Aug. 26, 1941. H. C. HARRISON 2,253,856

RELAY

Filed July 26, 1939

FIG. 1

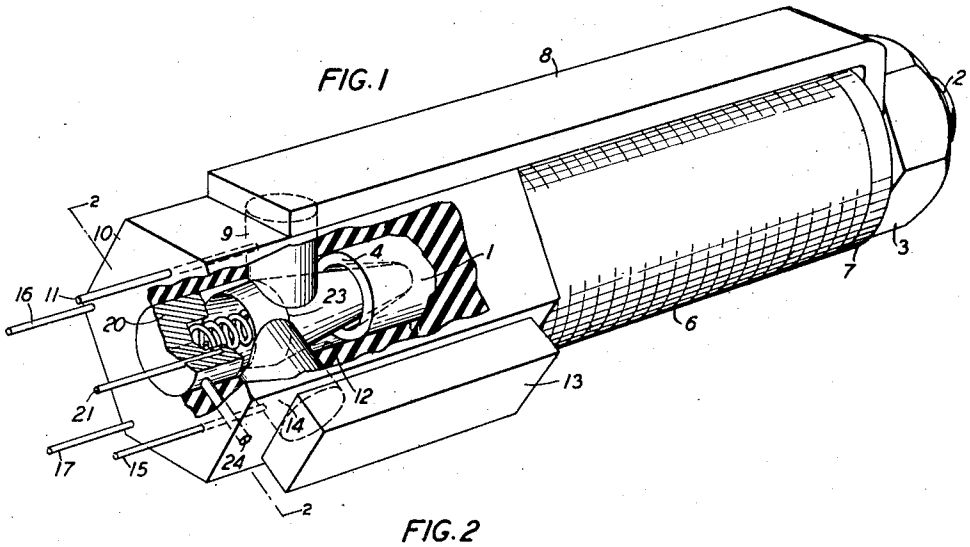


FIG. 2

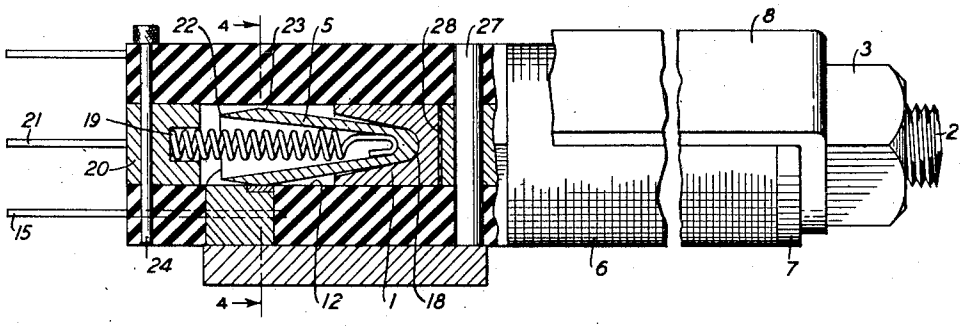


FIG. 3

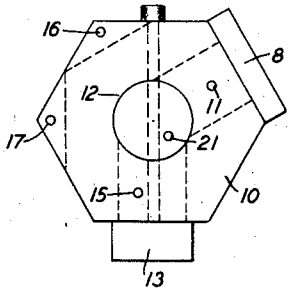


FIG. 4

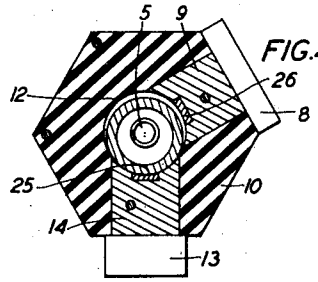


FIG. 5

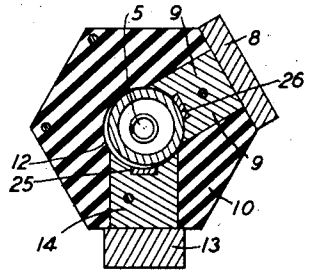


FIG. 7

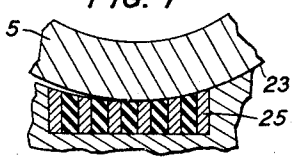
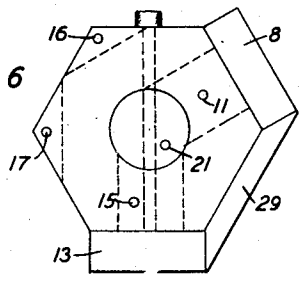


FIG. 6



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Patented Aug. 26, 1941 2,253,856

UNITED STATES PATENT OFFICE

2,253,856

RELAY

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Application July 26, 1939, Serial No. 286,501

10 Claims. (Cl. 200—87)

This invention relates to electromagnetic devices in general and more particularly to a relay in which use is made of a new and novel "roller" type armature for attaining high speed of operation and chatterless contact closures.

In connection with various circuit arrangements such as, for example, those employed for high speed telegraphy and other high speed signal circuits, there is a demand for a relay that will operate on very low currents, produce little or no contact vibration, and will maintain its adjustment constant over considerable periods of time. These requirements necessarily call for armature and contact elements that can be moved with very small quantities of power, and one of the objects of the invention is a relay employing a novel type of armature which is in normal engagement with a contact terminal and which, upon the excitation of the relay coil, is influenced to roll into engagement with another contact terminal.

To accomplish this object in accordance with the principal feature of the invention, there is provided in one embodiment thereof a relay having a core with a winding thereon and a detachable rearwardly extending parallel core leg. The end of the core is provided with a socket that fits into the longitudinal bore of an externally polyfaced block of insulating material, one of said faces being directly underneath the core leg. This face of the block, as well as another face, are each perforated to the surface of the longitudinal bore, the perforations being located at such a distance from the end of the block that one of the connecting apertures is located directly underneath the end of the core leg to the end of which a pole-piece is fitted that extends through the connecting block aperture to form, with the longitudinal bore thereof, a smooth circular finish. A metallic piece is connected by suitable means to the other perforated block face and a metallic extension is fitted therein and connected to the metallic piece, it having a face reamed to a smooth circular finish with the longitudinal aperture. If the relay is one form of a polar structure in which the armature, in its usual position, rests against the pole of a permanent magnet, the metallic piece will be a permanent magnet and the metallic extension therefrom will be a pole-piece which, of course, will be permanently magnetized. If the relay is another form of a polar structure in which the armature stays put when in contact with either pole but operates to move against the other when the exciting current is in the appropriate direction therefor, both pole-pieces are magnetically yoked together by a suitable permanent magnet collar. A hollow-shaped roller is pivoted in the core socket and positionally held therein by a spring interiorly wedged between the front end of the roller and the rear end of a cylindrical cap that fits into the end of longitudinal bore of the block.

The mounting position of the relay is normally horizontal and if the relay is not a polarized relay, the engagement of its roller armature with the surface of one of the pole-pieces may be controlled either by gravity, in which case the relay is mounted so that the pole-piece with which normal engagement is desired comes vertically underneath the armature, or by the action of the spring wedged between the interior of the roller and the cylindrical cap, which may be positioned in the direction of the pole-piece to be normally engaged and thus provide a tensioning force that will operate to position the armature against said pole-piece. If the relay is polarized, the metallic piece is a permanent magnet and the contact terminal is a pole-piece which attracts the roller armature into engagement therewith. When the core is energized and the leg thereof with its extension into the block core are magnetized, the magnetic force will cause the armature to roll from its position of rest into engagement with the magnetized pole-piece while the deenergization of the core will, of course, cause the armature to roll back to its original position.

These and other features of the invention will be more clearly understood by reference to the accompanying drawing, in which:

Fig. 1 is a perspective view of a relay that embodies the features of this invention, one side of its front being partly cut away to expose the interior arrangement of and the relationship between the armature, the core and the magnet pole-pieces;

Fig. 2 is a longitudinal view of the relay with the front side cut away along the section line 2—2 of Fig. 1;

Fig. 3 is a front end view of the relay;

Figs. 4 and 5 are cross-sectional views taken along the line 4—4 of Fig. 2 showing, respectively, the operated and unoperated positions of the roller armature;

Fig. 6 is a front end view of one form of a polar relay; while

Fig. 7 shows one form of contact especially suitable for reducing sparking.

Referring now to the drawing, there is provided a magnetizable core 1 threaded at one end 2 for the reception of the nut 3, and apertured at its other end 4 to form a socket for the reception of the roller armature 5. In the specific embodiment of the invention herein presented for illustration the aperture is conical, but the shape and depth of the socket will, of course, depend upon the shape of the armature, which may be cylindrical or conical, or of any other form suitable for rolling operation.

Fitted coaxially upon the core is a spool 6

having an insulated spoolhead 7 at the end nearest the mounting end of the core between which and the nut 3 is mounted, upon the core, the L-shaped core leg 8 of similar magnetic material as the core itself. A central aperture (not shown) is provided on the short bend of the leg which is sufficiently wide to pass through the core for abutment against the spoolhead and against which it is securely held in position by the nut 3, the long side of the leg being parallel to the axis of the core. A pole-piece projection 9 integral with or suitably secured to the leg 8 extends perpendicularly from the end thereof interiorly towards the center of the core, having its end surface arcuately reamed to be contiguous with the interior of the cylindrical aperture of the insulating block 10, as more particularly described hereinafter. A terminal lug 11 extends from the pole-piece outwardly through the block for external connection therewith.

Fitting over the core 1 and fastened thereto by any suitable means such as, for example, pin 27 which passes through an aperture in core 1, is the block 10 of insulating material having aligned apertures with that of core 1 for the passage of pin 27. The block may be of any desired configuration but preferably with rectangular parallel faces. It has a circular bore 12 coextensive with its length which is coaxial with the core 1 and of a diameter fractionally larger than that of the core to insure a snug fit therewith. The dimension of the block from core surface to the face which lies directly beneath the underside of the leg 8 is such as to provide a little clearance between the two, and this face is perforated to receive the polar extension 9, the bottom face of which is surfaced to provide arcuate continuity with the bore 12 of the block.

Upon one of the other faces of the block 10 there is provided a permanent magnet 13 which is held in position thereagainst by means of the pin 27 that passes through the block and core. At the other end of said magnet there is a cylindrical pole-piece 14 which passes through a circular perforation in the block 10 which is in the same vertical plane as the perforation for the pole-piece 9. The pole-piece 14 of the magnet 13 is, like pole-piece 9 on the core leg 8, reamed to have a pole face contour that provides arcuate continuity with the cylindrical surface of the bore 12, and is further provided with a terminal lug 15 which extends from one of its sides through the block 10 for outside connections. Should a "stay-put" polar relay be desired, in which, when no exciting current is passed through the coil 6, the armature remains attracted against either pole-piece, magnet 13 may be of any suitable structure adapted to yoke together the two pole-pieces 9 and 14 as shown in Fig. 6, for instance, by a permanent magnet structure having a cross-reach member 29 extending between the portion 13 and the core leg 8.

The armature 5 is, for the specific relay structure herein used to illustrate the invention, a bullet-shaped hollow structure of magnetic material having a tapering head 18 adapted for a swivel fit within the core socket, an outer base diameter 22 and an inner base diameter 23 slightly smaller than the diameter of the block bore 12, and a length such that when the armature is inserted within the core socket and held in that position, the vertical plane that passes through the centers of the pole-pieces 9 and 14 shall also pass through the circumference of the inner base diameter 23 and be engaged by the surfaces of said pole-pieces if the armature rolls into position for engagement therewith in the manner to be described hereinafter. A spring 19 has one end thereof seated in a depression in the inner face of the metal cap 20 and its other end inserted within and fitting into the hollow portion of the armature. When the cap is fitted into the end of the circular bore 12 and held in position by the bolt 24 passing through the block and cap, the spring becomes wedged between the head of the armature and the interior depression of the cap and pushes the head of the armature into the core socket, thereby holding it in position. A terminal lug 21 extends outwardly from the cap 20. If it is desired to cause the armature 5 to rest normally against one of the two pole-pieces regardless of the manner in which the relay is mounted, spring 19 may be given an axial deflection. The tension thus placed on the spring will exert a force upon the armature in the direction of the spring deflection, causing a section of its inner base circumference to press against its opposing bore surface which, of course, may be the surface of either of the two pole-pieces.

Having described the structural elements of one form of the relay and their arrangement with respect to each other, the operation of the relay will now be described.

The relay is horizontally mounted in any suitable support and held in that position by the nut 3. If the relay is mounted on an electrically conducting frame, the core 1 may be provided with a separate socket section for the armature 5 which is joined to the core by a film of varnish 28 or other suitable electrically insulating material. This will have the effect of insulating the armature from the core and, necessarily, from the support thereof. In the most general form, the disposition of the permanent magnet 13 on one of the faces of the block 10 is such that when the relay is mounted upon its support, the magnet is in line with the gravity pull on the armature, although this is not necessary if the armature is made to press against any portion of the bore surface by the deflection of the holding spring as described above, in which case the relay may be mounted with its pole-pieces in any position with respect to gravity. In the position assumed, the armature comes into engagement with the pole-piece 14 resting on the contact portion 25, it assuming the position of contact exemplified by Fig. 4. A working circuit may then be established through the lug 21 and metallic connection of the spring with the armature, and the armature engaged with pole-piece 14, outwardly through the lug 15 on the other side of the circuit, said armature, in this position, being out of contact with the pole-piece 9 of the core extension 8.

When current is passed through the coil 6, however, the core 1 and the extension 8 thereof becomes magnetized. The magnetic force of attraction induced thereby through the armature 5 will cause said armature to be attracted to the pole-piece 9, rolling out of contact with pole-piece 14 into contact with pole-piece 9, centering on the contact portion 26, in which position of the armature a working circuit may then be established through lug 11 of the pole-piece 9, the contact between the armature 5 and said pole-piece and lug 21. When the current ceases to flow the core is deenergized, the tractive force is eliminated, and the armature rolls back into

engagement with pole-piece 14. If the structure is a polar relay in which pole-pieces 9 and 14 are magnetically yoked together and to the permanent magnet 13 in the manner described above and the armature is initially centered out of contact with either pole by tension in the wedging spring 19, said armature will, of course, remain out of contact with each pole-piece from which position it will roll into engagement with either pole-piece only when the current through the exciting coil 6 is in the appropriate direction therefor.

The contact portions 25 and 26 may be of any suitable conducting material. In order to reduce contact sparking at the time the armature rolls out of engagement therewith, said contact portions may consist of alternate layers of mica and silver ground to a smooth finish as shown in Fig. 7. As the armature member rolls thereover, resistance is progressively added to the circuit to be opened. Thus the circuit is never completely opened in the sense of having infinite resistance, but the resistance can be made sufficiently high to reduce the current to any practical magnitude. With this type of contact, severe arcing conditions are avoided.

While I have described the principle of my invention in connection with its specific application to a relay having a particular structure, it is to be understood that various other applications and embodiments thereof may be made by those skilled in the art without departing from the spirit of the invention as defined within the scope of the appended claims.

What is claimed is:

1. An electromagnetic device comprising a coil, a magnetic structure having a core with a socket in one end thereof, pole-pieces, means for circularly disposing said pole-pieces around said aperture, and an armature seated in said socket adapted for rolling motion between said pole-pieces, said coil upon its energization producing a turning moment in said armature to roll said armature into contact wth one pole-piece or the other depending upon the direction of the magnetic force.

2. An electromagnetic device comprising a coil, a magnetic structure having a core with a conical socket in one end thereof, an insulating block fitting said core at said end provided with a bore coaxial with said core and coplanar perforations communicating perpendicularly with said bore, pole-pieces fitted into said perforations and magnetically yoked to said core, an armature adapted to fit into said socket for swivel action therein and for engagement with each of said pole-pieces, a cap closing the outer end of said coaxial bore, and a spring wedged between the interior end of said armature and said cap for holding said armature by the tension of said spring into an adjusted position with respect to said pole-pieces, said coil upon its energization producing a turning moment in said armature to roll said armature into contact with one pole-piece or the other, depending upon the direction of the resultant magnetic force.

3. A relay according to claim 5 in which said of said pole-pieces includes a contact portion adapted for engagement with said armature, said contact portion comprising alternate layers of mica and silver for increasing the resistance of the current path therethrough as said armature progressively rolls out of engagement with said contact portion.

4. An electromagnetic relay comprising a core recessed at one end, a coil mounted in said core, two pole-pieces, means for securing said two pole-pieces at an equiradial distance from the recessed end of said core, and a roller armature adapted to fit loosely in said recess whereby upon the excitation of said coil said armature rolls into engagement with one or the other of said pole-pieces in accordance with the resultant magnetic pull on said armature.

5. A relay comprising a coil and a magnetic structure having a core with a conical aperture, two pole-pieces, and an armature yieldably fitted into the aperture of said core for rolling movement into engagement with one or the other of said pole-pieces depending upon the direction of the resultant force exerted upon said armature by said pole-pieces upon the energization of said coil.

6. A relay comprising a coil, a magnetic structure provided with a conical aperture, a pole-piece magnetically yoked to said core, a permanently magnetized pole-piece and an armature fitted into the socket of said core for rolling movement into engagement with said first pole-piece upon the energization of said coil, said armature normally resting in engagement with said permanently magnetized pole-piece.

7. A relay comprising a core with a conical aperture, a coil wound on said core and a magnetic structure having two pole-pieces magnetically yoked to said core, and an armature yieldably retained in the aperture of said core for rolling movement into engagement with one or the other of said pole-pieces depending upon the direction of the magnetic force generated in said structure upon the energization of said coil, said armature being adapted normally to rest in a neutral position between said pole-pieces.

8. A relay comprising a coil, a magnetic structure provided with a core and two permanently magnetized pole-pieces, said core having a socket aperture at one end thereof, an armature, a spring for yieldably holding said armature in the aperture of said core whereby said armature is adapted for rolling movement into engagement with one of said pole-pieces upon the energization of said coil, said armature being normally held in engagement with the other of said pole-pieces by said spring.

9. A relay comprising a coil and a magnetic structure having a conical aperture at one end thereof, two pole-pieces, and an armature, a spring for yieldably holding said armature in the aperture of said core whereby said armature is adapted for rolling movement into engagement with one or the other of said pole-pieces depending upon the direction of the resultant magnetic force exerted upon said armature by said pole-pieces upon the energization of said coil, and means for completing work circuits through said armature and either of said pole-pieces.

10. A relay comprising a coil and a magnetic structure having a conical socket at one end thereof, two pole-pieces and an armature means for yieldably holding said armature in the socket aperture of said core whereby said armature is adapted for conical rolling motion to engage one or the other of said pole-pieces depending upon the direction of the resultant magnetic force exerted upon said armature by said pole-pieces upon the energization of said coil.

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