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RECIPROCATING ELECTRIC MOTOR

Original Filed Aug. 29, 1930

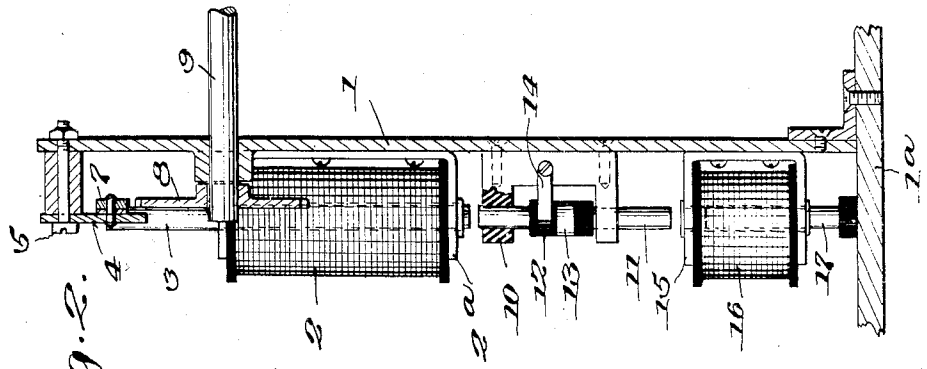


Fig. 2.

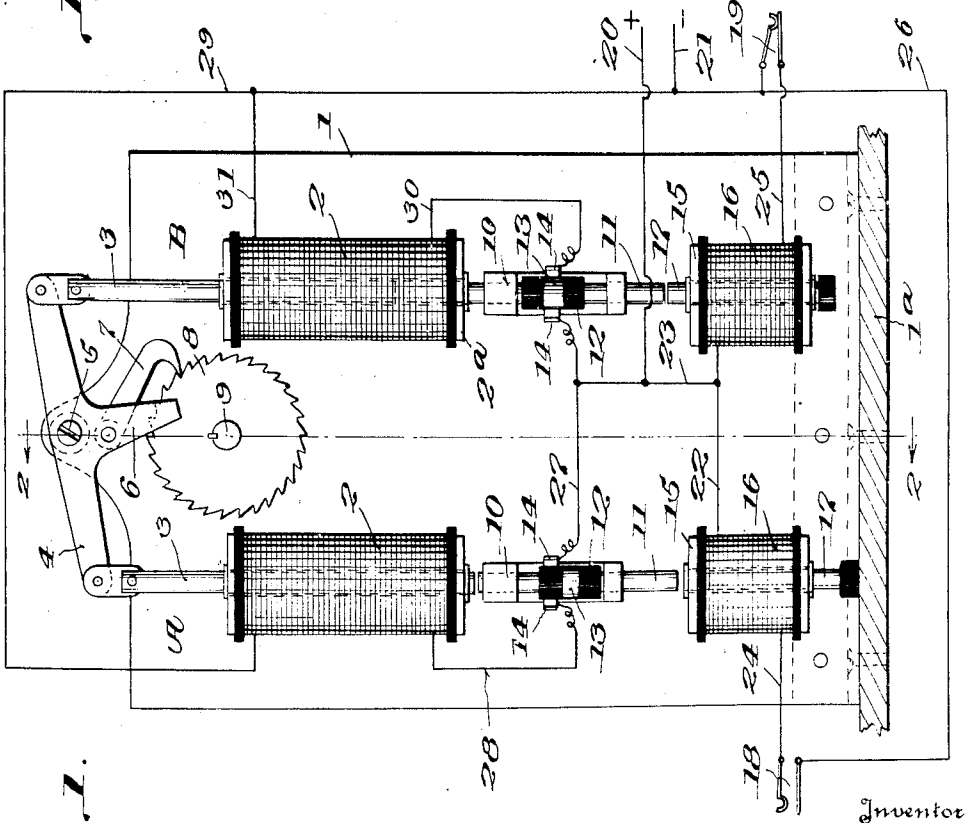


Fig. 1.

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RECIPROCATING ELECTRIC MOTOR

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8 Claims. (Cl. 175—335)

This invention relates to electric motors, and more particularly to reciprocating motors comprising one or more solenoids and means for controlling the supply of current thereto.

The present application constitutes a division of my prior application, Serial No. 478,760, filed August 29, 1930. Said prior application relates to game apparatus embodying in its construction registering mechanism operated by means of electromagnets and solenoids. In my said prior application, this mechanism was claimed only in combination with and as part of the game apparatus, while the present application is directed broadly to my improved arrangement of magnets and solenoids considered as a reciprocating electric motor.

In connection with mechanism comprising a solenoid mechanically coupled to some device to be actuated, is frequently happens that it is desired to operate said solenoid by means of a current impulse which is so short that the solenoid sometimes is not able to complete its stroke, with the result that the parts are left in an intermediate position. This may be due to the sluggishness of the solenoid or to the inertia of the mechanically connected device. The current impulses may be produced, as in my prior application, by the impact of a projectile with a circuit closer or contact device, or by engagement therewith of a rapidly moving element such as a wheel or the like.

The object of the present invention is to devise means whereby the energization of such a solenoid, initiated by the momentary operation of a contact device, will be maintained, independent of such device, until the solenoid completes its stroke. To this end I employ a pilot magnet for closing the circuit of the solenoid and provide a switch in said circuit so located as to be engaged and operated by the solenoid core itself when it reaches a predetermined point in its movement.

In order that the invention may be readily understood, reference is had to the accompanying drawing, in which:

Figure 1 is a front elevation of mechanism such as shown in my said prior application and comprising a pair of solenoids constructed to operate a ratchet wheel; and

Figure 2 is a vertical section taken substantially on the line 2—2 of Figure 1, looking in the direction of the arrows.

My improved motor mechanism is shown as comprising a pair of units designated A and B, each unit having a solenoid 2, the core 3 of which is pivotally connected to the end of a walking beam or lever 4 pivoted at 5 to the frame 1. The solenoids 2 are supported on this frame, preferably in a vertical position, by means of brackets 2^a, and the frame 1 rests upon and is secured to a base 1^a.

The lever 4 has an arm or extension 6 to which is pivoted a pawl 7 adapted to engage the teeth of a ratchet wheel 8 secured to a shaft 9 journaled in the frame 1 and adapted to drive any desired device. It will be observed that when the lever 4 is oscillated, the pawl 7 causes the ratchet wheel 8 to revolve.

Secured to the frame 1 beneath each solenoid 2 is a bracket 10 of insulating material, and mounted to reciprocate through alined openings in said bracket is a plunger 11 carrying a block of insulation 12 in which is set a metal ring 13. A pair of brushes 14 are secured to the bracket 10 and are adapted to resiliently bear against the cylinder 12 and ring 13. Obviously when the block 12 is in the position shown in Figure 2 the circuit between the brushes 14 is open, but when the plunger 11 is shifted into such a position as to bring the ring 13 between the brushes 14, as shown at the right of Figure 1, then the circuit between these brushes is closed.

Mounted beneath each bracket 10, and secured to the frame 1, as by means of a bracket 15, is a pilot magnet or small solenoid 16 having a movable core 17. Preferably, and as shown, the core 3 of each unit, the plunger 11 and the core 17 are all in alinement one over the other.

When the pilot magnets are de-energized, the core 17 rests upon the base 1^a, as shown in Figure 2, and at the left in Figure 1, but when either pilot magnet 16 is energized, the core 17 rises, engages the lower end of the plunger 11 and shifts the same upwardly so as to bring the ring 13 between the brushes 14. It will be understood that frictional means (not shown) are provided for maintaining the plungers 11 in any position to which they may be shifted. Thus, when such plungers are elevated, as shown at the right in Figure 1, they will remain elevated until pushed down by engagement of one of the plungers 3 with the upper end thereof.

Two circuit closers or contact devices 18 and 19 are provided. These may be located at any desired point and operated by any desired means. They are in the nature of spring devices which may be brought together or closed by engagement with some moving object, but which, as soon as such engagement ceases, automatically move apart or open.

20 and 21 represent the positive and negative sides, respectively, of a supply circuit for furnishing current to the apparatus. The positive lead 20 is connected by wires 23 and 22 with one side of each of the pilot magnets 16, while the other side of these pilot magnets is connected by wires 24 and 25 with one member of the circuit closers or contact devices 18 and 19, respectively.

The negative lead 21 is connected by wire 26 with the other member of each of said contact devices 18 and 19, so that upon closing of either of these contact devices, as for example the device 19, current is supplied to the corresponding pilot magnet 16 and the same is energized.

The positive lead 20 is also connected through a wire 27 with one member of each pair of brushes 14. The other member of the pair of brushes of unit A is connected by wire 28 with one side of the solenoid 2, and the other member of the pair of brushes 14 of unit B is connected by wire 30 with one side of the corresponding solenoid 2. The other side of each of the solenoids 2 is connected through wires 29 and 31 with the negative lead 21.

Thus, when one of the contact devices such as 19 is momentarily closed, as by the engagement therewith of a rapidly moving object such as a falling projectile or rotating wheel, the corresponding pilot magnet 16 is momentarily energized, this magnet being relatively small and being quick to respond. The energization of such magnet causes the core 17 thereof to move upwardly and shift the plunger 11 into the position shown at the right in Figure 1 in which the ring 13 connects the pair of brushes 14. Current then flows from the positive lead 20 through wire 27, brushes 14, wire 30, solenoid 2, wire 31 and wire 29 back to the negative lead 21. This energizes the solenoid 2 and causes the core 3 to be drawn down. The solenoid remains energized until the lower end of the core 3 engages the upper end of the plunger 11 and pushes it down into the position shown in Figure 2 in which the circuit of the solenoid is interrupted at the brushes 14.

In practice, the arrangement is such that the contact devices 18 and 19 are momentarily closed alternately. Thus, after the unit B has operated as described, the contact device 18 is next actuated, thus causing unit A to similarly operate. In this way the lever 4 is oscillated and the ratchet wheel 8 rotated.

It will be observed that the circuit of the operating solenoid is closed by the action of a momentary current impulse on the pilot magnet and that it remains closed until opened by the movement of the solenoid core itself. In this way a complete stroke is always insured.

While I have shown and described my improved mechanism as comprising a pair of units arranged to cooperate with each other to drive a ratchet device, it will be understood that the invention is not limited to the use of a pair of units, but may equally well be embodied in a single unit comprising a solenoid and pilot magnet. In the case of such a single unit, suitable means would, of course, be provided for returning the solenoid core to initial position after each operation.

What I claim is:

1. A reciprocating electric motor comprising a solenoid, mechanism to be driven connected with said solenoid, a circuit for supplying said solenoid with current, means responsive to a momentary impulse for closing said circuit, and mechanical means operated by said solenoid at the completion of its stroke for opening said circuit, said mechanical means serving to maintain said circuit open until again closed by said first mentioned means.

2. A reciprocating electric motor comprising a solenoid, mechanism to be driven connected with said solenoid, a circuit for supplying said solenoid with current, a pilot magnet which, when energized, serves to close said circuit, and mechanical means whereby the movement of the core of the solenoid itself serves to open said circuit, said mechanical means serving to maintain said circuit open until again closed by said first mentioned means.

3. A reciprocating electric motor comprising a solenoid, mechanism to be driven connected with said solenoid, a circuit for supplying said solenoid with current, a contact device for closing said circuit, means independent of said contact device for maintaining said circuit closed while said solenoid makes its stroke, and means positioned to be engaged and actuated by the core of said solenoid at a predetermined point in its movement for opening said circuit.

4. A reciprocating electric motor comprising a solenoid, a circuit for supplying current thereto, a switch controlling said circuit, a pilot magnet for closing said switch, means whereby the operation of the solenoid itself serves to mechanically open said switch, and means for maintaining said switch open until again closed by said pilot magnet.

5. A reciprocating electric motor comprising a solenoid, a circuit for supplying current thereto, a switch controlling said circuit, and a pilot magnet, said switch comprising a movable member positioned to be shifted to close said circuit by the energization of said pilot magnet, and to be engaged and shifted to open said circuit by the core of said solenoid itself.

6. A reciprocating electric motor comprising a solenoid, a circuit for supplying current thereto, a switch controlling said circuit, a contact device, means responsive to a momentary actuation of said contact device for closing said switch, means mechanically operated by the solenoid itself for opening said switch and means for maintaining said switch open until again closed by said pilot magnet.

7. A reciprocating electric motor comprising a solenoid, a circuit for supplying current thereto, a pilot magnet mounted adjacent said solenoid, a switch controlling said circuit and physically positioned between said solenoid and pilot magnet, means whereby a momentary energization of said pilot magnet serves to close said switch and the movement of the core of said solenoid serves to open it, and means for maintaining said switch open until again closed by said pilot magnet.

8. A reciprocating electric motor comprising a pair of solenoids having cores, a pivoted lever to opposite ends of which said cores are connected, a ratchet wheel, a pawl carried by said lever and constructed to engage said ratchet wheel, separate circuits for supplying said solenoids with current, a pair of contact devices, means whereby the alternate momentary actuation of said contact devices serves to alternately close said circuits and energize said solenoids, means for maintaining said circuits temporarily closed after said contact devices have opened, and means whereby each solenoid, when energized, serves to open its own respective circuit.

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