United States Patent

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[54] **VACUUM COAXIAL RELAY WITH TANDEMLY MOVABLE CONTACTS AND STATIONARY GROUNDING CONTACTS**
10 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **200/153,** 200/144, 333/97
[51] **Int. Cl.** **H01p 1/10,** H01h 33/66, H01h 45/14
[50] **Field of Search** ..... 200/144.2, 153.18; 333/97 (S), 7 (Cursory); 335/152 (Cursory), 206

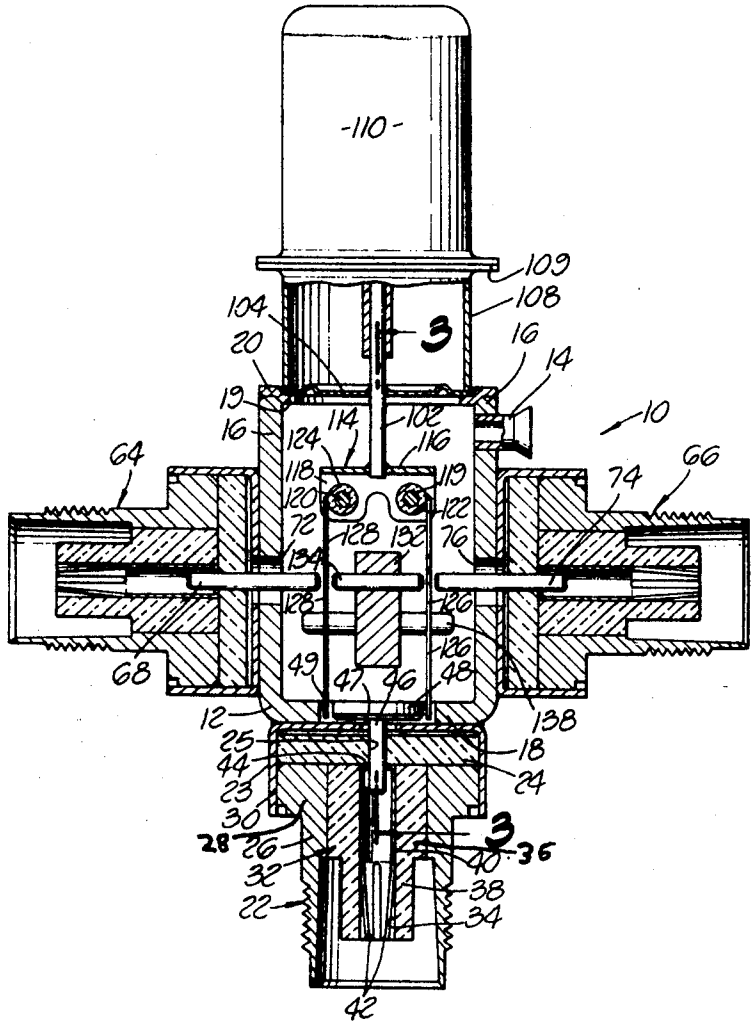
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ABSTRACT: The disclosure relates to a coaxial relay wherein a pair of contacts are movable in tandem in a vacuum environment. When one contact connects a common terminal to a first output terminal the other contact is connected to ground thus isolating the energy which may be coupled to a second output terminal. Further, when the common terminal is connected to the second output terminal the first contact isolates the first output terminal in a similar manner. The contacts are made of a thin flexible metal mounted on a saddle which is connected to a shaft. Movement of the shaft is transferred through the saddle to the contact, causing the desired switching to occur.



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SHEET 1 OF 2

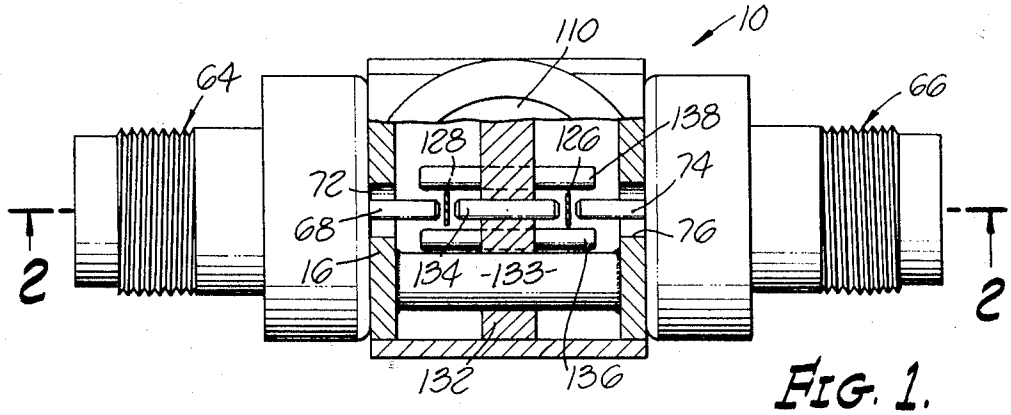


FIG. 1.

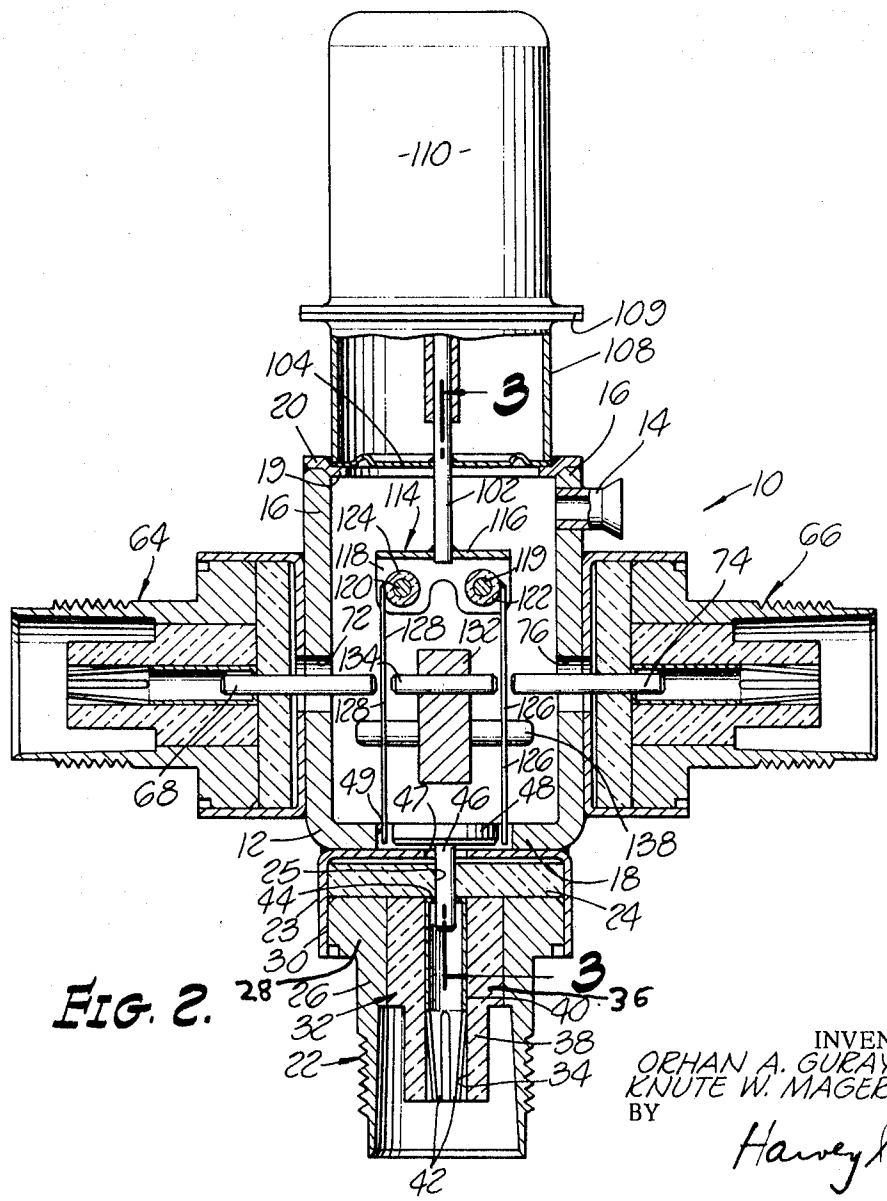


FIG. 2.

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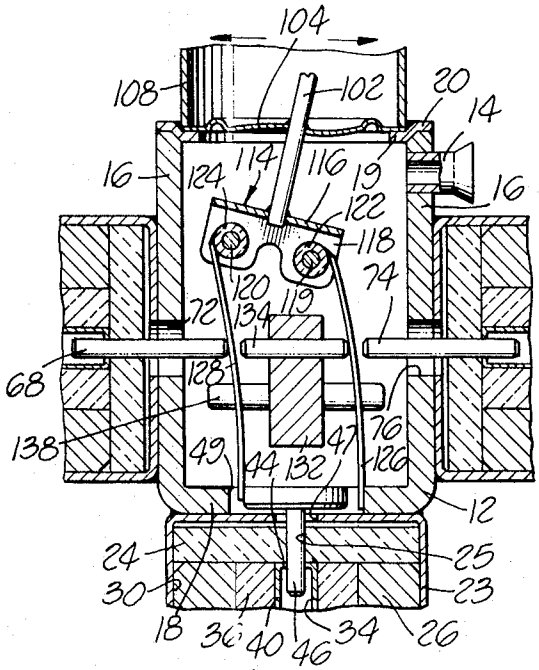


FIG. 5.

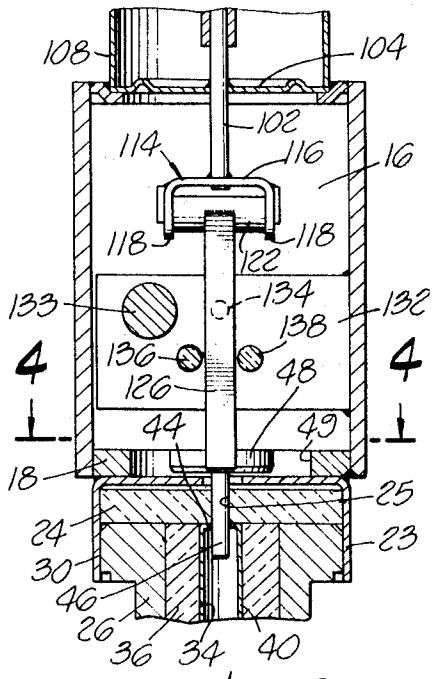


FIG. 3.

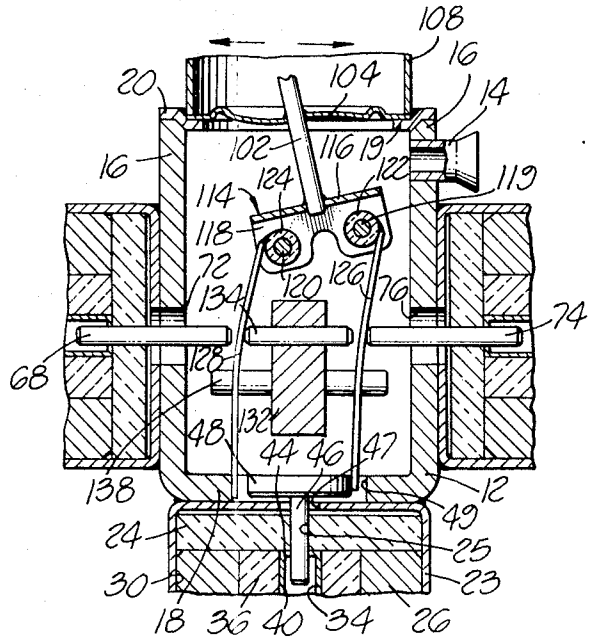


FIG. 6.

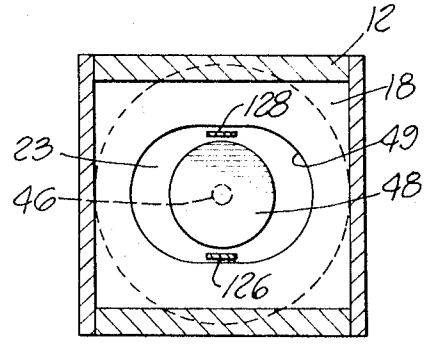


FIG. 4.

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VACUUM COAXIAL RELAY WITH TANDEMLY MOVABLE CONTACTS AND STATIONARY GROUNDING CONTACTS

VACUUM COAXIAL RELAY

The invention relates in general to vacuum coaxial relays and more particularly to a relay for isolating an unused output terminal when electrical energy is to be coupled between an input terminal and a pair of output terminals.

BACKGROUND OF THE INVENTION

Conventional single-pole double-throw mechanical relays normally have one moving contact which is in contact with a common terminal all the time. When transfer is made by energizing an actuator, the moving contact moves from a first output terminal to a second output terminal to complete the new path. Such a conventional relay normally has poor isolation between the moving contact and the unused output terminal resulting in coupling of electrical energy between the moving contact and the unused terminal. Further, such conventional coaxial relays are relatively slow in switching. Moreover, conventional coaxial relays have high RF (radio frequency) losses or insertion losses due to contamination of the contacts. Also, conventional relays have relatively low power carrying capacity compared to the size of the relay and a relatively low breakdown voltage.

In order to overcome the attendant disadvantages of prior art coaxial relays, the present invention provides high isolation between the unused relay terminal and the terminals having energy transmitted therethrough. Moreover, the relay provides a rapid actuation system for readily switching between terminals. Also by providing such a relay in a vacuum, contact contamination is virtually eliminated while simultaneously the power carrying capacity and breakdown voltage of the relay is greatly increased.

SUMMARY OF THE INVENTION

More particularly, the invention comprises a coaxial relay for electrically coupling a common terminal to a selected one of a first terminal and a second terminal. A first contact and a second contact are mounted in a housing. Relay actuating means are provided for moving the contacts tandemly so as to couple one of the contacts between the common terminal and one of the first and second terminals while simultaneously coupling the other contact between the other of the first and second terminals and the housing. The housing may be evacuated with the contact moving means mounted on a diaphragm which may form the top walls of the evacuated housing. Further, the contacts may be formed of a thin flexible conductive material extending into the slot formed in the bottom wall of the housing adjacent to the input terminal. The other end of the contacts may be secured to the contact moving means. A ground terminal may be provided adjacent the output terminal with the contact being coupled to the housing simultaneously being coupled to the ground terminal. Further, means may be provided for guiding the movements of the contacts.

The advantages of the invention both as to its construction and mode of operation will be readily appreciated as the same become better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the FIGS.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view, partly in section, of a preferred embodiment of a coaxial relay of the invention;

FIG. 2 depicts a front view partly in section of the coaxial relay of FIG. 1 in its nonoperational mode taken along the lines 2–2 of FIG. 1;

FIG. 3 is a side view partly in section of the coaxial relay of FIG. 2 taken along the lines 3–3 of FIG. 2;

FIG. 4 is a top view of the coaxial relay in section taken along the lines 4–4 of FIG. 3;

FIG. 5 depicts the coaxial relay shown in FIG. 2 in a first operational mode; and

FIG. 6 depicts the coaxial relay shown in FIG. 2 in a second operational mode.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is shown in the FIGS., a preferred embodiment of the coaxial relay **10** in accordance with the invention. The relay **10** comprises a main body **12** which is preferably evacuated through a tube **14** in its sidewall **16**. The body **12** further comprises a bottom wall **18** and an open top end **19** which terminates in a flange surface **20**.

A common terminal **22** of the relay is formed of a receptacle connector adjacent the bottom wall **18** of the body **12** and comprises a cup-shaped metal member **23** whose outer bottom surface is brazed or welded to the outer bottom surface of the bottom wall **18**. The bottom portion of the cup-shaped member **23** is filled with a cylindrical disc **24** of dielectric material having an opening **25** through the center thereof. Further, the terminal **22** is formed of a cylindrical metal member **26** the end of which comprises an annular radially outwardly extending shoulder **28** whose rear surface abuts the dielectric member **24** and is brazed or welded at its outer radially extending surface **30** to the inner surface of the cup-shaped member **23**. Further, a dielectric support member **32** having an opening therethrough **34** is fitted within the member **26**. The member **32** comprises an enlarged rear portion **36** and a reduced diameter forward portion **38**. Secured within the opening **34** is a socket member **40** whose forward portion comprises spring fingers **42** and whose rear portion **44** is secured to a pin contact **46**. The pin contact extends through the opening **25** of the dielectric member **24** and through an opening **47** in the rear wall of the cup-shaped member **23**. The pin contact **46** is brazed to a cylindrical contacting member **48** having a diameter less than an opening **49** in the bottom wall **18**.

The coaxial relay **10** further comprises a first output terminal **64** and a second output terminal **66** having a construction similar to that of the input connector **22**. The output connectors **64** and **66** are mounted on diametrically opposite sides of the sidewall **16** of the body **12** and may be brazed or soldered thereto. A pin contact **68** of the connector **64** extends through an opening **72** in the sidewall **16** and a pin contact **74** of connector **66** extends through an opening **76** in the sidewall **16**.

The actuator for the relay comprises a shaft **102** which extends through a flexible diaphragm **104** covering the top end **19** of the main body **12**. The diaphragm is normally brazed to flange **20** of top end **19**. Also secured to the flange **20** is an actuator cover **108** whose flange end **109** is secured to an actuator cover **110** which normally houses an actuator for moving the shaft **102**. The shaft **102** is secured within a hollow cylindrical member attached to the actuator within cover **110**.

The bottom of the actuator shaft **102** which extends into the body **12** is secured to a saddle **114**. The saddle **114** normally comprises a top section **116** and a pair of side bars **118** integral therewith, as is best illustrated in FIG. 3, to form a U-shaped member when viewed in a side view. Secured between the side members **118** is a first pin **119** and a second pin **120**. Surrounding the pins **119**, **120** are a first insulator bar **122** and a second insulator bar **124**, respectively. Secured to the bars **122** and **124** by means of brazing, are a pair of contacts **126**—**128**, respectively. Each of the contacts extend from the insulator bar **122** and **124**, straight down to the opening formed between the bottom wall **18** and the cylindrical contact member **48**. Each of the contacts **126**—**128** are formed of relatively thin flexible conductive material such as molybdenum which can withstand high temperatures and has high spring characteristics.

A ground plate **132** is housed within the main body **12**. The ground plate **132** is a rectangular shaped member which extends between two opposite sidewalls of the main body **12** and has an axis perpendicular to that of the contacts **68** and **74**. A cylindrical member **133** perpendicular to the axis of ground plate **132** is also secured to the sidewall **16** and to the ground plate **132** thus forming an additional ground connection as well as a support for the member **132**. Further, a tubular electrical ground contact **134** in the center of the body **12** is secured to the ground plate **132** and is axially aligned with both of the contacts **68** and **74**, but spaced therefrom at its ends. A pair of insulator posts **136** and **138** extend perpendicular to the axis of the ground plate **132** and are secured thereto. The posts are longer than the ground contact **134** and spaced apart a distance slightly greater than the width of the moving contacts **126—128**. The insulator posts **136—138** serve as a guide for the moving contacts **126—128**.

Referring now to FIGS. **5** and **6**, operation of the relay is as follows. When the top of actuator shaft **102** is moved to the right in the drawings, as shown in FIG. **5**, the shaft rocks at the diaphragm. This motion of the shaft is transferred to the contacts **126—128** through the saddle **116**, the pins **119**, **120** and the insulators **122—124**. The contacts being brazed on the insulators are free to turn on the pins. The top portion of the contacts move to the left until the contact **128** touches the contact **68** and the end of the contact **128** touches the contact **48**. Simultaneously, the contact **126** touches the pin **134** connecting the contact **126** to ground through the ground plate **132**. Further, the bottom of the contact **126** is also connected to ground through the bottom wall **18**. Thus, a path is formed from the connector terminal **22** to the connector terminal **64** while simultaneously the pin contact **74** of the connector terminal **66** is capacitively coupled to ground through the contact **126**.

Referring now to FIG. **6**, it can be readily seen that when the actuator is moved to the left, energy is transferred from the connector terminal **22** to the connector terminal **66** with the contact of connector terminal **64** being capacitively coupled to ground through the contact **128**.

While the terminals **64** and **66** have been referred to as output terminals, it should be understood, of course, that the terminals **64** and **66** could be input terminals as well, with the common terminal **22** comprising an output terminal.

We claim:

1. An evacuated coaxial relay for electrically coupling a common input terminal to a selected one of a first terminal and a second terminal comprising: first and second contacts mounted in an evacuated envelope, said first and second contacts being formed of thin flexible conductive material, said contacts each extending at one end into a slot formed in the wall of the housing adjacent said input terminal; and relay actuating means connected to the other ends of said contacts for moving said contacts tandemly so as to couple one of said contacts between said common terminal and one of said first and second terminals and contemporaneously coupling the other of said contacts at least to said housing.

2. A coaxial relay in accordance with claim **1** and further comprising a ground terminal adjacent said first and second terminals, said contact being coupled to said housing and simultaneously being coupled to said ground terminal.

3. A coaxial relay in accordance with claim **2** and further comprising means secured to said ground terminal for guiding the movement of said contacts.

4. A relay having at least one single-pole double-throw arrangement and actuating means for providing electrical continuity between a common external coaxial terminal and a selected one of first and second independent external coaxial terminals, comprising the combination of: a conductive enclosure in electrical contact with the outer conductors of all of said external coaxial terminals; a first fixed contact corresponding to the extended center conductor of said first independent external coaxial terminal extending through a wall of said enclosure; a second fixed contact corresponding to the extended center conductor of said second independent external coaxial terminal extending through a wall of said enclosure substantially in spaced opposition with said first fixed contact; a third fixed contact corresponding to the extended center conductor of said common external coaxial terminal extending within said enclosure substantially at right angles to said first and second contacts, said third contact being spaced laterally from said first and second contacts; means comprising a pair of elongated resilient conductive strips arranged in substantially parallel relationship and extending adjacent said third contact at one extremity and beyond said first and second contacts at the other extremity; means responsive to said actuating means for flexing said strips in tandem between first and second extreme positions whereby contact between said first fixed contact and said third contact is effected by one of said strips in said first extreme position, and contact between said second fixed contact and said third contact is effected by the other of said strips in said second extreme position; and means comprising a portion of the interior of said conductive housing for contacting the extremity of the one of said first strip not in contact with said fixed contacts during each of said extreme positions.

5. Apparatus according to claim **4** in which said housing includes an interior spaced shoulder adjacent to and spaced from said third fixed contact and the extremities of said strips adjacent said third fixed contact extend within the space between said third fixed contact and said shoulder on opposite sides of said third fixed contact.

6. Apparatus according to claim **5** including a conductive mechanical member electrically grounded to said enclosure and spaced between said first and second fixed contacts to engage said strips selectively.

7. Apparatus according to claim **5** in which said strips are joined by an insulating spacer at their extremity on the side of said first and second fixed contacts opposite said third fixed contact and said spacer is responsive to said actuating means for flexing said strips in tandem between said first and second extreme positions.

8. Apparatus according to claim **5** including an electrically floating mechanical member between, and spaced from, said first and second fixed contacts to provide a mechanical fulcrum operative against one of said strips at a corresponding one of said extreme positions.

9. Apparatus according to claim **7** in which said mechanical member is equally spaced from, and substantially between, the internally extending ends of said first and second contacts.

10. The invention according to claim **9** in which said conductive enclosure is evacuated.