Nov. 3, 1964 W. D. O'BRIEN 3,155,478

ADJUSTMENT OF SEALED REED CONTACTS

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FIG. 1

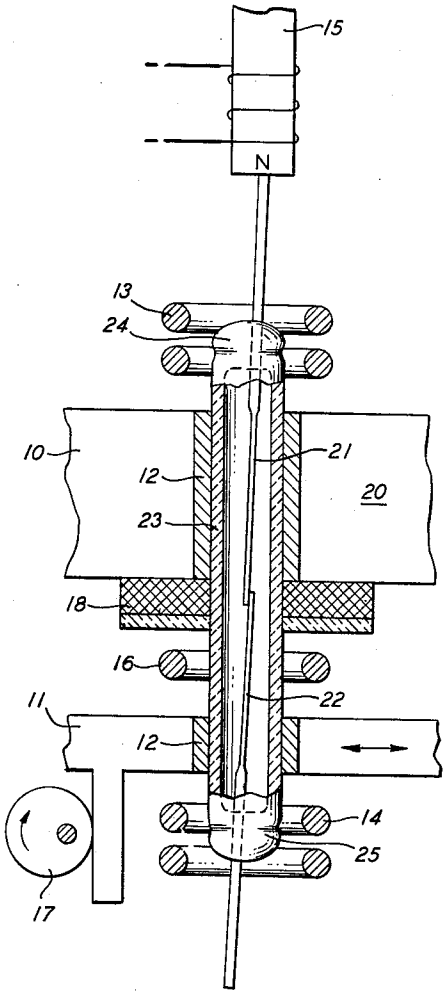
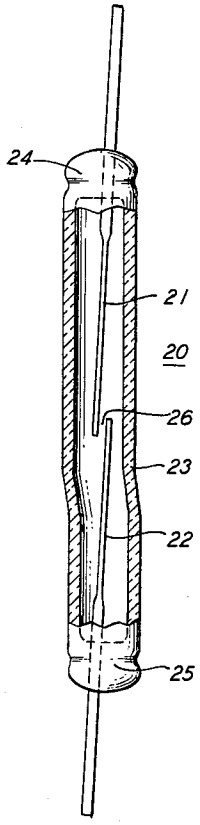


FIG. 2



INVENTOR
W. D. O'BRIEN
BY John C. Morris
ATTORNEY

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FIG. 3

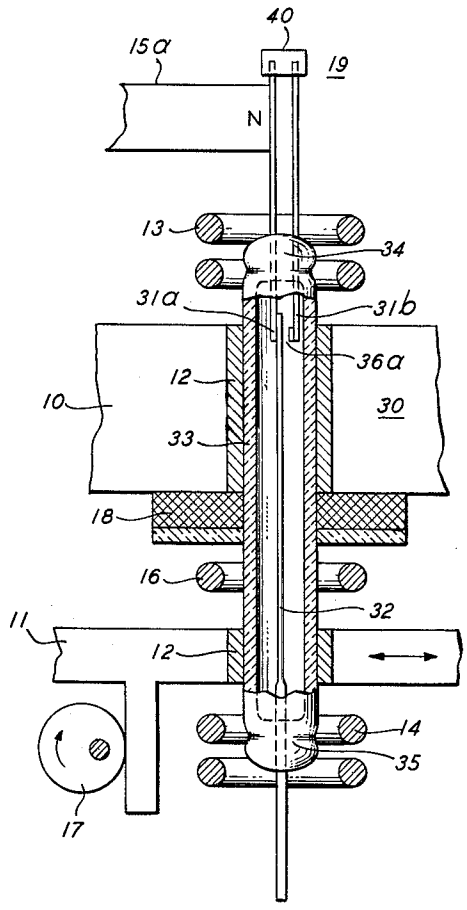
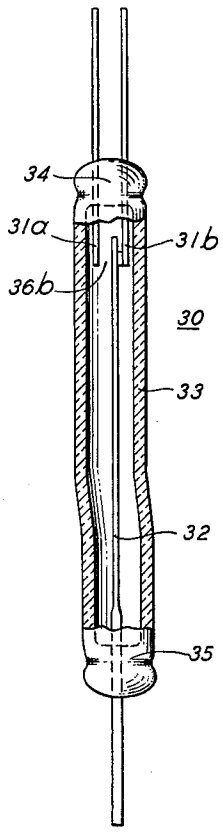


FIG. 4



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ADJUSTMENT OF SEALED REED CONTACTS

William D. O'Brien, New York, N.Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York

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This invention pertains to the fabrication of switches assembled in glass tubes and particularly relates to the process of reshaping tubes in which switch contacts of the reed type have been bonded. The glass tubes are reshaped in order to precisely adjust the orientation of the contacts sealed therein.

Switches of the type to which this invention applies generally comprise two or more magnetically responsive, relatively flexible reed members sealed in opposite ends of an encapsulating glass tube. The reeds are sealed in the tube in cantilevered, overlapping relation. At least two of the reeds are so sealed as to have an air gap between their overlapping ends. The resulting structure is commonly known as a reed switch. In order to establish a switching function, a magnetic field is impressed along the length of the tube through the overlapping reeds and the air gap therebetween. When a magnetic field is so applied, a force of attraction is developed between the overlapping reeds. As a consequence, the attracted reeds move together. When the reeds come together, electrical continuity is established therebetween. Conversely, removal of the magnetic field breaks electrical continuity by eliminating the force of attraction and permitting the reeds to move apart. In practice it has been found that the operating characteristics of the resulting switch depend largely on the orientation of the reeds or contacts sealed in the tube. As a consequence, it is advantageous to be able to adjust reed or contact orientation with precision. In the past many methods of orienting the contacts have been used. One representative method is the so-called "free-reed" process. The following steps are illustrative of the process:

(1) Two reeds or contacts, overlapped at their tips, are suspended in a magnetic field.

(2) The overlapped reeds are surrounded by a length of glass tube open at both ends.

(3) The top of the glass tube is sealed about the uppermost reed.

(4) The lower reed is moved away from the upper reed until a proper air gap is obtained between the overlapping tips.

(5) The air gap adjustment is made permanent by sealing the bottom of the glass tube about the lower reed.

While the foregoing has described the assembly of a switch having only two reeds, switches having more than two reeds are easily assembled in a like manner. However, it has been found that the heat required to make the seal in step 5 adversely affects the equilibrium relationships in the alloy from which reeds are commonly made. As a consequence, air gap adjustments, and back contact pressure in three element switches, are uncontrollably affected.

It is, therefore, an object of this invention to improve the method in which sealed contact reed switches are assembled.

A more specific object of this invention is to minimize the adverse effects on reed orientation caused by the heat of sealing.

These and other objects are obtained in accordance with the present invention wherein a sealed contact reed switch is assembled in a series of steps as follows:

(1) Two or more reeds are sealed in the ends of a glass tube in overlapping relation.

(2) The glass tube with the reeds sealed therein is placed in a clamping member and held firmly gripped at each end while heat is applied to the glass tube intermediate its ends until the tube material softens.

(3) The clamping members are moved with respect to each other whereby the tube is distorted along its long axis and the orientation between reeds or pressure between reeds is precisely adjusted.

(4) The tube is allowed to cool thereby permanently fixing the reed orientation.

Accordingly, a feature of this invention lies in the steps, and the order in which they occur, of fabricating a sealed contact reed switch wherein the switch is assembled, sealed, and then operatively adjusted.

Another feature of this invention is the process of softening and deforming a glass tube in order to obtain precise adjustment of the orientation of the reeds or contacts sealed therein.

This invention will be understood more clearly and fully from the following detailed description when taken with reference to the accompanying drawing in which:

FIG. 1 is a front view, partially sectioned, of one form of apparatus illustrative of this invention;

FIG. 2 is a sectioned view of a sealed contact reed switch of the type fabricated in accordance with this invention;

FIG. 3 is another front view, partially sectioned, of the apparatus shown in FIG. 1 wherein a sealed contact reed switch of the three element transfer type is being fabricated; and

FIG. 4 is a sectioned view of a sealed contact reed transfer switch fabricated in accordance with this invention.

Referring now to the drawing, FIG. 1 shows a switch 20 comprising reeds 21 and 22 sealed in overlapping relation in a tube 23. The switch 20 has one end gripped in a clamp 10 and the other end gripped in a clamp 11. The walls of the tube 23 are glass, and are protected from the clamps 10 and 11 by a material 12 which may also be conveniently designed to absorb heat. As shown, the switch 20 has been assembled but not adjusted. The ends 24 and 25 of the tube 23 have been sealed about the reeds 21 and 22, respectively, by the sealing coils 13 and 14. A source of magnetic field, illustrated by a coil 15, was used to suspend the reeds 21 and 22 by their tips in overlapping relation within the glass tube 23 until the ends 24 and 25 were sealed. The result is the illustrated switch 20.

In order to complete the fabrication of the switch 20, a heat coil 16 is used to heat and soften the glass walls of the tube 23. When the glass has softened sufficiently, a cam 17 moves the clamp 11 laterally with respect to the clamp 10 and subjects the tube 23 to a distorting force along the tube long axis. As a result, the tube 23 deforms and the tips of the reeds 21 and 22 are separated. The resulting separation is the air gap 26 shown in FIG. 2. Proper control of the air gap 26 during deformation is assured by continuous monitoring by a test coil 18. The completed switch 20 is shown in FIG. 2. It will be readily understood that adjustment of reed overlap can be accomplished in a similar manner by applying tensile or compressive forces to the softened tube. The material 12, while primarily protective, may be designed to absorb the heat generated in softening the tube 23 and may conveniently be an aluminum oxide ceramic. As a consequence, the heat will be conducted away from the reeds 21 and 22.

In FIG. 3 is shown a switch 30 of the three element transfer type which comprises the reeds 31*a*, 31*b*, and 32 sealed in overlapping relation in a tube 33. The tube 33 is conveniently made of glass, while the reeds 31*a* and 32 are ordinarily made of a magnetic material. The reed 31*b* may or may not be magnetic material as desired. As illus-

trated, the switch 30 has been assembled but not adjusted. In assembling the switch as shown, a contact assembly 19 was suspended in the unsealed tube 33 and held in place by the magnet 15*a*. As shown in FIG. 3, the contact assembly 19 includes the reeds 31*a*, 31*b*, and 32 with a clip 40 for firmly holding the reeds 31*a* and 31*b* a spaced distance apart. Further, the tip of the reed 32 was held in the contact assembly 19 magnetically suspended from the tip of the reed 31*a*. With the contact assembly 19 suspended in the tube 33, the end 34 was sealed by the sealing coil 13 and the position of the reeds 31*a* and 31*b* therein was permanently fixed. In a similar manner, the free end of the reed 32 was permanently fixed in the end 35 by the sealing coil 14.

The switch 30, as shown in FIG. 3, is completed in a manner identical to the completion of the switch 20 shown in FIGS. 1 and 2. The clamp 10 holds one end of the tube 33 while the clamp 11 holds the other end. The heating coil 16 softens the tube 33 and a distorting force is applied thereto by the cam 17. The air gap 36*b*, shown in FIG. 4, is substantially determined by the air gap 36*a* and the test coil 18 is used to monitor contact pressure between the reeds 32 and 31*b*. The completed switch 30 is shown in FIG. 4.

It is to be understood that the above-described arrangements are merely illustrative of the operation of the principles of the invention. It is expected that numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. The method of making a switch having reed contacts sealed in a glass tube, said tube having a long axis, comprising the steps of sealing a plurality of reed contacts in the ends of a glass tube in overlapping relation to one another in the plane of said long axis, clamping each end of the sealed tube in a suitable clamping member, heating a portion of the tube intermediate its ends until said portion becomes softened, and deforming said tube while said portion is soft by moving one clamping member with respect to the other a spaced distance in a direction perpendicular to the long axis of said tube whereby the orientation of overlapping reed contacts is adjusted.

2. The method of making a switch in accordance with claim 1 wherein the step of sealing a plurality of reed contacts in the ends of said glass tube comprises sealing a first reed contact in one end of said tube and sealing a second reed contact in the other end of said tube in an overlapping relation with said first reed.

3. The method of making a switch in accordance with claim 1 wherein the step of sealing a plurality of reed contacts in the ends of said glass tube comprises sealing first and second reed contacts parallel to one another in one end of said tube and sealing a third reed contact in the other end of said tube in an overlapping relation between said first and second reed contacts.

4. The process of adjusting the orientation of contacts in an encapsulating tube having a long axis comprising the steps of sealing at least one contact in each end of said tube, heating said encapsulating tube until the tube material softens sufficiently to permit distortion of said material, and thereafter distorting said tube until the desired orientation of contacts is obtained.

5. The process of adjusting the orientation of contacts sealed in an encapsulating tube in accordance with claim 4 wherein the contacts sealed in the ends of said tube are spaced in overlapping relation therein.

6. The process of adjusting the orientation of contacts sealed in an encapsulating tube having a long axis in accordance with claim 5 wherein one end of said tube is distorted with respect to the other end in a direction perpendicular to the long axis of said tube.

7. The process of adjusting the orientation of contacts sealed in an encapsulating tube having a long axis in accordance with claim 5 wherein said tube is heated and softened adjacent the area of contact overlap.

8. The method of adjusting the orientation of the contacts of a reed switch, said switch having oppositely extending overlapping reeds longitudinally sealed in a glass envelope, that comprises applying a clamp to each end of the envelope, softening an intermediate portion of the envelope, moving one clamp with respect to the other a controlled distance while said portion is soft to distort the envelope and move an associated reed sealed therein, and then hardening the softened portion of the envelope to retain the distortion.

9. The method of claim 8 in which the controlled distance is measured to space the contacts of the particular switch under adjustment from one another in their required relative positions.

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