May 6, 1958 W. B. WELLS ET AL 2,833,885

ELECTRICAL RELAYS

Filed Oct. 25, 1954 2 Sheets-Sheet 1

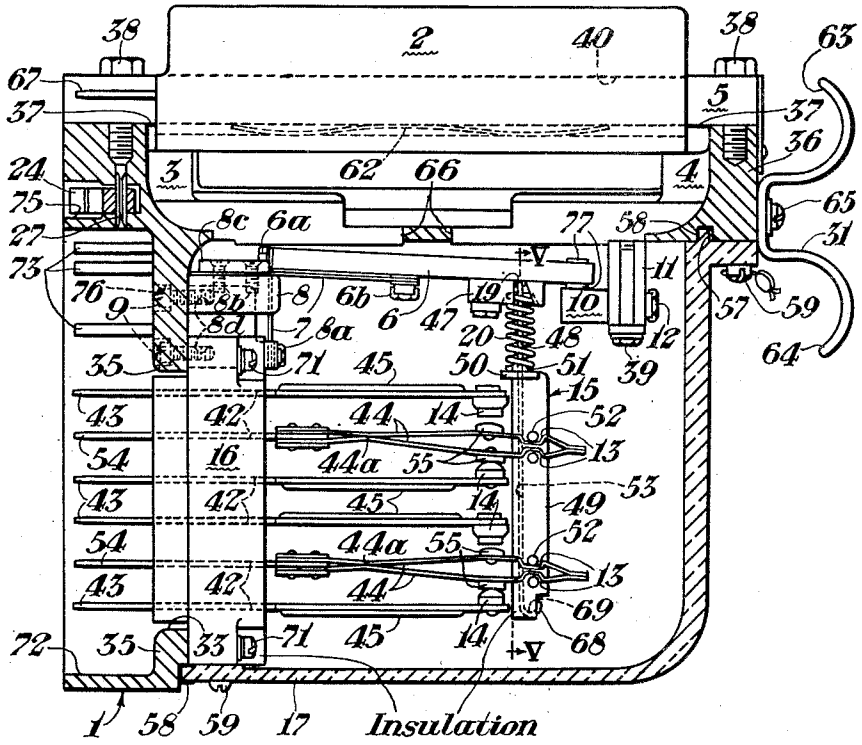

Fig. 1.

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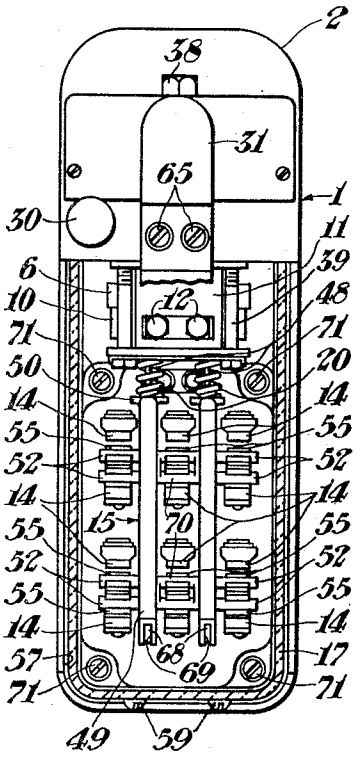

Fig. 2.

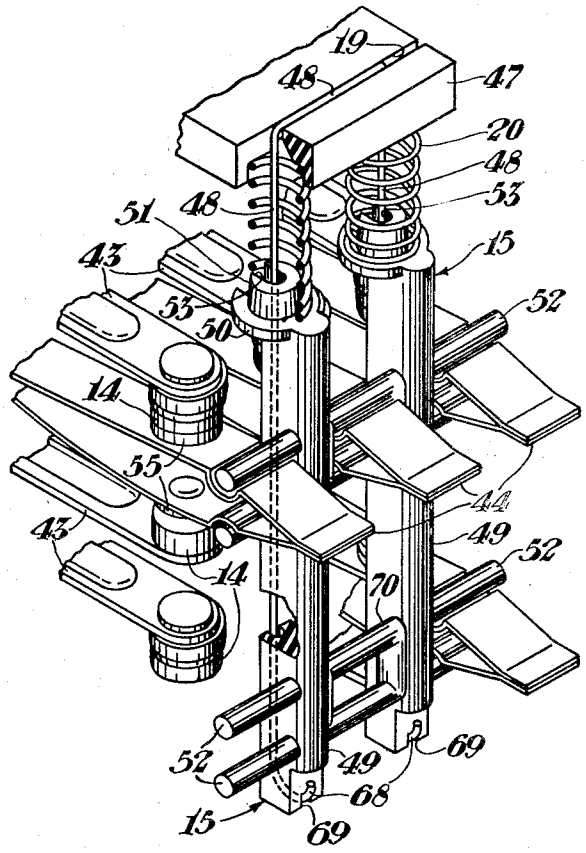

Fig. 3.

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ELECTRICAL RELAYS

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Application October 25, 1954, Serial No. 464,236

11 Claims. (Cl. 200—104)

Our invention relates to electrical relays, and particularly to a novel means for operatively connecting the movable contacts of an electrical relay with the movable armature.

In previous relays considerable difficulty has been experienced in operatively connecting the movable contacts of a relay with the movable armature of a relay without having lost mostion between the armature and the contacts. Over a period of long and extended use it was found that wear in the connections between the movable contacts and the relay armature sometimes caused considerable change in the adjustment of the contacts, and also in the operation of the relay contacts from one position to the other.

It is therefore, an object of our invention to provide a novel relay contact drive structure which prevents linkage lost motion.

Another object of our invention is to provide a novel contact driver for an electrical relay in which repair and adjustment costs are kept to a minimum.

Another object of our invention is to provide a novel contact driver structure that is simple in construction and inexpensive to manufacture.

Other objects, purposes and characteristic features of our invention will be in part obvious from the accompanying drawings and in part pointed out as the description of our invention progresses.

In practicing our invention we provide a relay, the movable contact driver of which is free of any lost motion so that the entire travel of the relay armature is available for motivating the movable contact members.

In describing our invention in detail, reference will be made to the accompanying drawings in which corresponding parts are generally identified by corresponding reference characters and in which:

Fig. 1 is a vertical sectional view showing one form of plug-in relay embodying our invention.

Fig. 2 is a front view of the relay embodying our invention, portions of which are broken away to illustrate to better advantage certain details of construction.

Fig. 3 is an isometric view of the contact driver linkage portions of which are broken away to better illustrate certain details of construction.

Referring to the drawings, the relay comprises a frame member 1 non-magnetic material, such as die cast aluminum. The frame member 1 consists of a vertical portion 35 and a horizontal forwardly extending portion 36. The portion 36 supports two core members or pole pieces 3 and 4 of magnetizable material which are preferably first machined, and then cast into the horizontal portion 36 of the frame member 1. The two pole pieces 3 and 4 are L-shaped and are so arranged that the ends 37 of the vertical legs of the pole pieces either project above or terminate flush with the upper surface of the horizontal portion 36, of the frame member 1. The upper ends 37 of the L-shaped pole pieces 3 and 4 are subsequently ground to provide a good magnetic circuit contact with a core member 5 which passes through and supports an

energizing coil 2. The core member 5 is secured to the portion 36 of the frame member 1 and against the upper ends 37 of the L-shaped pole pieces 3 and 4 by cap screws 38. The L-shaped pole pieces 3 and 4 are so cast within the frame portion 36 that a space or gap is formed between the adjacent inner ends 66 of the horizontal legs of the pole pieces 3 and 4. This space is filled with the non-magnetic material of the frame.

An armature 6 is pivotally secured to the vertical portion 35 of the frame member 1 by a suitable hinge construction comprising a support block 8 and three hinge springs 7. One of the hinge springs is vertically disposed to prevent vertical displacement of the armature 6 and is secured at its lower end to the support block 8 by screws 8*a*. The upper end of the vertical hinge spring 7 is secured to one end of the armature 6 by the screws 6*a*. The other two hinge springs 7 are horizontally disposed on opposite sides of the vertical spring 7 to prevent horizontal displacement of the armature 6. The inner ends of the two springs are secured to the top surface of the support block 8 by screws 8*b* and a retainer 8*c*, while the other ends are secured to the bottom surface of the armature 6 by screws 6*b*. The block 8 is secured to the vertical portion 35 of the frame member 1 by support block adjusting screws 9 passing through enlarged openings 76 in the frame member 1 and threaded into suitable screw openings 8*d* in the support block 8. With this arrangement the armature air gap between the horizontal legs of the pole pieces 3 and 4, in the frame 1, and armature 6 may be adjusted by shifting the armature support block 8 vertically along the portion 35. The armature 6 underlies and cooperates with the pole pieces 3 and 4.

Supported by the pole piece 4 is a hold-down pole piece member 10 secured by means of secrews 12 to a permanent magnet 11. The permanent magnet 11 is secured to the pole piece 4 by magnetizable bolts 39 which also act as a shunt to prevent the demagnetization of the magnet 11, if the magnet is subjected to any stray flux surges. It should be noted the hold-down pole piece 10 also serves as a back stop to limit movement of the armature 6 away from the pole pieces 3 and 4. The armature 6 is provided with the usual core pin 77 to prevent the armature from sticking, due to residual magnetism, to the hold-down pole piece 10 or to the pole piece 4.

The coil 2 has an opening 40 for receiving the core member 5. The coil 2 is further provided with a coating of substantially hard insulating material which supports two electrical prongs 67 at the rear end thereof. This arrangement eliminates the necessity of passing coil lead-in wires into the enclosed area of the relay contacts (which will hereinafter be described) and then through the vertical portion 35 of the frame 1. Located between the coil 2 and the core member 5 within the opening 40 is a vibration damper leaf spring 62 which tends to hold the coil firm, thus eliminating excessive movement.

The vertical portion 35 of the frame member 1 is provided with a rearwardly facing terminal receiving opening 72 for receiving the plug-in ends of the fixed contact members 43, the contact base members 54 and indexing pins 73. Located within the vertical portion 35 of the frame member 1, and opening into the treminal opening 72, is a contact block opening 33. Secured by suitable bolts 71 to the portion 35 and extending into the contact block opening 33 is contact support block or member 16 made of suitable insulating material. The contact support block 16 is provided with a plurality of openings 42 for receiving the ends of the fixed contact members 43 and movable contact base members 54. Each of the contact members 43 is provided with a reinforcing rib 45 and a contact point member 14. Each of the movable con-

tact base members 54 has secured thereto, movable contact leaf members 44 of spring material in a manner described hereinafter.

Attached to the movable armature 6 by a securing block 47 is a U-shaped contact actuator drive wire 48. The U-shaped drive wire 48 is disposed with its horizontal portion passing through an opening 19 in the securing block 47 with its ends extending downwardly from the securing block 47 and armature 6. The two downwardly extending ends of the drive wire 48 are secured to a contact actuating member 15. The contact actuating member 15 is of insulating material, and comprises two vertical members 49 of U-shaped cross section which are held in a spaced apart parallel relationship by integral vertically spaced apart horizontal pins 70 (see Fig. 3). The depending ends of the drive wire 48 pass through grooves or channels 53 formed in the U-shaped or channel members 49 and are turned upwardly as at 68 to engage the lower portion of the members 49. Extended outwardly from each of the vertical members 49 are integral projecting pins 52. At the upper end of each of the U-shaped members 49 is an enlarged spring seat 50 and a vertically extending smaller spring guide 51. At the lower end of each of the vertical U-shaped members 49 are contact actuator drive wire slots 69 for receiving the up-turned ends 68 of the drive wire 48.

Surrounding the two downwardly extending portions of the actuator drive wire 48, between the drive wire securing block 47 and the upper ends of the U-shaped members 49 of the member 15, are two actuator pressure springs 20. The pressure springs 20 act to force the actuating member away from the armature 6 and down against the hooked portions 68 of the drive wire 48.

Referring to the contacts, each of the movable contact base members 54 has secured thereto on opposite sides thereof one end each of two movable contact leaf spring members 44. Each of the two members 44, which are secured to the same base member 54, converges and contact each other at a point 44*a*. The two members then diverge and again converge in such a manner that, when the unsecured ends of the members are forced together the middle portions, between the contact point 44*a* and the free ends, are well separated. Attached to the intermediate middle portion of each of the members 44 is an electrical contact member 55 adapted to engage an associated one of the fixed contacts 14, in a manner hereinafter described.

Formed in the leaf spring members 44 between the contact members 55 and the unsecured ends of the leaf spring members 44 are transverse grooves 13. When the members 44 are inserted between adjacent pairs of movable contact projecting pins 52, or between adjacent pairs of horizontal pins 70, of the member 15, the transverse grooves 13 of the leaf spring members 44 engage the pins 52 or 70 firmly. In order for the contact leaf spring members 44 to pass between the projecting pins 52, or horizontal pins 70, of the member 15, the leaf spring members must be compressed. This causes the unsecured ends of the contact leaf spring members 44 to come into contact with each other and helps to cause each of the transverse grooves 13 of the members 44 to seat against the movable contact projecting pins 52 or horizontal pins 70 of the member 15. This eliminates all lost motion between the member 15 and the leaf spring member 44 as well as placing the leaf spring members 44 under an initial pressure for reducing contact bounce.

Located with a groove 57 adjacent the peripheral edge of the frame member 1 is a gasket or filler member 58. The gasket or filler member 58 is arranged to cooperate with a transparent cover member 17 to provide a weather tight seal for the relay contacts. The cover member 17 is secured to the frame member 1 by suitable bolts 59. It will be noted that the cover member is provided with a projecting edge which fits within the gasket member 58 providing a better seal.

The vertical portion 35, of the relay frame 1, is provided with a latch member 24 for holding the plug-in relay in place on a typical mounting base. The mounting base is not shown since it forms no part of our present invention. A typical mounting base is shown in the copending application Serial Number 459,970 to Harry E. Ashworth filed October 4, 1954, for Electrical Relays.

Secured to the forward end of the relay frame 1, as by bolts 65, is a relay handle member 31 provided with finger grip loops 63 and 64 for handling the relay while plugging it into or removing it from the mounting base.

Upon energization of the relay coil 2, the free end of the armature 6 is pulled upwardly to its attracted position in which the core pin 77 engages the pole piece 4. Movement of the armature to its attracted position lifts the contact actuator member 15, and movable contact leaf spring members 44 to thereby close the front contacts of the relay. It will be noted that the front contacts are made before the core pin 77 strikes the pole piece 4. This causes the bowed leaf springs supporting the front contacts 55 to be compressed, thus holding the front contacts 55 firmly together against the fixed contacts 14.

Upon deenergization of the relay coil 2, the armature 6 drops by gravity until the free end of the armature approaches the hold-down pole piece 10. At this time the action of gravity plus the effects of the hold-down pole piece magnet 11, act to pull the armature down firmly to the position in which the core pin 77 strikes the hold-down pole piece 10. It will be noted that the back contacts are made before the core pin 77 strikes the hold-down pole piece. This causes the bowed leaf springs supporting the back contacts 55 to be compressed, thus holding the back contacts 55 firmly against the fixed contacts 14.

The relay of our invention has the advantage of positive contact action without the introduction of lost motion in the linkage between the contacts and the armature, and the advantage of a reduction in the number of wear points in the contact actuating linkage.

Although we have herein shown and described only one form of relay embodying our invention it is to be understood that various changes and modifications may be made within the scope of the appended claims without departing from the spirit and scope of our invention.

Having thus described our invention, what we claim is:

1. A contact actuating linkage for interconnecting a movable contact actuating member and a plurality of movable contacts comprising an insulated movable contact actuating means, flexible means for securing said contact actuating means to said contact actuating member, and resilient means located between said contact actuating member and said contact actuating means for tensioning said flexible means to eliminate all lost motion between said contact actuating member and said contact actuating means.

2. In a relay having a movable means, a contact actuating structure comprising an insulated movable contact actuating member having a plurality of horizontally extending pairs of spaced apart insulated pins, a plurality of resilient leaf spring members disposed in pairs and provided with opposed transverse grooves, the members of each pair being biased apart by their own resiliency and extending between an associated pair of said insulated pins with the opposed grooves receiving said insulated pins, drive means for connecting said movable means to said contact actuating member, and resilient means biasing said contact actuating member in spaced relation from said movable means, said drive means and said resilient means providing an increment of movement of said contact actuating member for every increment of movement of said movable means.

3. In a relay having a movable armature, a contact actuating structure comprising, a plurality of pairs of

opposed biased apart resilient movable contact leaf spring members, a movable contact actuating member provided with a plurality of horizontally extending pairs of insulated pins, the leaf spring members of each opposed pair being provided with opposed transverse grooves which receive the insulated pairs of an opposed pair of pins in such manner that the spring members are held in compression by the pins, and drive means for connecting said armature to said contact actuating member, said drive means providing proportional movement of said contact actuating member for every increment of movement of said armature.

4. A contact actuating linkage comprising, a plurality of movable contacts, a drive wire securing block having a groove in its upper surface, a movable contact actuating member, drive wire means received within said groove of said securing block for connecting said securing block to said movable contact actuating member, and means surrounding said drive wire and cooperating with said block for constantly urging said drive wire firmly into said groove.

5. In a relay, a contact actuating structure comprising a movable member, a plurality of movable contacts, an insulated movable contact actuator, drive wire means for connecting said movable member to said movable contact actuator, said drive wire means being secured to said movable member through a drive wire securing block provided with a transverse groove in its upper surface for receiving said drive wire, means for securing said drive wire securing block to said movable member, and resilient means located between said securing block and said contact actuator for eliminating all lost motion due to wear.

6. In a relay, a contact actuating structure comprising, an armature, a plurality of movable contacts operable by a movable contact actuator and a drive wire which is secured to said armature through a drive wire securing block having an upper surface provided with a transverse groove for receiving said drive wire, means for securing said drive wire securing block to said armature, and spring means surrounding said drive wire between said drive wire securing block and said contact actuator for eliminating all lost motion between said armature and said contact actuator.

7. In a relay, a contact actuating structure comprising an armature, a plurality of opposed biased apart resilient movable contact leaf spring members disposed in pairs, an insulated movable contact actuating member provided with a plurality of horizontally extending pins disposed in pairs and retained in spaced apart relationship by two vertically positioned channel members, said opposed pairs of leaf spring members being provided with opposed transverse grooves for receiving while being compressed said opposed pairs of horizontal pins, drive means for connecting said armature to said contact actuating member, and coil spring means compressed between said contact actuating member and said armature for eliminating all lost motion between said armature and said movable contacts.

8. A contact actuating linkage comprising, a drive wire securing block, a U-shaped drive wire provided with the horizontal portion of its U secured to said securing block with the ends of its U extending downwardly away from said securing block, a movable contact actuator, said ends of said drive wire being passed downwardly through said contact actuator and secured to said actuator, and pressure means located between said securing block and said actuator for urging said securing block and said actuator away from each other to eliminate all lost motion between said securing block and said actuator.

9. A contact actuating linkage comprising a drive wire, a drive wire securing block provided with a transverse slot in its upper surface and two downwardly facing spring receiving recesses in its lower surface, a movable contact actuator, provided with a plurality of horizontally extending pairs of insulated pins held in spaced apart relationship by two spaced apart vertically positioned channel shaped members provided with spring seats at their upper ends, springs located between said upper ends, springs located between said upper ends of said vertically positioned channel members and said downwardly facing spring receiving recesses, said drive wire extending downwardly through said springs and through said vertically positioned channel shaped members and provided with upturned ends for engaging said vertical channel shaped members, said drive wire means and said springs acting as a positive drive means between said securing block and said movable contact actuator for eliminating all lost motion.

10. In a relay, a contact actuating linkage comprising a drive wire, a movable contact actuator and a drive wire securing block, said drive wire securing block being provided with a transverse slot in its upper surface and two downwardly facing spring receiving recesses in its lower surface, springs located between said contact actuator and said drive wire securing block, said drive wire extending downwardly through said springs and provided with upturned ends for fixedly engaging said contact actuator, said drive wire and said springs acting as a positive drive means between said securing block and said contact actuator for eliminating all lost motion.

11. In a relay provided with a frame, an armature pivoted to said frame, fixed contact and a movable contact, a movable contact actuating linkage comprising, a drive wire securing block, a movable contact actuator, and a drive wire for connecting said securing block to said contact actuator, coil spring means surrounding said drive wire for continually urging said contact actuator away from said securing block for eliminating all lost motion in said linkage.

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