

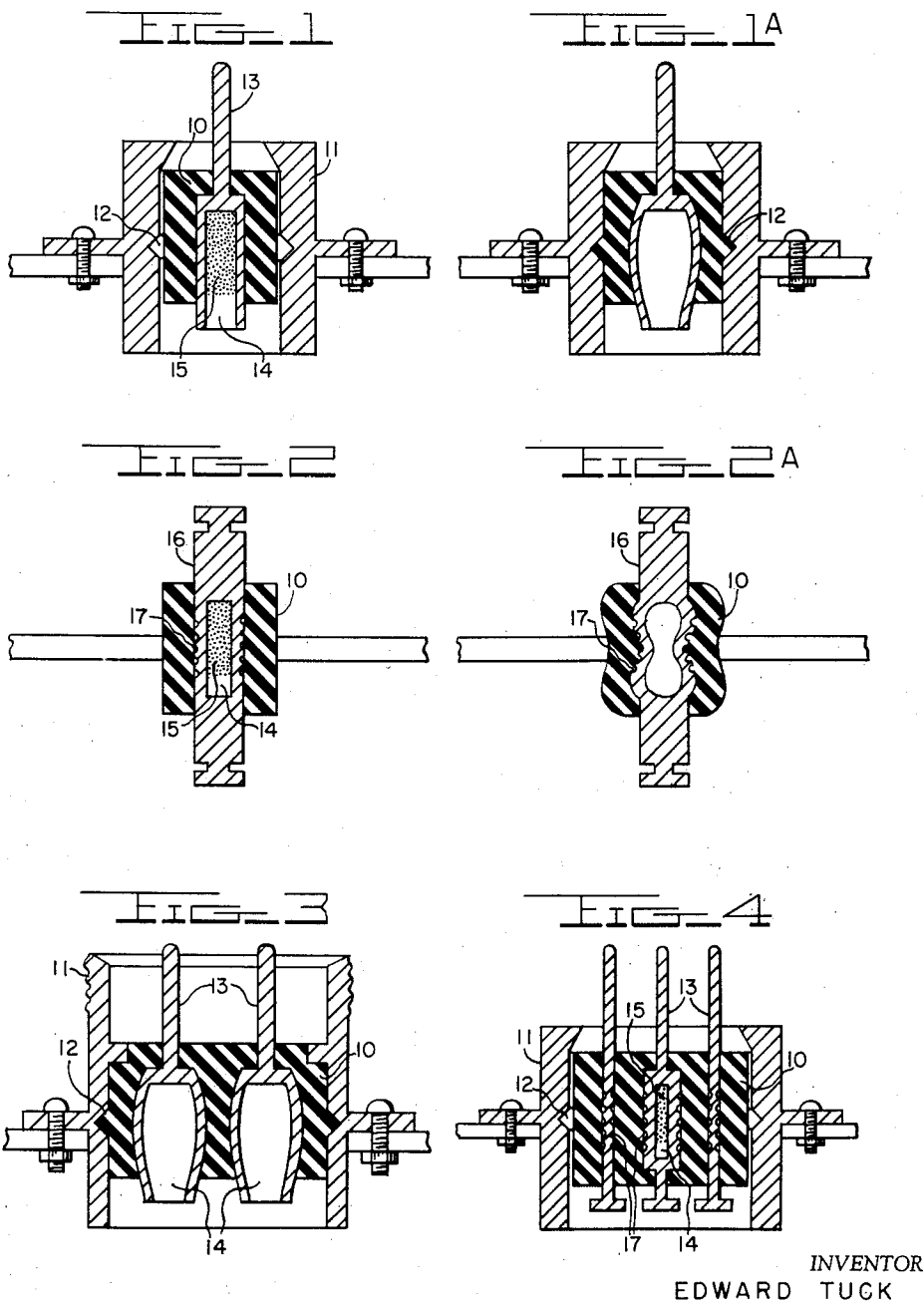
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EXPLOSIVE FEEDTHROUGH CONNECTOR

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EXPLOSIVE FEEDTHROUGH CONNECTOR

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates in general to electrical feedthrough connectors and in particular to pressure proof electrical connectors for use under high pressure differential conditions.

Standard electrical connectors of the feedthrough variety for mounting in a surface wall, or the like, ordinarily are unable to withstand any significant pressure differential across the connector. For example, electrical connectors wherein the terminals are encased in moulded Bakelite have been found to withstand pressure differentials up to approximately 30 pounds/sq. in. (p.s.i.) maximum. Still other connectors, where a resilient plastic insulating material, such as Teflon, is used in place of the Bakelite and the terminals are press fitted in the insulating material, for instance, have been found to withstand pressure differentials in the region 60–100 p.s.i. 100 p.s.i. appears to be the maximum pressure rating of most commercially available electrical feedthrough connectors.

While in many applications this 100 p.s.i. limit does not constitute a serious disadvantage, in some applications, for example in underwater sounding gear, it is most important that the electrical connectors employed be capable of withstanding a pressure differential far in excess of 100 p.s.i.

Accordingly, it is an object of this invention to provide an improved pressureproof electrical feedthrough connector which may be used under pressure differential conditions greater than 100 p.s.i.

It is another object of the invention to provide an improved electrical connector which may be simply and inexpensively assembled.

It is still another object of the invention to provide an improved electrical connector which does not require a precise machining of its component parts before assembly.

It is a further object of this invention to provide an improved electrical connector which is waterproof as well as extremely sturdy and durable.

Other objects of the invention will become apparent upon a more comprehensive understanding of the invention for which reference is had to the attached specification and drawings, wherein:

Figs. 1 and 1A are similar pictorial cutaway views of one embodiment of the invention in its before and after explosion states, respectively.

Figs. 2 and 2A are similar pictorial cutaway views of a second embodiment of the invention in its before and after explosion states, respectively.

Fig. 3 is a pictorial cutaway view of a third embodiment of the invention in its exploded state.

Fig. 4 is a pictorial cutaway view of a fourth embodiment of the invention in its unexploded state.

Briefly, the device of this invention is an electrical feedthrough means which comprises a resilient plastic insu-

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lating body and one or more electrical conductors extending through the insulating body. To effect the desirable pressure-proof quality of the invention, explosive means are provided as an integral part of the device for deforming the insulating body to firmly attach this body to both the conductor and the containing wall or housing.

Fig. 1 is a cross-sectional showing of a one pin plug unit embodiment of the invention. In this embodiment, a body of plastic insulating material, 10, is encased in a tubular metallic shell, 11. The plastic insulating material, which may be, for example, Teflon, has an outer configuration substantially the same as, but slightly smaller than, the general inner configuration of the metallic shell. In the preferred embodiment of this invention, as shown in Fig. 1, the inner configuration of the metallic shell may include an inner shoulder at one end thereof of sufficient depth to prevent the insulating material from passing through the shell. In addition, for reasons which will become apparent hereinafter, the inner configuration of the metallic shell may be marked by various indentations in the region closely adjacent the insulating material. As shown in Fig. 1 at 12 this indentation may take the form of a circumferential groove. It is understood, however, that any form of indentation, regular or irregular, might be substituted for the groove shown.

The insulating material is drilled to freely receive an electrical conductor 13 having a pin prong on one end and a wire connection means on the other. It will be appreciated that the two terminating means which are exemplarily shown in the drawing are not essential to the invention and that other types of terminating means may be readily substituted for those shown. In this embodiment of the invention, the conductor 13 is hollowed, as indicated at 14, and this hollow is partially filled with an explosive means, as indicated at 15. The particular type of explosive means employed in this embodiment is not critical insofar as the basic concept of the invention is concerned. As a specific example however, this explosive means may be gunpowder of the same type and quantity as is utilized in explosive rivets.

As in the case of explosive rivets, the gunpowder within the hollow section 14 may be exploded by the application of heat, approximately 165° C. to the hollowed section. When the conductor 13 is heated and the explosive means is fired thereby, the surrounding insulating body 10 is expanded to fill the indentations on the inner surface of the shell 11 as shown in Fig. 1A. In addition the resilient properties of the insulating material cause this deformed material to act as a constrictive force upon the deformed conductor 13. Thus in this embodiment the insulating body 10 may be instantaneously secured to both the surrounding shell housing and the conductor to form a pressure seal.

As previously mentioned, it has been found that common electrical connectors employing a similar insulating material to that employed in the Fig. 1 embodiment, but wherein the conductors are held in the insulating material by a forced or driving fit, can withstand a differential pressure up to a maximum of about 100 p.s.i. This low pressure rating is believed to be due, in part, to an observed slight shearing of the insulating material which occurs when the terminals are forcibly inserted. In comparison with these prior art connectors, the above described embodiment of Fig. 1 has been found to withstand a pressure differential more than ten times greater, over 1000 p.s.i.

Figs. 2 and 2A are cross-sectional showings of a feedthrough insulator embodiment of the invention. In this embodiment, the plastic insulating material 10, which is similar to that employed in Fig. 1, is adapted to be directly

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mounted in the wall and has an outer configuration substantially the same as, but slightly smaller than the hole in which it is inserted. As in the embodiment of Fig. 1, the insulating material is drilled to freely receive an electrical conductor. In this case, however, the drawing depicts a two terminal conductor 16 having a closed hollow, partially filled with an explosive means, as indicated at 15. In addition, the conductor 16 is marked by a series of ring grooves or indentations, as indicated at 17. These indentations, which may take a form other than that shown, if desired, serve to weaken the conductor wall and thus permit a greater expansion of the conductor in the area of indentation upon explosion which, of course, improves the conductor to insulating material bond.

Fig. 2A depicts the feedthrough insulator shown in Fig. 2 after explosion. As shown in the drawing, the explosion within the insulating material spreads the material in hourglass fashion to rigidly hold the feedthrough unit in the wall.

Fig. 3 depicts another embodiment of the invention in cross-sectional view. It will be seen that this embodiment is substantially the same as the embodiment of Fig. 1 but is expressly illustrative of the multi-conductor utility of the invention wherein each of the conductors may be exploded to provide the pressure proof seal. In this embodiment, as well as in the embodiment of Fig. 1, it has been found that the gas escaping from the opened internal explosion slightly corrodes the inner surface of the hollowed conductor. Thus for a proper electrical connection to the hollowed electrical terminal, it is believed generally advisable to ream the hollow by the insertion of a proper sized drill before making the connection.

Fig. 4 depicts still another embodiment of the invention in cross-sectional view which is illustrative of the multi-conductor utility of the invention. In this embodiment, however, only one of the conductors is explosive. It will be noted that this embodiment, like the embodiment of Fig. 3, incorporates the shell groove indentations first shown in the embodiment of Fig. 1. In addition, each of the conductors is marked by ring indentations in the manner shown in Fig. 2. As previously discussed, the ring indentations on the explosive conductor serve to weaken the wall thereof and thus permit a greater expansion in the area of indentation. In the case of the non-explosive conductors, of course, these ring indentations serve the same deforming utility as the ring indentation on the inner wall of the shell housing to further improve the pressure proof quality of the invention. It has been found that embodiments of this invention which include both conductor and shell indentations, as shown in Fig. 4, are capable of withstanding pressure differentials greater than 4000 p.s.i.

The explosive means in each of the embodiments of Figs. 2, 3 and 4 is of the same type and may be exploded in the same manner as the explosive means in the embodiment of Fig. 1. A particular advantage of the Fig. 2 and 4 embodiments of the invention which incorporate a closed hollow conductor is that they permit a silent explosion with no corrosion problem involved.

While a particular type of plastic insulating material, namely Teflon, has been utilized in each of the exemplary embodiments, it is understood, of course, that the invention is not to be limited to the use of Teflon as the insulating material and that other plastic insulating material may be substituted therefor. In the selection of a substitute it is important that the plastic insulating material may be heated up to the firing temperature of the explosive means, approximately 165° C., without damage, and that the material be resiliently expandable. The exemplarily shown material, Teflon, has the necessary resilient properties and may be heated up to 500° C. without damage.

Furthermore, while a reasonably close fit between the

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conductor means and the insulating body as well as between the insulating body and the shell housing or wall opening is required, it is understood that no rigid tolerances are involved in this invention. To employ the graduated fit terminology found in the Machinery's Handbook, 15th edition, page 1048, i.e., running fit, push fit, driving fit, forced fit and shrinkage fit—the requisite fit may be appropriately described as “a push fit” as distinguished from “a forced fit,” the “forced fit” being common to many prior art feedthrough connectors.

Finally, it is understood that this invention is to be limited only by the scope of the claims appended hereto.

What is claimed is:

1. An electrical feedthrough means for making an electrical connection through a wall surface having an aperture therein comprising at least one electrical conductor means having terminal connections on the ends thereof; a body of electrically insulating material encompassing the mid-portion of said conductor means; said insulating body being readily deformable under pressure and having an outer configuration adapted to substantially fill said aperture; and explosive means disposed within said body of insulating material; said explosive means being explodable and so disposed within said body of insulating material as to apply an internal pressure which deforms the perimeter of said body when said explosive means is exploded.

2. An electrical feedthrough means for making an electrical connection through a wall surface having an aperture therein comprising at least one electrical conductor means having terminal connections on the ends thereof; a body of electrically insulating material encompassing the mid-portion of said conductor means, and in substantially push fit relation thereto, for suspending said conductor means; said body of insulating material being readily deformable under pressure and having an outer configuration adapted to substantially fill said aperture; said conductor means being hollowed substantially within the region encompassed by said insulating body; and an explosive means disposed within the hollow of said conductor means; said explosive means being explodable to deform said conductor means such that said conductor means applies a pressure internal to said insulating body to deform said body.

3. An electrical feedthrough means for making an electrical connection through a wall surface having an aperture therein comprising elongated conductor means; a body of electrically insulating material encompassing said conductor means, and in substantially push fit relation thereto, such that said conductor extends through said insulating body, said body of insulating material being readily deformable under pressure and having an outer configuration adapted to substantially fill said aperture; said conductor means being hollowed substantially within the region encompassed by said insulating body and having indentations on a portion of the outer wall encompassed by said insulating body; and an explosive means disposed within the hollow of said conductor means; said explosive means being explodable to deform said conductor means such that said conductor means applies a pressure internal to said insulating body to deform said body.

4. An electrical feedthrough means for making an electrical connection through a wall surface having an aperture therein comprising elongated conductor means; a body of electrically insulating material encompassing said conductor means, and in substantially push fit relation thereto, such that said conductor extends through said insulating body; said body of insulating material being readily deformable under pressure and having an outer configuration adapted to substantially fill said aperture; said conductor means being hollowed substantially within the region encompassed by said insulating body and having circumferential indentations on a portion of the outer wall

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encompassed by said insulating body; and an explosive means disposed within the hollow of said conductor means; said explosive means being explodable to deform said conductor means such that said conductor means applies a pressure internal to said insulating body to deform said body.

5. An electrical feedthrough means comprising elongated conductor means; a hollow shell housing for mounting said electrical feedthrough means in a wall surface; a body of electrically insulating material, encompassing the mid-portion of said conductor means and in substantially push fit relation thereto, suspending said conductor means within the hollow of said shell housing; said housing having indentations as the inner surface thereof adjacent the outer surface of said insulating body; said insulating material being readily deformable under pressure; said conductor means being hollowed; and an explosive means disposed within the hollow of said conductor means; said explosive means being explodable to deform said conductor means such that said conductor means applies a pressure internal to said insulating body to deform said body.

6. An electrical feedthrough means comprising elongated conductor means; a hollow shell housing for mounting said electrical feedthrough means in a wall surface; a body of electrically insulating material encompassing the mid-portion of said conductor means and in substantially push fit relation thereto, suspending said conductor means within the hollow of said shell housing; said housing having circumferential indentations on the inner surface thereof adjacent the outer surface of said insulating body; said insulating material being readily deformable under pressure; said conductor means being hollowed; and an explosive means disposed within the hollow of said conductor means; said explosive means being explodable to deform said conductor means such that said conductor means applies a pressure internal to said insulating body to deform said body.

7. An electrical feedthrough means comprising elongated conductor means; a hollow shell housing for mounting said electrical feedthrough means in a wall surface; a body of electrically insulating material encompassing the mid-portion of said conductor means and in substantially push fit relation thereto, suspending said conductor means within the hollow of said shell housing; said hous-

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ing having circumferential indentations on the inner surface thereof adjacent the outer surface of said insulating body; said body of insulating material being readily deformable under pressure and having an outer configuration adapted to substantially fill said aperture; said conductor means being hollowed substantially within the region encompassed by said insulating body and having indentation on a portion of the outer wall encompassed by said insulating body; and an explosive means disposed with the hollow of said conductor means; said explosive means being explodable to deform said conductor means such that said conductor means applies a pressure internal to said insulating body to deform said body.

8. An electrical feedthrough means comprising elongated conductor means; a hollow shell housing for mounting said electrical feedthrough means in a wall surface; a body of electrically insulating material encompassing the mid-portion of said conductor means and in substantially push fit relation thereto, suspending said conductor means within the hollow of said shell housing; said housing having circumferential indentations on the inner surface thereof adjacent the outer surface of said insulating body; said body of insulating material being readily deformable under pressure and having an outer configuration adapted to substantially fill said aperture; said conductor means being hollowed substantially within the region encompassed by said insulating body and having circumferential indentations on a portion of the outer wall encompassed by said insulating body; and an explosive means disposed within the hollow of said conductor means; said explosive means being explodable to deform said conductor means such that said conductor means applies a pressure internal to said insulating body to deform said body.

References Cited in the file of this patent

UNITED STATES PATENTS

1,400,401	Allan	Dec. 13, 1921
2,387,742	Burrows	Oct. 30, 1945
2,615,591	Special	Oct. 28, 1952

FOREIGN PATENTS

953,892	France	May 30, 1949
641,917	Great Britain	Aug. 23, 1950
764,239	Germany	Apr. 12, 1954