

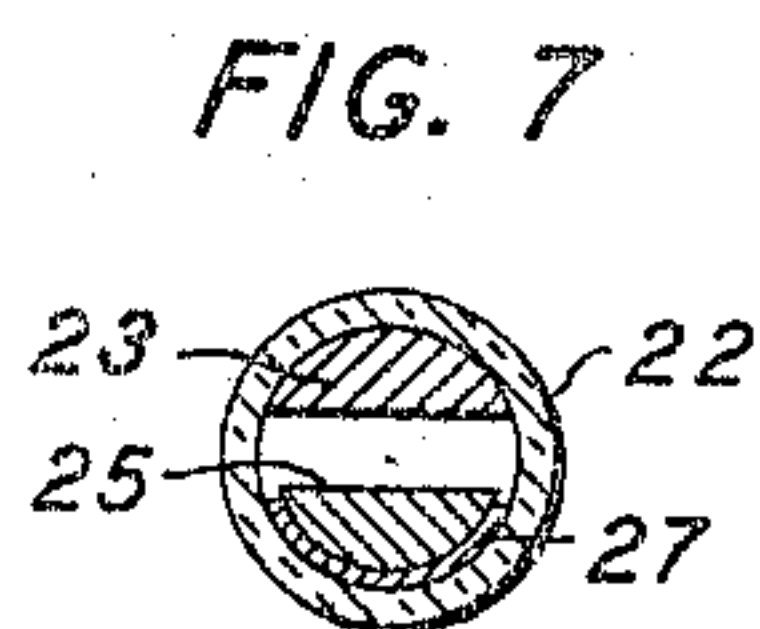
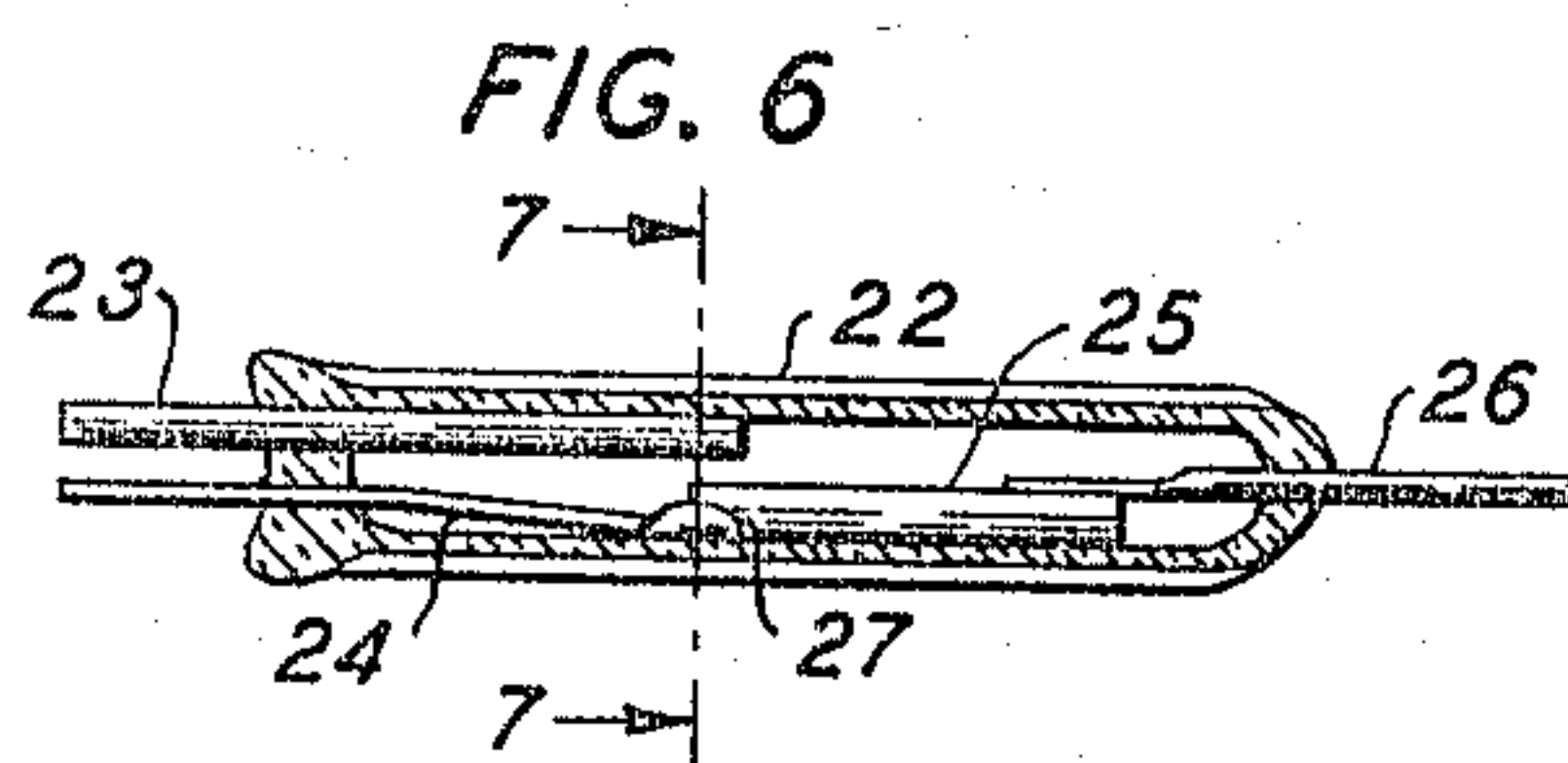
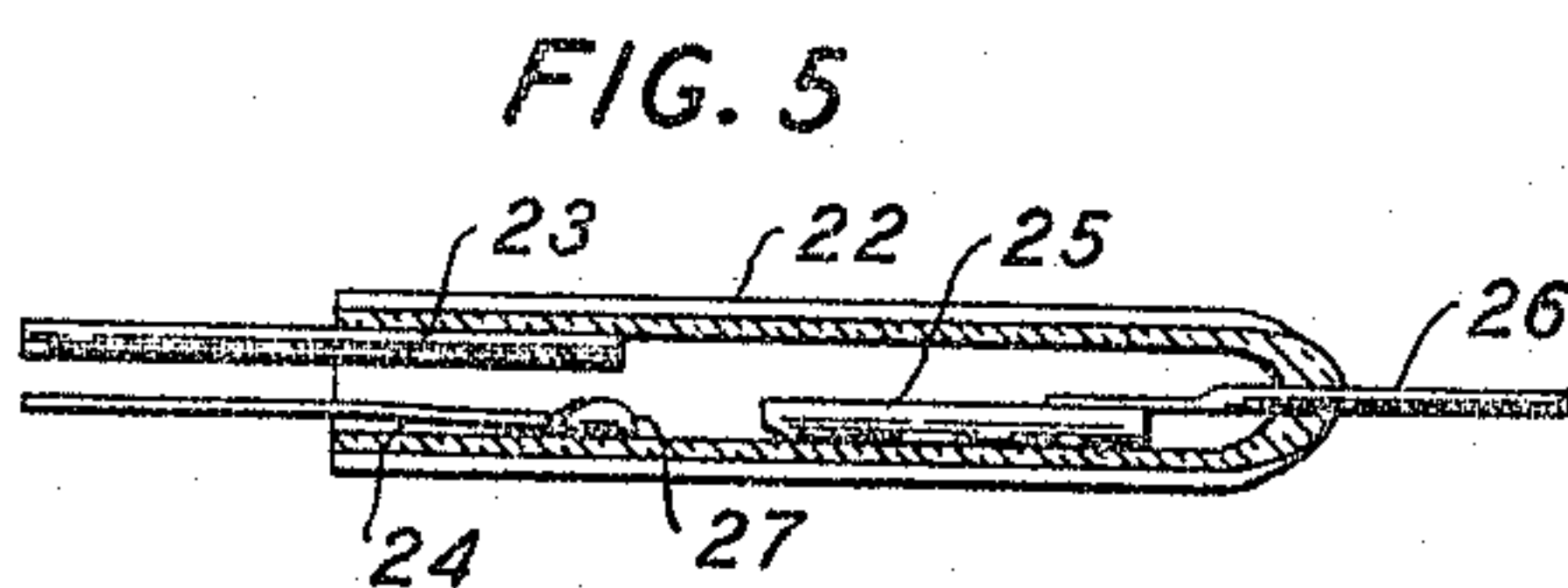
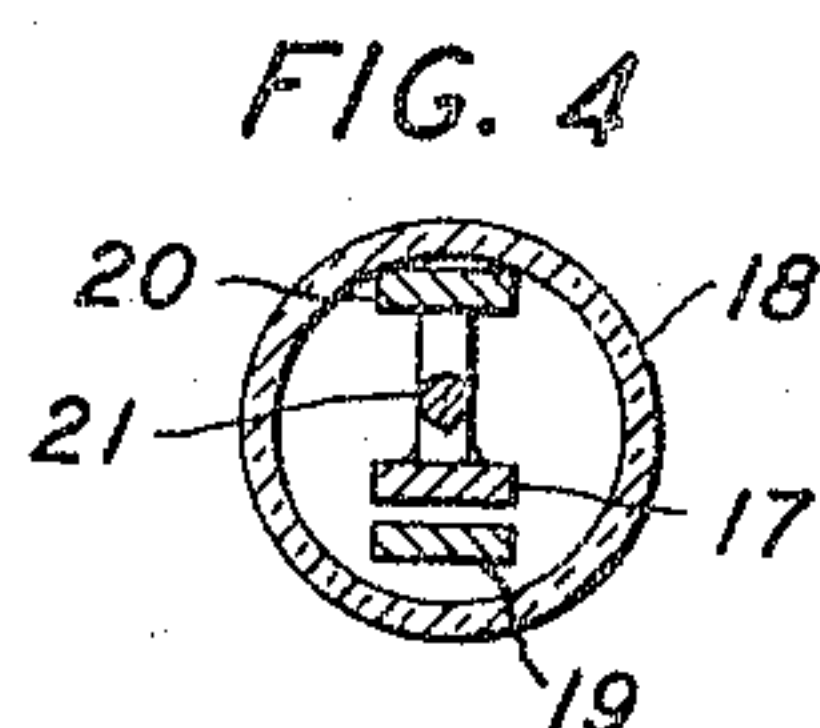
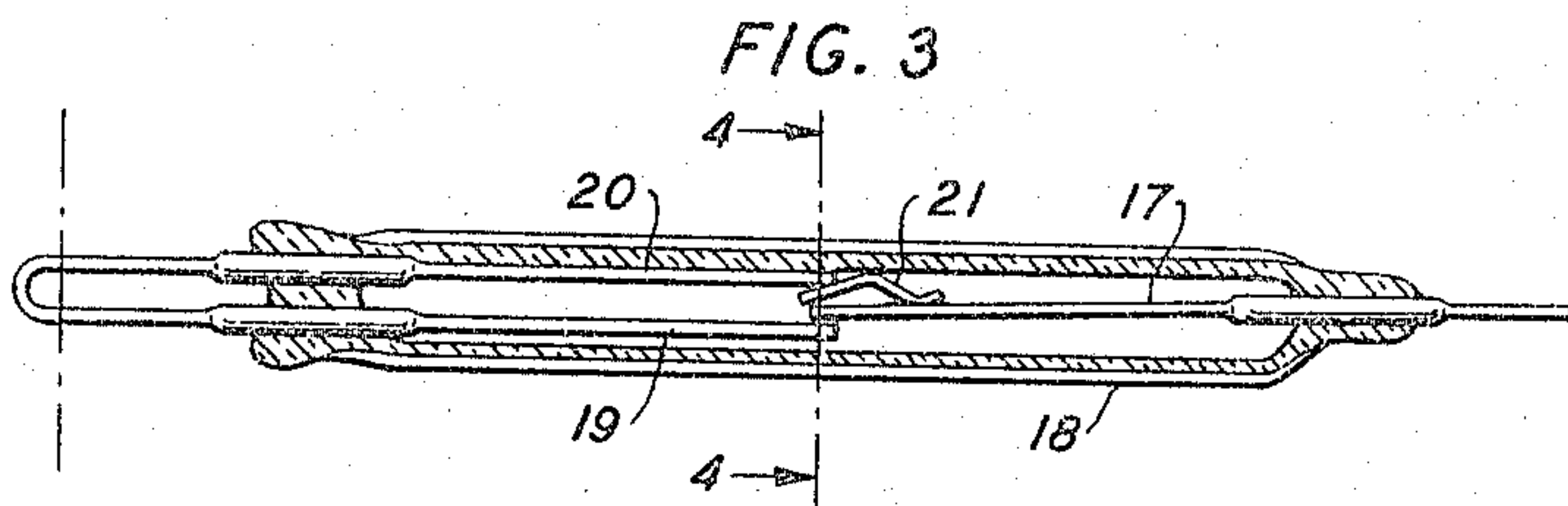
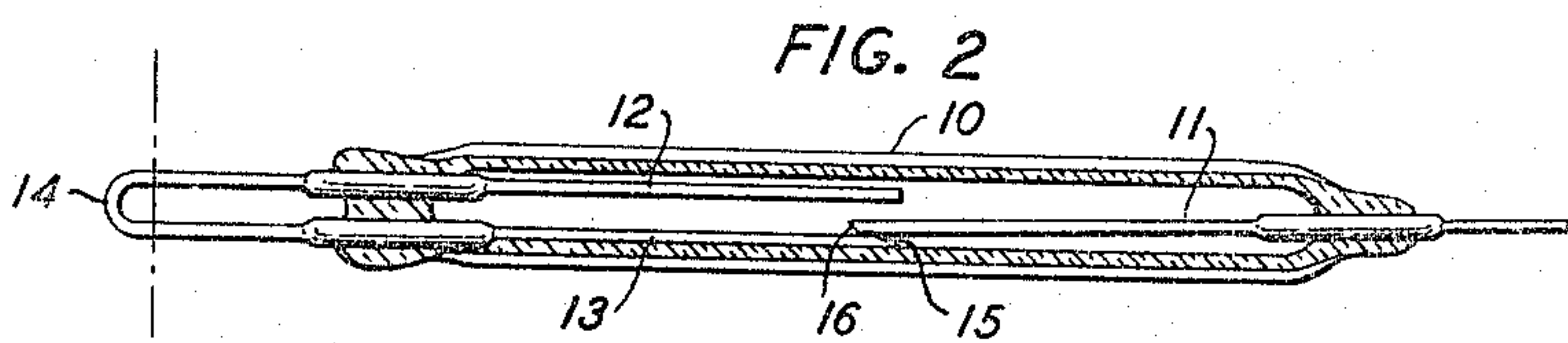
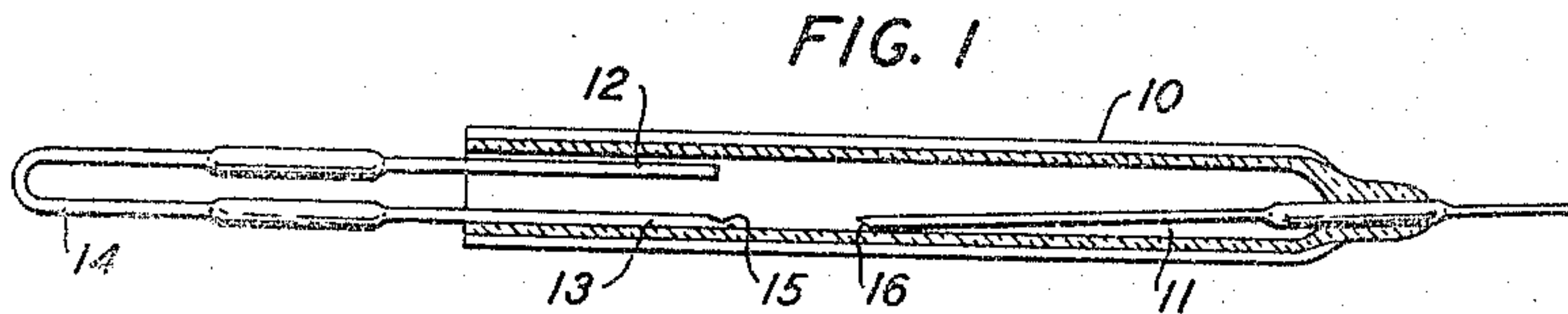
March 28, 1967

W. B. ELLWOOD ET AL

3,310,863

MANUFACTURE OF REED TYPE DEVICES

Filed April 10, 1963



INVENTORS: W. B. ELLWOOD
J. M. NIEDZWIECKI
BY John C. Morris

ATTORNEY

1

3,310,863

MANUFACTURE OF REED TYPE DEVICES

Walter B. Ellwood, New York, and Joseph M. Niedzwiecki, Haverstraw, N.Y., assignors to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York

Filed Apr. 10, 1963, Ser. No. 271,902

1 Claim. (Cl. 29—155.5)

This invention relates to circuit controlling devices and more specifically, to a method for manufacturing reed devices of the switch, relay, transfer or other similar type.

In general, circuit controlling devices of the reed type comprise a plurality of electrically conducting elements encapsulated and sealed within the ends of a container. The container is usually an elongated tubular member and the elements are sealed in a predetermined geometric orientation within its ends so that the design function, be it switching, transferring or other similar functions, takes place within the tube. The elements extend beyond the sealed ends so that electrical signals may be communicated to and from the device. The number of elements incorporated within each device depends upon the design function or the mechanical operations the device is proposed to accomplish. The element material can be magnetic or nonmagnetic and experience has indicated that glass is the most economic and practical encapsulating material.

The transfer switch presented by a majority of the prior art disclosures comprises three elements sealed within a glass container or enclosure. For the purposes of this disclosure and description, these elements may be called a front contact, a back contact, and a swinger or reed member. The elements are sealed in the ends of the enclosure so that the swinger is in mechanical and electrical contact with the back contact and spaced from the front contact when the device is in the rest position which will be subsequently defined. The swinger, or reed, is the electrical element located between the front and back contacts and is adapted to swing between them. That is, it is adapted to operatively traverse the gap established between the two contacts. The back contact is the contact in electrical and mechanical contiguity with the swinger when the device is in a rest position. The front contact is the spaced contact and the one to which the swinger swings when the device is operated. The elements may be sealed in either end of the container depending upon the geometric configuration desired.

The position described above is the unoperated or rest position—that is, with the swinger contiguous to the back contact. The device is operated by subjecting it to an appropriate actuating or motor force such as a magnetic force or force field. This may be accomplished in many ways such as by bringing the encapsulated structure into physical proximity to the field of a permanent magnet or other sources, or by passing an electrical current through turns of wire that have been wound around the container. If the front contact and swinger are of magnetic material, or if a preferential flux path, by design and selection of materials, is provided between the swinger and front contact, the swinger will traverse the space between it and the front contact and establish electrical continuity therebetween, thus creating a gap between it and the back contact. When the device is in such a position, it is designated as being in its operate, operated, transferred or switched position.

The device may be returned to its unoperated or rest position by removing the actuating force or terminating the flow of current through the wire wound around the container. The swinger will then return to its original position contiguous to the back contact.

2

In order to insure the proper return of the swinger, it is necessary in the manufacture of the device to provide prestressing between the swinger member and the back contact. The prestressing is also necessary to provide adequate contact force between the swinger member and back contact and to minimize or prevent other detrimental contact phenomena peculiar to devices of this kind such as contact chatter and oscillation of the members during or after the device has been operated. It is also desirable to be able to seal within the container or enclosure, an inert atmosphere, other than air, so that the device may operate over long periods of time without being affected by the detrimental effects of a natural environment. This requires an airtight seal between the elements and the container. Because of the above-mentioned requirements and others to be mentioned, serious problems are encountered in the manufacture of this type of device.

In particular, the paramount problem is the manufacture of the device with the desired amount of prestressing between the swinger member and back contact. The prestressing is particularly important because it determines the proper operation of the device. If the amount of prestressing is too great, and if the back contact is flexible, it may have a tendency to follow the swinger member when it is operated thereby causing all three members to come in contact with each other and thus short-circuiting the device. If the degree of prestressing is too small, then when the magnetic biasing is relieved, the back contact and the swinger member may be inclined to oscillate which may result in intermittent breaks in electrical continuity between them, called chattering. This affects the speed or response of the device in that it is extremely difficult to accurately operate the mechanism when its individual elements are in motion.

In addition, the degree of prestressing with its resultant force on the contact affects the net force required to move the swinger from the back to the front contact. The prestressing must be overcome before the swinger will traverse the air gap between the two contact members.

The air gap introduces another problem in that the previously mentioned force required to move the swinger member between the two contacts is also related to the gap width. Since the swinger member is essentially a cantilever spring, the greater the deflection of the lever required to traverse the gap, the more force required.

The manufacturing techniques of most of the prior art contemplate sealing the various elements within the tube by using special element materials and glass. The elements are held in the desired geometric orientation and then the ends of the glass tube are heated until they bond to the elements forming an elongated glass enclosure or container.

The main disadvantage of the indicated technique is that during the heating process and the consequent softening of the container material, the elements may yield elastically while in the molten or softened glass or may be affected by the sealing heat so that the predetermined gap width or degree of prestressing is annealed away, lost, altered, or changed an unknown amount. The result is that it is extremely difficult to predetermine the gap width, and also that the amount of prestressing, if any, resulting from the manufacturing process is unknown. In fact, because the physical dimensions of the elements are so small and the amount of heat required to significantly raise their temperatures is likewise small, the sealing operation and subsequent cooling may introduce unwanted and undesirable stress patterns.

The critical problem, therefore, is to establish during the manufacturing process, the gap width, contact force between the swinger member and back contact, and the spacing of the various elements within the enclosure once

3

the physical dimensions of the various components of the device have been determined.

It is an object of the invention to contribute to the manufacturing processes and techniques incorporated in the production of reed type devices.

A specific object is to overcome the problems encountered in determining the prestressing and placement of the various members of the device.

The invention contemplates a plurality of electrically conducting elements sealed within the ends of an elongated tube or envelope. The elements include a front contact, a back contact and a swinger member. The member is sealed in one end of the tube and the contacts in the other so that the back contact and swinger are contiguous to each other and the front contact spaced away. The device is produced by a series of ordered steps including first sealing the swinger in one end of the tube such that the swinger lies along the inside wall of the tube. Since the swinger thickness is known, the glass side wall provides a reference or data surface from which all further steps may be based. The swinger is at this time in an unstressed, free position against the side wall.

The front and back contacts are formed as a unit in a hairpin shape with the distance between the two arms of the pin and their thickness being predetermined. The contact unit is then inserted into the open end of the tube so that the back contact slips under the swinger and forces it away from the side wall of the tube.

The contact force between the swinger and the back contact then becomes a function of the thickness of the back contact. The gap width is determined by the depth of insertion of the hairpin, or, if desired, may be adjusted by changing the distance between the arms of the unit.

The second end is then sealed without interfering with the contact force because the tube material has a sufficient thermal resistance to allow the contact unit to be sealed before the heat raises the temperature of the swinger in the other end above its annealing temperature. Since the contact force was established subsequent to the sealing of the swinger member and prior to the sealing of the unit and because it was referenced to the relatively cool side wall and determined by the thickness of the back contact, the contact force does not become subject to the swinger sealing process and therefore can be accurately accounted for through the manufacturing process.

The process is then finished by clipping off the part of the contact unit that is common to both arms thereby leaving individual front and back contacts.

Such a method provides obvious advantages. By using the side walls of the enclosure as a reference point and sealing the swinger member adjacent the reference in a free and unstressed condition, the contact force and element positioning can be subsequently determined thereby isolating them from sealing processes that have a tendency to alter them.

The advantages of the device are obtained through its features one of which is isolating the contact force or prestressing and element spacing from the detrimental effects of sealing processes by sealing the swinger in one end of the container in a free or unstressed position and subsequently establishing the spacing and contact force.

Another feature of this invention is the use of the container side walls as a reference or data surface.

Another feature of the invention lies in setting the spacing of the elements and establishing the contact force by using the physical dimensions of the individual components making up the device.

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 showing the swinger sealed in one end of a tube and the front and back contacts being inserted as a unit in the other;

FIG. 2 is a sectional view of the device illustrated in

4

FIG. 1 showing both ends of the tube sealed around the contacts and member;

FIG. 3 is a sectional view of another device;

FIG. 4 is a cross sectional view taken along the line 4—4 of the device shown in FIG. 3;

FIG. 5 is a sectional view of still another device showing the contacts being inserted in the open end of a tube opposite the end in which the swinger is sealed;

FIG. 6 is a sectional view of the device illustrated in FIG. 5 showing the contacts and swinger sealed in the tube ends; and

FIG. 7 is a cross sectional view taken along line 7—7 of the device shown in FIG. 6.

The device, according to FIG. 2, comprises a container 10 having a swinger member 11 sealed in one end and a front contact 12 and a back contact 13 sealed in the other. The swinger member 11, in its unoperated position, is contiguous with the back contact 13 and spaced from the front contact 12. The inner end of the contact 13 should be of nonmagnetic material, or if made in one piece with the conductor 12, should be plated with nonmagnetic material in the area of overlap with member 11.

The device is assembled, according to the invention, and as shown in FIG. 1 by first sealing the swinger member 11 in one end of the container 10. The member 11 is sealed so that it either lies along or touches the side wall of the container 10. The front and back contacts 12 and 13 are formed in the shape of a hairpin having a common portion 14 joining them together. The hairpin is then inserted into the other end of the container or tube 10 so that the back contact 13 slips under the swinger member 11. It therefore lies between the member 11 and the side wall of the container 10. The end of the back contact 13 and the end of the swinger member 11 may have beveled surfaces 15 and 16 respectively, to facilitate inserting the back contact 13 underneath the member 11. The other end of the tube 10 is then sealed to fix the geometric relationship of the elements within the container 10. The last step of the process includes cutting off the portion 14 so that the front contact 12 is separate and distinct from the back contact 13.

The result of this structure and process is that the contact force between the member 11 and the contact 13 is a function of the thickness of the back contact 13 and the width of the gap between the member 11 and the contact 12 is a function of the depth of insertion of the hairpin including the contacts 12 and 13. The side wall of the glass tube 10 is used as a reference surface and reduces the dimensional uncertainties that establish the contact force and gap width to the thickness of the various elements 11, 12, and 13 and the distance between the ends of the two contacts 12 and 13 when they are bent into the hairpin shape. Since the member 11 is sealed into the container 10 first, any contact pressures subsequently generated will not be affected by following sealing processes because the length of the container 10 provides a sufficient thermal resistance to shield or isolate the member 11 from the heat required to seal the other end. This prevents any contact force or spacing within the container 10 to be altered or changed by annealing or other heat phenomenon.

In order to solve the problem of sealing an inert atmosphere within the container to protect the electrical elements, the invention contemplates the above described steps to be completed in a special chamber, such as a bell jar containing an inert gas like helium. Thus, when the second seal is made, the container has sealed within it an inert atmosphere which will allow its operation over considerable periods of time without the detrimental effects of a natural air atmosphere.

The device shown in FIGS. 3 and 4 is similar to that shown in FIGS. 1 and 2 in that it includes a swinger member 17 sealed in one end of a container 18 and a front contact 19 and a back contact 20 sealed in the

other. The device differs slightly in that the member 17 has an auxiliary nonmagnetic portion 21 welded to it. When the device is constructed, the member 17 is sealed in one end of the tube 18 with the portion 21 touching the side wall of the container 18. When the hairpin including the contacts 19 and 20 is inserted in the open end of the tube 18, the back contact 20 is inserted underneath the member 17 so that it lies between the side wall of the tube 18 and the portion 21. The latter is welded to the member 17 at a suitable angle so that the depth of insertion of the contact 20 will establish both the desired contact force between the member 17 and the contact 20 and the gap width between the member 17 and the contact 19. The principle remains the same, however, in that the side wall of the tube or container 18 is used as a reference surface from which the contact force and gap width are established. Also, by sealing the swinger member 17 in the end of the tube first and then establishing the force and gap, the latter are isolated from the heating effects of the subsequent sealing process because of the thermal resistance of the container 18.

Although the devices shown in FIGS. 1 through 4 may be made in very small sizes approximating two inches in length and a quarter inch in outside diameter, in order to miniaturize the structure, better use of available space is required. If the elements are flat and of rectangular cross section as shown in FIG. 4, considerable space within the tube is not used and prevents diminishing the size of the device. FIGS. 5 through 7 apply the principles of this invention to a structure capable of being miniaturized. The device comprises a tube or container 22 having a front contact 23 and a back contact 24 sealed in one end and a swinger member 25 sealed in the other. All of the elements are shaped to coincide with the inside curvature of the container side walls. The elements therefore make more efficient use of the available space. The device is assembled in a manner similar to that used for the ones above described in that the swinger member 25 is first sealed within one end of the container 22. The swinger member 25 further comprises an extension wire 26. When the wire 26 is sealed in the container end, the member 25 is placed contiguous to the side wall. The back contact 24 also includes a nonmagnetic contact portion 27. When the contact 24 is placed in the opposite end of the tube 22, the portion 27 is inserted underneath the member 25 so that it lies between the member 25 and

the side wall of the container 22. The completion of the manufacturing process has already been described above with reference to the other embodiments and is obvious.

Although the disclosure above includes three specific devices, it is obvious that changes both in the structure and the process disclosed can be made by those skilled in the art without departing from the scope of this disclosure and the appended claims.

What is claimed is:

The method of assembling a sealed reed switch including a back contact, a front contact, a reed-type swinger, and a tubular envelope; that comprises providing the swinger with a bevel end, sealing the swinger into one end of the envelope with the swinger's axial center line at an angle to the axial center line of the envelope and a portion of the level end of the swinger resting against the envelope wall and another portion of the bevel diverging away therefrom, inserting the contacts which are suitably spaced from each other and joined to each other at their outer ends by a common portion into the other end of the envelope with the axial center line of said contacts parallel to the axial center line of said envelope and said common portion remaining outside said envelope, wedging the back contact end between the swinger divergent bevel portion and the contiguous envelope wall to move the swinger and decrease the spacing between said front contact and said swinger by varying the depth of insertion of the back contact in the envelope and cause the divergent bevel end to ride thereupon with deeper insertion causing said angled swinger to come closer to said front contact and shallow insertion increasing the spacing between the front contact and the angled swinger, sealing the contacts into the other end of the envelope to fix their geometric relationship, and separating the front contact from the back contact by cutting off the common portion.

References Cited by the Examiner

UNITED STATES PATENTS

2,696,543	12/1954	Ellwood	200—87
3,056,869	10/1962	Dal Bianco	200—87
3,059,074	10/1962	Dal Bianco	200—87

JOHN F. CAMPBELL, *Primary Examiner*.

J. W. BOCK, R. W. CHURCH, *Assistant Examiners*.