down to its normal position, and the various operating steps are repeated in the same manner as already described. The ratchet wheel 41 is prevented from returning to its original position by the holding pawl 23.

Two or more oscillating cycles of the rotor may follow in quick succession until the spring 24 is tensioned sufficiently to counterbalance the tension of springs 45 and 46 and prevent the rotor from returning to its original position. Spring 24 may be made so short that a single operation will wind it up. When this state is reached, the commutator parts retain the position in which the brush is out of engagement with the cam 44. In the meantime, spring 24 has been driving the escapement, hand and other clock works forming the time unit, and continues to drive these parts.

When the tension of spring 24 has been sufficiently reduced by driving the clock works, the rotor and associated commutator parts return to the normal position, thereby causing the coil to be energized and the spring 24 tensioned again to such value that the parts are held with the contacts open.

I have observed in clocks constructed in accordance with the present disclosure that, when current is disconnected from the coils 6 and the rotor 8 is in its extreme counter-clockwise position (as viewed in Fig. 4), the clockwork (Fig. 6) is operated by the tension primary driving springs 45 and 46 through the secondary driving spring 24 or 24a. This continues until the rotor 8, after rotation in a clockwise direction (Fig. 4), strikes the stop 13a. From this point, spring 24a drives the clockwork until it is unwound unless, of course, electric current is turned on in the meantime and springs 45 and 46 are again placed under tension.

If it is desired to operate the clock on lighting current, e. g. 110 v., then the motor structure must be increased in size. Besides, owing to the fact that the current may be off for longer lapses of time, the clock spring 24 must be longer. This is shown in Fig. 5, wherein the long spring 24a is held within a drum formed by punchings in wheels 21a and 22a.

Because of the relative difference in the storing capacity of the spring 24a and springs 45 and 46, when the clock is first put into operation the drive spring 24a is tensioned to a plurality of units by successive oscillations of the motor rotor and thereafter is kept tensioned by the storing of one unit at a time, responsive to single oscillations of the rotor. The result of this is that if the supply current of the motor is turned off for a period of time greater than that necessary for the clock works to expend one unit of energy, the clock will continue to operate until all of the units of energy are used up and the spring 24a is totally unwound, or until current is again supplied to the motor, whereupon the driving spring 24a is immediately tensioned to its full operating value.

The teeth of the ratchet wheel 21 are made relatively fine so that if the voltage applied to the motor is low, the rotor may turn just far enough to open the contacts 43 and 44. On low voltage therefore, the time between oscillations of the rotor would be small, whereas if a relatively high voltage were supplied to the motor, the turning angle of the rotor would be large and consequently the time between the oscillations thereof would be greater. This feature insures that the device will operate over a relatively wide change in supply voltage and furthermore that shock to the parts upon the application of high voltage will be avoided. All of the energy will be taken up by the spring 24 or 24a.

The brush 43 should not disengage contact cam 44 until it is lifted free therefrom by the point of the hook 48 sliding quickly under the cam portion 49 of the spring 42. This insures that a quick break will be made and wearing of the contact points by minute arcs prevented. Adjustment of the contact cam relative to the brush can be made by loosening the screws 50 and 51, and moving the cam to a new position. Because of the rotary motion of the contact cam with respect to the brush, a wiping action is produced which tends to keep the contact surface clean and in efficient working condition.

When it is desired to repair the commutator or to replace any of its parts, the hook 48 thereof may be removed merely by unhooking the springs 45 and 46 and removing the screws 50 and 51. The contact cam 44 may now be removed. All of these parts are located at the back side of the whole clock unit and so may be repaired or adjusted without disturbing the rest of the motor unit, or the time unit. The entire motor unit may be separated from the clock merely by unscrewing the bolts which constitute the sole means of holding together the housings containing the motor and the clockwork.

What I claim is:

1. In an electric clock, an electric motor comprising a stator and a rotor, a clockwork comprising a toothed wheel, a pawl carried by said rotor and engaging said toothed wheel, a housing for said motor and for said clockwork, a cover for said housing, and fastening means engaging said housing and cover constituting the sole means of holding said motor and clockwork together.

2. In an electric clock, an electric motor comprising a stator and a rotor, a shaft for said rotor, a clockwork comprising a toothed wheel and a main shaft carrying the clock hands, said shafts being separate from one another, a spring pressed pawl carried by said rotor and engaging said toothed wheel, a housing for said motor and for said clockwork, a cover for said housing, and fastening means engaging said housing and cover constituting the sole means of holding said motor and clockwork together.

3. In an electric clock, an electric motor comprising a stator and a rotor, a shaft for said rotor, a clockwork comprising a toothed wheel and a main shaft carrying the clock hands, said shafts being separate from one another, a spring pressed pawl carried by said rotor and engaging said toothed wheel and constituting the sole connection between the motor and the clockwork, a housing for said motor and for said clockwork, a cover for said housing, and fastening means engaging said housing and cover constituting the means of holding said motor and clockwork together.

4. In an electric clock, an electric motor comprising a stator and a rotor, a clockwork comprising a toothed wheel, a housing for said motor and clockwork, and fastening means engaging said housing and constituting the sole means of holding said motor and clockwork together in said housing.

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