

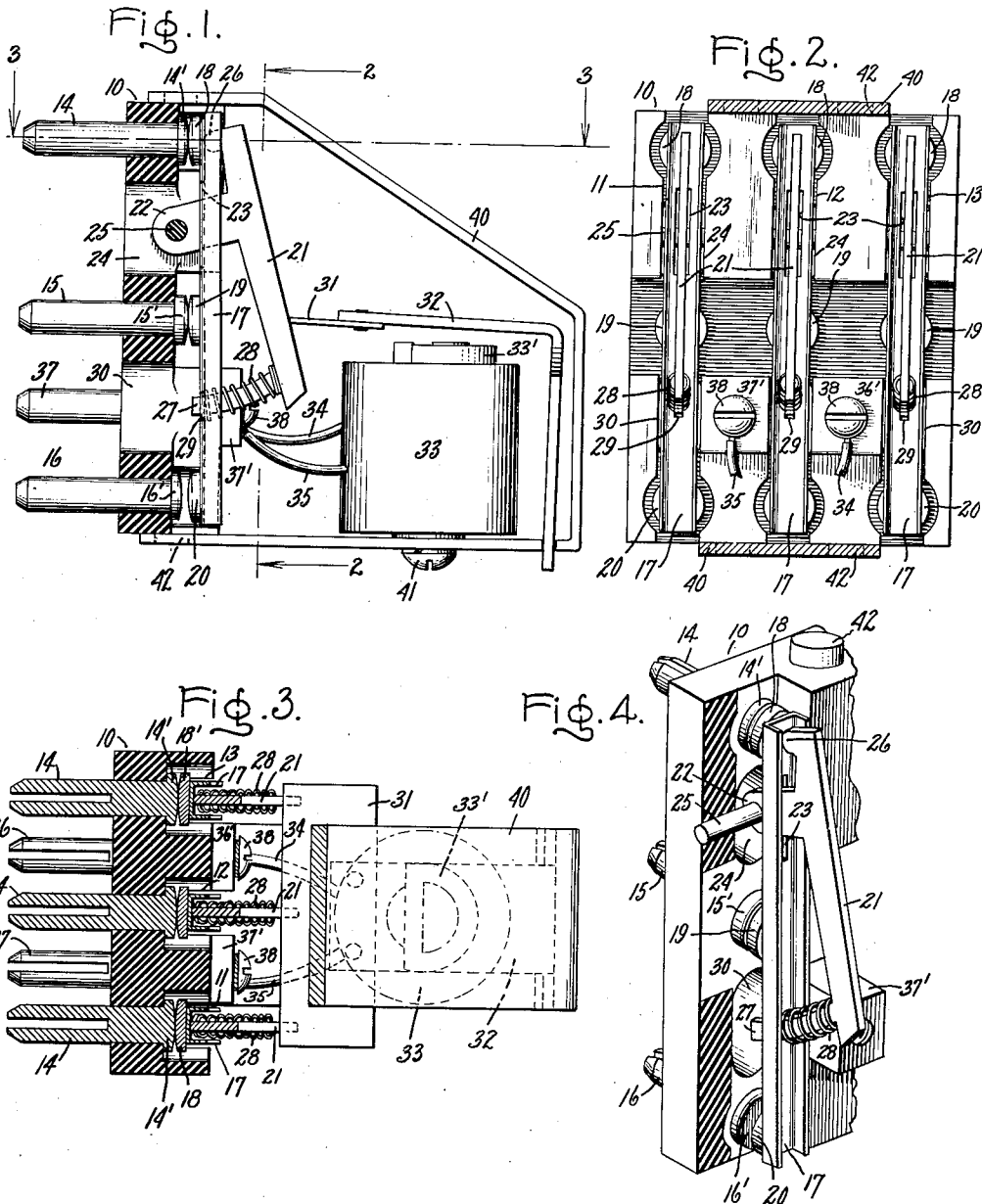
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RELAY

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RELAY

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My invention relates to electric switches and more particularly to electric relays.

One object of my invention is to provide a relay structure which eliminates the need for flexible conductors between stationary and movable members.

Another object of my invention is to provide a relay wherein the contact pressures between engaging contacts in each position of the moving member will be equal and constant.

For a better understanding of my invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the accompanying drawing, Fig. 1 is a side elevation partly in cross section of a relay built in accordance with my invention; Fig. 2 is a sectional view looking in the direction of arrows 2—2 in Fig. 1; Fig. 3 is a sectional view looking in the direction of arrows 3—3 in Fig. 1; and Fig. 4 is a perspective view, partly in cross section, of a fragment of the relay illustrated in Figs. 1, 2 and 3.

Referring to the drawing in detail, the relay built in accordance with my invention comprises a base 10 made of some suitable insulating material having therein three parallel grooves or channels 11, 12 and 13. In each groove are spaced three contact plugs 14, 15 and 16 provided with heads 14', 15', 16', respectively. The plugs project through the base 10 and the heads 14', 15' and 16' are positioned at the bottom of the groove. A movable contact arm 17, which is a channel-shaped rigid metal member, is positioned in each groove to cooperate with these stationary contacts, being provided with a contact 18 opposite to contact 14', a contact 19 opposite contact 15', and a contact 20 opposite contact 16'. Contact arm 17 is supported on the center contact 15'. Center contact 15' is somewhat higher than the contacts 14' and 16' and forms a pivot for arm 17 so that the arm may be tilted to effect an engagement of either contact 18 or 20 with its respective cooperating contact 14' or 16' while the contacts of the other pair are separated.

The contact arm 17 is actuated by an actuating lever 21 provided with an ear 22 which projects from a point intermediate its ends, through a slot 23 in the contact arm, into an opening 24 through the block 10 between the contacts 14' and 15' and is pivoted in that opening 24 by a pivot pin 25 made of a suitable insulating ma-

terial. The single pivot pin projects through the entire block 10 so as to pivot each one of the three similar actuating levers illustrated. The actuating lever is provided with a knob 26 at one end and with a tail member 27 near its other end. A helical spring member 28 is wound about tail member 27 and is placed under compression between the contact arm 17 and the under side of the lever 21. The tail member 27 projects through an opening 29 in the contact arm 17 and is shaped in the form of an arc of a circle having its center at the axis of the pivot pin 25. The opening 29 is made only large enough for the tail member 27 to project through the opening freely and thereby the contact arm is maintained, longitudinally, in a fixed relation to the stationary contacts. The arm is maintained in a fixed relation to the stationary contacts, laterally, by the sides of the groove. An opening 30 is provided in the block to enable the tail member to move downwardly when the lever 21 is turned. Lever 21 is actuated by an actuating bar 31 made of insulating material and attached to an armature 32 of an electromagnet 33. The slot 23 at the forward end of the contact arm 17 is made sufficiently wide so that the ear 22 may just move through it thereby maintaining the contact arm, at this end, aligned with the actuating lever. The slot is made longer, however, than the width of the ear 22 would require, in order to permit the ear to freely move longitudinally within the slot when moving about its pivot.

In the drawing, the contacts 14' and 18 are illustrated as being in engagement, such engagement being brought about by the expansion of the spring 28 against the lever 21 and the contact arm 17. This expansion of the spring effects a movement of the lever 21 about its pivot 25 until the knob 26 engages the contact arm 17 opposite to the contact 18 and effects an engagement between the contacts 14' and 18. The moment arms of the forces exerted by the spring 28 are such that the pressures between the contacts 18 and 14' and between contacts 19 and 15' are substantially equal. This equalization of the contact pressures is obtained by a proper spacing of the pivot points for the contact arm and the actuating lever and by a proper positioning of the spring 28. This spacing of the elements and its effect upon the contact pressures may be explained by reference to Fig. 1. In this figure, it is shown that the pivot pin 25 is positioned substantially half way between the contacts 14' and 15' and the spring 28 is positioned substantially half way between the contacts 15'

and 16'. The distances between contacts 14', 15' and between 15', 16' are also made equal to each other, therefore the halves of these distances are equal and may be used as unit distances for the purposes of this specification. It will also be noted that the axis of the pivot pin 25 is a short distance below the plane of contact between the contacts 15' and 19. This distance is so small that its effect upon contact pressures is immaterial and it is therefore assumed that the pivot pin and the engaging surfaces are substantially on the same plane. Bearing in mind the above relationship, the spring 28 exerts a force F upon the lever 21 and also upon the contact arm 17. That force, multiplied by its moment arm, measured in unit distances, as applied to contact 18, equals $2F$. That same force F is applied to the contact arm and tends to rotate that contact arm in a clockwise direction about its pivot 15' thereby reducing the force $2F$, applied by the actuating lever. This reducing force, at contact 18, acts at two unit distances from the pivot 15' and the force F is applied by the spring 28 at one unit distance from the pivot 15'. The reducing force is therefore one-half as great as the applied force F , or $F/2$. The total pressure between the contacts 14' and 18, therefore, is a pressure equal to the difference between $2F$ and $F/2$, or $3F/2$. By the same analysis, the pressure between contacts 15' and 19 is exerted by the spring 28 at three unit distances from the pivot 14' and is opposed at a point two unit distances from that same pivot. The effect of the spring 28 is then $3F$ and an equal opposing force at contact 15' has a moment arm of only two unit distances and is therefore equal to $3F/2$. The pressures between the two pairs of contacts 14', 18 and 15', 19 are therefore both equal to $3F/2$.

In operation, when the coil 33 is energized, the armature 32 is attracted, thereby moving the lever arm 21 in a clockwise direction to relieve the pressure upon contact 18 and exerting pressure upon contact arm 17 at a point substantially midway between the contacts 15' and 16' whereby the pressures between the two pairs of engaging contacts are substantially alike. The force of the spring 28 at this instant is designed to be three times the force it exerts when it is in its initial position or $3F$. This force being equally distributed over the two pairs of contacts, becomes $3F/2$ over each pair of contacts. In the illustrated example, the relay is provided with three sets of contacts, each contact arm being operated by an actuating lever 21 and the three actuating levers being simultaneously actuated by the bar 31 attached to the armature 32. The coil 33 is provided with a shading coil 33' and leads 34 and 35 which are attached to the heads of contact plugs 36 and 37 by means of suitable screws 38. The heads of plugs 36 and 37 are imbedded in insulating blocks 36' and 37'. The coil 33 is attached to a metallic frame 40 by a suitable screw 41 and the frame is attached to the base by pins 42 projecting from the ends of the base 10 into holes in the frame.

In the above construction for a relay, an unlimited number of operations may be obtained since no flexible lead is provided which, through repeated bending, would be subject to breakage. Furthermore, the specific arrangement of the actuating arm and the spacing of the points at which the actuating arm engages the contact arm provides a substantially equal and constant pressure between contacts. Furthermore, a simple helical spring provides the force necessary

to establish a desired pressure between the contacts. This spring can be designed to provide a predetermined pressure at each of its two positions, a helical spring being relatively easy to design to provide a constant and predetermined pressure. Furthermore, a single pivot pin provides the locking means for completing the assembly of all the elements of the relay, the actuating arms being interlocked with the contact arms and the complete assembly being locked in place by the single pivot pin 25. This reduces the number of parts of the relay to a minimum and correspondingly reduces its cost of manufacture.

The plugs 14, 15 and 16 with 36 and 37 provide an easy method of removing the relay from its circuits for inspection and repair and similarly for replacing it. Suitable sockets are provided in the receiving panel for such relays, each socket being connected to the circuit which it is to control. The plugs 36 and 37 are connected to similar sockets and to a circuit which controls the energization of the magnet coil 33 and thereby the operation of the relay. This manner of mounting relays is now well known and is not a part of my invention.

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

1. In an electric relay, the combination of a base, a group of spaced contacts mounted on said base, a movable contact arm provided with contacts arranged opposite to said base contacts, an intermediate pair of said contacts being higher than the others whereby said contact arm may pivot on said pair of contacts to effect an engagement of contacts on only one side of said pivot pair of contacts at a time, an actuating member for said contact arm, said actuating member being pivoted independently of said contact arm about a pivot spaced from said contact arm intermediate two adjacent pairs of said contacts on one side of said pivot contacts, and a spring member spaced intermediate two pairs of said contacts on the other side of said pivot contacts and arranged to exert a force upon said contact arm and upon said actuating member to effect an engagement of the pairs of contacts intermediate which said actuating arm is pivoted.

2. In an electric switch, the combination of a base, stationary contacts mounted in said base, a contact arm having contacts spaced opposite to said stationary contacts, an intermediate pair of said cooperating contacts being arranged to form a pivot upon which said contact arm may move to effect an engagement of cooperating contacts on one or the other side of said cooperating contacts, an actuating lever pivoted upon said base, an arcuate projection upon one end of said lever projecting through an opening in said contact arm arranged to maintain said contact arm in position upon said stationary contacts, and an operating spring mounted between said lever and contact arm upon said projection normally placed under compression to exert a force upon said lever and contact arm to move said lever about its pivot thereby moving the other end of said lever against said contact arm to effect an engagement of the contacts on the corresponding side of said pivot contacts.

3. In an electric switch, the combination of a base, stationary contacts mounted in said base, a contact arm having contacts spaced opposite to said stationary contacts, an intermediate pair of said cooperating contacts being arranged to form a pivot upon which said contact arm may move to

effect an engagement of cooperating contacts on one or the other side of said cooperating contacts, an actuating lever provided with a supporting arm intermediate its ends, said supporting arm projecting through said contact arm and pivoted upon said base, an arcuate projection upon one end of said lever projecting through an opening in said contact arm, said supporting arm and said arcuate projection maintaining said contact arm in position upon said stationary contacts, and an operating spring mounted between said lever and contact arm upon said arcuate projection normally placed under compression to exert a force upon said lever and contact arm to force said lever about its pivot thereby moving the other end of said lever against said contact arm to effect an engagement of the contacts on the corresponding side of said pivot contacts.

4. In an electric switch, the combination of a base, stationary contacts mounted in said base, a contact arm provided with contacts arranged to cooperate with said stationary contacts, an intermediate pair of said contacts being higher than the contacts on either side thereof to effect a separation of contacts on one side of said pivot contacts while contacts on the other side of said pivot contacts are in engagement, an actuating lever pivoted on said base at one side of said pivot contacts, a spring placed under compression between one end of said lever and said contact arm between two pairs of cooperating contacts on the other side of said pivot contacts to effect a movement of said actuating lever about its pivot and thereby to effect an actuation of said contact arm by the opposite end of said actuating lever, and an operating arm arranged to actuate said actuating lever against the pressure of said spring to effect a closure of the contacts on the opposite side of said pivoting pair of contacts and to effect a simultaneous separation of said first closed pair of contacts.

5. In an electric relay, the combination, of a base, a group of stationary contacts mounted on said base, a movable contact arm provided with contacts arranged to cooperate with said stationary contacts, the intermediate pair of contacts effecting a spacing of said contact arm such that said intermediate pair of contacts provides a pivot upon which said contact arm may operate to effect alternately an engagement of the contacts on either side of said pivot contacts, an actuating lever for said contact arm, said actuating lever being provided with a suitable supporting arm projecting through said contact arm, a pivot for said actuating lever engaging said supporting arm whereby said actuating lever is pivoted to said base and simultaneously holds said contact arm in position for cooperation with said stationary contacts, a spring engaging said contact arm and said actuating lever to effect an engagement of the contacts on one side of said pivoting pair of contacts, and an operating member for engaging said actuating lever to move it against the pressure of said spring thereby effecting a separation of the contacts on the one side of said pivoting pair of contacts and effecting a closure of the contacts on the other side of said pivoting pair of contacts.

6. In an electric relay, the combination of a

base, a multiple group of stationary contacts mounted on said base, a movable contact arm provided with contacts arranged to cooperate with each group of said stationary contacts, the intermediate pair of contacts of each group effecting a spacing of its contact arm such that said last-mentioned pair of contacts provides a pivot upon which said contact arm may operate to effect an engagement alternately of the contacts on either side of said pivot contacts, an actuating lever for each of said contact arms, a common pivot member for said actuating levers whereby each actuating lever is pivoted to said base, means for interlocking each contact arm with its actuating lever whereby said contact arm is maintained in position for cooperation with said stationary contacts, a spring engaging each contact arm and each corresponding actuating lever to effect an engagement of the contacts on one side of said pivoting pair of contacts, and an operating member for simultaneously engaging each actuating lever to move them against the pressure of said springs thereby effecting a separation of all the contacts on the one side of said pivoting pairs of contacts and effecting a closure of all the contacts on the other side of said pivoting pairs of contacts.

7. In an electric relay, the combination of a base, stationary contacts mounted on said base, a contact arm provided with contacts spaced to cooperate with said stationary contacts, an intermediate pair of said cooperating contacts being arranged to form a pivot for said contact arm, an actuating lever, a pivot pin for said actuating lever spaced between two pairs of cooperating contacts on one side of said pivot contacts, a spring mounted between one end of said lever and said contact arm at a point between two cooperating pairs of contacts on the other side of said pivot contacts, the spacing between said pairs of contacts and the spacing between said lever pivot, said contact arm pivot, and said actuating spring being of such relation that the pressures between engaging pairs of contacts are substantially equalized.

8. In an electric relay, the combination of a base, stationary contacts mounted in said base, a contact arm provided with contacts spaced to cooperate with said stationary contacts, an intermediate pair of said cooperating contacts being arranged to form a pivot for said contact arm, an actuating lever pivoted between two pairs of cooperating contacts on one side of said pivot contacts, an actuating spring mounted between said lever and said contact arm between two cooperating pairs of contacts on the other side of said pivot contacts, the spacing of said contacts, said actuating lever pivot and said actuating spring being such as to provide equal pressures between engaging pairs of contacts, an actuating member for operating said lever to compress said spring to effect a movement of said contact arm about its pivot and effect an engagement of contacts on the corresponding side of said pivot contacts the force of said spring under compression in the last-mentioned operation being such that the pressure of the engaging contacts remains the same as the pressure between the first-mentioned contacts.

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