United States Patent

Zimmerman, Jr.

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[54] **MOVABLE CONTACT CONNECTOR ASSEMBLY**

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[73] Assignee: **AMP Incorporated,** Harrisburg, Pa.

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[52] **U.S. Cl.**.....**339/221 R,** 339/147 R, 339/214 R, 339/262 RR

[51] **Int. Cl.** **H01r 9/08**

[58] **Field of Search**.....339/262, 255, 221, 258, 206, 339/207, 211, 213, 214, 215, 217, 147, 259; 151/69

[56] **References Cited**

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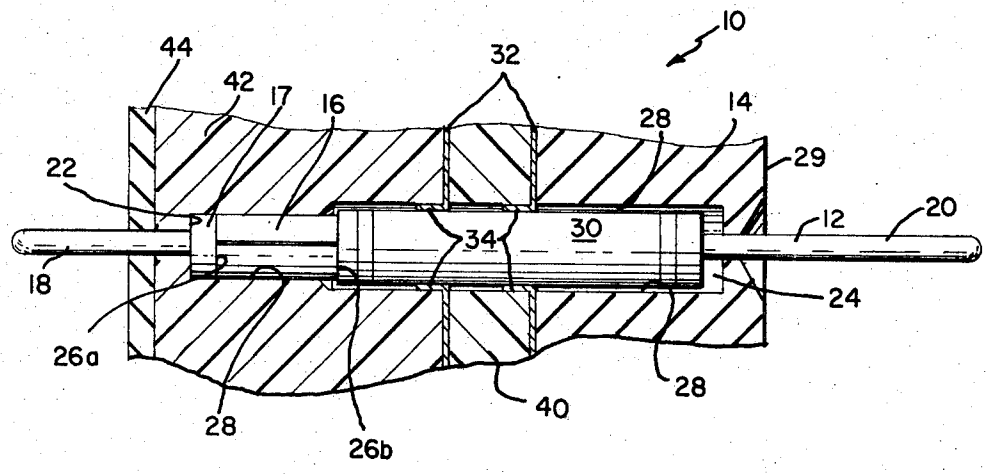
[57] **ABSTRACT**

A contact pin having a collar is removably retained within a housing cavity by a retention bushing comprising a longitudinally split cylindrical sleeve encircling the connector terminal of the pin. The collar of the pin is held between a shoulder at the rear of the cavity and the rear end of the sleeve. The walls of the cavity radially compress the sleeve so as to retain the contact pin and the sleeve within the housing.

2 Claims, 7 Drawing Figures



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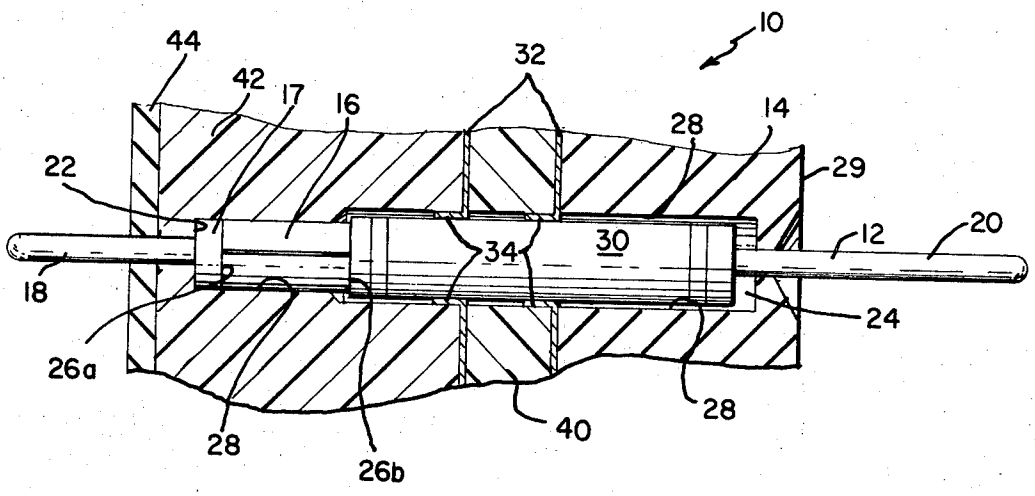

FIG. 1

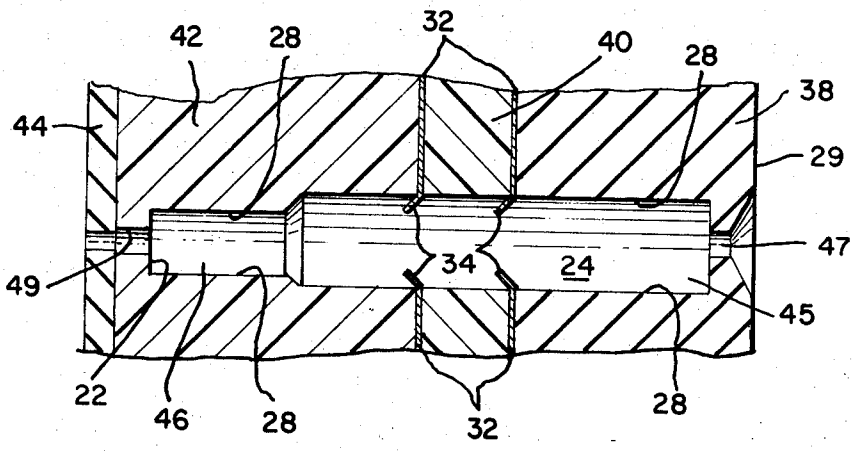

FIG. 2

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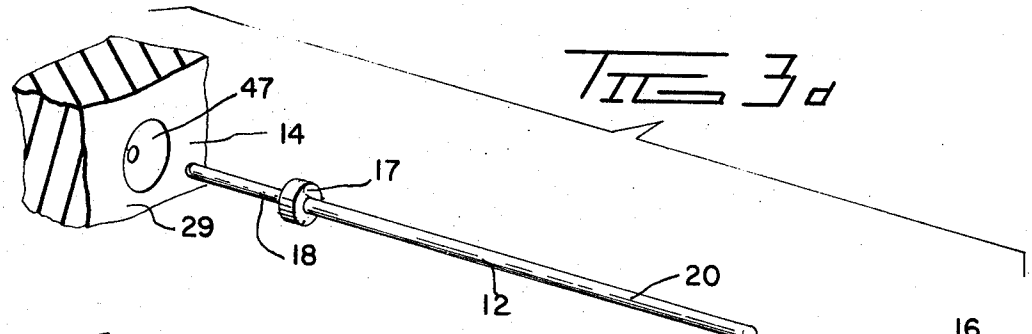

FIG 3a

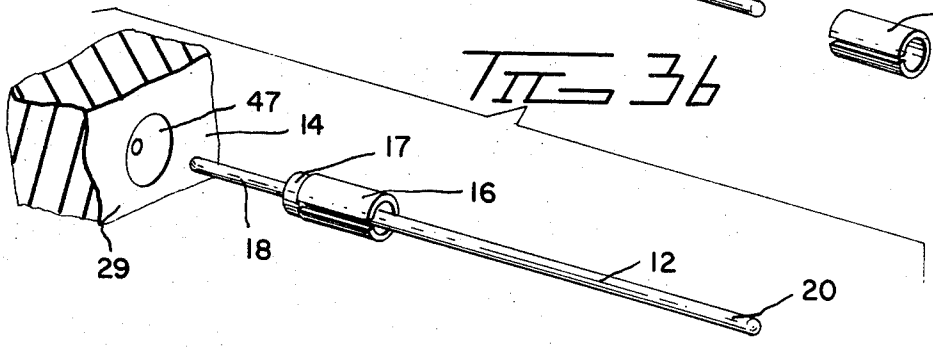

FIG 3b

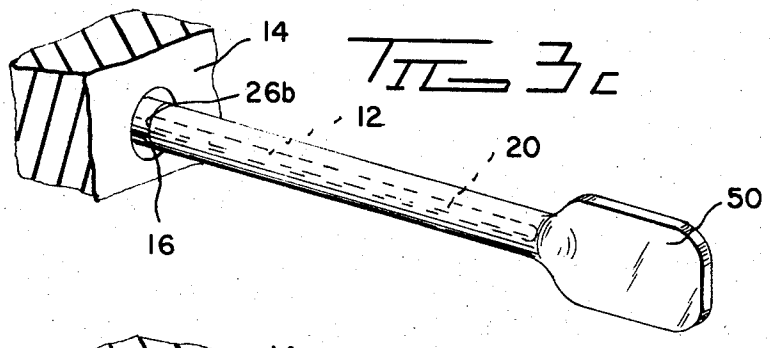

FIG 3c

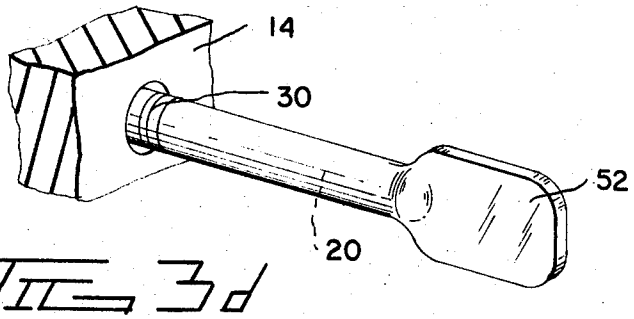

FIG 3d

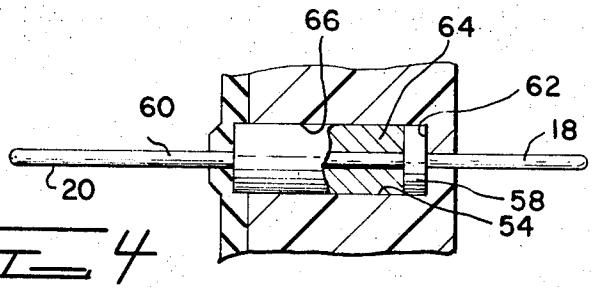

FIG 4

MOVABLE CONTACT CONNECTOR ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates to a connector assembly having a contact pin.

Conventionally, spring clips have been utilized for retaining contact pins in a cavity of a connector assembly housing. Frequently, the spring clips are snapped into place between radial shoulders of the housing which engage both ends of the clip as shown in U.S. Pat. No. 3,366,921 - Culver. With the Culver construction, the clip which is longitudinally split to permit radial compression during entry into the housing maintains a radially expanded state between the shoulders preventing removal of the clip from the housing. Insertion of the contact pin is achieved by passing the collar of the pin through the axial opening of the clip and past resilient fingers of the clip after the clip has been snapped into place. The collar is then held in place within the axial opening of the clip between one shoulder of the housing cavity and the resilient fingers of the clip. Removal of the contact pin is achieved by inserting a tool into the housing to release the resilient fingers thereby allowing the pin to be withdrawn from the clip and the housing with the clip remaining in the housing.

When a spring clip such as that shown in the Culver patent is used, it is difficult to prevent the transmission of mating and unmating loads of the connector through the contact pin. The flexible resilient fingers may yield to forces of mating and unmating thereby transmitting those forces to an easily broken solder connection of the contact pin. In some instances, the resilient fingers may break off under these forces as suggested in the Culver patent. In all instances, the transmission of the mating and unmating forces may only be minimized by closely controlling the tolerances of the assembly including the tolerance on the thickness of the contact pin collar, the tolerance on the distance between the ends of the resilient fingers and the end of the clip, and the tolerance on the distance between the radial shoulders of the housing.

Contact pins of the connector assembly are usually inserted from the rear of the assembly as disclosed in the Culver patent as well as U.S. Pat. No. 3,462,715 - Schor. When circuitry is soldered to solder posts of the contact pins at the rear of the assembly housing, removal of faulty contact pins or filters associated with the pins is greatly complicated. In many cases, the removal of a single pin with or without a filter will require separation of all of the circuitry from the other contact pins. This is particularly true when a spring clip such as that disclosed in the Culver patent is utilized which requires insertion of a tool to release the pin from engagement by the resilient fingers.

SUMMARY OF THE INVENTION

It is one object of the invention to provide an improved connector assembly which substantially prevents transmission of mating and unmating forces through the contact pin.

It is another object of the invention to provide an improved connector assembly which achieves the foregoing object while minimizing the necessity for close tolerances on the assembly.

In accordance with this object of the invention, the connector assembly comprises a contact pin including a collar portion and a shank portion forming a connector terminal. The shank portion of the contact pin is inserted into an axial opening of a radially resilient sleeve. A housing having a cavity including a shoulder means and cavity walls receives the radially resilient sleeve and the contact pin with the shoulder means abutting one side of the collar portion and the cavity walls radially compressing the resilient sleeve. The resilient sleeve bears against the other side of the collar portion with the end of the sleeve adjacent the shoulder means being spaced therefrom by the collar portion and the sleeve and the collar portion being held in position by a retention force due to the radial load of the resilient sleeve factored by the coefficient of friction between the sleeve and the cavity walls.

Another object of this invention is to provide an improved assembly which permits insertion and removal of contact pins from the front or mating side of the assembly housing.

In accordance with this object of the invention, the end of the sleeve remote from the shoulder means and near to the mating side of the housing is exposed within the cavity so as to permit removal of the sleeve when the retention force is exceeded. The opening between the cavity and the mating side of the housing with the connector terminal extending therethrough is of a size and shape so as to permit insertion and removal of the sleeve through the opening. When the assembly includes a tubular filter and the cavity includes a filter receiving section as well as a sleeve receiving section with the filter receiving section having a greater diameter than the sleeve receiving section, the cavity walls between the filter receiving section and the sleeve receiving section are tapered inwardly.

It is another object of the invention to provide a connector assembly of this type which entirely eliminates transmission of connector engagement and separation loads to solder joints.

In accordance with this object of the invention, the enlarged portion of the contact pin comprises a collar held against a shoulder at the rear end of the cavity by the sleeve so as to prevent relative motion between the contact pin and the housing during the engagement and separation of the connector.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view of the connector assembly;

FIG. **2** is a cross-sectional view of the connector assembly housing;

FIG. **3***a–d* are perspective views of the various steps in assembling the connector assembly; and

FIG. **4** is a cross-sectional view of another connector assembly.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. **1**, a connector assembly **10** comprises a contact pin **12** retained within a housing **14** by a retention bushing comprising a split sleeve **16**. The sleeve **16** is split longitudinally, as seen in FIGS. **1**, **3***a*, and **3***b*, making it radially resilient. In order to properly position the contact pin **12** within the housing **14**, a col-

lar 17 is provided which separates the rear shank portion or solder post 18 of the pin from a front shank portion or connector terminal 20. By bottoming one side of the collar 17 against a radial shoulder 22 at the rear of a housing cavity 24 with a rear end 26*a* of the sleeve 16 bearing against the other side of the collar 17, the contact pin may be retained within the cavity 24 by the sleeve 16.

The split sleeve 16 is held in place due to the radial compression provided by the walls 28 of the cavity 24. This radial compression of the sleeve 16 provides a retention force due to the radial load of the split sleeve 16 factored by the coefficient of friction between the sleeve 16 and the walls 28 of the cavity 24. Note that there is no annular notch in the walls 28 so that the force of retention is achieved entirely by the forces along the length of the sleeve 16 and not by any force at the front end 26*b* of the sleeve. Accordingly, both the pin 12 and the sleeve 16 may be inserted and removed simultaneously from the cavity 24 at the front or mating side 29 of the housing 14.

A fixed and proper position of the pin 12 after insertion into the cavity 24 is assured regardless of the longitudinal dimensions of the sleeve 16 and the cavity 24 or the thickness of the collar 17 by pushing on the sleeve 16 until the collar 17 is bottomed on the shoulder 22. Of course, sufficient force must be applied to the pin-sleeve combination so as to overcome the radial load factored by the coefficient of friction. In this connection, tools are utilized to overcome the retaining force provided by the split sleeve 16 which, for many purposes, may be 3 to 5 lbs. Once properly positioned, the contact pin 12 will minimize the transmission of mating and unmating forces to the solder post 18.

As shown in FIG. 1, the connector assembly further comprises a filter 30 which is located within the cavity 24 in front of the sleeve 16. Conductor ground planes 32, which are the subject matter of patent application (Attorney's Docket No. 7886), and assigned to the assignee of this invention, are provided within the housing 14 with contact between the filter 30 and the ground planes 32 being achieved through contacts 34 which are integrally and flexibly connected to the ground planes 32. The filter 30 may comprise any suitable miniature feedthrough low pass filter, and preferably is a deposited type distributed filter as fully disclosed in patent application Ser. No. 883,501, filed December 9, 1969, and assigned to the assignee of the present invention.

Referring now to both FIGS. 1 and 2, it will be seen that the cavity 24 forms part of an opening extending through the housing 14 which comprises a soft front insulator 38, an insulating spacer 40 between the ground planes 32, a rear insulating spacer 42 and a rear face 44 for receiving circuitry to be soldered to the solder post 18. At the front side 29, an opening 47 tapers inwardly in the insulator 38 to facilitate insertion and removal of the contact pin 12, the sleeve 16, and the filter 30 without damage to the housing 14. Similarly, the cavity walls joining a larger diameter filter receiving cavity section 45 and a smaller diameter sleeve receiving cavity section 46 are tapered so as to facilitate insertion of the sleeve 16 and the collar 22. The front end 26*b* of the sleeve 16 is exposed to the cavity section 45 to permit removal of the sleeve 16 from the front of the housing 14.

The diameters of the sleeve and the sleeve receiving section 46 of the cavity 24 are critical in order to maintain an appropriate retaining force. For example, a split sleeve 16 0.150 inches long and having an uncompressed outside diameter of 0.081 inches and an uncompressed inside diameter of 0.052 inches with a minimum slot width of 0.020 inches, where the split sleeve comprises beryllium copper or phospher bronze and the rear spacer 42 comprises either an epoxy, a phenolic, or diaphthalate, would require the section 16 to have a diameter of 0.075 in order to provide a 3 to 5 lb. retaining force. The spacer 40 is of the same material as spacer 42 and the front insulator 38 is of silicon rubber. The diameter of the cavity section 45 is also critical so as to maintain an appropriate spacing between the cavity walls of the section 45 and the filter 30 in order to establish the necessary electrical contact between the contacts 34 and the outer wall of the filter 30.

The shoulder 22 must have a sufficient area to provide a substantial bearing surface for the collar 17. For example, a shoulder diameter of 0.017 inches may be utilized while limiting the opening 49 in the rear spacer 42 to a diameter of 0.033 inches which substantially precludes passage of the collar 17 through the opening 49. The diameter of the opening 49 in the rear face 44 is somewhat smaller yet to assure a seal around the solder post 18 and prevent solder from entering the cavity 24. For this purpose, the face 44 may comprise a resilient material such as rubber to provide a good seal around the solder post 18 which may have a somewhat smaller diameter than the diameter of the connector terminal 20. Circuitry in a suitable form such as flexible etched circuitry, ribbon cable or P.C. boards may then be soldered directly to the face 44 at the solder post 18.

Reference will now be made to FIGS. 3*b*–3*c* in describing a method of assembling the various elements in the connector assembly as shown in FIGS. 3*a*. In the first step of the assembly as shown in FIG. 3*b*, the sleeve 16 is slipped over and is hanging more or less loosely on the connector terminal 20. Since the collar 17 is too large to enter or to pass through the axial opening of the substantially cylindrical and longitudinally split sleeve 16, the sleeve 16 will not slip over the collar 17.

The second step requires the insertion of the pin 12 into the cavity 24 from the front or mating side 29 of the housing 14. This step is performed by pressing on the end 26*b* of the sleeve 16 with a tool 50 which in turn presses on the collar 17 as shown in FIG. 3*c*. When the collar 17 is bottomed on the radial shoulder 22 as shown in FIGS. 1 and 2, the tool 50 is removed.

The filter 30 may then be slipped over the connector terminal 20 and forced into the cavity of the housing with a tool 52 as shown in FIG. 3*d*. Tool 52 may then be removed from the cavity. Removal of the pin 12, the sleeve 16, and the filter 30 may be accomplished by pulling on the connector terminal 20 or pushing on the solder post 18. In either case, the pin 12, the sleeve 16, and the filter 30 are removed from the front side 29 without damage to the housing 14.

In the embodiment of FIG. 4, the connector assembly does not include a filter. Accordingly, the cavity 54 comprises a single section of substantially uniform diameter for receiving a split sleeve retention bushing 64. As in the embodiment of FIGS. 1–3, a col-

lar 58 of a pin 60 is held against a shoulder 62 of the cavity 54 by the sleeve 64 which is radially compressed by walls 66 of the cavity 54.

It will be appreciated, that the connector assembly may comprise a plurality of cavities and contact pins with various circuit components soldered to the respective solder posts of those contact pins.

Although the invention has been described in terms of specific connector assemblies, it will be understood that the invention comprehends various modifications and equivalents of those assemblies which fall within the scope of the appended claims.

What is claimed is:

1. A connector assembly comprising: a contact pin including a collar portion and a shank portion for use as a connector terminal; a retention bushing comprising a radially resilient sleeve having an axial opening extending from one end to the other end of said sleeve, said shank portion extending through said opening; a housing having a cavity including a shoulder means abutting the side of said collar portion opposite said shank portion and cavity walls radially compressing said sleeve, said sleeve bearing against the other side of said collar portion, said sleeve and said collar portion being held in position by a retention force due to the radial load of the resilient sleeve factored by the coefficient of friction between said sleeve and said cavity walls; said housing has an opening between said cavity and the mating side of said housing with the connector terminal extending therethrough, said opening permitting insertion and removal of said sleeve and said collar portion therethrough without damage to the housing; said housing has another opening between said cavity and the rear side of said housing, said another opening substantially precluding insertion and removal of said sleeve and said collar portion therethrough; and said assembly further comprises a tubular feedthrough low pass filter concentrically disposed about a portion of said shank portion of said connector terminal, said filter being spaced from said collar portion by said retention bushing; and said housing, in addition to the sleeve receiving cavity section, further includes a filter receiving cavity section comprising said first mentioned opening, said filter receiving cavity section having a larger diameter than said sleeve receiving cavity section, said cavity walls between said sleeve receiving cavity section and said filter receiving cavity section being tapered inwardly toward said sleeve receiving cavity section.

2. In a connector assembly, comprising: a housing provided with a first cavity of relatively small cross section, a second cavity intersecting said first cavity and defining a shoulder at the intersection with said first cavity, a third cavity of relatively large cross section, a contact pin received through said first and said second and said third cavities, a collar on said pin freely received through said second and said third cavities and abuttingly engaged against said shoulder, a retention bushing comprising a radially expansible sleeve freely received over said contact pin and in abutment against said collar, said bushing being radially expansible internally of said second cavity in compressive engagement radially outward against said housing and abuttingly retaining said collar in engagement against said shoulder, said collar and said bushing in mutual abutting engagement and comprising a fastening structure fixedly securing said contact pin against longitudinal movement in said first and said second and said third cavities, a generally tubular feedthrough low pass filter received over said contact pin and freely received internally of said third cavity, said filter in abutting engagement against said bushing, said bushing positively locating said filter longitudinally within said third cavity, and at least one ground plane member mounted on said housing, a portion of said ground plane member protruding into said third cavity and mechanically and electrically engaging said filter.

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