Jan. 3, 1967 G. E. GRIGGS ETAL 3,296,568

MINIATURE ELECTROMAGNETIC RELAY

Filed March 11, 1963

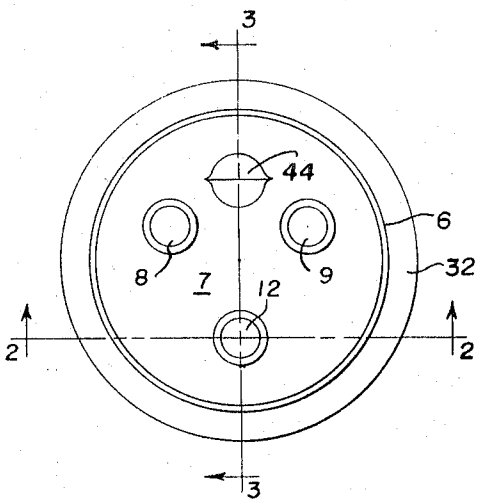

Fig-4

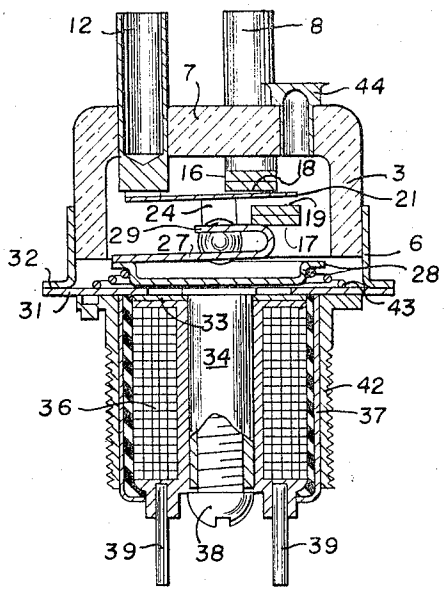

Fig-3

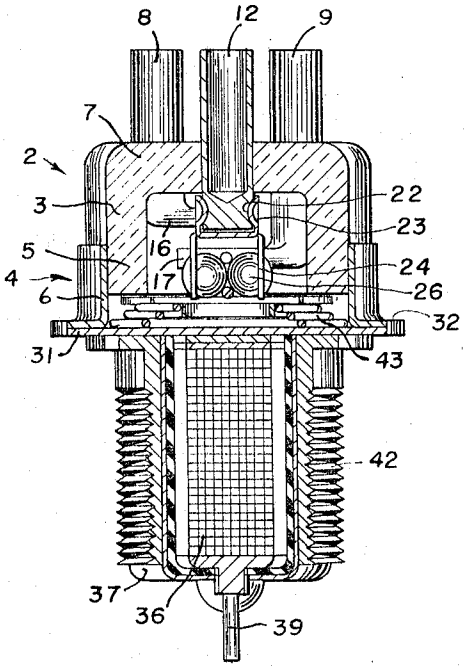

Fig-2

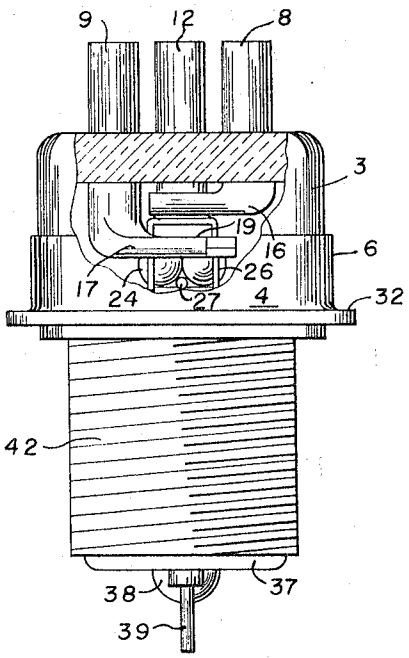

Fig-1

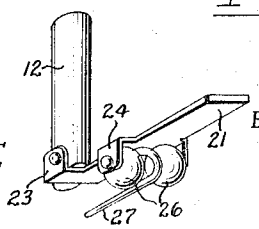

Fig-5

INVENTORS
GLENN E. GRIGGS
JEAN H. HAWKINS
CLARK T. ROESSLER

BY John J. Leavitt

United States Patent Office

3,296,568

Patented Jan. 3, 1967

3,296,568

MINIATURE ELECTROMAGNETIC RELAY

Glenn E. Griggs, San Jose, Jean H. Hawkins, Campbell, and Clark T. Roessler, San Jose, Calif., assignors to Jennings Radio Manufacturing Corporation, San Jose, Calif., a corporation of Delaware

Filed Mar. 11, 1963, Ser. No. 264,417
7 Claims. (Cl. 335—154)

This invention relates to electric relays, and particularly to a miniature relay embodying an hermetically sealed housing.

The advent of missiles, space vehicles, and jet aircraft has created the need for a relatively high voltage, high frequency electric relay of rugged construction for airborne radio communication equipment. Accordingly, it is one of the principal objects of the invention to provide a miniature, highly reliable, vibration-free relay having the capability of operating at approximately two and one-half kilovolts at sixteen megacycles, while carrying up to approximately seven amperes of current.

Because of the relatively high radio frequencies utilized with airborne radio equipment, it is necessary that relays used in communication circuits be fast operating. It is therefore another object of the invention to provide a relay capable of operating in about one millisecond.

Since reliability is an important factor in the use of relays in airborne equipment, and since enclosing relay contacts within an hermetically sealed housing having a controlled atmosphere or no atmosphere, i.e., a vacuum, increases the reliability, it is another object of the present invention to provide a miniature relay in which the contact points are enclosed within an hermetically sealed housing.

The ability of a relay to withstand impact shocks and high acceleration and deceleration forces is determined to a large extent by the nature and mounting of movable parts in the relay. It is therefore another object of the invention to provide a relay capable of withstanding such forces to at least 10 G's at vibration levels of 1000 cycles per second.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will become apparent from the following description and the drawings. It is to be understood however that the invention is not limited by the description and the drawing, as it may be embodied in various forms within the scope of the appended claims.

Broadly considered, the relay of the invention comprises a hollow housing having opposed shell-like wall portions on one of which are mounted a plurality of terminal leads, portions of which extend into the housing. Within the hollow housing is mounted a suitable actuating mechanism to effect make and break operation of a mobile contact mounted within the housing in a manner to selectively make or break a circuit through one of a plurality of fixed contacts and an adjacent terminal lead common to both fixed contacts. Suitable means associated with the mobile contact provide a resilient spring loading on the mobile contact tending to eleminate vibration thereof.

Referring to the drawings:

FIG. 1 is an elevation of the relay, a portion of the housing being broken away to reveal the interior construction.

FIG. 2 is a sectional view of the relay taken in the plane indicated by the line 2—2 in FIG. 4.

FIG. 3 is a vertical cross-sectional view taken in the plane indicated by the line 3—3 in FIG. 4.

FIG. 4 is a plan view of the relay.

FIG. 5 is a fragmentary perspective view of the mobile contact assembly illustrating the manner in which it is

pivotally attached to the common terminal lead and to the armature.

All of the figures are drawn approximately twice actual size.

In terms of greater detail, the miniature relay comprises a housing designated generally by the numeral 2, and including a first or upper shell-like portion 3 preferably fabricated from a dielectric material such as ceramic, and a second or lower shell-like portion 4 of metal, the shell-like portions being provided with cylindrically extending peripheral portions 5 and 6, respectively, adapted to be overlapped as shown and hermetically bonded as by brazing.

Shell portion 3 is provided with a wall 7 through which extend a plurality of substantially identical terminal leads 8, 9 and 12, each of the terminal leads being hermetically bonded as by brazing within a suitable aperture formed in the ceramic wall 7.

It will thus be seen that the dielectric wall rigidly supports each terminal lead on the housing and electrically insulates each terminal lead from the other terminal leads and from the associated shell portion when that shell portion is fabricated from metallic material as indicated in the drawing. It will of course be understood that the shell portion 3 can be fabricated from a metallic material, in which case a dielectric bushing (not shown) would be interposed between each terminal lead and the shell and bonded directly to both. Such a construction is disclosed and claimed in copending application Ser. No. 238,364 filed in the name of one of the applicants herein and assigned to the assignee of the present invention and application. The portion of each terminal lead outside the housing beyond the dielectric wall 7 provides for connection of the relay into a circuit, while the terminal lead portions within the housing are utilized to support cooperatively related fixed and mobile contacts.

As shown in FIGS. 2 and 3, two of the spaced and electrically insulated terminal leads are utilized to support a pair of rigid, plate-like conductive contact members 16 and 17, each of which is supported on an associated terminal lead. The fixed contact plates may be formed from a separate plate brazed to the end of the terminal leads, or they may formed by a flattened end portion of the tubular terminal lead which is then appropriately sealed with solder. The fixed contact plates are arranged in vertically spaced parallelism so that opposed fixed contact surfaces 18 and 19 are presented for engagement by a mobile contact 21.

The inner end of the remaining or common terminal lead (FIGS. 2 and 3) is hermetically sealed and provided with depressions or indentations 22 on opposite sides thereof which are resiliently engaged by a pair of spaced integral tabs 23 formed on one end of the mobile contact and dimpled as shown to fit the depressions on the lead. The strap-like mobile contact 21 (FIG. 3) extends transversely across the housing between the spaced fixed contact plates.

In order to effect movement of the mobile contact plate, the mobile contact is formed with a pair of depending spaced resilient tabs 24 (FIGS. 1, 2 and 3) intermediate the ends of the mobile contact and extending in a direction opposite to the tabs 23. The tabs 24 are also dimpled as shown best in FIG. 2, and serve to resiliently retain therebetween a pair of dielectric spheres 26 each of which has a spherical portion of its periphery caught in the depression formed by the dimple in the next adjacent tab 24.

Trapped between the two spheres is a resilient connector arm or bracket 27 which in the embodiment illustrated comprises a small diameter (.025") wire secured

at one end to the periphery of an associated spring-pressed magnetizable armature 28 as by spot-welding, and at its other or free end being looped or turned back upon itself to provide a portion 29 spaced and parallel to the main portion of the resilient actuator as shown best in FIG. 3. The space between the main transverse portion of the wire and portion 29 is gauged so that the looped end of the wire may be snugly caught between the dielectric spheres. It will thus be seen that the actuating assembly is economical to manufacture and easily assembled. A prototype relay constructed according to this disclosure has successfully operated for over five million operations.

To actuate the armature, the relay is provided with an annular magnetizable end-wall portion 31, preferably fabricated from 1018 steel and having its outer periphery hermetically heli-arc welded to a radially extending flange 32 formed on housing shell 6, the latter preferably fabricated from nickel-iron. The central aperture of the end-wall is hermetically sealed by a non-magnetic annular metallic wall 33 having a magnetizable core 34 of 1018 steel supported centrally thereon. It will thus be seen that the elements 6, 31, 33 and 34 define a vacuum or hermetically tight metallic end-wall assembly sealing the open end of the dielectric shell 2.

Surrounding the core, a coil 36 is provided removably held in place thereon by a magnetizable cup 37 preferably fabricated of 1018 steel and locked to the core by screw 38. The depth of the cup and the length of the core are proportioned so that the open end of the cup is pressed tightly against the underside of end wall portion 31 near its inner periphery. The outer peripheral surfaces of the cup are plated to withstand the corrosive effects of salt spray. Terminals 39 are provided passing through the bottom of the coil-supporting cup to enable connection of the coil to an appropriate source of power. Preferably, the coil within the cup is encapsulated therein to eliminate vibration of the coil within the supporting cup. The magnetic circuit about the coil is thus completed through the cup 37 which is contained within or surrounded by a cylindrical non-magnetic sleeve 42, preferably of molybdenum, snugly surrounding the coil-supporting cup. The sleeve is permanently and rigidly attached at one end to the underside of end-wall portion 1, but it is not required that this union bye of a hermetic nature.

In operation, when the coil is energized the armature is pulled down against the end-wall portion 31 against the opposing pressure exerted by coil spring 43 so as to complete the magnetic circuit. In its normal condition, the spring resiliently retains the armature spaced from the core, with the free end of the mobile contact in surface engagement with fixed contact surface 18. In this position of the parts the inherent flexibility of the strap-like mobile contact provides a predetermined amount of overtravel so as to eliminate contact bounce and decrease contact resistance.

The embodiment illustrated utilizes an evacuated housing provided with a suitable tubulation 44, but it is to be understood that instead of being evacuated the housing may be charged with a suitable gas either above or below atmospheric pressure.

We claim:

1. A relay comprising a housing including a dielectric cup portion, at least three spaced terminal leads extending into and supported on the dielectric cup portion to provide inner and outer spaced terminal ends, a pair of fixed contacts within the dielectric cup portion supported on the inner terminal ends of two of the terminal leads and comprising rigid plate-like conductive members having spaced free-end portions providing fixed contact surfaces, an elongated mobile contact supported within the housing and normally resiliently urged in a first direction to displace the mobile contact to make a circuit through one of the fixed contacts of the pair and the third terminal lead, and an actuating assembly mounted on the housing and connected to the mobile contact intermediate its ends and operable to move the mobile contact in a second direction opposite to said first direction to displace the mobile contact to break a circuit through said one of said fixed contacts and make a circuit through the other one of the fixed contacts and said third terminal lead, said terminal leads comprising tubular metallic members hermetically brazed around their outer peripheries to the dielectric cup portion and two of which have flattened and hermetically sealed end portions within the housing constituting said pair of fixed contacts.

2. A relay comprising a housing including a dielectric cup portion, at least three spaced terminal leads extending into and supported on the dielectric cup portion to provide inner and outer spaced terminal ends, a pair of fixed contacts within the dielectric cup portion supported on the inner terminal ends of two of the terminal leads and comprising rigid plate-like conductive members having spaced free-end portions providing fixed contact surfaces, an elongated mobile contact supported within the housing and normally resiliently urged in a first direction to displace the mobile contact to make a circuit through one of the fixed contacts of the pair and the third terminal lead, and an actuating assembly mounted on the housing and connected to the mobile contact intermediate its ends and operable to move the mobile contact in a second direction opposite to said first direction to displace the mobile contact to break a circuit through said one of said fixed contacts and make a circuit through the other one of the fixed contacts and said third terminal lead, said actuating assembly comprising an electromagnetically operated solenoid including a spring-pressed armature resiliently urged in said first direction, and dielectric means pivotally interposed between the armature and the mobile contact and electrically insulating the actuating assembly from the mobile contact.

3. In a relay including a hermetically sealed housing, a plurality of terminal leads extending into the housing, fixed contacts on the inner ends of at least two of said leads, a mobile contact assembly comprising a strap-like conductive member pivotally supported by one of its ends on a terminal lead common to the leads provided with said fixed contacts, means for moving the mobile contact assembly including a solenoid actuated spring-pressed armature within the housing, and resilient means interposed between the armature and an intermediate portion of the mobile contact to effect pivotal movement of the mobile contact without flexure in response to movement of the armature.

4. The combination according to claim 3, in which said means interposed between the armature and mobile contact comprises a pair of dielectric spheres pivotally supported on the mobile contact and a thrust member having one end trapped between the spheres and its other end fixed to the armature.

5. The combination according to claim 4, in which said thrust member comprises a resilient wire having a looped portion trapped between the spheres.

6. In an electromagnetic relay including a housing, a mobile contact within the housing comprising a strap-like conductive member having two oppositely extending pairs of integral tabs spaced along the strap-like conductive member, means supported on the housing and extending between the tabs constituting one pair and pivotally connected thereto, a magnetically responsive armature movably mounted within the housing, a pair of dielectric spheres supported between the tabs of the other pair thereof, and a thrust member mounted at one end on the armature and having its other end trapped between said dielectric spheres.

7. The combination according to claim 6, in which said thrust member comprises a resilient wire looped at

one end and having its other end secured to the armature with portions of said spheres projecting into the loop from opposite sides thereof.

References Cited by the Examiner

UNITED STATES PATENTS

1,905,751	4/1933	Rankin.	
2,472,274	6/1949	Beleskas	200—153.18
2,911,498	11/1959	Sausser	200—153.18 X
2,933,572	4/1960	Howell et al.	200—144.2
3,026,394	3/1962	Jennings	200—144.2
3,033,957	5/1962	Dean	200—87 X
3,042,774	7/1962	Hawkins	200—144.2
3,079,481	2/1963	Jennings.	
3,119,911	1/1964	Cherry	200—87
3,161,749	12/1964	Perry et al.	200—144.2

BERNARD A. GILHEANY, *Primary Examiner.*

ROBERT K. SCHAEFER, *Examiner.*

B. DOBECK, *Assistant Examiner*