March 10, 1964 W. F. JUPTNER 3,124,671

PROTECTION OF RELAYS AGAINST ORGANIC VAPOR

Filed June 11, 1962

FIG. 1.

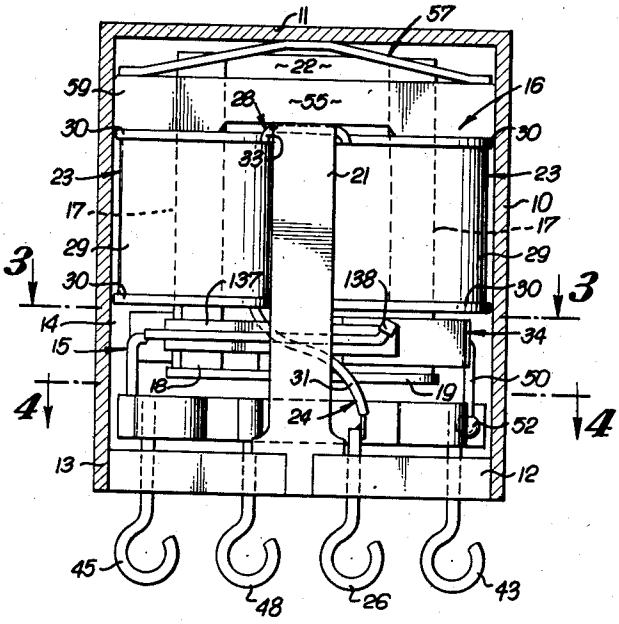


FIG. 2.

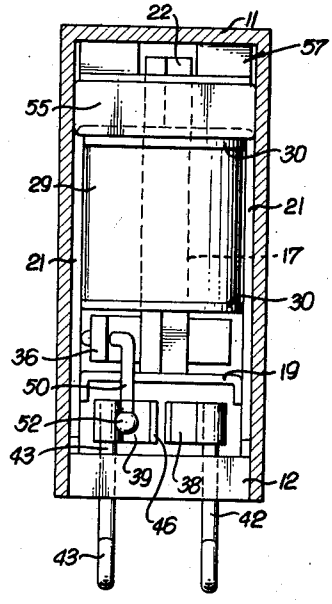


FIG. 3.

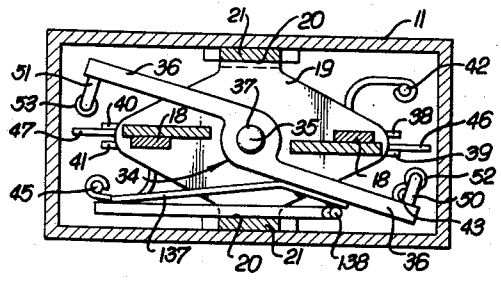


FIG. 4.

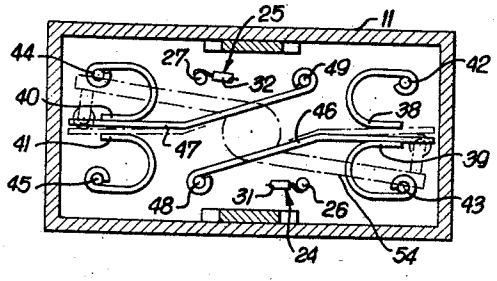


FIG. 5.

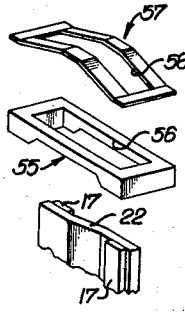
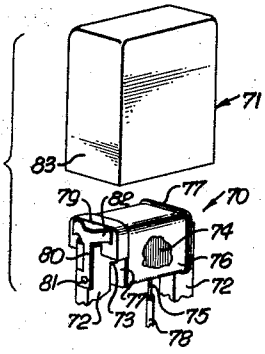


FIG. 6.



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PROTECTION OF RELAYS AGAINST ORGANIC VAPOR

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This invention relates generally to relays, and more particularly concerns the protection of relay contacts and other parts from the effects of vapor condensation thereon at both high and lower temperatures.

Relays of the type with which the invention is primarily concerned have wiring, as for example coil wiring, that is insulated with organic material such as polytetrafluoroethylene, polyethylene and nylon. When encapsulated within a hermetically sealed shell, it is found that organic vapor develops within the shell interior, especially at high ambient temperatures, and to the extent of a few microns of partial vapor pressure, even though the insulation is preliminarily baked before assembly in the shell, to drive off organic molecules which would evaporate more readily. The vapor tends to condense on relay parts and particularly the electrical contacts, and under the effects of arcing and mechanical engagement the organic molecules tend to decompose forming other gases and solids, such as carbon, and non-conductive layers, at so called dry voltages. As a result, relay performance at higher temperatures is prejudiced.

Problems also exist under low temperature conditions, as for example the condensation of water vapor from "dry" nitrogen filler gas at around —65° C. Efforts to solve the latter problem have included the utilization of activated charcoal to absorb water vapor; however, this material is unstable in that it tends to give off absorbed water vapor at higher temperatures.

The present invention contemplates primarily the solution to the problem of organic vapor development within the capsule, and in its broader aspects concerns the provision within the capsule or shell of a porous glass material functioning to adsorb organic vapor to the extent that the relay contacts may perform efficiently and without malfunction as described above. A relay unit incorporating the invention includes an encapsulating shell, an assembly sealed within the shell and including a frame having pole means, wiring including electromagnetic coil means carried by the frame, an armature supported to pivot toward and away from the pole means, electrical contacts engageable and disengageable in response to armature pivoting, organic insulation on the wiring and from which molecules escape to produce organic vapor within the shell, and porous glass insert means within the shell interior to adsorb organic vapor keeping it from condensing on the contacts Typically, the porous glass insert comprises a laterally elongated body located between one end of the shell and a pair of electromagnetic coils surrounding a pair of frame legs terminating at laterally spaced poles, electrical contacts being longitudinally spaced from the coils on which the bulk of the organic insulation is found and is proximate to the porous insert. Also, the body or insert typically contains a central opening through which the relay assembly frame projects, and yieldable spring means is provided to urge the insert longitudinatlly toward the coils to hold it adjacent thereto, as will be more completely described.

These and other objects and advantages of the invention, as well as the details of an illustrative embodiment, will be more fully understood from the following detailed description of the drawing, in which:

FIG. 1 is a side elevation taken in section showing the construction of a typical relay incorporating the invention;

FIG. 2 is a section taken in end elevation of the FIG. 1 relay;

FIG. 3 is a section taken on line 3—3 of FIG. 1;

FIG. 4 is a section taken on line 4—4 of FIG. 1;

FIG. 5 is an exploded perspective showing of the porous glass insert, spring, and frame portion receivable through the insert and spring; and FIG. 6 is a perspective showing of a modified form of the invention.

In the drawing the encapsulating shell is designated at 10, one end thereof being designated at 11 and the longitudinally opposite end thereof receiving a base 12 in the form of a plate peripherally and hermetically sealed to the shell rim 13. Typically, the interior 14 of the shell is substantially completely evacuated, although a filler gas such as nitrogen or an inert gas may be filled into the interior.

The base 12 carries an assembly projecting interiorly of the shell and generally designated at 15. As shown, the assembly includes a magnetizable frame 16 having two laterally spaced legs 17 projecting longitudinally toward the base to terminate at laterally spaced poles 18, the latter being connected by a frame terminal strip 19. The strip or sheet 19 is supported at 20 by a pair of longitudinally suspended frame supports 21 which project between the base 12 and the frame cross piece 22 to support the latter which in turn is interconnected with the frame legs 16.

The relay assembly 15 also has wiring including a pair of electromagnetic coils 23 respectively surrounding the legs 17 in spaced relation to the base 12, the wiring also including leads 24 and 25 extending between the terminals 26 and 27 and one coil 23. A jumper lead is shown at 28 extending between the coils proximate the cross piece 22. In this connection, it will be understood that sheets of organic insulation 29 are wrapped about the wiring of the two coils 23, the latter being confined betwen insulative end plates 30. Also, organic insulation in tubing form is provided on the leads 24, 25 and 28 as indicated at 31–33. Such organic insulation typically comprises polytetrafluoroethylene, polyethylene or nylon, such material being characterized in that organic molecules escape into the shell interior under elevated ambient temperature conditions as for example 300–400° F., to produce organic vapor therein.

The assembly 15 also includes a laterally elongated armature 34 supported by the frame to pivot about a longitudinal central axis 35 so that the armature arms 36 pivot toward and away from the poles 18 in response to energization and de-energization of the coils 23. A longitudinally extending post 37 is typically supported by the plate 19 to pivot the armature, and a flat spring 137 biases the armature against the stop 138 shown in FIG. 3.

The assembly 15 also includes electrical contacts located in the space between the armature and the base to be engageable and disengageable in response to armature pivoting. Typical contacts are shown at 38–41 as being in the form of curved metallic strips the ends of which are anchored to the terminal posts 42–45 in such manner that elongated contact arms 46 and 47 respectively project between the pairs of contacts 38 and 39, and 40 and 41. The arms are anchored to the terminal posts 48 and 49 in such manner as to be spring biased into engagement with the contacts 39 and 40.

The armature legs 36 carry terminal actuator prongs 50 and 51 carrying glass terminal beads 52 and 53 located to deflect the contact arms 46 and 47 into alternate engagement with the contacts 38 and 41 upon pivoting of the armature in response to coil energization. This alternate position of the armature is indicated in broken lines at 54 in FIG. 4. As stated in the introduction, organic vapor tends to condense on the contacts 38–41

and arms 46 and 47 to interfere with the good electrical contact which it is normally desired to establish between the arms and the contacts.

To obviate the foregoing difficulty, a porous glass insert is provided within the shell interior to adsorb organic vapor keeping it from condensing on the contacts. Such an insert is shown in one highly desirable form at 55 to be mounted by the assembly 15 proximate the cross piece 22, thereby to remain exposed to contact by the organic vapor developing within the interior 14 of the shell. The insert 55 is illustrated to comprise a laterally elongated body located between the coils and the end 11 of the shell remote from the base 12. The body 55 contains a central opening 56, typically generally rectangular, and through which the frame projects in such manner that the insert 55 is confined against lateral displacement.

The body is urged yieldably and longitudinally toward the coils 23 by means which typically takes the form of a flat spring 57 also containing a central opening 58 through which the frame cross piece projects. Upon assembly the spring is compressed between the end 11 of the shell and the upper face 59 of the insert body 55, keeping the insert from rattling and impact fragmentation within the shell, and also keeping the insert proximate the coils 23 about which the bulk of the insulation is found.

The porous glass insert has the typical composition recited as follows:

	Percent
SiO_2	96.3
B_2O_3	2.95
Na_2O	0.04
$R_2O_3+RO_2$	0.72
Organic matter	None

In addition typical physical properties of the porous glass insert are listed as follows:

Apparent density (dry)	1.5 gm./cc.
Void space	28% by volume.
Average pore diameter	4 millimicrons.
Internal surface area	200 sq. meters per gm.
Appearance	Opalescent.
Average modulus of rupture of abraded ¼" rods, R.T.	6000 p.s.i.
Elastic modulus, R.T.	2.5×10^6 p.s.i.
Loss tangent at room temperature and 100 C	.007.
Dielectric constant at R.T. and 100 C	3.1.

The porous glass material possesses considerable structural strength and as previously described adsorbs organic molecules to an extent such that there is no problem with establishment of good electrical contact as respects the relay contacts and contact arm under high ambient temperature conditions. In addition, the glass adsorbs water molecules which may be present within the relay shell interior to obviate any water condensation problems on the contacts at extremely low temperatures.

In the modified relay shown in FIG. 6, a portion of the assembly 70 which normally projects interiorly of the shell 71 is illustrated prior to insertion therein. The assembly includes a magnetizable frame having two laterally spaced legs 72 projecting longitudinally, as well as a cross piece 73 interconnecting the legs. The assembly has wiring including a coil 74 surrounding the cross piece 73, and a coil lead 75. A sheet of organic insulation 76 is wrapped about the coil, which is confined between insulative end plates 77. Also, organic insulation in tubing form is provided at 78 on lead 75. The remainder of the relay structure, not shown, may be similar to that previously described.

A porous glass insert shown at 79 is mounted by the assembly, and has U-shape to straddle the frame at cross piece 73 adjacent to end plate 77, thereby to remain exposed to contact by the organic vapor developing within the interior of the shell. The insert body is yieldably urged laterally toward and against the end plate 77, for in-place retention, by a T-shaped flat spring 80, the stem of which is anchored to the frame at 81. The spring head has flat spring arms 82 which project toward the insert body for compressive engagement therewith. Upon assembly, the spring head is compressed between the side wall 83 of the shell and the U-shaped insert, keeping the latter from rattling and fragmenting within the shell. The insert body is confined longitudinally between the top wall of the shell and the cross piece.

I claim:

1. In a relay unit, an encapsulating shell, an assembly sealed within the shell and including a frame having pole means, wiring including electromagnetic coil means carried by the frame, an armature supported to pivot toward and away from the pole means, electrical contacts engageable and disengageable in response to armature pivoting, organic insulation on said wiring and from which molecules escape to produce organic vapor within the shell, and porous glass insert means within the shell interior to adsorb organic vapor keeping adsorbed vapor from condensing on said contacts, said insert means consisting of a solid, structurally strong body having a modulus of rupture of several thousand p.s.i. and the body consisting essentially of oxides of silicon, sodium and boron.

2. The combination of claim 1 including a spring located within the shell to yieldably confine the insert body urging it toward the frame and coil assembly when said assembly is fully inserted within the shell.

3. The combination of claim 1 in which the assembly includes a base sealed to the shell rim portion, the frame having two laterally spaced legs projecting longitudinally toward the base to terminate at said pole means, the frame also having a cross piece interconnecting the legs at the ends thereof furthest from the base, said coil means including a pair of coils surrounding said legs in spaced relation to the base, the insert body being laterally elongated and confined between said coils and the end of the shell remote from said base, the body containing a central opening through which the frame projects.

4. The combination of claim 1 in which the frame has two laterally spaced legs projecting longitudinally to terminate at said pole means, the frame also having a cross piece interconnecting the legs, the coil means surrounding said cross piece, said insert body being generally U-shaped to straddle the cross piece and being confined between the coil means and a side wall of the shell.

5. The combination of claim 4 including a spring urging said body toward the coil.

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