

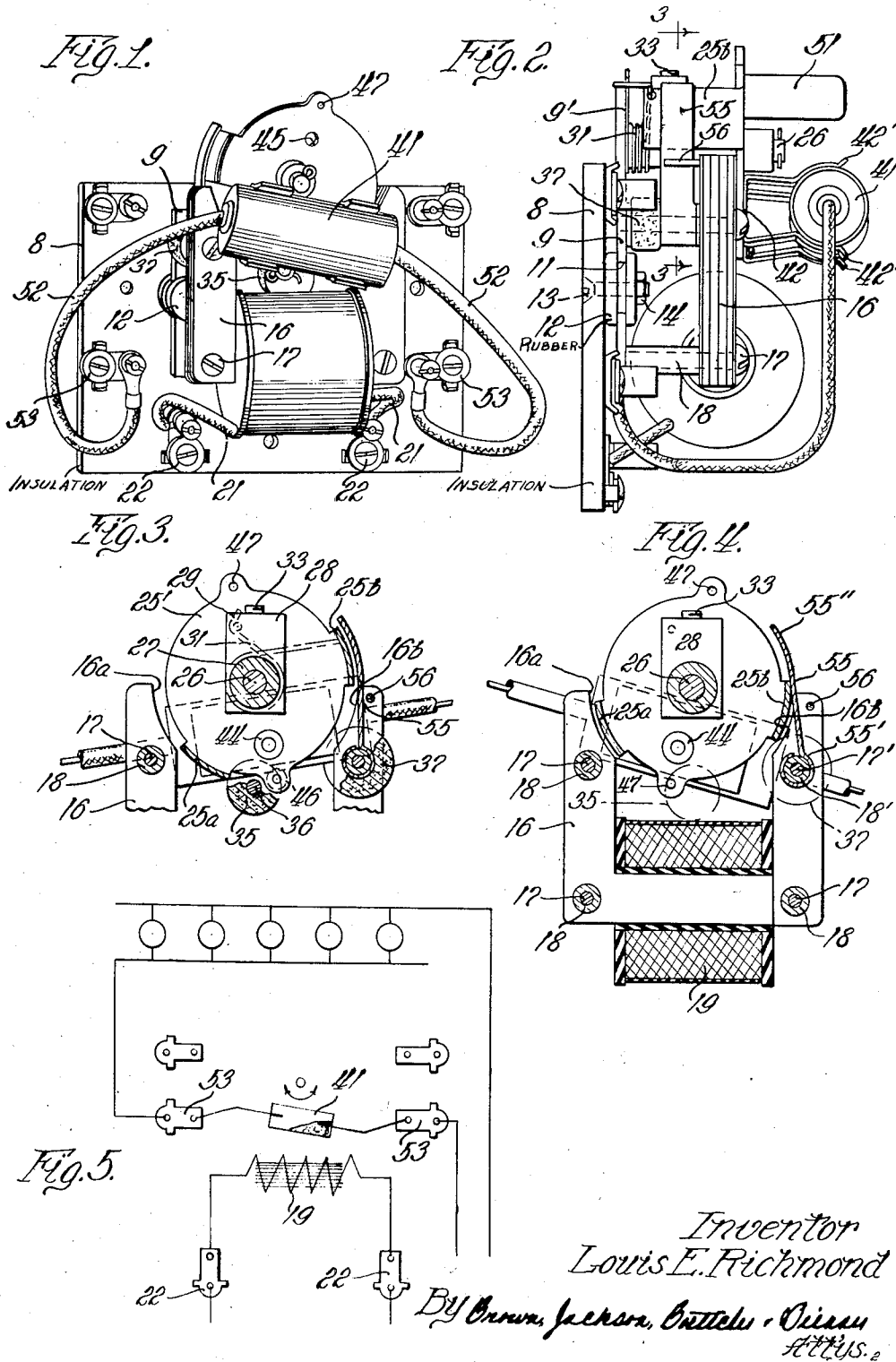
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RELAY

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RELAY

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1 Claim. (Cl. 175—336)

The present invention relates to relays and similar switching devices wherein relatively rapid circuit making and breaking operation are performed with an oscillatory motion, and wherein the mass of the moving parts and switching medium have substantial inertia, and hence are subject to recoil or other objectionable motion in the oscillatory throw of the device. The general object of the present invention is to provide improved magnetically responsive brake means in such relays or similar switching devices, serving to damp or eliminate such recoil and other objectionable motion, so that the device will have a substantially dead-beat operation.

The need for such magnetically responsive brake mechanism arises particularly in the case of relatively high speed relays of the tilting mercury tube type, and accordingly I have disclosed my invention in such embodiment, but I wish it to be understood that the invention is not necessarily limited thereto. In operating a tilting tube type of mercury relay at relatively high speeds, the mass of the mercury rolling from one end of the tube to the other sets up forces which tend to cause the mercury to splash or bounce around within the tube and thereby disturb the intended regular timing of the circuit opening and closing function of the relay. This condition is frequently of a more aggravated nature in the quiet type of relay in which the armature does not make metallic contact with its mating pole pieces but merely rotates toward or into the path of maximum flux density.

In my improved relay, the splashing or bouncing of the mercury and the other objectionable characteristics arising from recoil, etc., are avoided by the action of the aforementioned magnetic brake apparatus. By virtue of the fact that this brake is magnetically responsive to the energization of the relay electromagnet, it follows that the timing of the brake action and the intensity of the brake action are automatically predetermined by the energizing impulses transmitted to the relay electromagnet. Upon the de-energization of said electromagnet, the brake is substantially non-effective to retard the return motion of the armature and mercury tube, and hence the device is substantially frictionless in this direction of motion and can return to its normal position freely and easily.

Another feature of my improved relay is that its operation is substantially noiseless, there being no hum or chatter when the contact is made, this being true in both the alternating and direct current embodiments.

Other features, objects and advantages of the invention will appear from the following detail description of one preferred embodiment thereof. In the accompanying drawing illustrating such embodiment:

Figure 1 is a front perspective view of the relay, the armature and the mercury tube being illustrated in the positions they assume when the relay is deenergized;

Figure 2 is a side elevational view of the relay;

Figure 3 is a fragmentary transverse sectional view taken approximately on the plane of the line 3—3 of Figure 2, this view also showing the position of the armature and mercury tube in the deenergized condition of the relay;

Figure 4 is a view generally similar to Figure 3, but illustrating the corresponding positions of the armature, mercury tube and magnetic brake for the energized condition of the relay; and

Figure 5 is a circuit diagram showing the circuit connections and one typical utility of the relay.

The relay structure is mounted on an insulating back panel 3 which carries the electromagnet, armature, and the several terminal posts through which electrical connection is established with these parts. The electromagnet and armature are not mounted directly on said back panel 3, but are preferably carried on a supporting plate 9 which has a cushioned or sound-absorbing mounting on the back panel 3. This mounting is obtained by extending horizontal slots 11 (Figure 2) into each vertical side edge of the plate. Inserted into each of these slots is a spool-shaped soft rubber bushing 12, the enlarged heads of which engage the front and back sides of the metallic plate 9 and space this plate from the back panel 3. Screws 13 pass through the back panel 3 and through these rubber bushings 12, receiving washers and nuts 14 on their front ends for securing the bushings to the back panel.

A U-shaped electromagnetic field structure 16 is supported on the mounting plate 9 in forwardly spaced relation therefrom. Cap screws 17 pass through holes in the corner portions of this core structure and then extend through spacing sleeves or posts 18 which space the field structure from the mounting plate 9, the inner ends of these screws threading into tapped holes in said mounting plate. One of these screws 17 and its post 18 serve as a support for the magnetic brake, as will be later described. The field structure 16 is preferably laminated, and surrounding the lower leg thereof is the electromagnet 19 which energizes the field. The electromagnet is con-

nected through end conductors 21 which are secured to terminal posts 22 mounted on the back panel 8. The vertical legs of the field structure 16 terminate in pole pieces 16a and 16b between which rotates the armature 25. The screws 17 and sleeves 18 may magnetically insulate the field structure from the mounting plate 9, or this plate may be of non-magnetic metal, so as to avoid a magnetic short-circuit between the pole pieces 16a-16b. The armature is preferably in the form of a sheet metal stamping comprising a disk portion 25', from the periphery of which project axially extending segments 25a and 25b. These segments function as armature poles adapted to rotate across the arcuate pole pieces 16a and 16b of the field structure 16, as clearly shown in Figure 2. The armature 25 is mounted for oscillatory movement on a stationary pivot pin 26 which has its rear end rigidly anchored in an ear portion 9' projecting upwardly from the mounting plate 9. A sleeve or boss 27 projects forwardly from the mounting plate portion 9', concentrically of the pivot pin 26, for adjustably supporting a block 28. The latter carries a pin 29 against which is hooked a torsion spring 31 which encircles the sleeve or boss 27, the other end of this spring being hooked in an aperture in the armature pole 25b, as indicated in dotted lines in Figure 3. It will be apparent that by rotating the block 28 a short distance in one direction or the other the tension in the spring 31 can be increased or decreased as desired. The block may be mounted for rotation on the sleeve 27, or it may be formed integral with said sleeve and the latter be arranged for rotation on the pivot pin 26, the block being fixedly held in any adjusted position by tightening up the set screw 33. The spring 31 normally tends to hold the armature 25 in the position illustrated in Figure 3. In this position, the lower or trailing edge of the armature pole 25a remains pressed against a bumper stop, preferably in the form of a felt collar 35, which is mounted on a pin 36 projecting forwardly from the mounting plate 9. Another felt collar 37 is mounted on the aforementioned mounting screw and post 17'-18' which carry the magnetic brake element, this second felt washer serving as a bumper stop to be engaged by the lower or leading edge of the armature pole 25b, whereby to limit the range of motion of the armature in its actuated direction of throw.

The armature is adapted to carry either one or two mercury switches 41, as desired. Only one mercury switch is shown, this being mounted on the lower half of the rotor or armature, but in the event that two switches are to be employed, the mounting thereof is merely duplicated on the upper half of the armature. The mounting for each rotary switch is in the form of a clip 42 having laterally spaced pairs of spring arms 42' between which the mercury tube is snapped, as shown in Figure 2. This clip has its base portion secured to the armature disk 25' by an eyelet or other suitable pivot 44 which passes through the base of the clip and through an aperture 45 in the disk portion 25'. A clamping screw 46 threads into a tapped ear 47 that projects from the disk 25', the head of this screw exerting clamping pressure against the base portion of the clip 42. By virtue of the above arrangement, the clip 42 and mercury tube 41 can be inclined to different angular positions on the armature, and then secured in a certain desired position by the tightening of the screw 46, such adjustment enabling

the angles of inclination of the mercury switch to be varied for the circuit open and circuit closed positions of the armature. As shown in Figure 1, the apertures 45 and 47 in the upper half of the armature disk 25' provide for the mounting of the second clip 42 when two mercury switches are to be mounted on the armature. It may be desired that the armature have approximately the same mass when either one switch or two switches are employed, in which case a weight 51 may be secured to the upper portion of the armature by a clamping screw passing through the aperture 45, this weight approximating the mass of a mercury tube and its mounting clip. Flexible conductors 52 extending from the ends of the mercury switch connect with the terminal posts 53 extending from the back panel 8.

The magnetic brake comprises an arm 55, composed of a magnetically responsive metal, this arm being mounted for limited oscillatory movement adjacent to the armature 25. Preferably, the lower end of this arm is bent into a circular loop 55' which encircles the spacer sleeve 17' and is rotatable thereon, although it will be understood that this oscillatory mounting of the magnetic brake arm may be provided for in other ways. The brake arm is in immediate proximity to the field core structure 16, as shown in Figure 2, so that a considerable portion of the magnetic flux threads the brake arm 55. The upper portion of said brake arm is given an arcuate curvature, as indicated at 55'', this curvature corresponding approximately to the curvature of the outer surface of the armature pole 25b. A stop pin 56, composed of copper or brass, projects rearwardly from the adjacent upper end of the core structure to serve as a limiting stop for limiting the outward swinging movement of the brake arm away from the armature.

In the operation of the device, the energization of the electromagnet 19 by an impulse of current creates a flux path through the field structure from one pole piece 16a-16b to the other. The armature 25 immediately oscillates towards its actuated position so as to bring its armature poles 25a-25b into position to reduce the magnetic reluctance of the gap between the field poles 16a-16b. Simultaneously with the beginning of this oscillatory movement of the armature, the brake arm 55 is magnetically attracted into engagement with the armature pole 25b. The brake arm remains in contact against said armature pole during the energized interval, while the armature is completing its oscillatory throw to the actuated position illustrated in Figure 4. The frictional retardation which this brake arm exerts against the armature is proportioned to damp or eliminate recoil at the end of the throw, so that the device will have a substantially dead-beat operation, but this frictional retarding force is not sufficiently high, however, to greatly impede the motion of the armature or to introduce high frictional losses. Immediately upon the cessation of the current impulse energizing the electromagnet 19, the attracting force holding the brake arm against the armature pole 25b ceases. Hence, in the ensuing return oscillation of the armature, the brake arm is not effective to exert any objectionable magnetic drag against the armature. Also, because the brake arm is mounted in a stationary support and is not responsive to any centrifugal force arising from rotary motion of the armature, said brake arm therefore exerts no centrifugal drag on the armature in the return motion of the latter. Thus, there is no objec-

tionable friction loss resulting from brake operation at this time. If desired, a very light spring pressure or gravity action might be employed to positively move the brake arm out of engaging contact with the armature during such return oscillation, if desired, although I do not find this necessary in the arrangement shown because of the insignificant friction which the brake arm exerts against the rotor during the return oscillation. The brake apparatus is very quick in its operation for high speed actuation of the relay. Furthermore, the entire operation is practically noiseless, this being true in both the alternating and in the direct current embodiments of the relay.

While I have illustrated and described what I regard to be the preferred embodiment of my invention, nevertheless it will be understood that such is merely exemplary and that numerous modifications and rearrangements may be made therein without departing from the essence of the invention.

I claim:

In a relay structure for actuating a mercury tube switch, the combination of an electromagnet including a field structure comprising a pair of field poles, a pivot pin mounted substantially centrally between said field poles, said field poles having arcuate faces substantially concentric with

respect to said pivot pin, an armature mounted substantially centrally on said pivot pin for oscillatory movement relatively to said field structure and comprising a pair of arcuate armature poles which are formed substantially concentric with respect to said pivot pin and which normally lie substantially out of registry with said arcuate field poles, thereby resulting in a two-gap field structure in which both gaps are of approximately the same dimensions, and automatic brake means for imposing a dead-beat retarding force on the oscillatory motion of said armature, said brake means comprising an arcuate brake shoe of magnetic material pivotally mounted on a pivot axis carried by said field structure in spaced relation to said pivot pin, said brake shoe projecting as an extension from one of said field poles and normally lying in proximity to one of said armature poles, to be effective at one of said gaps whereby said brake shoe establishes an unsymmetrical flux path through said field and armature poles at one of said gaps when said armature is in its normal position, said brake shoe being attracted magnetically into direct contact against said latter armature pole for exerting a frictional retarding force on the armature when the electromagnet is energized.

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