

June 2, 1959

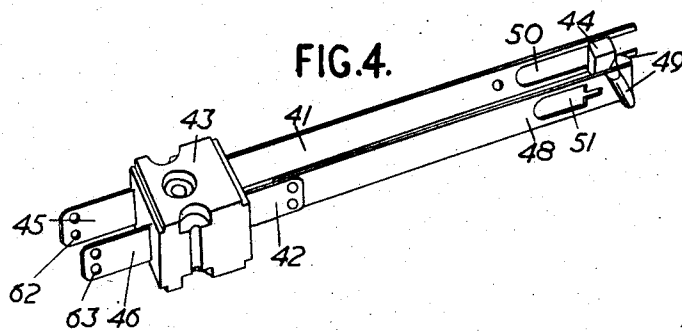
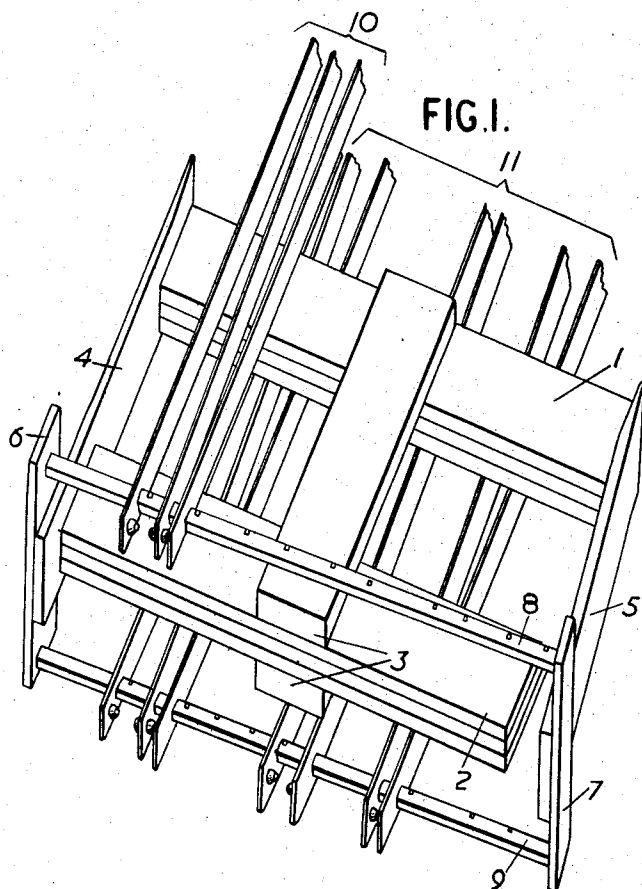
W. H. D. YULE ET AL

2,889,425

ELECTRICAL RELAYS

Filed Aug. 8, 1956

5 Sheets-Sheet 1



Inventors
W. H. D. YULE-
J. C. KINGDOM

By *Robert Harding Jr.*
Attorney

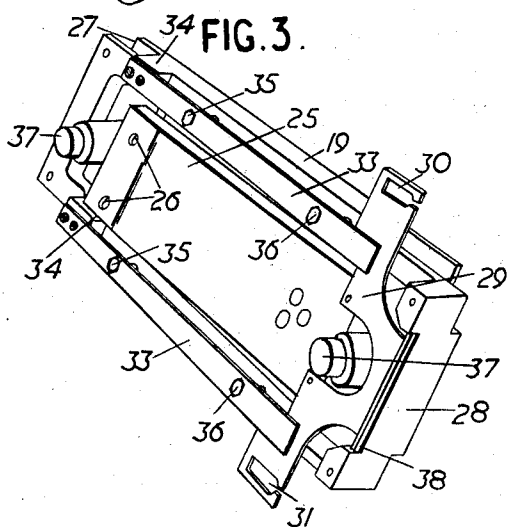
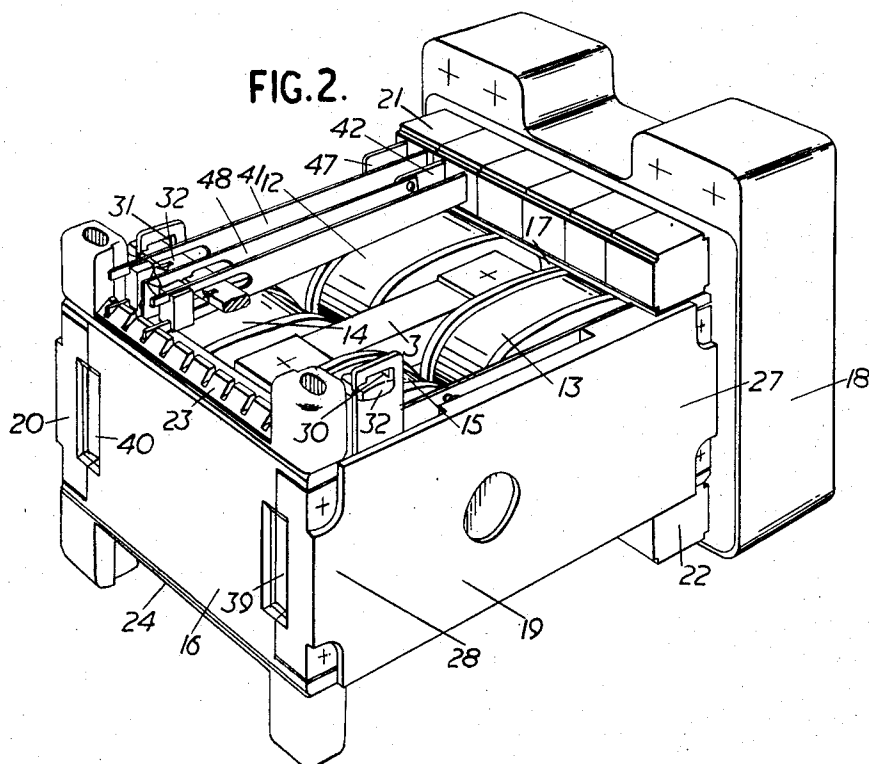
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Inventors
W. H. D. YULE
J. C. KINGDOM
By *Robert H. Harding Jr.*
Attorney

June 2, 1959

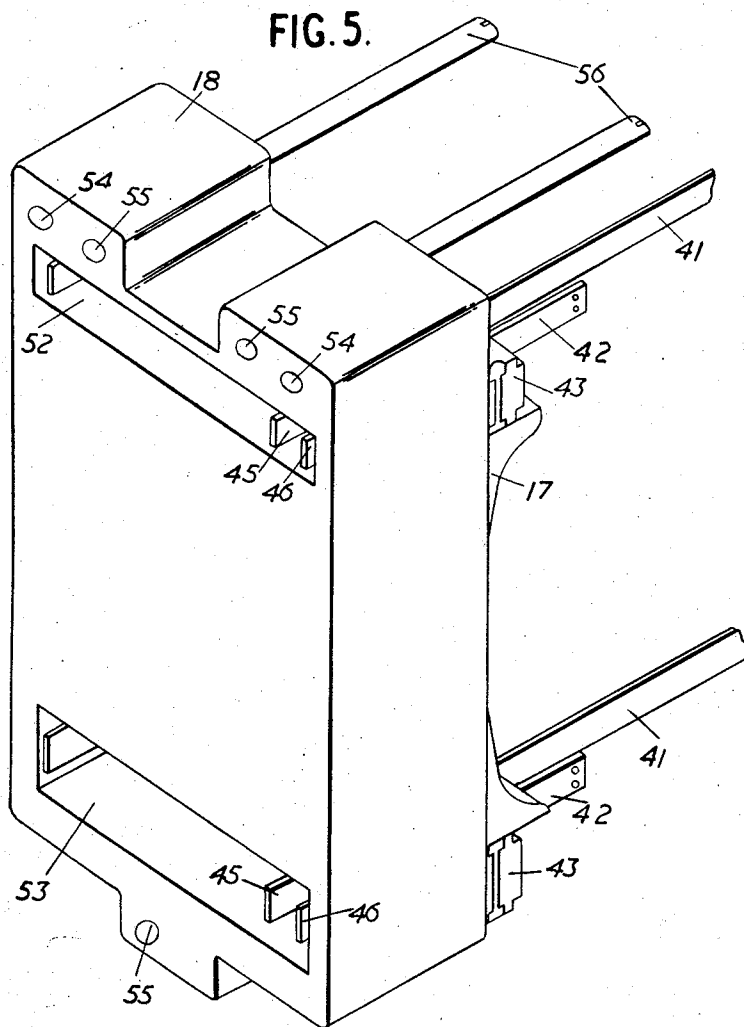
W. H. D. YULE ET AL

2,889,425

ELECTRICAL RELAYS

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5 Sheets-Sheet 3



Inventors
W. H. D. YULE
J. C. KINGDOM

By *Robert Handberg Jr.*
Attorney

June 2, 1959

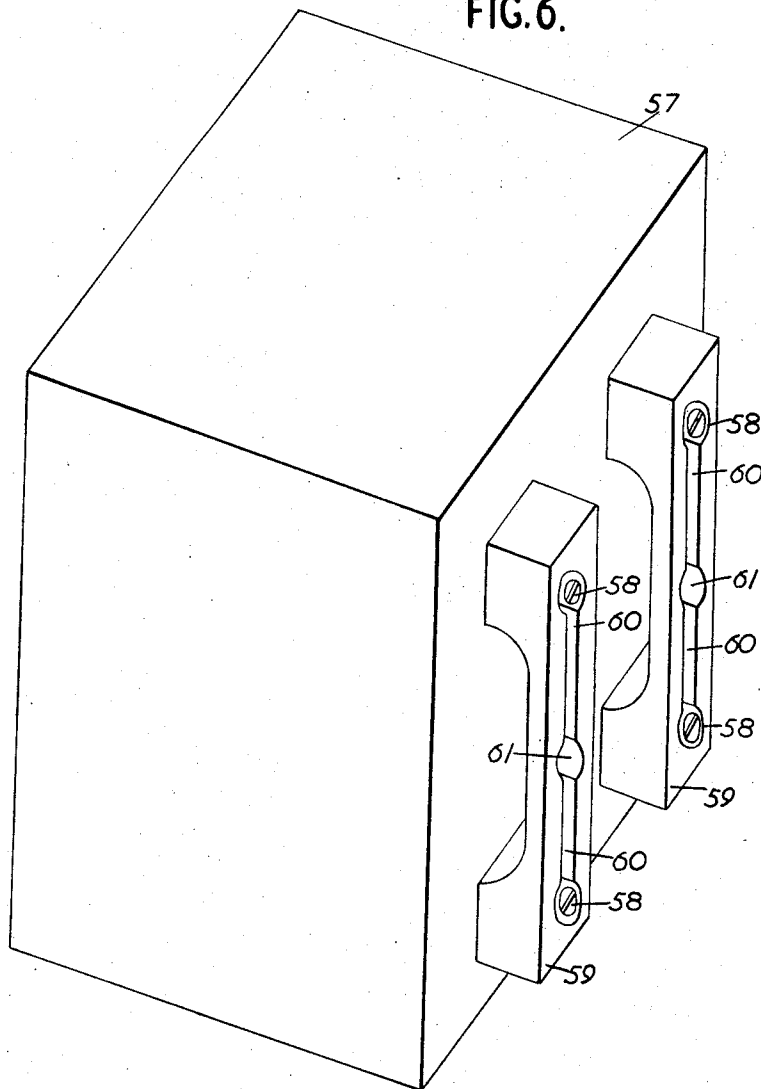
W. H. D. YULE ET AL
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FIG. 6.



Inventors
W. H. D. YULE
J. C. KINGDOM
By *Robert Harding Jr.*
Attorney

June 2, 1959

W. H. D. YULE ET AL
ELECTRICAL RELAYS

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FIG. 8.

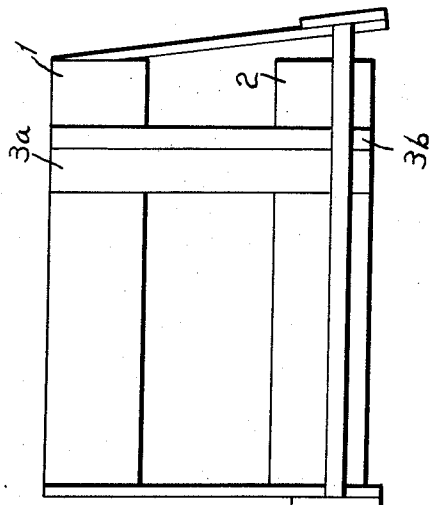
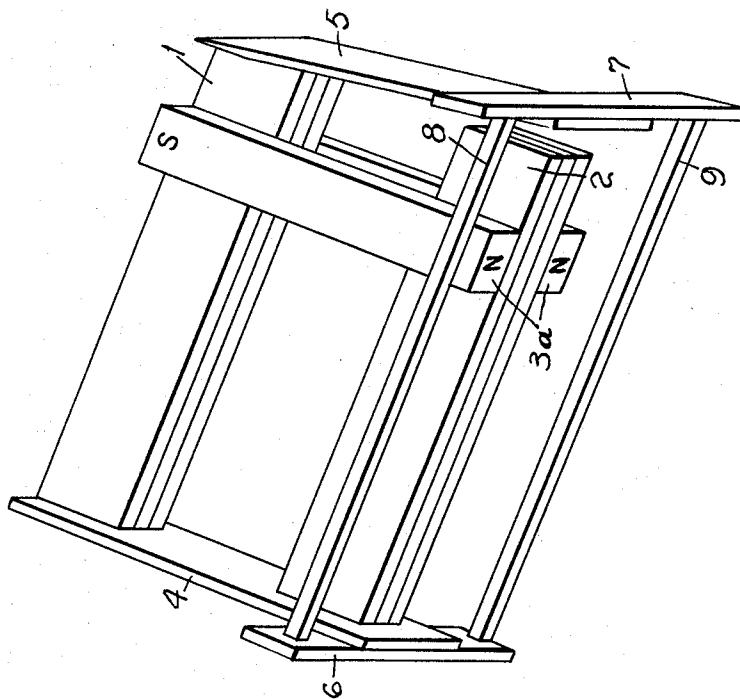


FIG. 7.



Inventors
W. H. D. YULE
J. C. KINGDOM
By *Albert Keno*
Attorney

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ELECTRICAL RELAYS

William Henry Drury Yule and John Cyril Kingdom,
London, England, assignors to International Standard
Electric Corporation, New York, N.Y.

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11 Claims. (Cl. 200—104)

This invention relates to electromagnetic relays.

The main feature of the invention consists in an electromagnetic relay comprising a pair of reciprocating armatures, a contact spring coupled to said armatures and adapted to be moved in one direction by the movement of a first of said armatures and in the opposite direction by the movement of said second armature.

Another feature of the invention consists in an electromagnetic relay comprising an electromagnet and a magnetic yoke substantially parallel therewith, a magnetic bar interconnecting said electromagnet and said yoke, a first armature across an end face of the electromagnet and of the yoke and a second armature across the other end faces of the electromagnet and the yoke, both armatures movable respectively to and from the faces of said electromagnet, means for mechanically interconnecting said armatures so that movement of one armature in one direction caused by electromagnetic attraction to the respective face of the electromagnet or the yoke, causes similar movement of the other armature in the opposite direction, a plurality of fixed springs and a plurality of movable contact springs coupled to said mechanical interconnecting means, said movable spring adapted to be moved into and out of engagement with said fixed springs by the movements of said armatures.

The invention will be clearly understood from the following description read in conjunction with the accompanying drawings in which:

Fig. 1 is a perspective view of the general structural arrangements of a relay;

Fig. 2 is a perspective view of a relay assembled on a mounting base;

Fig. 3 is a perspective view of an armature assembly unit, viewed from the armature side;

Fig. 4 is a perspective view of a contact spring unit;

Fig. 5 is a perspective view of a relay base;

Fig. 6 is a perspective view of a relay cover.

Fig. 7 is a perspective view of a modified form of the yoke and armature of Fig. 1 with the connecting bars made of permanent magnetic material adjacent one end of the core; and

Fig. 8 is a plan view of another modification of the core system utilizing a soft iron shunt around a permanent magnet.

Referring first to Fig. 1, the magnetic structure of a relay consists in principle of two substantially parallel magnetic cores or yokes 1, 2, one or both of which carry one or more windings (not shown) and which may comprise an assembly of laminations with or without pole pieces or faces, connected together by a magnetic bar or bars 3. In Fig. 1 the bars 3 are shown at the centres of the cores 1, 2 but it or they may equally well be situated towards the right or left ends of the cores 1, 2, as shown, for example, in Fig. 7. Each end of the H or U shaped structure thus formed is bridged by an armature, 4, 5. Both armatures 4, 5 are arranged to rock or hinge at the same core which may be regarded as the yoke of the

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relay even though it may carry a winding and may even carry the only winding of the relay. In Fig. 1 the core 1 thus becomes the yoke of the relay. The ends of the armatures 4, 5, opposite the other core, 2 are mechanically inter-connected so that when one of the armatures is operated, that is to say is attracted to the core 2, the other armature is held in unoperated position even though there may be some magnetic force attracting it towards the core 2.

In Fig. 1 the mechanical interconnection is achieved by providing each of the armatures 4, 5 with a cross-plate, 6, 7 and joining the cross-plates together by means of pusher bars 8, 9. The pusher bars 8, 9, are conveniently made of insulating material and are arranged to operate contact springs, shown generally at 10, 11, lying above and below across the structure formed by the cores 1, 2 and the bar or bars 3. As will be later described, the pusher bars 8, 9 engage only the lever springs and push and pull these springs into and out of engagement with their respective buffer springs. It is unnecessary for the lever springs to be biased in either direction.

One method of operation of the relay uses the bar or bars 3, placed centrally across cores 1, 2, as shown in Fig. 1 and having a separate winding on each side of the bars 3, on say the core 2. Current in one winding alone will cause the attraction of one armature which will push the lever springs in one direction and current in the other winding alone will cause the attraction of the other armature which will push the lever springs in the other direction.

With such an arrangement it is necessary always to have current in one of the windings. By replacing the bar or bars 3 by permanent magnet or magnets 3a, as shown in Fig. 7, the last attracted armature may be made to remain attracted even though the current in the windings be removed. In Fig. 7, the contacts have been omitted to simplify the showing. For this method of operation the permanent magnet or magnets may be placed between the center and one end of the cores 1, 2, as shown in Fig. 7, and only one winding on say the core 2, is necessary, the direction of current in the winding determining which armature shall be attracted. When the current in the winding is removed the last attracted armature is retained in operated position by the magnetic flux from the magnets. The flux concentration near the right-hand side of cores 1 and 2 is greater than that at the left-hand side thereof. Thus the relay behaves as a side-stable polarised relay, characterised by symmetry of operation.

In another embodiment of the invention as shown in Fig. 8 the bars 3 are replaced by permanent magnets 3a provided with soft iron shunts 3b. The magnets and shunts are conveniently placed at one end of the cores 1, 2, say near to armature 5, and one winding is placed on say the core 2. Furthermore, the reluctance of the armature 5, nearer the magnets, is made substantially greater than that of the other armature, when in operated position and is also spring-biased away from the core 2. The soft iron shunts are so dimensioned that when the coil is de-energised, they effectively short-circuit the magnets so that the magnetic flux in the cores 1, 2 is insufficient to hold the armature 5, nearer the magnets, in operated position. Thus with no current in the coil, the armature 4 is operated. This is the unoperated condition of the relay. Current in the coil in one direction will cause greater attraction of the armature 4 while current in the other direction will cause attraction of the armature 5, thus pushing away armature 4. This is the operated condition of the relay and cessation of the current will allow armature 5 to restore under the action of its spring-bias. In this way the relay operates as a magnetically

biased relay, operating to one polarity of energising current only and restoring to its unoperated state on disconnection. If desired the residual gap between armature 5 and core 2 may be made relatively large and/or the pole area of the core 2 presented to the armature 5 may be made relatively small.

Other variations of the aforementioned arrangements may be made by using, slugs, sleeves, short-circuited windings, shaded poles and other devices well known in the art, applied to either or bolt of the cores 1, 2 and/or the armatures 4, 5.

For instance, by suitable modification of the reluctance values of the different parts, dissimilar armature arrangements may be used.

The magnetic structures, armatures and contact springs so far described require some form of framework to retain them in correct relative positions.

The complete structural arrangements of a relay embodying the invention will now be described with reference to Figs. 2-4.

In Fig. 2 can be seen a magnetic bar 3 bridging the top-sides of two cores passing through the windings 12, 13, 14, 15. A similar magnetic bar (not visible in the drawing) bridges the under-side of the cores and the bars and cores are securely attached to a front non-magnetic casting 16 and a rear non-magnetic casting 17. The rear casting 17 is securely attached to the relay mounting base 18 which will be further described with relation to Fig. 5. An armature plate 19, seen in greater detail in Fig. 3, is attached to the castings 16, 17, across the right-hand ends of the cores, as seen in Fig. 2 and a similar armature plate 20 is attached to the castings 16, 17 across the left hand end of the cores. Contact spring units 21, seen in greater detail in Fig. 4, are secured along the top of the casting 17 with the contact ends of the spring lying across, but not touching, the core and coil assembly towards the front casting 16. Further spring contact units 22, are secured along the underside of the casting 17 in similar manner. Buffer blocks 23, 24, of insulating material, are secured respectively along the top and under sides of casting 16 and are suitably slotted to engage the buffer springs of the springs units 21, 22 respectively. As seen in Fig. 3, armature plate 19 (as also armature plate 20) houses a substantially flat bar armature 25 positioned in the plate 19 by two pins passing through holes 26 and fixed near the end 27 of the plate 19 which is attached to the rear casting 17. The end of armature 25 remote from the holes 26 carries a non-magnetic cross-plate 29. The ends of the cross-plate 29 are slotted, as at 30, 31 for engagement with pusher bars, as seen in Fig. 2, in which pusher bar 32 engages with slot 30 in the cross-plate of the armature in plate 19 and with slot 31 in the cross-plate of the armature in plate 20.

The application of spring-bias to an armature may be made as shown in Fig. 3. Leaf springs 33 are attached at bosses 34 on the armature plate 19 at the armature hinge end 27, on either side of the armature 25 and bearing on the crossplate 29. Screws 35 may be used for tensioning the springs 33 to keep the armature in its unoperated position and screws 36 may be used for increasing the tension of the springs 33 just as or just before the armature is in its operated position. The armature plate 19 carries two bosses 37 for engagement with the coil spools of the relay when assembled thereto whereby the coil and core assembly is located and steadied. Furthermore the end 28 of the armature plate 19 is recessed and chamfered as at 38. These recesses, in cooperation with similar recesses in the front casting 16 of the relay, form apertures or windows, as seen at 39, 40 in Fig. 2, through which the end of one of the cross-plates 29 or of the armatures may be seen depending on which armature is in operated position. The ends of the cross-plates or armatures may be suitably colored for this purpose.

Turning now to the contact spring units 21, 22, a typical unit is shown in Fig. 4. Such a unit comprises a stiff

buffer spring 41 moulded, side-by-side with a short spring 42 of similar thickness, in an insulating moulding 43. The moulding 43 is arranged with suitable screw-holes for attachment to the top or bottom of casting 17 (Fig. 2). One end of the buffer spring 41 is long enough to reach into a slot in the appropriate buffer block 23 or 24 and carries a contact 44. The other end 45 extends far enough to form a plug-in relay base 18 as will be later described.

Alternatively or additionally, holes 62 in the end may be provided for the easy attachment of a wire or wires to the spring 41.

Similarly, one end 46 of the short spring 42 extends far enough to form a plug in the relay base 18 and may be similarly provided with holes 63, while the other end may be used either for terminating one end of one of the windings as at 47, Fig. 2, or may have attached to it a thin flexible lever spring as at 48, Fig. 4, carrying a contact or contacts 49 in alignment with contact 44.

Behind the contacts 44 on buffer springs 41 and behind the contacts 49 on lever springs 48 there are apertures 50, 51 respectively. As seen in Fig. 2, pusher bar 32, in addition to engaging in slots 30, 31 as already explained, passes through all the apertures 50, 51 in the springs 41, 48 comprising the contact spring units 21 and engages with the lever springs 48 but not the buffer springs 41. It will thus be understood that the pusher bar 32 forms a mechanical link between the two armatures of the relay and that when one armature moves from its unoperated to its operated position, the other armature moves from its operated to its unoperated position and that the lever springs 48 engaged by the pusher bar 32 are moved from one extreme position, in engagement with a back buffer spring if any, to the other extreme position, in engagement with a front buffer spring if any. Furthermore, the position and movement of each buffer spring is governed by the slot in buffer block 23 in which it is located, the lever springs not being located in such slots. It will be further understood that any contact spring units 22 on the under side of the relay, as seen in Fig. 2, are similarly actuated by another pusher bar, not visible in Fig. 2, interlinking the other end of the same armature cross-plates.

Turning now to the relay mounting base 18, as shown in Fig. 5, this comprises a substantially rectangular insulating moulding having recesses 52, 53, into which the spring ends 45, 46 of the upper and lower contact spring units project respectively when the rear casting 17 of the relay is secured thereto. Guide holes 54 are provided to enable the relay to be threaded onto pins on a jack base so that the jack springs enter the recesses 52, 53 and make correct connection with the respective spring ends 45, 46. Further holes 55 in the relay base 18 enable the relay base to be secured to the jack by means of screws such as 56 from the front of the relay base.

The relay may be protected by a cover, shown in Fig. 6, comprising a box-like structure 57 of, say, a transparent thermoplastic, held in position by screws 58, passing into the front casting 16 (Fig. 2) of the relay. The screws 58 also hold in position handles 59 into which they may be countersunk. Furthermore the screws 58 may be used for sealing on the cover against unauthorised removal by, say, threading wires through the heads of the screws and attaching a seal to the wires. The wires may be conveniently embedded in slots 60 running between the counter sinks in the handles 59 and the seals may be embedded in holes 61 in the slots. In this way the handles, by which the relay may be carried, inserted and withdrawn from a jack, protect the securing and sealing arrangements while the screws 58 perform the triple function of securing the handles, securing the cover and providing sealing means.

Although certain embodiments of the invention have been described for the purpose of illustration, it will be understood that modifications and adaptations thereof occurring to those skilled in the art may be made with-

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out departing from the scope of the invention as defined in the appended claims.

While the principles of the invention have been described above in connection with specific embodiments, and particular modifications thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

What we claim is:

1. An electromagnetic relay comprising an electromagnet and a magnetic yoke spaced therefrom and substantially parallel therewith, magnetic bar means interconnecting said electromagnet and said yoke, a first armature having a portion mounted to rock across an end face of said yoke and a second armature having a portion mounted to rock across the other end face of said yoke, said armatures having other portions for cooperation with opposite faces of said electromagnet, respectively, and movable respectively to and from the faces of said electromagnet, means for mechanically interconnecting said armatures so that movement of one armature toward the face of the electromagnet with which it cooperates, causes movement of the other armature away from the face of the electromagnet with which it cooperates, a plurality of fixed springs and a plurality of movable contact springs coupled to said mechanical interconnecting means, said movable springs adapted to be moved into and out of engagement with said fixed springs by the movements of said armatures.

2. An electromagnetic relay as claimed in claim 1, in which said magnetic bar means comprises permanent magnet means interconnecting the electromagnet and yoke whereby the last attracted armature is retained attracted to the said respective face.

3. An electromagnetic relay as claimed in claim 1 in which said yoke comprises an electromagnet.

4. An electromagnetic relay as claimed in claim 3 in which said magnetic bar means comprises a pair of parallel permanent magnets having corresponding ends in contact with opposite surfaces of said electromagnets and intermediate the ends thereof.

5. An electromagnetic relay as claimed in claim 3 in which said magnetic bar means comprises a permanent magnet substantially at one end of the electromagnets.

6. An electromagnetic relay as claimed in claim 3 and in which the permanent magnet is shunted by a soft iron bar.

7. An electromagnetic relay as claimed in claim 1 wherein each said armature is mounted in a detachable armature assembly unit comprising a non-magnetic armature plate, housing and armature, and attached to non-magnetic members forming the front and rear faces of the relay.

8. An electromagnetic relay as claimed in claim 7 in which each said armature plate co-operates with its associated front face member to form an aperture in line with a predetermined portion of an armature when in either the operated or unoperated position.

9. An electromagnetic relay as claimed in claim 1 wherein said contact springs are disposed across said yoke and said electromagnet intermediate said armatures.

10. An electromagnetic relay as claimed in claim 3 in which said magnetic bar means comprises a pair of parallel permanent magnets having corresponding ends in contact with opposite surfaces of said electromagnets substantially near one end of said electromagnets.

11. An electromagnetic relay as claimed in claim 4, and in which said permanent magnets are shunted by soft iron bars.

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