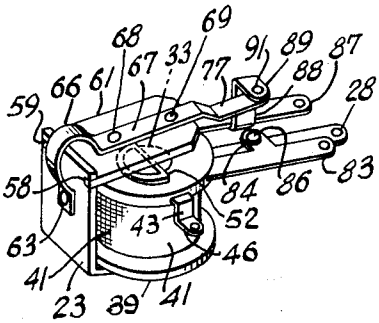
June 23, 1970 D. J. DAVIS 3,517,358

RELAY

Filed Nov. 6, 1967 3 Sheets-Sheet 1

Fig. 1.



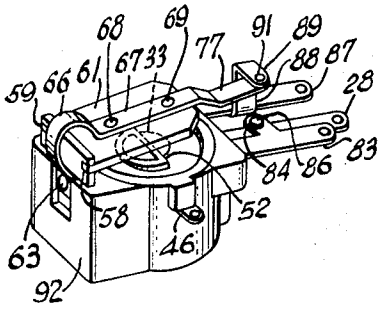
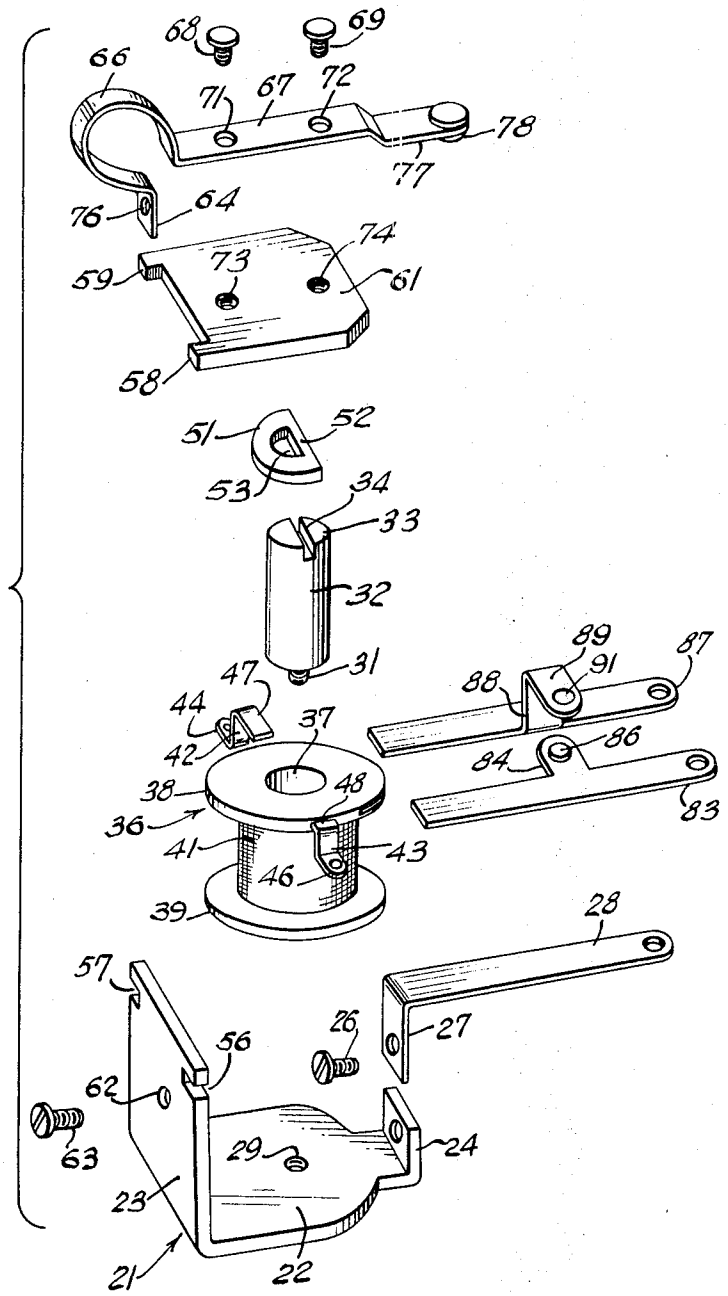


Fig. 8.

Fig. 2.



INVENTOR
DHUAINE J. DAVIS

BY L. Jordan Finnick
ATTORNEY

June 23, 1970 D. J. DAVIS 3,517,358

RELAY

Filed Nov. 6, 1967 3 Sheets-Sheet 2

Fig. 3.

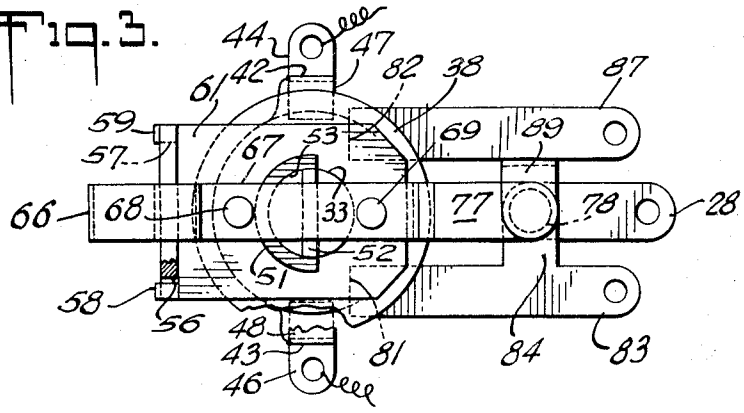


Fig. 4.

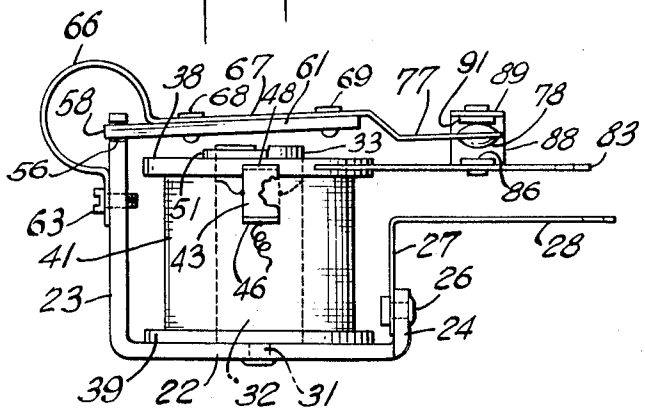


Fig. 5.

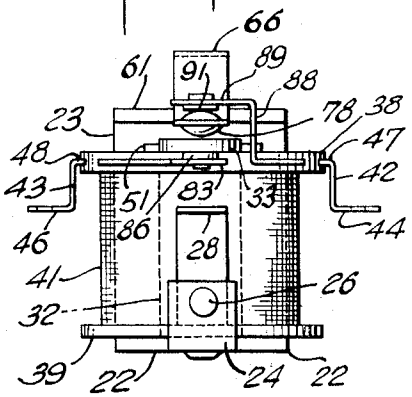


Fig. 6.

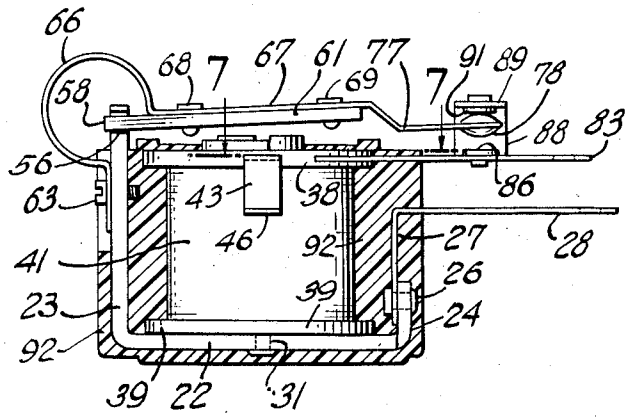
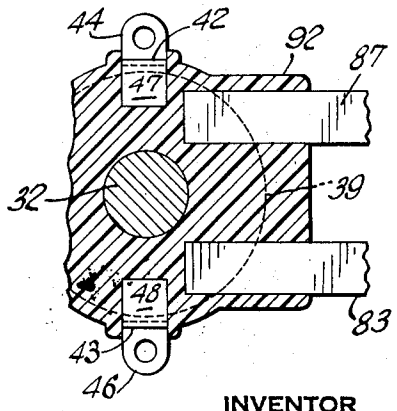


Fig. 7.



INVENTOR
DHUAINE J. DAVIS
BY
ATTORNEY

June 23, 1970 D. J. DAVIS 3,517,358

RELAY

Filed Nov. 6, 1967 3 Sheets-Sheet 3

Fig. 9.

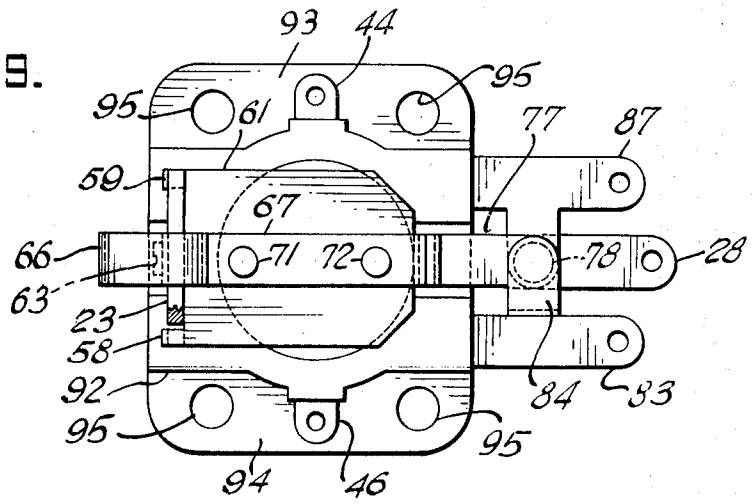


Fig. 10.

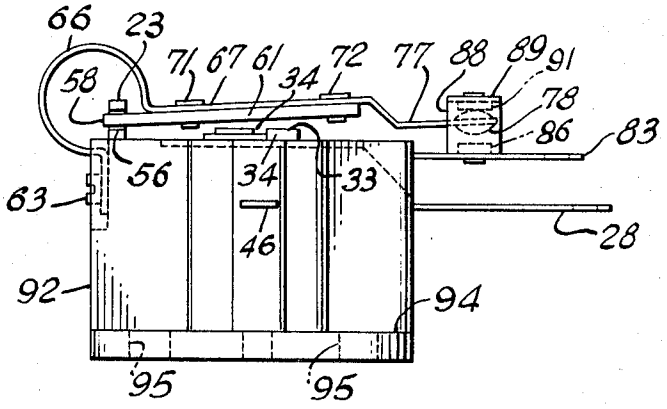


Fig. 11.

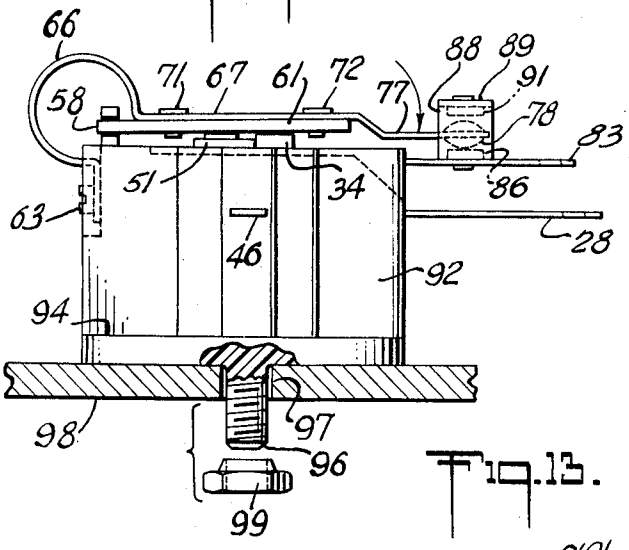


Fig. 12.

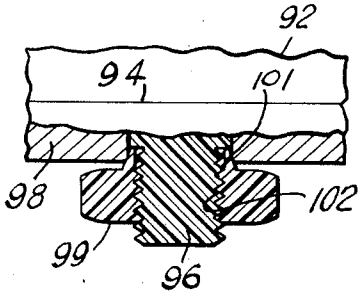
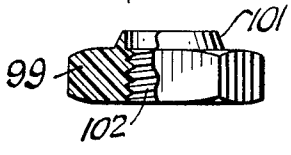


Fig. 13.



INVENTOR
DHUAINE J. DAVIS
BY
L. Jordan Kinnick
ATTORNEY

United States Patent Office 3,517,358 Patented June 23, 1970

3,517,358

RELAY

DhuAine J. Davis, Wheaton, Ill., assignor to Hermetic Coil Co., Inc., Wheaton, Ill., a corporation of Connecticut

Filed Nov. 6, 1967, Ser. No. 680,644
Int. Cl. H01h 85/02
U.S. Cl. 335—192 11 Claims

ABSTRACT OF THE DISCLOSURE

A relay having a coil form that supports electrical contacts and an insulated frame conducting electrical current. Unitary spring biasing means that cooperate with both the armature and the alternating contact element of the relay. Biasing spring also performs current transmitting function. Encapsulation of relay effectively insulates circuit terminals and electromagnetic components.

BACKGROUND OF THE INVENTION

Field of the invvention

This invention relates to relays and, more particularly, to a novel relay structure wherein the relay frame performs a current carrying function in addition to supporting the various components of the relay and wherein the armature biasing means also conducts the relay current to the alternating relay contact element.

Description of the prior art

Prior art relays display complex structures which have multifarious parts to perform separate functions. Such prior relays frequently have cumbersome means for insulating the electrical terminals from each other and manifest crude construction principles which produce devices that are not only cumbersome but are also larger in size than is necessary to perform the relay function.

SUMMARY OF THE INVENTION

The present invention comprises a relay having an L-shaped frame that not only supports the relay coil and magnetizable core, but also performs the function of transmitting current from the power source for operating the alternating contact of the relay. Furthermore, the relay armature biasing means is connected to the frame to transmit current to the alternating contact which is mounted directly on the relay armature. By this means, a considerable number of parts of prior art relays are eliminated and there is provided a relay that is considerably more compact in space and less expensive to produce than prior relays. Furthermore, the arrangement of parts and the reduction of their number permits easy encapsulation of a large part of the relay assembly so that the latter is readily handled for installation purposes. The encapsulation also provides convenient electrical insulation of the relay coil as well as insulation between the circuit terminals connected to the relay.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view, approximately actual size, of one embodiment of the device embracing the present invention;

FIG. 2 is an exploded perspective view of several parts of the device shown in FIG. 1;

FIG. 3 is an enlarged top view of the device shown in FIG. 1, some parts being omitted, some parts being broken away, and other parts being shown in dotted outline;

FIG. 4 is a side view of the device shown in FIG. 3;

FIG. 5 is a front end view of the device shown in FIG. 4;

FIG. 6 is a ceneral vertical partial section view of the device shown in FIG. 4, some parts being shown in elevation and some parts being omitted;

FIG. 7 is a section view taken approximately on line 7—7 of FIG. 6;

FIG. 8 is similar to FIG. 1 wherein the device is encapsulated;

FIG. 9 is a top view of an encapsulated embodiment of the device shown in the previous figures, and including an enlarged integrally formed mounting base;

FIG. 10 is a side view of the device shown in FIG. 9;

FIG. 11 is a side view of another encapsulated embodiment of the present invention with the substitution of a mounting screw for the integral mounting base of FIG. 9, and showing in exploded relation a mounting nut removably threadable on said screw for securing the device on a board or the like;

FIG. 12 is an enlarged fragmentary view of a portion of FIG. 11 showing the mounting nut engaged with the mounting screw; and

FIG. 13 is a partial section and partially broken away enlarged view of the mounting nut shown in FIGS. 11 and 12.

DESCRIPTION OF THE PREFERRED EMBODIMENTS AND OPERATION

Referring now to the drawings in detail, the embodiment shown in FIGS. 1 through 6 comprises an electrically conductive L-shape metal frame, generally designated **21**, having a horizontal base **22** and a vertical support wall **23** integrally formed at the rear end of said base. Integrally formed at the forward end of base **22** is an upwardly extending bracket **24** to which is attached by means of suitable rivet **26** or the like, the vertical leg **27** of an elongated horizontally extending power line terminal **28**.

Secured in aperture **29** in base **22** is the stub **31** of a a vertically extending elongated soft iron magnetizable core **32**, the upper flat surface **33** of which has a diametrically slotted recess **34** formed therein.

Surrounding core **32** is a circular spool, generally designated **36**, having a vertical tubular portion **37** and integrally formed upper and lower flanges **38** and **39**, respectively, said spool being made of a suitable insulating material. Core **32** forms a close slidable fit with the interior aperture of spool tube **37**. Flange **39** rests on the top surface of base **22**.

Wound around spool tube **37** is a coil **41** of electrical wire, the ends of said coil being connected to electrically conductive lugs **42** and **43**, respectively. Lugs **42** and **43** have integrally formed, outwardly extending terminals **44** and **46**, respectively, to which a relay actuator is connected. Lugs **42** and **43** have integrally formed support arms **47** and **48**, respectively, which are inserted and secured in corresponding horizontal slots in opposite edges of flange **38**.

Removably mounted on the top of core **32** is a semi-circular shaped shading coil **51** having an integrally formed diameter bar **52** which is removably insertable into slot **34**, while the semi-circular aperture **53** of said coil interfits with a semi-circular segment of the top of core **32**. Shading coil **51** is made of a suitable electrically conductive but non-magnetic material such as copper or brass and lies flat on the top surface of flange **38**.

Formed at or near the upper end of wall **23** at the side edges thereof are recesses **56** and **57** which horizontally accommodate respective legs **58** and **59** integrally formed at the rear end of an armature plate **61** which is arrayed generally horizontally above and across the top of spool **36**. The cooperation of legs **58** and **59** with respective

recesses **56** and **57** permit the limited pivotal action of armature plate **61** in respect of wall **23**.

Threaded aperture **62** in wall **23** accommodates screw **63** to secure arm **64** of a curved electrically conductive sheet metal spring **66**, said spring having an integrally formed bracket **67** which is connected to armature plate **61** by means of rivets **68** and **69** or the like extending through apertures **71** and **72**, respectively, of said bracket, and through apertures **73** and **74**, respectively, of armature plate **61**. Aperture **76** in arm **64** through which screw **63** extends is somewhat elongated in shape whereby the vertical position of said arm may be adjusted upwards and downwards before being secured to wall **23** so that the proper tension of spring **66** may be adjusted and controlled for optimum pivotal operation of armature **61**. Integrally formed on the forward end of bracket **67** is an armature terminal **77** on the end of which is mounted alternating relay contact element **78**.

Flange **38** has a pair of spaced apart horizontal recesses **81** and **82**. Recess **81** accommodates one end of a first electrically conductive terminal element **83**, the other end of which is connectable to electrical apparatus that is controlled by the relay. Intermediate the ends of terminal **83** is an integrally formed laterally extending arm **84** on which is mounted contact element **86**.

Recess **82** in flange **38** accommodates one end of a second electrically conductive terminal element **87**, the other end of which is connectable to the electrical apparatus controlled by the relay device. Formed integrally intermediate the ends of second terminal **87** is an upwardly extending arm **88** which terminates in a laterally extending lug **89** on which is mounted a contact element **91**. Contact element **91** is spaced apart and disposed vertically above contact element **86**. Contact element **78** on armature terminal **77** is located in the space between contact elements **86** and **91** and is normally in electrical contact with contact element **91**, as shown in FIGS. 4, 5, 6 and 10. In this condition, it will be noted that armature plate **61** is normally urged upwardly and spaced apart from the top of core **32** under the action of spring **66**. When coil **41** is electrically energized in the manner well known in the art, core **32** becomes magnetized whereby the magnetic forces generated at the upper end of said core causes armature plate **61** to be magnetically attracted to and moved downwardly upon the top of said core and held in that position as shown in FIG. 11, whereby contact element **78** on armature arm **77** is displaced from contact element **91** and is caused to make electrical contact with contact element **86**.

Since the hot line lower terminal **28** is connected to the power source, the electrical current passes therethrough, through base **22**, wall **23**, thence through spring **66**, terminal **77**, and contact element **78**, to complete a circuit either between contact element **86** or contact element **91**, according as coil **41** is energized or deenergized.

Thus, by means of the novel structure disclosed herein, the L-shaped frame **21** of the relay is utilized to conduct current from the electrical power source. Also, the alternating relay contact **78** is mounted directly upon the working armature **61**, whereby a great number of component parts of previous relays are completely eliminated. The biasing spring **66** operating armature **61** is utilized to conduct the electrical current from L-shaped frame **21** to the alternating contact **78** of the relay. Accordingly, the fewer component parts of the present relay perform multiple functions in contrast to single functions of a much greater number of parts in prior art devices.

The relay of the present invention is encapsulated in a case or housing **92** of nylon, Bakelite, or other suitable electrically insulating material, which hermetically seals spool **36** and coil **41** from the atmosphere and encloses most of the L-shaped frame **21** therein. The encapsulation also secures terminals **28**, **83** and **87**, and lugs **42** and **43** in position and fixes them rigidly in their respective slots in flange **38**. The encapsulation also serves effectively as protective insulation for the current carrying

frame **21** as well as to secure most of the component parts together in a unitary structure that is compact and easily handled for installation purposes. The encapsulation also serves to insulate the circuit terminals **28**, **83** and **87** from each other. Coil terminals **44** and **46** also extend through the encapsulation of case **92** for connection to a coil energizing electrical circuit.

In a further embodiment as disclosed in FIGS. 9 and 10, case **92** may have integrally formed laterally extending mounting flanges **93** and **94** with apertures **95** for accommodating screws or bolts to secure the encapsulated relay in a fixed position upon a panel board or the like.

In another embodiment, the bottom of case **92** has a downwardly extending threaded bolt **96** integrally formed with the lower portion of said case and made of the same insulating material. Mounting bolt **96** which is located centrally of case **92** extends through a suitable aperture **97** in mounting board **98** and is threadably engaged by nut **99** to secure case **92** firmly in position. See FIGS. 11, 12 and 13.

Nut **99** is made of nylon or the like and has a thin, short integrally circular flange **101** extending laterally at the periphery of its axial aperture **102**, said flange being somewhat flexible and deformable. When nut **99** is turned tight on bolt **96** against board **98**, flange **101** becomes deformed and wedged between the body of said nut and said board to effectively lock the nut on the bolt. The thin flexible and deformable flange **101** serves as an effective lock nut means for assembling the relay upon a board or the like.

It is evident from the foregoing description of the present invention that in addition to the advantages described hereinbefore, the means for securing the magnetic core to the frame with the wire wound spool located on the core and with the slots in the spool flange being adapted to receive the end portions of electrical terminals results in an assembly fixture that holds the component parts together prior to encapsulation, thereby greatly reducing assembly costs and effectively accomplishing a considerable diminution in size of the final relay device.

Although the present invention has been described with reference to particular embodiments and examples, it will be apparent to those skilled in the art that variations and modifications can be substituted therefor without departing from the principles and true spirit of the invention.

I claim:

1. A relay comprising an electrically conductive frame, means on said frame for connecting the latter to an electric power source, an armature hinged directly to said frame, electromagnetic means on said frame for moving said armature between first and second circuit positions, a biasing spring connected between said frame and said armature, said spring normally urging said armature apart from said electromagnetic means when the latter is deenergized, an alternating terminal integral with said spring and movable with said armature, the current from said power source being conducted through said frame, said spring and said alternating terminal, said electromagnetic means comprising a spool of insulating material, said spool having end flanges, an electrical coil wound around said spool between said flanges, a magnetizable core extending through the interior of said spool, first and second spaced apart slots in the edge of one flange of said spool, first and second circuit terminals the ends of which are inserted into respective first and second slots and being insulated from said electrical coil, and an encapsulating case of insulating material surrounding a portion of said frame and completely surrounding and enclosing said spool, said encapsulating material securing said first and second terminals in said respective slots, said alternating terminal being movable by said armature into electrical contact with either of said first and second circuit terminals according as said electromagnetic means is energized and deenergized.

2. A relay according to claim 1 and further comprising an electrically conductive power circuit terminal connected to said frame, said terminal extending through said encapsulating case and insulated from said first and second circuit terminals.

3. A relay according to claim 2 wherein said first and second circuit terminals are laterally spaced apart and said alternating terminal is movable vertically in a plane intermediate said circuit terminals, and further comprising an integrally formed extension on said first circuit terminal, an integral extension on said second circuit terminal, the ends of the extensions on said first and second circuit terminals being located at opposite ends of the vertical path described by said alternating terminal which makes electrical contact with either of said extensions as said electromagnetic means is energized and de-energized.

4. A relay comprising an electrically conductive frame, a magnetic core mounted on a portion of said frame, a wire wound spool of insulating material positioned around said core, a flange on said spool, first and second spaced apart slots in said flange, first and second circuit terminals removably inserted into said first and second slots and supported in position therein, third and fourth spaced apart slots in said flange, third and fourth terminals removably inserted into said respective third and fourth slots, said third and fourth terminals being connected to respective ends of the wire winding on said spool, a power terminal connected to said frame and an encapsulating case of insulating material surrounding the major portion of said frame and enclosing said wire wound spool, said encapsulating material securing said first, second, third and fourth terminals firmly in their respective slots while exposed portions of said terminals extend outwardly from said case for connection to external circuitry.

5. A relay according to claim 4 wherein said frame is generally L-shaped with said power terminal being connected to said frame near one end thereof; and further including first and second spaced electrical contacts respectively associated with said first and second circuit terminals externally of said encapsulating material; and an armature pivotally connected to said L-shaped frame at the other end thereof and including a movable contact interposed between said first and second contacts, said armature being located externally of said encapsulating material.

6. A relay comprising: an electrically conductive generally L-shaped frame; a power terminal secured to said frame at one end thereof; an armature pivotally secured to said frame at the other end thereof and including at least one electrical contact movable therewith; a spool formed of an electrically insulating material secured to said frame, said spool having at least one end flange formed of an insulating material and including at least one recess therein; an electrical winding wound about said spool; terminal means including a first portion received within said recess and a second portion mounting a contact and adapted to be engaged by the contact on said armature; and an encapsulating case formed of an insulating material surrounding the major portion of said frame and said spool and securing said terminal means in said recess.

7. A relay according to claim 6 wherein said flange includes a second recess spaced from said first recess, and a second terminal means received within said second recess, said second terminal means including a contact portion adapted to be engaged by the contact on said armature and electrically spaced from the contact on said first named terminal means.

8. A relay according to claim 6 further including a pair of spaced slots in said flange and a pair of electrically conductive lug means terminating in terminals received in respective ones of said slots, said lug means being electrically connected to the winding on said spool.

9. A relay according to claim 6 further including a second recess in said flange spaced from said first recess; a pair of slots in said flange spaced from said first and second recesses and from each other; terminal lugs received in respective ones of said slots and electrically connected to said winding and a second terminal means received in said second recess, said second terminal means having a contact portion spaced from the contact portion of said first terminal means and adapted to be engaged by the contact on said armature; said encapsulating case encompassing substantially all of said structure with substantially only said armature, said first and second contact portions, said first and second terminal means, portions of said lugs and said terminal extending therefrom.

10. A relay according to claim 6 wherein said encapsulating case includes an outward projection terminating in a threaded end.

11. A relay according to claim 10 and further comprising a plastic nut, a thin deformable integral circular flange formed at one end of the interior aperture of said nut, said nut being threadably received on the threaded end of said projection.

References Cited

UNITED STATES PATENTS

2,802,193	8/1957	Biba	336—192
2,883,635	4/1959	Clark	336—192
2,867,702	1/1959	Rice	335—187
2,907,847	10/1959	Grenier	335—202
2,920,160	1/1960	Heath	335—187
3,001,567	9/1961	Brill	151—7
3,040,143	6/1962	Peay	335—202
3,129,304	4/1964	Hyink	335—202
3,308,407	3/1967	Lake	335—187

FOREIGN PATENTS

1,027,313	4/1958	Germany.

BERNARD A. GILHEANY, Primary Examiner

H. BROOME, Assistant Examtner