May 13, 1941. J. M. WILSON 2,241,838

RELAY

Filed March 31, 1939

Fig.1

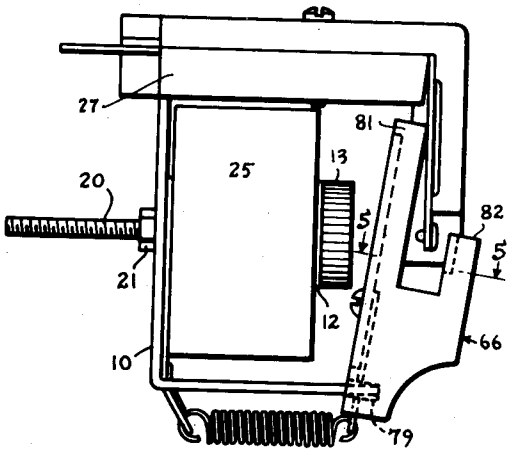


Fig.2

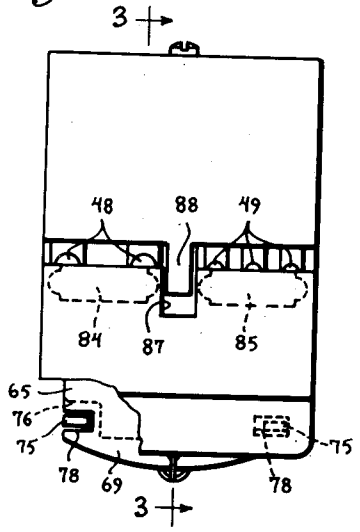


Fig.3

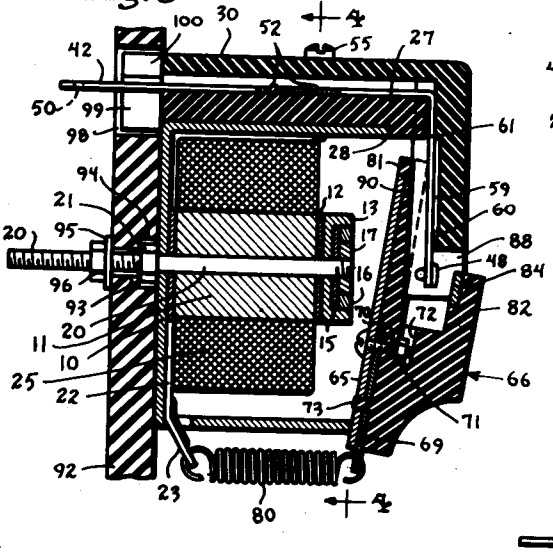


Fig.4

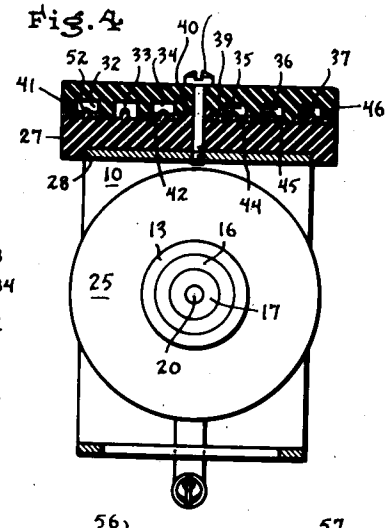




Fig.6

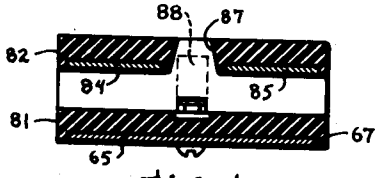


Fig.5

Inventor

John M. Wilson

By

George H. Fisher

Attorney

Patented May 13, 1941 2,241,838

UNITED STATES PATENT OFFICE

2,241,838

RELAY

John M. Wilson, Minneapolis, Minn., assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

Application March 31, 1939, Serial No. 265,187

12 Claims. (Cl. 200—104)

The present invention is concerned with an improved relay and more particularly one of the electromagnetic type.

An object of the present invention is to provide a relay structure in which the contact members are almost completely enclosed with insulating material so as to eliminate any danger of contact of foreign objects therewith and to decrease the accumulation of dust on the contact members.

To the above end, one object of the present invention is to provide a relay wherein the contact arms thereof are held in spaced relation between two members of insulating material.

A further object of the present invention is to provide such a relay in which two members of insulating material are provided with spaced parallel channels in which the contact arms are held.

A further object of the present invention is to make provision for use of contact arms of two different current carrying capacities.

A further object of the present invention is to provide a relay which is extremely quiet in its operation. To this end, one object of the invention is to provide a relay wherein noise at the hinge connection between the armature and the core is substantially eliminated.

A further object of the invention is to provide an electromagnetic relay which is shaded to insure quiet operation with alternating current but which is so designed as to eliminate any danger of the relay remaining in closed position due to residual flux.

Other objects of the present invention will be apparent from a consideration of the accompanying specification, claims and drawing, of which

Figure 1 is a side elevational view of the improved relay;

Figure 2 is a front elevational view of the relay;

Figure 3 is a sectional view of the relay, the section being taken along the line 3—3 of Figure 2 and in the direction indicated by the arrows;

Figure 4 is a sectional view, the section being taken along the line 4—4 of Figure 3 in the direction of the arrows adjacent that line;

Figure 5 is a sectional view taken along the line 5—5 of Figure 1 in the direction indicated by the arrows; and

Figure 6 is a detail view partly in section of one type of contact arm.

The improved relay comprises a U shaped core member best indicated in Figure 3 and designated by the reference numeral 10. This core member is formed of a plate of magnetic material which is stamped into the U shaped form it assumes in the relay. Secured to the core member 10 is a cylindrical core member 11. Located adjacent the core member 11 is a disc 12 of non-magnetic material such as brass. Located against the disc 12 is a cup shaped member 13 of magnetic material. In the bottom of the recess of member 13 is a second disc 15 of non-magnetic material such as brass. Located over this disc 15 is a ring 16 of suitable electrically conducting material such as copper. A disc 17 of magnetic material and having a threaded central opening therein is located within the ring 16. The core members 10 and 11, the disc 12, the cup shaped member 13, and the disc 15 are all provided with a central aperture through which extends a bolt 20. The end of the bolt is threaded into the screw threaded aperture of the magnetic disc 17. A nut 21 threaded onto the other end of the bolt 20 serves to engage the core member 10 and to clamp the entire assembly together and to core member 10. A thin metallic strip 22 of magnetic material is interposed between the core members 10 and 11. This strip 22 is provided with an apertured ear 23 which while relatively rigid can be bent for purposes to be described later.

Surrounding the core member 11 is a coil 25. This coil may take any suitable form.

Located on top of and partially surrounding the upper leg of the core member 10 is a plate 27 of suitable insulating material such as "Bakelite." As best indicated in Figures 3 and 4, the insulating member 27 is provided with a rectangular recess 28 into which the upper leg of core member 10 fits so that only the lower face of this leg of core member 10 is exposed.

Overlying the insulating member 27 is a second insulating member 30 which is similarly formed of "Bakelite" or a corresponding material. Member 30 is generally L shaped with the long leg of the L extending horizontally and overlying insulating member 27 with the short leg extending downwardly at right angles to member 27. The lower surface of the horizontal leg of insulating member 30 is provided with a plurality of grooves best shown in Figure 4. It will be noted from Figure 4 that there are six of these grooves, these grooves being designated by the reference numerals 32, 33, 34, 35, 36, and 37. Grooves 32, 33, and 34 are separated from the grooves 35, 36, and 37 by a grooved projecting wall 39 into which fits a projecting rib 40 of the insulating plate 27. The wall 39 thus performs two func-

tions. In the first place, it acts as an insulating barrier between the contact arms located in grooves 32, 33, and 34 on the one hand and grooves 35, 36, and 37 on the other hand. The wall 39 by reason of the groove into which rib 40 of plate 27 fits also functions to interlock the insulating members 29 and 30 against relative sidewise movement.

The grooves 33 and 36 consist simply of rectangular channels of substantial depth. The grooves 32, 34, 35, and 37 are slightly different, however, in that adjacent the lower edges thereof the side walls of the grooves are further recessed to define channels of wider width but narrower depth. The grooves 32, 34, 35, and 37 thus provide two different sizes of rectangular channels. The purpose of this is to provide for the use of either one of two sizes of contact arms. In certain applications it is desirable to use a relay for both heavy current and low current purposes. Thus in the case of temperature controlling apparatus, certain of the circuits are low voltage and carry very little current, these circuits being the low voltage control circuits. Other circuits such as the motor circuits are usually high voltage and carry considerable current. For the carrying of the heavy currents, relatively large contacts are required, which contacts are unnecessary for low voltage purposes. These high voltage load circuits usually require, moreover, a simple single-pole single-throw switch for the control thereof, whereas the control circuits often require the simultaneous connection of three electrically separate contact members.

The channels 32, 34, 35, and 37, as pointed out above, permit the use of either wide or narrow contact arms while the channels 33 and 36 permit only the the use of narrow contact arms. It is thus possible on one side to provide three narrow contact arms, while it is possible to provide only two wide contact arms. While the relay as a whole can be provided with four wide arms or six narrow arms, the relay has been illustrated as being provided with two wide contact arms on one side and three narrow contact arms on the other. The wide contact arms have been designated by the reference numerals 41 and 42 and the narrow contact arms by the reference numerals 44, 45, and 46. As indicated in Figure 3, these arms are all L-shaped to provide a long horizontally extending arm which is mounted in the channels of insulating member 30 and a shorter vertically extending arm at the end of which is secured a contact member, which in the case of wider arms 41 and 42 is designated by the reference numeral 48. The contacts of the narrow arms 44, 45, and 46 are designated by the reference numeral 49. The horizontal leg of each contact arm is provided with an aperture 50 to function as a terminal for the contact arm. The aperture 50 is designed to receive and have secured thereto a wire of a conductor. In the middle of the horizontal leg of each contact arm there are two apertures into which extend projecting bosses 52. These bosses serve to hold the contact arms in position and cooperate with the grooves 32 to 37 in firmly holding the contact arms. The bosses 52 are particularly useful in assembling the device inasmuch as the contact arms can first be placed in the proper position by being mounted over the bosses 52. Thereafter it is relatively easy to apply the insulating member 30 inasmuch as the rib 40 of plate 27 will first enter the groove of the projecting wall 39. As soon as these two members are thus interfitted, the arms will automatically enter the channels provided by grooves 32 to 37. The insulating members 27 and 30 are held to the core member 10 and are clamped against the contact arms by means of a screw 55 which extends through the two insulating members and is threadedly connected with the upper leg of core member 10.

In view of the greater depth of the narrower channels provided by grooves 32 to 37, it is necessary that the narrower contact arms be provided with some means for insuring that these contact arms will lie in the same plane as the wider contact arms 41 and 42. For this reason, the contact arms of the type of contact arms 44 to 46 are provided with curved struck-up portions 56 and 57, as indicated in Figure 6.

The downwardly extending leg of insulating member 30 is recessed at 59 to provide a rib 60 against which all of the contact arms bear. The purpose of this is to insure that the contacts are all aligned in the same plane. By reason of the resiliency of the contact arms these will all bear firmly against the rib 60 which by reason of its proximity to the contacts 48 and 49 will insure that these contacts are aligned in the same plane. The right-hand edge of insulating plate 27 is bevelled slightly at 61 to permit flexing of the downwardly extending legs of the contact arms.

The structure which has been described so far is the core and contact arm structure. The armature structure will now be described. The armature proper is designated by the reference numeral 65 and comprises a plate of magnetic material. Located adjacent the armature 65 is an insulating member 66 of suitably moulded material such as "Bakelite". As best shown in Figures 3 and 5, the insulating member 66 is so formed as to provide a recess 67 in which the armature 65 lies so that the insulating member 66 covers all but the inner face of armature member 65. Secured between the armature 65 and insulating member 66 is a plate 69 of non-magnetic material such as brass. The insulating member 66, plate 69 and armature 65 are held together by a bolt 70, the nut 71 of which is located in a slot 72 which is of sufficiently narrow width to prevent turning of the nut 71. A boss 73 extends from the insulating member 66 through aligned apertures in plate 69 and armature 65. The boss 73 and the screw 70 serve to hold plate 69 and armature 65 against any movement relative to each other.

The lower leg of core member 10 is provided with projecting tongues 75. The armature 65 is notched at each corner as shown in dotted lines in connection with one corner in Figure 2. The plate 69 is provided with apertures 78 located over the notched portion 76 and in a position adapted to receive the tongues 75. The tongues 75 thus project through the notch 76, the apertures in the plate 78, and into recesses 79 in the insulating member 66. The apertures 78 in plate 69 are smaller than either the notches 76 or the recesses 79 in the insulating member 66 so that the movement of member 66 transversely to the lower leg of core member 10 is restrained by the edges of apertures 78. The plate 69, by reason of the restraining effect of apertures 78, prevents actual contact between the tongues 75 and the armature member 65.

The armature is held in position and is biased to open position by means of a spring 80. One end of this spring is secured in the aperture of

ear 23 and the other end of the spring is secured to the plate 69. As indicated previously, the ear 23 is capable of being bent when sufficient force is applied thereto. In the initial adjustment of the relay, this makes possible an adjustment of the pull-in and drop-out voltage since any bending of the ear 23 alters the tension of spring 80. The ear 23 is of sufficient rigidity, however, to maintain its position against the stresses to which it is subjected during normal operation of the relay.

The upper portion of insulating member 66 is divided into two spaced arms 81 and 82. The arm 82 is the shorter of the two arms and has moulded therein contact members 84 and 85. These contact members are of silver or other similar material adapted to withstand the arcing incidental to the making and breaking of contacts. The shape of these contact members as indicated in dotted lines in Figure 2 is such as to insure their being firmly held in the insulating material within which they are moulded. The contact member 84 is designed to engage contacts 48 and the contact member 85 contacts 49. It is to be understood that either contact 84 or 85 is adapted to engage either two of the wide contacts 84 or three of the narrow contacts 49. Upon engagement of the contact members 84, 85 with their associated contacts 48 or 49, the contacts engaged are electrically connected together so that the circuits controlled thereby are closed.

As indicated in Figures 2 and 5, the shorter arm 82 is provided with a slot 87. As best indicated in Figure 5, this slot is tapered slightly. The slot 87 is designed to cooperate with a rib 88 which projects outwardly and downwardly from the downwardly extending leg of the insulating member 30. The rib 88 is primarily for the purpose of providing an insulating barrier between contact arms 41 and 42 on the one hand and contact arms 44, 45, and 46 on the other hand. The rib 88 incidentally, however, in cooperating with the groove 87 serves to guide the movement of the armature to its energized position. By reason of the tapered nature of groove 87, this guiding action is made more effective. The long arm 81 is provided with a groove 90 into which the inner portion of rib 88 extends when the armature is in its deenergized position as shown in Figure 3. By reason of this groove, it is possible to provide the rib 88 of sufficient width to adequately insure electrical separation of contact arms 41 and 42 from contact arms 44, 45, and 46 and at the same time to permit sufficient movement of the armature.

The relay will ordinarily be mounted upon some supporting panel which has been shown in Figure 3 and designated by the reference numeral 92. This panel is provided with an aperture 93 for the bolt 20 and a counterbore 94 for the nut 21. The relay is held firmly in position by means of a washer 95 and a nut 96. The panel 92 is further provided with an aperture 98 through which extends the terminal portions of the contract arms. The insulating members 27 and 30 are provided with lugs 99 and 100 which when the relay is assembled are disposed laterally adjacent each other. The lugs 99 and 100 are located between the two groups of contact arms and hence serve as a continuation of the wall 39 so as to further insure electrical separation of the two groups of contacts. The lugs 99 and 100, moreover, enter the aperture 98 and serve to key the relay in position to prevent any rotation of the same about the bolt 20.

It is to be understood that upon energization of relay coil 25, a magnetic circuit will be established through the core member 11, lower portion of core member 10, and the armature 65. The structure comprising the two non-magnetic discs 12 and 15, the magnetic cup shaped member 13 and disc 17 and the conductor ring 16 are provided for the purpose of insuring adequate shading action for use of the relay with alternating current and sufficient protection from residual magnetism to permit the relay to be used with direct current. The ring 16 acts as a shading ring so that the flux in travelling between the armature 65 and the core member 11 may take either of two parallel paths, one through the rim of the cup shaped member 13 and the other through the magnetic disc 17. In travelling over the latter path, the flux is subjected to the shading action of ring 16 so as to be out of phase with the flux passing through the rim of the cup shaped member 13. Thus at the point of contact between the core member and the normally spaced portion of the armature, the flux is divided into two components displaced in phase so that at no time do both components of the flux simultaneously assume a zero value.

The discs 12 and 15 are for the purpose of interruptting the flow of flux occurring as a result of residual magnetism. The usual method of accomplishing this result is to either plate the armature with a non-magnetic material or to place a disc of non-magnetic material at some point in the magnetic circuit. The plating of the armature with non-magnetic material has the disadvantage that the pull on the armature is considerably reduced. The insertion of the disc of non-magnetic material in the magnetic circuit prevents flow of flux through either of the main magnetic circuits but does not prevent a flow of flux through a circuit around the shading ring. Thus, referring to applicant's construction if it were not for the disc 15, it would be possible to have a flux path set up from the armature through the rim of the cup shaped member 13 and through magnetic disc 17 back to the armature. The disc 15 prevents such a flow of flux. The disc 15 is not, however, sufficient in itself inasmuch as flux could still flow from the armature through cup shaped member 13 and core members 11 and 10 back to the armature. By the provision of these two disks the possibility of the armature sticking by reason of residual flux is substantially eliminated. At the same time, the flux flow due to the energization of the coil 25 is not unduly retarded. Moreover, even disregarding the feature of the non-magnetic discs 12 and 15, the above described construction provides a simple shaded pole structure.

It will be seen that I have provided a highly compact relay in which the contacts are substantially enclosed and which is adapted for use with either alternating current or direct current. When used with alternating current, the relay is extremely free from vibration and at all times is free from the danger of sticking in closed position due to residual magnetism. The improved relay, moreover, is adaptable for use with either a number of low voltage contacts or a lesser number of high voltage contacts or a combination of the two.

While I have shown a specific form of the invention for purposes of illustration, it is to be understood that the invention is limited only by the scope of the appended claims.

I claim as my invention:

1. In an electromagnetic relay, a core structure having a plurality of legs, a coil surrounding one leg of said core structure, an insulating plate covering another leg of said core structure, a second insulating plate overlying said first plate, said plates collectively providing spaced channels therebetween, L-shaped contact arms each having one leg thereof substantially completely enclosed in one of said channels and the other leg overlying said coil, and an armature structure pivotally secured to said core structure and overlying said coil carrying leg, said armature structure comprising a magnetic armature member, an insulating member secured thereto, and contact means carried by said insulating member and engaging said contact arms.

2. In an electromagnetic relay, a core structure, a coil associated therewith, a resilient contact arm secured to said core structure, and an armature structure pivotally mounted on said core structure, said armature structure comprising a magnetic armature member extending between said contact arm and said coil, an insulating member partially surrounding said armature member and having a portion extending over said contact arm, and a contact member molded in the inner surface of said extending portion and adapted to engage said contact arm.

3. In an electromagnetic relay, a core structure, a coil associated therewith, an L-shaped contact arm having one leg secured to said core structure and the other leg overlying said coil, an L-shaped insulating member positioned adjacent said contact arm and substantially covering the same except for the contact and terminal portions thereof, and an armature structure pivotally mounted on said core structure, said armature structure comprising a magnetic armature member extending between said contact arm and said coil, an insulating member partially surrounding said armature member and having a portion extending over said contact arm, and a contact member molded in the inner surface of said extending portion and adapted to engage said contact arm.

4. In an electromagnetic relay, a core member, a coil surrounding a portion of said core member, an armature having apertures therethrough, said core member having integral tongues extending into said apertures to form a hinge connection with said armature, and a strip of non-magnetic material adjacent said armature, said strip being provided with apertures corresponding in position to but smaller than the apertures in said armature whereby said tongues are held magnetically spaced from said armature.

5. In an electromagnetic relay, a core member, a coil surrounding a portion of said core member, contact members carried by said core member, an armature member having apertures therethrough, said core member having integral tongues extending into said apertures to form a hinge connection with said armature, a strip of non-magnetic material adjacent said armature, said strip being provided with apertures corresponding in position to but smaller than the apertures in said armature whereby said tongues are held magnetically spaced from said armature, and a member of insulating material secured to said armature and said strip, substantially enclosing all but the inner face of the armature, and carrying contact means adapted to engage said contact members.

6. In an electromagnetic relay, a core structure, a coil associated therewith, a first contact member secured to said core structure, a member of insulating material substantially covering said contact member, an armature structure pivotally secured to said core structure, said armature structure comprising an armature member and a member of insulating material extending into close proximity with said first named insulating member and carrying a second contact member adapted to engage said first contact member, said insulating members being provided with a cooperating tongue and groove to guide the movement of the armature to its energized position.

7. In a relay adaptable to carry currents of different magnitudes, a pair of insulating members formed so as to provide therebetween a plurality of channels of substantially rectangular cross-section, adapted to receive rectangular contact arms of a certain current carrying capacity, said channels being provided with relatively narrower and deeper sections adapted to receive contact arms of a different current carrying capacity, means for holding said insulating members together against said contact arms, means carrying a contact member adapted to bridge certain of said contact arms, and means for relatively moving said contact member carrying means and said contact arms.

8. In a relay, two relatively movable portions, one of said portions comprising a pair of members of insulating material, collectively providing therebetween at least two groups of laterally spaced channels of substantially rectangular cross-section adapted to receive rectangular contact arms of a certain current carrying capacity, said channels being provided with relatively narrower and deeper sections adapted to receive contact arms of a different current carrying capacity, interlocking faces on said members between said groups of channels, contact arms of one current carrying capacity being received in the narrow portions of one group of said channels, contact arms of a different current carrying capacity being received in the wide portions of the other group of said channels, means for holding said faces interlocked, thereby confining said arms in said channels, the other of said portions comprising a member of insulating material carrying contact means adapted to engage said contact arms, and means for relatively moving said two portions to effect engagement between said contact means and said contact arms.

9. In an electromagnetic relay, a core structure, a coil associated therewith, an L-shaped contact arm having one leg secured to said core structure and the other leg overlying said coil, an L-shaped insulating member positioned adjacent said contact arm and substantially covering the same except for the contact and terminal portions thereof, and an armature structure pivotally mounted on said core structure, said armature structure comprising a magnetic armature member extending between said contact arm and said coil, and an insulating member partially surrounding said armature member and carrying a contact member adapted to engage said contact arm.

10. In an electromagnetic relay, a core structure, a coil associated therewith, at least two stationary contact members secured in spaced apart relation to said core structure, a member of insulating material covering all of said contact members except their extremities, said insulating member having a rib extending between said

contact members with a portion projecting between said extremities, an armature structure movably secured to said core structure, said armature structure comprising an armature member and a member of insulating material extending into close proximity with said first named insulating member and carrying at least two spaced contact members adapted to engage said stationary contact members, said last mentioned insulating member having a groove between said last mentioned contacts for cooperation with the projecting portion of said rib.

11. In an electromagnetic relay, a core structure, a coil associated therewith, at least two groups of stationary contact members secured in parallel spaced apart relation to said core structure, a member of insulating material covering all of said contact members except their extremities, said insulating member having a rib extending between said groups of contact members with a portion projecting between said extremities, an armature structure movably secured to said core structure, said armature structure comprising an armature member and a member of insulating material extending into close proximity with said first named insulating member and carrying at least two spaced bridging contact members adapted to bridge the contact members of each group, said last mentioned insulating member having a groove between said bridging contacts for cooperation with the projecting portion of said rib.

12. In an electromagnetic relay, a core structure, a coil associated therewith, at least two stationary contact members secured in spaced apart relation to said core structure, a member of insulating material extending between said contact members and having a portion projecting beyond their extremities, an armature structure movably secured to said core structure, said armature structure comprising an armature member and a member of insulating material carrying at least two spaced contact members adapted to engage said stationary contact members, said projecting portion extending between said armature contact members into close proximity with said last mentioned insulating member when said contacts are engaged.

JOHN M. WILSON.