No. 620,864. Patented Mar. 7, 1899.

# J. BUTCHER.

## ELECTRIC CLOCK.

(Application filed Sept. 22, 1897.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 2.

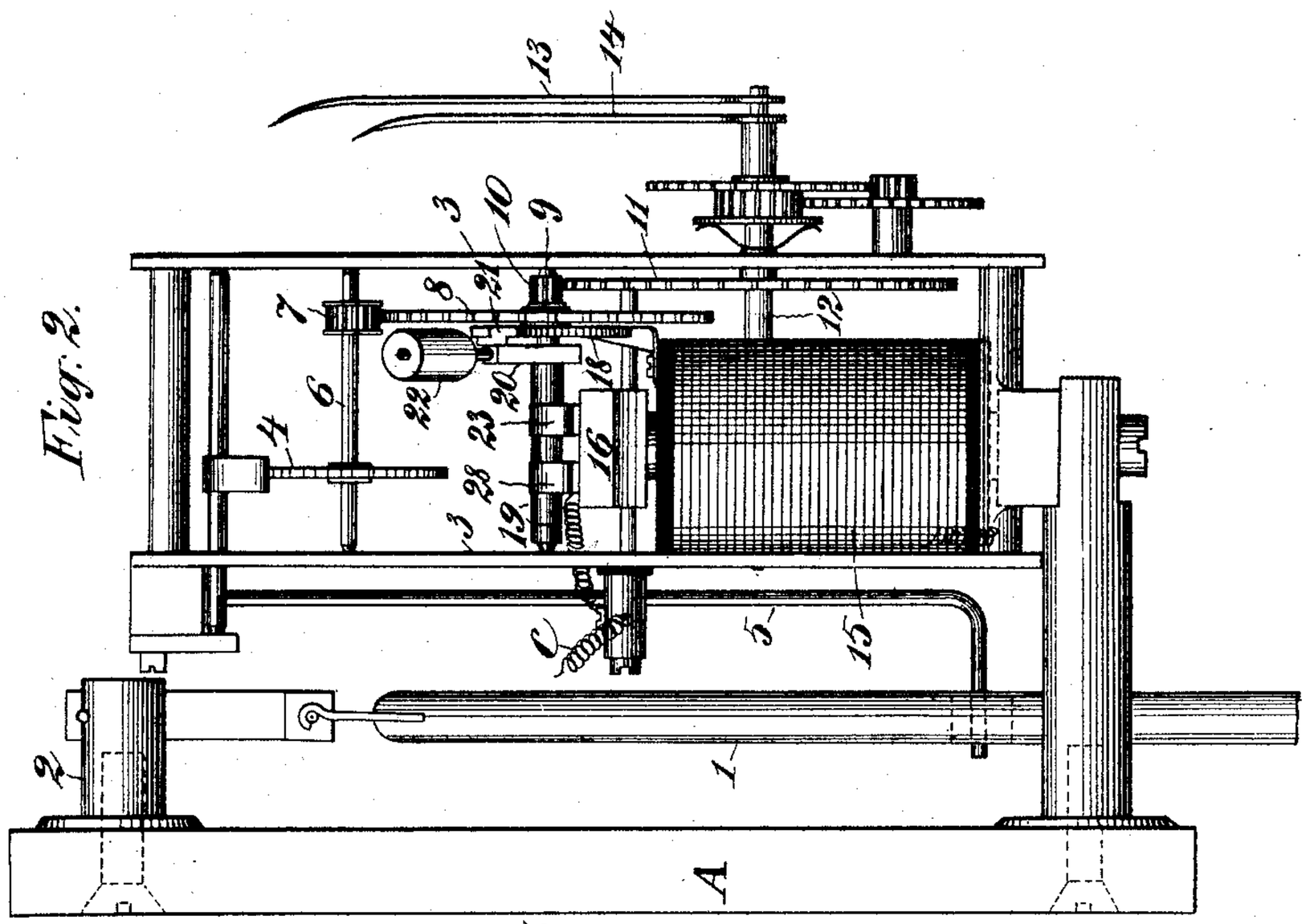
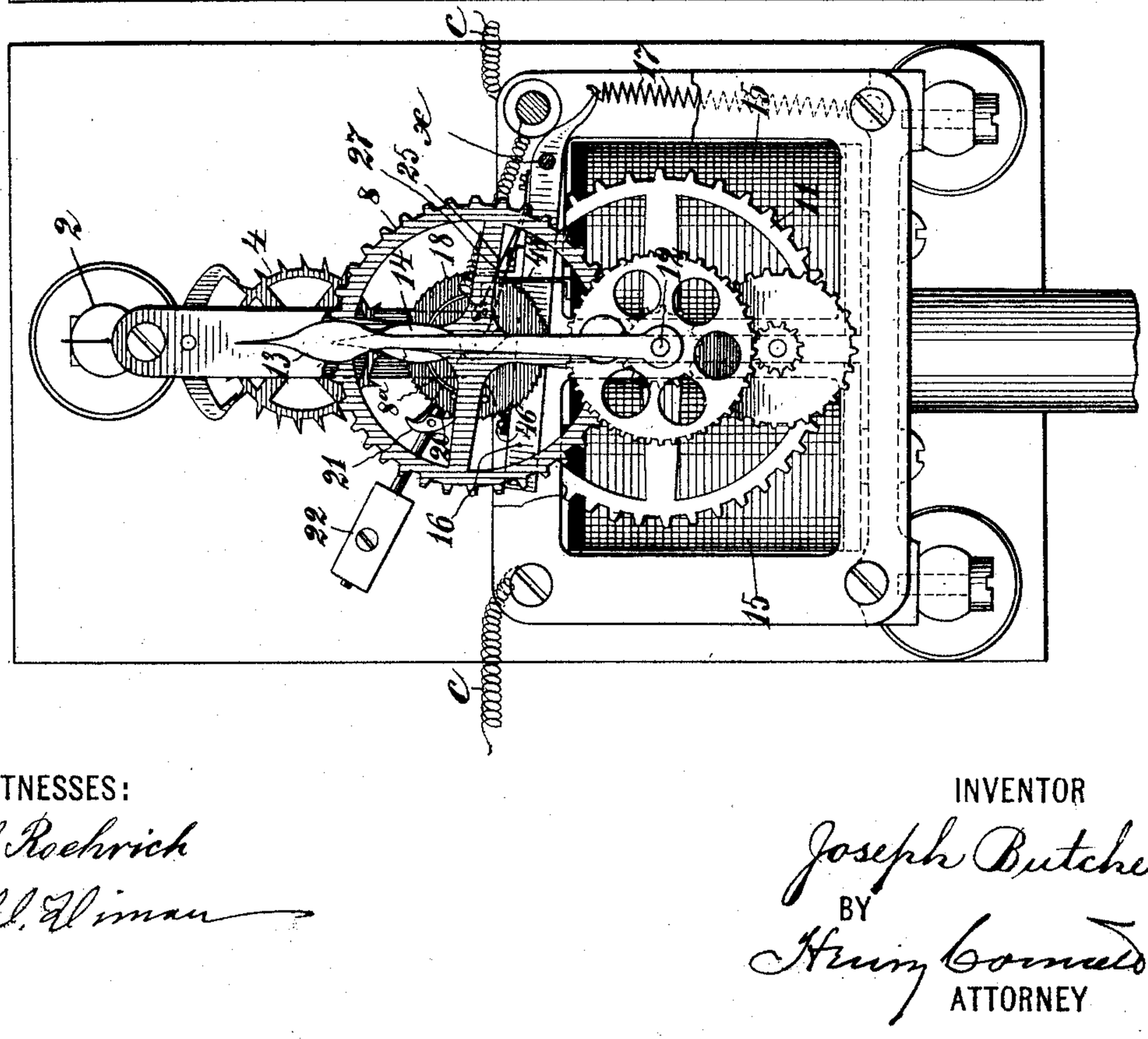



Fig. 1.

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No. 620,864. Patented Mar. 7, 1899.

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## ELECTRIC CLOCK.

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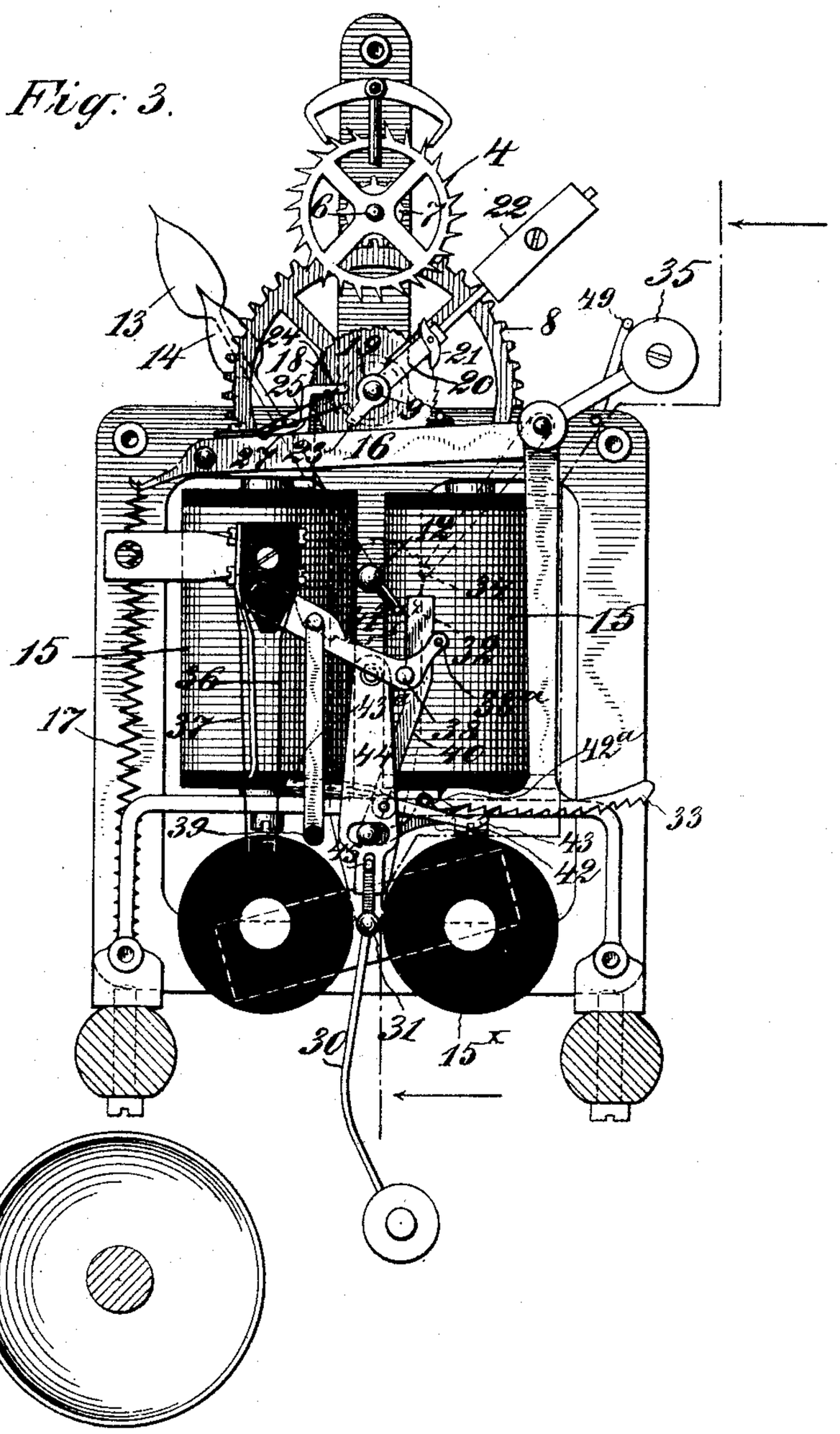
(No Model.) 5 Sheets—Sheet 2.

*Fig. 3.*

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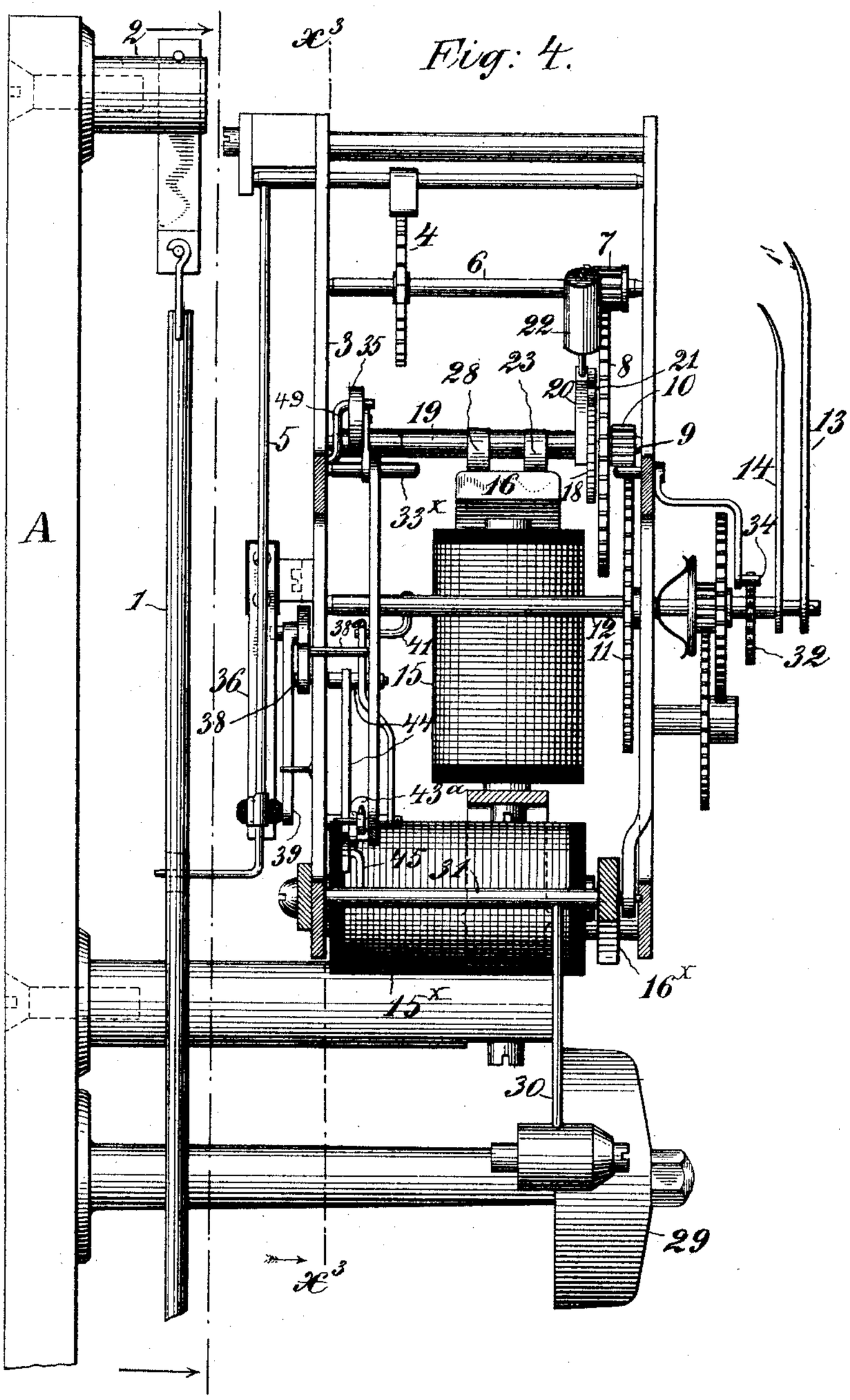
## ELECTRIC CLOCK.

(Application filed Sept. 22, 1897.)

(No Model.) 5 Sheets—Sheet 3.

Fig. 4.

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## ELECTRIC CLOCK.

(Application filed Sept. 22, 1897.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 5.

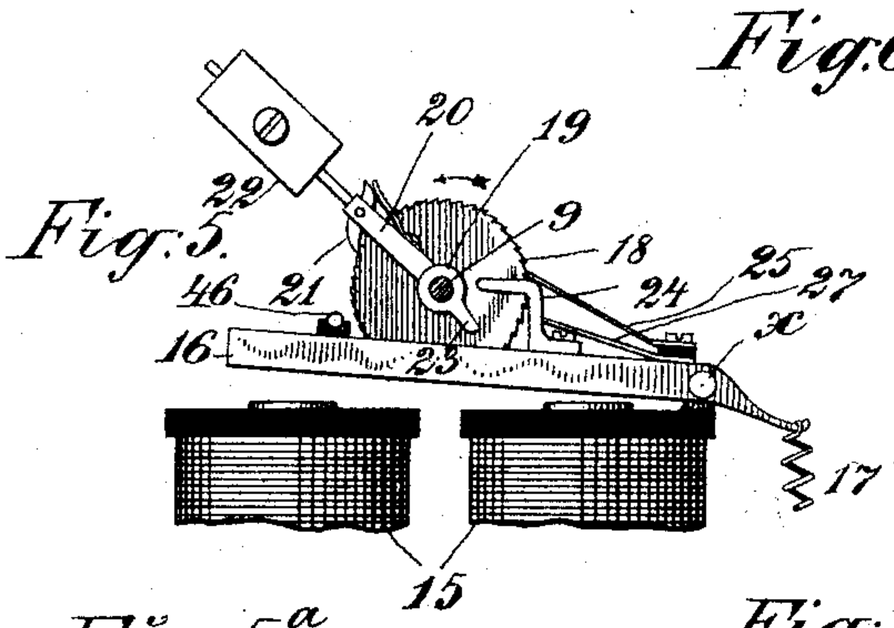



Fig. 6.

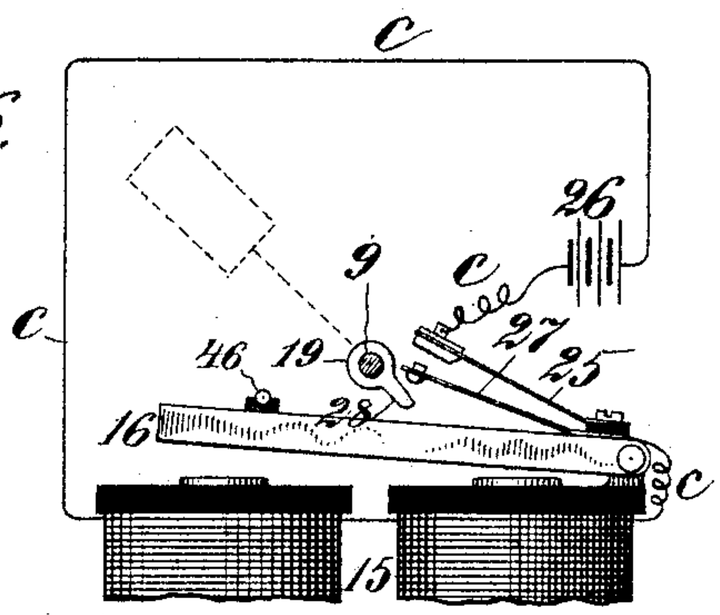



Fig. 5a.

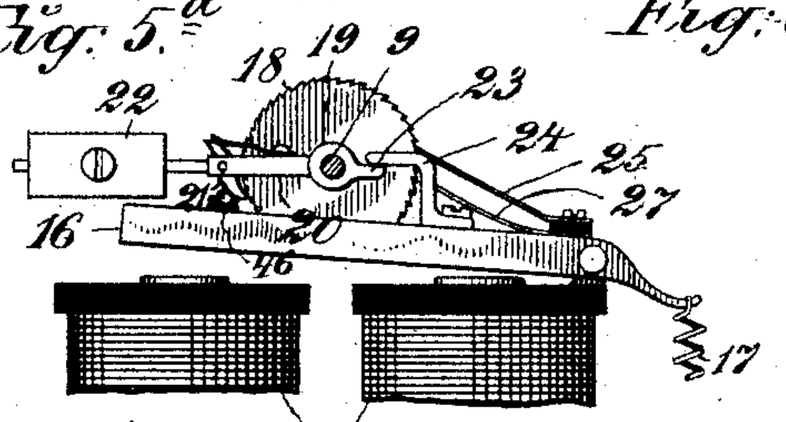



Fig. 6a.

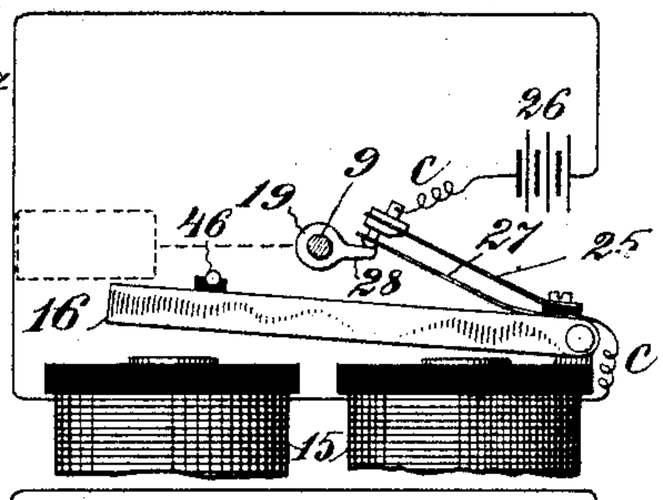



Fig 5b.

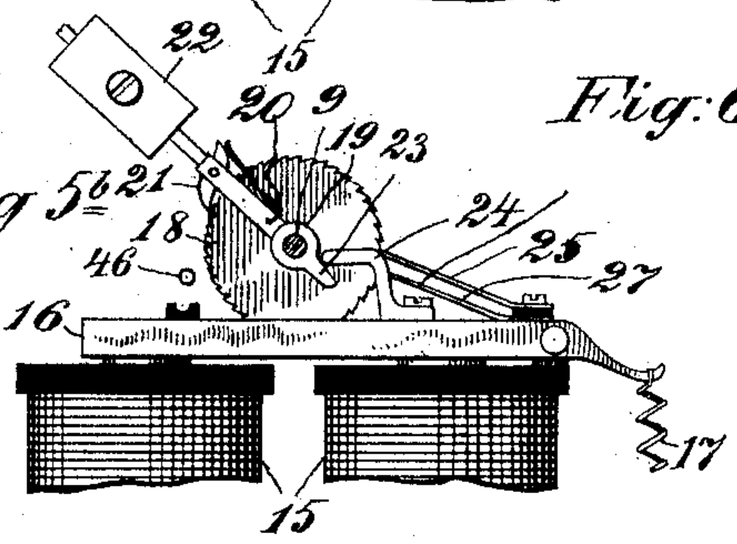



Fig. 6b.

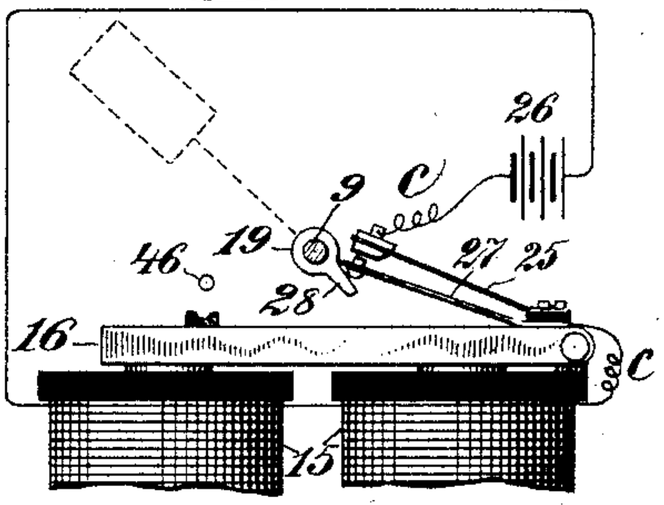



Fig. 7.

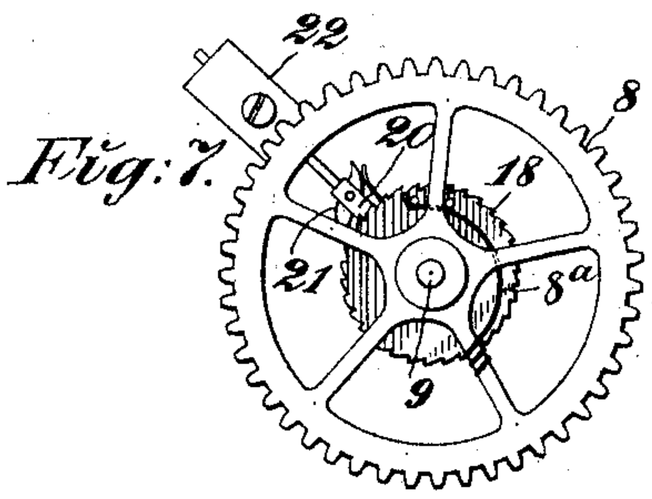



Fig. 8.

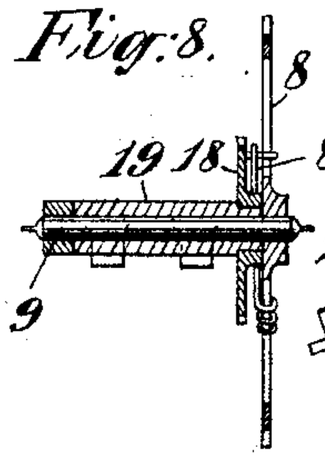
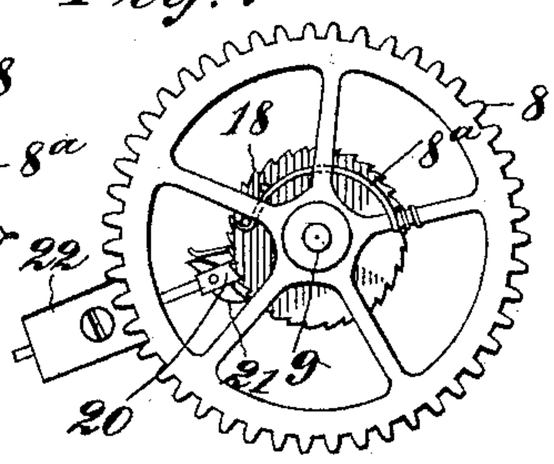



Fig. 7a.

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No. 620,864. Patented Mar. 7, 1899.

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## ELECTRIC CLOCK.

(Application filed Sept. 22, 1897.)

(No Model.) 5 Sheets—Sheet 5.

Fig: 9.

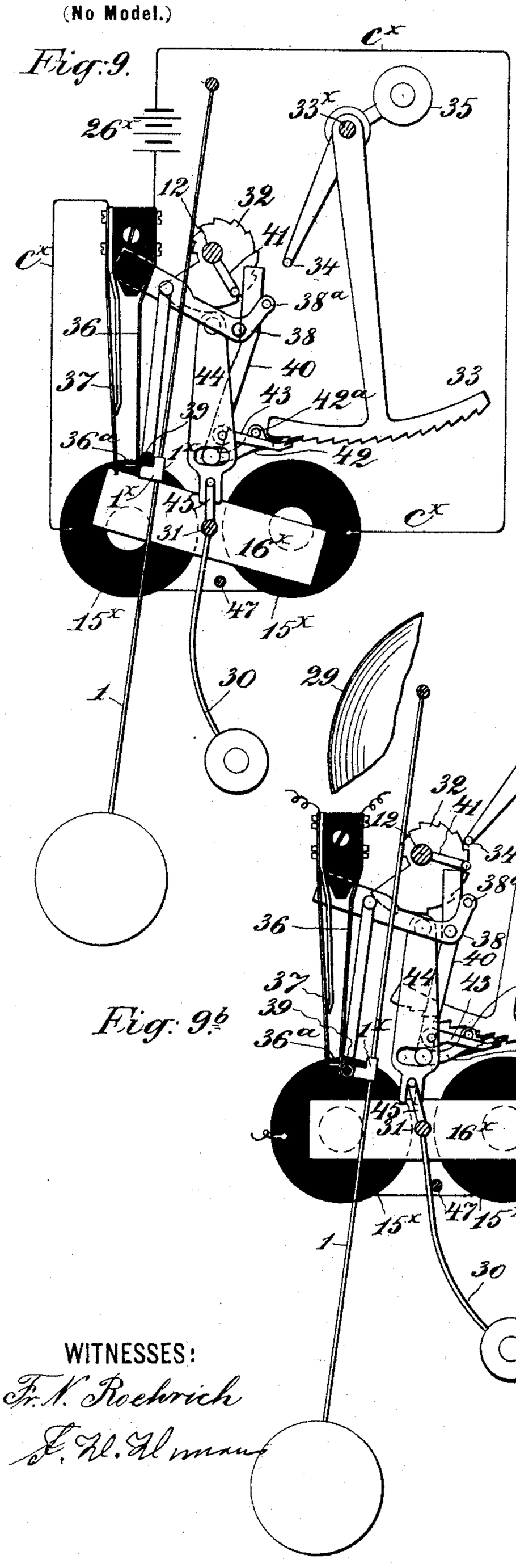


Fig: 9a

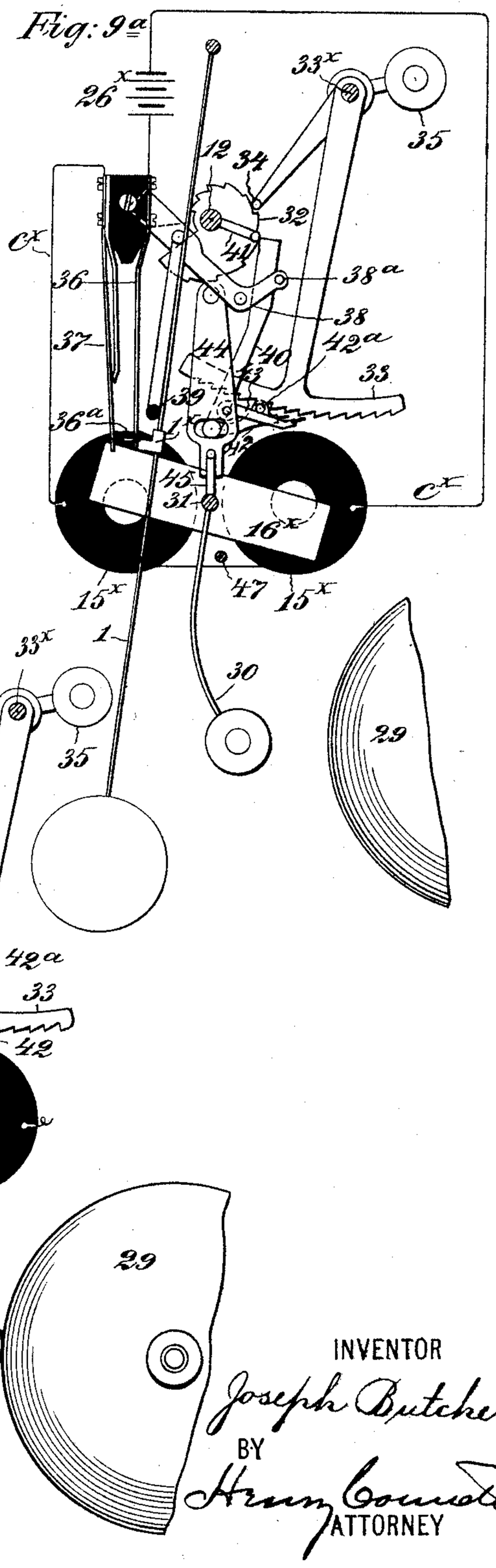


Fig: 9b




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# UNITED STATES PATENT OFFICE.

JOSEPH BUTCHER, OF MELROSE, MASSACHUSETTS.

## ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 620,864, dated March 7, 1899.

Application filed September 22, 1897. Serial No. 652,543. (No model.)

*To all whom it may concern:*

Be it known that I, JOSEPH BUTCHER, a citizen of the United States, residing at Melrose, Middlesex county, Massachusetts, have invented certain new and useful Improvements in Electric Clocks, of which the following is a specification.

This invention relates to the class of electric clocks actuated by a weight raised at intervals by the automatic closing of an electric circuit through an electromagnet; and the object is in part to improve the mechanism for operating the hands of the clock and in part to improve the electrical mechanism for striking the hours, all as will be hereinafter described.

In the accompanying drawings a clock is shown without the striking mechanism, in order to illustrate the clock in its simplest form, and a clock is also shown with a striking mechanism.

In the said drawings, Figure 1 is a face view or elevation of the mechanism of a clock embodying the invention so far only as the driving of the hands of the clock is concerned, and Fig. 2 is a side elevation of the left-hand side of the same. Fig. 3 is a sectional elevation of a clock embodying the invention and including both the means for driving the hands and that for operating a mechanism for striking the hours. This view is a section on line $x^3$ in Fig. 4 as seen from the rear. Fig. 4 is substantially a vertical mid-section of the clock seen in Fig. 3. Figs. 5, $5^a$, and $5^b$ are somewhat diagrammatic detail views illustrating the mechanism for lifting the weight in three different positions; and Figs. 6, $6^a$, and $6^b$ are three similar views, also diagrammatic, illustrating the electrical circuit connections in the three positions seen in Figs. 5, $5^a$, and $5^b$. Figs. 7 and $7^a$ are detail views illustrating a means in two positions for maintaining the movement of the hands while the weight is being lifted, and Fig. 8 is a sectional detail view illustrating the mounting of the weight and its lever. Figs. 9, $9^a$, and $9^b$ are detail views illustrating the striking mechanism under different conditions.

The mechanism for driving the hands, which is the same in both of the illustrated embodiments, will now be described with reference, especially, to Figs. 1 and 2 and the detail views Figs. 5 to 8. As here shown, a pendulum 1 is suspended in the usual manner from a support 2 on an upright base A, and the movement-frame 3 of the clock is mounted on the same base in front of the pendulum. The escapement 4, which may be of the usual kind, is connected with the pendulum by a pendent forked arm 5, also of the usual kind. The arbor 6 of the verge-wheel bears a pinion 7, which gears with a wheel 8, and on the arbor 9 of this wheel is a pinion 10, which gears with a wheel 11 on the main arbor 12 of the clock. This arbor bears the minute-hand 13, the hour-hand 14 being mounted on a sleeve on the arbor 12 and driven from the latter by a train in the usual way. The dial is not shown in the drawings, as it is not necessary to the full understanding of the invention.

The mechanism described above has no special novelty; but its elements have been lettered and designated, so that the novel features now to be described may be clearly understood.

Mounted in the frame 3 is an electromagnet 15, provided with an armature 16, pivotally mounted at $x$, Fig. 5, and held elevated or away from the poles of the magnet by a spring 17. On the arbor 9, Fig. 8, is loosely mounted a ratchet-wheel 18, which is connected to the wheel 8, fixed on said arbor, by a maintaining-spring $8^a$. (Seen best in Figs. 7 and $7^a$.) The purpose of this spring will be hereinafter explained; but, as it is not deemed absolutely indispensable, for the purposes of description the ratchet-wheel may be assumed to be secured rigidly to the wheel 8 or to the arbor 9.

On the arbor 9 is a loose sleeve 19, on which is an arm 20, which carries a spring-pawl 21, that engages the teeth of the ratchet-wheel 18, and the weight 22, which serves to drive the clock mechanism. The construction of the mechanism is such that when the armature 16 is attracted by the electromagnet the sleeve 19 is partially rotated on the arbor 9, thus raising the weight-arm and weight, the pawl 21 riding over the teeth of the ratchet-wheel and engaging them above, and the means for effecting this result will now be described, with especial reference to Figs. 5, $5^a$, and $5^b$.

On the sleeve 19 is a projecting lug 23, called the "lifting-lug," which when the weight 22 shall have descended to its lowest point, Fig. 5ª, takes under a shoulder or bracket 24 on the armature, and when the armature is attracted to the magnet this bracket acts on and depresses the lifting-lug, so as to rotate the sleeve 19, thus elevating the weight 22. The parts then occupy the positions seen in Fig. 5ᵇ. The movement of the armature to the magnet, however, instantly breaks the circuit through the magnet, and the spring 17 again elevates it or moves it away from the magnet, and the parts will then occupy the positions seen in Fig. 5, which may be taken as the starting-point, the weight 22 being then in its elevated position and acting through the arm 20 and pawl 21 to rotate the ratchet-wheel in the direction of the arrow in this figure, and thus drive the mechanism of the clock.

It should be explained that in Figs. 5, 5ª, and 5ᵇ the ratchet-wheel is represented, for convenience of illustration, in full lines and back of the other parts; but as a matter of fact it is in front of them, as will be seen in Fig. 2. Figs. 5, 5ª, and 5ᵇ are diagrammatic in this respect.

The electrical connections and the circuit closing and breaking devices are best illustrated in Figs. 6, 6ª, and 6ᵇ and will now be explained.

A stiff arm 25, here shown as mounted on and insulated from the armature, forms one terminal of the circuit *c*, which includes a generator 26, preferably a dry battery, and the electromagnet 15, the other terminal being a light spring-arm 27. The arms 25 and 27 carry contact-pieces, preferably of platinum, at their respective free ends, which may be brought together to close the normally open circuit by an upward pressure, as here shown, on the spring-arm 27, and this closure is effected when the weight 22 shall have descended to its lowest point by a closing-lug 28 on the sleeve 19, as seen in Fig. 6ª. Thus when the weight has descended to the predetermined extent the electric circuit is closed, the electromagnet excited, the armature attracted, and the weight instantly elevated to the position seen in Fig. 5; but this elevation of the weight by rotation of the sleeve 19 removes the pressure of the closing-lug 28 on the spring-arm 27 and allows the latter to spring away and again break the circuit, so that the movements of the armature to and from the magnet are effected instantaneously, being so rapid that the eye can scarcely detect them. This lifting of the weight is of course periodical and may be effected about every two minutes, the weight driving the clock mechanism during that period, and the movement of the armature in lifting the weight being so rapid, occupying only a very small fraction of a second, this fraction may be disregarded in an ordinary clock. However, if it be desired, the maintaining-spring 8ª, before referred to as connecting the ratchet-wheel 18 with the wheel 8, may be employed to maintain the movement of the wheel 8 while the weight is being lifted.

The above-described mechanism for driving the hands of the clock differs from that ordinarily employed in this form of clocks in the employment of special elastic contact devices distinct from the lifting devices, whereby the attraction of the armature raises the weight. The contact devices are actuated by a special lug on the sleeve 19, and the instant the armature is drawn down, so as to raise the weight, the spring-contacts separate and the circuit is broken.

The construction of the striking mechanism will now be described with especial reference to Figs. 3 and 4 and to the detail views Figs. 9, 9ª, and 9ᵇ, these latter being somewhat diagrammatic.

29 is an ordinary gong or bell, and 30 the hammer of the same. The arm of the hammer is fixed to a rocking arbor 31 in the frame 3, on which is fixed an armature $16^{\times}$ of an electromagnet $15^{\times}$. Normally the armature and hammer-arm occupy the positions seen in Figs. 9 and 9ª; but when the magnet is excited the armature is rocked to the position seen in Fig. 9ᵇ, whereby the head of the hammer is caused to strike the bell. On the same arbor with the hour-hand is the usual snail 32 to determine the number of strokes corresponding to the hour. 33 is the rack, suspended from a rock-shaft $33^{\times}$ in the frame and provided with an arm having a stud 34 to bear on the snail 32 and a weight 35 to bring the rack back and the stud up to the snail.

36 and 37 are two spring-terminals of a circuit $c^{\times}$, including the magnet $15^{\times}$ and a generator $26^{\times}$. On the terminal 36 is a suitable contact pin or piece 36ª, which may be brought to bear on the terminal 37 by a light pressure on the terminal 36.

On the vibrating pendulum 1, or, as here shown, on the forked arm 5, which swings with the pendulum, is fixed a block $1^{\times}$, which when the pendulum reaches the farthest limit of its swing, Fig. 9ª, approaches closely to the terminal 36, and suspended from one arm of a lifting-lever 38 on the frame is an interposing piece 39, adapted to be dropped down to a position in the path of the block $1^{\times}$ on the pendulum, so that in its swing the piece 39 will interpose between said block and the terminal 36 and when the pendulum swings to that side cause the stud 36ª on the terminal 36 to touch the terminal 37 and close the circuit through the electromagnet $15^{\times}$, thus actuating the hammer of the striking mechanism. A pin or projection 38ª on the other arm of the lever 38 takes behind an upright arm 40, pivotally mounted at its lower end on a stud in the frame, said arm 40 being in the path of the ordinary lift-hook pin 41 on the arbor 12, which carries the minute-hand. Fixed rigidly to the pivot-boss of the arm 40 is the detent-pawl 42, which engages the teeth

of the rack 33, the operating-pawl 43 being mounted pivotally on a swinging pawl-carrier 44, suspended on the frame 3 at its upper end and having a slot in its lower free end which is engaged by a short arm 45 on the rocking arbor 31, carrying the bell-hammer and the armature $16^{\times}$. The operating-pawl 43 is held up to the rack by a light weight $43^{a}$, back of its pivot, as indicated in Figs. 3 and 4, or by any well-known means.

The operation is as follows: When the minute-hand approaches the numeral "12" on the dial, the lift-hook 41 will be in position to engage the upright arm 40, Fig. 9, and as the said hand nears the hour-numeral the arm 40 will be pressed back by the hook 41. The effect of this is to depress the detent-pawl 42 out of engagement with the teeth of the rack 33, and as the detent-pawl has a laterally-projecting stud $42^{a}$, which takes over the operating-pawl, this latter will also be depressed out of engagement with the rack-teeth. The weight 35 of the rack now swings the latter over to the position seen in Fig. $9^{a}$ until the stud 34 comes in contact with the snail 32. The lift-hook 41 passes the end of the arm 40 at the moment the minute-hand reaches "12" on the dial, and the weighted arm of the lever 38 swings the arm 40 over to the position seen in Fig. $9^{b}$, allowing the pawls to engage the rack and also permitting the interposing piece 39 to descend to its operative position in the path of the block $1^{\times}$. Now when the pendulum 1 swings over to that side, Fig. $9^{b}$, the block $1^{\times}$ thereon impinges on the piece 39 and through it presses the contact-pin on the terminal 36 into contact with the terminal 37, thus closing the circuit through the magnet $15^{\times}$. The magnet is excited, and the armature $16^{\times}$ is thus brought instantly to the position seen in Fig. $9^{b}$, and the hammer strikes the bell 29. This movement of the armature also causes the short arm 45 to swing the pawl-carrier 44 over in such a way as to retract the operating-pawl 43 to the extent of one tooth. The pendulum now swings back, the circuit is broken between the terminals 36 and 37, and the hammer falls back from the bell by gravity, thus swinging the pawl-carrier in the opposite direction and moving the rack 33 ahead one tooth. This operation will be repeated at each swing of the pendulum until at the last stroke, when the operating-pawl by engaging the last tooth of the rack pushes the latter forward and causes the uncut heel or inclined face of the rack to wipe over the detent-pawl, thus depressing the latter slightly and acting through the arm 40 and lever 38 to thus raise the interposing piece 39 up out of the path of the block $1^{\times}$. The operating-pawl now acts as a detent-pawl and holds the rack, Fig. 9, in this normal position until the minute-hand shall have traversed the dial again.

I do not of course make any claim to the snail 32, the pin or stud 34, and the rack 33, as these are common devices in the striking mechanisms of clocks.

In order to limit and cushion the back movement of the armature 16, a detent 46 may be placed above it, as shown, and in order to limit the movement of the armature $16^{\times}$ and arrest the hammer-head, so that it may strike the bell by the elasticity of the hammer-arm, a stud 47 may be employed, as indicated in Figs. 9, $9^{a}$, and $9^{b}$.

The ratchet-wheel 18 will have a detent-pawl 48. This is a common device and obviously may be arranged in various ways. In order to limit the movement of the rack 33, a stop or detent may also be provided. In the drawings, Fig. 3, this stop 49 is shown placed so as to engage the weight 35.

As before stated, the block $1^{\times}$ is really mounted on the forked arm 5; but this is only because this arm is, in the construction shown, in the most available position. The arm 5 moves with the pendulum, and, mechanically speaking, the block $1^{\times}$ moves with and is carried by the pendulum.

So much of this invention as relates to driving the hands of a clock may of course be employed for driving any similar light-running mechanism as well; but it is especially well adapted for driving a clock or other timepiece. The electric energy may be derived from any generator, whether situated near the clock or not.

Obvious equivalents for the several mechanical devices shown may of course be substituted therefor. The invention is not limited strictly to devices shown. The block $1^{\times}$ may be a part of the pendulum and practically is a part thereof. The circuits $c$ and $c^{\times}$ may be complete circuits, including each a generator, the latter being within the clock-case, or they may obviously be only partial circuits, so far as the clock is concerned, adapted to be completed by coupling them to public or street wires.

Having thus described my invention, I claim—

1. As a means for imparting rotation to an arbor of a shaft by regular impulses, the combination with a ratchet-wheel fixed on said arbor, and a weighted pawl-carrier and pawl adapted, in its descent, to impart a partial rotation to said ratchet-wheel, of an electromagnet, its armature provided with a bracket 24, to engage a lug 23 on the pawl-carrier and raise the same when the armature is attracted, the said lug 23, a partial electric circuit including said electromagnet, and means for closing the circuit through said magnet when the pawl-carrier descends, said means comprising the arm 25, mounted on and insulated from the armature and forming one terminal of the circuit, the spring-arm 27, carried by the armature and forming the other terminal of the circuit, the contact on the arm 27 being situated below that on the arm 25, and a lug 28, carried by the weighted pawl-arm and situated below the arm 27, said lug being in position to press upward the spring-terminal into contact with the upper terminal when

the pawl-arm shall have descended to its lowest point, substantially as set forth.

2. In a clock, the combination with the driving-arbor 9, the wheel 8, fixed thereon, the ratchet-wheel 18, loose thereon, and the maintaining-spring 8ª, connecting said wheels 8 and 18, of the sleeve 19, loose on the arbor 9, and provided with the lifting-lug 23 and circuit-closing lug 28, the pawl-carrying arm 20, fixed to said sleeve, the pawl 21 and weight 22, on said arm, the electromagnet 15, provided with an armature 16 and armature-spring 17, the bracket 24 on the armature and engaging the lifting-lug, and an open, partial electric circuit having terminals 25 and 27, one of said terminals being in the path of the upwardly-moving lug 28, whereby the descent of the weight 22 is adapted to bring said terminals together, substantially as set forth.

3. In a clock, the combination with a bell, its hammer, and a rock-shaft to which the hammer is attached, of an electromagnet, its armature carried by said rock-shaft, a normally open electric circuit including a generator and said electromagnet, said circuit having terminals adjacent to the path of some part of the pendulum of the clock, the said pendulum, a movable interposing piece adapted to be moved into the space between the pendulum and one of said terminals, whereby the pendulum is caused to close the said circuit at each of its vibrations, means for regulating the number of strokes on the bell and means independent of the pendulum for operating the said interposing piece, substantially as set forth.

4. In an electrically-operated striking mechanism for a clock, the combination with the rack 33, the hammer and bell, the former fixed to a rock-shaft 31, the said rock-shaft, electrical means for rocking said shaft and thus causing the hammer to strike the bell, the operating-pawl engaging the rack 33, said pawl being mounted on a suspended pawl-carrier 44, said pawl-carrier, the arm 45 on the rock-shaft engaging said pawl-arm, whereby the pawl is moved to and fro at each stroke of the hammer, a stop-pawl engaging the said rack, and means for controlling the electric energy which actuates the hammer.

5. In an electrically-operated striking mechanism for a clock, the combination with the rack 33, the hammer and bell, a rock-shaft 31 carrying said hammer, electrical means for rocking said shaft and thus actuating the bell-hammer, an operating-pawl 43, engaging said rack, means whereby the rocking of said shaft operates said pawl, a stop-pawl 42, engaging said rack, an arm 40, rigidly connected with the stop-pawl and situated in the path of the strike-pin of the clock, the said pin, the lever 38, having a pin 38ª which takes behind the arm 40, an interfering-piece 39, carried by said lever and adapted to be moved by the depression of the stop-pawl, the pendulum of the clock, and means substantially as described whereby the position of the piece 39 governs the electric energy which actuates the hammer.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JOSEPH BUTCHER.

Witnesses:
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PETER A. ROSS.