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3,323,199

METHOD FOR MAKING ELECTRICAL COMPONENTS

Original Filed Dec. 20, 1962

FIG. 1

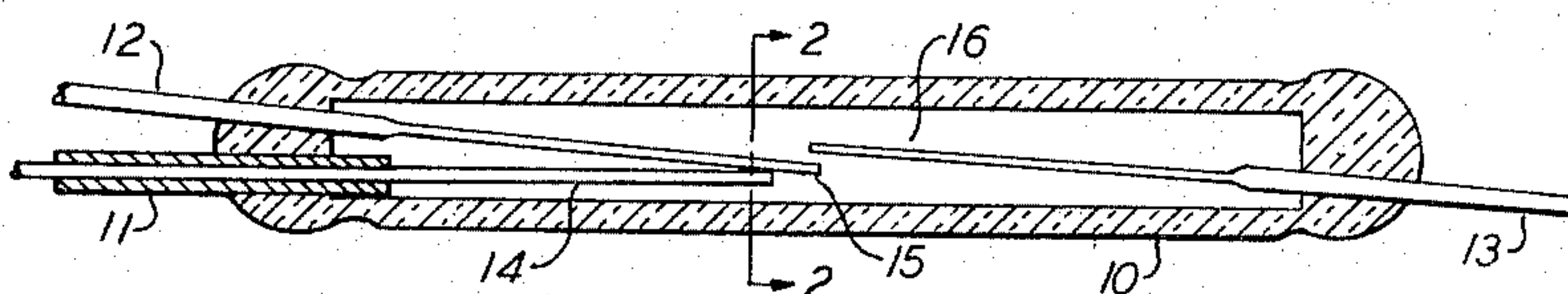


FIG. 2

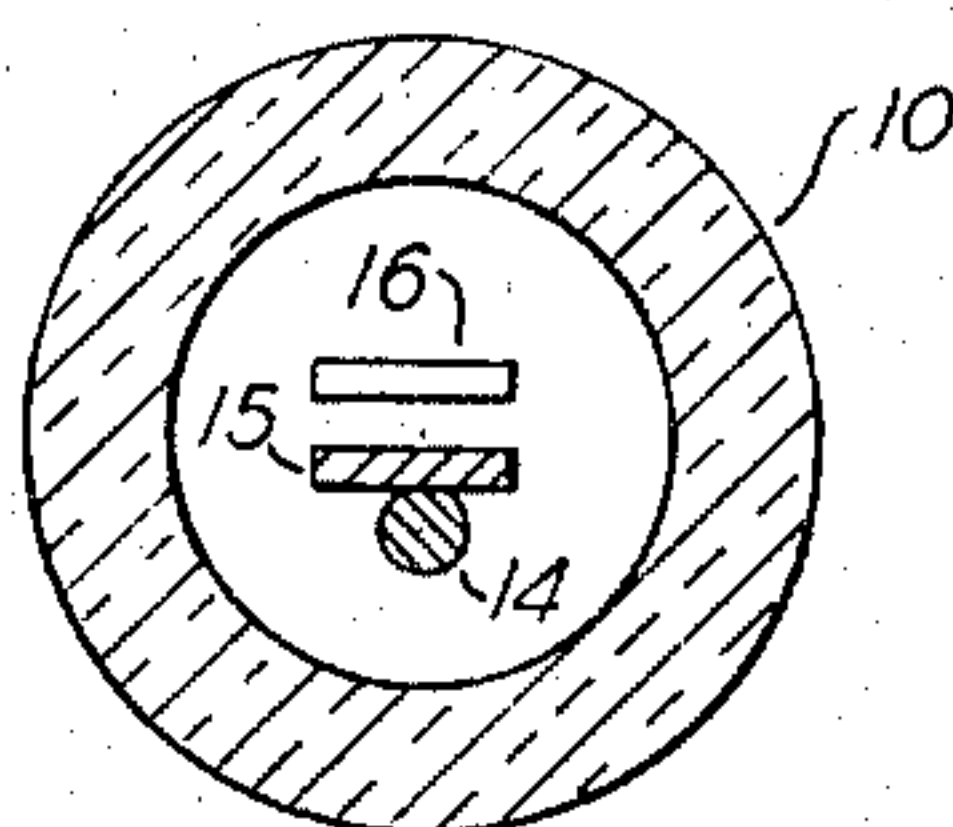


FIG. 3

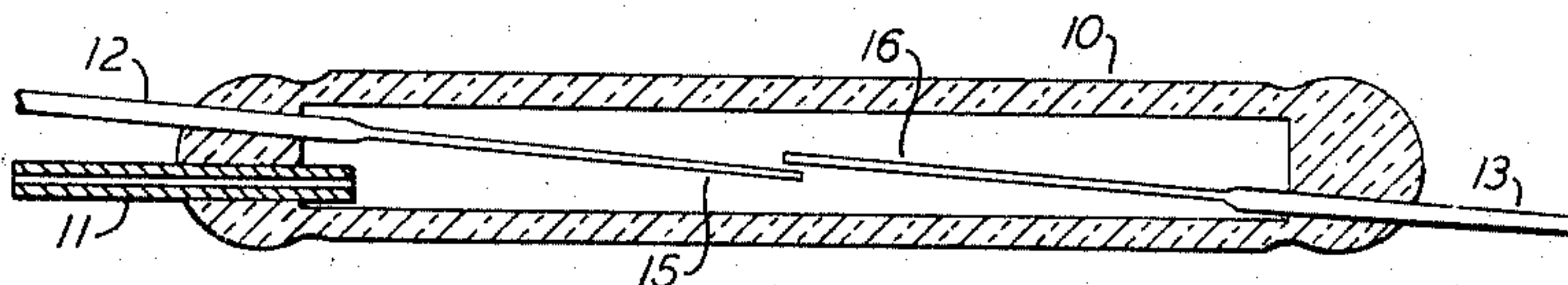
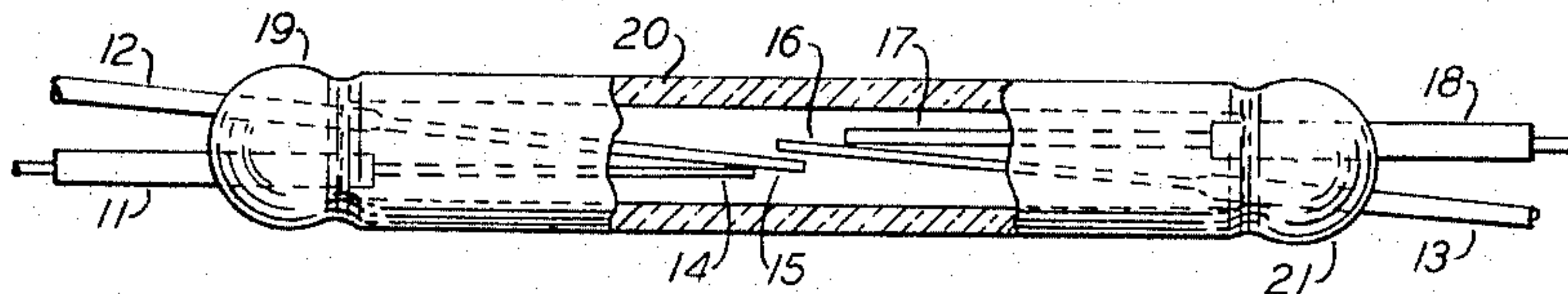


FIG. 4



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METHOD FOR MAKING ELECTRICAL COMPONENTS

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Original application Dec. 20, 1962, Ser. No. 246,193, now Patent No. 3,261,939, dated July 19, 1966. Divided and this application Apr. 5, 1965, Ser. No. 445,541

1 Claim. (Cl. 29—155.5)

This invention relates to circuit controlling devices, and more specifically, to methods for making reed devices of the switch relay or transfer type and is a division application of my previous application, Serial No. 246,193, filed on December 20, 1962, now Patent No. 3,261,939.

In general, circuit controlling devices of the reed type comprise a plurality of conducting elements that are encapsulated within a sealed container, the number of elements depending upon the design function of the device. All, or some of the elements, are usually made from materials sensitive to magnetic forces and the most usual encapsulating material is glass.

The transfer type switch presented by a substantial part of the prior art comprises three electrically conducting elements sealed in a definite geometric pattern in the extremities of an elongated glass tube. For the purpose of description, the elements can be referred to as a front contact member, back contact member and a swinger contact member. The geometric pattern previously referred to generally comprises the sealing of the back contact contiguous to the swinger which is in contrast to the spaced positioning of the swinger with respect to the front contact. The individual contacts can be fixed in either end of the tube depending upon the mechanical configuration desired.

The device as described above is in the unoperated position, that is, with the swinger in electrical contiguity with the back contact. The description of how the device is operated is contained in my previous application.

The operation of the device results in the swinger traversing the space between it and the front contact. Electrical continuity is established between the swinger and the front contact and a space or electrical discontinuity is established between the swinger and the back contact when the device is operated.

The device must be made in such a way that after it is operated it will automatically return to its unoperated position. In order to ensure the return of the swinger member to contiguity with the back contact, it is desirable to prestress, in some way, the two latter mentioned elements against each other. The prestressing creates a force between the swinger and back contact that urges the swinger toward the back contact. This force ensures electrical continuity between the swinger and back contact but because of the dimensions of the various elements, their critical spacing and physical properties, serious problems are encountered in the manufacture of these devices.

Since these devices are usually operated by magnetic forces, one of the factors that contributes to the magnitude of the magnetic force necessary to operate the device is the physical dimensions of the various elements. Physical dimensions of the elements formed from magnetic material determine the limits of magnetic flux that can be generated within the elements before they become satu-

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rated. The physical dimensions further define the force necessary to deflect the swinger across the gap between it and the front contact. Therefore, the cross sections of the elements must be large enough to allow the build up of magnetic forces sufficient to attract the movable members across the air gap yet not so great that the forces required to move the swinger across the space cannot be generated before the elements become magnetically saturated.

The spacing between the elements is also critical because it directly affects the force necessary to cross the gap between the swinger and the front contact. Since the elements are essentially cantilever beams, the force necessary to deflect the beam is directly proportional to the distance the beam is deflected. The greater the spacing between the swinger and the front contact, the greater the force needed to operate the device.

In addition, if the prestressing between the swinger and the back contact is too large, there is a tendency for the back contact to follow the swinger across the spacing when it is magnetically operated and cause a short circuit of the three elements. If the prestressing is too little, when the magnetic biasing is released the swinger and back contacts may have a tendency to oscillate which may result in intermittent breaks in electrical continuity called chattering. Prestressing directly affects the response speed of the device since it is extremely difficult to accurately operate the mechanism when any of its parts are in motion.

Obtaining the proper magnitude of prestressing between the movable or swinging member and the back contact introduces further problems. If an attempt is made to define the degree of prestressing between the movable member and the back contact, and the critical spacing of the elements within the encapsulating envelope before the elements are sealed in the encapsulating material, the heating and cooling of the material may substantially alter or anneal away the desired properties and can, in some instances, introduce unwanted stress patterns.

The critical problem therefore arises in establishing, during the manufacturing process, the contact force between the swinger element and the back contact and the spacing of the various elements within the device once the physical dimensions of the elements have been determined.

The invention is embodied within a method for making a device that comprises a plurality of elements within the ends or side walls of an elongated tubular container or envelope. At least one of the sealed elements is a tube or duct member. An electrical conductor is then inserted through the tube or duct member until it comes into physical and electrical contact, on the inside of the envelope, with another of the elements that was sealed in an envelope end. The inserted member becomes a back contact and the other element becomes the movable or swinger member. The contact force between the members is then adjusted and controlled by varying the depth of insertion of the inserted member in the tube. When the proper degree of contact force has been obtained, a portion of the tube is physically deformed or crimped and sealed about the member.

The above method provides obvious advantages. For example, all the elements of the device can be sealed within the ends of the glass container in a free or unstressed condition while the glass container material is hot without fear of annealing away any desired stress patterns. The

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stress or contact forces between the swinger and back contact members are introduced through the subsequent insertion process when the container material is cold, thereby alleviating the problem of annealing the sealed members.

Another advantage is the furnishing of means for controlling and adjusting the amount of contact force by the insertion of the back contact through the tube.

Other objects, advantages and features will be obvious and understood from the following detailed description when read in conjunction with the drawing, in which:

FIG. 1 is a sectional view of a device manufactured by one embodiment of the invention;

FIG. 2 is a sectional view of the device shown in FIG. 1 taken generally along line 2—2 of FIG. 1;

FIG. 3 is a sectional view of the device shown in FIGS. 1 and 2 before the manufacturing process is completed; and

FIG. 4 is a sectional view of another device manufactured by another embodiment of the invention.

In accordance with the various figures and especially with reference to FIGS. 1 and 2, the device comprises an elongated container 10, sealed in the ends of which are a variety of elements including an apertured element or an access tube 11 and two reed members 12 and 13. The shape of the container 10 shown in the various figures is for illustrative purposes only. The invention may be practiced by sealing the elements or members within the side walls of a container 10 regardless of its shape if the relationship between the elements, members, and the container 10 is maintained as subsequently described. Those portions, including the ends of the members 12 and 13 that are encapsulated within the container 10 are flattened in cross section into a ribbon or reed-type generally rectangular cross section. One dimension of the rectangle is much greater than the other dimension and the reeds therefore have a tendency to bend preferentially in the direction of the smaller rectangular dimension. For the purposes of disclosure, the movable member 12 will be designated as a swinger or swinger member and the member 13 will be designated as a front contact or front contact member. The swinger 12 and the front contact 13 are held within the container 10 such that their ends 15 and 16 respectively, are in a spaced apart relationship in the unoperated position shown in FIGS. 1, 2 and 3. The apertured element or access tube 11 is held in the end of the container 10 such that its axial line intercepts the swinger 12 near its end 15. A back contact 14 that is crimped within the access tube 11 is in electrical and physical contact with the swinger end 15.

The method of making the device comprises sealing the tube 11 and the two reed members 12 and 13 in the ends of the container 10 while the container material is still hot. Because the elements are in a free position and not in a deflected or prestressed state, the heat from the container does not affect them in that it cannot anneal away any desired contact forces or stresses that are to be subsequently generated.

After container material has cooled, the device will appear as shown in FIG. 3. The back contact 14 which is complementary to access tube 11 as is shown in FIG. 1, is then inserted through the access tube 11 until it contacts the swinger end 15. It is apparent that the degree of insertion of the back contact 14 within the tube 11 determines the contact force between the back contact 14 and the swinger end 15 and the gap spacing between the swinger end 15 and the front contact end 16. The contact forces and reed spacing can be controlled and adjusted by varying the insertion depth of the back contact 14 in the tube 11. The contact force and spacing of the elements 12 and 13 are not subject to the annealing heat of the hot container material because they are established subsequent to the cooling of the container 10.

After the desired amount of contact force between the swinger 15 and the back contact 14 has been established, a portion of the duct, apertured element, or access tube 11 is crimped, or in some other similar manner physically

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deformed and sealed around the back contact 14 to fix or make permanent the physical relationship of the elements within the container 10.

It is to be noted that the access tube 11 can further be used to define the atmosphere inside the container of a special environment, such as an inert argon atmosphere is desired.

FIG. 4 illustrates another embodiment of the invention, in that the device shown is capable of a multiplicity of switching functions. FIG. 4 describes a device comprising an elongated container 20 having sealed in each of its ends a reed member and an access tube. In end 19 of the container 20 is sealed a swinger member 12 and an access tube 11, while in end 21 access tube 18 and front contact member 13 are sealed. Crimped or permanently fixed within the tube 11 is a back contact member 14 and within tube 18 is a second back contact member 17.

The device is assembled by sealing the swinger 12, the contact member 13, and the access tubes 11 and 18 in the ends of the container 20. The end 15 of the swinger 12 overlaps and is spaced away from the end 16 of the front contact 13.

The access tubes 11 and 18 are sealed within the ends of the container 20 such that the axial center line of the tube 11 intersects the end 15 of the swinger 12 and the axial center line of the tube 18 intersects the end 16 of the front contact 13. Back contact 14 is then inserted through access tube 11 and back contact 17 is inserted through tube 18.

The device as shown in FIG. 4 is in its unoperated position; that is, the end 15 of the swinger 12 is spaced away from the end 16 of the front contact 13. The back contacts 14 and 17 are inserted through the access tubes 11 and 18, respectively, so that the ends of the back contacts 14 and 17 come in contact with the ends 15 and 16 of the swinger 12 and the front contact 13, respectively. The contact force between the back contact 14 and the end 15 and the contact force between the back contact 17 and the end 16 and the spacing between the end 15 and the end 16 may be adjusted by adjusting the depth of insertion of the back contacts 14 and 17 in their respective access tubes 11 and 18.

Similar to the device shown in FIGS. 1, 2 and 3, the contact force and spacing of the various elements of the device shown in FIG. 4 are isolated from the annealing heat of the sealing operation in which the various members were sealed within the ends of the encapsulating material.

Although two embodiments of the invention have been disclosed, it will be obvious to those skilled in the art that modifications too numerous to mention may be made without departing from the spirit and scope of this disclosure and the appended claim.

What is claimed is:

A method for making a magnetically actuated glass-encapsulated sealed reed switch of the type having an elongated rigid glass chamber and two opposed, controllable reed members supported in said chamber ends, at least one of which members is deformable, comprising the steps of:

orienting the two reed members within their supportive glass chamber ends so that the contact ends of said reed members are in spaced-apart, overlapping relation;

orienting an axially straight access tube within and through the chamber end supporting said deformable reed so that the tube axis intersects the contact end of said deformable reed and said tube inner end is adjacent thereto;

positioning said access tube outer end to extend well outwardly of its supportive chamber end;

sealing and cooling said glass chamber ends to fix the orientations of said two reed members and of said access tube;

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inserting a rigid complementary electrical conductor through said access tube and into physical engagement with said adjacent reed member contact end; adjusting the force between said engaged reed member and said rigid conductor, thereby to adjust said space relation between said reed contact ends; and crimping said access tube to said rigid conductor to secure said conductor and seal said tube.

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