Dec. 27, 1966 O. HRYNEWYCZ 3,295,078

RELAY

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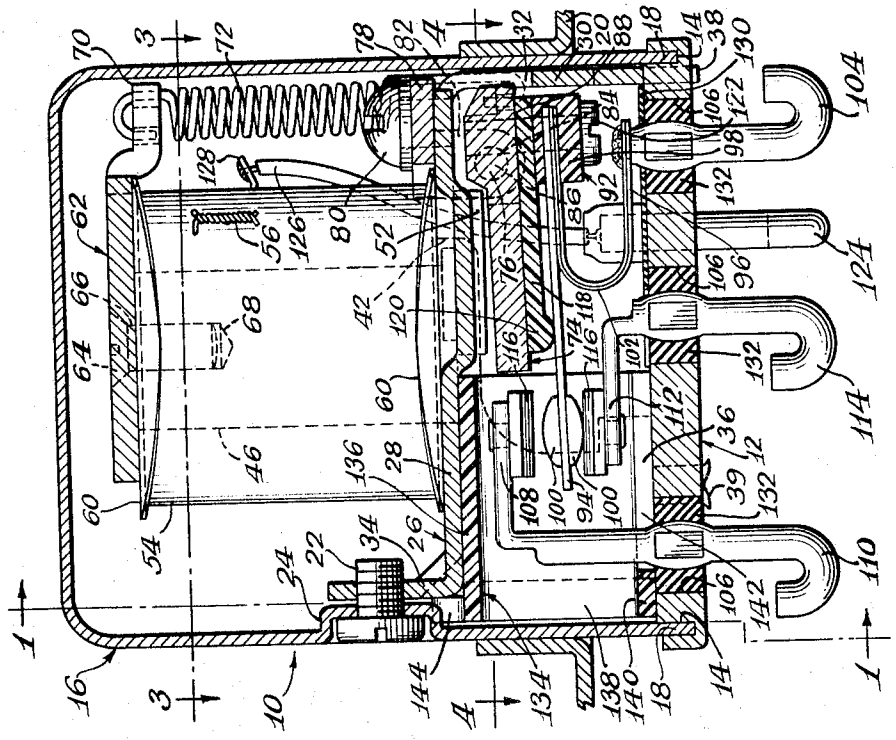


FIG. 2.

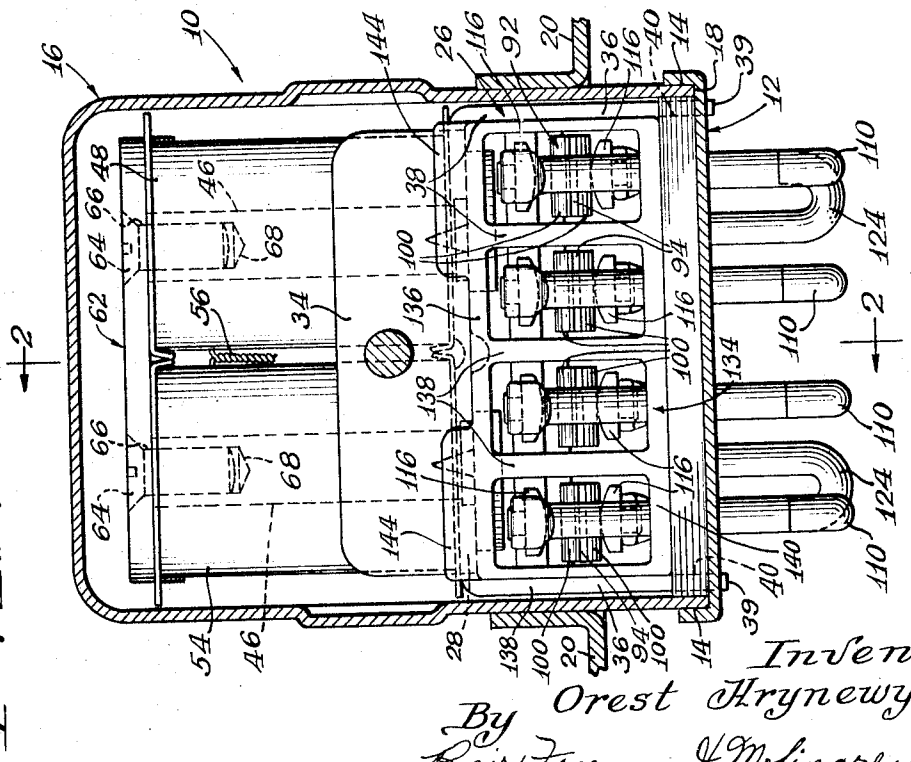


FIG. 1.

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FIG. 3.

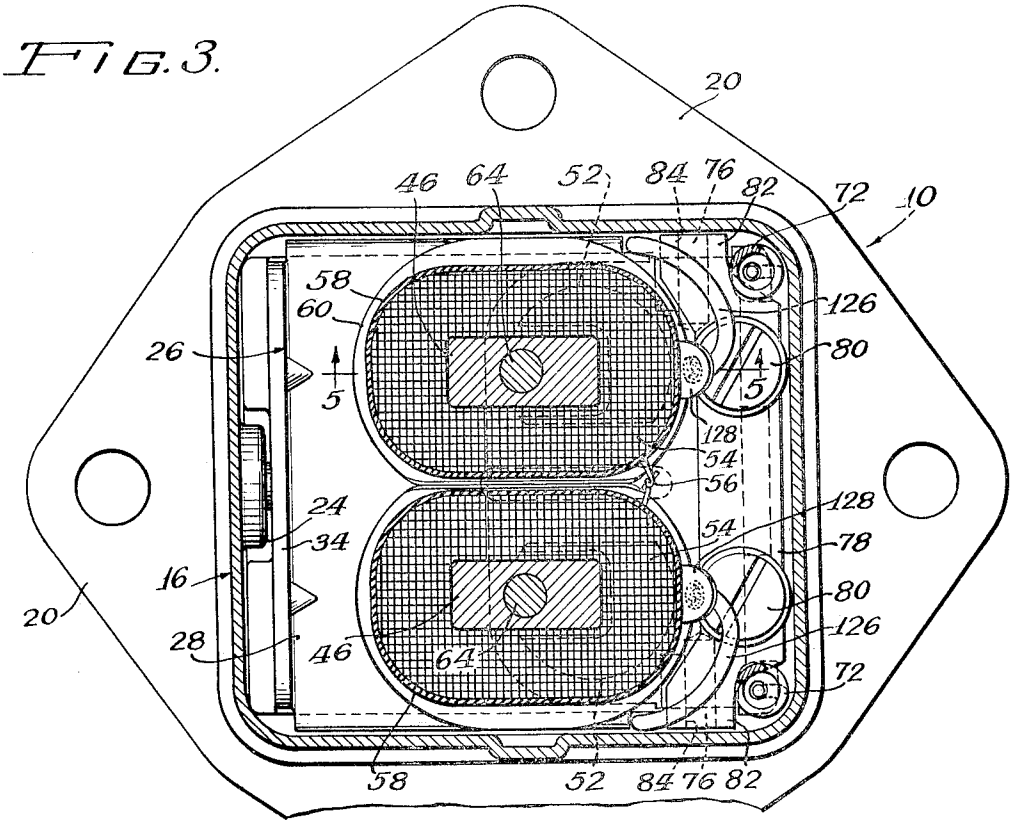


FIG. 4.

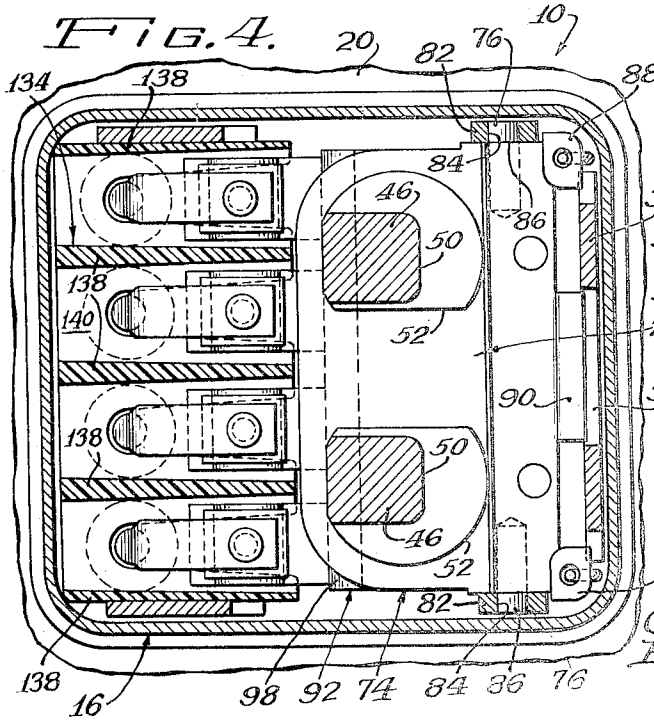
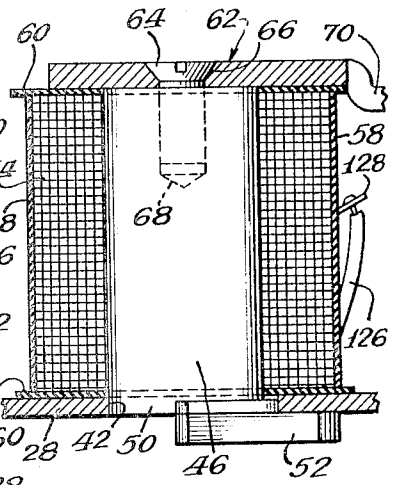


FIG. 5.



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3,295,078

RELAY

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15 Claims. (Cl. 335—124)

This invention relates to an improved relay construction and it particularly relates to a highly compact and lightweight relay having a multiplicity of electrical contacts thereon.

The electrical supply industry is very competitive and this is particularly true in the sale of electrical relays. As a result, electrical manufacturers are constantly striving to improve their relay constructions while at the same time reducing their manufacturing costs. Particularly important ways in which relays can be improved are by reducing their size and weight. Size reduction is particularly important in the electronic industry in the manufacture of compact electrical or electronic devices. Weight reduction is found to be very important in the aircraft industry. Since it is common to use as many as two hundred relays in an aircraft, a weight reduction of only a few ounces per relay provides a significant cost saving in the construction of the aircraft.

It is therefore an important object of this invention to provide an improved relay construction of highly economical construction.

It is a further object of this invention to provide an improved relay construction of highly economical construction wherein the relay is significantly lesser in weight than prior art relays having equal electrical ratings.

It is also an object of this invention to provide a light weight and economical relay which is highly compact in comparison to relays of equal electrical rating.

Further purposes and objects of this invention will appear as the specification proceeds.

A particular embodiment of the present invention is illustrated in the accompanying drawings wherein:

FIGURE 1 is a transverse sectional view taken along the line 1—1 of FIGURE 2 showing the internal construction of my improved relay;

FIGURE 2 is a longitudinal sectional view taken along the line 2—2 of FIGURE 1;

FIGURE 3 is a sectional view taken along the line 3—3 of FIGURE 2 wherein the upper portion of the interior of my relay is shown;

FIGURE 4 is a sectional view taken along the line 4—4 of FIGURE 2 wherein the lower portion of the interior of my relay is shown; and

FIGURE 5 is a partially sectioned, detail view of a coil and core assembly used with my improved relay.

Referring to the drawings, my improved relay 10 is provided with a base or header portion 12, which constitutes a metallic plate-like structure which is substantially rectangular in configuration. The header 12 has a peripheral, upwardly opening groove 14 which receives the lower edges 18 of an enclosure or relay cover member 16 therein. The lower edges 18 of the cover 16 have the same shape as the peripheral groove 14 so as to be snugly received thereby. The cover 16 combined with the header enclose the inner, operating portions of the relay 10 and act to protect these parts from injurious effects from such things as air-carried impurities and dust. The cover 16 includes a mounting flange 20 around its periphery which is secured at the lower portion of the cover 16, such as by welding. The flange 20 is used for securing the entire relay assembly 10 to a control panel or the like (not shown). The cover 16 is secured to the relay by a screw 22 which passes through an

aperture in a depressed portion 24 in one side wall of the cover member 16.

An integral mounting or support bracket 26 is secured to the base or header 12. Preferably, securement is accomplished by a staking operation. The bracket 26 comprises an upper support shelf 28 which is spaced from and is substantially parallel with the upper surface of the header 12. The rearward end of the support shelf 28 has a downturned portion 30, which is substantially perpendicular to the shelf portion 28. A cut-out area 32 is provided in the downturned portion 30 for receiving a portion of the armature 74.

The opposite or forward end of the shelf 28 includes an upturned portion or flange 34 which is also substantially perpendicular to the shelf portion 28. The upturned flange 34 has a central threaded aperture therein for receiving the securing screw 22 for the cover 16. The support bracket 26 includes a pair of lateral, downturned legs 36, substantially perpendicular to the shelf 28, which are positioned at the forward end of the relay 10. Each leg 36 includes a lower projection 39 while the downturned flange 30 also has a pair of similar projections 38. Each projection 38 and 39 passes through an aperture 40 adjacent the peripheral groove 14 in the base 12 and extends beyond the lower surface of the header 12. The projections 38 and 39 are secured to the base 12 by a staking operation so as to provide a highly economical and simple securement of the bracket 26 to the base 12.

The bracket shelf 28 includes a pair of centrally positioned core-receiving apertures 42 which snugly receive the coil-forming cores 46 therein. Referring particularly to FIGURES 3, 4 and 5, each core 46 passes through one aperture 42 in the shelf 26 and is secured to the shelf 28. In my core construction, it is important for maximum utilization of iron in a minimum space to provide cores 46 which are non-circular or substantially rectangular in cross-section, the longer sides of the cores 46 being parallel with each other and being parallel with the lateral sides of the header 12. The lower end 50 of each core 46 is provided with an integral widened portion or pad 52 which is offset from the central axis of the core 46. The lower end of the core and its pad 52 pass through the aperture 42 and the pad 52 is slid to one side of the aperture 42. Each pad 52 is then welded to the underside of the support shelf 28 in order to secure the respective cores 46 thereto. After coils 54 are positioned around the cores 46, a portion of the shelf 28 is interposed between a pad 52 and the coil 54.

Electrical coils 54 are wound about each of the cores 46 and the individual coils are electrically connected at 56. The coils are wound so that the magnetic field passes upwardly through one of the cores 46 and downwardly through the other of the cores 46. The outer lateral surfaces of each of the coils 54 is covered by a thin walled insulating material 58, preferably of thin walled Teflon. The upper and lower ends of the coil formations 46 are covered by thin-walled, fiber-like insulators 60, also preferably of Teflon material. In the applicant's construction, the thin-walled insulating material for the coils 54 provides for maximum ampere turns in a minimum space.

The tops or upper ends of the cores 46 and coils 54 have secured thereon a field piece 62 of magnetic material; the insulators 60 are interposed between the upper end of the cores 46 and coils 54 and the lower surface of the field piece 62. The field piece 62 provides for and permits the passage of a magnetic field from one core 46 to the other core 46. The field piece 62 is secured in place by screws 64 which pass through suitable apertures 66 in the field piece and are threaded into threaded bores 68 provided in each of the upper ends of the cores 46. Spring support arms 70 project from the rear lateral edges

of field piece 62 and are provided for securely receiving the ends of the two armature biasing springs 72.

An armature 74 is pivotally or hingedly mounted on the support bracket 26 and is biased away from the coils 54 and cores 46 by a pair of spring members 72 which provide a balanced, uniform pivoting movement for the armature assembly 74. The armature 74, constructed of magnetic material, is aligned with the pads 52 or lower ends of the cores 46 whereby the armature 74 will be pivoted upwardly against the pads 52 when current flows through the coils 54 to magnetically attract the armature 74. Upon de-energization of the coils 54, the springs 72 bias the armature 74 about the pivot point 76 so that the main body of the armature 74 is pivoted away from the pads 52.

A hinge member 78 is secured to the rearward upper side of the support bracket shelf 28. Securement is accomplished by screws 80 which are threaded into the threaded apertures in the shelf 28. The hinge member 78 is provided with a pair of forwardly offset, downturned ears 82 at its opposite ends. Each ear 82 has an aperture 84 therein for receiving a pivot pin 86 which is secured to each of the rear lateral edges of the armature 74. The pivot pins 86 are rotatable within the apertures 84 to provide smooth pivoting movement of the armature 74 in response to the energization and de-energization of the coils 54.

A pair of rearward projections 88 are located on the armature 74 and have apertures for securely receiving the ends of the spring members 72. A tongue 90 on the armature 74 projects through the cut-out portion 32 in the downturned portion 30 of the support bracket 26. An important advantage resulting from the novel use of a hinge member 78 for pivoting the armature is that movement of the armature 74 is in two planes so as to provide for maximum utilization of the magnetic field set up by the coils 54 and to also provide for ease of adjustment of the armature 74 with respect to the cores 46.

A moving blade assembly 92 is insulatingly carried by the pivoted armature 74 and includes a plurality of individual blade contact members 94, preferably of semi-rigid copper construction, and an equal number of current carrying members 96, each being in electrical contact with a moving contact blade 94. The blades 94 and current carrying members 96 are embedded within a molded insulating block 98. Each moving blade 94 is provided with upper and lower contact rivets 100, fastened by welding, which are located at the free or moving end of the moving blade members 94. The current carrying members 96 are of copper but are sufficiently flexible so as to be bent to form an arcuate or bight portion 102. In this manner, ends of the current carrying members 96 are electrically connected, as by welding, to the upper ends of the contact pin members 104 which provide for connection of the relay 10 to exterior electrical circuits. The pins 104 insulatingly and sealably pass through apertures 106 provided in the header 12.

The rivets 100 at the free ends of the moving blades 94 move into electrical contact with the terminal portions 108 of the pin contact members 110 as the blade contacts 94 are pivoted upwardly and move into electrical contact with the terminal portions 112 of the pin contacts 114 as the blade contacts are pivoted downwardly. The pin contacts 110 and 114 are provided with rivet contacts 116 similar in construction to the rivets 100 at the free end of the blade members 94. A lifter 118 of insulating material is interposed between the blade contact members 94 and the armature 74 so as to provide for electrical insulation therebetween. The molded lifter 118 includes an elongated boss 120 at its outer end for causing each of the blade members 94 to be maintained in lateral alignment; in this way, electrical contact is made with the terminals 108 and 112 of the pin contacts 110 and 114 at substantially the same time. The molded insulating block 98 and the insulating lifter 118 are secured to the lower side of the armature member 74 by screws 122 which pass through suitable apertures in each of the molded parts and the screws are threaded into the armature 74 to provide for firm securement.

The moving blade assembly 92 provides for a highly compact and economical structure as the current carrying members 96 are embedded adjacent the moving blades 94 in the insulating mass 98, to thereby uniformly position the blades 94 relative to each other. The boss or lip 120 of the lifter 118 is an important feature since it compensates for any initial misalignment between the blade members 94 within the molded block 98.

A third set of pin contacts 124 are insulatingly carried by the header 12 and are connected to the pair of wire leads 126 of the coils 54. The wires 126 extend from connection with the terminals 128 of the coils and are welded to the upper ends of the pin contacts 124. The wire leads are covered by insulation. An insulating layer or film 130 is interposed between the upper surface of the header 12 and the lower legs of the current carrying members 96 so as to assure electrical insulation between the current carrying portion of the relay 10 and the non-current carrying portions thereof. All pin contacts 104, 110, 114, and 124 are insulatingly carried within the header 12. The insulation is provided by an annular mass of glass material 132 which is interposed between the header walls forming the apertures 106 and each of the pin members themselves. The glass is bounded or fused to the header and each of the pins. This construction assists in minimizing contamination of the internal parts of the relay 10.

Another important feature of my relay 10 is the contact barrier 134 which provides insulation between adjacent contacts of the individual sets of pins 110 and 114 and moving blades 94. The structure permits the spacing therebetween to be minimal while at the same time arc over which commonly occurs in three-phase applications, is avoided. The contact barrier 134 has an upper wall 136 which supports a multiplicity of downwardly extending walls 138 which in turn are joined by a base 140. The base 140 is substantially parallel with the upper wall 136 while the upright walls 138 are also maintained substantially parallel with respect to each other. The base 140 includes inwardly projecting slots 142 which are aligned with the forward pin members 110 and permit the positioning of the barrier 134 in the relay 10 and the interposing of the walls 138 between the adjacent sets of contacts and moving blades. The outer surfaces of the barrier is slidingly received between the inner surfaces of the shelf 28 and legs 36 of the bracket 26 and the header 12. A stop portion 144 extends upwardly from the outer edge of the upper wall 136 and contacts the upstanding flange 34 of the shelf 28 to prevent excessive inward movement thereof. The contact barrier 134 thus permits my relay 10 to be compact in structure and yet be used in three-phase applications.

Although the operation of the relay 10 is believed to be clear from the foregoing detailed description of the invention, a brief description of the operation of the relay will be provided. When the coils 54 are electrically energized, a magnetic field is created and attracts the armature 74 to the bottoms of the cores 46. The rivets 100 on the moving blades then are drawn into electrical contact with each of the rivets 116 of the forward pin contacts 110. Thus, when the relay is in the energized condition current flows from the pin contact members 104, through the current-carrying members 96, through the blade members 94, and then to the forward pin contacts 110. When the coils are de-energized, the springs 72 uniformly pivot the armature 74 downwardly and away from the cores 46 until the rivets 100 of the moving blades 94 contact the rivets 116 of the intermediate pin members 114. Thus, when the relay 10 is in a de-energized condition, the current flow is the same as when it is in an energized condition, except that current flows ultimately to (or from)

the intermediate pin contacts **114** rather than the forward pin contacts **110**.

From the foregoing, it is seen that I have provided an improved relay construction which is highly compact in construction and light in weight. The many novel structural features of the construction contribute to this overall result. For example, a relay, rated at 10 amps, made in accordance with my invention is three to four times lighter in weight and three to four times more compact than any other known relay construction; such a relay made according to my invention weighs only about 2½ ounces. This compactness and lightness is very important in many industries, particularly in the aircraft and electronic industries. The weight savings is particularly important in the aircraft industry since every pound saved in constructing an airplane effects significant monetary savings.

Contributing to the compactness and lightweight structure of my relay **10** is my novel core construction as well as the use of thin-walled insulating material for the coils. The contact barrier also contributes to the important advantages of my invention since the contacts may be located in close proximity without fear of arc over when the relay is used for three phase applications. The dual springs, lifter and novel armature-hinge construction contribute to a further advantage in that the adjustment of and movement of the armature and moving blades may be held to a high degree of accuracy. The novel support bracket in my relay **10** is also important in that it acts as a basic relay structure while acting as a mounting structure for the armature assembly, moving blade assembly, and contact barrier holder. Another significant advantage of my relay **10** is that it is possible to provide welded electrical connections rather than the less satisfactory soldered connections.

While in the foregoing there has been provided a detailed description of a particular embodiment of the present invention, it is to be understood that all equivalents obvious to those having skill in the art are to be included within the scope of the invention as claimed.

What I claim and desire to secure by Letters Patent is:

1. A relay construction comprising a base, a contact member insulatingly carried by said base, a mounting bracket supported by said base and having a shelf spaced from said base, electrical coil means having ends mounted on said shelf, an armature pivotally carried by said bracket and being movable in response to energization and de-energization of said coil means, and a moving blade contact insulatingly carried by said armature and movable in and out of electrical contact with said contact member as said armature is moved by said coil means, said moving blade contact being insulatingly embedded in a molded insulating mass which is secured to said armature, a current carrying member having one end embedded in said molded insulating mass in electrical contact with said moving blade contact, and a pin member insulatingly carried by said base and contiguous with and being directly electrically connected to the other end of said current carrying member.

2. The device of claim **1** wherein a multiplicity of moving blade contacts are insulatingly embedded within said molded mass, a multiplicity of contact members are insulatingly carried by said base, a multiplicity of pin members which are insulatingly carried by said base, and a multiplicity of current carrying members pass between said blade contact and said pin members.

3. The device of claim **2** wherein a lifter member of insulating material is interposed between said contacts and said armature in order to assist in maintaining electrical insulation therebetween, said lifter member including a raised elongated boss for laterally aligning said moving blade contacts in the same plane with each other.

4. The device of claim **2** wherein means are interposed between each cooperating set of said contact members and said blade contacts for providing insulation therebetween so as to substantially eliminate electrical arc over when said relay is used for three phase applications.

5. The device of claim **4** wherein said insulating means comprises an integral structure of insulating material having adjacent channels for isolating each of said sets from each other, said structure being slidably received between said bracket and said base so as to be readily removable from said relay.

6. The device of claim **1** wherein each of said coil means comprises a non-circular cross-section magnetic core secured to said shelf, and an electrical coil wound about said core, thin-wall insulating material enclosing the exterior surfaces of said coil for electrically insulating said coil.

7. A relay construction comprising a header, pin contact members insulatingly passing upwardly through said header, a support bracket mounted upon said header and including a shelf which is substantially parallel with and spaced above said header, first and second magnetic cores fixed to and extending upwardly from said shelf, electrical coils wound about each of said cores, said wound coils being maintained in close proximity, thin-wall electrical insulation for insulating the exterior surfaces of said coils, the magnetic field created by said coil passing upwardly through one of said cores and downwardly through the other of said cores, a field piece mounted at the upper ends of said coils for passing the magnetic field from said first core to said second core, an armature hingedly carried by said bracket and being movable in response to energization and de-energization of said coils, moving blade contact members insulatingly carried by said armature, a molded block member secured to said armature and receiving said moving blade contacts therein, and current carrying members having one of their ends embedded in said block and being in electrical contact with each of said moving blade contact members, the other ends of said current carrying members being directly electrically connected with and being contiguous with a set of said pin contact members.

8. The device of claim **7** wherein a separate hinge member is secured to said bracket and pivot pins are carried by said armature for cooperating with said hinge member for providing pivotal movement of said armature.

9. The relay of claim **7** including an integral insulating structure having means for insulating each set of moving contacts and pin members from another set whereby said relay avoids arcing and is useful in connection with three phase applications.

10. The relay of claim **7** wherein said armature is biased away from the lower ends of said cores by a pair of spring members having their first ends secured to said field piece and their opposite ends secured to said armature, and an insulating lifter member is interposed between said moving blade contacts and said armature and has an elongated boss assist in maintaining said moving blade contacts in the same plane.

11. The improvement of claim **7** wherein a lifter member is interposed between said moving blade contacts and said armature in order to electrically insulate said moving contact blades from said armature and to laterally align said blade contacts with each other.

12. The device of claim **1** including first and second coil means, first and second rectangular cores secured to said support member for receiving said coil means thereabout, said coil means being in close lateral proximity to each other, said rectangular cores providing for maximum iron usage in a minimum space, and thin walled insulation on the outer surfaces of said coil assembly in order to provide for maximum ampere turns in a minimum space.

13. The device of claim **1** wherein said base has apertures therein, said contact member passes through said aperture, and an annular mass of insulating material is interposed between the portion of the base defining the apertures and the contact member to thereby insulatingly carry the contact member with respect to the base and to

minimize contamination of the operating parts of the relay.

14. The device of claim **7** wherein said header has a plurality of spaced apertures therein, said pin contact members pass through said apertures, an annular mass of insulating material is bonded to the portion of said header which defines said apertures and to said pin contact members so as to insulatingly carry said pin contact members and to minimize contamination to relay parts.

15. The device of claim **1** including integral electrical insulating means having adjacent isolated channels and insulating walls separating said channels, said channels surrouding adjacent sets of blade contacts and pin contacts

in order to avoid arcing therebetween when the relay is used in three phase applications.

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