United States Patent [19]

Joslyn et al.

[11] **3,781,986**

[45] **Jan. 1, 1974**

[54] **METHOD OF MOUNTING ELECTRICAL CONTACTS WITHIN A CONNECTOR BODY**

[75] Inventors: **Carl R. Joslyn,** Unadilla; **John W. Dyce,** Sidney, both of N.Y.

[73] Assignee: **The Bendix Corporation,** Southfield, Mich.

[22] Filed: **May 30, 1972**

[21] Appl. No.: **257,614**

[52] **U.S. Cl.** ..... **29/630 D,** 29/624, 29/625, 174/145

[51] **Int. Cl.** **H01r 9/00**

[58] **Field of Search** ..... 29/624, 627, 630 C, 29/630 B, 630 D, 631, 203, 626, 625; 174/50.52, 50.56, 50.61, 50.62, 59, 74, 77, 76, 145, 154, 176, 180; 339/220 R, 220 T, 218 R, 218 M, 210 R, 210 M, 262 R, 258 R

[56] **References Cited**

UNITED STATES PATENTS

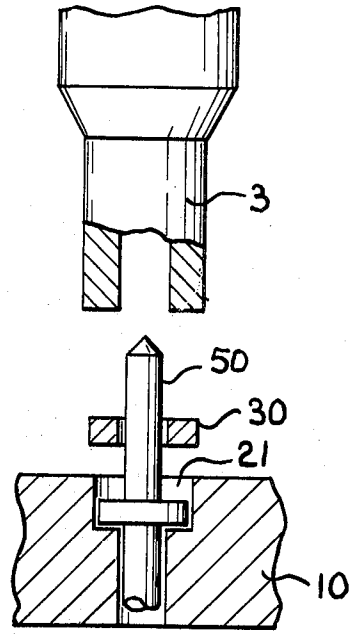
2,829,426	4/1958	Franklin	29/627
3,006,069	10/1961	Rhoads et al.	29/624 X
3,081,374	3/1963	Burch	174/50.52 UX
3,089,449	5/1963	Gutbier	29/626 UX
3,239,895	3/1966	Stuckert	29/625
3,517,437	6/1970	Szobonya	29/630 R
3,705,380	12/1972	Roberts	339/218 R

Primary Examiner—Charles W. Lanham
Assistant Examiner—Joseph A. Walkowski
Attorney—Raymond J. Eifler et al.

[57] **ABSTRACT**

A method of assembling metal contacts in thermoplastic inserts of an electrical connector, the thermoplastic body having a plurality of contact receiving passages therethrough, each of which has a shoulder therein and terminates through one face of the insert through a projection so that when a contact with a shoulder thereon is placed against the shoulder in the passage and the projecting portion is heated and caused to abut against the shoulder of the contact, the contact will be secured in the passage when the thermoplastic material cools.

10 Claims, 7 Drawing Figures



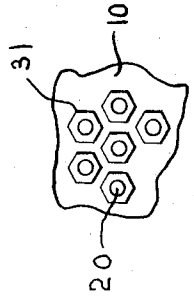


FIGURE 7

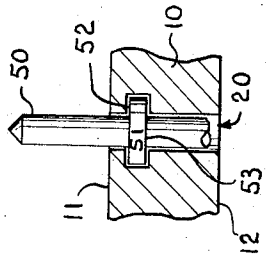


FIGURE 3

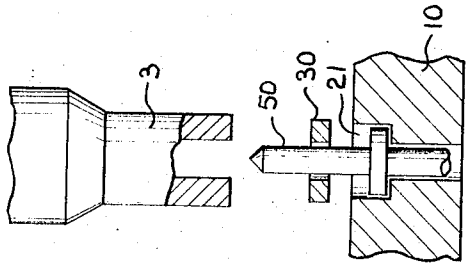


FIGURE 2

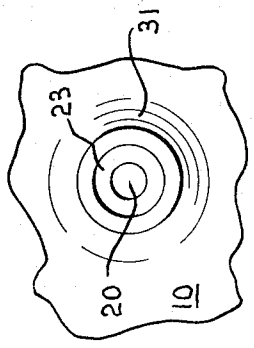


FIGURE 6

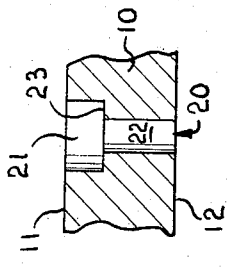


FIGURE 1

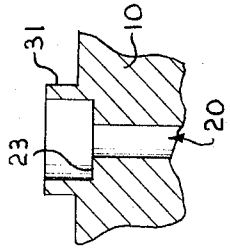


FIGURE 4

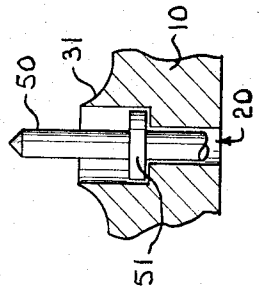


FIGURE 5

METHOD OF MOUNTING ELECTRICAL CONTACTS WITHIN A CONNECTOR BODY

BACKGROUND OF THE INVENTION

This invention relates to a method of manufacturing electrical connectors and more specifically to a method of securing the electrical contacts to a thermoplastic insulator surrounding the contacts.

In the manufacture of electrical connectors it is highly desirable that the method employed be inexpensive, accurate, reliable and adaptable to a high degree of automation. The basic step in the fabrication of the connectors is that of attaching or joining the insulating element to the conducting elements, and a variety of methods have been used. For example, the conductor or contact may be fixed in place as the insulator is molded or otherwise formed, or the insulator may be a multi-piece construction employing adhesives or mechanical fasteners for joining the pieces. In both of these approaches the operations involved are costly and require rigid controls for accurate positioning.

Another approach to simplified manufacture was to utilize a thermoplastic material which requires a metal contact retention mechanism in a passage of a thermoplastic insulator to confine the contacts. An example of this approach may be found in U.S. Pat. No. 3,494,998 entitled "Method of Connector Manufacturing" issued Feb. 10, 1970 to J. W. Anhalt. This approach is undesirable as it utilizes an extra assembly that adds extra expense and extra steps in assembling the contact mounting assembly.

SUMMARY OF THE INVENTION

This invention provides a method of mounting electrical contacts that does not require the use of metal clips or sleeves to retain the contacts in their mounted position.

The invention is an electrical connector characterized by a thermoplastic insert that is formed with a plurality of bores, each of which terminates at one end of the insert in an extension that is heated and pressed into position around a contact to secure the contact in position.

In one embodiment of the invention the method of assembling the mounted contacts in the insert comprises the steps of: forming a thermoplastic insulator (**10**) having a projecting portion (**31**), a forward face (**11**) and a flat rear face (**12**); forming a bore (**20**) in the insulator having an enlarged forward portion (**21**) that opens at the front face (**11**) and a smaller rear portion (**22**) that defines at the junction of the two coaxial passages a forward facing radial shoulder (**23**); inserting from the forward face of the thermoplastic insulator an electrical contact having a forward portion and a rear portion separated by a collar that has a cross-sectional area larger than the smaller passage in the insert so that the collar engages the forward facing shoulder of the insert; and applying sufficient heat and pressure against the projecting portion of the forward face of the insulator surrounding the contact so as to cause the thermoplastic material to flow or move inwardly to decrease the opening in the enlarged portion (**21**) of the passage, whereby the thermoplastic material when cooled provides a rigid annular abutment against the contact collar that prevents the contact from being withdrawn from the bore in the insulator. The maximum axial forces that the contact is subjected to are generally in the rearward direction and therefore one of the distinct advantages of this invention is that the majority of the insulating material is behind the collar of the contact **50** to prevent rearward movement, the contact being subjected to a much lesser axial force in the forward direction, which occurs when the connector contacts are unmated.

Accordingly, it is an object of this invention to provide an inexpensive and simple thermal forming method for captivating an electrical terminal element such as a terminal pin within a thermoplastic insulator without requiring retaining clips.

It is still another object of this invention to provide an inexpensive method of assembling electrical connectors.

It is another object of this invention to provide a means whereby individual contacts may be replaced, obviating the need to replace the entire connector because of a single defective contact.

The above and other objects and features of the invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings and claims which form a part of this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a portion of a thermoplastic electrical connector insert with a contact receiving passage therein.

FIG. **2** illustrates a thermoplastic insert with an electrical contact disposed in the passage and a replacement material ring in position to be pressed into place and heated by a tool.

FIG. **3** illustrates an electrical contact after it has been mounted within a thermoplastic insert.

FIG. **4** illustrates an alternate embodiment of the invention wherein the thermoplastic material that locks the contact in position is formed in a projection that is an integral part of the thermoplastic insert.

FIG. **5** is a view similar to that shown in FIG. **4** except that the extended portion of the thermoplastic insert is conically shaped.

FIG. **6** is a top view of a thermoplastic insert wherein the thermoplastic projections are a plurality of truncated cones.

FIG. **7** is a top view of a thermoplastic insert wherein the thermoplastic projections are a plurality of noncircular retention towers.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to the drawings, FIG. **1** illustrates a thermoplastic insert **10** having a front face **11**, a rear face **12** and a bore **20** therethrough. The bore **20** includes a first larger passage **21** that terminates at the front face **11** of the insert **10** and a smaller second passage **22** that terminates at the rear face **12** of the insert **10**, the junction of the passages **21** and **22** forming a forward facing shoulder **23** that is generally parallel with the front face **11** of the insert **10**.

The insert **10** is formed from an appropriate thermoplastic material and may be an acetal resin or other appropriate thermoplastic such as nylon or polycarbonate. Glass-filled nylon may also be used. One commercially available thermoplastic is a glass-filled nylon material (Nylaglass). Another is a polycarbonate sold by General Electric Company under the trade name Lexan.

FIG. 2 illustrates the electrical contact 50 located in its proper position in the passage 20 of the insert 10. Disposed around the forward portion from the contact 50 is a doughnut-shaped piece of thermoplastic material 30 which will be heated and pressed into abutting relationship with the collar 51 of the contact 50 by the tool 3. The tool 3 heats the thermoplastic material 30 and the insert 10 until the materials flow together. When the thermoplastic cools, there is formed a rigid annular shoulder which retains the contact.

FIG. 3 illustrates the electrical contact 50 mounted within the thermoplastic insert 10. As can be seen, the collar 51 of the contact 50 has its forwardly facing shoulder 52 abutting against the thermoplastic material which is now an integral part of the insert 10 and its rearwardly facing shoulder 53 in abutment with shoulder 23 of the insert 10. It can now be readily appreciated that the contact 50 is restrained from axial movement in either direction and that with respect to axial movement in the rear direction, there is a greater ability to withstand axial forces because of the greater mass of thermoplastic material behind the collar 51.

Referring now to FIGS. 1, 2 and 3, assembly of one or more electrical contacts 50 may be accomplished as follows: an electrical contact 50 is placed into the bore 20 of the insert 10 until the rearwardly facing shoulder 53 of the collar 51 abuts the forwardly facing shoulder 23 of the insert 10; next, a doughnut-shaped piece of thermoplastic material is heated and pressed into place by a suitable tool 3; and then the thermoplastic material is allowed to cool, wherein it solidifies to prevent the electrical contact 50 from being withdrawn from the passage 20.

FIG. 4 illustrates the portion of an electrical connector insert that includes, as an integral portion of the insert, the necessary thermoplastic material to lock a contact in fixed position.

In the embodiment shown, the thermoplastic insert 10 includes a plurality of projections 31 that extend from one face thereof. In this embodiment the contact (not shown) is placed in the bore 20 so that the collar thereof abuts against shoulder 23. A suitable tool is used to heat and press into position the forward projection 31 which when cooled provides an annular abutment that prevents the contact from being withdrawn from the passage 20. Contacts may be withdrawn after mounting by heating the portion of the insert around the contact and pulling the contact from the passage 20. A new contact may then be placed in the passage 20 and the insert heated again. In the event that repeated removal of contacts makes remounting of a contact difficult, a cutting tool may be used to ream out the forward portion 21 of the passage 20. The new contact may then be mounted in the hole by adding new material as illustrated in FIG. 2.

FIG. 5 is a view similar to that shown in FIG. 4 except that the forwardly extending projections are conically shaped and an electrical contact is shown in the passage 20. In this embodiment a suitable tool is also used to heat and press the forward projection 31 into abutment with the collar 51 of the contact 50 whereby the material, when cool, provides an annular abutment that prevents the contact 50 from being withdrawn from the passage 20.

FIG. 6 is a partial plan view of a connector insert that includes a plurality of forward extending projections 31 that are frustoconically shaped. In this embodiment, which is similar to that shown in FIGS. 4 and 5, an electrical contact may be inserted into the bore 20 and the projection 31 is then heated and pressed into position by a suitable tool which locks the contact in a fixed position.

FIG. 7 is a partial plan view of an electrical connector insert wherein the forward extending projections 31 are a plurality of noncircular retention towers extending from one face of the insert 10.

While a preferred embodiment of the invention has been disclosed, it will be apparent to those skilled in the art that changes may be made to the invention as set forth in the appended claims, and in some cases certain features of the invention may be used to advantage without corresponding use of other features. For example, although the invention has been described in the context of mounting contacts in a thermoplastic insert, the invention also contemplates the demounting of the contacts by heating the thermoplastic insert and withdrawing the terminal. In this regard, once the contact 50 is withdrawn from a passage 20, a cutting tool may be used to remove any excess material from the passage so that a new contact can be inserted. Further, the thermoplastic inserts which embody the forward projecting portion are adaptable to repeated insertion and withdrawal of contacts 50. Also, although removal of individual contacts has been discussed, the invention also makes it possible to mount a plurality of contacts in a connector insert in one operation. Accordingly, it is intended that the illustrative and descriptive materials herein be used to illustrate the principles of the invention and not to limit the scope thereof.

Having described the invention, what is claimed is:

1. A method of manufacturing an electrical connector component comprising the steps of:
   - providing a thermoplastic insulator having a flat forward face and a flat rear face;
   - forming a bore in the insulator having a passage opening at the forward face and a second smaller passage opening at the rear face defining at the junction of the two passages a forward facing radial shoulder;
   - inserting into the passage in the insulator an electrical contact having a forward portion and a rear portion separated by a collar thereon that has a rearward facing shoulder that engages the forward facing shoulder of the insert;
   - inserting a ring-shaped piece of thermoplastic material over the forward portion of said contact until it engages the forward facing shoulder thereon; and
   - applying sufficient heat and pressure against the ring-shaped piece of thermoplastic material so as to cause the thermoplastic material of the ring and the insulator to bond together in a manner such that the forward face remains substantially flat, whereby the material when cooled provides an annular abutment against the contact collar that prevents the contact from being withdrawn from the bore in the insulator.

2. A method of mounting electrical contacts which comprises the steps of:
   - forming a body of thermoplastic material having a flat face on one side and a face on the opposite side that includes a plurality of truncated cones, each of said cones having a bore therethrough that extends to the opposite face of the body, each of said bores having an enlarged bore portion on the side of the

body having the truncated cones thereon, the enlarged portion of the bore forming a shoulder at the interface with the remaining smaller portion of the bore;

inserting into the bore in the thermoplastic body from the side having the cones an electrical contact having a forward portion and a rear portion separated by a collar thereon that engages the shoulder of the thermoplastic body; and

applying sufficient heat to the truncated cone portion of the thermoplastic insert to cause the thermoplastic material to move radially inwardly and abut the other shoulder of said collar, whereby the material when cool provides an annular abutment against the contact collar that prevents the contact from being withdrawn from the bore in the insulator.

3. A method of mounting electrical contacts which comprises the steps of:

forming a body of thermoplastic material having a flat face on one side and a face on the opposite side that includes a plurality of truncated cones, each of said cones having a bore therethrough that extends to the opposite face of the body, each of said bores having a larger cross-sectional area on the side of the body having the truncated cones thereon, the enlarged portion of the passage forming a shoulder at the interface with the smaller passage;

inserting into the passage in the thermoplastic body an electrical contact having a forward portion and a rear portion separated by a collar thereon that engages the shoulder of the thermoplastic body; and

applying sufficient heat and pressure against the truncated cone portion of the thermoplastic insulator surrounding the contact as to cause the thermoplastic material to abut the collar on the contact whereby when the thermoplastic material cools, the contact is prevented from being withdrawn from the bore by the deformed thermoplastic material.

4. A method of manufacturing an electrical connector component comprising the steps of:

providing a thermoplastic insulator having a first flat face and a second face;

forming a bore in the insulator having a first passage opening at the first face and a second smaller passage opening at the second face defining at the junction of the two passages a radial shoulder;

inserting into the passage in the insulator an electrical contact having a forward portion and a rear portion separated by a collar thereon that has two shoulders facing in opposite directions, one of which engages the shoulder of the insert;

inserting a ring-shaped piece of thermoplastic material over the contact until it engages the other shoulder of said collar; and

applying sufficient heat and pressure against the ring-shaped piece of thermoplastic material so as to cause the thermoplastic material of the ring and the insulator to bond together in a manner such that the forward face remains substantially flat, whereby the material, when cooled, provides an annular abutment against the contact collar that prevents the contact from being withdrawn from the bore in the insulator.

5. A method of mounting electrical contacts which comprises the steps of:

forming a body of thermoplastic material having a first face of one side that includes a plurality of projections, each of said projections having a bore therethrough that extends to an opposite second face of the body, each of said bores having a first section and a second smaller section coaxial therewith that terminates on the other side of said thermoplastic body, the enlarged section of the bore forming a shoulder at the interface with the smaller section of the bore;

inserting into the passage in the thermoplastic body from the first face side an electrical contact having a forward portion and a rear portion separated by a collar thereon having a first and second shoulder, one of which engages the shoulder of the thermoplastic body; and

applying sufficient heat and pressure to the projecting portion of the thermoplastic insert to cause the thermoplastic material to abut said other shoulder of said contact collar, whereby the material when cool provides an annular abutment against the contact collar that prevents the contact from being withdrawn from the bore in the insulator.

6. A method of mounting electrical contacts which comprises the steps of:

forming a body of thermoplastic material having a first face on one side and a second face on the opposite side that includes a plurality of projections, each of said projections having a bore therethrough that extends from the first face to the opposite second face of the body, each of said bores having an enlarged section and a coaxial smaller section, the enlarged section of the bore forming a shoulder at the interface with the smaller section;

inserting into the passage in the thermoplastic body an electrical contact having a forward portion and a rear portion separated by a collar thereon that engages the shoulder of the thermoplastic body; and

applying sufficient heat and pressure to the projections to cause the thermoplastic material to move radially inwardly and abut the collar on the contact on both sides thereof, whereby when the thermoplastic material cools, the contact is prevented from being withdrawn from the bore in the insulator.

7. The method as recited in claim **6** wherein said projections formed integral with said body are cylindrically shaped.

8. The method as recited in claim **6** wherein said projections formed integral with said body are conically shaped.

9. The method as recited in claim **6** wherein said projections formed integral with said body are truncated cones.

10. The method as recited in claim **6** wherein said projections formed integral with said body are noncircular projections.

* * * * *