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STRAIN RELIEF FOR CABLE CONNECTORS

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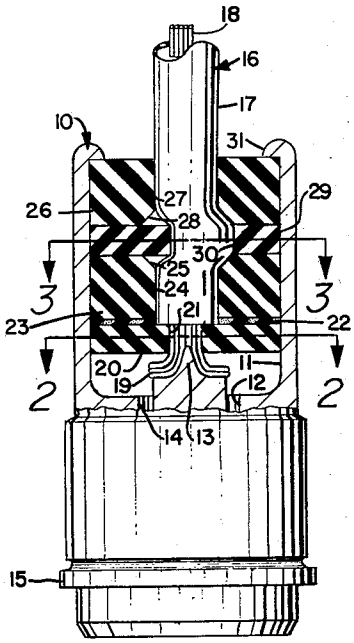


Fig 1

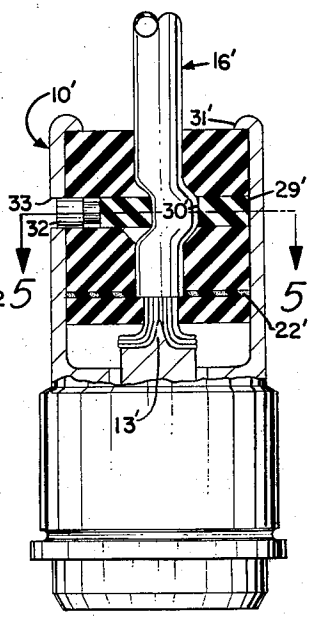


Fig 4

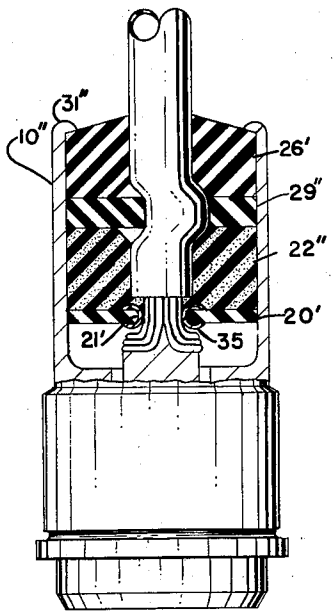


Fig 6

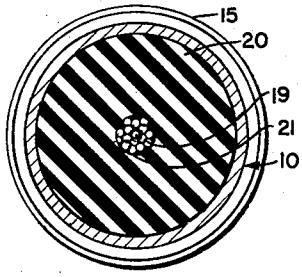


Fig 2

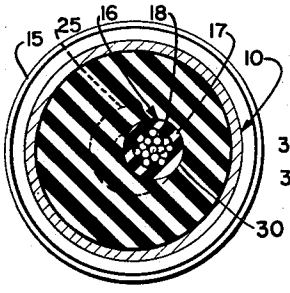


Fig 3

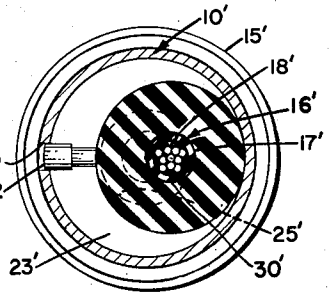


Fig 5

INVENTOR.
HOWARD W. WALDO

BY D. Gordon Angus

ATTORNEY

United States Patent Office

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STRAIN RELIEF FOR CABLE CONNECTORS

Howard W. Waldo, Pomona, Calif., assignor to Aerojet-General Corporation, Azusa, Calif., a corporation of Ohio

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This invention relates to connectors and more particularly to electrical connectors providing for relief of mechanical strain on a cable attached to such a connector.

An object of this invention is to provide for a simple and easily manufactured strain relieving electrical connector which utilizes a minimum of space.

Relief of mechanical strains on a cable attached to an electrical connector is desirable to ensure that the electrical connection is securely maintained. Numerous designs of strain relieving electrical connectors have heretofore comprised holding the attached cable in a firm and fixed conductive relationship to an electrically conductive contact by means of mechanically screwed clamps, or the like. Such clamp devices or other holding devices have generally required substantial additional space in excess of the space required by the electrical connection immediate to electrical contact itself. For this reason, in electrical devices in which reliability of electrical contacts is imperative, the providing of electrical connections with strain relieving connector devices has frequently resulted in excess use of space which is undesirable for devices requiring small and light weight electrical circuit connections such as for airborne equipment.

This invention provides for such a small and light weight strain relieving electrical connector which is simple and easily manufactured by providing a device in which an electrical cable snubs itself mechanically in a fixed position relative to an electrical contact. This is accomplished by having the electrical cable frictionally held between surfaces in a partially offset or bent position.

A feature of the invention resides in a plurality of electrically insulating washers held in a hollow body, each washer having a hole through which the electrical cable passes, at least one of which intermediate washer holes is offset from the other holes disposed in opposite adjoining washers of the plurality.

A related feature resides in the combination of a spear shaped terminus member of the electrical contact and an associated and surrounding substantially rigid washer member, between which the several strands of wire cable are securely held.

These and other features will be more fully understood from the following detailed description and accompanying drawings, of which:

Fig. 1 is a side view partly in cross-section of a connector device according to this invention;

Fig. 2 is a cross-section taken at line 2—2 in Fig. 1;

Fig. 3 is a cross-section taken at line 3—3 in Fig. 1;

Fig. 4 is a variation of the device of Figs. 1 to 3;

Fig. 5 is a cross-section taken at line 5—5 in Fig. 4, and

Fig. 6 is still another variation of the device of Figs. 1 to 3.

In Figs. 1, 2, and 3 there is shown a connector body 10 having a hollow chamber 11 preferably cylindrical in shape extending into one end. A connecting electrical terminal 12 having a spear-shaped conductive terminus 13 points upward from the bottom of the chamber 11 through a hole 14 provided in the chamber bottom. Electrical connection from the connecting electrical terminal 12 to another cable, or the like, is made by attaching a suitably fitting opposing connector member to the body 10 at the end having the ridge 15. This attachment is made in such a manner that any attached connector member is securely fixed to the body 10 and has a cable electrically conductive with the connecting electrical terminal 12. An attached connector member is not here shown as it does not comprise any part of this invention.

A wire cable 16 having an outer insulation jacket 17 and a plurality of wire strands 18 through its center is provided. This is the cable which is to be securely held in the strain relieving connector, and the cable which is electrically contacted by the connecting terminal 12 at a cable end 19. The end 19 of the cable has its insulation jacket 17 removed from an end segment of cable length.

The uncovered strands of the cable end 19 are uniformly spread around the spear-shaped conductive terminus 13 of the electrical terminal 12. Preferably the spear-shaped terminus 13 is centrally disposed within the chamber 11 and its shape is concentric with respect to the cylindrical chamber's center. An electrically insulating washer 20, preferably of fiber, fits loosely within the cylindrical chamber 11 and has a hole 21 through its center provided to fit around the uncovered strands of the cable end 19. The spread uncovered strands of the cable end 19 are therefore securely held in the washer hole 21 between the washer 20 and the spear-shaped terminus 13. This arrangement, as best shown in Fig. 2, provides tight electrical contact between the individual cable strands and the spear-shaped terminus. The cable end 19 and terminus 13 may, however, be soldered together for a more assured contact.

A compressible washer 22, preferably of rubber, is disposed on one of its sides adjacent to the washer 20, so that it fits around the end insulated area of the cable 16. Adjacent to the compressible washer 22 on its opposite side is an inner washer 23, preferably of fiber, positioned so as to surround the cable 16. The washer 23 has a central hole 24 through which the cable 16 is snugly fitted. The upper surface of the washer 23 is countersunk at 25 around the central hole 24. An electrically insulating uppermost end washer 26 preferably of fiber, also has a central hole 27 and a lower countersunk area at 28 around the central hole 27.

Between the inner washer 23 and the end washer 26 there is a central washer 29, also preferably of fiber, having an offset hole 30 through which the cable 16 is passed. The offset position of the hole 30 is best shown in Fig. 3. The countersunk areas 25 and 28 of the inner washer and end washer respectively, each face toward the central washer 29 and provide the otherwise unoccupied space through which the deformed insulated cable 16 passes back toward a central position so that the cable is then situated to pass through the washers 20, 22, 23 and 26 at their centers. These washers and the washer 29 having the offset hole all fit within the cylindrical chamber 11 so as to loosely touch the chamber wall at random positions on their peripheries.

A lip 31, around the periphery of the entrance end of the chamber 11, is crimped inward toward the chamber. This crimping leaves the compressible washer 22 in a compressed condition so that the washer 22 has compressible material pressing inward tightly, all around the periphery of the insulated cable 16, and it also has compressible material pressing outward tightly against the inner wall of the chamber 11 entirely around the chamber. The compression of the washer 22 thus provides a moisture seal by expanding outward to the wall of the chamber 11 and inward to the insulating jacket 17. This washer compression also compensates by suitable degree of compression, for varying thickness of washers

and varying depth of chambers, such as 11, normally expected in manufacture. The compressible washer thus acts as a manufacturing tolerance trap for any such variance of dimensions of these parts. A center washer having an off set hole may conveniently be approximately one half as thick as the diameter of the insulated covered cable which passes through its off set hole, whereas an end fiber washer and an inner fiber washer each adjacent to opposite sides of the center washer may each conveniently be approximately as thick as the diameter of the insulation covered cable which passes through them.

In Figs. 4 and 5 there is shown a variation of the device of Figs. 1, 2 and 3 in which an off set washer 29' of the device is staked by a stake 32 as well as being compressed by a crimped lip 31'. This arrangement also satisfactorily squeezes and compresses the compressible washer 22'. The off set washer 29' may actually have a hole 30' provided through its center for the insulation covered cable 16'. The hole 30' is then off set by displacing the whole washer 29' thus distorting the cable 16'. The connector of Figs. 4 and 5 is first assembled and crimped on the crimped lip 31'. A hole 33 is provided in the connector body 10' opposite the washer 29' so that after crimping, a stake 32 is forced into the hole 33 opposite the washer 29'. This operation off sets the entire washer 29' including its hole 30' through which the insulated cable 16' passes. Additional cable, required to form the distortion of the cable by this off setting operation, is drawn from cable from the exterior of the connector rather than away from the interior contacting terminus 13'. All substituted parts in the alternative embodiments of this invention are similarly numbered with primed original numbers, although it is to be understood that the parts are not necessarily interchangeable because of differences in size, but that substituted parts perform similar functions.

Fig. 6 shows another variation of the device substantially similar to the device of Figs. 1, 2 and 3 in which a fiber washer 20' having a central hole 21' is provided with a substantially rigid conductive eyelet 35, such as of brass material. A thicker compressible washer 22'' is also used in place of the compressible washer 22 of Fig. 1. An end washer 26' used in place of the end washer 26 of the device of Figs. 1, 2 and 3, is higher around the center of its exterior side than at its peripheral edges. This arrangement does not require the lip 31'' of the body 10'' to be crimped as much as the device of Figs. 1, 2 and 3.

The deformation of the cable 16 by the washers having the off set hole results in bending the strands 18 slightly and deforming the insulation jacket 17 at the position of the off set washer. This is best shown in Fig. 1, and in the variations of the device in Figs. 4 and 6. The deformation of the cable grips the cable and prevents it from being dislodged by pulling, pushing, or twisting of the cable.

This device, or any of its variations provides a simple connector which grips a stranded cable in a firm mechanical grip in a minimum of space. The surrounding washers and connector body need not be a great deal larger than the insulated cable in diameter, and the plurality of washers taken together need only have a combined thickness of no more than two or three times the diameter of the insulated cable, or even less. Those washers specified as being of fiber may be fabricated of other suitable rigid electrical insulation material such as Teflon, rubber of the hard vulcanized type, or the like. The device comprises simple parts which do not require extremely close manufacturing tolerances. It is moisture tight as well as providing for secure electrical contact between a stranded wire cable and a connector terminal. The junction of the stranded cable 16 and the connector terminal 12 may also be conveniently soldered in this device, or in any of its variations. Even without soldering the spear-shaped probe 13 of the connector terminal 12 penetrates into the wire strands to maintain electrical contact over a wide range of conditions.

Other design variations of this mechanical gripping, moisture tight electrical connector which requires limited space, much like the designs of the principal embodiment and the second and the third variations discussed and illustrated, are obviously possible.

A connector, such as disclosed above, may be physically attached by a clamp over the ridge 15 to another cable connector or to an electrical device, thereby providing a secure physical connection to such other cable or to an electrical device respectively. Such a connection is not shown in any view since it does not comprise a part of this invention.

Although specific embodiments of my invention have been illustrated and described in detail, it is my desire that this invention shall not be limited to these specific embodiments but only as limited by the appended claims, since persons skilled in the art may devise other embodiments still within the limitation of said claims.

I claim:

1. A connector for attachment to the end of a stranded cable, said connector comprising a connector body having a chamber opening to the exterior of said body, means for closing a portion of the opening to said chamber, a prong structure disposed in said chamber, a plurality of washers held compactly within said chamber by said means for closing a portion of the opening to said chamber, each of said washers having a hole through which the end of said stranded cable passes, one of said washers being of sufficient width to isolate the cable within the connector body from stresses due to flexure of the external portion of the cable, another one of said washers having a hole off set from the positions of the holes through the other of said washers thereby deforming the cable passing through said washers, said other washer having the off set hole being held tightly between two adjacent washers, said prong structure being directed to the hole in the one of said plurality of washers closest to said prong structure the several strand ends of said end of said cable contacting said prong structure so as to be held between said prong structure and the one of said plurality of washers closest to said prong structure.

2. Apparatus according to claim 1 wherein one of said plurality of washers is deformed to provide a moisture tight seal around said cable.

3. An electrical connector for attachment to the end of a stranded electrical cable, said connector comprising a connector body having a chamber opening to the exterior of said body, means at the periphery of said chamber opening for closing a portion of said opening, a conductive prong protruding from substantially the center of the bottom of said chamber, said conductive prong being in electrical contact with said stranded electrical cable end, a plurality of washers all but one of which have centrally disposed holes, said stranded electrical cable end passing through said holes in said washers, a first of said plurality of washers being of sufficient width to isolate the cable within the connector body from stresses due to flexure of the external portion of the cable, a second of said plurality of washers having an off center disposed hole, said last mentioned washer being held between and in contact with said first washer and another of said washers having centrally disposed holes, said plurality of washers including said washer having the off center hole being so disposed within said chamber as to be held tightly therein by said means at the periphery of said chamber opening, said prong structure being directed to said centrally disposed hole in the nearest of said plurality of washers whereby said washers deform said end of stranded cable from a straight position, thereby holding said cable end in a gripped relationship with respect to said connector body and said washers.

4. Apparatus according to claim 3 wherein at least one of said plurality of washers having a centrally dis-

posed hole therethrough is deformed to provide a moisture tight seal around said cable.

5. An electrical connector for attachment to the end of a stranded electrical cable, comprising a connector body having a chamber opening to the exterior of said body, means at the periphery of said chamber opening for closing a portion of said opening, said chamber opening having substantially the same area in cross section as said chamber, a conductive prong in electrical communication with said electrical device, said conductive prong protruding from substantially the center of the bottom of said chamber and pointing toward said chamber opening, the strands of said electrical cable end being disposed and arranged around the periphery of said conductive prong to provide good electrical connection between said cable strands and said conductive prong, a fiber washer disposed around said cable end strands adjacent to said conductive prong, an insulating compressible washer disposed around said stranded cable adjacent to the side of said fiber washer remote from the bottom of said chamber, a second fiber washer disposed around said stranded cable adjacent to said compressible washer, said end of said cable passing through said second fiber washer, said compressible washer and said first fiber washer substantially in alignment with the center of said centrally disposed conductive prong, a third fiber washer disposed around said stranded cable adjacent to said second fiber washer, said third fiber washer having a hole therethrough which said cable passes through, said hole through the third fiber washer being disposed and arranged so as to be substantially in the direction in which said conductive prong is disposed with said hole being substantially off set from the position of disposition of said conductive prong and parallel thereto, a fourth fiber washer disposed around said stranded cable adjacent to said third fiber washer, said fourth fiber washer having said stranded cable passing therethrough substantially in alignment with the center of said centrally disposed conductive prong, said means on said body for closing a portion of said chamber opening being so disposed and arranged as to contact in tight relationship the exterior facing side of said fourth fiber washer thereby compressing said compressible washer so as to provide a moisture tight seal of said compressible washer inward toward a peripheral circumference of said stranded cable and outward toward an internal circumferential wall of said chamber within the body, each of said fiber washers having central disposition of said cable being of substantially the same cross-section as the area of said chamber, contacting the internal circumferential wall of said chamber at random positions, said stranded cable being distorted from a normal, in alignment position with respect to said conductive prong by means of the off set hole through said third fiber washer, said cable distortion thereby providing a firm mechanical grip of said connector on said stranded cable.

6. Apparatus according to claim 5 in which said third fiber washer is made to have a hole therethrough off set from the position of said conductive prong by having a stake provided on one side to hold said third fiber washer with its hole in an off set position, said stake contacting the outer circumference of said third fiber washer and in fixed relationship to said connector body so as to hold said third fiber washer with its hole in an off set position with respect to the disposition of said conductive prong.

7. Apparatus according to claim 5 in which said strands of cable ends are soldered to the periphery of said conductive prong.

8. Apparatus according to claim 5 in which the surface of said second fiber washer adjacent to said third fiber washer, and in which the surface of said fourth fiber washer adjacent to said third fiber washer are each countersunk at areas near their centers, thereby providing space through which said distorted cable passes to a central position in alignment with said conductive prong.

9. A connector for connecting a stranded cable to a structure, said connector comprising a connector body having a chamber opening to the exterior of said body, means for closing a portion of the opening to said chamber, prong means in said chamber; a plurality of washers held compactly in a stacked arrangement within said chamber by said means for closing a portion of the opening to said chamber, each of said washers having a hole through which passes said stranded cable, one of said washers being of sufficient width to isolate the cable within the connector body from stresses due to flexure of the external portion of the cable, another one of said washers having a hole off set from the holes through the other of said washers which have holes which are in alignment, thereby deforming the cable passing through the plurality of washers, said prong structure being directed to the hole in the one of said plurality of said washers closest to said prong structure said stranded cable on a cable end being so disposed and arranged with individual strand ends of the cable contacting said prong means so as to be held between said prong means and the walls of the hole of one of said washers which is closest to said prong means, said deforming of the cable thereby maintaining said stranded cable end in fixed conductive relationship to said prong means.

10. Apparatus according to claim 9 wherein yet another of said plurality of washers is deformed to provide a moisture tight seal around said cable.

11. An electrical connector for attachment to the end of a stranded electrical cable, comprising a connector body having a chamber opening to the exterior of said body, means at the periphery of said chamber opening for closing a portion of said opening, said chamber opening having substantially the same area in cross-section as said chamber, a conductive prong in electrical communication with an electrical device, said conductive prong protruding from substantially the center of the bottom of said chamber and pointing toward said chamber opening, the strands of said electrical cable end being disposed and arranged around the periphery of said conductive prong to provide good electrical connection between said cable strands and said conductive prong, a fiber washer adjacent to said conductive prong, a metal eyelet centrally located within said fiber washer and disposed around said cable end strands through which pass said strands to said conductive prong, an insulating compressible washer disposed around said stranded cable adjacent to the side of said fiber washer remote from the bottom of said chamber, a second fiber washer disposed around said cable adjacent to said compressible washer, said end of said cable passing through said second fiber washer, said compressible washer and said first fiber washer substantially in alignment with the center of said centrally disposed conductive prong, said second fiber washer having a hole therethrough which said cable passes through, said hole through the second fiber washer being disposed and arranged so as to be substantially in the direction in which said conductive prong is disposed with said hole being substantially off set from the position of disposition of said conductive prong and parallel thereto, a third fiber washer disposed around said stranded cable adjacent to said second fiber washer, said third fiber washer having said cable passing therethrough substantially in alignment with the center of said centrally disposed conductive prong, said means on said body for closing a portion of said chamber opening being so disposed and arranged as to contact in tight relationship the exterior facing of said fourth fiber washer thereby compressing said compressible washer so as to provide a moisture tight seal of said compressible washer inward toward a peripheral circumference of said cable and outward toward an internal circumferential wall of said chamber within the body, each of said fiber washers having central disposition of said cable being of substantially the same cross-

section as the area of said chamber, said cable being distorted from a normal, in alignment position with respect to said conductive prong by means of the off set hole through said third fiber washer, said cable distortion thereby providing a firm mechanical grip of said connector on said cable.

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