No. 677,360. Patented July 2, 1901.

C. H. KEENEY.

ELECTRIC CURRENT CONTROLLER.

(Application filed May 6, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

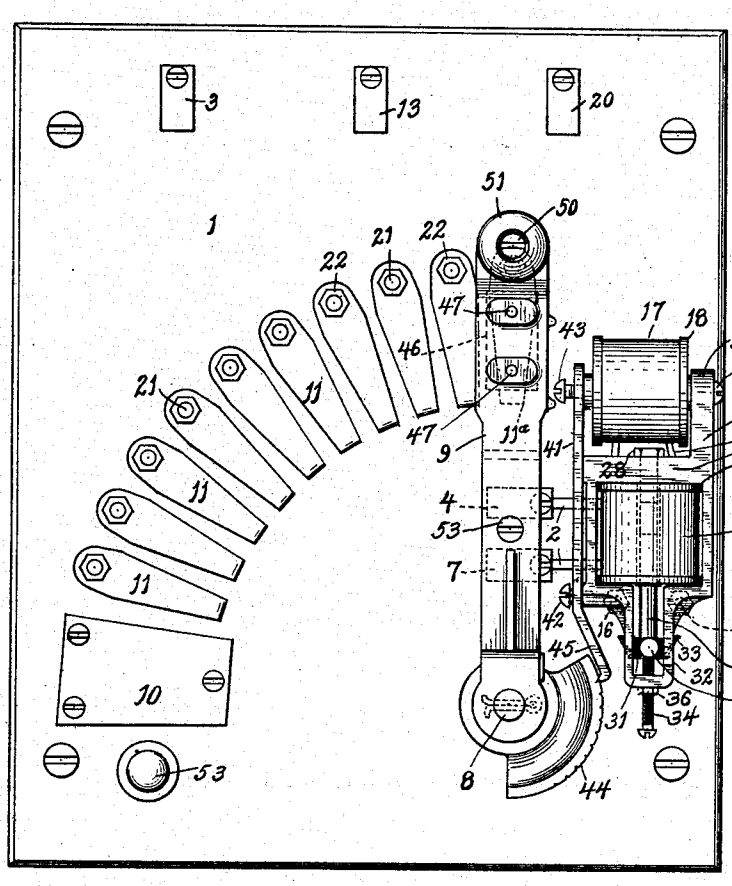


Fig. 2.

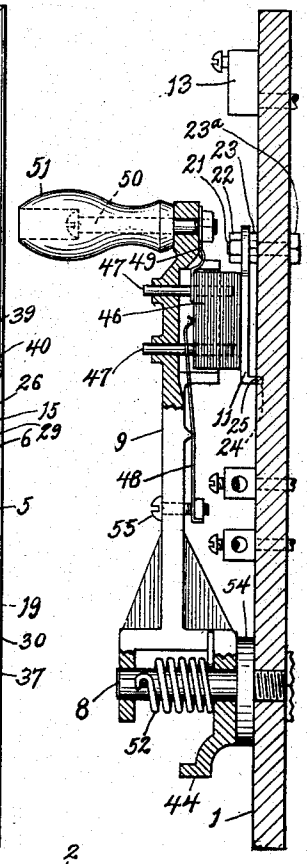
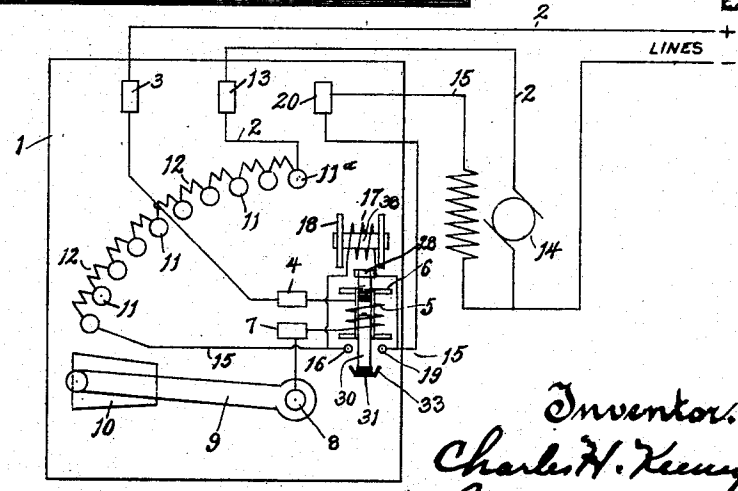


Fig. 8.



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Fig. 3.

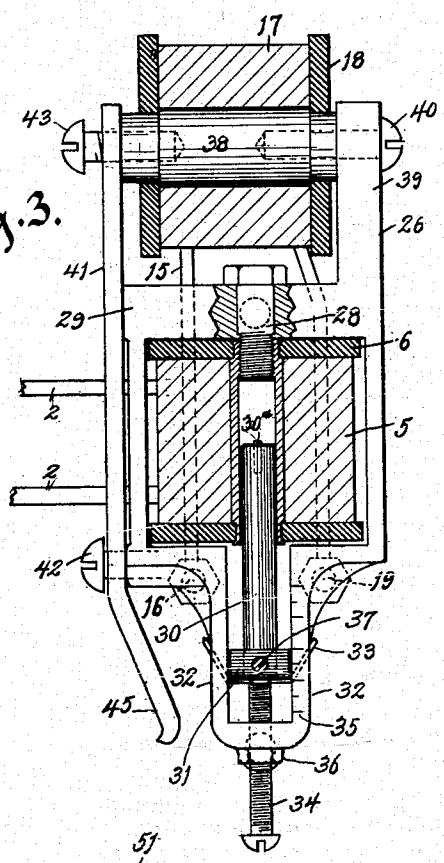


Fig. 4.

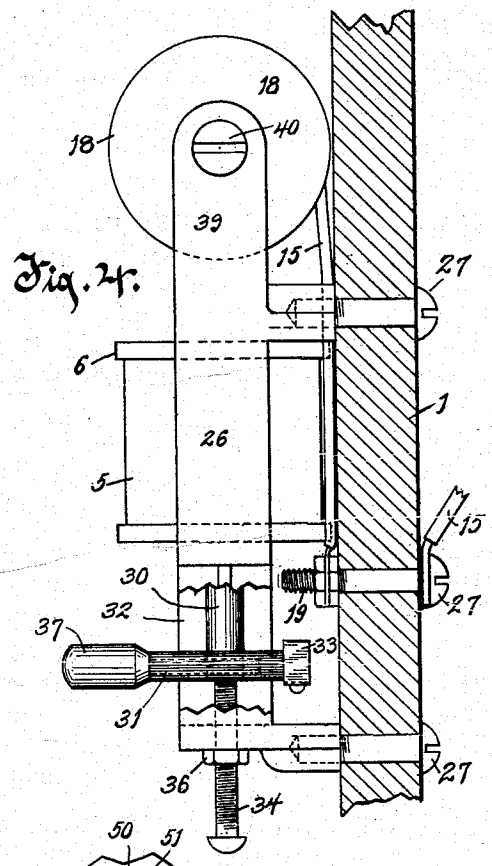


Fig. 5.

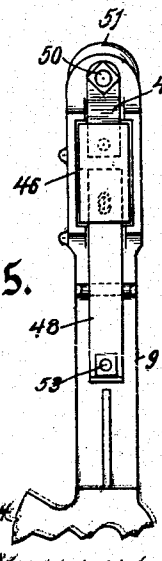
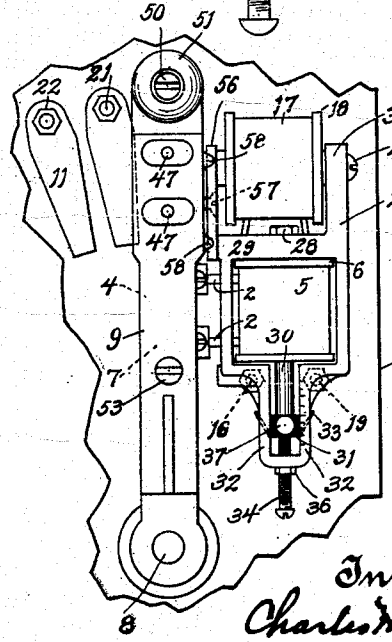


Fig. 7.



Fig. 6.



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UNITED STATES PATENT OFFICE.

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ELECTRIC-CURRENT CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 677,360, dated July 2, 1901.

Application filed May 6, 1901. Serial No. 58,886. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. KEENEY, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a new and useful Improvement in Electric-Current Controllers, of which the following is a description, reference being had to the accompanying drawings, which are a part of this specification.

The object of my invention is to provide an improved electric-current controller, and it includes novel devices for automatically controlling an electric current both by regulating the amount of amperage of the current and by wholly cutting it off, the invention being directed chiefly to the form, construction, and arrangement of the novel devices wherein and whereby simplicity of parts and a minimum of expense in construction are secured with a maximum of strength and durability and the highest adaptability for and effectiveness in work.

The invention consists of the devices and their combinations, as herein described and claimed, or the equivalents thereof.

In the drawings, Figure 1 represents an elevation of my improved devices as secured to and fixed on a vertical support. Fig. 2 is an edge view, partly in section, of some of the devices shown in front elevation in Fig. 1. Fig. 3 is a detail, partly in section, of an electromagnet and solenoid with related parts involved in my invention. Fig. 4 is a side view, principally in outline, of devices shown in Fig. 3, parts being broken away and a fragment of the insulating-support being shown in section. Fig. 5 is an inverted or under side view of the switch-arm shown in its relation to other parts in Fig. 1. Fig. 6 is an elevation of a modified form of construction. Fig. 7 is an end view of a segmental contact-piece, a number of which contact-pieces are shown arranged in an arc in Fig. 1. Fig. 8 is a diagrammatic representation of an electric system in which my improved controller is indicated as a part thereof, showing its relation to an electric system.

In the drawings, 1 is a base or support for my improved devices and is preferably a slab of slate secured to a wall or other convenient vertically-disposed support. This slab of slate serves not only as a support for the operative devices, but is also an insulator therefor electrically. Other means of supporting and insulating the devices may be used, if preferred. In the diagram in Fig. 8 this slab of slate is indicated and the electric system in which my improved devices are adapted to be employed are indicated in connection with the devices thereon. The line wire or conductor 2 leads to a binding-post 3, and thence to a binding-post 4, and therefrom by a solenoid-coil 5 about its spool 6, and thence to a binding-post 7, and therefrom to a pivot-post 8. A swinging switch-arm 9 is pivoted on and is in electrical contact with the post 8, the switch-arm being so arranged as to be capable of being swung from its contact with an insulating-plate 10, fixed on the slate 1, to any one of a series of contact-pieces 11 11, arranged in an arc corresponding with the arc of motion of the free extremity of the arm. These several contact-pieces are connected electrically to each other by resistance mediums 12, as coils of wire or otherwise, and from the last contact-piece 11^a the line wire or conductor 2 runs to a binding-post 13 and thence to and is continued beyond a motor 14. A shunt line or branch conductor 15 leads from a contact-piece 11 to a contact-post 16, and thence by an electromagnet-coil 17 about its spool 18 and to another contact-post 19, and thence to a binding-post 20, and from this post by a motor shunt-coil to the line-wire 2 at the distant side of the motor 14.

The several binding-posts, contact-pieces, and contact-posts hereinbefore enumerated are mounted and thereby supported and insulated on the slate 1. The plate 10, of insulating material, is a mere rest for the free extremity of the switch-arm 9 and is provided as a convenient means of construction, rather than to leave an elevation on the surface of the slab 1.

The several contact-pieces 11 are preferably constructed of strips of metal in tapering or segmental form and are arranged in an arc of a circle, their outer ends being secured to the supporting-slate conveniently by means of a screw 21, provided with nuts 22, 23, and 23^a. The binding-nuts 23 and 23^a hold the screw in place in the slate 1, and the nut 22 clamps the contact-piece 11 in place on the nut 23 at a distance from the slate 1.

The other and inner extremity of the contact-piece is provided with a tang 24 and adjacent shoulders 25, and the extremity of the contact-piece is turned at a right angle to its principal plane, whereby the tang 24 is adapted to and does enter a recess therefor in the slab 1, and the shoulders 25 rest on the slab. By this means the contact-pieces are held securely in position on and preferably away from the slab and in such manner that the swinging free extremity of the switch-arm 9 can contact electrically with the pieces and at the same time be free to pass over them as the arm is swung around. The contact-pieces are tapered or in segmental form, the side edges of the contact-pieces being substantially in radial lines, being thereby especially adapted to break contact with a radially-disposed contact member on the switch-arm synchronously along the extended straight edge of its contacting surface.

An iron frame 26 is secured to the slate 1 conveniently by means of screws 27 27 and is thereby supported and insulated. This frame is so formed as to serve as the support for the spools 6 and 18, on which the coils 5 and 17, respectively, are wound. The spool 6 is placed in an aperture in the frame 26 and is secured in place therein by an iron screw 28, turning through a transverse medial member 29 of the frame into the brass non-magnetic tubular axial member of the spool 6 at the top of the spool, thus supporting the spool depending removably from the frame. The iron screw 28, fixed in the iron frame 26, serves also as a magnetic pole of the solenoid-coil 5. A bar of soft iron 30, inserted loosely in the brass non-magnetic tubular axial member of the spool 6, is movable endwise therein and serves as the core of a solenoid. A block 31, of insulating material, secured to the lower end of the bar 30, is so formed as also to be a cross-head adapted to travel vertically between the elongated guideway members 32 32, forming a part of the frame 26, and prevent axial rotation of the bar. The construction and disposition of the tubular member of spool 6, the guideway members 32, the bar 30, and the block 31 are such as to guide and control the movement of the bar or solenoid-core vertically in the spool 6. A strip of metal 33, secured to and thereby insulated on the block 31, is so formed as to be adapted to contact concurrently at its respective ends with the contact-posts 16 and 19, short-circuiting the coil 17 when the solenoid-core is attracted and drawn up to the magnetic-pole screw 28 when the solenoid is energized electrically. A brass non-magnetic pin 30^a is fixed in and projects slightly from the end of bar 30 which contacts with the screw 28 when the bar is attracted magnetically thereto and so separate the bar and screw that the bar will quickly fall when the electric energy is cut from the solenoid, and thus prevents the bar being held up by any residual magnetism. A set-screw 34 turns vertically through an extremity of the frame 26 and supports thereon the block 31 and the bar solenoid-core 30. The set-screw 34 is adjustable, so that the solenoid-core may be raised or lowered, making the distance between its upper extremity and the magnetic-pole screw 28 less or greater, as desired. A scale 35 on one of the ways 32 is adapted to indicate the position to which the solenoid-core should be adjusted to be lifted from its position on set-screw 34 to the screw 28 by a predetermined overload of electric current. A jam-nut 36 is advisably employed on the set-screw 34. A knob or handle 37, of insulating material, is advisably fixed on the block 31, by means of which the attendant can, if desired, lift the block and core, bringing the circuit-closer 33 up into contact with the contact-posts 16 and 19.

The spool 18 is mounted on a metal core 38, and this metal core is secured to a projecting member 39 of the frame 26 by a screw 40, turning through the projecting member into the end of the core axially. The core 38 is disposed parallel with the transverse medial member 29 of the frame 26, the construction being such that the free end of the core 38 and a corresponding end of the medial member 29 are substantially in the same plane, so as to be adapted to be contacted by a metal armature 41. This armature 41 is supported in upright position pivotally on the frame 26 by a screw 42, which passes loosely through an aperture in the armature therefor and turns into the frame. The construction is such that the armature may rest against the core 38 and the medial member 29 of the frame, as shown in Figs. 1 and 3, or the armature may tilt away from the core and medial member 29. A brass screw 43, passing through an aperture therefor in the armature 41, is fixed in the core 38 and serves as a guide and adjustable non-magnetic stop for the movement of the armature. It will be understood that when the magnet, consisting of the core 38, and the medial member 29 are energized electrically by a current of electricity passing through the coil 17 on the core 18 the armature 41 will be attracted and held to the magnet.

The metal switch-arm 9, pivoted on and having electric contact with the pivot-post 8, is provided with a segment 44, having peripheral notches at a little distance from each other and corresponding in number and registration with the contact-pieces 11 and adapted to be engaged releasably by a finger 45, projecting at one extremity from the swinging armature 41. The notches in the segment 44 are so disposed that the switch-arm 9 will be held by the finger 45 in contact with any one of the pieces 11 to which the switch is moved by the finger entering a corresponding notch in the segment. A block of carbon 46, adapted to serve as a contact member, contacting severally with the contact-pieces 11, is mounted on the switch-arm

9 by means of guide-pins 47, fixed in the block of carbon, which pins extend loosely through the switch-arm 9 and permit of the movement of the block toward and from the switch-arm and so as to be constantly in the plane of the surface of the contact-pieces 11, which is also the plane of the surface of the plate 10. The block 46 rests constantly on some one or more of these contact-pieces 11 or on the plate 10. A spring 48, secured to the switch-arm 9, bears against the block 46 and holds it yieldingly to its work. A flexible strip of metal 49, preferably of copper, secured to the switch-arm 9 conveniently by means of the screw 50 and to the block 46, insures a constant electric connection between the switch-arm and the block 46. The metal pins 47, fixed in the block 46 and passing through the switch-arm 9, would ordinarily provide an electric circuit; but the metal strip 49 insures the electrical connection. A handle 51 is secured to the switch-arm 9 by the screw 50. A spring 52, secured at one end to and coiled about the post 8, bears at its inner end against the switch-arm 9 and is adapted as a torsional spring to throw the switch-arm 9 around and hold it yieldingly on the plate 10, resting against a stop 53, fixed in the slate 1, and the spring 52, serving as an expansion-spring, is adapted to press the switch-arm toward the slate and hold it on the post 8 and firmly against the metal collar 54, fixed on the post 8, thereby forming a sure and constant electrical contact of the switch-arm with the post. The strength of the spring 48 is adjustable by means of the screw 55 and the nut turning thereon, the screw passing through the spring near one extremity, which spring is fulcrumed medially on a rib projecting from the switch-arm 9. The nut on screw 55 is held against rotation by a shoulder on the spring against which the nut contacts.

When the switch-arm 9 rests on the plate 10, the circuit is broken through the line 2. When the line is closed, which is accomplished by swinging the switch-arm 9 around to any one of the contact-pieces 11, the armature 41 will be attracted to the magnet, including the core 38, and the finger 45 will engage the segment 44 and hold the switch-arm 9 in position against the torsional action of the spring 52, which tends to throw the arm 9 around to the plate 10 and open the circuit. If the strength of the current passing through the line is too light to hold the armature 41 up to its work, it will tilt away from its magnet, and thereby release the segment 44, permitting the arm 9 to swing around to the plate 10, and thus break the circuit. If, on the other hand, while the switch-arm 9 is around to and in contact with a contact-piece 11, the current should become too strong, and thereby overload the line, the solenoid-core 30 will be lifted by such excess of current to the magnetic pole-screw 28, thereby bringing the circuit-closer 31 into electrical contact with the posts 16 and 19 and short-circuiting the electromagnet-coil 17 and releasing the armature 41, permitting the switch-arm 9, under the torsional effort of spring 52, to swing around to plate 10, thereby opening the electric circuit through the motor.

In the modified form of device shown in Fig. 6 the notched segment 44 of Fig. 1 is omitted, and an armature 56, mounted loosely on the switch-arm 9, is substituted for the armature 41 of the form of device shown in Fig. 1. A screw 57 passes loosely through the armature medially and turns into the switch-arm. Lugs 58 58 on the switch-arm prevent the armature from motion rotatively about the screw 57 as a pivot.

What I claim as my invention is—

1. In a controller for electric current, an iron frame, an electromagnet-spool and its coil mounted on the frame, and a solenoid-spool and its coil suspended on the frame from a medial bar thereof located between the electromagnet-spool and the solenoid-spool.

2. In a controller for electric current, an iron frame, an electromagnet-spool mounted on the frame, a solenoid-spool having a non-magnetic tubular axial member, and an iron screw through a part of the frame located between the two spools and turning by its thread into the tubular axial member of the solenoid-spool.

3. In electrical devices, an iron frame, a solenoid-spool having a tubular non-magnetic axial member, and an iron screw through a member of the frame and turning by its thread into the tubular member of the spool and suspending the spool removably on the frame, the screw being adapted to serve as a magnetic pole of the solenoid.

4. In electric devices, an iron frame, a solenoid-spool having a tubular non-magnetic axial member, an iron screw through a member of the frame and turning by its thread into the tubular member of the spool and suspending the spool on the frame, the screw being adapted to serve as a magnetic pole of the solenoid, and a soft-iron solenoid-core supported normally on the frame and arranged to travel vertically in and be guided by the tubular member of the solenoid.

5. In electrical devices, an iron frame, a solenoid-spool having a non-magnetic tubular axial member, means suspending the spool on the frame, a solenoid-core adapted to travel endwise in the tubular axial member of the spool, a block of insulating material secured to the end of the solenoid-core and guided in its movements with the core by ways in the frame, and means for adjusting the core to a desired position in the spool-tube.

6. In electrical devices, an iron frame, a solenoid-spool having a non-magnetic tubular axial member, an iron magnetic spool-screw in the frame turning into the non-magnetic tubular member of the spool at the top, a solenoid-core movable endwise in the tubular member of the spool, a block of insulating material fixed on the lower end of the core, and an adjustable screw in the frame on the

end of which said block and core are supported normally, the core being adapted by means of the set-screw to be adjusted at a greater or less distance from the iron magnetic pole-screw.

7. In electrical devices, an iron frame, an electromagnet-coil mounted on the frame, the coil having lined terminal contact-posts adjacent to the frame, a solenoid-coil mounted in the frame, a solenoid-core movable endwise in the hollow axis of the solenoid-coil, an insulating-block on the outer end of the core and an electric contact-strip on the insulating-block adapted to be put into contact with said contact-posts when the core under magnetic energy is drawn into the solenoid-coil.

8. In electrical devices, an integral iron frame, an iron core secured rigidly to the iron frame, an electromagnet spool and coil on said core, an armature arranged to contact with the free extremity of said core and with a parallel member of said frame, a solenoid spool and coil mounted on the same frame, a solenoid-core movable endwise in the solenoid-spool, an insulating-block on the free end of the solenoid-core, an electric contact-piece fixed on the insulating-block, and electric contact-posts disposed to be connected by the contact-piece on said insulating-block when the solenoid-core is drawn into its coil by magnetic energy, the contact-posts being connected electrically to terminals of the electromagnet-coil.

9. In combination in electrical devices, an iron frame having an integral projecting member 26 substantially at a right angle to the part 29, an iron core 38 parallel with part 29 and secured detachably and magnetically to the member 26, an electric coil spool on said core, and a movable armature adapted to be attracted to and to connect the core and the part 29 as magnetic poles.

10. In combination in electrical devices, an iron frame having an integral projecting member 26 substantially at a right angle to the part 29, an iron core 38 parallel with part 29 secured detachably and magnetically to the member 26, an electric-coil spool on said core, a movable armature adapted to be attracted to and to connect the core and the part 29 as magnetic poles, and a brass screw 43 inserted in said core and passing loosely through the armature and serving as a non-magnetic guide for the armature.

11. In electrical devices, an iron frame provided with a core supporting an electric coil, an armature hinged on the frame by a screw passing loosely through the armature medially, the armature being arranged to contact with said core and a part of the frame as magnetic poles and having a finger extension beyond its hinge adapted to serve as a switch-locking device.

12. In electrical devices, an iron frame provided with a core supporting an electric coil, an armature hinged on the frame by a screw passing loosely through the armature medially, the armature being arranged to contact with said core and a part of the frame as magnetic poles and having a finger extension beyond its hinge adapted to serve as a switch-locking device, and a swinging switch-arm provided with a segment having notches adapted to be engaged by the finger on the armature.

13. In electrical devices, a solenoid-spool provided with a non-magnetic tubular axial member, a soft-iron magnetic pole in one extremity of the tubular axial member, an iron solenoid-core movable endwise in the tubular axial member of the spool and a non-magnetic pin in the end of the core adapted to contact with the magnetic pole and prevent the direct contact of the core with the pole when attracted thereto by the energy of the solenoid.

14. In electrical devices, a solenoid-spool provided with a non-magnetic tubular axial member, a soft-iron magnetic pole in one extremity of the tubular axial member, an iron solenoid-core movable sidewise in the tubular axial member of the spool, an elongated block of insulating material disposed transversely of and secured medially to the end of the core, an electric contact-piece mounted on the insulating-block at a distance from the core, and an adjustable supporting-screw bearing against the end of the core.

15. In electrical devices, a swinging switch-arm, a post provided with a collar, and a spring secured at one end to and coiled about the post and bearing against the switch-arm, the spring acting expansively to hold the arm to the collar and torsionally to throw the arm around in one direction laterally.

16. In electrical devices, a swinging switch-arm, an electric contact-block provided with a plurality of pins passing loosely through the switch-arm, and means for holding the block yieldingly away from the arm.

17. In electrical devices, a swinging switch-arm, an electric contact-block provided with a plurality of pins passing loosely through the switch-arm, a spring bearing against the block and held adjustably on the arm adapted to push the block yieldingly away from the arm.

18. In electrical devices, a swinging switch-arm, an electric contact-block provided with a plurality of pins passing loosely through the switch-arm, a flat spring fulcrumed medially on the arm and bearing at one end on the block and provided with a shoulder at its other end, a nut engaged by the shoulder and a screw revoluble in the arm turning into the nut and adapted to regulate the strength of the spring.

19. In electrical devices, a swinging switch-arm, an electric contact-block provided with a plurality of pins passing loosely through the switch-arm, means for holding the block yield-

ingly away from the arm, and a flexible copper strip connected to the arm and to the block.

20. In electrical devices, a segmental contact-piece provided at one end with a tang and a shoulder directed substantially at a right angle to the principal plane of the contact-piece, and means for securing the other end of the contact-piece to a support.

21. In a controller for electric current, an integral iron frame, an electromagnet mounted on the frame, a solenoid mounted on the frame and electrically connected to the armature of a motor, and means adapted to short-circuit the electromagnet by an electric overload of the motor-armature to a predetermined extent.

22. In a controller for electric current, an integral iron frame, an electromagnet mounted on the frame, a solenoid on the frame and electrically connected to the armature of a motor, an armature held magnetically to the frame, and means for releasing magnetically the armature by short-circuiting the electromagnet at a predetermined overload of the motor-armature.

23. In a controller for electric current, an iron frame, an electromagnet-spool and its coil mounted on the frame, and a solenoid-spool and its coil mounted on the frame, a medial bar of the frame being located between the electromagnet-spool and the solenoid-spool.

24. In a controller for electric current, an integral iron frame, an electromagnet and a solenoid mounted on the frame, an armature hinged to the frame, and means for magnetically releasing the armature by short-circuiting the electromagnet.

25. In a controller for electric current, an integral iron frame, an electromagnet and a solenoid mounted on the frame, and means for short-circuiting the electromagnet.

26. In a controller for electric current, an integral iron frame, an electromagnet and a solenoid mounted on the frame, an armature held magnetically to the frame, and means for magnetically releasing the armature by short-circuiting the electromagnet.

27. In a controller for electric current, an integral iron frame arranged to act as magnetic poles to both an electromagnet and a solenoid attached thereto, and means for short-circuiting the electromagnet by the solenoid.

In testimony whereof I affix my signature in presence of two witnesses.

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