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(54) Apparatus and method for insulating electrical leads.

(57) An apparatus 10 for insertion through an aperture 19 of an electrically conductive heat sink 17 to insulate electric leads 15 from the heat sink 17, said apparatus 10 comprising an elongated member 20 formed from elastic, electrically nonconductive material and having at least one bore 26 extending therethrough for receiving the electric leads 15.

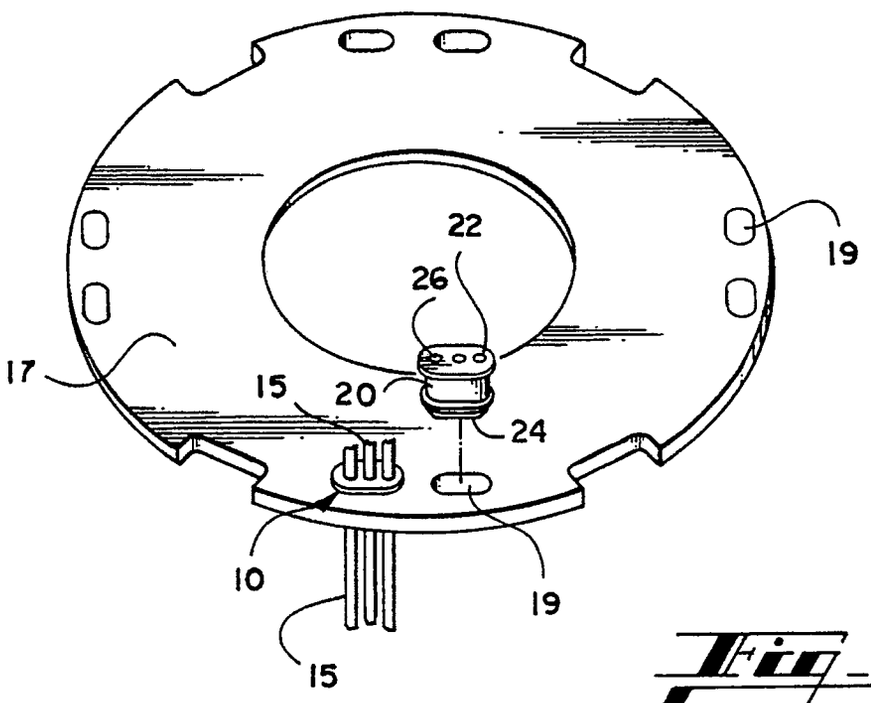

Fig_2

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APPARATUS AND METHOD FOR INSULATING ELECTRICAL LEADS

This invention was made with Government support under Contract No. FO8635-88-C-0093 awarded by the Department of the Air Force. The Government has certain rights in this invention.

TECHNICAL FIELD OF THE INVENTION

The invention relates to insulators for electric leads in general, and more particularly to insulators used to shield electric leads from a heat sink.

BACKGROUND OF THE INVENTION

Two common elements in electrical assemblies are electric leads and heat sinks. Electric leads are wires made from highly electrically conductive metals such as copper, aluminum, gold, silver, or platinum. The purpose of electric leads is to conduct electrical or electromagnetic energy. A heat sink is used to dissipate heat energy from an electronic assembly by means of conduction, convection and radiation.

Heat sinks are constructed primarily from highly heat-conductive metals. These metals are usually some of the same metals (for example, aluminum) which are used as conductors because the properties which make them highly heat conductive also make them highly electrically conductive. A problem arises when electric leads are placed proximate to a heat sink in an electronic assembly in that the electric leads will create undesirable paths for electric or electromagnetic current.

In order to prevent undesirable conduction between electric leads and heat sinks, the electric leads must be insulated from the heat sink. Electric leads must also be kept separate and insulated from each other when it is necessary to gather them proximate to a heat sink.

The problems set forth above are particularly troublesome in missile assemblies. In order to conserve and fully utilize limited space im missiles, it is often necessary to pass electric leads through a heat sink. Often, in excess of seventy (70) leads may have to be placed through an aperture of a heat sink. This problem is particularly acute when the leads of a missile's control section electronics-power hybrid subassembly are passed through a heat sink of the assembly.

The usual method of insulating electric leads involves encasing each lead in an insulating sleeve. To perform this operation, first, a desired length of sleeve is cut from a strand of insulating material. Next, the lead is inserted into the sleeve. To ensure that the sleeve remains in place over the lead, the sleeve is heat-shrunk into place. The insulated lead is then put into place proximate to the heat sink, and is normally threaded through an aperture in the heat sink. This method of insulating leads is time consuming because multiple steps are involved and the entire sequence must be repeated for each lead.

BRIEF SUMMARY OF THE INVENTION

It is an object of the invention to provide a simple, effective, time-saving inexpensive means for insulating electric leads from electrically conductive heat sinks and the like.

According to a broad aspect of the invention, a member is constructed from an elastic, nonconductive material. The member is shaped such that it may be easily inserted into an aperture designed to serve as a wire conduit through a heat sink or the like. The member has at least one bore extending through its length through which an electric lead may be easily inserted. The invention greatly reduces the time to insulate electric leads by enabling a simple two-step process to be used: first, insertion of the invention through the aperture, then, insertion of the electric leads through the invention.

Other aspects, objects, features and advantages of the present invention will become apparent to those skilled in the art upon reading the detailed description of preferred embodiments in conjunction with the accompanying drawings and appended claims.

DESCRIPTION OF THE DRAWINGS

Fig. 1 is an isometric view of a preferred embodiment of the invention.

Fig. 2 is a view of the invention of Fig. 1 as used with a heat sink.

Fig. 3 is a top plan view of the invention of Fig. 1.

Fig. 4 is a front elevation view of the invention of Fig. 1.

Fig. 5 is a side elevation view of the invention of Fig. 1.

Fig. 6 is an isometric view of an insulating apparatus according to another embodiment of

the invention.

Fig. 7 is a view of the invention of Fig. 6 as used with a heat sink.

Fig. 8 is a top plan view of the invention of Fig. 6.

Fig. 9 is a front elevation view of the invention of Fig. 6.

DETAILED DESCRIPTION OF PREFERRED EXEMPLARY EMBODIMENTS OF THE INVENTION

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the present invention, the invention will now be described by reference to the following description of two embodiments taken in conjunction with the accompanying drawings.

A multiple-bore insulating apparatus 10 according to one embodiment of the invention is shown in Figs. 1 through 5. Fig. 1 shows the general configuration of the apparatus 10 with leads 15 inserted therethrough. Fig. 2 shows the apparatus 10 inserted through an aperture 19 of a heat sink 17. The apparatus 10 has an elongated body 20 which is extended to fully insulate leads 15 from the metal surfaces of the heat sink 17. The apparatus 10 is made from a non-conductive material such as rubber or silicone. In particular, flourosilicone MIL-R-25988, Type II, Class 2, Grade 50 has been shown to be suitable. The elastic properties of rubber and silicone enable the apparatus 10 to be quickly and easily inserted into an aperture 19 of a heat sink 17. The flanged top 22 and the bevelled, flanged bottom 24 of the apparatus are slightly larger than the apperture 19 of the heat sink 17. When the bottom 24 is pressed against the aperture 19 of the heat sink 17, the elasticity of the apparatus 10 allows the bottom 24 to deform sufficiently to pass through the aperture 19. The bevelled configuration of the bottom 24 helps to facilitate the insertion. The body 20 has a cross-sectional configuration which corresponds to the shape of the aperture 19. The body 20 has a girth slightly larger than the aperture 19 of the heat sink 17 but small enough for the body 20 to fit through the aperture 19. The ensuing fit between the aperture 19 and the body 20 is snug and helps to hold the apparatus 10 in place as the body 20 is slightly compressed by the aperture 19. The flanged top 22 helps to prevent the apparatus 10 from slipping through the aperture 19 from its top end. The flanged bottom 24 helps to prevent the apparatus 10 from slipping through the aperture 19 from its bottom end. The body 20 is elongated to enclose the segment of lead 15 which must pass through the heat sink 17. The lead 15 is inserted through a bore 26 of the apparatus 10. The bore 26 is optimally sized to be slightly larger than the lead 15 which will be passed therethrough. As previously mentioned, the body 20 is slightly compressed by the aperture 19. This compression reduces the bore 26 cavity such that there will be a snug fit between the apparatus 10 and the leads 15 inserted therethrough. The snug fit helps to maintain the lead 15 in place once inserted. However, the lead 15 is easily insertable through the bore 26 because of the elasticity of the apparatus 10 and the low coefficient of friction between metals which comprise leads and rubber or silicone which comprise the invention. The preferred embodiment of Fig. 1 illustrates a multiple-bore apparatus 10. The apparatus 10 allows for a quick, easy two-step method for insulating leads 15 from a heat sink 17 having aperture 19: First, insert the the apparatus 10; then, insert the leads 15.

Fig. 3 further illustrates the spacing between the bores 26 of a multiple-bore apparatus 10. The spacing is necessary because it is essential that leads 15 also be insulated from one another when multiple leads 15 must be placed through the aperture 19 of a heat sink 17.

Fig. 4 further illustrates the spacing between bores 26 and the flanging of the top 22 and the bottom 24 which are configured to lock the apparatus 10 in place after its insertion through an aperture 19. The manner in which the flanged bottom 24 is bevelled is also illustrated. Fig. 5 further illustrates the bore 26 alignment, the bevelled bottom 24 and the relation between the body 20, flanged top 22 and flanged bottom 24.

The invention is also effective in a single-bore configuration as illustrated by another embodiment of the invention as shown in Figs. 6 through 9. The single-bore configuration accomplishes the objective of the invention via the same quick, easy two-step process: An apparatus 30 is inserted through aperture 39; then the lead 35 is inserted through the bore 46. The apparatus 30 is inserted in the aperture 39 in the same manner as the multiple-bore apparatus. The bevelled, flanged bottom 44 serves to facilitate insertion of the appartus 30 and also to help prevent the apparatus 30 from slipping through the heat sink 17 aperture 39 from the bottom end of the apparatus 30 after it has been inserted. Flanged top 42 helps to prevent the apparatus 30 from slippling through the heat sink 17 aperture 39 from the top end of the apparatus 30. Fig. 7 illustrates three (3) apparatus 30 inserted respectively through three (3) apertures 39. Each apparatus 30 snugly fits into and fully occupies the aperture 39, the body 40 being substantially identical to the cross-sectional area of the aperture 39. Although this is the preferred method of using the single-bore apparatus 30, the apparatus 30 may

also be used as inserts through a larger aperture such as the aperture 19 which receives the multiple-bore apparatus 10 described above. When so used, the body 40 of the apparatus 30 has a different cross-sectional configuration than the shape of the aperture 19 and has a smaller cross-sectional area than that of the multiple-bore apparatus 10. Likewise, the cross-sectional area is smaller than the opening of the aperture 19 of the heat sink 17. However, the girth or width of the body 40 is sufficient to create a snug fit between the body 40 and the aperture 19. More than one apparatus 30 may be inserted side by side in aperture 19. As in the multiple-bore embodiment, the snug fit between the apparatus 30 and an aperture 19, and particularly between the apparatus 30 and the apperture 39, helps to maintain the invention 30 in place after insertion and also decreases the size of the bore 46 to create a snug fit between a lead 35 and a bore 46. As before, the bore 46 is optimally slightly larger than a lead 35 to be inserted therethrough. Figs. 6 and 7 illustrate this particular single-bore embodiment of the apparatus 30 in a multiple-apparatus configuration wherein each distinct apparatus 30 is connected to another via a connecting strip 48. Preferably, the connecting strip 48 connects the flanged top 42 of one apparatus 30 to the flanged top 42 of another apparatus 30 as shown. The connecting strip 48 may be made from insulating material such as rubber or silicone. It is optimally made from the same material as the apparatus 30. Use of the same material for the apparatus 30 and connecting strips 48 allows for ease in manufacturing by an injection-mold process and also helps to insure that the apparatus 30 and strips 48 bond well to each other. The multiple-apparatus arrangement is an alternate to the multiple-bore apparatus 10 method of providing for the insulation of multiple leads 15. The joined apparatus 30 may be manufactured in any number for convenience in shipping and use. The number of apparatus 30 actually used may be selected by severing at the appropriate connecting strip 48 the desired number of apparatus 30 from the excess portion.

As should be apparent from the foregoing specification, the invention is susceptible of being embodied with various alterations and modifications which may differ from those which have been described in the preceding specification and description. Accordingly, the following claims are intended to cover all alterations and modifications which do not depart from the spirit and scope of the invention.

Claims

(1) An apparatus for insulating electric leads from an electrically conductive heat sink, the heat sink having at least one aperture for the through passage of the electric leads, said apparatus comprising:
an elongated member for insertion through the at least one aperture, said elongated member formed from elastic, electrically nonconductive material, said elongated member having at least one bore therethrough for respectively receiving an at least one of the electric leads, respectively.

(2) The invention of Claim 1, said elongated member having a disk-like, flanged top.

(3) The invention of Claim 1, said elongated member having a disk-like, flanged bottom.

(4) The invention of Claim 3, wherein said disk-like flanged bottom is bevelled.

(5) The invention of Claim 1, said elongated member having a cross-sectional area substantially conforming to but slightly larger than the at least one aperture of the heat sink.

(6) The invention of Claim 1, said elongated member having a width slightly greater than a width of the at least one aperture.

(7) An apparatus for insulating electric leads from an electrically conductive heat sink, the heat sink defining at least one aperture for the passage of the electric leads, said apparatus comprising:
an elongated member for insertion through the at least one aperture, said elongated member formed from silicone, said elongated member having a cross-sectional configuration substantially conforming to but slightly greater than the at least one aperture, said elongated member having a disk-like flanged top and a bevelled, disk-like flanged bottom, said elongated member defining at least one bore therethrough for respectively receiving one of the electric leads, said bore having a diameter slightly larger than a diameter of the lead,
whereby said apparatus may be inserted into the aperture of the heat sink by placing said bevelled, disk-like flanged bottom upon the aperture and urging said apparatus through the aperture until said disk-like flanged top rests over the aperture.

(8) An apparatus for insulating electric leads from an electrically conductive heat sink, the heat sink defining at least one aperture for the passage of the electric leads, said apparatus comprising:
an elongated member for insertion through the at least one aperture, said elongated member formed from silicone, said elongated member having a cross-sectional area substantially less than the at least one aperture, and having a width slightly greater than a width of the at least one aperture, said elongated member having a disk-like flanged top and a bevelled, disk-like flanged bottom, said elongated member defining a bore therethrough for receiving one of the electric leads, said bore having

a diameter slightly larger than a diameter of the leads,
whereby said apparatus may be inserted into the aperture of the heat sink by placing said bevelled, disk-like flanged bottom upon the aperture and urging said apparatus through the aperture until said disk-like flanged top rests over the aperture.
(9) The invention of Claim 8, wherein at least one said apparatus is connected to at least one other said apparatus by a silicone strip connecting said disk-like flanged top of said at least one said apparatus to said disk-like flanged top of said at least one other said apparatus.
(10) In a missile, an apparatus for insulating electric leads of a hybrid subassembly in the missile from a heat sink through which the leads must be inserted, the heat sink defining at least one aperture for the through passage of the electric leads, said missile apparatus comprising:
an elongated member for insertion through the at least one aperture, said elongated member made from an elastic, electrically nonconductive material, said elongated member having a disk-like flanged top and a bevelled, disk-like flanged bottom, said elongated member defining at least one bore therethrough for receiving one of the electric leads, said bore having a diameter slightly larger than a diameter of the lead, whereby said apparatus may be inserted into the aperture of the heat sink by placing said bevelled, disk-like flanged bottom upon the aperture and urging said apparatus through the aperture until said disk-like flanged top rests over the aperture.
(11) The invention of Claim 10, said elongated member having three bores therethrough.
(12) The invention of Claim 10, said elongated member having a cross-sectional configuration substantially conforming to but slightly greater than the at least one aperture.
(13) The invention of Claim 12, said elongated member having a cross-sectional configuration substantially identical to but slightly greater than the at least one aperture.
(14) The invention of Claim 10, said member having a cross-sectional area substantially less than the at least one aperture, and having a width slightly greater than a width of the at least one aperture.
(15) The invention of Claim 10, wherein said elastic, electrically nonconductive material is silicone.
(16) The invention of Claim 10, wherein at least one said missile apparatus is connected to at least one other said missile apparatus by connecting means.
(17) The invention of Claim 16, wherein said at least one said missile apparatus is connected to said at least one other said missile apparatus by connecting means connecting said disk-like flanged top of said at least one said missile apparatus to said disk-like flanged top of said at least one other said missile apparatus.
(18) The invention of Claim 17, wherein said connecting means comprises a strip of connecting material.
(19) The invention of Claim 18, wherein said connecting material is electrically nonconductive material.
(20) The invention of Claim 19, wherein said electrically nonconductive material comprises said elastic, electrically nonconductive material which comprises said missile apparatus.

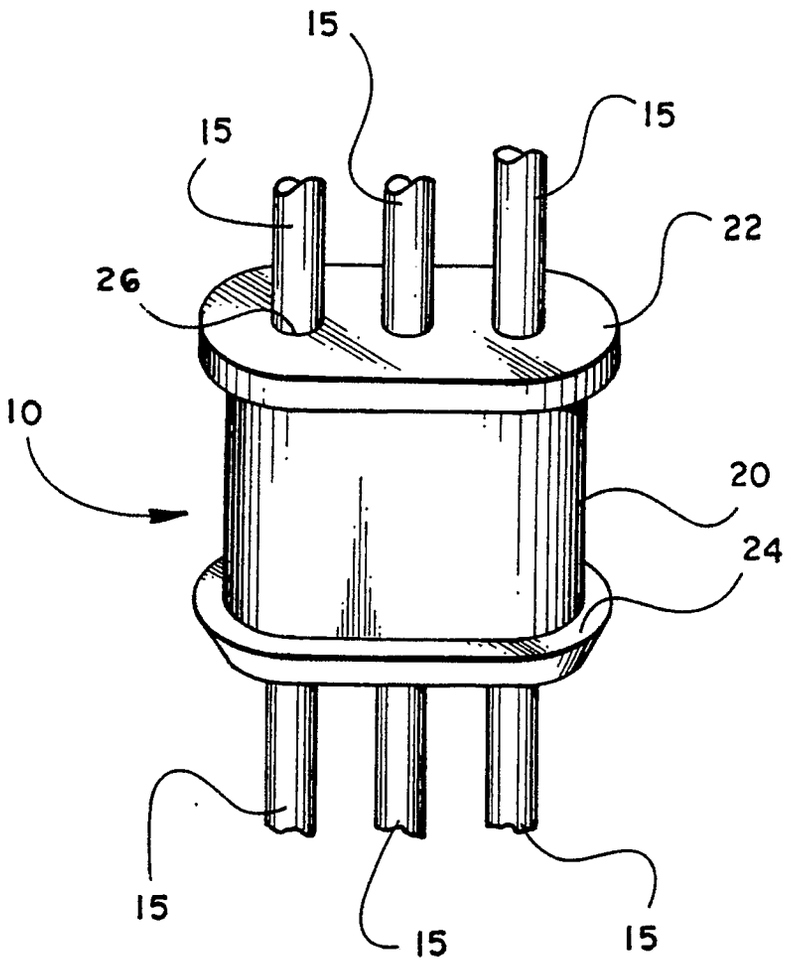


Fig_1

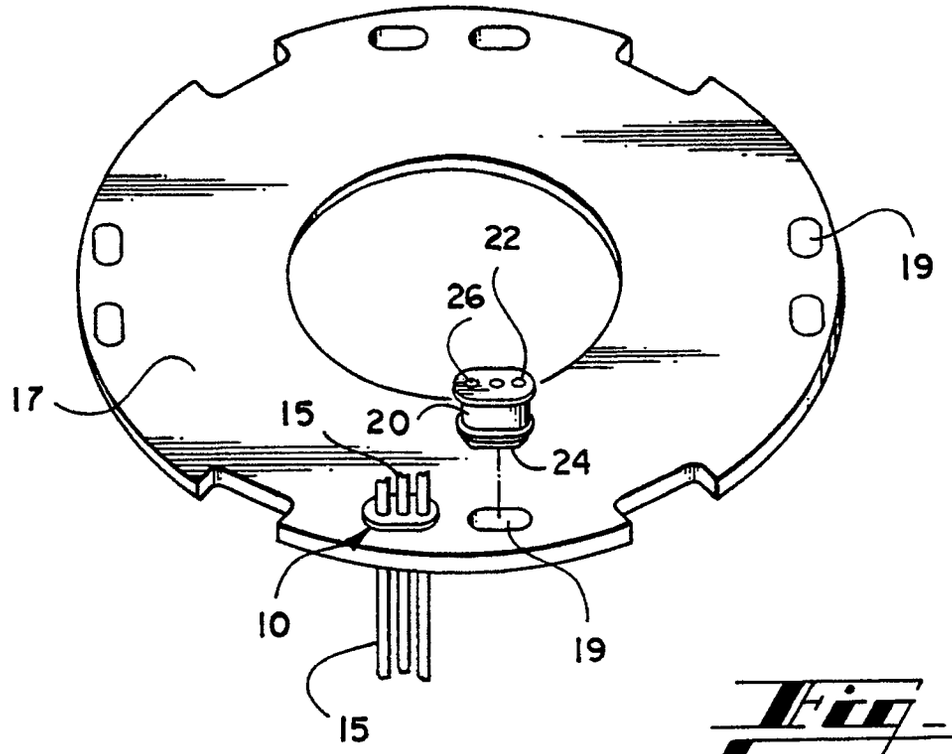


Fig_2

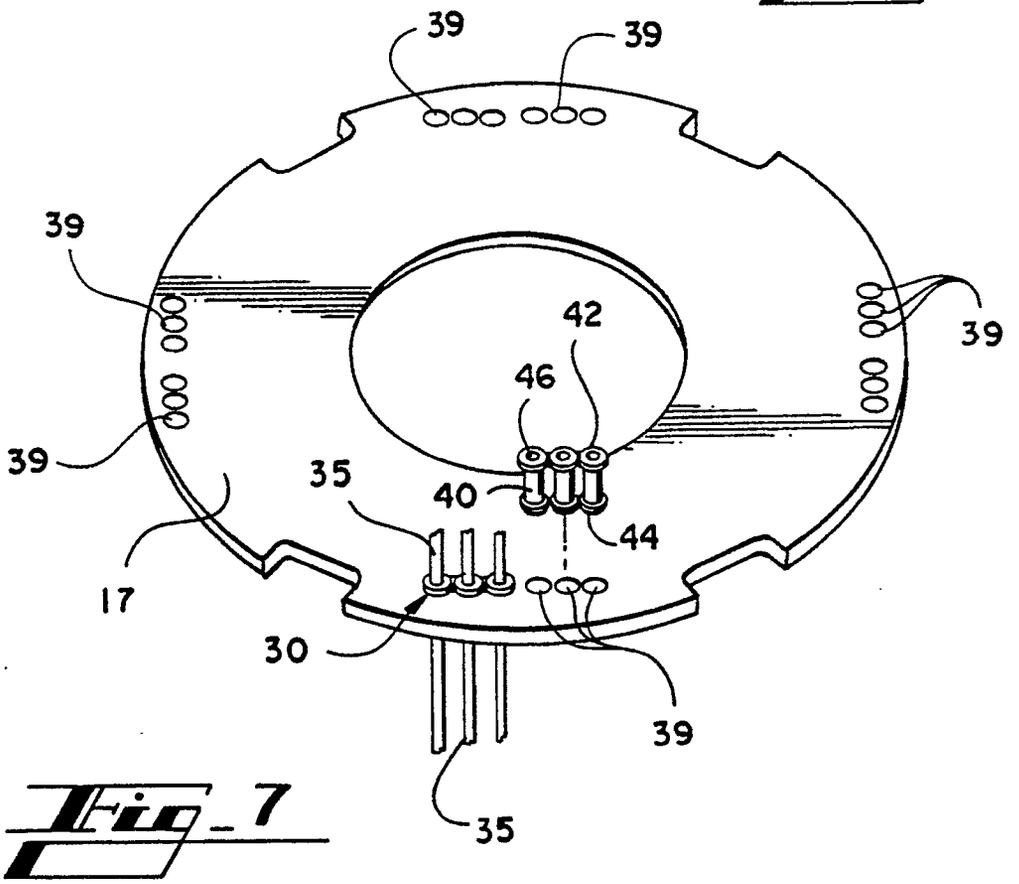


Fig_7

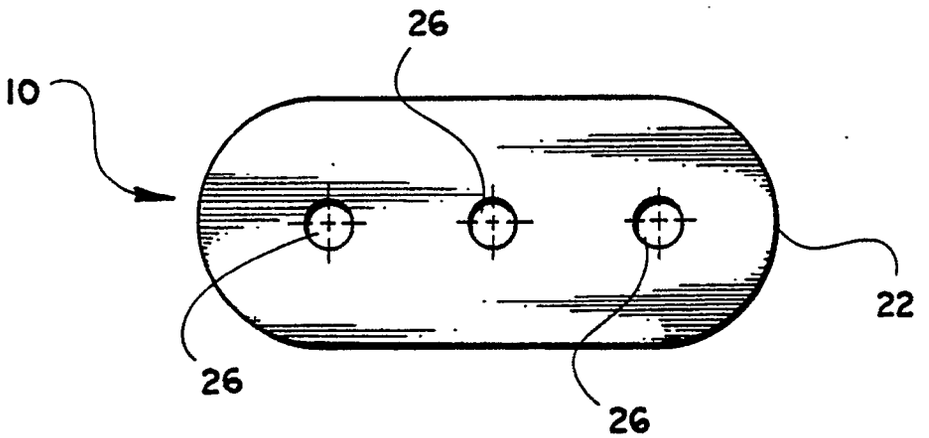


Fig_3

Fig_4

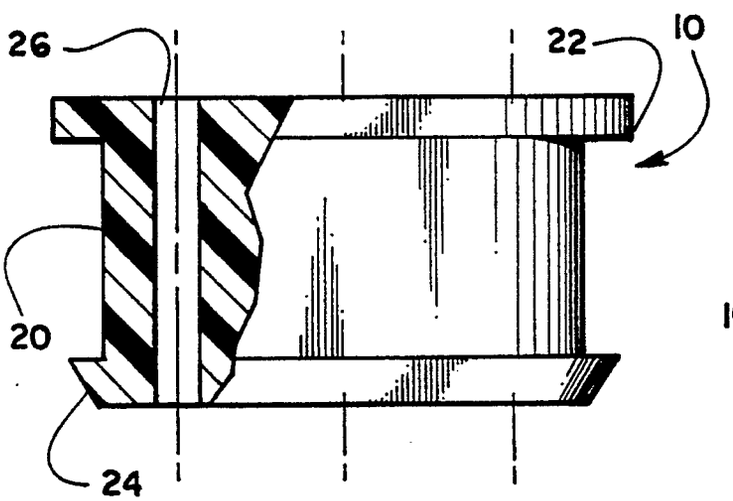
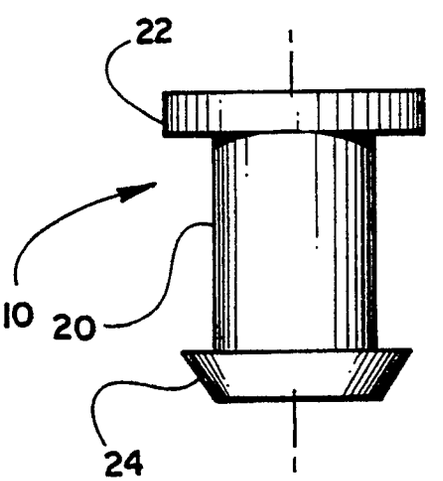


Fig_5



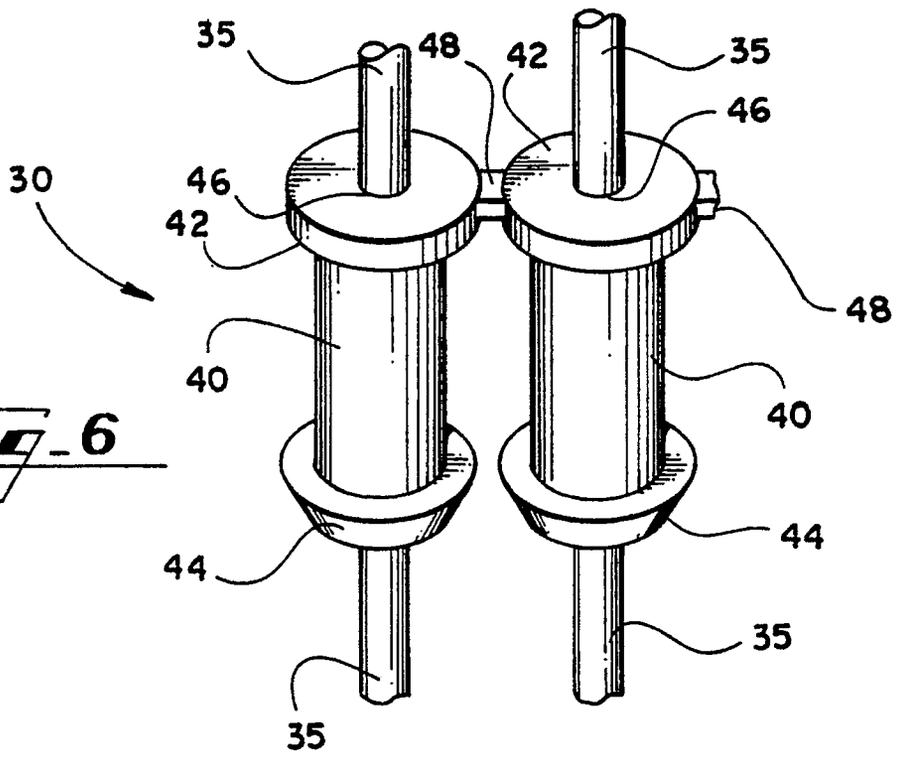


Fig_6

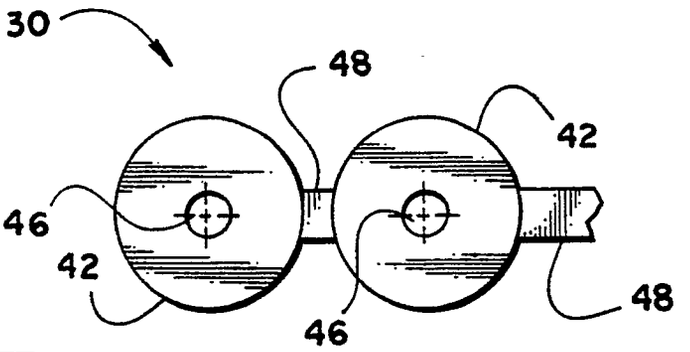


Fig_8

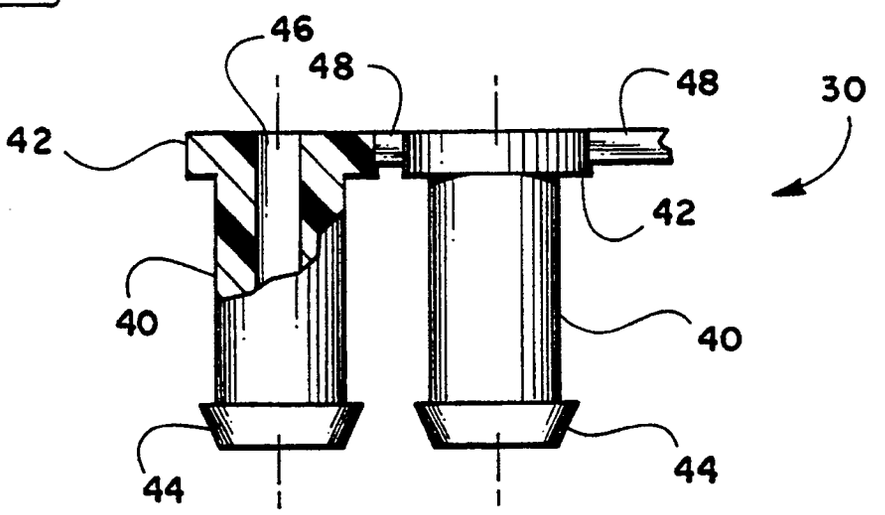


Fig_9