A. S. CUBITT.

TIME AND CURRENT LIMIT RELAY.

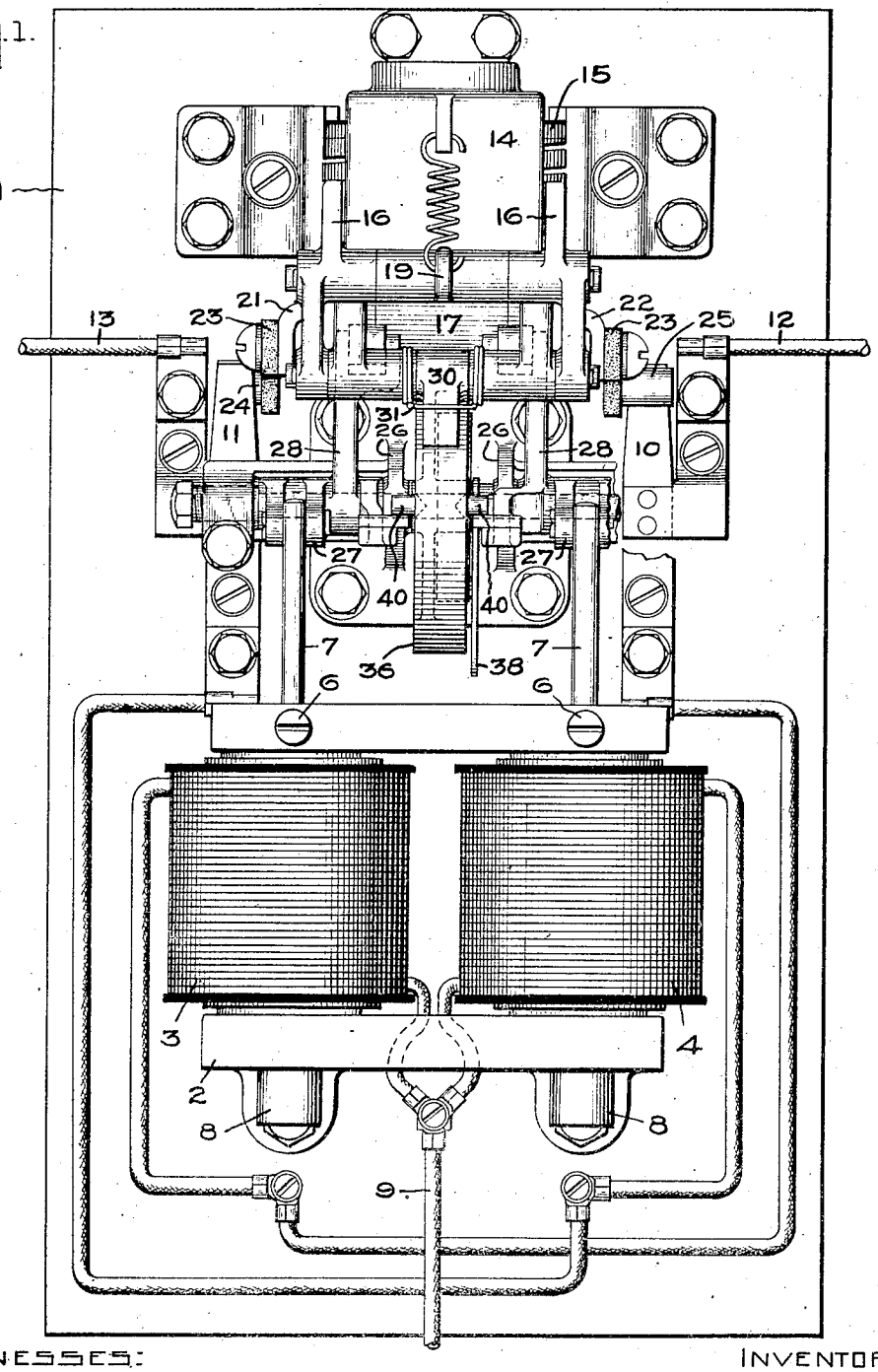
APPLICATION FILED OCT. 15, 1909.

1,019,425.

Patented Mar. 5, 1912.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

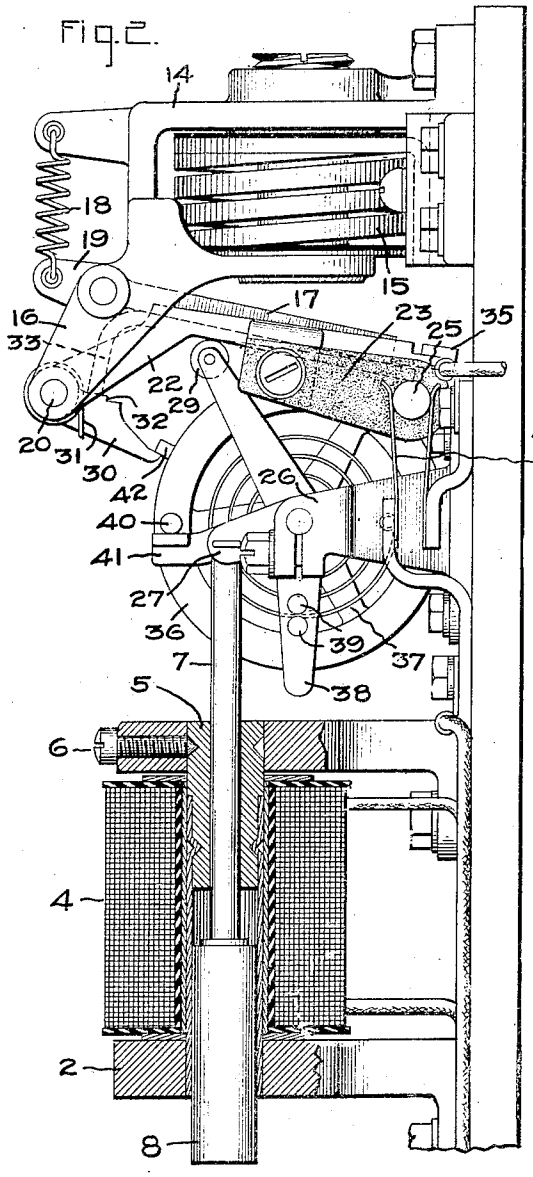


Fig. 3.

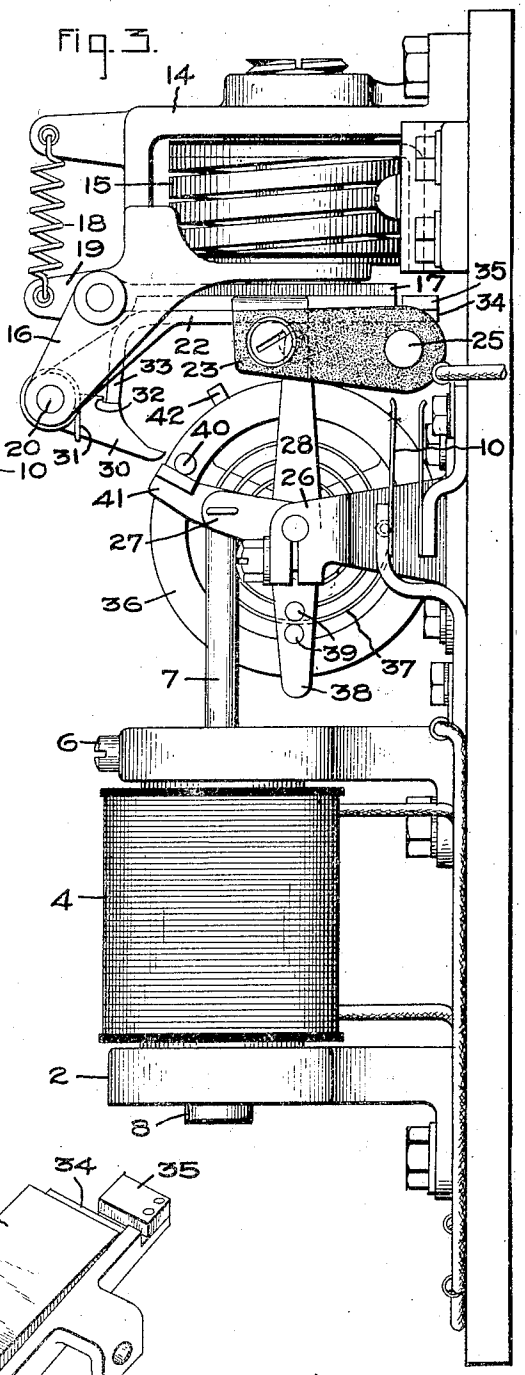
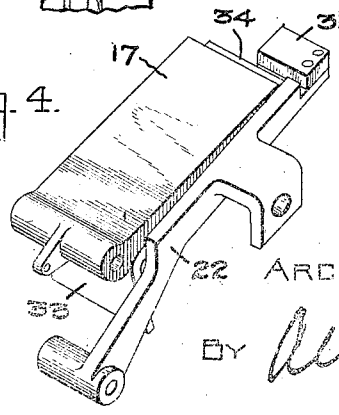


Fig. 4.



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UNITED STATES PATENT OFFICE.

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TIME AND CURRENT LIMIT RELAY.

1,019,425. Specification of Letters Patent. Patented Mar. 5, 1912.

Application filed October 15, 1909. Serial No. 522,799.

To all whom it may concern:

Be it known that I, ARCHIBALD S. CUBITT, a subject of the King of Great Britain, residing at Pittsfield, in the county of Berkshire and State of Massachusetts, have invented certain new and useful Improvements in Time and Current Limit Relays, of which the following is a specification.

This invention relates to the operation of electrically controlled switches and particularly to the operation of a plurality of such switches successively and in a certain order. It is especially useful in connection with systems of electric motor control in which the supply of current is increased step by step by means of a plurality of electrically controlled switches, the successive operation of said switches taking place with a definite interval of time between them. It is now customary to make this interval depend not only upon a mechanical device giving a fixed minimum length to said interval, but also to govern it by an electromagnet in circuit with the motor so that the operation of the next switch will not occur until the counter-electromotive force of the motor cuts down the impressed current to a definite value.

In my pending application filed May 7, 1908, Serial Number 431,442, I have shown such a system in which there are two actuating wires controlled by a relay mechanism so that they are cut into circuit alternately, each wire controlling alternate switches. The present application has reference to a relay mechanism for such a "two-wire notching system," in which a mechanical time-limiting device giving a definite minimum time interval is combined with the current coil in series with the motor and giving a variable time interval. The mechanical time-limiting element I prefer to use is a flywheel, which is set rotating by either of the relay solenoids when energized in a direction opposite to that in which it is biased by a spiral spring. When the energy imparted to it by the relay is expended the spring returns it to a normal position, and the time which is required to effect this operation is the minimum interval between the successive closings of the switches.

In the accompanying drawings, Figure 1 is a front elevation of my improved relay; Fig. 2 is a side elevation, partly in section, showing the relay deënergized; Fig. 3 is a side elevation, showing the position of the parts when the relay is energized; and Fig. 4 is a perspective view of the current coil armature and one of the relay switch-arms.

To a suitable panel 1 of insulating material is secured a two-armed bracket 2 which supports the two relay coils 3, 4. Each coil has an upper fixed tubular core 5 secured by a set screw 6 and serving as a guide for the rod 7 attached to the lower movable core 8. One terminal of each coil is connected to the common supply wire 9, their other terminals being respectively connected with one of a pair of switch contacts 10, 11, each located on the opposite side of the panel from that where its coil is placed. The other contacts of each pair are connected respectively to the actuating wires 12, 13 running to the motor-controlling switches.

Near the top of the panel 1 is secured a bracket 14 which supports the current coil 15. Projecting from said bracket 14 are parallel arms 16 between which is pivoted an armature 17, which is biased away from the coil by a spring 18 attached to the bracket 14 and to a lug 19 extending beyond the pivot of said armature. The lower ends of the arms 16 are connected by a pin 20 on which are loosely pivoted two switch-arms 21, 22. Each arm has a strip 23 of insulating material secured to one side of it, carrying metallic pins 24, 25 each of which is adapted to enter between and connect the contacts 11 or 10 as the case may be, thus closing the circuit of the relay coil connected thereto.

The switch-arms 21, 22 drop and close by gravity, but they are opened by the respective relay coils 3, 4. A bracket 26 projects from the panel 1 near the upper end of each rod 7 and serves as a fulcrum for a crank-arm 27 to which said rod is pivoted. An arm 28 extends from the hub of said crank and carries at its upper end a roller 29 which lies beneath and in contact with the armature 17 and the adjacent switch-arm 21 or 22; said arms being located on each side of the armature in proximity thereto. A latch 30 is loosely pivoted on the pin 20 between the switch-arms, and is biased upward by a spring 31. It is provided with a shoulder 32 which can engage a tongue 33 project-

ing downwardly from the armature 17. At the free end of the armature is a lip 34 adapted to engage beneath lugs 35 extending laterally from the adjacent free ends of the switch-arms 21, 22.

Between the cranks 27 is rotatably mounted a flywheel 36, preferably journaled on the common shaft of said cranks, but free to rotate thereon. A spiral spring 37 is coiled within said flywheel, having one end attached to said wheel and the other to one of the brackets 26. A radial angularly-adjustable lever 38 provided with two studs 39 between which said spring passes, enables the effective length of said spring to be varied at will. From each side of the rim of the flywheel projects a pin 40 with which engages an actuator 41 extending from the hub of the adjacent crank. A radial lug 42 projects from the rim of the wheel and is adapted to trip the latch 30.

The operation is as follows: In accordance with the disclosure in my aforesaid pending application, the relay coils 3, 4 are alternately energized. The lifting of a core 8 turns the crank 27 to which it is connected, and throws over the arm 28, which lifts the corresponding switch arm and removes the contact pin 24 or 25 from its corresponding contacts 11 or 10, opening the circuit of the other relay coil. The arm 28 also lifts the armature 17, bringing it near enough to the current coil 15 to be attracted and held thereby. The energizing of the relay coil is only momentary, the core, crank and arm returning to their normal positions very quickly. Inasmuch as the armature and the switch-arm are pivoted at different points, the lip 34 on the armature will slide under the lug 35 on the switch-arm as they rise, so that when the armature is held by the coil 15 it also supports the switch-arm and keeps the switch open so long as said current coil remains energized. While the armature is adapted to be lifted by each of the arms 28, yet each arm lifts only its corresponding switch-arm, the other not being engaged by the lip on the armature in its normal position. The turning of the crank by the core 8 also throws up the actuator 41 extending from said crank. This, by reason of its engagement with the pin 40, imparts a rotary movement to the flywheel 36, which turns over until its momentum is checked by the increasing tension of the spring 37. This turning of the wheel removes the lug 42 from engagement with the spring latch 30, allowing said latch to rise so that its shoulder 32 will engage the tongue 33 on the armature and lock the armature in its raised position. The switch is thus kept open not only by the attraction of the current coil but also by the mechanical lock, and cannot close until the current in said coil is reduced to a certain value and the lock is tripped also. So long as the current persists or the lock remains in service, the switch will be held open. The lock will be tripped when the flywheel makes its return rotation, urged by the spiral spring, and the lug 42 strikes the end of the latch and carries it down to the position shown in Fig. 2. The tension of the spiral spring 37 is greater than that of the spring 31, so that the latter cannot exert any rebounding effect on the wheel. During the time that the switch is open, the other relay cannot be energized, as it is in circuit with said switch. The length of this time interval depends upon two factors, one being the time it takes the flywheel to turn over and return, the other being the subsidence of the current energizing the current coil. The first is a predetermined interval which insures a certain minimum delay between the successive actuation of the motor-controlling switches. The second may cause a longer delay now and then, owing to varying conditions of operation. In either case, the invention provides for a gradual acceleration of the motor by the automatic and alternate operation of the two relay coils.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In an electric switch, a switch member, an electromagnet for operating the same, a flywheel for controlling the operation of said switch member biased to rotate in one direction, and means for moving said wheel against its bias upon the energization of said magnet.

2. In an electric switch, the combination with a pivoted arm for opening said switch, of a fly-wheel biased to rotate in one direction, and an actuator moving with said arm and acting to turn said wheel in the opposite direction.

3. In an electric switch, the combination with a movable switch-arm, of a pivoted arm for opening said switch, a flywheel cooperating with said switch-arm and biased to turn in a direction to close said switch, and means for moving said pivoted arm and simultaneously turning said wheel in the opposite direction.

4. In an electric switch, the combination with a movable switch-arm, of a crank having an arm on its hub for opening said switch, a flywheel biased to turn in one direction, means whereby said wheel effects the closing of said switch, and an actuator on said hub for turning said wheel in the opposite direction when said switch is opened.

5. In an electric switch, the combination with a movable switch-arm, of a crank having an arm on its hub for opening said switch, a lock for holding said switch open, a flywheel biased to turn in one direction, a lug on said wheel to trip said lock, and an actuator on said hub for rotating said wheel

in the opposite direction when said switch is opened.

6. In an electric switch, the combination with a movable switch-arm, of an electromagnet, a pivoted armature therefor adjacent to said switch-arm and adapted to engage therewith when said arm is opened, a crank having an arm for lifting both the switch-arm and the armature, a lock for engaging said armature, a flywheel biased to rotate in one direction, a lug on said wheel to trip said lock, and an actuator on said hub for giving said wheel a rotation in the opposite direction when said switch is opened.

7. The combination with two relay coils adapted to operate alternately, of a switch-arm actuated by each coil and controlling the circuit of the other coil, a flywheel biased to rotate in one direction and close said switch-arms, and means whereby each coil can impart to said wheel a rotation in the opposite direction when said coil opens its switch-arm.

8. In a time and current relay, the combination with two relay coils adapted to operate alternately, of a switch-arm actuated by each coil and controlling the circuit of the other coil, a current coil adjacent to said relay coils, an armature therefor adapted to engage with and hold each switch-arm when open, a lock for said armature, a flywheel biased to rotate in a direction to trip said lock, and means whereby each coil can impart to said wheel a rotation in the opposite direction when said coil opens its switch-arm.

9. In a time and current relay, the combination with two relay coils, of a single current coil, an armature therefor having a lip, two independent switch-arms adjacent to said armature but pivoted at a different point and having lugs adapted to be engaged by said lip, and means whereby each coil can lift said armature and its respective switch-arm to open the circuit of the other coil.

10. In a time and current relay, the combination with two relay coils, of a single current coil, an armature therefor having a lip, two independent switch-arms adjacent to said armature but pivoted at a different point and having lugs adapted to be engaged by said lip, means whereby each relay coil can lift said armature and its respective switch-arm to open the circuit of the other coil, a mechanical lock for holding said armature and arm raised, a flywheel biased to rotate in a direction to trip said lock, and actuators respectively moved by said coils to give said wheel a rotation in an opposite direction simultaneously with the lifting of said armature.

In witness whereof, I have hereunto set my hand this 14th day of October, 1909.

ARCHIBALD S. CUBITT.

Witnesses:

HELEN ORFORD,

BENJAMIN B. HULL.