F. B. COOK.

RELAY.

APPLICATION FILED DEC. 14, 1914.

1,185,369.

Patented May 30, 1916.

2 SHEETS—SHEET 1.

FIG. 1

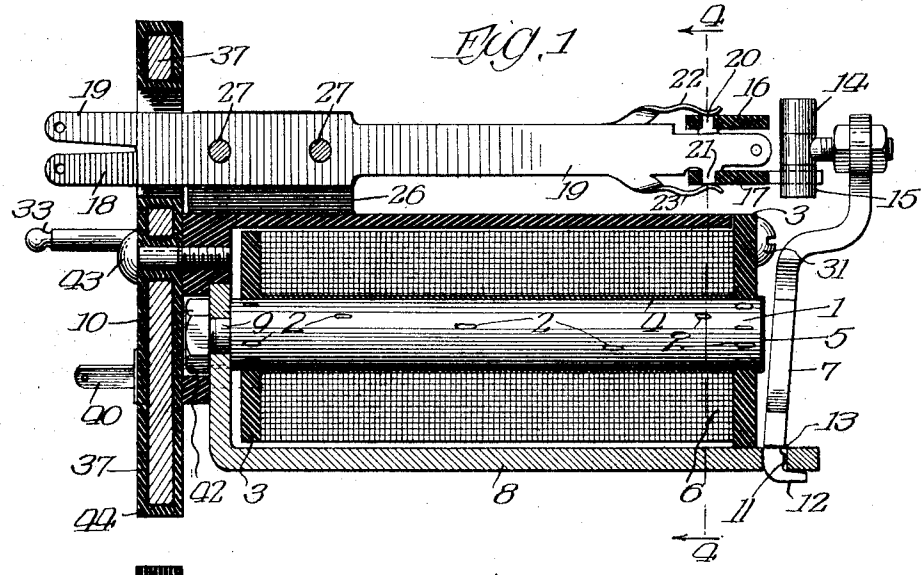


FIG. 2

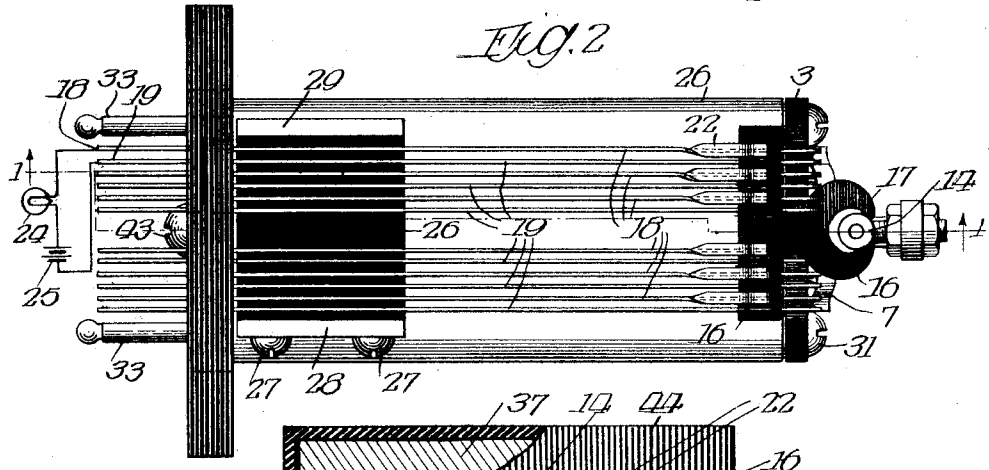
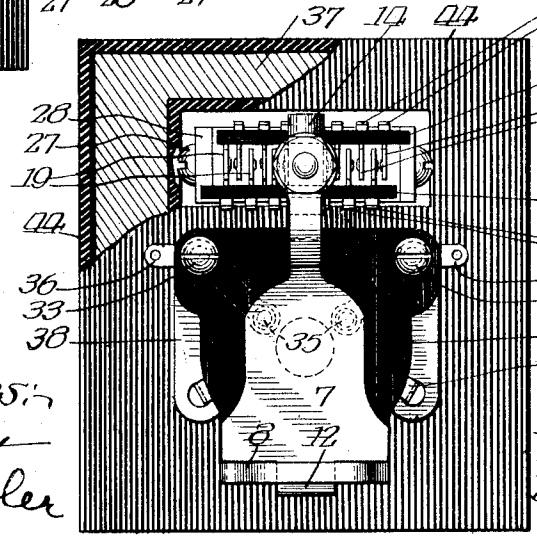


FIG. 3



Witnesses:-

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2 SHEETS—SHEET 2.

Fig. 4

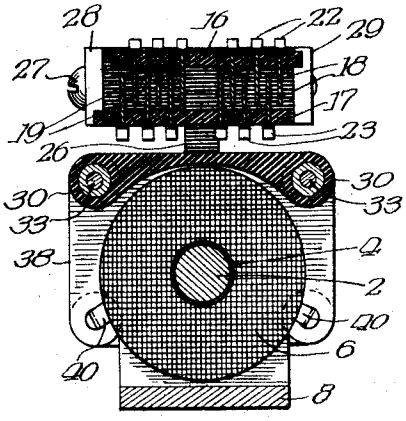


Fig. 5

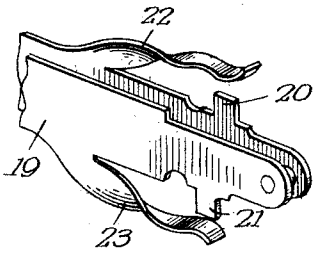


Fig. 6

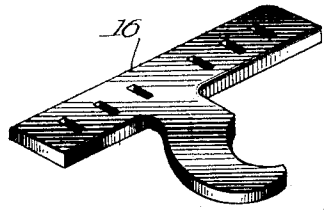


Fig. 7

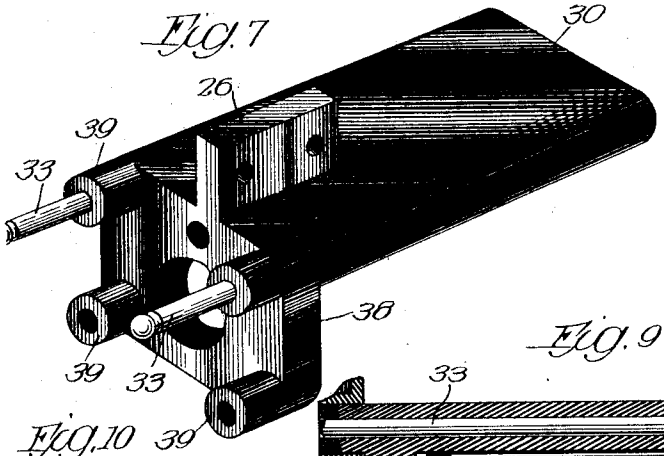


Fig. 8

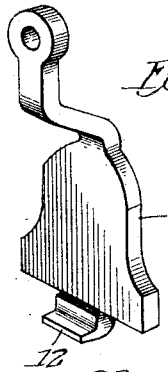


Fig. 9

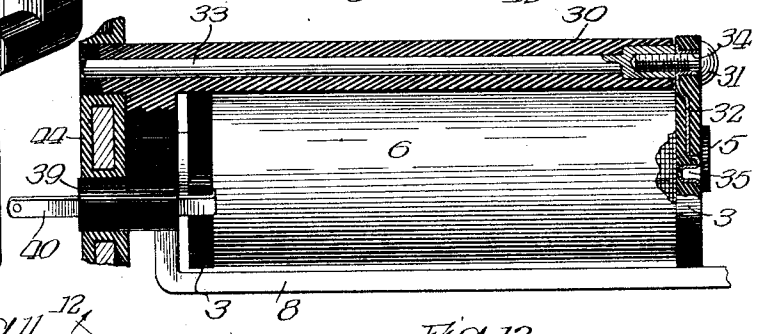


Fig. 10

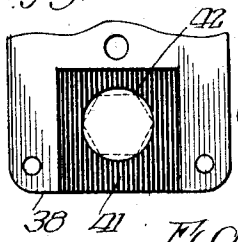


Fig. 11

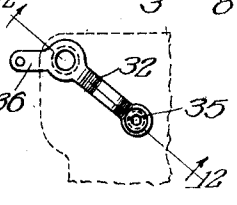
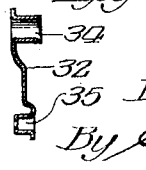


Fig. 12



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UNITED STATES PATENT OFFICE.

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RELAY.

1,185,369. Specification of Letters Patent. Patented May 30, 1916.

Application filed December 14, 1914. Serial No. 877,123.

To all whom it may concern:

Be it known that I, FRANK B. COOK, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Relays, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to electrical equipment employing coils of wire and has a number of objects and advantages in view.

My invention, in one of its aspects, relates to relays which are employed for controlling electrical circuits, the object of this feature of my invention being to improve relay efficiency by requiring a minimum movement of a relay armature across a minimum air gap to effect the required movement of a circuit controlling switch. I accomplish this object of my invention by so interrelating the armature with the two complemental contacts of the switch that belong to the same circuit that such contacts may both be moved by the armature in opposing directions. In the case of a normally open circuit the armature would move both of these contacts mutually toward each other to close the circuit and in the case of a normally closed circuit the armature would move both of these contacts mutually away from each other to open the circuit.

By means of my invention I am enabled to operate two groups of contact springs, in which contacts of each group are individual to contacts of the other, it being possible simultaneously to effect circuit changes in a plurality of circuits with the same minimum movement of the armature through a minimum air gap, this movement not needing to be larger than that which would obtain if but two contacts were controlled by the same armature.

The invention has for another of its objects the provision of an improved arrangement of insulation for defining the winding space for the helix of an electro-magnet or other circuit coil, for maintaining a fixed relationship of this winding space with the core of the magnet, and for preventing access of the magnet winding to the magnet core. Where the magnet includes an armature movable toward and from an end of the core the adjacent portion of the insulation that defines the winding space is caused to carry a non-magnetic stop that serves to limit the extent to which the armature may move toward the core so as to keep the armature out of direct contact with the core to prevent it from sticking thereto. This stop is preferably formed of the same insulating substance from which the structure which defines the winding space is formed.

My invention has for another of its objects the provision of improved means for mounting electrical windings, and the provision of improved winding terminals and circuit terminals in conjunction with the electrical winding and the mounting therefor.

The invention in all of its aspects will be more fully explained by reference to the accompanying drawings showing the preferred embodiment thereof and in which—

Figure 1 is a view in sectional elevation of a relay constructed and mounted in accordance with my invention; Fig. 2 is a plan view of the structure illustrated in Fig. 1; Fig. 3 is a front elevation of the structure with a part broken away more clearly to reveal a feature of construction; Fig. 4 is a sectional view on line 4—4 of Fig. 1; Figs. 5 and 6 are perspective views illustrating details of the relay proper; Fig. 7 is a perspective view illustrating a mounting for the relay proper; Fig. 8 is a perspective view illustrating the preferred form of relay armature; Fig. 9 is a side elevation, partially broken away, of a part of the structure; Fig. 10 is a front view of the rear portion of the relay mounting illustrated in Fig. 7; Fig. 11 is a front view of the preferred form of circuit terminal; and Fig. 12 is a sectional view on line 12—12 of Fig. 11.

Like parts are indicated by similar characters of reference throughout the different figures.

The magnetic core 1, if not naturally sufficiently irregular to accomplish one of the objects of my invention, may be provided with irregularities such as the depressions illustrated at 2. Some of these depressions

are desirably so located as to lie in the planes of the spool heads 3 whose central openings receive the ends of the core. The core 1 is disposed within a space in a molding machine that conforms to the shape and size of the spool heads and to a sleeve 4 which is to surround the core, the core being coaxial with the sleeve 4. After the core is thus located within the molding machine molding composition is forced into the space that is not occupied by the core whereby the spool heads 3 and the insulating sleeve 4 are formed integrally. The core 1 is also desirably so located within the molding machine that a slight clearance exists at its forward end whereby a spacer of insulating material 5 is integrally formed with the elements 3 and 4, this spacer being desirably in the form of a cap which covers the central opening in the spool head and the portion of the core 1 that projects beyond the forward spool head 3.

By means of the structural characteristics so far specifically described, the core 1 is maintained in fixed relation with the spool heads 3 and the sleeve 4 whereby a definite winding space for the magnet winding 6 is assured, and whereby access of any portion of the winding directly to the core 1 is absolutely prevented since no cracks or interstices exist between the insulating sleeve 4 and the spool heads integrally formed therewith. The spacer 5 is not only carried directly by the forward spool head 3, which I believe is novel with me, but is also integrally formed therewith whereby the relationship of this spacer with the core 1 and the relay armature 7 is definitely maintained, particularly when this spool head is brought into fixed relation with the core.

The yoke 8 of magnetic material is angular in shape, the shorter and upright leg of the yoke having an opening therein which receives the threaded reduced end 9 of the core, the yoke being clamped into engagement with the core by means of a nut 10. The longer side of the yoke desirably projects forwardly beyond the structure to constitute an armature mounting being there formed with an oblong opening 11 which receives the angular tongue 12 of the armature 7. The opening 11 is not much wider than the thickness of the tongue, a formation which may be adopted because of the presence of a transverse groove 13 in the lower portion of the armature spaced apart from the horizontal branch of the tongue 12 about the thickness of the yoke to permit the groove to lie at the upper surface of the yoke 8 to enable said groove 13 to permit of articulation of the armature tongue with the yoke 8. The horizontal forwardly extending branch of the tongue 12 underlies the forward portion of the yoke 8 so that the armature cannot be removed until it is swung to the right nearly to parallelism with the adjacent side of the yoke 8. The upper end of the armature carries two vertically disposed preferably metallic cam rollers 14, 15 which engage cams 16 17, preferably of insulating material, which are respectively mechanically connected with a set of contact springs 18 and a set of contact springs 19, each contact spring 18 coöperating with a contact spring 19 in the control of a circuit. As illustrated the contacts 18 are normally out of contact with their complemental contacts 19 in which case circuit changes are effected by bringing the contacts 18 and their complemental contacts 19 together, though the invention is not to be limited to the normally separated relation of the contacts 18 from their complemental contacts 19. The cams 16 and 17 have enlarged base portions. The springs 18 and 19 are desirably respectively provided with lugs 20 and 21 at their unmounted ends which pass through correspondingly shaped openings in the bases of the cams 16 and 17 whereby the bases of the cams 16 and 17 constitute couplers to couple the unmounted ends of the springs to which they pertain so that the movement of the cam 16 will cause the simultaneous movement of the springs 18 coupled therewith and movement of the cam 17 will cause simultaneous movement of the springs 19 coupled therewith. The mechanical union of the cams 16 and 17 with the springs 18 and 19 to which they pertain is maintained by the spring clips 22, 23 respectively integrally formed with the springs 18 and 19 but twisted to occupy planes transverse to the planes of said springs so as to have flat engagement with the bases of the cams where these cams receive the lugs 20 and 21. The engaging faces of the cams 16 and 17 oppose each other and are spaced apart. That is these cams are symmetrically arranged with spacing therebetween for receiving the cam rollers 14 and 15 whereby the cams will be forced apart upon each attraction of the armature 7 toward the core 1. In this way the armature 7 is caused to operate both sets of springs 18 and 19 whereby each spring 18, 19 is moved toward its complement 19, 18. Hitherto it was the practice to cause the armature positively to move one spring toward its complement and to cause movement of such complement merely as a result of the movement of the first spring. By means of the construction of my invention any two springs that are complemental to each other are moved by the armature independently of each other in opposite directions. In the embodiment of the invention illustrated the armature causes the movement of two complemental springs toward each other in opposing directions, to bring the springs into contact, though obviously

such movement by the armature upon two complemental springs would be reversed to spread the springs apart if such springs are normally in contact. When the relay is de-energized the resilience of the springs will force the same to normal position and in moving to such normal position they will move the cams 16 and 17 to their normal position whereby the armature will be given its idle location. It will be seen that the swinging movement of the armature for a given relative movement of any two complemental contacts 18, 19 is less than would be required were these two contacts not moved in opposite directions independently of each other by the armature. The air gap that exists between the relay core and the armature may, therefore, be materially reduced thereby greatly increasing the efficiency of the relay when it is employed to cause the mutual approach or mutual separation (if the springs are normally in contact) of any two springs 18, 19 that enter into the control of the same circuit, one form of circuit being illustrated in Fig. 2 where adjacent springs 18 and 19 constitute the normally separated terminals of a circuit including a signaling lamp 24 and a battery 25, the lamp being caused to glow each time the terminals 18 and 19 of its circuit are caused mutually to approach upon the attraction of the armature. It is not necessary to illustrate circuits that are controlled by each of the other five pairs of coöperating contacts 18, 19.

The springs 18 and 19 are insulated from each other and are clamped to the upwardly extending insulating lug 26 by means of screws 27 that pass freely through the clamping plate 28 and are in threaded engagement with the clamping plate 29. The lug 26 is integrally formed with a mounting 30 that extends longitudinally of and overlies the relay winding, the nether surface of the mounting 30 being concave to conform in shape to the winding. The forward end of the mounting 30 nearly reaches the forward spool head 3 and is maintained in assembly therewith by means of binding screws 31, these binding screws also operating to maintain the winding strip metal terminals 32 in engagement with circuit terminals 33 that project slightly forwardly of the mounting 30 to enable the screws 31 to bring the winding terminals and circuit terminals into firm engagement (as will be seen by inspecting Fig. 9) without interference due to direct engagement between the forward spool head and front end of the mounting 30. The winding terminals are preferably of the form illustrated most clearly in Figs. 9, 11 and 12 which illustrate a terminal formed of strip metal stamped into the shape illustrated, a portion being in the form of a flanged tube 34 whose flange engages the forward end of the rod 33 while another part of the terminal is in the form of a cup 35 that is initially filled with solder and thereafter bored out to receive an end of the magnet winding, the drill leaving sufficient of the solder to permit of the ready union of the winding terminal and winding end. The terminals 32 may each be provided with a supplemental tab 36 for union with a winding end in case it is not desired to attach such winding end to the cup 35. The terminals 32 are molded within the forward spool head 3 in order to secure a definite location thereof. The circuit terminals 33 are likewise molded in the body of insulating material 30 and project to the rear of this body in order that they may be passed through the mounting plate 37 where connection may be made with the circuit. The vertical branch 38 of the mounting 30 is provided with rearwardly extending cylindrical continuations 39 that pass through suitable openings in the mounting plate 37. The lower cylindrical continuations 39 are hollow to permit of the passage therethrough of winding terminals 40 which may be employed if the winding is to be connected in circuit thereat instead of at the terminals 32 or which may be of service in conjunction with the terminals 32 if the relay winding is subdivided into two coils. The vertical branch of the angular mounting 30 is provided with a vertical groove 41 through which there is a circular hole 42 in which the nut 10 may snugly turn. The groove 41 conforms in shape to the vertical branch of the yoke 8, this yoke branch and the nut 10 coöperating respectively with the groove 41 and the hole 42 to position the rear end of the magnet winding with respect to the mounting 30, the forward end of the magnet winding being positioned with respect to the forward end of the mounting 30 by the screws 31. The single screw 43 is passed through the mounting plate 37 into the mounting 30 to hold the mounting 30 and mounting plate 37 together, the cylindrical portions 39 serving to prevent rotation of the magnet structure upon the plate 37.

The metallic mounting plate 37 is formed with holes not only for receiving the extensions 39 and the shank of the screw 43 but also for receiving the terminal ends of the springs 18 and 19. Each hole in the metallic mounting plate 37 is lined with insulation (44) so as to avoid electrical connection between the same and the metallic parts passing therethrough. All other surfaces of the mounting plate are also faced with insulation. In thus insulating the mounting plate it is placed in a molding machine that has suitable spacing for the flow of insulating fluid which is caused to surround all portions of the mounting plate and to line

all holes therein so that no metal of the mounting plate is exposed.

While I have herein shown and particularly described the preferred embodiment of my invention I do not wish to be limited to the precise details of construction shown as changes may readily be made without departing from the spirit of my invention, but

Having thus described my invention I claim as new and desire to secure by Letters Patent the following:—

1. An electro-magnet including its armature and a mounting for the armature, said armature mounting having an armature receiving opening while the armature has a tongue provided with an angular extension, the body of the tongue being received in said opening while the angular extension of said tongue underlies the mounting, the armature being provided with a groove therein adjacent the upper surface of the armature mounting for purpose of assembly.

2. An electro-magnet including its armature and a mounting for the armature, said armature mounting having an armature receiving opening while the armature has a tongue provided with a forwardly projecting angular extension, the body of the tongue being received in said opening while the angular extension of said tongue underlies the mounting, the armature being provided with a groove therein adjacent the upper surface of the armature mounting for purpose of assembly.

3. A relay including the armature thereof; a contact which is to be moved by the armature; and an element interposed between the armature and the contact to transmit motion from the armature to the contact, said element having spaced apart portions between which an engaging portion of the armature structure is received and with respect to which such armature portion may have lost motion, one of these spaced apart portions serving to transmit the armature movement to the contact while the other of these portions serves to limit the extent to which the armature may be retracted.

4. A switch structure including a contact spring having a spring clip integrally formed therewith; and means for actuating the contact spring maintained in engagement therewith by said clip.

5. A switch structure including a contact spring having a spring clip integrally formed therewith; a lug carried by the spring contact; and a contact actuator engaged by said lug, the spring clip operating to maintain the engagement between the contact actuator and the lug.

6. The combination with a winding; of a spool therefor; a winding terminal carried by a head of the spool; a mounting for the winding; a circuit terminal carried by the winding mounting; and means for maintaining these terminals in engagement.

7. The combination with a winding; of a spool therefor; a winding terminal carried by a head of the spool; a mounting for the winding having a portion extending longitudinally of the winding; a circuit terminal extending longitudinally of and carried by said portion; and a screw for maintaining said spool head and mounting in assembly and operating to maintain the said terminals in engagement.

8. The combination with a winding; of a core therefor; a yoke; means for assembling the yoke and core which includes a nut; a mounting for the winding including a portion 38 having a groove 41 corresponding in shape to the adjacent portion of the yoke and a hole 42 within which the nut is snugly received; and means for holding the winding structure and mounting together.

9. The combination with a winding; of a core therefor; a yoke; means for assembling the yoke and core which includes a nut; a mounting for the winding including angularly related portions one of which is provided with a groove 41 corresponding in shape to the adjacent portion of the yoke and a hole 42 within which the nut is snugly received; a head at the other end of the core opposite the nut for taking part in defining the winding space; and a screw for holding the head and the adjacent end of the winding mounting in assembly.

10. The combination with a winding; of a core therefor; a yoke; means for assembling the yoke and core; a mounting for the winding including a portion 38 having a groove 41 corresponding in shape to the adjacent portion of the yoke; and means for holding the winding structure and mounting together.

11. The combination with a winding; of a core therefor; a yoke; means for assembling the yoke and core; a mounting for the winding including angularly related portions one of which is provided with a groove 41 corresponding in shape to the adjacent portion of the yoke; a head at the other end of the core opposite the nut for taking part in defining the winding space; and a screw for holding the head and the adjacent end of the winding mounting in assembly.

12. The combination with a winding; of a mounting therefor, the adjacent portions of the winding structure and winding mounting having formations taking part in effecting their relative disposition; and means for holding the winding structure and mounting together.

13. The combination with a winding; of a mounting therefor including angularly related portions, the winding structure and

one of said portions having interengaging formations taking part in effecting their relative disposition; a head at the other end of the mounting taking part in defining the winding space; and a screw for holding the head and the other angular portion of the winding mounting in assembly.

In witness whereof, I hereunto subscribe my name this first day of December, A. D. 1914.

FRANK B. COOK.

Witnesses:
ETTA L. WHITE,
G. L. CROGG.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."