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B. F. CARPENTER.

KINETIC SOLENOID.

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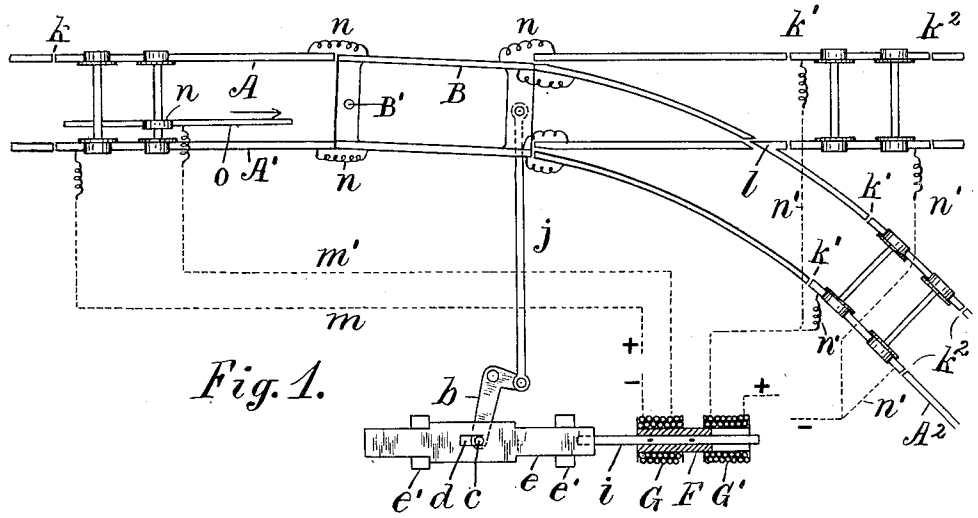


Fig. 1.

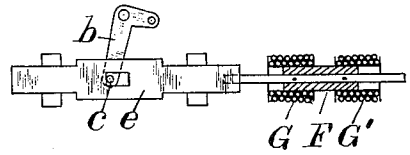
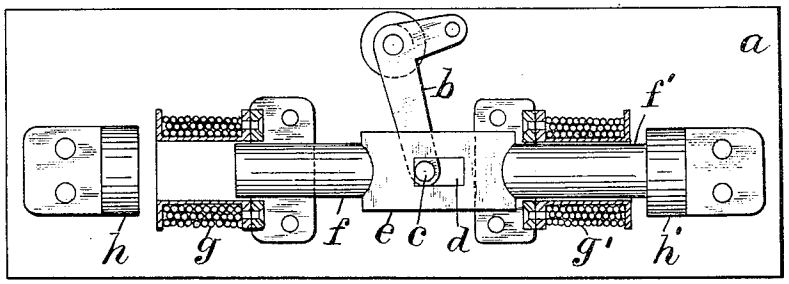


Fig. 2.

Fig. 3.



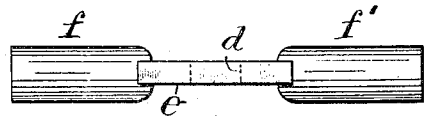


Fig. 4.

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UNITED STATES PATENT OFFICE.

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KINETIC SOLENOID.

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Application filed May 12, 1904. Renewed December 30, 1905. Serial No. 293,934.

To all whom it may concern:

Be it known that I, BENJAMIN F. CARPENTER, a citizen of the United States, whose residence and post-office address is 132 Chestnut street, Roselle Park, county of Union, State of New Jersey, have invented certain new and useful Improvements in Kinetic Solenoids, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

The present invention relates to that class of switch-shifting devices which is adapted to move the switch or analogous body at irregular or arbitrary intervals and employs an armature which moves through a greater distance than the body, so as to operate by its momentum, and thus produce a greater effect in propelling the body than can be secured by the direct application of the same magnetic attraction. In this invention a solenoid is provided with a sliding armature having a greater movement than that of the body and so connected with the body to be moved that the armature when the solenoid is energized is first moved clear of any resistance from such body and then impacts with the body, so that the momentum of the armature is combined with the attraction of the solenoid in the actual moving of the body. The energy thus exerted is much greater than the mere pull of the solenoid in its first operation upon the armature, as it is well known that the attraction of a solenoid increases up to a certain point as the armature moves into the coil. The stroke of the body may be definite, and the stroke of the armature is preferably limited by firm stops, so as to control its movement entirely independent of the body which is to be moved.

I have termed the device a "kinetic" solenoid, as the invention belongs to that class in which a solenoid is used, and the armature is set in motion before it is employed to perform any work.

The invention is illustrated herein in connection with a switch in a railway-track and with means for holding the switch open until a car has passed safely from the main track onto a siding or branch; but the invention may be applied to various other purposes, as for actuating valves, signal apparatus, and other devices.

In the drawings, Figure 1 is a plan of a railway-track with the solenoid and its connections to the switch shown in diagrammatic form with the armature at one end of its stroke and a slot in the armature applied to a crank-pin for moving the switch. Fig. 2 shows the armature moved toward the crank-pin to impact with the same and move the switch. In Figs. 1 and 2 a single armature is shown connected with a slotted bar by a tie-rod and two solenoids applied to such armature. Fig. 3 shows a plan of a construction in which two armatures are connected with opposite ends of the slot-bar and a separate solenoid applied to each armature. In Figs. 1, 2, and 3 the solenoids are shown in section. Fig. 4 is an edge view of the slotted bar with an armature at each end.

In Fig. 3, *a* designates a bed-plate upon which a lever *b* is pivoted to move any object with which it may be connected. The lever has a crank-pin *c*, fitted to a slot *d* in a slot-bar *e*, and armatures *f* and *f'* are connected with opposite ends of the slot-bar.

Solenoid-coils *g* and *g'* are arranged to attract the armatures *f* and *f'*, and stops *h* and *h'* are provided at the rear end of each coil to limit the movement of the armatures and slot-bar. The armature *f'* is shown in contact with the stop *h'*, the armature *f* under such conditions projecting but slightly into the solenoid *g*, so that the attraction of such solenoid when energized is but slight. Such attraction, however, when the solenoid *g* is energized increases rapidly up to a certain limit, so that when the end of the slot contacts with the crank-pin *c* the momentum of the slot-bar and attached armatures operates to move the crank-pin, as well as the increasing attraction of the solenoid *g*.

The stroke of the armature when attracted by the coil *g* is arrested by the stop *h*, which is made of suitable character to resist the concussions, and thus regulates the stroke of the crank-pin *c*. The armatures are shown of cylindrical form and the slot-bar of flat character, held from turning by contact with the crank-lever *b*.

The slot-bar and the armatures are made of very considerable weight in proportion to the parts of the mechanism with which they are connected, so that the movement of the object may be easily effected by the momentum derived from such weight when superadded to the attraction of the solenoid. The slot in the bar gives the armature the same advantage in its reverse movement by the at-

traction of the solenoid g', the stroke being limited at each reciprocation by the stops h and h'.

In Figs. 1 and 2 a single armature F is shown with solenoid-coils G and G′ fitted to the same to reciprocate it in the manner just described, and the armature is connected with the slotted bar e by a tie-rod i. The slot-bar is shown mounted in guides e', while the solenoids themselves form the guide for the slot-bar and armatures with the construction shown in Fig. 3.

In Fig. 1 the main-track rails are designated A A′, the branch-track rails A^2, and the switch-rails B. The rails B are shown tied into a frame and pivoted at B′, with a link j connecting such frame to the lever b. The track-rails and branch rails are shown with an isolated portion extended from k to k', embracing the switch-rails, a portion preceding the switch and a portion succeeding the switch beyond the frog l, where the branch rails leave the main rails. The switch-rails are electrically connected with the adjacent rails by wires n.

The electric operation of the switches is very convenient for operating pneumatic-despatch railways in which single cars carrying freight are propelled in succession by an air-blast, and it is very desirable in such railways that no switch should be shifted after the passage of one car if a succeeding car is too close to permit the switch to be readjusted to the main rails. By the connections shown in Fig. 1 the switch may be kept in a fixed position until the first car has entirely left the main line and prevented from shifting if another car is close enough to be within the danger limit. The track portions between k and k' form what may be termed a "danger-section," and it would not be safe to commence the shifting of the switch if one car succeeded another within such section. Conductors m m' connect the insulating-section k k' and an insulated bar o with the solenoid G. The usual signs + and − are applied to the conductors n and n' adjacent to the solenoids G and G′ in Fig. 1, thus indicating that these conductors are connected to a suitable source of electricity to furnish the current required for operating solenoids. Any form of generator, as a primary battery or dynamo, may be used for supplying the current for such purpose. The axles of a car-truck approaching the switch are shown on the track near the point k with a disk N on one of the axles arranged to contact with the insulated bar o, such contact energizing the solenoid G, which then shifts the switch in line with the branch rails A^2. Insulated sections are formed in the rails extending from k' to k^2 and connected by conductors n' to the solenoid g'.

The passage of the car from the danger-section cuts off the current from the solenoid G and the movement of the car upon the section k' k^2 energizes the solenoid G′, which reverses the movement of the lock-bar and closes the switch. Such operation is, however, prevented if a second car enters the danger-section between k and k' upon either the main rails or branch rails before the first car has reached the section k' k^2, as such second car serves to hold the circuit closed through the solenoid G, and the action of this solenoid is under these conditions more powerful than that of the solenoid G′ when the first car closes the circuit through the coil G′. Such greater power of the solenoid G is due to the fact that the armature is within such solenoid and within the sphere of its greatest attraction, while the solenoid G′ possesses but a feeble attraction upon the armature so long as it remains in the solenoid G. If the car-axle were unprovided with the disk n or with a disk in a different position, the switch would remain closed and the car would continue on the main-line rail.

Various arrangements of the disk and insulated bar o permit cars to be shunted automatically into different stations.

The second car thus safeguards the switch from being shifted, which might cause an accident if the second car should pass the switch before it was fully closed. The holding of the switch in a fixed position until both cars have passed out of the danger-section entirely prevents any accident while passing over the switch, while it compels the second car to pass over the same route as the first, which might not have been its destination. Such divergence of the car from its intended course is, however, much preferable to an accident which would block the track.

The operation of the solenoid G′ upon the switch is the same when the switch is set in line with the main rails, as it then possesses a greater energy than the solenoid G and operates so long as cars are passing over the danger-section of the main rails to hold the switch closed, and thus enable all of such cars to pass the switch safely. I have termed the device by which these operations are effected a "kinetic solenoid," as the solenoid operating with a slot-bar is able by the combined momentum of the bar and the attraction of the coil to do a great deal more work than can be effected by the coil alone, and I have made a special claim to that operation of two solenoids by which each in turn possesses a greater control than the other over the parts to be moved by reason of its greater proximity to the armature connected with such parts.

I am aware that a vibrating armature is used for operating various tools by its momentum, but the conditions in such a construction are entirely different from those to which the present invention is applied, as the momentum of the armature is in striking a

blow upon the tool the chief means utilized to effect the tool; but in the present construction the momentum of the armature is employed chiefly to overcome the inertia of the object to be moved, and thus initiate its movement, while the attraction of the armature operates thereafter to continue the movement of the body when the force of the momentum is entirely expended.

The invention also differs from the use of a vibrating armature to operate a tool, as the present construction is adapted to move the resisting body at irregular or arbitrary intervals, and the electric circuit which actuates the solenoid is operated independently of the resisting body, so as to actuate the solenoid and armature at irregular or arbitrary intervals governed by conditions entirely other than the condition of the resisting body itself. Thus the switch in the example shown may remain open or closed for an indefinite time until the conditions of the service move a car upon or off of a danger-section, which results in energizing one of the solenoids and shifting the switch.

I am aware that solenoids have been employed to actuate railway-switches and do not, therefore, claim a solenoid, broadly, for such purpose.

Having thus set forth the nature of the invention, what is claimed herein is—

1. The combination, with a resisting body having a stud, of a slot-bar fitted to the stud, an armature attached to the slot-bar, and a solenoid adapted to move the armature with the slot-bar at first clear of such stud, and finally, to draw the end of the slot against the stud to move the body by impact.

2. The combination, with a resisting body having a stud, of a slot-bar having slot fitted to the stud, an armature attached to the slot-bar, and a solenoid arranged and operated to move the armature with the slot-bar at first clear of such stud, and finally to move the body by impact with the stud, and to hold the body firmly thereafter by the maximum attraction of the solenoid at the end of said movement.

3. The combination, with a body to be moved through a definite stroke, of an armature having movement greater than such stroke and arranged and operated to impact with the object when its stroke is partially completed, and two solenoids arranged and operated to attract the armature in opposite directions, one or both of such solenoids being adapted to hold the object firmly in position by the maximum attraction of the solenoid at the end of said movement.

4. The combination, with a crank-arm having a crank-pin, of a slot-bar having slot fitted movably to the crank-pin to shift the crank, an armature attached to the slot-bar to move longitudinally therewith, and a solenoid adapted to attract the armature with the slot-bar and to move the crank by the impact and momentum of the slot-bar.

5. In an automatic rail-switch shifter, the combination, with the switch-rails, of a lever connected thereto and having a stud, a slot-bar having slot fitted movably to the stud to shift the lever, an armature connected with such slot-bar, two solenoids adapted to attract the armature in opposite directions, separate circuits for energizing the two solenoids, and means at opposite ends of the switch-rails to be operated by a passing car, for energizing the solenoids successively, whereby the switch may be alternately opened and closed by the reciprocation of the slot-bar.

6. In an automatic rail-switch shifter, the combination, with the switch-rails, of a lever connected thereto and having a stud, a slot-bar having slot fitted movably to the stud to shift the lever, an armature connected with such slot-bar, two solenoids adapted to attract the armature in opposite directions, and to exert their greatest attraction at the opposite ends of the armature's movement, circuits for energizing the two solenoids, and means at opposite ends of the switch-rails to be operated by a passing car for energizing the solenoids successively, the switch being held securely in either position by the maximum attraction of the solenoid upon the armature when the switch-rail is fully moved.

7. In an automatic rail-switch shifter, the combination, with main rails and branch rails, of switch-rails connecting the same and electrically connected with both, means for insulating the switch-rails and the portion preceding and succeeding the same beyond the frog at their junction, to form a "danger-section," a lever connected to the switch-rails and having a stud or crank-pin, a slot-bar having slot fitted movably to the stud to shift the lever, an armature connected with such slot-bar, and a solenoid adapted to attract the armature with circuit closed by the passage of a car over such danger-section, whereby the switch is opened and held opened while any car remains upon such section.

8. In an automatic rail-switch shifter, the combination, with main rails and branch rails, of switch-rails connecting the same and electrically connected with both, means for insulating the switch-rails and the portion preceding and succeeding the same beyond the frog at their junction, to form a danger-section, a lever connected to the switch-rails and having a stud or crank-pin, a slot-bar having slot fitted movably to the stud to shift the lever, an armature connected with such slot-bar, and a solenoid adapted to attract the armature with circuit closed by the passage of a car over such danger-section, a reversing-solenoid to reverse the movement of the armature, a supplemental insulated section beyond the end of such danger-section with a

circuit connected to the reversing-solenoid, such circuit operating when the car passes the supplemental section to energize the reversing-solenoid and shift the switch to the main line.

9. The combination, with a body to be moved and an armature connected therewith, of two solenoids arranged and operated to attract the armature in opposite directions, and either of said solenoids being adapted to hold the armature at the end of its stroke against the primary attraction of the other solenoid.

10. The combination, with a railway-switch moved at irregular or arbitrary intervals, and a slotted connection for actuation by a magnetic armature, of a solenoid having a heavy armature arranged and operated to move at first clear of any resistance from such switch connection, and finally to impact with the switch connection and move the same by the combined energy of the momentum of the armature and the attraction of the solenoid, and an electric circuit connected with the solenoid-coil, with means actuated entirely independent of the solenoid and switch, for operating the said circuit.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

BENJAMIN F. CARPENTER.

Witnesses:

L. LEE,

THOMAS S. CRANE.