June 4, 1968 J. S. CHENHALL 3,387,239

ELECTRO-MECHANICAL RELAYS

Filed March 23, 1966 2 Sheets-Sheet 1

FIG1

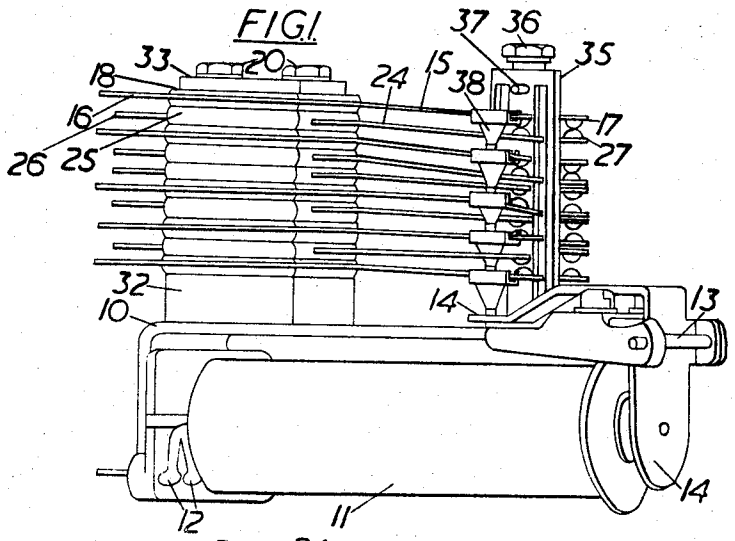


FIG2

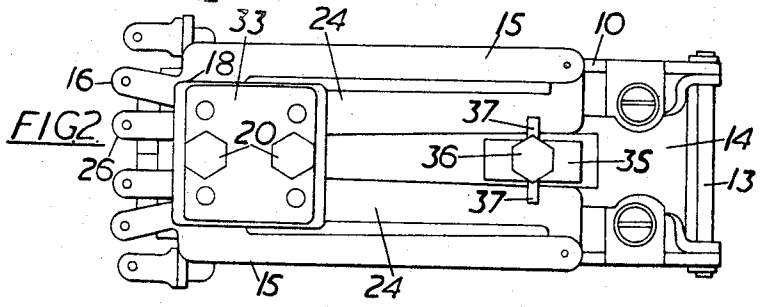
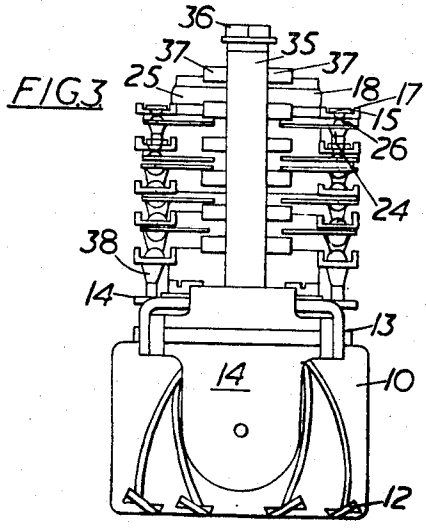


FIG3



Inventor

JOHN SAMUEL CHENHALL

By

Barnes, Kisselle, Raisch & Choate

Attorney

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ELECTRO-MECHANICAL RELAYS

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FIG4

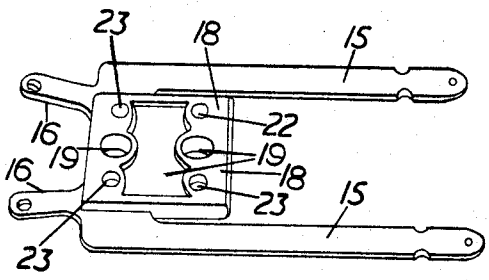


FIG5

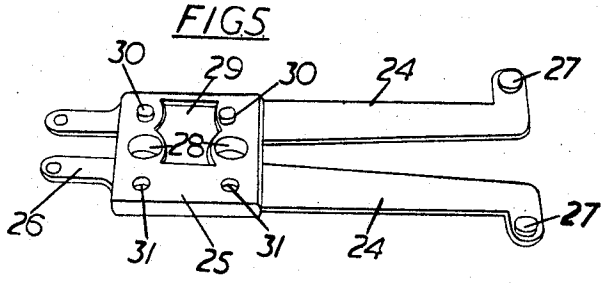


FIG6

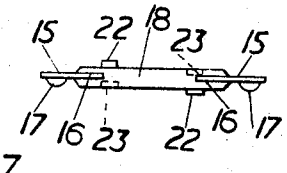
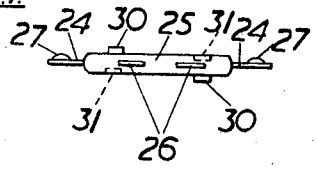


FIG7



Inventor

JOHN SAMUEL CHENHALL

By Barnes, Kissselle, Raisch & Choate

Attorney

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ELECTRO-MECHANICAL RELAYS

John Samuel Chenhall, Port Hacking, New South Wales, Australia, assignor to Elevators Pty. Limited, Waterloo, New South Wales, Australia

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9 Claims. (Cl. 335—135)

ABSTRACT OF THE DISCLOSURE

The contacts in or for an electro-mechanical relay are moulded singly or in pairs into plastic wafers through which a securing screw passes so that the whole stack may be quickly assembled with the parts in their correct relative positions, the wafers preferably interlocking with one another.

This invention relates to improvements in the construction of an electro-mechanical relay, whose function is to perform switching of electrical circuits by means of contact springs when the operating coil of the relay is energised.

One object of the invention is to provide a relay so constructed that the insulation between the spring sets and the frame will withstand high test voltages, such as those of the order of 2,500 volts, 50 cycles, without any special precautions during assembly.

Another object is to provide a relay whose magnet or solenoid when energised is capable of operating a relatively large number of contacts, for example, up to 12 normally open contacts or 12 normally closed contacts or 8 changeover contacts or a combination of contact types involving an equivalent mechanical loading of the relay.

A third object is to greatly reduce the number of component parts in the relay and so reduce cost and time of assembly.

The relays with which the invention is concerned are of the kind in which movement of a part when a solenoid or magnetic coil is energised or de-energised moves simultaneously one or more series of electric contacts arranged one above the other into or out of contact with other stationary contacts interspersed between them.

Such stacks of contacts (or "pile-ups") are normally built up from separate contact springs held at one end of each by insulating blocks. Screws pass through such blocks and springs, such screws being insulated from the metal contacts by plastic sleeves or the like.

Usually there will be two such stacks or "pile-ups" arranged side by side and operated at the same time when the coil is energised. Hitherto the contacts of each such stack have been quite separate from those of the other stack and the whole assembly operation of said contacts and separate spacer blocks, including the positioning of a buffer block between said contacts and various projections thereon to hold the fixed contacts in position, has been of a fiddling and time consuming nature which has increased the cost of such relays, as well as sometimes causing unreliability in service.

According to the present invention a contact for installation in an electro-mechanical relay has moulded around it at or near one end a plastic wafer and there is provision for the screw or screws or other securing means to hold said contact in the pile-up to pass through a portion of that wafer and not through the contact itself.

In a preferred form in accordance with the invention the contacts are produced in pairs, one contact of each pair forming part of one of each of two parallel pile-ups, the said pairs of contacts being held together and in their correct mutually relative position (but insulated from one another) by a plastic wafer moulded around both of them at or near one end, there being provision for securing screw or screws or other securing means to pass through the central portion of the wafer between the two contacts.

Preferably also the wafers are so formed as to interlock with one another so that they automatically position the contacts correctly during assembly.

The "wafers" are relatively thin sheets or discs of plastic material, their total thickness however being considerably greater than the thickness of the metal contacts themselves.

The preferred material from which the wafers are moulded is nylon but other suitable plastic materials may be employed if preferred.

Further features of this invention will be apparent from the following description of one preferred constructional embodiment thereof, and by reference to the accompanying explanatory drawings which illustrate one example of a two stack electro-mechanical relay constructed in accordance with the invention.

In the said drawings:

FIGURE 1 is a side view of the relay in question; and

FIGURE 2 a plan view thereof, while

FIGURE 3 is an end view thereof;

FIGURES 4 and 5 are views of separate assemblies of pairs of movable and fixed contacts respectively, while

FIGURES 6 and 7 show the pairs of FIGURES 4 and 5 respectively in end view.

In this construction an electro-mechanical relay comprises a frame **10** for holding a coil magnet **11** having electrical connection lugs **12** and a pivot **13** for an armature or clapper **14**. Such pivot **13** is a horizontal rod at one end of the frame **10** which passes through lugs upon the armature **14**. The latter is of generally L-shape having a generally nearly vertical portion extending down in front of the electric coil magnet **11** and a generally horizontal portion which extends under each of two stacks or pile-ups of "stationary" and "movable" contacts hereinafter described. When the magnet **11** is energised the inner end of the horizontal part of the armature **14** rises and through suitable mechanical arrangements raises all the movable contacts aforesaid into or out of contact with their associated stationary contacts.

The contacts are made in pairs and alternate pairs in vertical sequence differ from one another; being stationary or movable respectively.

One type of pairs of contacts, namely the movable contacts, is illustrated in FIGURES 4 and 6. It comprises two straight contact blade springs **15** arranged parallel to each other and with lugs **16** for connection of wiring by soldering, clip-on connection or otherwise at one end (the rearward end) and silver or other contact points **17** on one face at their other or forward end.

Each said contact has a portion which lies inside a moulded wafer **18** of nylon. This wafer is of rectangular form and lies between the two contact blades **15**. The contact blades do not touch each other inside the wafer **18** but are well spaced from one another.

The fixed and movable contact blades **15, 24** do not overlap each other (otherwise than within the thickness of the plastic wafers **18, 25**) except where the contact points **27** are located and thus the risk of accidentally short-circuiting is minimised. The movable contacts **15** themselves are well spaced apart by half the thickness of each of the two wafers **18** which contain them plus the entire thickness of the intervening wafer **25** holding a pair of fixed contacts **24**.

The terminal connection tabs **26** for all the fixed contacts lie above each other but well spaced vertically and the terminal contact tabs **16** for all the movable contacts

also lie one above the other but well spaced vertically and in addition, because the latter are splayed outwards slightly as seen in FIGURE 4, they are spaced horizontally also from the connection tabs **26** upon the other contacts between them. This minimises the risk of short-circuit and also facilitates the connection of wiring to such terminal tabs.

The central portion of the wafer **18** is formed with two holes **19** through which securing screws **20** to hold the stack of contacts in position upon the base or frame **10** can pass.

The two flat faces of the wafer **18** are slightly hallowed out in their central portions to reduce the area of contact and thereby ensure that superposed wafers bear snugly against each other.

The wafer **18** is also formed on each face with a pair of projections **22** and a pair of recesses **23** adapted to receive similar projections **22** on another wafer, each pair being towards one for and aft edge of the wafer.

Where there is a pair of projections **22** on one face of the wafer there is a pair of recesses **23** adapted to receive similar projections immediately below them on the other face, and vice versa.

The second type of double contacts namely the stationary contacts is illustrated in FIGURES 5 and 7 and comprises flat metallic blade springs **24** which extend longitudinally through similar square wafers **25** with contacts **26** for soldered, clip-on or other terminal connections at one end beyond the wafer and at their other ends extending horizontally in an outward direction. Their outward extremities hold silver or other contact points **27**. The size and shape of the wafer **25**, the holes **28** therethrough the central hollowing of its faces at **29** and the projections **30** and recesses **31** are the same as those for the first described pairs of contacts, respectively corresponding to features **19**, **21**, **22** and **23** previously described.

The edges of all the wafers **18**, **25** are rounded or bevelled off from the centre planes of said wafers all round, thereby increasing the lengths of the leakage paths between superposed contacts.

With this construction it is a simple matter to lay one pair of contacts of one kind (movable or stationary) upon a block **32** at the rear end of the frame **10** containing projections and recesses corresponding to those of the wafers **18**, **25** and then another pair of contacts of the other kind upon the first. Another pair of the first kind is then placed upon the second pair and so on until say half a dozen or more pairs of double contacts have been so assembled. All these hold themselves in their correct positions relative to one another because of the interlocking projections and recesses **22**, **23**, **30**, **31**. They are all then clamped in position by a cover plate **33** and the bolts **20** which are passed through the said cover plate, the stack of wafers **18**, **25** the block **32** and into the frame **10** of the relay below such stack.

Secured to each of the movable contact blades **15** is a short push rod **38** of insulating material, which engages with the surface of the movable contact blade **15** above or below it. Other types of mechanical interconnection between the movable contacts and the armature **14** are possible and the present invention is not limited to this particular push rod construction.

At the forward end of the relay (where the armature **14** is located) there is a buffer block **35** in the form of a moulding which fits nonrotatably into the frame **10** and extends up between the two pile-ups of contacts. It is held to the frame by a suitable bolt **36** passing through a longitudinal hole in its centre. The armature **14** divides to pass with clearance on each side of this buffer block **35**.

This buffer block has integrally moulded projections **37** upon its side faces and the "stationary" spring contact blades **24** engage against the upper or lower faces of such projections **37**, so limiting their downward or upward movement while permitting them some movement

in the opposite vertical direction to enable resilient engagement with them of the movable contacts which are not restrained by the buffer block projections **37** since their blades **15** are more widely spaced apart.

According as to whether the movable and stationary contacts are positioned with the one face or the other uppermost and how they are engaged with the projections **37** on the buffer block **35** the relay contacts **17**, **27** may be arranged in a wide variety of forms to cover various switching arrangements. For example all may be open normally and closed when the magnet **10** is energised or vice versa or some may be opened and others closed when the magnet is energised. Or all or some of the movable contacts may move to open one circuit and close another by moving from one pair of stationary contacts below them to another pair above them.

Thus there is great flexibility of arrangement possible in this relay and the assembly operations are greatly simplified, while economy is effected not only through some speeding up in assembly but through the absence of many small parts customarily necessary.

The pile-ups are clamped to the relay frame **10** by the bolts **20** which pass through the moulded wafers **18**, **25** without passing through the blades **15** or **24**, thereby affording a high insulation level between the contacts and the frame **10** without the use of insulating tubes or the like to insulate the blade springs from the clamping screws.

The moulded wafers **18**, **25** greatly reduce the number of parts which are assembled to form a pile-up, thereby achieving substantial economies in manufacture and assembly.

The moulded wafers **18**, **25** being provided with male and female spigot interconnections **22**, **23**, **30**, **31** clip together in their correct positions during assembly without the use of screws.

Because of the accurate location of the blades **15**, **24** in the moulding die, the contact tips thereof are less likely to suffer lateral displacement in relation to each other than when such blades are separately assembled, according to current practice.

Moulding the contacts in pairs further reduces the number of separate parts for final assembly, so reducing assembly cost and time.

The blade springs **15**, **24** can be pretensioned two at a time.

Words of position such as "above" as used in this specification are based upon the assumption that the pile-ups of movable and stationary contacts are arranged vertically above the armature **14**. However it will be appreciated that the relay can be mounted in any position and that when the pile-ups are not vertically arranged appropriate changes are to be made at the wording.

I claim:

1. A pair of contacts for installation in an electromechanical relay, one contact of such pair being adapted to form part of one of each of two parallel pile-ups the said pairs of contacts being held together and in their correct mutually relative positions but insulated from one another by a plastic wafer moulded around both of them at or near one end, there being at least one hole for securing means to pass through the central portion of the said wafer between the two contacts.

2. A pair of contacts as claimed in claim **1** in which the wafers are so formed that a plurality of them when mutually superposed will interlock with one another so that they automatically position the contacts correctly during assembly.

3. A contact or pair of contacts as claimed in claim **2** comprising a pair of projections and a pair of recesses adapted to receive similar projections upon each face of said wafer, the projections upon one face coming immediately below the recesses on the other.

4. A contact as claimed in claim **1** in which the flat

faces of the wafer are slightly hollowed out in their central portions.

5. A pair of contacts as claimed in claim 1 comprising also terminal lugs for connection of wiring which are splayed outwards slightly from the centre line of the pair of contacts.

6. A pair of contacts as claimed in claim 1 comprising also terminal lugs for connection of wiring which are parallel to the centre line of the pair of contacts.

7. A contact as claimed in claim 1 in which the edges of the wafer are rounded or beveled from their central plane.

8. An electro-mechanical relay comprising an electro-magnet or solenoid, an armature adapted to be moved when said electro-magnet or solenoid is energized and to return to its initial position when said electro-magnet or solenoid is de-energized, together with a plurality of contacts as claimed in claim 2 secured in position relatively to said relay by means passing through the wafers specified and a mechanical interconnection between said armature and each of the movable contacts specified.

9. An electro-mechanical relay as claimed in claim 8 comprising also a buffer block positioned between pairs of contacts and having projections adapted to engage and limit any travel of the stationary contacts.

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BERNARD A. GILHEANY, *Primary Examiner.*

H. BROOME, *Assistant Examiner.*