Sept. 25, 1956 A. F. HORLACHER 2,764,656

RELAY

Filed July 26, 1952

Fig. 1.

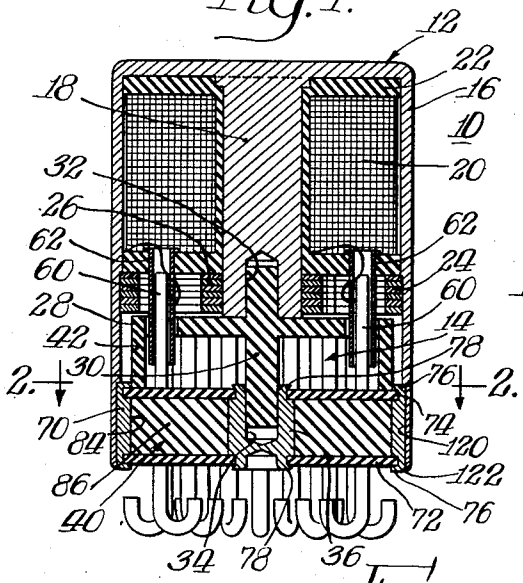



Fig. 2.

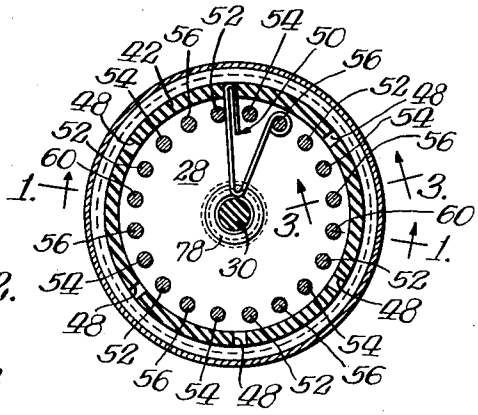



Fig. 4.

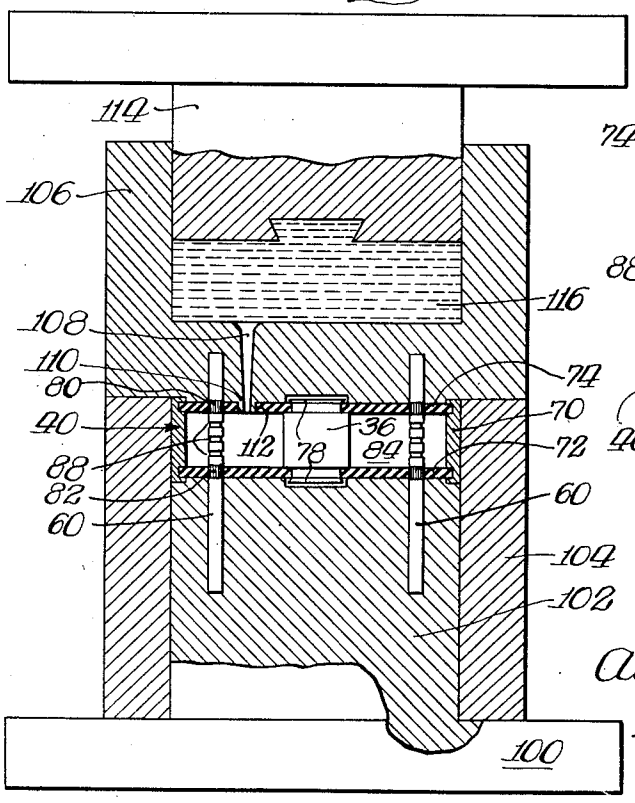
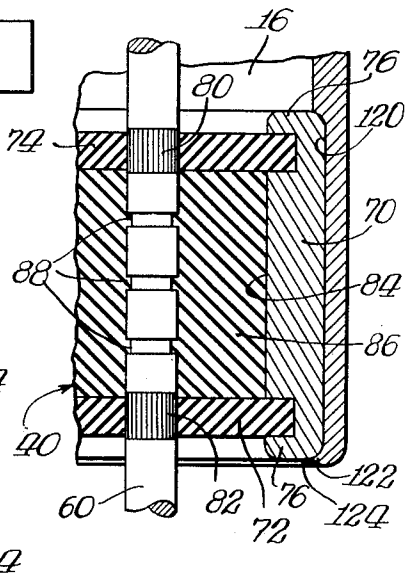



Fig. 3.

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2,764,656

# RELAY

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Application July 26, 1952, Serial No. 301,096

12 Claims. (Cl. 200—168)

The present invention relates to electric relays, and more particularly to improved contact structures for relays which are especially suitable for use in applications where they are likely to be subjected to considerable shock and vibration, required to be operated by small currents, over a wide temperature range, and which are required to be hermetically sealed.

Many efforts have heretofore been made to devise relays for use in installations in which vibration is prevalent and which are sealed and operated over considerable temperature ranges. Aircraft installations may be considered typical. It is thus an object of the present invention to provide a new and improved relay which is operable under the conditions mentioned, and which is also economical to construct and assemble.

A further object of the present invention is to provide a new and improved relay which is sealed in a container to render it immune to moisture and injurious elements, whereby its field of use is expanded, and its operating life is increased.

A further object of the present invention is to provide a new and improved contact structure, particularly adapted for relays, comprising a base or supporting structure including contact pins or terminals mounted in spaced apart relationship within a tubular member and sealed thereto in gas-tight relation by a rubber compound vulcanized in situ under pressure.

A further object of the present invention is to provide a new and improved relay base and contact structure, including means for securing the contacts or terminals in fixed and spaced relation, means for hermetically sealing the contacts to the base structure, and also providing the base structure with means whereby it can be secured in gas-tight relation to suitable relay housing means.

A further and more specific object of the present invention is the provision of a new and improved contact structure, including a tubular metallic shell, a pair of circular plates of rigid insulating material held in opposed spaced relation by the shell, a series of contacts or terminals extending through and rigidly secured to the plates, and sealing means extruded into the space between the plates and secured to the shell, plates and contact terminals.

A further object of the present invention is to provide a new and improved method for producing contact-base structures which comprises the steps of assembling a tubular shell and end plates to form a hollow housing, inserting contacts or terminals through the plates, extruding a vulcanizable material preferably such as a substitute rubber compound, e. g., neoprene, into the space bounded by the shell and end plates, and then vulcanizing the neoprene in situ while maintaining it under pressure.

In brief, the contact structure of the present invention includes a cylindrical shell of metal such as brass, a pair of circular end plates of insulating material such as silicone fiber glass, and preferably also a central supporting and bearing defining element of metal such as brass. The end plates are provided with a series of apertures for the reception of contact or terminal pins. The latter are



provided with knurled portions so located that when the pins are inserted through the end plates they are held fixedly by the latter. The end plates are secured to the cylindrical shell and to the central supporting element with the contact pins preferably protruding through opposite sides of the assembly. Thereafter, vulcanizable rubber compound, preferably a synthetic compound, such as neoprene, is inserted into a chamber defined by the end plates, shell and bearing structure, and cured or vulcanized while maintained under pressure and at an elevated temperature. The result is a very rigid and efficient hermetically sealed base-contact structure that can be utilized for various purposes and particularly in the manufacture of hermetically sealed relays comprising a housing which can be secured to the shell.

Other objects and advantages of the present invention will become apparent from the ensuing description of an illustrative embodiment thereof, in the course of which reference is had to the accompanying drawing in which:

Fig. 1 is an axial cross-section through a relay constructed in accordance with the invention, the view being taken generally along the line 1—1 of Fig. 2, and with the movable contact structure omitted;

Fig. 2 is a transverse sectional view taken along the line 2—2 of Fig. 1 and showing but one of the several movable contacts with which the relay is provided;

Fig. 3 is an enlarged fragmentary cross-sectional view taken along the line 3—3 of Fig. 2; and

Fig. 4 is a sectional view illustrating apparatus utilized during the manufacture of the combined base and contact structure.

Referring now to the drawing, the relay of the present invention is illustrated in its entirety by the reference character **10**. It may include many features of the similar relay disclosed and claimed in my copending application, Serial No. 230,169, filed June 6, 1951, and assigned to the assignee of this application.

The relay may comprise two units **12** and **14**. Unit **12** consists of a cup-shaped housing **16** and a central axially extending core **18**, both made of magnetic material. Unit **14** consists of the remainder of the relay and includes, in brief, a coil **20**, a coil bobbin **22**, a magnetic stator **24** in intimate contact with the interior of housing **16** and located adjacent the lower (as viewed in Fig. 1) end of bobbin **22** to which it may be secured, a rotor **26** rotatable about the lower end of core **18**, a generally cup-shaped contact actuator **28** of insulating material to which the rotor is secured and provided with a shaft **30** rotatably mounted in a counterbore **32** at the end of core **18** and in a counterbore **34** formed in a stud **36** secured to base structure **40** which is constructed in accordance with the present invention.

The rotor **26** and actuator **28** constitute an assembly. The actuator **28** has an axially extending peripheral outer wall **42** provided with a series of spaced apart axially extending slots into which the outer ends of the movable contacts **50** (of which but one is shown in Fig. 2) extend so that when the rotor-actuator is turned in response to the supply of electrical energy to the winding **20**, the various contacts are moved as away from engagement with a first stationary contact and into engagement with a second contact. The stationary normally engaged contacts, which are shown as contact pins, are indicated by the reference characters **52** while the stationary normally non-engaged contacts are indicated by the reference characters **54**. The movable contacts, it may be noted, are fixedly secured at one end to other stationary contact pins such as **56**. The pins may be made of suitable material such as brass or silver.

The base assembly includes also the diametrically opposed pins **60** which are longer than the others and through which an energizing circuit for the coil **20** is com-

pleted through the tubular connectors **62**, as best illustrated in Fig. 1.

As heretofore indicated, the contact structure is constructed in accordance with the present invention. It includes the various contact pins **52**, **54**, **56**, and **60**, and these are fixedly secured in hermetically sealed fashion in the base. The base includes a tubular, preferably circular, shell **70** made of some suitable material such as brass, from which the stud **36** is also made. The base further includes a pair of generally circular rigid end plates **72** and **74** which are preferably made of silicone fiber glass. The plates are secured to the shell by the bent or rolled over end flanges **76** provided at opposite ends of the shell and defining internal shoulders at opposite ends of the shell. The stud is secured in central apertures in the end plates by bending or peening over the flanged end portions **78** of the stud which define external shoulders. It is seen that with this type of construction the end plates are rigidly and effectively secured in fixed spaced apart relation relative to each other by the shoulders on the end shell and stud against which the central and outer portions of the end plates abut.

In order securely and rigidly to hold the contact pins in position, the end plates are provided with a number of small spaced apart openings having diameters substantially equal to or slightly less than the outside diameters of the pins. The pins are provided with knurled portions **80** and **82**, as best illustrated in Fig. 3, so that when the pins are driven into place in the end plates they will be structurally held rigidly in place by the knurled portions. The knurling should be relatively heavy to insure good holding.

The contact pins are effectively hermetically sealed as is the remainder of the contact structure inside of the shell in a novel manner. In accordance with the present invention there is introduced into the space or chamber, indicated by reference character **84** and provided by the shell and end plates, a vulcanizable substitute rubber compound, such as neoprene, indicated by the reference character **86**. The neoprene is inserted into the space by apparatus such as that illustrated in Fig. 4 and it is therein vulcanized under pressure and at an elevated temperature. Additionally to hold the pins, the latter may be provided with a series of annular grooves **88** into which the extruded and vulcanized neoprene extends.

One form of apparatus that can be used in carrying out the process of forming the seal is illustrated in Fig. 4. The apparatus here shown is of the type using a transfer molding process. It includes a supporting base structure **100** having an upstanding central cylindrical portion **102** surrounded by a tubular member **104** extending a short distance above portion **102** and providing a space at the upper end of the structure for the reception of the unfilled base structure **40**. Portion **102** is provided with suitable apertures for the reception of the pins, of which only pins **60** are shown. It will be noted that the lower plate **72** is seated upon the support **102** and that a depressable press element **106** is shown seated upon the upper side of the top plate **74** whereby the plates are both held against movement away from each other. Press element **106** is also provided with suitable apertures for the reception of the terminal pins. It is also provided with a discharge opening **108** from which projects a nozzle **110** through which the neoprene can be supplied under pressure to the chamber **84**, the upper plate **74** being provided with a small opening **112** into which the nozzle **110** projects. The press element has associated with it a punch **114** adapted to be moved downwardly thereby to force the neoprene confined within a supply cylinder **116** through the discharge opening **108** of nozzle **110** into the interior of the base structure. The neoprene is forced into the interior at a substantial pressure, say about one and one-half or two tons total for the base structure shown which has a diameter of approximately one inch. The



neoprene is slowly vulcanized or cured, while the pressure is maintained, by the application of heat thereto through the molding apparatus which may be maintained at an elevated temperature. The result is a construction in which the neoprene is very effectively bonded to the brass structures, such as the stud, end shell and contact pins, and yet good adhesion is achieved between the neoprene and terminal pins which may be made of coined silver instead of brass.

From the foregoing description it is apparent that the base-pin assembly can be fabricated readily and economically. There is produced an effective sealing between the terminals and the base structure, and the latter can also be effectively sealed to the housing. To do this the open end of the housing is provided with an inset portion **120** into which the base structure is placed. The open end then is rolled over the base structure as indicated by the reference character **122**, after which the rolled over parts can be sealed as by solder **124** thereby to provide a very adequately hermetically sealed structure. The interior of the housing can be evacuated and filled with inert gas if desired.

The apparatus of the present invention provides a mechanically accurate and rigid seal structure which is not likely to be adversely affected by shocks and vibrations and which will operate efficiently over wide temperature variations and under widely varying conditions of various sorts. It enables low resistance contact pins to be utilized with effective sealing and there is no likelihood of mechanical tolerances being exceeded during construction. While disclosed in connection with a relay structure, the invention may be utilized elsewhere, as in the construction of contact structures of various types.

While the present invention has been described in connection with the details of an illustrative embodiment thereof, it should be understood that it is not intended to be limitative of the invention except as set forth in the accompanying claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A contact structure, including in combination, a pair of rigid plates of insulating material, a unitary structure supporting said plates in a substantially fixed parallel spaced apart relationship and for preventing movement of said plates toward each other so as to define a cavity, and contact pins mounted upon said plates and extending through said cavity, each of said pins having spaced apart portions configured non-rotatably securing the pin to each of said plates.

2. A contact structure, including in combination a pair of rigid plates of insulating material, supporting structure embracing the edges of each of said plates to hold them in a substantially fixed parallel spaced apart relationship and to prevent movement of said plates toward each other so as to define a cavity, and contact pins mounted upon said plates and extending through said cavity, each of said pins having spaced apart knurled portions non-rotatably securing the pin to each of said plates.

3. A contact structure, including in combination, a pair of rigid plates of insulating material, structure rigidly supporting said plates in a substantially parallel spaced apart relationship to form a chamber and for preventing movement of said plates toward each other, contact pins secured to said plates, and a filling of rubber compound under pressure in said chamber and vulcanized in situ to be bonded to said structure to form a sealed unitary contact structure.

4. A contact structure, including in combination, a pair of circular rigid plates of insulating material, a metallic cylindrical band engaging opposite surfaces of each of said plates for supporting said plates in a substantially fixed parallel spaced apart relationship and to prevent movement of said plates toward each other so as to define a cavity, and contact pins mounted upon said plates and extending through said cavity, each of said pins having

spaced apart portions configured non-rotatably securing the pin to each of said plates.

5. A contact structure, including in combination, a pair of circular, centrally apertured rigid plates of insulating material, means including a metallic cylindrical band secured to the outer peripheries of said plates and a stud secured to the central portions of said plates for supporting said plates in substantially parallel spaced apart relationship, contact pins mounted upon said plates and each having spaced apart portions configured non-rotatably securing the pin to each of said plates, and a filling of rubber compound vulcanized under pressure in the region between the band and plates to be bonded to the engaged surfaces of the band, pins, and stud.

6. The method of constructing a contact structure comprising assembling a pair of plates, a plurality of contact pins and a tubular shell to form a base structure including the plates in parallel spaced apart relationship with the pins passing therethrough and the shell surrounding the periphery of the plates to form a chamber, introducing a vulcanizable rubber compound into said chamber, and vulcanizing said compound in said chamber while maintaining it under pressure.

7. The method of constructing a contact structure comprising assembling a pair of plates, a plurality of contact pins and a shell to form a structure with the plates in spaced apart relationship within the shell and supporting the pins therein, introducing a vulcanizable rubber compound into said shell, and vulcanizing said compound while maintaining it under pressure against the pins, plates and interior of the shell.

8. The method of constructing a contact structure comprising assembling a plurality of elongated contact elements and a tubular shell means configured to delimit a hollow cavity and to support said elements in spaced apart relationship with the elements at least in part within the shell, introducing a vulcanizable rubber compound into said cavity, and vulcanizing said compound while maintaining it under pressure against the elements and interior of the shell.

9. A relay, including in combination, a base-contact structure including a metallic tubular shell, said shell having internal shoulders at its opposite ends, a pair of silicone fiber glass end plates mounted in said shoulders and secured thereto by bent over end portions of said shell, each of said plates having a central aperture, a stud having external shoulders at its opposite ends, the ends of said stud passing through the central apertures in said plates and having its ends bent over the plates to secure the stud to the plates, said plates having a series of aligned apertures therein, contact pins passing through the apertures, a filling of rubber compound vulcanized under pressure filling the region between the plates, shell and stud; and a housing element having an end portion encircling and hermetically sealed to said shell.



10. A relay, including in combination, a base-contact structure including a metallic tubular shell, said shell having internal shoulders at its opposite ends, a pair of silicone fiber glass end plates mounted in said shoulders and secured thereto by bent over end portions of said shell, each of said plates having a central aperture, a stud having external shoulders at its opposite ends, the ends of said stud passing through the central apertures in said plates and having its ends bent over the plates to secure the stud to the plates, said plates having a series of aligned apertures therein, contact pins passing through the apertures, said pins being substantially of the same size as the apertures and having knurled portions securely engaging the plates and grooved portions between the plates, a filling of rubber compound filling the region between the plates, shell and stud and vulcanized therein under pressure; and a housing element having an end portion encircling and hermetically sealed to said shell.

11. A contact structure including a metallic tubular shell, said shell having internal shoulders at its opposite ends, a pair of silicone fiber glass end plates mounted in said shoulders and secured thereto by bent over end portions of said shell, each of said plates having a central aperture, a stud having external shoulders at its opposite ends, the ends of said stud passing through the central apertures in said plates and bent over the plates to secure the stud to the plates, said plates having a series of aligned apertures therein, contact pins passing through the apertures, said pins being substantially of the same size as the apertures and having knurled portions securely engaging the plates and grooved portions between the plates, and a filling of rubber of compound vulcanized under pressure filling the region between the plates, shell and stud.

12. The method of constructing a sealed contact structure which comprises assembling a pair of plates having apertures in a spaced relation within a hollow shell to define a chamber, inserting a plurality of contact elements in said apertures so that a portion of each of the pins is positioned within the chamber, injecting a mass of vulcanizable material into said chamber, and applying heat and pressure to said material to vulcanize said material in situ so that said material is bonded to the engaged surfaces of said shell and said contact elements.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,312,408 | Hansen | Mar. 2, 1943 |
| 2,389,592 | Bucklen et al. | Nov. 27, 1945 |
| 2,451,176 | Schellman | Oct. 12, 1948 |
| 2,451,810 | Cohen | Oct. 19, 1948 |
| 2,667,553 | Moorehead et al. | Jan. 26, 1954 |
| 2,668,207 | Bengtsson | Feb. 2, 1954 |