Nov. 4, 1969 C. D. STEPHENSON 3,477,061

CONTACT RETENTION DEVICE

Filed June 20, 1966 2 Sheets-Sheet 1

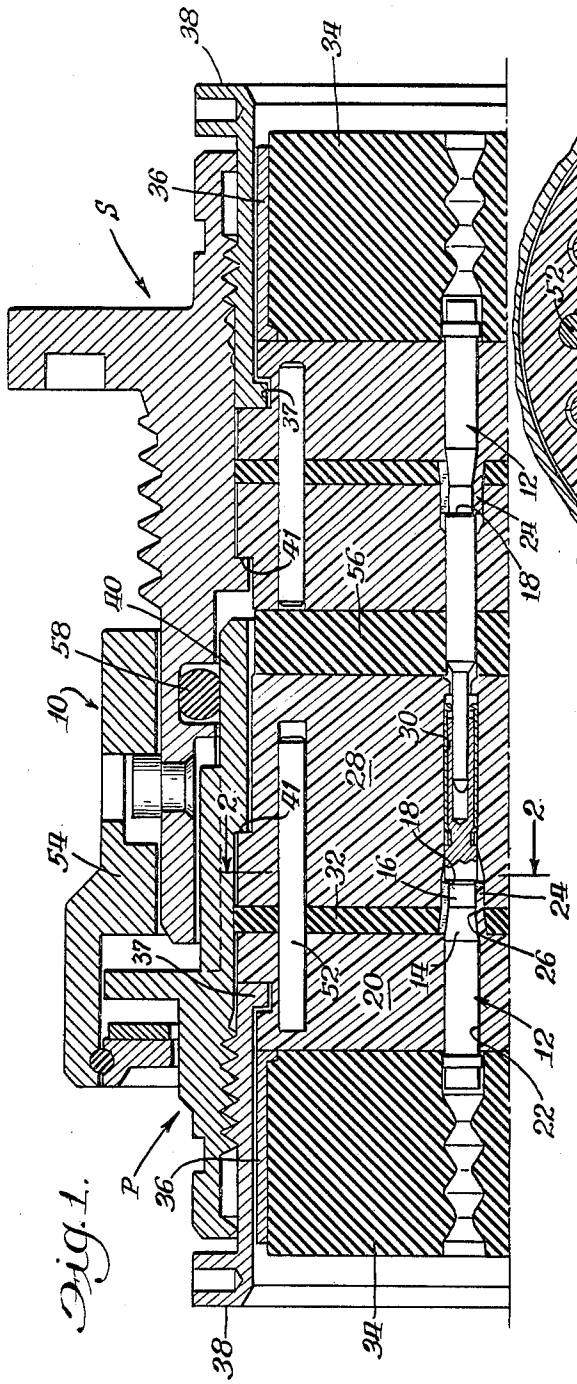

Fig. 1.

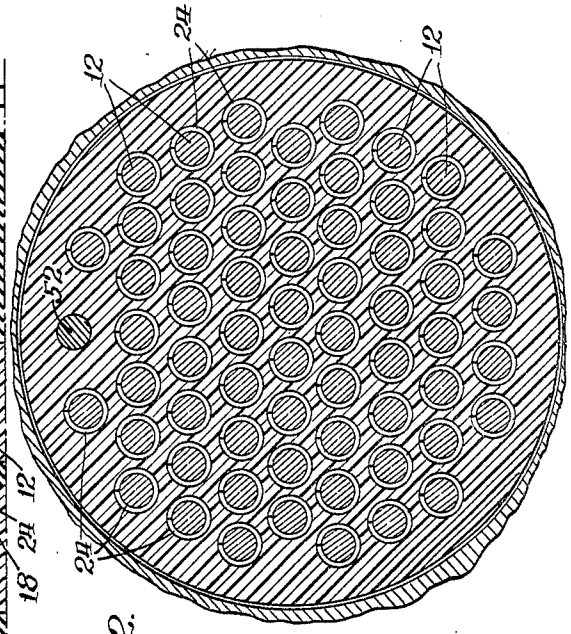

Fig. 2.

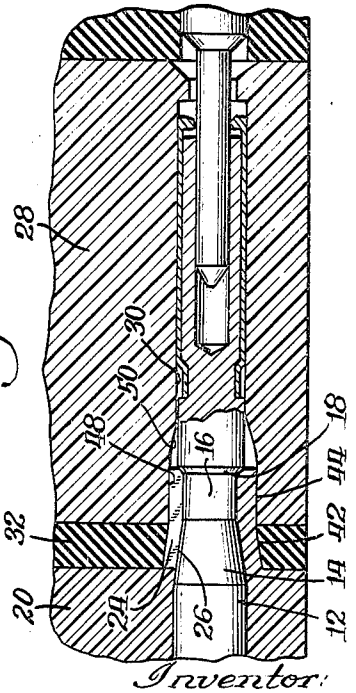

Fig. 3.

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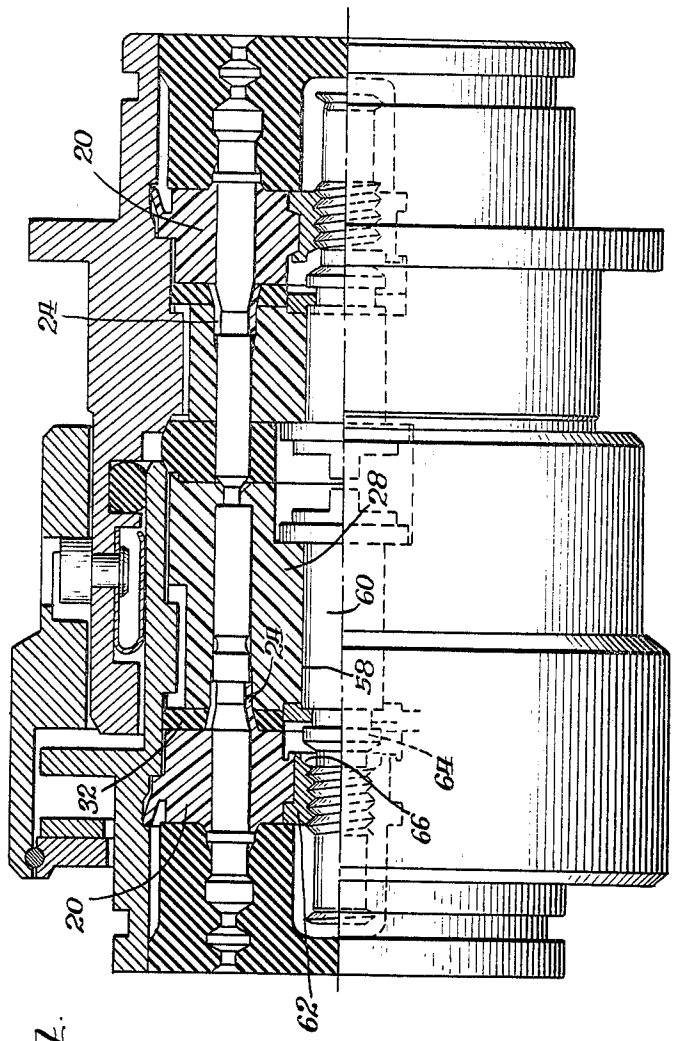

Fig. 4.

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CONTACT RETENTION DEVICE

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U.S. Cl. 339—59 8 Claims

ABSTRACT OF THE DISCLOSURE

The present invention relates to electrical connectors and more particularly to devices for retention of contacts within an electrical connector.

In the joining of electrical conductors it is often necessary to provide a connector having male and female portions each of which hold contacts wherein the contacts may be individually removed and replaced as necessary. To best accomplish this ability to install and remove and replace selected connector contacts as desired, the present invention proposes a contact retention system designed to

(a) firmly hold the contacts within the connector during normal operation;
(b) yieldably hold said contacts during and after insertion and assembly; and
(c) to readily release any individual contacts as desired while retaining others against accidental dislodgement.

It is another object of the present invention to provide a contact retention device wherein the individual contacts may be closely grouped together while maintaining adequate dielectric separation between each contact.

It is another object of the present invention to provide a contact retention device that does not score the contact upon insertion therein.

It is another object of the present invention to provide a contact retention device that, when a contact is inserted therein, confines and secures the contact similar to a molded-in condition.

It is another object of the present invention to provide a contact retention device wherein the contacts are confined to minimize the effect of shock and vibration thereon while maintaining concentricity and axial alignment thereof.

It is yet another object of the present invention to provide a contact retention device which is characterized by ease of operation, ease of fabrication and low cost of production.

Other objects will become more apparent as the detailed description proceeds.

In general, the present invention comprises an electrical connector having at least one electrical contact, mounted in and secured to a resilient dielectric body having a passage therethrough sized to accept said contact. Said resilient dielectric body has an extension thereof with a passage therethrough coaxial with the passage of said resilient dielectric body and sized to accept said contact and restrain axial motion thereof. A hard dielectric body having a passage therethrough sized to accept the extension of said resilient dielectric body and restrain radial expansion thereof is provided. Means are also provided for bringing the extension of said resilient dielectric body in coaxial engagement with the passage of said hard dielectric body, whereby said contact is restrained in axial motion.

Further understanding of the present invention may best be obtained from consideration of the accompanying drawings wherein:

FIGURE 1 is a cross sectional view of a connector showing a contact retention device according to the present invention contained therein.

FIGURE 2 is a cross section of the connector plug of FIGURE 1 taken along line 2—2 thereof.

FIGURE 3 is an enlarged section of the connector of FIGURE 1 clearly illustrating the contact retention portions of the present invention in plug engagement.

FIGURE 4 is a cross sectional diagram of a connector illustrating an alternate embodiment of the present invention.

FIGURE 1 illustrates a connector **10** with the plug P (male portion) male and socket S (female half) engaged. A contact holding device according to the present invention is shown for each of the male and female halves of the connector **10**. For purposes of clarity of illustration and ease of understanding of the present invention, only one mated male and female contact is illustrated in cross section in FIGURE 1, it being understood that other contacts are present within the connector **10** as shown in FIGURE 2.

The following description is directed to the plug half S of the connector, it being understood that the present invention exists in like form within the socket half. The contact holding device of the present invention accommodates a conventional contact **12** shown as including a tapering portion **14** extending to a reduced neck portion **16** forming a tapered latching abutment **18**. The contact holding device consists of a resilient dielectric member **20** having passages **22** therethrough sized to accommodate each of the contacts **12**, and provided with tubular or sleeve-like extensions **24** surrounding each contact and with passages **26** therethrough coaxial with the passages **22**. The interior walls of the passages **22** conforms to the normal external diameter of contact **12**, while the interior walls of passage **26** of extension **24** are shaped such that they essentially conform to the tapering portion **14**, reduced neck portion **16**, and abutment **18** of the contact. The internal surface of passage **26** of extension **24** is biased into engagement with abutment **18**; that is, it is sized such that it exerts a compressive radial force on the aforementioned portions of contact **12** when in engagement therewith. Thus, when contact **12** is inserted through the passages **22** and **26** of resilient dielectric member **20** it expands the extension **24** thereof, after which the extension **24** snaps about the tapered portion **14**, reduced portion **16** and abutment **18** of the contact **12** to restrain axial motion of contact **12** enough to hold it (and an attached conductor) in position unless deliberate axial force is applied to remove it.

A hard dielectric member **28** is mounted within the connector **10** and has a passage **30** therethrough to permit the insertion therein of contact **12**. The passage **30** has an enlargement **48** thereof sized to accommodate in close fitting relationship the extension **24** of resilient dielectric member **20**. A soft sealing gasket **32** is inserted between resilient dielectric member **20** and hard dielectric member **28** to provide a waterproof seal therebetween. A soft sealing grommet **34** is cemented to the resilient dielectric member **20** to provide a seal about contacts **12** and the conductors attached thereto. A hard sleeve **36** is disposed about grommet **34** in contact therewith and the assembly of sleeve **36** and grommet **34** is cemented to the resilient dielectric member **20**. The rearward end of plug P is internally threaded to receive an externally threaded ring **38**, which is rotatably mounted about hard sleeve **36**, and the resilient dielectric member **20** and is interlocked therewith by flange **37** so that it imparts axial motion to the resilient dielectric member **20** upon rotation to the ring. The hard sleeve **36** serves to confine radial expansion of grommet **34** and

provides a rotating engagement surface for ring 38. The forward portion 40 of plug P has a shoulder 41 whereby hard dielectric member 28 is held in fixed relationship therewith.

Turning to FIGURE 3, an enlargement is shown for the extension 24 of resilient dielectric member 20. As previously stated, the internal surface of passage 26 through extension 24 conforms essentially to the tapered portion 14, reduced neck portion 16 and abutment 18, while the passage 22 in dielectric 20 conforms to the normal external diameter of contact 12. The external surface of the extension 24 may comprise two sections, a tapered section 42 and a straight section 44. The conforming enlargement in the passage 30 of hard dielectric member 28 may also comprise two sections, as for example a straight section 48 conforming to the straight section 44 of extension 24 and a tapered section 50. The soft sealing gasket 32 conforms and seals to the tapered section 42 of extension 24. Thus, when the extension 24 is inserted within the passage 30 of hard dielectric member 28, the enlarged portion of passage 30 confines the extension portion 24 of resilient dielectric member 20 to prohibit, or at least forcefully restrain radial expansion thereof.

The contact restraining device illustrated in FIGURES 1 to 3 and described supra operates as follows. The contact 12 is connected by conventional crimping, soldering or welding techniques to a conductor. The contact 12 is then inserted into the passage 22 of resilient dielectric member 20 and the passage 26 of extension 24. The extension 24 of resilient dielectric member 20 snaps about the tapered portion 14, reduced straight portion 16 and abutment 18 of the contact 12 to exert enough radial compressive force thereon to yieldably restrain the contact 12 and conductor attached thereto against accidental dislodgement. Ring 38 is then rotated and axially advanced to move the resilient dielectric member 20, extension 24 thereof, and the sealing gasket 32 into engagement with the hard dielectric member 28. The enlargement 48 of the hard dielectric member 28 receives and confines the extension 24 of resilient member 20 to restrain radial expansion thereof and thus prevent dislodgement of the contact 12 by any force insufficient to damage or destroy the parts. One or more guide pins 52 may be used to assure polarized mating of the contacts within the two members 20 and 28.

It is to be understood that the foregoing technique and construction is used for each contact to be mounted within the connector 10. To remove any contact or contacts or to inspect the same, the ring 38 is at least partially unscrewed from plug P to draw the resilient dielectric member 20 and sealing gasket 32, rearwardly, thus withdrawing the extension 24 from the enlargement 48 in the hard dielectric member 28. If desired, the resilient dielectric member 20, together with the contacts 12 embedded therein, may be completely withdrawn from the connector 10. The contacts 12 may then be visually inspected or, if necessary, be extracted individually from the resilient dielectric member 20. To extract a contact 12 from the resilient dielectric member 20, it is recommended that a simple tool having an end conforming to the end of the contact 12 be used. To extract the contact 12, axial pressure is brought to bear with the tool on the end of the contact 12, whereby the tapered surface of abutment 18 will act as a cam to expand the extension 24 and permit the rearward removal of the contact 12 therefrom.

The foregoing description is made with respect to the plug half P of the connector 10 of FIGURE 1. It is to be understood that the socket half S of the connector 10 is of like construction. The two halves of the connector 10 are brought into engagement using any conventional means such as the illustrated captive bayonet coupling 54. Upon engagement of the two halves, conventional gasket 56 and O-ring members 58 are provided to effect and complete waterproof sealing of the connector 10.

In the preferred embodiment of FIGURE 1 a suitable material for the resilient dielectric member 20 has been found to be a fluorine containing thermoplastic resin having a high molecular weight polymer of vinylidene fluoride. It has further been found advantageous to cut through one side of extension 24 as shown in FIGURE 2 to facilitate expansion thereof when contact 12 is inserted therein.

An alternate embodiment of the present invention is shown in FIGURE 4. The embodiment of FIGURE 4 differs from the embodiment of FIGURES 1 to 3 in the means used to bring the member 20 and extension 24 thereof into engagement with member 28 and gasket 32. In the embodiment of FIGURE 4 a centrally located screw-nut arrangement is used to bring the aforementioned members into engagement with the hard dielectric member 28. A passage 58 extends through the hard dielectric member 28 to accept a screw 60. The passage 58 has a counterbore to accept the head of the screw 60. A nut 62 is fixedly embedded in the resilient dielectric member 20 coaxial with the passage 58 in the hard dielectric member 28. The screw 60 has an abutment 64 therealong which is engageable with a counterbored portion 66 of nut 62. Thus, when the contact or contacts 12 have been inserted in the resilient dielectric member 20 and the extension or extensions 24 thereof, the member 28 is axially advanced into the plug shell P until the screw 60 in hard dielectric member 28 engages the nut 62. The screw 60 is then turned and the rotational motion thereof is translated into relative axial motion of members 20 and 28 to bring them in engagement and confine extension 24 within hard dielectric member 28 to restrain axial motion of contact or contacts 12.

With a contact retention device manufactured according to the aforedescribed teachings, the contacts are retained similar to a molded-in condition and are confined so as to minimize the effect of shock and vibration thereon. Further, adequate dielectric separation may be maintained between the contacts while providing a contact retention device which is characterized by ease of operation, ease of fabricationa and low cost of production.

Persons skilled in the art will, of course, readily adapt the teachings of the present invention to embodiments far different than those illustrated and described above.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In an electrical connector, an electrical contact having a portion thereof tapering to form an abutment intermediate its ends and extending through a dielectric body having a passage sized to accept said contact, said dielectric body carrying a radially expansible sleeve-like member disposed about said tapering portion of said contact and extending from one face of said dielectric body into engagement with said abutment to restrain axial motion of said contact, together with a contact locking member having a substantially non-expansible fixed diameter passage therethrough surrounding said contact and in closely fitting engagement around said sleeve-like member to prevent release of said contact.

2. The device according to claim 1 wherein the sleeve-like member carried on said dielectric body is split along the length thereof and further including moisture gasket sealing means disposed between said dielectric bodies and about the sleeve-like member of said dielectric body.

3. An electrical connector according to claim 1 wherein said locking member comprises a hard dielectric body having a passage therethrough sized to accept the aforesaid sleeve-like member and restrain radial expansion thereof, and means for bringing said sleeve-like member in coaxial engagement with the passage of said hard dielectric body, whereby said contact is locked against axial motion.

4. In an electrical connector, an electrical contact having a portion thereof tapering to form an abutment on said contact, a resilient dielectric body having a passage sized to accept said contact, said resilient dielectric body including an integral radially expansible tubular sleeve-like extension disposed about said tapering portion of said contact and extending from one face of said dielectric body into engagement with said abutment to restrain axial motion of said contact together, with a hard dielectric body having a passage therethrough sized to accept said contact and in close fit relationship around the extension of said resilient dielectric body, a shell member surrounding and carrying said hard dielectric body with the axis thereof substantially parallel to the axis of said passage through said hard dielectric body, and means connected to said resilient dielectric body engageable with said shell member to cause coaxial engagement of the tubular sleeve-like extension of said resilient dielectric body with the passage of said hard dielectric body.

5. The device according to claim 4 wherein the extension of said resilient dielectric body is cut through at least one side along the length thereof and further including moisture gasket sealing means disposed between said dielectric bodies and about the extension of said resilient dielectric body.

6. In an electrical connector having a plug or socket adapted to be detachably interconnected to another connector, the combination of at least one dielectric body within said plug or socket, with contacts carried by said dielectric body and adapted to electrically interengage contacts of said other connector; at least some of said contacts having a latching abutment thereon, with a retention device adapted to engage said abutment in a latching position wherein said device will yieldably restrain said contact against undesired displacement with respect to the aforesaid dielectric body while permitting release of one or more contacts by exertion of moderate manual force thereon, together with locking means normally engaging the aforesaid retention devices of all contacts to hold them in substantially unyielding engagement with their contact abutments and thus positively lock all contacts in place, and means for disengaging said locking means from the retention devices to permit selective manual release of any contact from its dielectric body without release of the others.

7. An electrical connector according to claim 6 wherein the retention device is of solid but yieldable plastic material and wherein coacting cam surfaces are provided between the abutment and retention device to allow the retention device, when unlocked, to automatically disengage the abutment of the contact in response to force exerted on the contact.

8. An electrical connector according to claim 7 wherein there are a multiplicity of contacts, and wherein the locking means includes an exterior shell enclosing the dielectric bodies and contacts and shiftable means at least partially within the shell but manually accessible from the exterior thereof to cause the locking means of all of said contacts to disengage all of the retention devices thereof.

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