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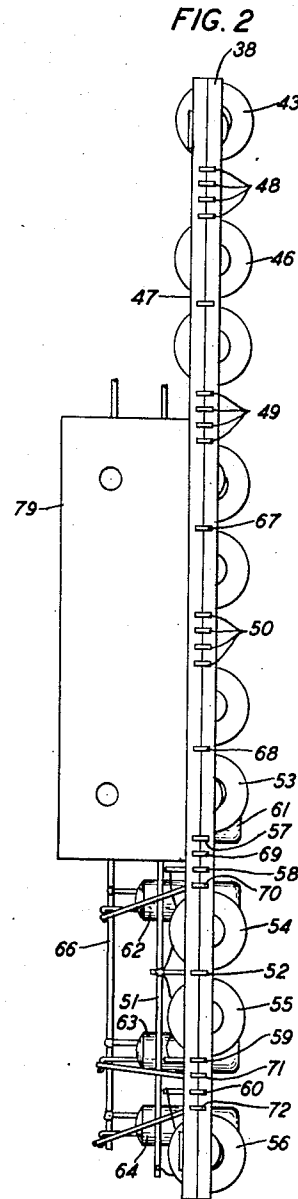
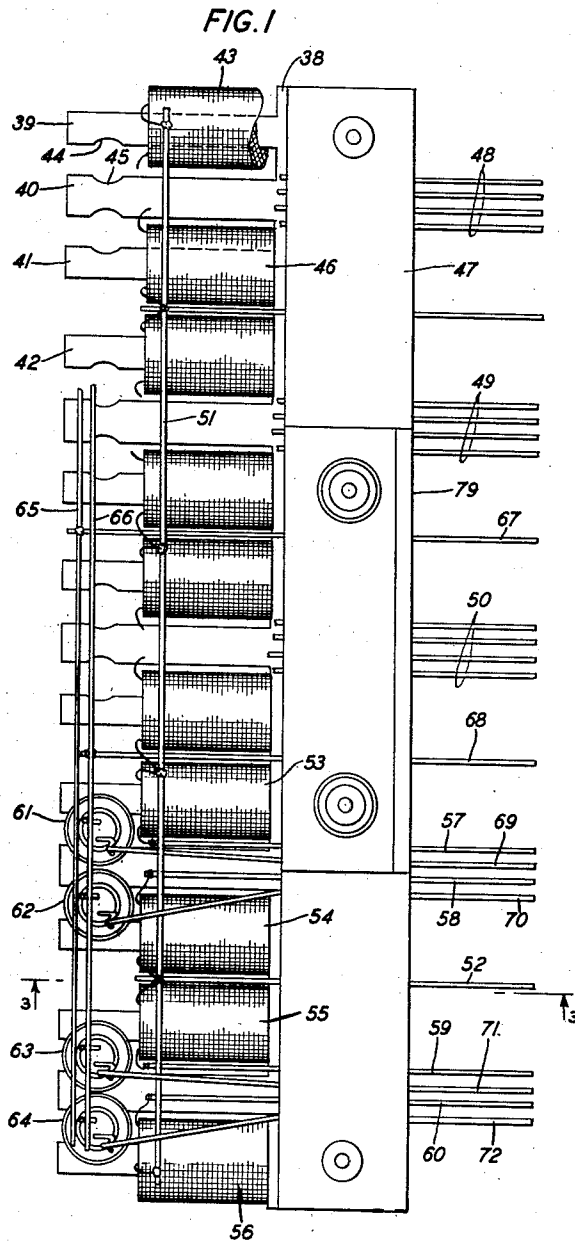
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2,387,017

ELECTRIC SWITCH

Original Filed June 15, 1940

2 Sheets-Sheet 1



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FIG. 3

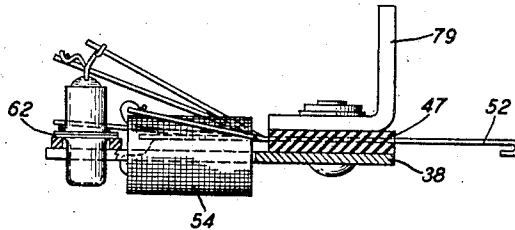


FIG. 4

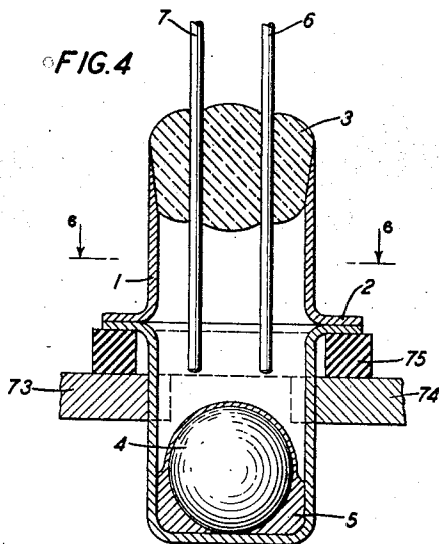


FIG. 5

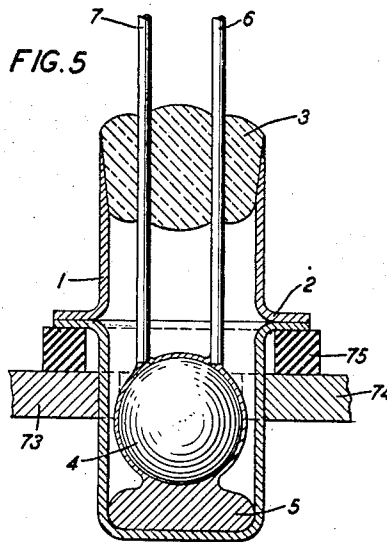
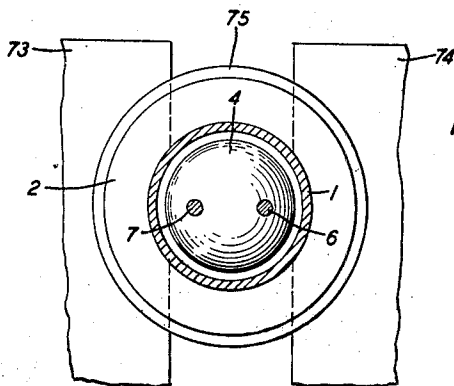


FIG. 6



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UNITED STATES PATENT OFFICE

2,387,017

ELECTRIC SWITCH

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Original application June 15, 1940, Serial No. 340,653. Divided and this application August 22, 1942, Serial No. 455,740

5 Claims. (Cl. 200—98)

This invention relates to electromagnetic relays and switches, and the present application is a division of applicant's Patent 2,309,953 of February 2, 1943.

The objects of the invention are to attain a greater degree of simplicity both in the structure and in the principle of operation of relays and similar devices; to realize a higher efficiency as a result of these simplifications; to obtain improved magnetic circuits for operating the circuit-making contacts; and in other respects to improve these devices and to increase their usefulness for circuit controlling purposes.

It is well recognized that mercury has certain advantages over solid contacts for opening and closing electric circuits. Being a fluid, it presents a fresh surface for each contact closure and does not become corroded and pitted as a result of successive circuit interruptions. On the other hand solid contacts have advantages too. They can be made of materials that are lighter than mercury and can be moved at higher speeds. Also it is possible to apply the forces of the magnetic field more directly to solid contact-operating elements than to a mass of mercury for effecting the desired circuit closures and openings.

Accordingly the foregoing objects of the present invention are achieved by an improved switch or relay assembly which realizes not only the advantages of mercury as a contact-making medium and the characteristic advantages of solid contact elements but also includes an improved common magnetic structure for a plurality of the switch or relay units.

To this end the magnetic structure of the relay assembly consists of a comb of magnetic material with the teeth spaced in groups, each group of teeth forming the magnetic circuits for a number of switches. More specifically the adjacent edges of the central and outside teeth of a group of three are provided with notches near the ends of the teeth, thus forming two openings for receiving and holding a pair of the switch units. The two outside teeth serve as the cores for the individual coils, and the central tooth forms a common magnetic return path, the base of the comb serving as the yoke completing the magnetic circuits. The structure is assembled by first slipping the individual coils over the outside teeth of each group, inserting the switch units in their openings or sockets, securing a fabricated wire terminal strip to the base of the magnetic comb, and finally soldering the various terminal wires of the strip to the proper terminals of the switch units and coils.

The foregoing and other features of the invention will be described more fully in the following specification.

In the drawings accompanying the specification:

Fig. 1 is a top plan view of a relay assembly including a common operating magnetic structure and a plurality of individual relay operating means;

Fig. 2 is a rear view of the assembly shown in Fig. 1;

Fig. 3 is an end view of the assembly; and

Figs. 4, 5 and 6, inclusive, show one form of the relay operating unit.

While the invention is not limited to any particular size or proportions for the relay operating unit it may be noted that this relay is especially useful in electrical systems where relatively small currents are involved such, for example, as currents of the magnitude commonly used in telephone, telegraph and other communication systems. For these purposes the dimensions of the relay may be relatively small, and it should be understood that the figures shown in the drawings are much enlarged in order to facilitate a clear understanding of the construction.

Before discussing the relay assembly as a whole, which is illustrated in Figs. 1 to 3, a detailed description will be given of the relay operating unit.

Referring first, therefore, to Figs. 4, 5 and 6, the operating unit here disclosed comprises a metal container 1 which is formed by welding together the circumferential flanges of two small cylindrical eyelets. The metal of which the eyelets are made is preferably of a non-magnetic character. If desirable, however, the upper eyelet may be made of magnetic material, such as stainless steel. The external shoulder 2 formed by the juncture of the flanges in the welding operation serves, as will be explained more fully hereinafter, to locate and hold the unit in position in the assembly. The upper end of the container or tube 1 formed from the eyelets may be sealed with a mass 3 of any insulating material, such as glass. During the welding operation or at any other convenient time the interior of the tube 1 may be evacuated and, if desired, filled with any suitable gas.

The process by which the housing tube 1 is formed and the process of evacuating it and charging it with a desired gas or gases are the subject-matter of Patent 2,326,296 to H. C. Harrison and J. B. Little, dated August 10, 1943.

The armature of the relay consists of a ball 4

of magnetic material. The ball 4, which may be either hollow or solid, normally rests in a mercury pool 5 in the bottom of the tube 1. The depth of the mercury pool, and the diameter of the ball are of such dimensions and the external surface of the ball is such that the mercury adheres or clings to the ball with considerable force and by capillary attraction constantly maintains a film of the liquid over the entire surface of the ball projecting above the level of the pool. These forces may be augmented by coating or plating the external surface of the ball 4 with certain substances, such as platinum, nickel, and copper, and by maintaining the coated surfaces free from corrosion. This may be done, as above mentioned, by introducing inert gases into the container.

The armature 4 cooperates with a pair of stationary terminals 6 and 7, which are sealed into the insulating mass 3. When it is desired to operate the relay, a magnetic field is produced for attracting the ball 4 upward into engagement with the contact surfaces of the terminals 6 and 7. As the ball 4 moves up out of the pool 5 to its operated position (Fig. 5), the adhesion of the mercury to the ball distorts the shape of the pool and sets up in the mercury mass forces of surface tension which tend to draw the ball back to its normal position.

Since the surface of the ball is constantly coated with a film of mercury, some of the liquid is transferred to the contact surfaces of the terminals 6 and 7 by the repeated engagement of the ball with these terminals. Thus each circuit closure between the terminals 6 and 7 by way of the mercury coated ball is in effect established by bringing two liquid covered surfaces together. Similarly, each circuit opening is made by severing these liquid covered surfaces. In this way the solid contacts of the relay are protected against sparking, corrosion and other detrimental effects.

When it is desired to release the relay, the magnetic field is removed, whereupon the force of gravity, assisted by the forces of surface tension and adhesion in the mercury, draws the ball quickly back to its normal position.

The relay above described is particularly applicable to multiunit assemblies in which a plurality of individual relays are associated with a common magnetic structure. One such relay assembly is illustrated in Figs. 1 to 3 comprising a common magnetic member, individual operating coils and relay units mounted on said member and a common terminal member. The magnetic member 38 is made from a flat sheet of magnetic material and is formed like a comb with a series of teeth 39, 40, 41, 42, etc., which constitute the magnetic circuits for the individual relays. The teeth of the magnetic member 38 are arranged in groups of three, each group constituting the magnetic circuits for a pair of relays. For example, the teeth 39 and 40, together with the common portion of the strip 38, form the magnetic circuit for a single relay, the operating winding 43 being located on the tooth 39. The inner adjacent edges of the teeth 39 and 40 are provided with circular notches 44 and 45 to receive and hold one of the relay operating units, such as the unit shown in Fig. 4. Similarly the teeth 40 and 41 form the magnetic circuit for the second relay of the pair, and the operating winding 46 for this relay is located on the outside tooth 41. In like manner the remaining teeth of the magnetic strip 38 are arranged in groups of three.

The terminal member, which supplies the electrical connections for the operating windings and relay units, comprises an insulating strip 47 having molded therein or otherwise secured thereto a series of groups of terminals 48, 49, 50, etc. The terminal strip 47 is secured to the magnetic member 38, and the individual terminal conductors are connected in any desired manner with the terminals of the operating windings and with the terminals of the relay units.

Although the drawings illustrate one specific method of wiring the coils and relay units, numerous other wiring plans may be used depending upon the functions to be performed by the relays. In the plan illustrated in the drawings one terminal of each of the energizing coils is connected to a common bus 51 which in turn is supplied by the feed terminal wire 52. The other terminal of each coil is connected to an individual wire in the associated terminal group. For example, each of the coils 53, 54, 55 and 56, and the same is true of the remaining coils, has one terminal connected to the common bus 51. The other terminals of coils 53, 54, 55 and 56 are connected respectively to the terminal wires 57, 58, 59 and 60. Each of the relay units, such as the units 61, 62, 63 and 64, has one of its terminals connected to the common bus wire 65 and another of its terminals connected to the common bus wire 66. These bus wires are supplied over terminal conductors 67 and 68, respectively. The third terminals of these relay units are connected respectively to the individual terminal conductors 69, 70, 71 and 72.

When the relay units are thus assembled with the magnetic structure, the magnetic ball armature of each unit is located in operative relation to the air-gap formed by the adjacent teeth of the magnetic comb which support the unit. This relation is clearly shown in Fig. 4 where the ball 4 is seen to rest in its normal position somewhat below the center of the air-gap formed by the adjacent teeth 73 and 74. An insulating washer 75 may be inserted between the magnetic teeth 73 and 74 and the shoulder 2 on the container 1 to fix the desired relation between the armature 4 and the air-gap.

It will be understood that alternative relay structures, such as those shown in applicant's Patent 2,309,953 of February 2, 1943, may be incorporated in a relay assembly similar to the one shown herein.

Although the teeth of the magnetic member 38 in Fig. 1 are shown with notches for receiving the relay units, it will be understood that these teeth may have straight edges if desirable, the relay units being held in place by any other suitable means.

These relay assemblies may be mounted on relay racks, switch frames, or in any other desired manner, the assembly shown in the drawings being secured to a suitable supporting plate 79.

What is claimed is:

1. In combination, a plurality of switch units each comprising a container and contact-making devices, a common magnetic circuit for said switch units comprising a comb of magnetic material, the adjacent sides of the teeth of said comb being shaped to form recesses for receiving and holding the individual switch units, and individual operating coils for said switch units mounted on the teeth of said magnetic comb.

2. In combination, a plurality of switch units each comprising a housing tube and contact-making

ing devices, a common magnetic circuit for said switch units comprising a comb of magnetic material, the adjacent sides of the teeth of said comb being shaped to form recesses for receiving and holding the individual switch units, and individual operating coils mounted on certain ones of the teeth of said comb, the tooth intermediate each pair of switch units serving as a common magnetic return path for both units.

3. In combination, a plurality of switch units each comprising a housing tube having contact-making devices therein, a common magnetic member for said switch units comprising a strip of sheet magnetic material having spaced integral projections extending on one side thereof, said projections being spaced in groups of three, the adjacent edges of the projections of each group having notches therein to form recesses for receiving and holding a pair of said switch units, individual energizing coils mounted on the outside projections of each group, the middle projection of each group serving as a common magnetic return member for both switches, and a terminal strip secured to said magnetic member having a series of wire terminals projecting into operative relation with the terminals of said switch units and energizing coils.

4. In combination, a plurality of switch units each comprising a cylindrical housing tube having contact-making devices therein, a common magnetic member for said switch units comprising a strip of thin magnetic material having

spaced integral projections extending on one side thereof, the spacing between adjacent projections being less than the diameter of one of said switch units, the inside edges of the adjacent projections having notches therein for receiving and holding said switch units, individual energizing coils mounted on said projections which serve as magnetic cores therefor, a terminal strip secured to the common portion of said magnetic member, and terminal wires molded in said terminal strip and projecting therefrom for connection with the terminals of said switch units and energizing coils.

5. In combination, a plurality of switch units, each including a housing member having fixed contacts therein and a magnetic ball which normally rests in the bottom thereof, a common magnetic circuit for said switch units comprising a comb of magnetic material, the teeth of said comb having their adjacent sides shaped to form recesses for receiving and holding the individual housing members of said units and serving as pole members for attracting said magnetic balls, each of said housing members cooperating with the adjacent teeth supporting it to fix the position of the ball with respect to the air-gap formed by said teeth, and individual coils for said switch units mounted on the teeth of said magnetic comb for attracting the magnetic balls into the associated air-gaps and into engagement with the corresponding fixed contacts.

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