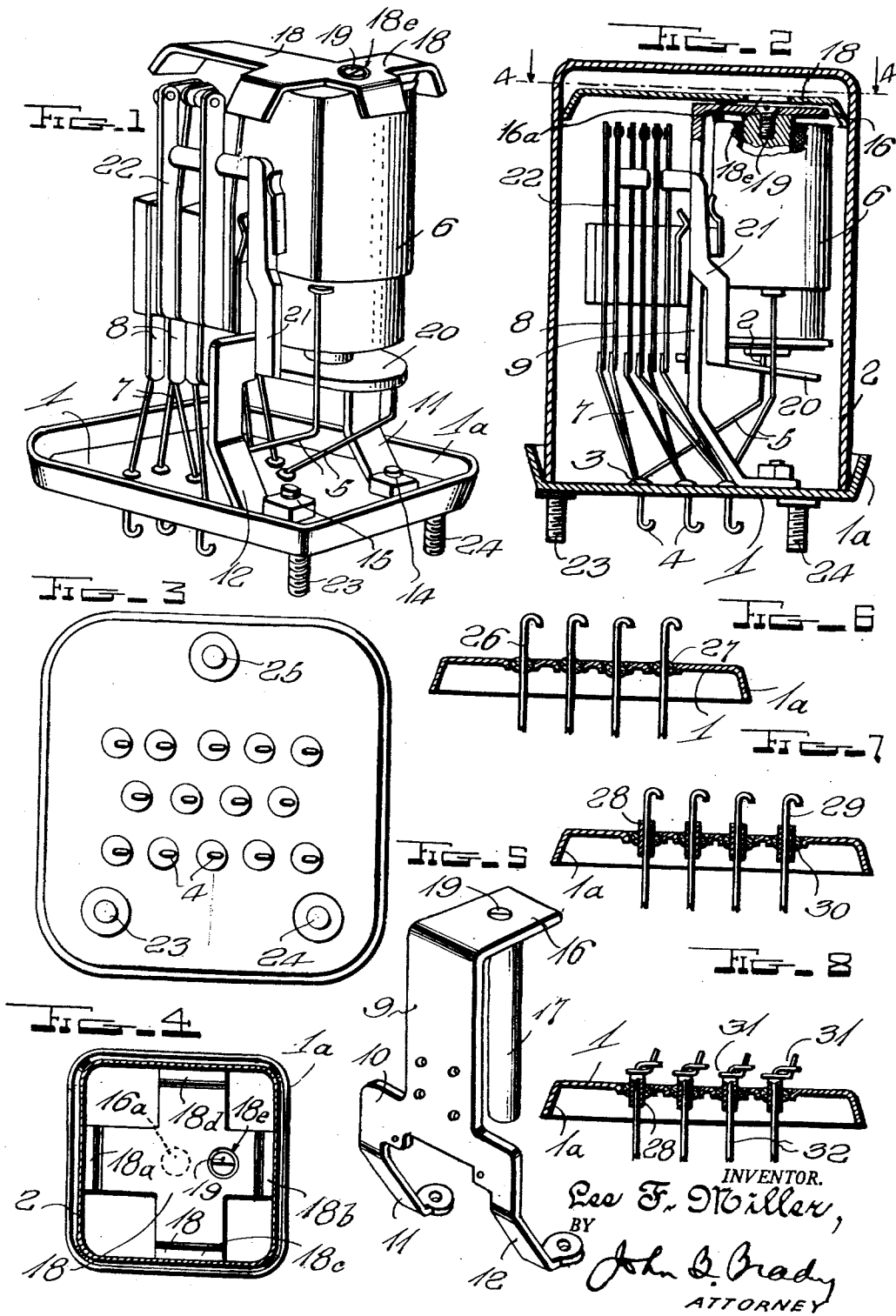


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ELECTROMAGNETIC RELAY

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ELECTROMAGNETIC RELAY

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My invention relates broadly to electromagnetic relays, and more particularly to an improved construction of electromagnetic relay having high electrical efficiency and reliability of operation.

One of the objects of my invention is to provide a construction of encased electrical relay having means for rapidly dissipating the thermal heat developed during extended operation of the relay.

Still another object of my invention is to provide a construction of electromagnetic relay having a metallic casing for housing the relay with coating mechanical centering means for the housing extending from the relay and establishing wiping connection with the interior wall of the metallic casing surrounding the relay for thermally conducting the heat generated in the relay into the metallic casing for rapidly dissipating the heat.

Another object of my invention is to provide a construction of electromagnetic relay in which the magnetic frame of the relay forms a vertically extending bracket from which the electromagnetic operating mechanism is suspended for compactly mounting the components of the relay mechanism.

Still another object of my invention is to provide a construction of multi-pole hermetically sealed electric relay capable of meeting very rigid specifications and very precise tolerances in mass production such as relay operation in 100° C. ambient temperatures, 10 G vibration tests, 25 G shock tests and -65° C. cold temperatures.

Other and further objects of my invention reside in the arrangement of connecting leads to the relay winding and contacts for conducting heat from the interior of the hermetically sealed relay for external dissipations as set forth more fully in the following specification by reference to the accompanying drawings in which:

Figure 1 is a perspective view illustrating the electromagnetic relay of my invention; Fig. 2 is a vertical sectional view through the relay illustrating the thermally conductive paths which I provide between the relay mechanism and the casing for the relay for dissipating heat from the relay and also centering the casing around the relay; Fig. 3 is a bottom plan of the hermetically sealed case of the relay; Fig. 4 is a horizontal sectional view taken substantially on line 4—4 of Fig. 2; Fig. 5 is a perspective view of the magnetic frame of the relay showing the coextensive supporting feet coextensive for mounting the relay

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operating winding on a vertical axis; Fig. 6 is a vertical sectional view taken through one construction of lead in connector system for the relay of my invention; Fig. 7 shows a modified form of mounting for the connector system; and Fig. 8 shows a still further modified form of connector system embodying my invention.

My invention is directed to an improved electromagnetic relay construction which is substantially hermetically sealed within a can but wherein the operating parts of the relay are thermally connected with the encasing housing for rapidly conducting away heat which may be generated in the relay. At the same time the thermally conducting means which forms a heat dissipating path for rapidly conducting away heat from the relay, serves as a centering means for mounting the enclosing casing over the relay operating mechanism and protecting the relay spring contacts against injury as the enclosing casing is moved over the relay mechanism. The frame structure of the relay of my invention is formed with a pair of supporting feet for mounting the electromagnetic operating mechanism in a position depending downwardly with respect to the casing in a position extending longitudinally of the enclosing casing and in a position which enables leads from the relay winding and contacts of the relay to effect rapid heat transfer from the interior of the casing for dissipation externally of the casing.

Referring to the drawings in detail, reference character 1 designates a metallic end plate or mounting member having an upstanding peripheral skirt 1a adapted to receive the end of the metallic rectangular casing for the relay represented at 2 in Figs. 1 and 4. The end plate or mounting member 1 provides supporting means for the insulation means 3 forming supports for terminal connectors 4 which are connected through leads 5 with the operating winding 6 of the relay and through leads 7 with the leaf springs which I have illustrated generally at 8. The frame of the relay is constructed in a very special manner as illustrated more clearly in Fig. 5. The frame comprises a longitudinally extending magnetic strip 9 which is broadened in width at 10 and provided with a pair of angularly disposed feet 11 and 12 which are secured by suitable connecting means 14 and 15 with the end plate 1 of the relay. The upper end of magnetic strip 9 extends substantially normal to the frame as represented at 16 and supports the depending magnetic core 17 through screw 19. The electromagnetic winding 6 surrounds the mag-

netic core 17. The metallic heat conducting spacer shown at 18 is spot welded to the end of frame 16 as shown at 16a. The metallic heat conducting spacer 18 is apertured at 18e so that after being spot welded at 16a to frame 16 the magnetic core 17 may be fastened to the frame 16 by use of a screw driver passed through the aperture 18e for turning screw 19 to a firm position connecting magnetic core 17 with frame 16. Metallic spacer or plate 18 has arms extending in diametrically opposed directions and provided with wiping surfaces 18a, 18b, 18c and 18d at their extremities and establish wiping thermal contact with the interior walls of the metallic casing 2 and at the same time forming centering means for the casing with respect to end plate or mounting member 1 and constituting a hood under which the spring pile-up contact assemblies are protected against injury as the casing is moved into position. Thus, a thermal conductive path is provided between the relay construction and the metallic casing 2 so that heat generated in the relay is rapidly conducted away by conductive transfer and dissipated through the walls of the metallic casing 2 and obstructions which may be in the path of the spring pile-up contact assemblies are prevented from abutting against the contact assemblies as the casing is moved into position.

The relay is provided with armature 20 coacting with magnetic core 17. Armature 20 is provided with longitudinally extending arms one of which can be seen at 21 and which serve to operate the spring pile up contact assemblies shown generally at 22 in Figs. 1 and 2. It will be understood that any number of such spring pile up contact assemblies may be employed and operated by movement of the armature 20. The circuit connections from the several spring pile up contact assemblies as well as the circuit connection from the actuating winding 6 of the relay extend to the terminals 4 projecting through the base structure of the relay.

Figs. 1 and 2 illustrate the complete relay assembly in a perspective and a sectional view to show the general construction. The magnetic structure 9, Fig. 5 has been devised to provide two substantial mounting legs 11 and 12 which are extensions of the relay frame itself and shaped by properly forming and bending a metal stamping of suitable shape. The relay frame 9 and mounting arrangement is designed to fasten directly to the mounting member 1 by welding, by soldering, or by studs shown at 14 and 15 which are welded to the mounting member 1. These studs are threaded for machine nuts, or can be riveted over the mounting feet. This design eliminates the necessity for providing a separate metal bracket on which the relay might be fastened and supported and provides a solid metallic thermally conductive path directly from the magnetic coil core 17, Fig. 5, to the relay can cover 1, as shown in Figs. 1 and 2. When the complete relay assembly, Figs. 1 and 2, is mounted to a metal chassis by means of the threaded studs which are welded to the cover 1 there is thus provided a direct thermally conductive path from the magnetic coil core 17, through the structure 9 to the cover 1 to the chassis on which the relay is bolted by means of the threaded studs 23, 24 and 25 welded to the cover 9.

This highly efficient means of conducting the heat from the relay coil 6 to the outside mounting surface of the sealed assembly makes it possible to build a relay whose coil temperature

does not exceed 115° C. when the relay is operated in an ambient temperature around the relay of 100° C.

The metallic spacer 18 is fastened to the upper end of the relay frame 16 and shaped so that it contacts the four inside walls of the can 2 and centers or locates the upper end of the relay within the can 2. This spacer, in conjunction with the hereinbefore described mounting arrangement, provides a very strong mounting and support for the relatively heavy relay assembly within the can and allows the relay to withstand rigid shock and vibration tests without damage. The arm of the metallic spacer 18 that carries wiping surface 18a extends over the spring pile-up contact assemblies 22 and serves as a protector against any obstructions which might tend to bend the contact assemblies as the casing 2 is moved into position.

Another novel feature of my construction is the header or cover assembly which may have the forms shown in Figs. 6, 7 and 8 and which carries the hermetic seal bushings, and the methods for providing the electrical connection from the relay leaf springs 8, inside the can, to the terminations outside the can. Note that in Fig. 3, the locations of the hermetic bushings are such that very short and direct connections are possible from a given relay leaf spring 8 through a leadout bushing.

With this construction the leads are self-supporting and need not be provided with insulation to space them apart electrically.

Fig. 6 shows a solid wire 26 sealed into the hermetic insulated bushings 27 and of such a length and size that it can be formed into a loop or solder terminal on the outside and fastened directly to the proper relay leaf springs 8 on the inside. This arrangement provides direct electrical connection from the relay contact arm to the solder loop with one solder joint at the leaf spring.

Fig. 7 illustrates a header design using hollow tubes 28 sealed into the hermetic bushings. With this arrangement a solid copper wire 29 can be soldered to the relay leaf springs 8, passed through the hollow tubes 28 in the hermetic bushing 30, and be formed into a solder loop on the outside. The seal is completed by flowing solder around the copper wire where it enters or leaves the tube. This construction allows a solid copper wire to be connected directly to the relay leaf spring 8, pass out through the hermetic bushing 30, and serve on the outside as the solder hook or lug. This allows a very low resistance connection to be made to the relay leaf springs 8.

Fig. 8 illustrates a header construction using hollow tubes 28 sealed into the hermetic bushings 30 with a solder lug 31 attached to the outside end of the tube 28 by spinning over end of tube 28, or by a press fit with the tube. With this arrangement a solid copper wire can be soldered to the relay leaf springs 8 and passed out through the tubes 28, this wire is wrapped over the lug 31, and then solder is flowed down into the tube, and around the copper wire 32, so as to seal off the tubes and make connections to the lugs 31.

This construction has the advantage of providing the lug 31 for external leads from the relay, and by providing the lug 31 for external connection, there is little danger of melting open the solder seal around the tube, when making connection to the relay in service.

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The arrangements shown in Figs. 7 and 8 provide very low resistance connection to be made. This is explained by the fact that the special metals generally available, which can be successfully fused with the special glass mixtures or other inorganic mixtures have a very low electrical conductivity. Actually they have three times the resistance of copper.

By using thin wall tubes 28 of this high resistance metal, to fuse with the hermetic bushings, and running copper wire through the tube, the result is a very low resistance connection.

The substantially linear conductors leading to the terminals from the lugs of the relay leaf springs serve as short heat conducting paths for leading off heat generated within the relay for dissipation beyond the exterior of the casing. These leads are not to be confused with the conventional flexible conductors normally used but are actually thermal conductors which transfer the heat from the interior to the exterior of the casing.

I have found the structure of electromagnetic relay as described herein highly practical and efficient in its operation, and while I have described my invention in certain of its preferred embodiments, I desire that it be understood that no limitations upon my invention are intended other than may be imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. Heat dissipative means for encased electromagnetic devices comprising in combination, a mounting member, a bracket member carried by said mounting member and terminating in a frame portion displaced from the central axis of said mounting member, attachment means extending through said frame portion, a magnetic core with an electromagnetic winding subject to incidental generation of heat during the operation thereof associated therewith and extending toward said mounting member and engaged by said attachment means and detachably supported with respect to said frame portion, a spring pile-up contact assembly mounted on said bracket member, a metallic heat conducting spacer comprising a metal plate fastened to said frame portion and extending in a transverse plane in spaced relation to and substantially parallel with said mounting member, said heat conducting spacer having radially disposed arms terminating in wiping surfaces substantially aligned with the margins of said mounting member, one of said arms extending over said spring pile-up contact assembly and forming a protective means therefor, and a metallic cover member closed at one end and open at the other end and slidable over the wiping surfaces of said radially disposed arms to a position in which said open end engages the margins of said mounting member while the wiping surfaces of said arms maintain heat transfer relation with the interior side walls of said cover member and with the plane surface of said heat conducting spacer spaced from the interior of the closed end of said cover member.

2. Heat dissipative means for encased electromagnetic devices as set forth in claim 1 in which the arm of said heat conducting spacer which extends over said spring pile-up contact assembly is longer than the others of said arms and extends from the frame portion displaced from the central axis of the mounting member to a position aligned with one of the margins of said

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mounting member whereby all of said arms center said cover member in its movement over said bracket member while the wiping surfaces of said arms maintain heat transfer relation with the interior side walls of said cover member.

3. Heat dissipative means for encased electromagnetic devices as set forth in claim 1 in which said heat conducting spacer is fastened to said frame portion at a position remote from the position in which said attachment means extends through said frame portion for supporting said magnetic core with the heat generating winding associated therewith.

4. Heat dissipative means for encased electromagnetic devices as set forth in claim 1 in which said heat conducting spacer is apertured immediately over the position at which the attachment means extends through said frame portion for providing access to said attachment means through said heat conducting spacer while attaching or detaching the magnetic core with respect to said frame portion.

5. An electromagnetic relay comprising a base structure, terminal contacts carried by said base structure, a magnetic relay including a frame supported by said base structure, an electromagnetic actuating winding and spring pile-up contact assemblies associated with said magnetic frame, a metallic housing and shield closed at one end and open at the other end with the open end thereof insertable over said magnetic relay, a thermally conductive plate having a plurality of radially disposed arms connected with said magnetic relay frame in a position spaced from said base structure and extending in a plane substantially parallel thereto and spaced from the closed end of said housing and shield and extending over said spring pile-up assemblies and forming a protective means therefor, the terminating ends of said arms extending angularly toward said base structure, the interior side walls of said metallic housing and shield establishing wiping thermally conductive connection with the angularly extending ends of said arms, said metallic housing and shield forming a closure with said base structure whereby heat incident to the operation of said magnetic actuating winding is transmitted through the relay frame and through said arms and the angularly extending ends thereof to said metallic housing and shield.

6. An electromagnetic relay comprising a base structure, terminal contacts carried by said base structure, a magnetic relay frame supported by said base structure, an electromagnetic actuating winding and spring pile-up contact assemblies associated with said magnetic frame, a thermally conductive plate substantially in the form of a Maltese Cross extending in a plane spaced from said base structure and extending substantially parallel thereto and connected with said relay frame and extending over said spring pile-up assemblies and forming a protective means therefor, said plate terminating in an angularly disposed wiping face at each end thereof, a metallic housing and shield having a substantially rectangular section, with the interior walls thereof establishing sliding, thermally conductive connection with the wiping faces of said thermally conductive plate, said metallic housing and shield forming a closure with respect to said base structure whereby heat incident to the operation of said magnetic actuating winding is transmitted through said relay frame and through said ther-

mally conductive plate to the side walls of said metallic housing and shield.

7. An electromagnetic relay having a base structure, a frame structure for said electromagnetic relay having mounting means thereon connected with said base structure, an electromagnetic operating winding carried by said frame structure, a movable armature controlled by said electromagnetic operating winding, a housing enclosing said relay and forming a closure therefor with said base structure, a spring pile up assembly including leaf spring members controlled by said movable armature and terminating within said housing, a cross member fastened to said frame structure and having arms establishing wiping contact with the inside walls of said housing, one of said arms extending over and forming a protector for said spring pile-up assembly as said housing is moved over said frame structure, thermally and electrically conductive members extending from the terminating ends of said leaf spring members, terminal connectors insulatingly supported by said base structure and projecting exteriorly of said base structure and electrically connected at their inner ends with said thermally and electrically conductive members, whereby said thermally and electrically conductive members serve to transmit heat generated within said electromagnetic relay for dissipation exteriorly of said housing.

8. An electromagnetic relay having a base structure, a frame structure for said electromagnetic relay having mounting means thereon connected with said base structure, an electromagnetic operating winding carried by said frame structure, a movable armature controlled by said electromagnetic operating winding, a housing enclosing said relay and forming a closure therefor

with said base structure, a spring pile up assembly including leaf spring members terminating within said housing and controlled by said movable armature, a cross member fastened to said frame structure and having arms establishing wiping contact with the inside walls of said housing, one of said arms extending over and forming a protector for said spring pile-up assembly as said housing is moved over said frame structure, thermally and electrically conductive members extending from the terminating ends of said leaf spring members, terminal connectors insulatingly supported by said base structure and projecting exteriorly of said base structure and electrically connected at their inner ends with said thermally and electrically conductive members, whereby said thermally and electrically conductive members serve to transmit heat generated within said electromagnetic relay for dissipation exteriorly of said housing through said base structure, and a thermally conductive plate carried by said frame structure and establishing frictional contact with the opposite interior side walls of said housing for effecting the further transmission of heat generated within said electromagnetic relay to the said housing for dissipation exteriorly thereof.

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