April 14, 1964 R. HYINK ETAL 3,129,304

REVERSIBLE CONTACT MOLDED FRAME RELAY

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Fig. 2

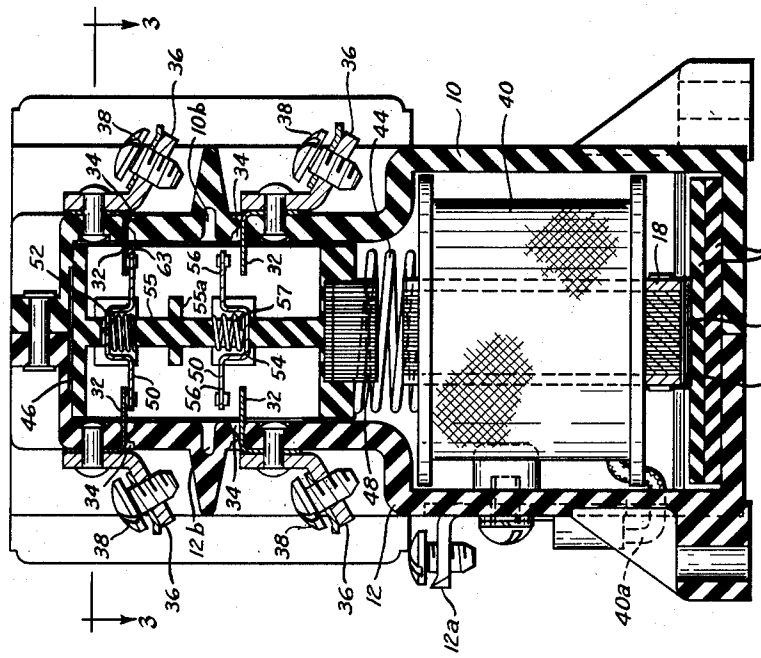
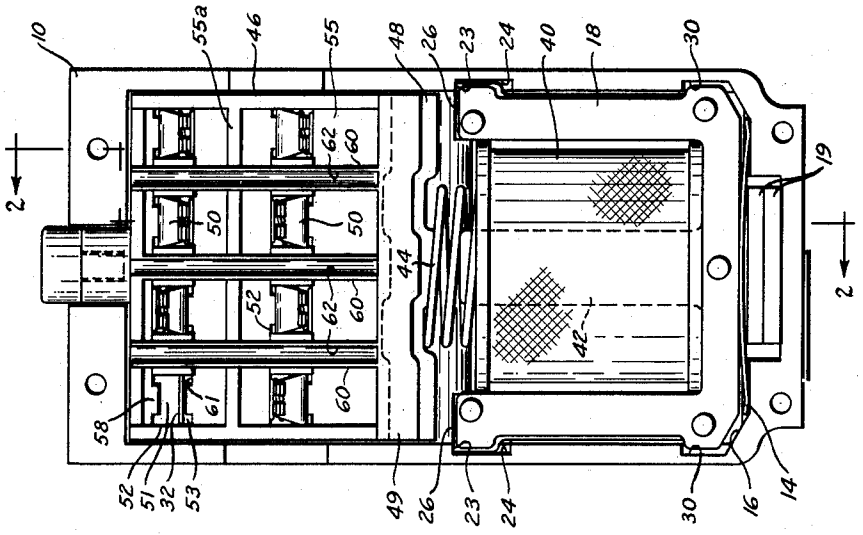


Fig. 1

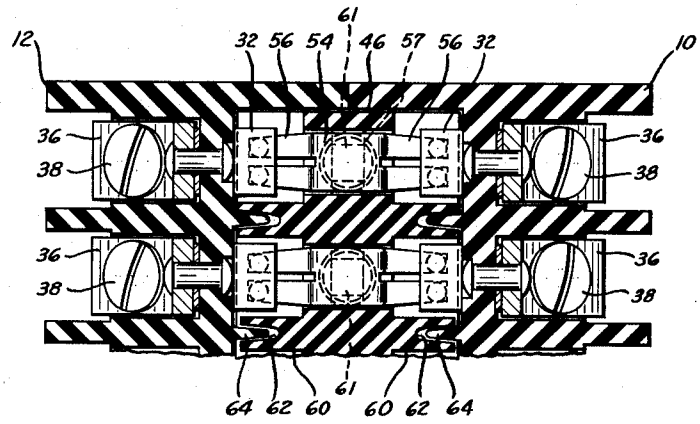


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REVERSIBLE CONTACT MOLDED FRAME RELAY

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Fig. 3



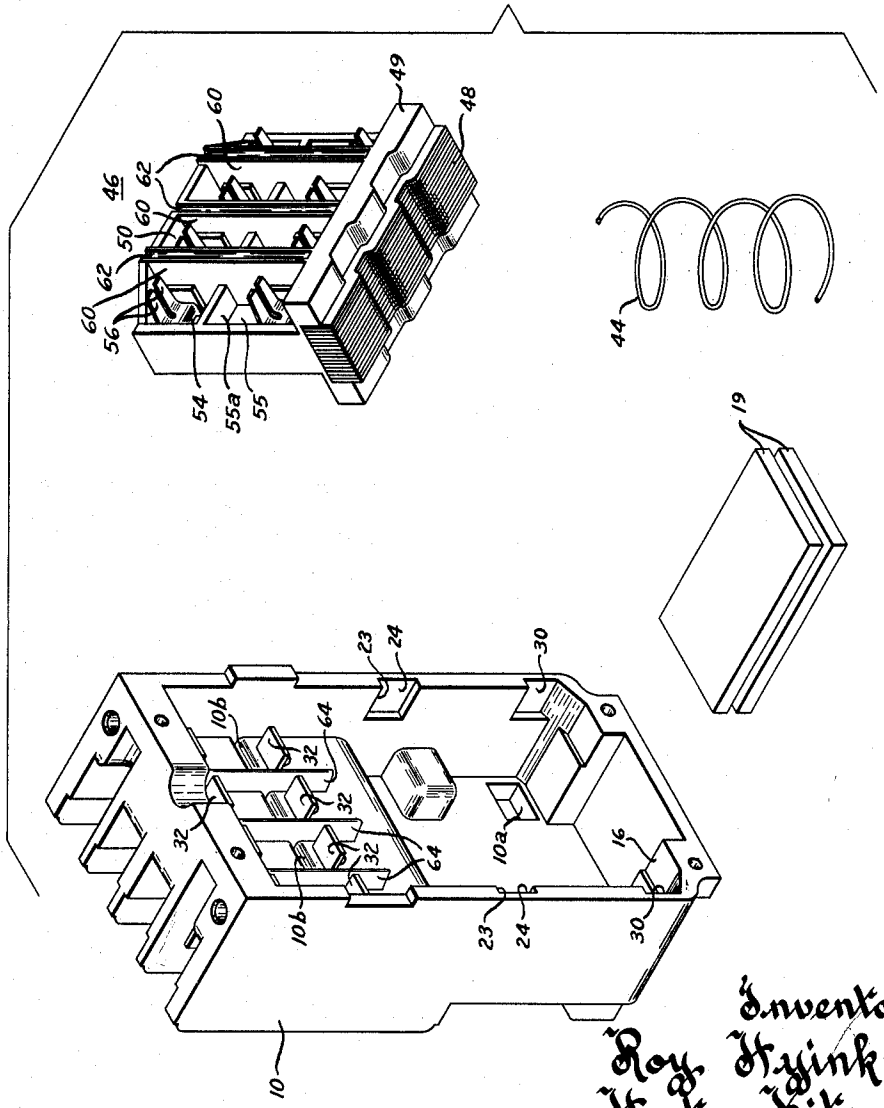
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REVERSIBLE CONTACT MOLDED FRAME RELAY

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Fig. 4a



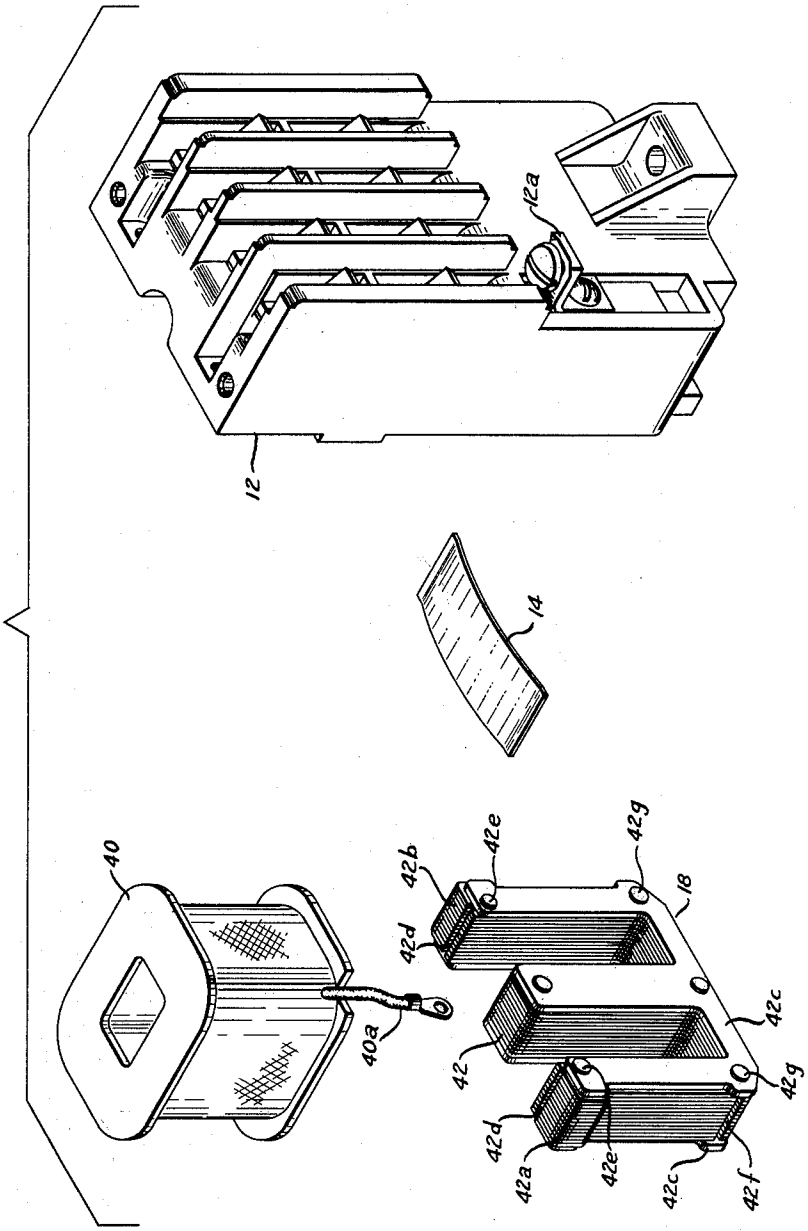
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Fig. 4b



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REVERSIBLE CONTACT MOLDED FRAME RELAY

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Filed Sept. 23, 1960, Ser. No. 58,003
13 Claims. (Cl. 200—104)

This invention relates to electromagnetic relays and particularly to a miniaturized relay for use on machine tools and other types of machinery.

A demand has recently arisen for a small, less expensive, light duty machine relay with a lower voltage rating than the standard 600 volt relay currently in use. This interest build-up is evident in both the machine tool and general machinery industries where the trend is toward better use of panel space and more economy.

One object of this invention is to reduce the size of a machine relay and yet maintain a voltage rating on the order of 300 volts and provide contacts convertible from normally open to normally closed and vice versa.

Another object is to provide in such miniaturized relay a wear allowance which is held within closer manufacturing tolerances.

The height of the relay is reduced by the novel construction of the contact carrying assembly described next. The present device utilizes a reversible contact and spring arrangement which fits in the same window of the contact carrying assembly for either normally open or normally closed position and operatively contacts the same fixed contact from either position. This is accomplished by a single window which extends beyond either side of the fixed contact and a movable contact with an offset or U-shaped central spring engaging portion. This permits the spring to push the movable contact toward the fixed contact from either end of the single window. This eliminates a second window and also cuts down overall height.

Generally the amount of wear allowance of the device is among other things affected by the tolerances of the magnet frame. In the present design portions of the magnet frame sealing faces are biased into registration with grooves in the relay housing which are molded a precise distance from that portion of the housing which carries the fixed contacts. With the sealing faces thus fixed with respect to the fixed contacts within the close tolerances characteristic of molded parts and the large tolerances of the magnet frame eliminated, the wear allowance for this miniaturized device may be held within closer tolerances.

Other objects and advantages will be pointed out in, or be apparent from the specification and claims as will obvious modifications of the embodiment shown in the drawings in which:

FIGURE 1 is a view of the present invention with one of the two symmetrical housing portions removed and with one movable contact removed from a window in the carrier member;

FIG. 2 is a sectional view taken on line 2—2 in FIG. 1;

FIG. 3 is a sectional view taken on line 3—3 in FIG. 2;

FIG. 4*a* is an exploded isometric view of one housing portion, the armature and movable contact carrying member, the armature support spring and the cushion on which the support spring rests; and

FIG. 4*b* is an exploded isometric view of the other housing portion, the coil, the magnet frame and the leaf spring which supports the frame.

Referring to the drawings, the relay housing is comprised of a pair of right and left-hand symmetrical portions 10 and 12. The housing has a groove 16 in the bottom (formed half in housing portion 10 and half in portion 12) in which a leaf spring 14 is mounted, and an E-shaped magnet frame 18 rests on top of the leaf spring and is biased upward by the spring and cushion pads 19 so that portions of the electromagnetic sealing faces 26 of the magnet frame contact upper edges 23 of grooves 24 which form abutments in the sides of the housing against which the frame is biased. Other grooves 30 at the housing bottom also receive projecting portions of the magnet frame to assure a wobble free mounting of this element. Cushion pads 19 are mounted below the mid-portion of the leaf spring within a recess in the bottom of the housing and serve to absorb the shock imposed on the magnet frame when the armature seals. Thus, the cushion cuts down recoil of the frame thereby reducing the bouncing effect between the armature and frame, and hence reducing the contact bounce also. Stationary contacts 32 project through apertures 34 in the sides of the housing and are riveted to the housing and to terminal brackets 36 to which terminal screws 38 are connected exteriorly of the housing. Terminal screws 38 are tightened down to grip connecting wires.

The apertures in the housing through which the fixed contacts project are molded into the housing as are the grooves in the sides of the housing which act as stops for the sealing faces of the magnet frame. This permits very close tolerances to be held on the spaces between the magnet sealing faces and the stationary contacts. This precise spacing allows a small tolerance on the wear allowance with the result that a large minimum wear allowance can be built into this device in proportion to its size, as will appear hereinafter.

A coil 40 is mounted over the center leg 42 of the magnet frame, and a coil spring 44 fits over and around such center leg and seats against the top of the coil to support a carrier member 46 shown in FIG. 4*a* having an armature 48 molded into its base 49 and having movable contacts 50 mounted in windows 52 shown in FIGS. 1 and 2 which are formed in the vertical portion 55 of the member. Spring 44 biases member 46 against the top of the housing when the relay is in its normal deenergized position.

The wear allowance, being the distance the carrier member can travel after the normally open movable contacts touch the fixed stops against and before the armature contacts the legs of the magnet frame, ordinarily depends upon the tolerances of the magnet frame, the carrier, the armature, and the housing in which the stationary contacts are mounted. However, in the present construction in which the magnet frame sealing faces are biased into grooves a specified distance from the fixed contacts, the tolerances of the magnet frame become immaterial. Therefore, a wear allowance of increased magnitude is achieved since the manufacturing tolerances of the wear allowance are reduced.

In order to achieve relay versatility, it is desirable to make each movable contact adaptable for assembly in either a normally open or a normally closed position.

This construction is achieved in the present device by positioning a movable contact mounting window in the contact carrier and providing stationary contacts positioned relative to the window which combine to provide a highly compact reversible mount for such contact. When the carrier is biased to normal position (as described above) each window 52 has a portion 51 projecting above a stationary contact 32 and a portion 53 projecting below such contact. A movable contact 50 having a U-shaped body portion 54 and laterally extending arms 56 is mounted in each window by means of a coil spring 57 which fits over a protrusion 58 at one end and projects into the confines of and against the U-shaped body of the contact. The protrusion anchors the spring in

the window and the body portion of the contact and the spring end hold the contact in the window. The offset body portion of the movable contact permits the spring **57** to bear against the bottom edge **61** of a window and bias the movable contact into engagement with the bottom surface **63** of a stationary contact with the distance between such bottom window edge and bottom stationary contact surface being kept to a minimum while the length of the spring is kept sufficiently great to provide good contact pressures since the spring projects on either side of the stationary contact. The spring and contact arms combine to provide the desired contact pressures in this device and a large amount of contact arm flexure is not required to develop these pressures. Therefore arm flexure need not be great so that contact life is prolonged. It will therefore be appreciated that the present construction conserves the height of the contact mounting windows and hence of the carrier in respect to conventional structures, since conventional reversible contact carrying structures mount the contact biasing spring either completely on one side or the other of the stationary contacts thereby requiring room for a full spring length on both sides of the stationary contact, while obtaining the advantages of using a separate spring to develop a larger part of contact pressures.

It is desirable to provide several terminals in as small a horizontal distance as possible, and to this end the movable contacts are insulatively separated by dividers **60** which have grooves **62** shown in FIGS. 1 and 3 that cooperate with ribs **64** on the housing to guide the reciprocation of the contact member and to electrically separate adjacent contacts. This construction makes it possible to crowd several contacts into a minimum of space thereby reducing the width of the relay.

As shown in FIG. 4*b*, magnet frame **18** is provided with the aforementioned center leg **42** or inner leg and a pair of outer legs **42***a* and **42***b*. The magnet frame comprises a stack of thin laminations clamped together by a pair of clamping members **42***c* and rivets extending therethrough and through the laminations.

The upper end of each outer leg **42***a* and **42***b* is provided with a slot **42***d* in the laminations extending into the hole provided in the laminations for rivet **42***e*. Another slot **42***f* is provided on the lower end of the outer surface of each outer leg extending into the hole provided in the laminations for rivet **42***g*. The purpose of these slots is to afford the magnet a phase-shifted flux shading coil effect, that is, to split the flux at the air gap. Lower slot **42***f* interrupts the flux path on the outer side of rivet **42***g* and causes the flux to be concentrated in the portion of leg **42***f* which is on the inner side of rivet **42***g*. Upper slot **42***d* splits the flux path so that some of the flux traverses the right-hand portion of the sealing surface and the remainder of the flux traverses the left-hand portion of the sealing surface of leg **42***a*. Rivets **42***e* and **42***g* and the portions of clamping members **42***c* on opposite sides of leg **42***a* form a closed loop shading coil turn for conducting current induced therein by the flux within this loop and which flux traverses the left-hand portion of the sealing surface of the leg. This shading effect causes the absolute value of the magnetic force to be maintained above zero value at all times.

Energizing coil **40** shown in FIGS. 2 and 4*b* is provided with a conductor **40***a* which extends through an aperture in housing portion **12** and is connected to a terminal bracket **12***a* mounted on the outer side of housing portion **12**. Housing portion **10** is provided with a similar aperture **10***a* shown in FIG. 4*a* to provide access for the other conductor (not shown) of the operating coil for connection to a similar terminal bracket exteriorly of the housing.

Vertical portion **55** of the contact carrier is provided with horizontal ribs **55***a* on opposite sides thereof as shown in FIG. 2 to lengthen the insulating distance between the movable contacts. Housing portions **10** and **12** are provided with horizontal internal grooves **10***b* and **12***b* to lengthen the insulating distance between the stationary contacts.

The present device is quickly and easily assembled by placing the various parts in housing portion **10** and then closing the housing by securing housing portion **12** to portion **10**.

Although but one embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the appended claims.

We claim:

1. In an electromagnetically actuated switch:
   (*a*) a molded insulating housing;
   (*b*) a switch comprising stationary contacts and movable contacts and an electromagnet comprising a magnet frame having a sealing surface, an energizing coil and an armature for attraction to said sealing surface when said coil is energized thereby to actuate said movable contacts into engagement with said stationary contacts;
   (*c*) and means for determining the wear allowance of the contacts and said switch comprising:
   (*d*) means molded in said housing for positioning said stationary contacts and said sealing surface relative to one another to provide an accurate distance therebetween due to the inherent dimensional accuracy of the molded housing whereby manufacturing tolerances of the magnet frame are eliminated in determining contact wear allowance thereby to reduce the tolerance of the contact wear allowance.

2. The invention defined in claim 1, wherein said means molded in said housing for positioning said sealing surface comprises:
   (*a*) at least one abutment molded in said housing against which a portion of said sealing surface is positioned to fix the distance between said stationary contacts and said sealing surface.

3. The invention defined in claim 2, together with spring means biasing said frame into engagement with said abutment.

4. The invention defined in claim 3, together with a cushion pad between said housing and said spring means for supporting the latter to absorb shocks imposed on said magnet frame and thereby to reduce recoil of said frame after such shocks cease.

5. An electroresponsive device comprising a molded housing having molded therein a fixed contact mounting opening and a magnet frame abutment, a magnet frame having an electromagnetic sealing face in engagement with said abutment in said housing, a coil surrounding a portion of said frame, a stationary contact mounted in said opening and fixed with respect to said housing and said abutment, armature and contact carrying means reciprocable within said housing, an armature on said means having an electromagnetic sealing face adapted to engage said first mentioned sealing face to limit the energized position of said carrying means, a contact movably carried by said means and engageable with said stationary contact, and a spring acting between said carrying means and said movable contact to urge said movable contact toward said stationary contact whereby the wear allowance for said contacts is independent of the manufacturing tolerances of said frame.

6. The device according to claim 5, in which a spring resting on the bottom of said housing presses said magnet frame sealing face against said abutment.

7. In an electromagnetically actuated switch having a pair of spaced stationary contacts in a common plane:
   (*a*) a contact carrier between said stationary contacts and movable relative thereto;
   (*b*) an aperture in said carrier between said stationary contacts and having one side movable toward and away from the plane of said stationary contacts from

one side thereof and having another side movable toward and away from the plane of said stationary contacts from the other side thereof;

(*c*) a movable contact in said aperture having opposite ends overlapping the respective stationary contacts;

(*d*) and means resiliently biasing said movable contact against one of said sides of said aperture whereby said movable contact is normally open relative to said stationary contacts and said movable contact being removable from said aperture and re-insertable in reversed position between said resilient biasing means and the opposite side of said aperture whereby said movable contact is normally closed relative to said stationary contacts.

8. In an electromagnetically actuated switch having a pair of spaced stationary contacts in a common plane:

(*a*) a contact carrier between said stationary contacts and reciprocably movable relative thereto;

(*b*) an aperture in said carrier between said stationary contacts having opposite side portions spaced on opposite sides of the plane of said stationary contacts;

(*c*) a movable contact in said aperture having an offset mid-portion and opposite end portions overlapping the respective stationary contacts;

(*d*) a spring between the sides of said offset portion and biasing said offset portion against one of said side portions of said aperture to afford a normally open condition of said movable and stationary contacts;

(*e*) and the opposite side portions of said aperture being symmetrical whereby said movable contact can be reversed and biased by said spring against the other side portion of said aperture to afford a normally closed condition of said movable and stationary contacts.

9. In an electromagnetically actuated switch, a housing, a pair of spaced stationary contacts projecting inside said housing, a movable contact carrier reciprocable in said housing, said contact carrier being biased to a normal position in said housing, a window in said carrier positioned opposite said stationary contacts and having portions extending both above and below the plane of said stationary contacts when said carrier is in normal position, a contact in said window being adapted for relocation from one side of said window to a reversed position against the other side of said window to assume a selected normally open or a normally closed position as respects said stationary contacts when said carrier is in normal position, and a spring in said window biasing said movable contact toward said stationary contacts, said spring extending partly above and partly below said plane of said stationary contacts whereby a spring of sufficient size to develop good contact pressures fits in said window while keeping the height of said carrier to a minimum.

10. The invention according to claim 9 in which said movable contact has a U-shaped body portion and arms extending laterally therefrom for cooperation with said stationary contacts, said spring having one end projecting into said U-shaped body portion and the other end bearing on an edge of said window.

11. The invention according to claim 10, in which said edge of said window has a protrusion thereon over which said spring fits to hold said spring in said window.

12. In an electroresponsive device, a pair of like molded insulation housing members having complementary engaging portions for mating assembly with one another, a magnet frame and operating coil unit, means on said frame and said housing members for interlocking supporting engagement therebetween, stationary contacts mounted interiorly of said housing members, and armature and movable contact carrier unit having movable contacts removably mounted thereon, said movable contacts being normally closed with certain of said stationary contacts and normally open with others of said stationary contacts, interfitting portions on said contact carrier and said housing members for sliding engagement therebetween, and means for biasing said frame relative to said housing members to accurately position said frame relative to said stationary contacts, the flexure of the movable contacts being relatively small to reduce the stress thereon and said interlocking means being accurately spaced from said stationary contacts to significantly increase the wear allowance of the device.

13. The invention defined in claim 12, wherein said contact carrier comprises an insulating member having an aperture therein for each movable contact, said insulating member having opposed projections extending partially into said aperture, said movable contact being formed of a longitudinal strap bent into a U-shape at its mid-portion with laterally extending contact arms and being slidable into its normal position in said aperture, and a helical compression spring having one end mounted on a first one of said projections and the other end between the sides of said U-shaped mid-portion to press said movable contact against the other projection and to retain said movable contact in said aperture, said movable contact being reversible between normally open and normally closed positions relative to the stationary contacts whereby said one end of said spring is mounted on said other projection and presses said movable contact against said first projection.

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