

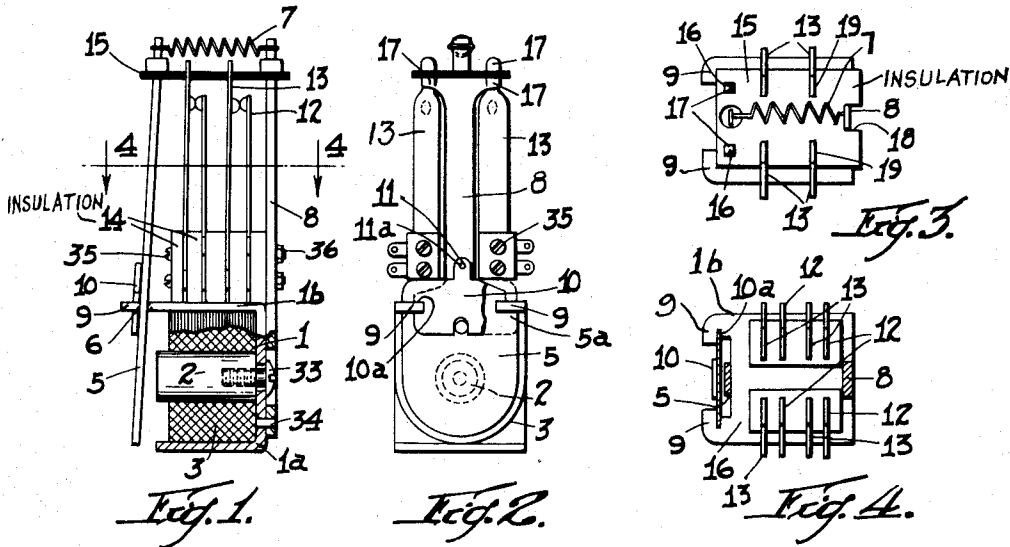
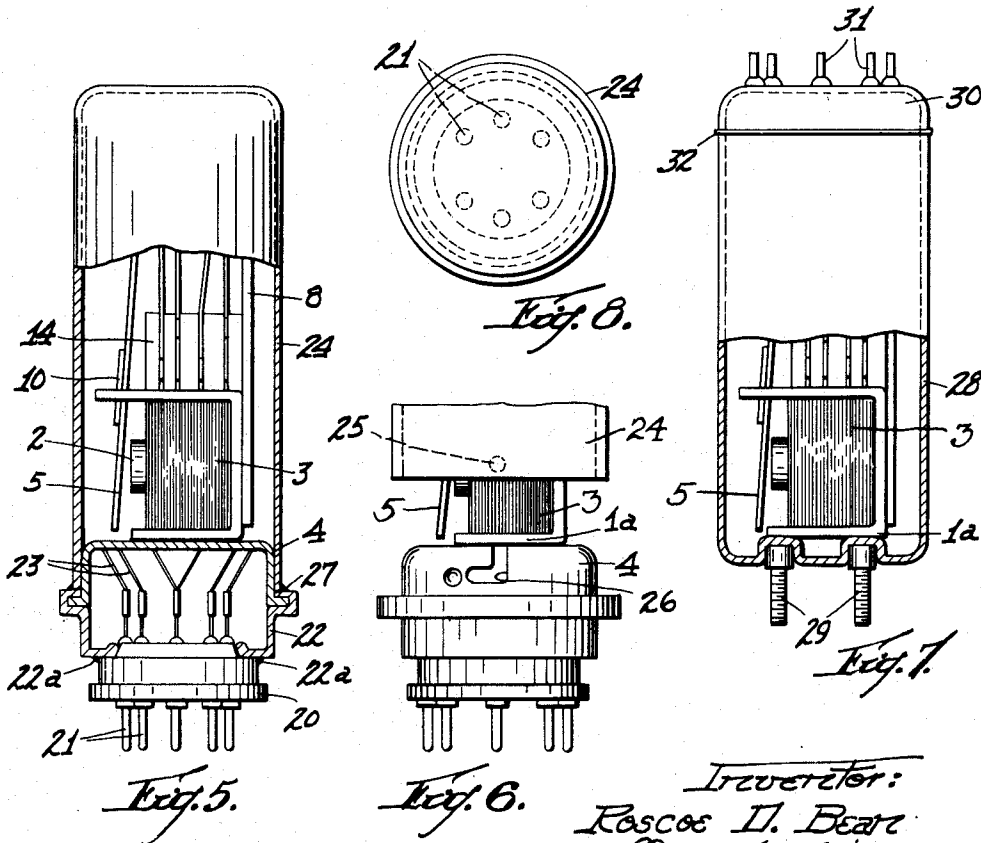
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ELECTROMAGNETIC RELAY CONSTRUCTION

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ELECTROMAGNETIC RELAY
CONSTRUCTION

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The present invention relates generally to electromagnetic relays and has for its object to provide an improved relay construction that will be simple and compact for ease of manufacture and assembly, as well as being reliable in operation.

Another object of the invention is to provide a relay construction which will occupy a minimum area when mounted, with the mounting area approximating the space required for an average radio tube. As a result, the relay of the present invention is particularly adapted for plug-in connection on a suitable panel or mounting, and as will later appear, the compact arrangement of parts makes it possible to provide the relay with a tubular cover of small diameter which may be hermetically sealed to prevent the entrance of dust or dirt.

The above and other advantageous features of the invention will hereinafter more fully appear from the following description considered in connection with the accompanying drawings in which:

Fig. 1 is a view in side elevation of a relay unit assembly embodying the present invention.

Fig. 2 is a view in front elevation of the parts shown in Fig. 1.

Fig. 3 is a top plan view of the relay shown in Fig. 1.

Fig. 4 is a horizontal sectional view along the line 4—4 of Fig. 1 looking in the direction of the arrows.

Fig. 5 shows the relay unit of Fig. 1 mounted for plug-in connection, and provided with a cover.

Fig. 6 is a detail showing the mounting of a cover on the base of Fig. 5.

Fig. 7 shows the relay unit of Fig. 1 adapted for a different form of mounting.

Fig. 8 is a top plan view of the relay shown in Fig. 5.

Referring to the drawings, the relay consists of a frame 1 of magnetic material, which frame is of U-shaped form and provides a central core 2 also of magnetic material which is surrounded by an energizing winding 3. One leg 1a of the frame 1 provides a member for mounting the relay on a suitable base 4, later described in detail with reference to Fig. 5, by means of which the relay may be readily connected to the circuit that is to be controlled through a plug-in connection.

The other leg 1b of the frame 1 serves to support a substantially spade-shaped armature 5 by means of a pivot 6, it being noted that the armature 5 extends upwardly above the pivot 6 for a distance considerably greater than the

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length of the armature between the pivot 6 and the leg 1a of the frame. The armature 5 is normally held away from the core 2 by means of a spring 7 connected between the free end of the armature 5 and an upward extension 8 of the frame 1, at right angles to the legs 1a and 1b. It is to be noted from Fig. 2 that the lower end of the armature 5 is generally circular in form concentric with the core 2 and winding 3, while the remainder of the armature which extends above the pivot 6 is of a reduced width so that the armature is substantially in balance about its pivot 6, insofar as the distribution of its weight is concerned.

As best shown in Fig. 4, the leg 1b of the frame provides a pair of lugs 9, between which the armature 5 extends, with the armature providing shoulders 5a which bear against the lugs 9. In order to hold the armature in position between the lugs 9, a thin locking plate 10 is mounted on the outside of the armature 5 as shown in Fig. 2, in which a portion of the plate 10 is broken away to show the armature beneath it. The locking plate 10 provides shoulders 10a that are disposed on opposite sides of the lugs 9 with respect to the shoulders 5a on the armature, so that when the plate 10 is mounted in position, the armature 5 is adapted to turn about the pivot 6 which is provided by the leg 1b of the frame in a manner which will next be described.

In order to mount the armature 5 on the pivot 6, the armature is first inserted between the lugs 9 to bring its shoulders 5a into engagement with the lugs. It is to be noted in Fig. 4 that the thickness of the armature 5 is somewhat less than the space between the armature 5 and the overhanging ends of the lugs 9. This space is just enough to snugly receive the locking plate 10 when the latter is inserted over the armature to bring the shoulders 10a of the plate into engagement with lugs. As the plate 10 reaches this position, a pin 11 fixed on the armature 5 snaps into an opening 11a provided in the plate 10. As a result, the plate 10 is locked in position with the edges of the shoulders 10a bearing on the lugs 9.

When the winding 3 is deenergized and the armature extends in a substantially vertical position as shown in Figs. 1 and 2, the shoulders 10a of the plate 10 serve as knife-edge bearings for supporting the armature. However, when the winding 3 is energized, the pull of the core on the lower end of the armature tends to slightly lift the armature as it closes the air gap, so that the armature then tends to turn about the straight

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edge of the frame leg 1b between the lugs 9. Therefore, the armature is normally supported on knife-edge bearings when it is open so that the armature is extremely sensitive to a pull exerted by a core 2 when the winding 3 is energized. However, as soon as the armature starts to pull in, it turns about the end of the leg 1b, so that the pivot becomes part of the magnetic circuit as the armature completes its movement. Therefore, the armature 5 is adapted for turning about a straight edge at all times, so that there is no pivot pin to wear loose as in conventional relay construction.

The extension 8 of the frame also serves to support a contact assembly which consists of a number of pairs of relatively movable contacts 12 and 13 mounted on insulating blocks 14. It is to be noted that the contacts 12 and 13 extend substantially parallel to and on opposite sides of the armature 5, which arrangement permits the use of a maximum number of contact pairs without increasing the size of the relay, as determined by the length of the winding 3.

In order to operate the contacts 12 and 13, in response to pivotal movement of the armature 5, an actuating member 15 composed of insulating material extends from the free end of the armature 5 at right angles to the contacts 12 and 13. As best shown in Fig. 3, one end of the member 15 provides slots 16 in which are received ears 17 formed at the end of the armature 5. The opposite end of the member 15 provides a slot 18 for receiving the frame extension 8, with the slot 18 being located between the slots 16 so that the member 15 is held against turning movement with respect to the armature, when the member 15 moves with the armature at right angles to the contacts 12 and 13.

One contact 13 of each pair is made of thin flexible material and the end of each contact 13 extends beyond the associated contact 12 into a slot 19 provided by the actuating member 15. Therefore, movement of the member 15 by the armature 5 causes all of the contacts 13 to move in unison with respect to the stationary contacts 12. It is apparent from a consideration of Fig. 3 that the contacts 13 will be moved uniformly due to the fact that the actuating member 15 is guided by the frame extension 8 in cooperation with the slot 18. With the arrangement shown, it is therefore possible to actuate four different pairs of contacts, with complete uniformity as regards the degree of relative movement between each contact pair.

Furthermore, with the spring 7 extending between the ends of the movable contacts 13 where they enter the slots 19, an extremely uniform closing pressure is maintained between the contacts. It will be apparent from a consideration of Figs. 3 and 4, that all moving parts of the relay are free from any strains tending to throw the parts out of balance when the armature 5 is turned against the pull of the spring 7 in response to energization of the winding 3. This maintenance of a balanced condition is due to a number of factors, including the pivotal support of the armature on a straight edge and the symmetrical relation of the contacts with reference to a straight line between the central axis of the spring 7 and the magnetic axis of the core 2 and winding 3, as is clearly evident from Fig. 2.

As previously pointed out, the relay of the present invention is particularly adapted for plug-in connection and for this purpose the leg 1a of the frame 1 is secured to a base 4 which is shown

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in Fig. 5 as being of cup-shaped form. For the purpose of establishing connections between the winding 3 and the contacts 12 and 13 and outside circuits to be controlled by the relay, the base 4 for the frame 1 is mounted on a terminal block 20 of insulating material which provides a number of metal prongs 21 that are adapted to be received in a suitable receptacle when the relay is used for a plug-in connection. The terminal block 20 is attached to the base 4 by means of a second cup-shaped member 22, connected to the block 20 around its outside edge by a seal 22a and adapted to receive the open end of the base 4. The terminal prongs 21 are connected to conductors 23 leading from the contacts 12 and 13 within the space between the base 4 and the member 22, so that the entire assembly of relay parts carried by the frame 1 is mounted, as a unit, on the terminal block 20, the prongs 21 of which provide for plug-in connection of the entire relay.

In order to protect the contacts of the relay from dust and dirt, a cylindrical cover 24 is mounted on the base 4. This cover is adapted to be locked in position on the base 4 by means of a projection 25 formed on the inside surface of the cover, which projection 25 is adapted to be received in a slot 26 formed in the base 4. The slot 26 has portions at right angles to each other, so that entry of the projection 25 into the slot 26, followed by turning of the cover 24, causes the cover to be locked in position on the base 4 against endwise removal, as will be evident from a consideration of Fig. 6.

Should it be desired to hermetically seal the contacts within the cover 24, so as to render the inner contact chamber entirely air tight, the cover 24 is first locked in position on the base and then a ring of solder is run around the inner edge of the cover 4 adjacent to the junction of the base 4 with the member 22. This ring of solder is indicated at 27 and obviously the seal can be very readily made after the parts have been assembled.

While the relay has been described as being adapted for plug-in connection, the assembly of parts carried by the frame 1 can also be mounted without a base, with provision for leading in wires to the winding and contacts through the top of the relay. Such a mounting is shown in Fig. 7, wherein the leg 1a of the frame 1 is mounted directly on the bottom of a cylindrical cover 28. In order to secure the relay to a suitable supporting member, the cover provides a pair of studs 29. The cover 28 is open at its upper end and is adapted to be closed by a cap 30 that carries a number of terminals 31 for establishing connections from outside circuits to the winding 3 and the several pairs of contacts 12 and 13. The relay assembly of Fig. 7 can also be hermetically sealed by a ring of solder 32 applied around the junction between the cover 28 and its cap 30.

From the foregoing, it is apparent that by the present invention there is provided an improved electromagnetic relay construction in which the working parts of the relay, as mounted on the frame 1, can be readily assembled to constitute a complete unit which will occupy a minimum area when mounted for plug-in connection, or otherwise, as described above. This same relay unit, by reason of its compact arrangement of parts is readily provided with a tubular cover to exclude dust and dirt, which cover may be hermetically sealed, after mounting, by an easily performed operation.

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The arrangement of parts in the relay unit is such that it will occupy a mounting area approximating the space required for an average radio tube, thereby adapting the relay for many uses in connection with electronic control apparatus in which the base or panel is of limited area, so that mounting space in the plane of the base or panel is extremely limited. This economy of mounting space is obtained by arranging the magnetic axis of the winding at right angles to the length of the contacts. As a result, the winding can be of maximum size, for a given base area required for mounting the relay, while the contacts are of sufficient length to insure the desired flexibility, without increasing this base area.

It is to be noted that the armature 5 extends beyond its pivot 6 in a direction parallel to the contacts 12 and 13 for a distance considerably greater than the extension of the armature beyond its pivot in the opposite direction where it faces the magnetic core. As a result, there is a considerable multiplication of the movement of the armature 5 through the air gap normally separating it from the core 2, this multiplied movement being transmitted by the actuating member 15 to obtain the desired separation between the several pairs of contacts 12 and 13.

As previously pointed out, the armature is in balance as regards the distribution of its mass with reference to the pivot 6, and an extremely uniform operation of the contacts is obtained by reason of the symmetrical arrangement of the parts engaging the contact actuating member, as shown in Fig. 3. It is apparent that with the pull of the core 2 and the pull of the spring 7 applied at opposite ends of the armature, the disposition of the contacts on opposite sides of the longitudinal axis of the armature will result in uniform movement of the contacts 13, with respect to the fixed contacts 12.

The relay unit shown in Fig. 1 is of extremely simple construction that lends itself to ease of manufacture and assembly. In putting together the relay unit, the winding 3 is first mounted on the core 2 between the lugs 1a and 1b of the frame, with the core being held in position by single screw 33 that is accessible through a hole in the frame extension 8, as indicated in section in Fig. 1. The frame extension 8 is secured to the frame 1 by rivets 34 and the contact assemblies are secured to the extension 8 on opposite sides of the armature by screws 35 that are readily accessible from the front of the relay as shown in Fig. 2. These screws 35 extend through the several pairs of contacts 12 and 13 and associated insulating blocks 14 and various arrangements of contacts that may be desired are carried in stock already assembled on the screws 35, so that the contact assembly can be quickly completed by passing the screws of selected assemblies through the frame extension 8 and securing contact assemblies in position by nuts 36.

The assembly of the armature 5 on the frame to obtain pivotal support of the armature, without the use of a pivot pin, has been previously described, so that the mounting of the armature is completed as the plate 10 is snapped into position. When this has been done, the assembly of the entire relay unit is quickly completed by positioning the actuating member 15 so as to receive the ears 17 and the contacts 13 in the slots 16 and 19, respectively. The spring 7 is then connected at its ends to the armature 5 and to the extension 8, to maintain the parts in the position of Fig. 1, with the contacts closed in readi-

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ness for operation in response to energization of the winding 3. While the contacts 12 and 13 are shown as being closed with the armature 5 open, obviously the contacts can be arranged to be held open by the spring 7, in readiness for closure in response to energization of the winding 3.

With the construction described above, it is apparent that the member 15 for operating the contacts 12 and 13 is pivotally connected to the armature 5 by the ears 17, while the opposite end of the member 15 is guided by the fixed frame extension 8, in cooperation with the slot 18 at the end of the member 8. Therefore, when the armature 5 is turned about its pivot, the member 15 is free to adjust itself to different positions of the armature, as it is guided by the slot 18, and since the ends of the contacts 13 are freely received in the slots 19 of the actuating member 15, there will be no binding between the contacts 13 and the member 15, as the latter turns slightly about its pivotal connection with the upper end of the armature 5.

The fact that the spring 7 extends between the end of the armature 5 and the frame extension 8 results in the pull of the spring being exerted along a straight line that is symmetrically disposed between the ends of the contacts 13, as shown, Fig. 3. Therefore, the movable contacts 13 will be held in engagement with the stationary contacts 12 with an extremely uniform closing pressure that is a direct measure of the tension of the spring 7. Furthermore, turning movement of the armature 5 in response to energization of the winding 3 will result in an extremely uniform separation of the contacts to open the electrical circuits under control of the relay, due to the fact that the actuating member 15 always moves in a straight line, as determined by the guiding action of the slot 18. With the arrangement shown, there is substantially no lost motion between the actuating member 15 and the movable contacts 13, since the ends of the contacts 13 move as a unit with the ears 17 at the end of the armature. This absence of lost motion permits the armature 5 to operate with a very small air gap between its lower end and the core 2, thereby increasing the degree of sensitivity of the relay.

I claim:

1. An electromagnetic relay comprising, in combination, an elongated and substantially flat frame member, a pair of parallel inner and outer magnetic legs disposed at right angles upon and spaced transversely of said frame member at a first end portion thereof, a magnetic core element projecting between and in parallel relation with said legs, an operating coil surrounding said coil directly between said legs, an insulated contact-supporting block mounted upon said frame member between a second end portion of said frame member and said legs, a plurality of relatively movable contacts extending from said block and lengthwise of and toward the second end of said frame member, an elongated magnetic armature disposed substantially in parallel relation with said frame member and being pivotally mounted intermediate its ends upon the free end portion of said inner leg so that one end portion of the armature faces said core while its other end faces the free end portions of said contacts, a tension spring connecting the second end of said frame with the corresponding end of said armature, and an insulated actuating member connected with said armature for actuating said contacts in response to movements of said armature.

2. An electromagnetic relay comprising, in combination, an elongated and substantially flat non-magnetic frame member, a U-shaped magnetic element carried upon a first end portion of said frame so that the two leg portions thereof are spaced apart transversely of said frame, a magnetic core element carried by said magnetic element and disposed at right angles to said frame and between said legs, an operating coil surrounding said core directly between said legs, an insulated contact-supporting block mounted upon said frame member between a second end portion of said frame member and said legs, a plurality of relatively movable contacts extending from said block in a direction lengthwise of said frame and toward the second end of said frame, an elongated magnetic armature disposed substantially in parallel relation with said frame member and being pivotally mounted intermediate its ends upon the free end portion of the inner leg so that one end portion of the armature faces said core while its other end faces the free end portions of said contacts, a tension spring connecting the second end of said frame with the corresponding end of said armature, and an insulated actuating member connected with said armature for actuating said contacts in response to movements of said armature.

3. An electromagnetic relay comprising, in combination, a substantially cylindrical terminal block having plug-in terminal prongs projecting from one flat face thereof, a substantially U-shaped magnetic element having one leg portion thereof secured directly upon the other flat face of said terminal block so that the two leg portions of said magnetic element are spaced from each other axially of said terminal block, a magnetic core element carried by said magnetic element and disposed at right angles to the axis of said terminal block and between said legs, an operating coil surrounding said core directly between said legs, an elongated and substantially flat frame member having one end portion thereof secured to the body portion of said magnetic element so as to extend in parallel relation with the axis of said terminal block, an insulated contact-supporting block mounted upon said frame member between a second end portion of said frame member and said magnetic element, a plurality of relatively movable contacts having free end portions extending from said block in a direction lengthwise of said frame and toward the second end of said frame, an elongated magnetic armature disposed substantially in parallel relation with said frame member and being pivotally mounted intermediate its ends upon the free end portion of that leg which is spaced from said terminal block so that one end portion of the armature faces said core while its other end faces the

free end portions of said contacts, a tension spring connecting the second end of said frame with the corresponding end of said armature, an insulated actuating member connected with said armature for actuating said contacts in response to movements of said armature, and electrical conductor means for operatively connecting said coil and said contacts to said terminal prongs.

4. In an electromagnetic relay device having an elongated frame member, an operating coil mounted upon a first end portion of said frame and having its axis arranged transversely of said frame, and a plurality of relatively movable contact members insulatively mounted upon an intermediate portion of said frame and having free ends extending in parallelism with and toward a second end portion of said frame; the combination therewith of a magnetic plate extending at right angles to and transversely across said frame between said coil and said contacts, said plate being provided adjacent its outer edge portions with a slot, a substantially spade-shaped magnetic armature having its handle or narrow portion pivotally mounted within said plate slot so that the blade or wide portion thereof faces said coil while its handle portion faces the free ends of said contacts, said blade portion of said armature being wider than the slot is long so as to prevent lengthwise movement of said armature within said slot in one direction, a shouldered locking plate having a thickness substantially less than that of said armature and being carried upon the outer face of said armature with the shouldered portion thereof engaging that side of said plate remote from said armature blade so as to function as a knife-edge fulcrum for said armature, during movement thereof in one direction, a tension spring connecting the second end of said frame with the corresponding end of said armature, and an actuating member connected with said armature for actuating said contacts in response to movements of said armature.

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