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Malone et al.

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[54] **ELECTRICAL CONDUCTOR FEED THROUGH AND SEAL**

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[73] Assignee: **The Singer Company**, Little Falls, N.J.

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[52] **U.S. Cl.** ..... **174/151**, 339/17 F

[51] **Int. Cl.** **H01b 17/30**

[58] **Field of Search** ..... 174/18, 50.56, 117 FF, 174/151; 339/17 F, 59 R, 94 A, 126 R, 126 RS, 214 R, 214 C

[56] **References Cited**

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[57] **ABSTRACT**

An electrical conductor feed through and seal is provided which allows for the passing of electrical conductors, imbedded in flextape, from outside an enclosure to within an enclosure without the use of headers. Flextapes are used which are configured, in part, to match the profile of the mating surfaces of the enclosure. The tapes are bonded together at this point by a suitable adhesive. An elastomeric material of suitable durometer is inserted between the bonded flextapes and each mating surface, so that when the mating surfaces are drawn together, the required seal is formed.

6 Claims, 5 Drawing Figures

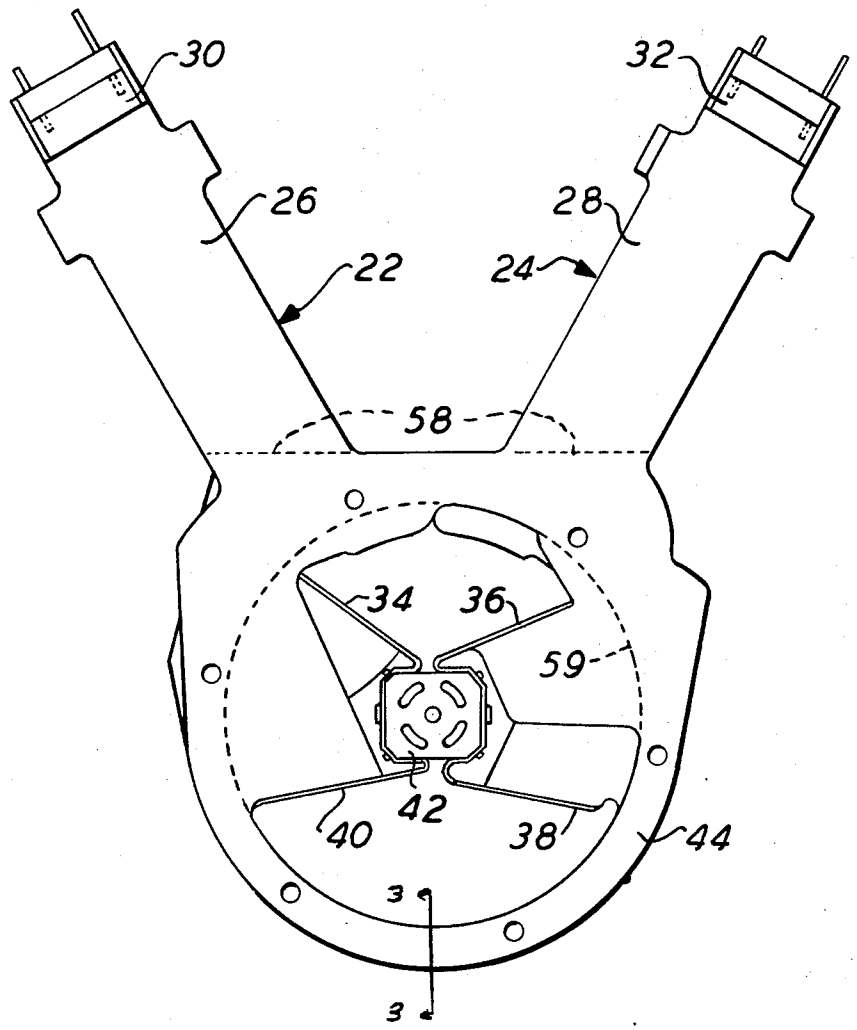


FIG. 1

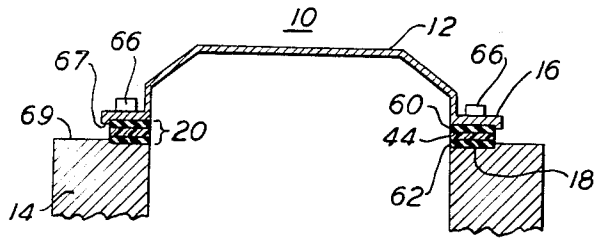


FIG. 3

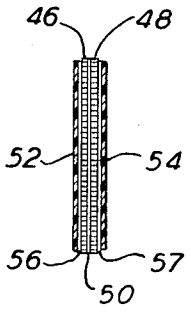


FIG. 2

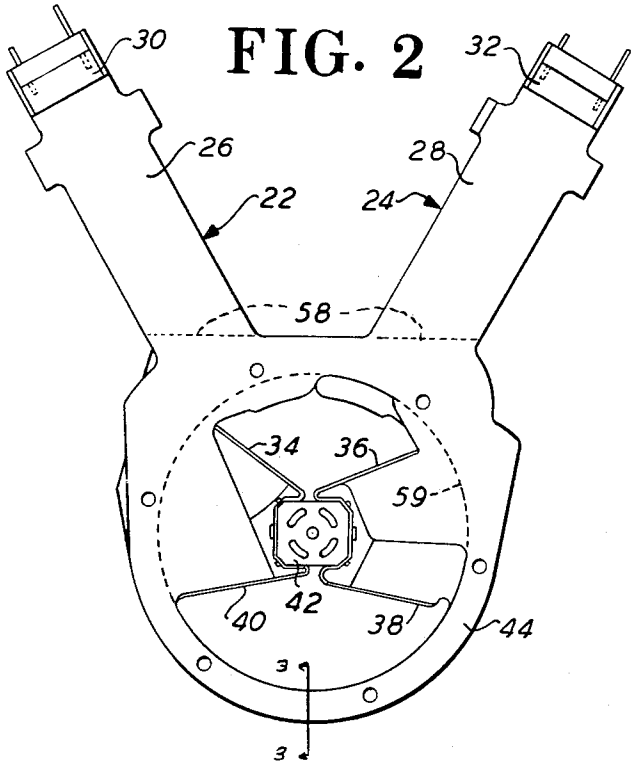


FIG. 4

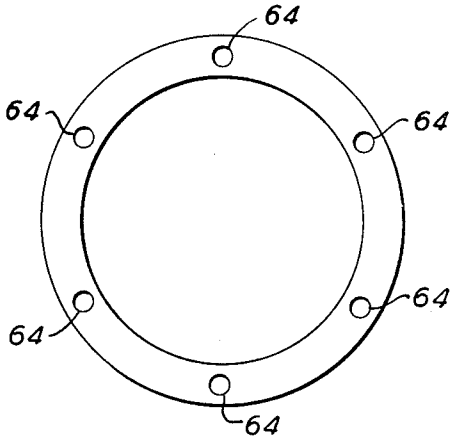
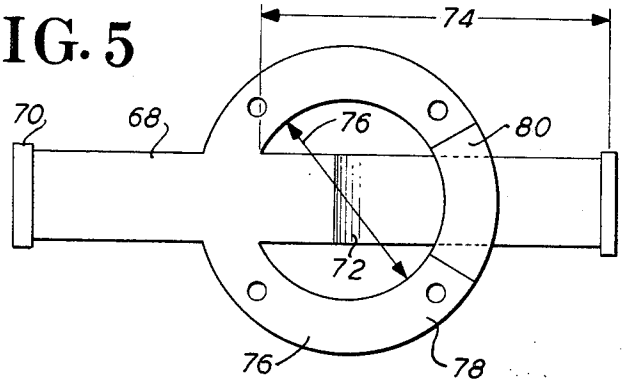


FIG. 5



ELECTRICAL CONDUCTOR FEED THROUGH AND SEAL

This invention relates to seals for enclosures and in particular to a seal which provides for the passage of electrical conductors therethrough without detracting from the effectivity of the seal.

BACKGROUND OF THE INVENTION

Equipment which is used in today's aerospace applications is subjected to many variations in environmental conditions. This equipment typically is of a high precision nature which necessitates operation in a virtually stable, dust free and moisture free environment. To achieve the necessary operating environment, such equipment is mounted within a housing, which is then sealed, evacuated and filled with a moisture and dust free gas. To maintain a satisfactory operating environment for such equipment, the quality of the seal must be such as to insure leakage rates on the order of 1 cc/in/year. This leakage rate has to be maintained over wide variations in pressure differential across the seal.

Heretofore, such a seal was achieved through the use of the well known "0-ring," a ring of circular rubber interposed between the mating surfaces of the sections comprising the equipment housing. When the surfaces were screwed together, the ring was compessed to thereby provide the necessary seal. Electrical connections to electronic and electromechanical equipment within the housing in such prior systems had to be made using glass headers soldered or cemented into the housing cover. Such headers had groups of terminal pins mounted in the glass for isolation. Appropriate connections were made to the outboard and inboard ends of the terminal pins to thereby provide the necessary electrical connections between the equipment mounted within the housing and the equipment without. The use of such headers necessarily required a relatively large size cover to mount them, with the result that the mating surface contact area remained relatively large thereby prohibiting the leakage rate from decreasing beyond a certain minimum.

Recent technological advances have resulted in miniaturization of electronic assemblies and electromechanical components. This has fostered the desire to build smaller equipment with the same or better operating capabilities as the previous equipment. One limitation to the development of smaller equipment is the use of the "0-ring" and header arrangement to provide the seal and needed electrical connections. Another limitation of the use of headers is the requirement of having to make two solder connections, one on each end of the terminal pin, for each electrical connection. This decreases the reliability of the system and requires the use of an additional flextape or wiring harness to connect from the components internal to the housing to the inboard terminal pins.

It is therefore an object of this invention to provide a means for electrically connecting components within an enclosure to components outside the enclosure, without the need for intermediate headers.

It is a further object of this invention to provide a seal for said enclosure having at least the same leak rate as prior art seals.

Briefly summarized, the present invention relates to an electrical conductor feed through and seal which utilizes flextapes and an elastomeric material inserted between the flextapes and the mating surfaces of the barrier to be sealed to effect the feed through and seal. The tapes each have a portion extending without the enclosure and a portion extending within the enclosure. Each tape also has a third portion, configured to the profile of the mating surfaces, which is bonded to the tapes in juxtaposition thereto. The seal is completed by the insertion of the elastomeric material, of suitable durometer and leakage rate, between the bonded flextapes and the mating surfaces of the barrier to be sealed.

For a better understanding of the present invention, together with other and further objects thereof, reference is made to the following description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross sectional view of an enclosure using the feed through seal of this invention.

FIG. 2 is a plan view of a portion of the invention.

FIG. 3 is the view along line 3—3 of FIG. 2

FIG. 4 is an elevational view of a part of the invention.

FIG. 5 is a plan view of another embodiment of the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to FIG. 1, there is shown an enclosure **10**, including an end cover **12** and a housing **14** within which could be mounted precision electro-mechanical components and their supporting electronic assemblies. Mating surfaces **16** and **18** are machined to a predetermined roughness which preferably is less than one sixty-fourth micro-inch. This level of roughness will be a function of the desired leakage rate for the seal. Sandwiched between mating surfaces **16** and **18** is a multilayer composite **20**, which provides a means of electrical interface between the outside and inside of the enclosure **10**.

FIG. 2 shows a typical arrangement comprising a portion of composite **20**. Flextapes **22** and **24**, fabricated in a manner similar to the process set out in U. S. Pat. No. 2,997,521, each have a first portion, **26** and **28** respectively, extending without the enclosure **10**. Each of these sections interfaces with sources of electrical power and electrical signals through the use of connectors **30** and **32** or by any other suitable means recognized in the art.

Each of the flextapes **22** and **24** also has a portion thereof extending within the enclosure, such as **34, 36, 38** and **40**. These portions feed the various power levels and electrical signals, picked up by connectors **30** and **32** to the various electronic and electromechanical components within the enclosure. One way of effecting this distribution of power and signal is terminating the portions **34, 36, 38** and **40** at a common terminal block **42**, from which the power and signals are then routed to the appropriate components within the enclosure.

Each of the flextapes **22** and **24** also has a third portion, the contour of which, generally, follows the shape of the mating surfaces **16** and **18**. The flextapes are aligned so that the third portion of each is superimposed, one of the other as at **44**.

FIG. 3 illustrates the composite relationship between the overlapping portion of each flextape. Flextape portion **46** is bondec to flextape **48** through the use of polytetrafluoroethylene **50**, commercially available as

TEFLON, a registered trademark of the Dupont Company. A suitable amount of TEFLON is used to insure that the voids between the portions **46** and **48**, caused by surface irregularities in each opposing face, are filled thereby eliminating sneak paths which could detract from the effectiveness of the seal. In addition, the outer surfaces **52** and **54** of each tape have bonded to them sheets of polyimide, commercially available as KAPTON or sheets of polyester commercially available as MYLAR, both registered trademarks of the Dupont Company. Again, the bonding material **56** and **57** is TEFLON and the amount used thereof is that necessary to eliminate possible sneak paths. Referring to FIG. **2**, the bonding of the flextape layers and KAPTON sheet extends to point **58** on the outer perimeter and to point **59** on the inner perimeter. This reserves the flexibility of the first and second portions of the flextapes **22** and **24**.

Returning to FIG. **1**, in addition to the bonded flextape layer just described, composite layer **20** includes two gaskets of elastomeric material **60** and **62** which are sandwiched between the flextape layer and mating surfaces **16** and **18**. These gaskets, preferably, may be made of Butyl rubber, and may have a durometer preferably between 20 and 75, as measured on a Shore A scale, well known in the art. Typically, their thickness may be on the order of 0.020 inch to 0.030 inch. The type of material selected, Butyl being a preferred selection, depends on the leakage rate to be achieved by the seal under the environmental conditions to which it is exposed. Butyl rubber, for example, has a leakage rate of 1 cc/in/year. Other suitable materials would include Nitrile or Viton rubber.

To facilitate the production process, the gaskets **60** and **62** may be cemented to the flextape layer through the use of an appropriate adhesive although this is not absolutely necessary to achieve typical leak rates.

FIG. **4** shows a typical configuration for gaskets **60** and **62**. The contour of each gasket follows generally the contour of the third portion of the flextape layer, which in turn, is configured to reflect the contour of mating surfaces **16** and **18**. Each gasket has the requisite number of thru holes **64**, which align with their counterparts in the flextape laye and each of the mating surfaces.

Screws **66** secure end cover **12** to housing **14** with the composite layer **20** sandwiched therebetween. The screws are tightened to a predetermined torque level, thereby compressing composite layer **20**. The torque level is such as to provide a sufficient amount of compression to result in a prescribed leakage rate.

Note, that in order to prevent cold flow, i.e., the extrusion of the gasket material due to the compressive pressures exerted when the cover **12** is secured to the housing, the cover **12** and housing **14** are each provided with a protrusion **67** and **69** respectively. These protrusions generally extend to one-half to three-fouths the thickness of the gasket material. Without this restraint sneak paths could develop, in particular, in the vicinity of the thru holes **64**. Where a higher quality seal is desired, similar protrusions could be provided on the inside rim of the cover and housing to thereby prevent cold flow at the inner diameter of the composite. Generally, however, there is an inherent resistance to cold flow at the inner diameter due to the existence of the compressive forces within the material, thereby minimizing the need for these additional protrusions.

An alternate method for minimizing cold flow could be to reinforce the gasket material by imbeding therein fibrous material such as asbestos. This technique is not suitable, however, when the gas e.g. Helium, filling the enclosure **10** has a molecular size smaller than that of the fibrous material used. When this is the case, increased leakage occurs due to the sneak paths through the fibrous material.

Other variations in the basic invention described above can be made. Of course, it should be obvious that the flextape composite need not be limited to only two flextapes. It could be only one tape or it could be more than two.

FIG. **5** depicts an alternate construction of the invention which can be used when the portion of the flextape within the enclosure is longer in length than the inner diameter (in the case of a circular third portion) of the previously identified third portion of the tape. Flextape portion **68**, terminated in connector **70**, serves the same function as tape **26** or **28** and connector **30** or **32** described above. Interior tape portion **72** is longer in length, **74**, then the inside diameter **76** of the third portion **78**, of the flextape. Because of the extra length, when the flextape is fabricated, a section of the third portion **78** must be eliminated. Consequently, when the composite layer constituting the seal is put together, the section of the tape eliminated in the tape fabrication process must be added. This section is shown at **80**. It essentially is a piece of flextape (the number of such pieces equal to the number of flextapes whose interior portion length is longer than diameter **76**) which is bonded together, with the remaining portion **78**, in a manner identical to that described above. Gaskets of elastomeric material would then be added to either side of the composite as hereinabove described.

Other variations in the configuration of the invention could be made which would be readily apparent to those skilled in the art and which would be within the scope of the appended claims.

What is claimed is:

1. A device for providing an electrical conductor feed through and seal between the mating surfaces of an enclosure which comprises:

a plurality of flexible electrical cables, each having a portion thereof extending without said enclosure, another portion extending within said enclosure and a third portion substantially aligned with the third portion of the other said flexible cables;

said aligned third portions configured such that they are continuously interposed between the mating surfaces of said enclosure,

bonding adhesive interposed between said third portions for bonding each layer to the ones juxtaposed thereto; and

an elastomeric material disposed between and contguous with each of the outermost third portions and the mating surfaces of said enclosure.

2. The device of claim **1** where each of said mating surfaces has a protrusion extending from the outer perimeter thereof to thereby restrain the outward extrusion of said elastomeric material when said mating surfaces are drawn together.

3. The device of claim **2** where the elastomeric material has a durometer greater than 20 and less than 75 on the Shore A scale.

4. The device of claim **3** where the elastomeric material is Butyl rubber.

5. The device of claim **1** which includes a layer of polyimide bonded to the outboard side of each of the outermost third portions.

6. The device of claim **5** where the elastomeric material is bonded to the outboard side of each of said polyimide layers.

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