

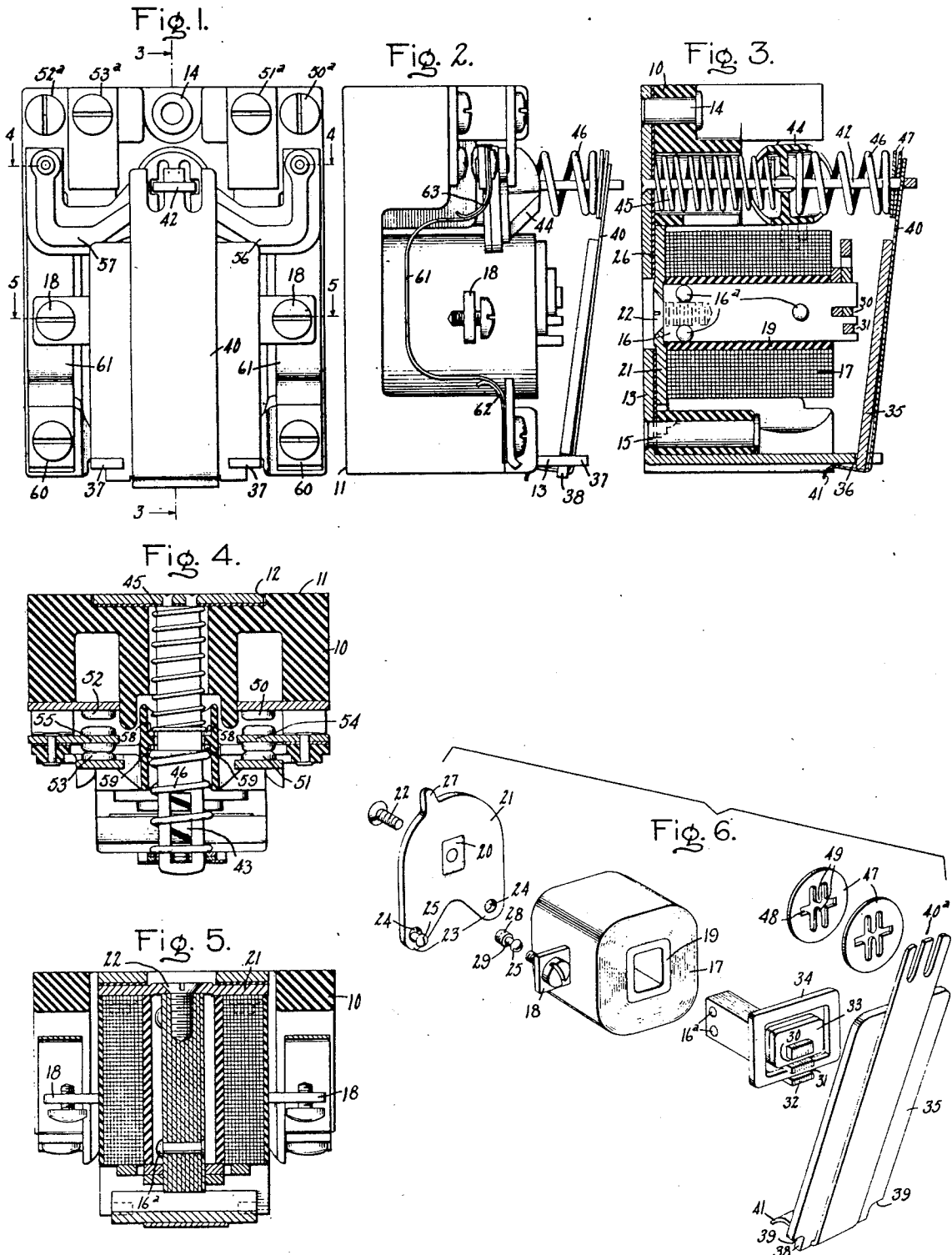
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MAGNETICALLY OPERATED DEVICE

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MAGNETICALLY OPERATED DEVICE

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My invention relates to magnetically operated devices, more particularly to magnetic relays and the like, and has for its object the provision of an improved device of this character which is simple and reliable and has a long operating life.

It is well-known in the art that alternating-current magnets require pole shades to make them quiet when closed. The pole shade consists of a short-circuited winding around a portion of the cross-section of the magnetic circuit at the point of required magnetic force. The effect of this shading coil is to displace the magnetic flux threading it relative to the flux not threading it, though pursuing a parallel path. This displaced or shaded flux lags the unshaded flux by an electrical angle of less than 90 electrical degrees. Since the directions of these two components of flux are parallel, each provides its own component of magnetic force across the pole face varying sinusoidally though slightly distorted by saturation of the iron pole face. Each of these force components is of zero value twice each cycle, but so long as the shaded component lags the unshaded component, the sum of these two forces is never zero. One feature of my invention relates to the provision of an improved pole shade construction using a pair of short-circuited windings, the first of which encircles a portion of the magnetic core and the second of which encircles a second portion of the magnetic core as well as encircling the first portion of the magnetic core and leaving a third portion of the core unshaded. In this manner a three-phase flux is provided at the pole face of the core member which gives a more uniform pull on the armature and therefore, more quiet operation and greater total pull.

Another feature of my invention relates to a resiliently mounted movable contact carriage operable between an upper and lower fixed contact by the armature of the relay and adapted to provide a wiping engagement of the movable contacts with either of the fixed contacts.

For a more complete understanding of all the features of my invention, reference should be had to the accompanying drawing in which Fig. 1 is a plan view of a magnetically operated relay embodying my invention; Fig. 2 is a left side elevational view of Fig. 1; Fig. 3 is a sectional view taken along the line 3-3 of Fig. 1 looking in the direction of the arrows; Fig. 4 is an inverted sectional view taken along the line 4-4 of Fig. 1 looking in the direction of the arrows; Fig. 5 is an inverted sectional view taken along the line 5-5 of Fig. 1 looking in the direction

of the arrows; Fig. 6 is an exploded view of some of the parts of the relay shown in perspective.

Referring to the drawing, I have shown my invention in one form as applied to a magnetically operated relay. The relay includes a base of suitable insulating material upon which the various parts are mounted and secured. The bottom face 11 of the base 10, best shown as the upper edge of the inverted sectional view of the relay in Fig. 4, is provided with a groove 12 extending longitudinally thereof into which one leg of an L-shaped magnetizable frame 13 is secured by means of the hollow rivets or eyelets 14 and 15 cooperating with the base. The hollow rivets 14 and 15 themselves constitute suitable bolt holes in the base 10 into which bolts may be inserted for fastening the relay to a panel or the like. The other leg of the L-shaped magnetizable frame 13 extends upwardly along one side of the base 10, as seen in Fig. 3 projecting a short distance above the upper portion of the base. A portion of the base 10 is moulded with an opening across which extends the frame 13 as shown in Fig. 5 whereby a well or recess is formed into which a core member 16 and its energizing winding 17 are disposed. The core member 16 consists essentially of a series of laminations of magnetizable material fastened together by means of the rivets 16a to form an elongated pole piece or core member of substantially rectangular cross-section. The vertically disposed core member 16, which extends upwardly from the bottom of the base 10 in the well provided therefor, is surrounded by a number of turns of fine wire constituting an energizing coil 17 provided at its sides with the terminals 18, the core member 16 forming a support for the winding 17 and separated therefrom by a sleeve of insulating material 19 which surrounds the core member.

As shown in Fig. 6, the core 16 has its lower end positioned in a recess 20 struck into an auxiliary frame plate 21 which is fastened to the core member 16 by a screw 22 threaded longitudinally into the bottom of the core member. A pair of extensions or ears 23 are provided on the auxiliary frame plate 21 having the holes 24 therein adapted to receive the screws 25 which are threaded into the frame 13 to secure the auxiliary frame plate 21 thereto. As shown, I have provided a sheet of insulating material 26, such as paper, between the auxiliary frame plate 21 and the main frame 13 to increase the reluctance of the magnetic circuit including these two members. On the auxiliary frame plate 21

opposite the extensions 23, I have provided a further extension or nib 27 which registers with a recess or slot in the base 10 and engages a wall thereof for holding the auxiliary plate 21 in position on the base.

With the auxiliary frame plate 21 and fastening means I have provided, the core member 16, the energizing winding 17, and the auxiliary frame plate 21 may be easily assembled and disassembled from the base 10 and main frame 13 as a unitary structure when the relay is mounted on a panel. Thus, one is enabled to make replacements in the field, particularly of the energizing winding 17, without disturbing the relay on its mounting. To disassemble the unitary core and winding, it is only necessary to loosen the screws 25 from the frame 13 and give the core 16 a slight twist or rotary motion to displace the nib 27 on the auxiliary frame plate 21 from its recess in the base 10 and then remove the core unit from its well in the base.

The screws 25, besides being easily accessible from the upper part of the base 10 for unfastening by means of a screw driver, are also disposed in the holes 24 in the auxiliary frame plate 21 in a manner so that they will not fall out while these parts are being assembled or disassembled. At their lower ends the screws 25 are provided with a threaded portion 28 and at their upper ends nearest the head of the screw with an undercut portion 29 of reduced diameter. By providing internal threads in the holes 24, the lower threaded portions 28 of the screws 25 must be first threaded through the holes 24. After that, the under cut portions 29 of the screws 25 are loosely disposed in the holes 24 so that the screws 25 may be threaded into screw holes in the frame 13 to fasten the auxiliary frame plate 21 to the frame. Because of the internal threads in the holes 24, the screws 25 are not easily removable from the plate 21 without first aligning the threads for screw engagement and, therefore, are not likely to fall out of the auxiliary frame plate during assembly or coil replacement.

As hereinbefore explained, to provide a more uniform pull and increased quiet torque characteristics in the alternating-current magnet, I have provided a pole shading construction comprising a pair of parallel slots 30 and 31 in the upper end of the core member 16 which divide the cross-sectional area of the upper end of the core member into three distinct areas, which taken together comprise a single pole face 32 on the core. One of the three extending portions of the core member 16 comprising the pole face 32 is encircled by a shunted pole shader winding 33 which may be formed of two short-circuited turns of copper wire or punched copper plates to provide a low resistance shader. The middle extension on the core member is encircled by a larger shunted pole shader winding 34 which also surrounds the shaded extension encircled by the pole shader 33 and may comprise a single short-circuited turn of copper wire of substantially greater resistance value than the winding 33. The third extension on the core member 16 having no pole shader thereabout constitutes the unshaded portion of the pole face 32. The pole shaders 33 and 34 are secured in the grooves 30 and 31 respectively by swaging the copper in these grooves. As shown in Fig. 3, it will be noted that the upper surfaces of the pole shaders 33 and 34 are on substantially the same plane, the slot 31 being only made deep enough for this

purpose, and no deeper, to avoid undue weakening of the core member 16 at this point.

The cooperating individual shader windings 33 and 34, when properly proportioned, are well adapted to change the flux characteristics of the core member 16 to provide a more uniform pull and greater quiet torque than can be obtained with a single shader winding. The three phase flux components provided thereby, when acting together, have a greater minimum intensity than the usual two phase flux. The intensity of this minimum value of flux is a determinant of quiet torque characteristics; the higher the minimum flux value during each cycle, the less is the likelihood of the attracted armature to overcome the attracting forces and chatter. A more uniform pull on the armature is obtained since the difference between the maximum and minimum values of flux during each cycle is lessened. By encircling the shader winding 34 about both of the shaded portions of the pole face 32, the middle portion of the pole face is shaded, and at the same time, the other shaded portion of the pole face which is surrounded by its own shader winding 33 is, in effect, doubly shaded. A three phase flux is provided which has a component at the unshaded portion of the pole face which follows closely the variations in energization current in the coil 17. The middle portion of the pole face 32 has a flux component which lags the energization current by an electrical angle of less than 90°, and the flux at the doubly shaded portion lags the energization current to a greater extent than the middle portion, but less than 90 electrical degrees. Relative lag is determined by relative amount of shading provided by the shading windings 33 and 34.

Referring now to Fig. 3, the top of the upwardly extending leg of the frame 13 is provided with a fulcrum edge 36 on which an armature 35 is mounted for pivotal movement. At either side of the fulcrum edge 36 on the frame 13 is a projection 37 cooperating with a short projecting portion 38 of the armature 35 which extends across the fulcrum edge 36 and rests thereon. The projecting portion 38 of the armature 35 is disposed between the projections 37 on the frame which prevent any substantial lateral displacement of the armature 35 on the fulcrum edge 36. The upper ends of the extensions 37 on the frame 13 extend laterally inwardly over the projecting portion 38 of the armature 35 in an overhanging relation thereto for preventing any substantial upward movement of the armature 35 off of the fulcrum 36. The projecting portion 38 of the armature 35 is notched at either side to form the shoulders 39 which cooperate with the extensions 37 on the frame 13 to prevent any substantial longitudinal movement of the armature 35 on the fulcrum 36 in one direction. Secured to the upper surface of the armature 35 is a spring strip 40 extending longitudinally thereof having a bent end portion 41 adjacent the fulcrum edge 36 which cooperates with the frame 13 to prevent any substantial longitudinal movement of the armature 35 on the fulcrum 36 in the other direction. In other words, the armature 35 is positioned on the fulcrum edge 36 and is prevented from moving more than a very limited amount longitudinally and laterally thereon by reason of the cooperating spring 40, the extensions 37 on the frame, and the shoulders 39 on the armature. By raising the end 41, the

spring 40 is deflected upward and removal of the armature 35 from the frame is permitted.

The main body of the armature 35 extends laterally above the core member 16 and is pivotally movable about the fulcrum 36 adjacent the pole face 32 upon energization of the coil 17. The opposite end of the spring strip 40 from that nearest the fulcrum 36 extends beyond the end of the armature 35 and is resiliently supported by spring means which normally bias the armature to its unattracted position as well as provide a connection with contact operating means operable by the movement of the armature between its attracted and unattracted positions. The support and contact operating means includes a guide member or post 42 which may be formed by a metal strip staked at its lower end into the frame 13. The upper end of the guide post 42 contains a slot or groove 43 running longitudinally thereof into which one prong of a trifurcated end portion 40a of the spring strip 40 is disposed for movement up and down in the groove 43. On the metal guide post 42, I have slidably mounted a contact carriage 44 of insulating material, the carriage 44 having a central aperture for receiving the guide post 42. The contact carriage 44 is molded with suitable well-shaped upper and lower ends to receive and seat a pair of helical springs 45 and 46 therein. The springs 45 and 46 encircle the guide post 42, the spring 45 serving to support the carriage 44 and resting on the insulating liner 26 of the frame 13. The spring 46 is interposed between the upper side of the carriage 44 and the end 40a of the spring 40 to provide a resilient connection for transmitting the downward movement of the armature 35 to the carriage.

For adjusting the disposition of the armature 35 with respect to the free position of the spring 46, I have provided the spacing washers 47 between spring strip 40 and the upper end of the helical spring 46. The spacing washers 47 are provided with an aperture 48 for receiving the guide post 42 and have a pair of diametrically opposed inwardly extending portions 49 projecting into the groove 43 on the guide post 42. The ends of the projections 49 are spaced apart slightly less than the thickness of the end of the guide post 42 which forms the top wall of the groove 43. These washers may be made of any resilient material, preferably in the form of thin metal punchings which may be pushed over the end of the guide post 42 in the number desired and which will be retained in place thereon by the projections 49 disposing themselves in the groove 43. Because of the projections 49, the spacing washers are unable to fall off of the guide post 42 but may be easily assembled on and removed from the post, the projections 49 being forced apart slightly for this purpose in the course of assembly or removal.

Secured to the base 10 are the terminals 50a, 51a, 52a, and 53a each connected to one of the fixed contacts 50, 51, 52, and 53. The fixed contacts 50, 51 and 52, 53 comprise spaced apart pairs of contacts which cooperate with the movable contacts 54 and 55 respectively disposed therebetween for engagement with the upper set 50 and 52, as seen in Fig. 4, when the armature 35 is in the attracted position, and for engagement with the lower set of contacts 51 and 53 when the armature is in the unattracted position. Extending at opposite sides of the contact carriage 44 are a pair of arms 56 and 57

on which the movable contacts are mounted, the arms being displaced off the center line of guide post 42 or offset for providing a leverage means on said contact carriage 44 whereby the carriage is given a tilting or pivotal movement as the contacts are engaged and disengaged. The contact carriage 44 is slidable on the guide post 42, as hereinbefore mentioned, and it is also arranged for limited pivotal movement about the guide post 42 so that the movable contacts 54 10 and 55 are given a wiping or rolling action upon engagement and disengagement with the respective fixed contacts.

The effectiveness and uniformity of this wiping action is enhanced by providing the pairs 15 of pivot points 58 and 59 on the contact carriage 44 upon which the springs 45 and 46, respectively, are seated. The center lines of the pivot points are on the same vertical plane and are disposed adjacent the narrow edges of the guide post 42. The fixed contacts are also disposed on a common vertical plane which is parallel to the plane of the pivot points. In this manner, as the carriage 44 is slidably moved up and down along the guide post 42, a definite moment arm is provided for tilting the carriage 25 44 as the contacts engage and disengage. This definite moment arm for the tilting of the contact carriage 44 provides a substantially uniform wiping and rolling engagement of the contacts 30 desirable for avoiding and breaking pin point welds on the contact surfaces, scrubbing dust and foreign matter therefrom and providing good engagement of the contacts.

Connecting the movable contacts 54 and 55 in 35 circuit with a pair of terminals 60 provided therefor secured to the base 10 are the resilient conductors 61 which are adapted to flex in accordance with the movement of the contact carriage. The conductors 61 are of substantially 40 U-shaped configuration having outwardly bent ends at the point of connection with the terminals 60 and movable contacts 54 and 55. To minimize the life shortening effects of fatigue to which the conductors 61 are subjected during frequent operation of the relay over long 45 periods by reducing the deflection and hence the stress at the points of support, I have provided the strengthening members 62 and 63 at these outwardly bent end portions of the conductors 61. The strengtheners 62 and 63 comprise strips of metal or other flexible material fitted along the inner curvature of the bends of the conductors 61 which assist in distributing the bending stress at these points over a wide 50 area and greatly assist in prolonging the life of the conductors 61.

In operation of the relay, the armature 35 is normally supported freely by the springs 45 and 46 in the unattracted position above the pole 60 face 32 of the core member 16. The movable contacts 54 and 55 are maintained in engagement with the upper fixed contacts 51 and 53 for making the circuit including the terminals 51a, the contacts 51 and 54, a conductor 61 and 65 a terminal 60, and the circuit including the terminal 53a, the contacts 53 and 55, a conductor 61, and a terminal 60. When the winding 17 is energized, the armature 35 is attracted downwardly to the core 16 and the force of its movement is transmitted to the contact carriage 44 by the helical spring 46. The downward movement of the contact carriage 44 disengages the previously engaged contacts 51 and 54 also 53 and 55. Upon sufficient downward travel, the 75

contacts 50 and 54 also 52 and 55 start to engage, the contact carriage 44 being in substantially upright or vertical alignment with the vertical axis of the guide post 42 on which it slides. As the contacts engage, further downward movement of the contact carriage 44 brings into play the leverage action of the arms 56 and 57 thereon which cause the carriage to rock or tilt on the conveniently placed pivot points 58 and 59 of the carriage upon which the springs 45 and 46 are bearing. This rocking action wipes the movable contacts 54 and 55 across the fixed contacts 50 and 52 in a desirable manner and good engagement of these contacts is provided. Two further circuits are then completed and each includes one of the lower fixed contacts 50 and 52 instead of the upper fixed contacts 51 and 53 as before. The wiping engagement of the contacts 51 and 54 also 53 and 55 occurs in an identical manner when the armature 35 moves back to its unattracted position. Moreover, in each instance as the contacts disengage, some wiping action is effected between those contacts.

The switch device described herein is covered in my divisional application, Serial No. 331,662, filed April 25, 1940.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

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

1. A magnetically operable device comprising a base of insulating material adapted to be mounted on a panel, a magnetic frame mounted on the bottom of said base, a core member, an energizing winding on said core member, an auxiliary frame plate secured to the bottom of said core member having an extension thereon projecting beyond the periphery of said energizing winding, fastening means including said extension of said auxiliary frame plate accessible from the upper side of said base for securing said auxiliary frame plate to said frame thereby enabling easy removal of said auxiliary frame plate, core member, and energizing winding from said frame and base when said device is mounted on a panel.

2. A magnetically operable device comprising a base of insulating material adapted to be mounted on a panel, a magnetic frame mounted on the bottom of said base, a core member and an energizing winding therefor projecting upwardly in a well provided in said base, an auxiliary frame plate secured to the bottom of said core member having a depression struck therein in which the end of said core member is seated and fastened, fastening means for securing said core member in said well on said base comprising a projection on said auxiliary frame plate which cooperates with a recess in said base and may be positioned in an engaging relationship with a wall of said recess and a further projection on said frame plate having an aperture for receiving a screw which threads into said magnetic frame, said screw being accessible from the upper side of said base for enabling assembly and removal of said core member, energizing winding

and auxiliary frame plate when said device is mounted on a panel.

3. A magnetically operable device comprising a base of insulating material arranged to be mounted on a support with a bottom side next to the support and with an oppositely disposed top side, said base being provided with an opening, a magnetic frame on the bottom side of said base and having a portion extending across said opening, said frame being provided with a leg extending laterally from said bottom side across one end of said base, a magnetic core member forming a second leg, an energizing winding on said core member, a magnetic plate secured to one end of said core member having extensions projecting beyond the periphery of said winding, said plate and said winding fitting in said opening in said base, means cooperating with said extensions for detachably securing said plate to said frame with said plate in magnetic flux conducting relation with said portion of said frame.

4. A magnetically operable device comprising a base of insulating material provided with oppositely disposed bottom and top sides, said bottom side being provided with a groove and said base being provided with an opening communicating with said groove, a magnetizable frame having a first leg fitting in said groove and secured to said base, and a second leg extending across one end of said base toward said top side, a magnetizable core member, a magnetizable plate secured to one end of said core member, an energizing winding mounted on said core member, extensions on said plate projecting beyond the periphery of said winding, said plate and said winding fitting into said opening in said base into magnetic flux conducting relation with said first leg, means cooperating with said extensions and accessible from said top side of said base for detachably securing said plate to said first leg, whereby said core member, plate and winding are secured to said first leg and removable as a unit from said front side of said base.

5. A magnetically operable device comprising a base of insulating material provided with oppositely disposed bottom and top sides, said bottom side being provided with a groove and said base being provided with an opening between said sides communicating with said groove, an L-shaped magnetizable frame having a first leg fitting in said groove and secured to said base, the second leg of said frame extending across one end of said base to a point above said top side, a magnetizable core member, a magnetizable plate secured to one end of said core member, an energizing winding mounted on said core member against said plate, extensions on said plate projecting beyond the periphery of said winding, said plate and said winding fitting into said opening in said base into magnetic flux conducting relation with said first leg, means cooperating with said extensions and accessible from said top side of said base for detachably securing said plate to said first leg, whereby said core member, plate and winding are secured to said first leg and removable as a unit from said front side of said base, and an armature pivotally mounted on the end of said second leg movable to an attracted position into engagement with the other end of said core member.

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