United States Patent

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[72] Inventor **Doyle D. Mullin**
Minneapolis, Minn.

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[73] Assignee **Omnetics, Inc.**
Minneapolis, Minn.

[54] **MINIATURE CONNECTOR AND METHOD OF MAKING**
16 Claims, 14 Drawing Figs.

[52] **U.S. Cl.** ..... **339/192 R,** 339/196 M, 339/210 M, 339/218 M
[51] **Int. Cl.** **H01r 33/76**
[50] **Field of Search** ..... 339/17 E, 17 F, 17 L, 17 LC, 17 LM, 17 M, 17 N, 176 M, 176 MP, 176 MF, 196, 206, 208, 210, 218, 192

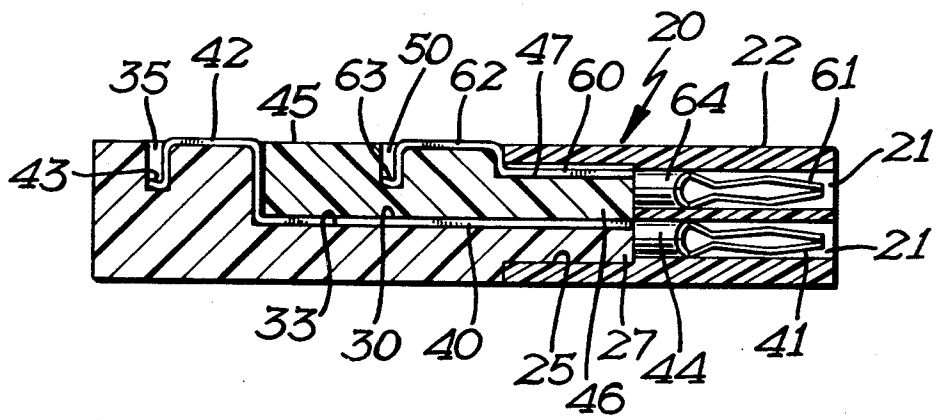
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Primary Examiner—Ernest R. Purser
Assistant Examiner—Lawrence J. Staab
Attorney—Schroeder, Siegfried & Ryan

ABSTRACT: An electrical connector generally formed in miniature size for use with a mating plug having a plurality of closely adjacent extending terminals is formed from a rectangular insulated body having a cavity forming an end cap with a plurality of parallel bores disposed in multiple rows and extending longitudinally through the end face of the end cap into which is inserted at least a pair of insulation body members having a plurality of grooves formed in each communicating with the bores in the end cap. A plurality of pin terminals are secured within the bores and grooves, the rear terminals are secured within the bores and grooves, the rear portions of each having a pad formed thereon to which a conductor may be connected, and the forward portions being recessed within the bores. The plurality of bodies are bonded together to form an integral unit.



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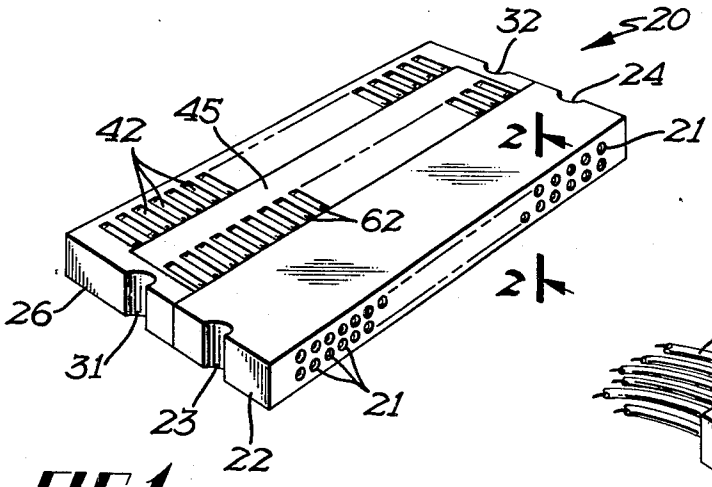


FIG 1

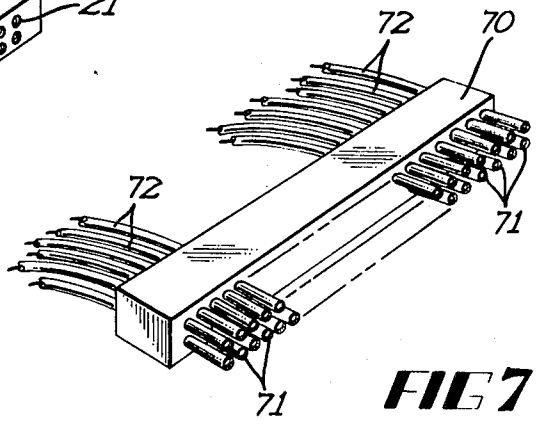


FIG 7

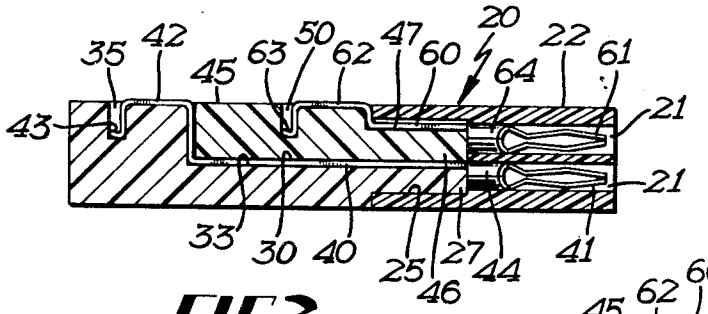


FIG 2

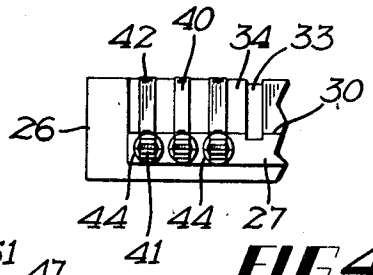


FIG 4

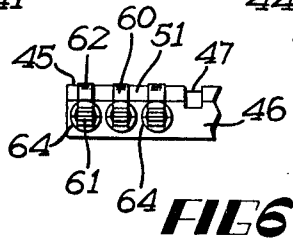


FIG 6

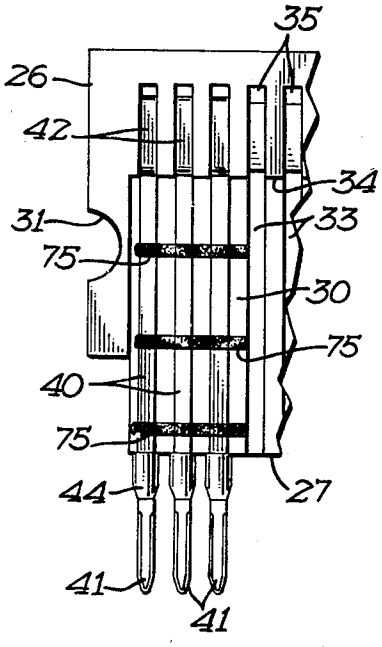


FIG 3

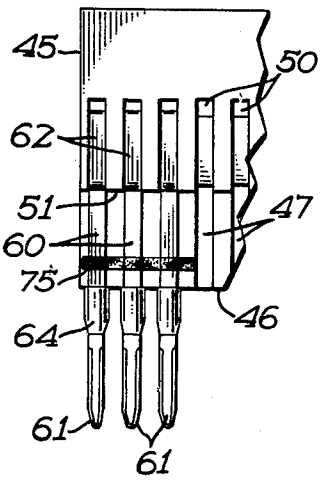


FIG 5

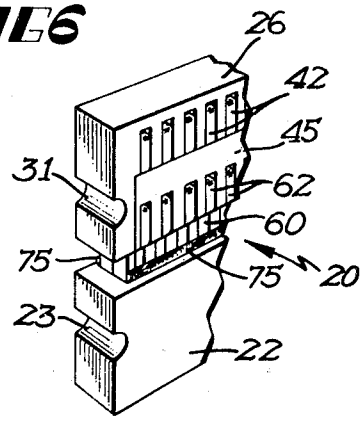


FIG 8

INVENTOR.
DOYLE D. MULLIN

BY Schroeder, Siegfried & Ryan ATTORNEYS

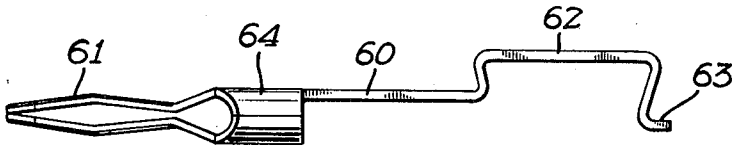


FIG 9

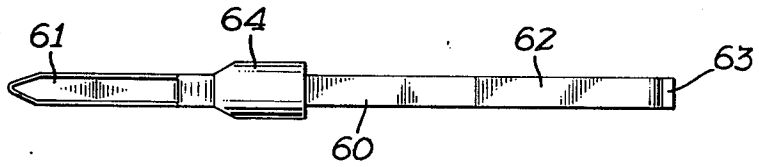


FIG 10

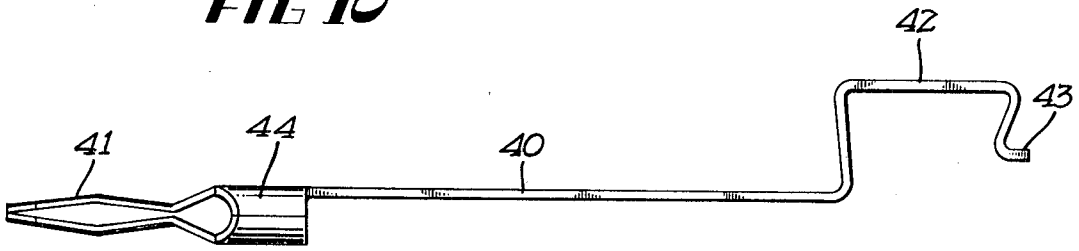


FIG 11

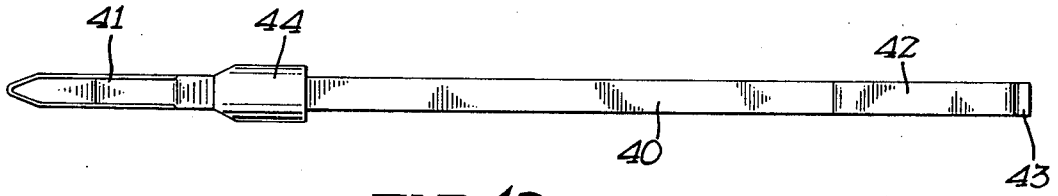


FIG 12

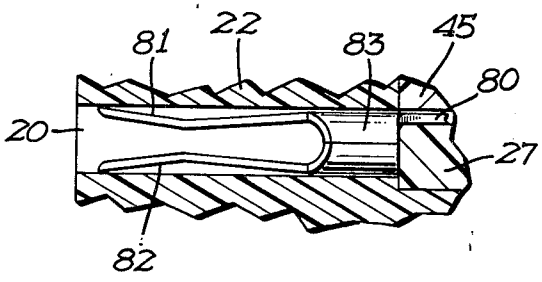


FIG 13

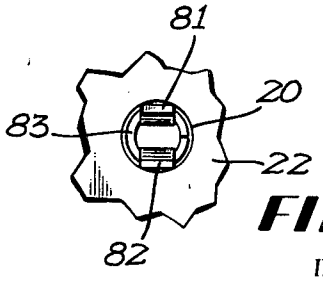


FIG 14

INVENTOR.
DOYLE D. MULLIN
BY
Schroeder, Siegfried & Ryan
ATTORNEYS

MINIATURE CONNECTOR AND METHOD OF MAKING

The method of forming the integral unit is directed to securing the pin terminals in the cooperating insulation body members and allowing the ends of the pin terminals to extend beyond the edge of the bodies, bonding the bodies together to form a subassembly, pressing the subassembly into the cavity and the pins into the bores of the first insulation body and bonding the unit together.

This invention relates to the field of electrical connectors and more particularly to the field of miniature connectors and the method of making the miniature connectors.

Numerous attempts have been made in the connector art to produce miniature connectors which will retain their reliability after repeated use. One of the methods of accomplishing more reliability is to in effect, reverse the normal structure of constructing the two main parts to the connector. That is, improved reliability and results are obtained where the male pins are in effect, tubular members which are formed and adapted to engage a number of other pin members which are secured within the bore. In other words, the so-called "pin" is shielded within a bore to protect it against damage because of the rather delicate nature of the pins themselves. It is generally known of course, that a tubular structure has a greater resistance to a shearing or bending force than the small solid pin or structure forming the pin and therefore a general practice has been to reverse the so-called structure. However, a problem still exists in producing the portion of the connector in which the so-called "pins" are contained and this is particularly true where multiple rows of pins are contained in a single connector. The problem of reliability must be maintained and this is particularly true in the computer art where a good many of the miniature type connectors are in use and find numerous applications. Because of the size of the pin terminals themselves, the so-called "pigtails" or other portion of the terminals to which conductors are secured either by soldering or spot-welding or through some other means, extreme care must be taken in assembly of the mechanism and the overall structure must be so designed that it will withstand repeated use without failure of the parts. Because of the very small nature of the parts, the method of assembly is also extremely important and in a good many instances, very time consuming in attempting to align the small pin ends of the terminals within the bores which are used to protect the pins.

It is therefore a general object of the present invention to provide an improved method of manufacturing, and an improved structure forming a miniature connector.

It is still another object of this invention to provide a miniature connector formed of a plurality of pieces each securing the pin terminals which are fitted into an end cap.

It is yet another object of this invention to provide a connector having a plurality of terminals which is easily assembled.

It is still another object of this invention to provide a miniature connector in which the terminals are anchored to as many pieces forming a subassembly as there are rows of pin terminals.

It is still another object of this invention to provide a miniature connector in which all the conductor pads may be aligned on the same side of the connector by securing each row of terminals to a single body member before assembly.

It is still a further object of this invention to form a tubular sleeve locating member formed integrally and intermediate the pin terminal and the connector pad of each terminal member.

It is still a further object of this invention to form a miniature connector by securing a plurality of pin terminals to insulation bodies and pressing the bodies into an end cap member and bonding the assembly into an integral unit.

These and other objects and advantages of the invention will more fully appear from the following description, made in connection with the accompanying drawings, wherein like reference characters refer to the same or similar parts throughout the several views, and in which:

FIG. 1 is a perspective view of the main portion of a miniature connector;

FIG. 2 is a cross-sectional view of the connector unit as found in FIG. 1 and taken along the lines 2—2;

FIG. 3 is a plan view of a partial section of one of the members which is secured in the end cap of the connector;

FIG. 4 is a front elevation view of the partial section shown in FIG. 3;

FIG. 5 is a plan view of a partial section of the connector unit which is adapted to be secured in the section shown in FIGS, 3 and 4;

FIG. 6 is a front elevation view of the partial section shown in FIG. 5;

FIG. 7 is a perspective view of the mating portion of the connector which is used to mate with the connector member found in FIG. 1;

FIG. 8 is a perspective view of a partial section of the connector;

FIG. 9 is a side elevation of a short pin which is used in the connector;

FIG. 10 is a top plan view of the short pin shown in FIG. 9;

FIG. 11 is a side elevation view of a long pin which is used in the electrical connector;

FIG. 12 is a top plan view of the long pin shown in FIG. 11;

FIG. 13 is a partial section view of an alternate construction for receiving an alternate pin; and

FIG. 14 is a front elevation view of the alternate construction shown in FIG. 13.

In FIGS. 1 and 2, an electrical connector 20 is shown which is of the miniature type and is shown having a plurality of bores 21 formed in the end of a member 22 forming an end cap of first insulation body member. Member 22, as shown, if formed from a readily moldable insulating material such as diallyl phthalate and is approximately 1.70 inches in length, approximately 0.140 inch in width or thickness, and approximately 0.345 inch in depth. Where a means of mounting the connector to a frame assembly is required, a pair of cutout indentations 23 and 24 are provided through the edges of the end cap member 22. Bores 21 are approximately 0.040 inch in diameter and are longitudinally spaced on 0.050 inch centers, the two rows separated by a space of approximately 0.050 inch. A cavity 25 is formed within end cap 22 and is approximately 0.135 inch deep, having a width of approximately 0.10 inch and a longitudinal dimension of approximately 1.60 inches. Thus, the depth of the bores is approximately 0.210 inch deep.

A second insulation body or member 26 is formed having an end portion 27 which is of reduced cross-sectional area and is constructed and arranged to lie within cavity 25. An indentation 30 is formed in the second insulation body 26 in one of the lateral face. Another pair of cutout indentations 31 and 32 are formed in the edges thereof to provide a mounting convenience for the connector. The indentation is formed over the major portion of the second insulation body 26 and contains a plurality of grooves 33 formed therein which lie in the bottom of the indentation, along its vertically extending edge 34 and along the outer surface of the member, the groove terminating in a recess 35 which extends parallel to the edge 34 of indentation 30. In other words, the recesses communicate transversely with the rearward portion of the plurality of grooves 33 which is formed in the surface face of the insulation member 26. Insulation member 26 is approximately 1.70 inches in length, approximately 0.140 inch in width or thickness, and approximately 0.555 inch in depth. The end portion has material removed on the face opposite the grooves approximately 0.133 inch from the end of the member to facilitate alignment with the end cap and the grooves are approximately 0.009 inch in depth, the indentation being made approximately 0.070 inch in depth. Recess 35 is approximately 0.050 inch in depth and approximately 0.25 inch in length, the width of the grooves being approximately 0.023 inch spaced on 0.05 inch centers.

Disposed in grooves 33, are a plurality of pin terminals 40 which have a forward pin portion 41 and a rearward portion 42 which is adapted to be connected to electrical conductors by suitable means such as soldering or spot-welding. At the very end of pin terminal 40 is a small "pigtail" 43 which is disposed at the bottom of recess 35 and is used to help anchor pin terminal 40 in place. A tubular sleeve member 44 is formed integrally with pin terminal 40 intermediate the forward and rearward portions, the sleeve member abutting the edge of the end portion 27 of the second insulating body member 26. In other words, the tubular sleeve member rests against the edge of the insulating member so that as any force is applied in an axial direction to the forward pin portion 41, the force is transmitted to member 26 to prevent pin portion 41 from being pushed rearwardly into the connector member. Pin terminal 40 is shown in more detail in FIGS. 11 and 12, the terminal being formed from Beryllium Copper, having a thickness of approximately 0.005 inch. Pin terminal 40 is approximately 0.020 inches wide and is approximately 0.713 inch long from the end of the "pigtail" to the point of the pin which is formed in bayonet shape. It will also be observed that there is a "springlike" action which will take place between the prongs or portions forming the forward pin portion 41 such that when a tubular member is slipped over the forward pin portion, it will be compressed and in electrical contact with a mating tubular member. It may also be desirable to chamfer or round off the edges of the forward portion of the pin members. It will also be found that the length of the forward portion of the pin member 41 and the tubular sleeve member is approximately 0.198 inch in length which means that the forward portion of the pin terminal 41 does not protrude beyond the end of bores 21 into which they are disposed.

Another insulation body member 45 also has an end portion 46 of reduced cross-sectional area which is constructed and arranged to lie adjacent end portion 27 of member 26, the two being fitted into cavity 25 of end cap 22. Insulation body member 45 is so dimensioned as to lie within indentation 30 formed in body member 26. Member 45 is similar in many respects to that of insulation member 26 in that a plurality of grooves 47 are formed in the face and end portion 46 of member 45. A plurality of recesses 50 communicate with grooves 47 in the same manner as that shown for grooves 33 and recesses 35. Because of the reduced cross section, and edge portion 51 is formed longitudinally across insulation body member 45. Member 45 is approximately 1.602 inches in length, 0.073 inch in thickness or width and approximately 0.375 inch deep. The reduced end portion is approximately 0.126 inch in length and the depth and width of the grooves and recesses are the same as that expressed for insulation member 26. Thus, member 45 is fitted within indentation 30 in the first insulation body member 26 and it will be found that grooves 47 overlie grooves 33 so that they are aligned with bores 21.

Each of another plurality of pin terminals 60 has a forward pin portion 61 and a rearward pin portion 62, the rearward portion terminating in a "pigtail" member 63. The forward pin portion 61 is identical to that of forward pin portion 41 as is rearward portions 42 and 62, the difference being between the vertical leg which joins the main body of the pin. A tubular sleeve member 64 is formed integral with pin member 60 and is located immediately to the rear of the forward pin portion 61 and when assembled in grooves 47, abuts edge 46 of insulation body member 45. It will be seen from FIG. 6 that tubular sleeve member 64 prevents the pin from being forced rearwardly when a mating connector member is forced over the end of the springlike members forming the forward ends 61. Pin terminals 60 are made of the same material as that of pin terminal 40 and have an overall length of approximately 0.463 inch which also disposes the forward end within the bores 21 so that they do not protrude beyond the face of the end cap 22.

A so-called mating male plug 79 is formed with a plurality of closely adjacent tubular extending connecting members 71 which mate with bores 21 and the forward end of the pin terminals such as portions 41 and 61. Terminals 71 are secured in a block of material of the same type used to form the other parts of connector 20 and have a plurality of electrical conductors 72 connected to members 71. It will be noted that the internal face of terminals 71 are chamfered or beveled to insure proper mating and electrical contact with terminals 61 and 41.

In some applications, it may be desirable to form pins 71 of a solid tubular or rectangular construction. When using this type of so-called "male" plug, a variation in the form and construction of the forward portion of the pin terminals is made such as found in FIGS. 13 and 14. As found therein, a pin terminal 80 is secured within bore 20 and has a pair of spring-leaf members 81 and 82 at the forward portion of the pin terminal, a tubular member 83 being formed integrally therewith and as a part of pin terminal 80. Leaf spring member 81 and 82 converge towards each other and have their forward most tips secured nearer the outer edges of bores 20 in an opposite manner to that shown for the pins found in FIGS. 9 through 12. Thus, when a circular or square cross section pin is pressed into bore 20, members 81 and 82 are resiliently urged outwardly to form a good electrical contact.

METHOD OF FORMING CONNECTOR

Connector 20 is assembled by positioning the plurality of pin terminals 40 in grooves 33 by anchoring "pigtails" 43 in recesses 35 and insuring that all of the tubular sleeve members 44 are in an abutting relationship with the edge of member 27. Pins 60 are then secured in a similar manner within grooves 47 of insulation body member 45, the "pigtail" portions 63 being anchored in recess 50. Each of the tubular sleeve members 64 is abutted against edge 46 of insulation terminal member 45 to insure that it is properly located.

Two or three lines of an epoxy adhesive 75 are applied transversely across pin terminals 40 in the indentation area of installation body member 26. Body member 45 with pins 60 disposed in slots 47 are then secured to body member 26 by pressing body member 45 and terminals 60 carried therewith into the indentation and thus, cause the flow of adhesive 75 to bond the two body members, 26 and 45 together. The adhesive may be applied by a rubber stamp which is in the form of a "knife" blade edge to apply thin lines of the cement.

The subassembly formed by body members 26, 45 and the respective pin terminals 40 and 60 is then inserted into end cap 22. The subassembly is merely started into end cap and the pressure of pin terminals 40 and 60 pressing against the cooperating members along with a frictional contact of the forward portion of the pin terminals 41 and 61, holds the end cap in place against further movement. Another line of epoxy cement 75 is then applied across the sides of insulation terminal body 26 and 45 (FIG. 8). The subassembly, formed of insulation body members 26 and 45 and their accompanying terminal members are then pressed into end cap 22, the adhesive thus bonding the various assembled members into an integral unit. For certain epoxies, it may be desirable to cure the epoxy at a particular temperature for a given period of time. It has been found that through the use of an epoxy adhesive formed from Hysol C9–4198 and Hysol H2–3561, a curing time of approximately 2 hours at 140° Fahrenheit produces an ample bond.

Soldering flux is applied to the solder pads 42 and 46 of the pin terminals and the terminals may be dipped in a solder pot for two to three seconds to produce a proper solder pad connection for electrical conductors.

It will also be recognized that alternate forms of constructing the connector may be made while carrying out the teaching of the present invention. For instance, a pair of body members 45 may have pins 60 assembled thereto in the manner previously described. Adhesive 75 is then applied to

the back (opposite the side having the terminals) of one of the members and another insulation body member **45** is then pressed to the first body member in a back-to-back relationship. Thus, a new subassembly is formed and the subassembly would then be pressed into the end cap **22** and while in a position such as that shown in FIG. **8**, an epoxy cement would be applied to each side of the new subassembly and the subassembly would then be pressed together to form another connector member.

What I claim is:

1. An electrical connector capable of miniature construction for use with a mating plug having a plurality of closely adjacent extending terminals, said connector comprising:

a. first insulation body means having a cavity forming end cap means having an inner surface with a plurality of parallel juxtaposition bores disposed in at least one row and extending longitudinally between said inner surface and the end face of said end cap means;

b. a plurality of pin terminal means each having a forward pin portion recessed within substantially the entire length of said plurality of bores disposed in said end cap means and having a rearward portion adapted to be connected to electrical conductor means with a depending tail segment formed at the rear portion of each of said plurality of pin terminals, said tail segment engaging said first insulation body means in a manner preventing displacement through the end face of said cap means and with a tubular sleeve member formed intermediate said forward pin portion and said rearward portion, and communicating with the inner surface of said first insulation body;

c. at least one other insulation body means having an end portion constructed and arranged to lie within said cavity of said end cap means and engage the rear portion of each of said plurality of pin terminal means;

d. and bonding means bonding said other insulation body means between the inner faces of said end cap means thereby bonding said insulation body means into an integral unit.

2. An electrical connector capable of miniature construction for use with a mating plug having a plurality of closely adjacent extending terminals, said connector comprising:

a. a first insulation body having a cavity forming an end cap with a plurality of parallel juxtaposition bores disposed in multiple rows and extending longitudinally through the end face of said end cap;

b. a plurality of pin terminals each having a forward pin portion recessed within said plurality of bores disposed in said end cap and having a rearward portion adapted to be connected to an electrical conductor;

c. a plurality of second insulation bodies equal in number to the number forming said multiple rows, each having an end portion of reduced cross sectional area constructed and arranged to lie within said cavity of said end cap and having a plurality of grooves formed in a surface face of each of said second insulation bodies including said end portion, said plurality of grooves communicating with certain of said plurality of bores formed in said first insulation body, said plurality of pin terminals having said rearward portions of each disposed in said plurality of grooves;

d. and bonding material bonding said plurality of second insulation bodies between said plurality of pin terminals, and bonding the end portions of said second insulation bodies and the inner communicating surfaces of said end cap thereby bonding said insulation bodies into an integral member.

3. The structure as set forth in claim **2** including:

e. a plurality of recesses communicating transversely with the rearward portions of said plurality of grooves formed in said surface face of each of said second insulation bodies;

f. a plurality of depending tail segments formed at the rear portion of each of said plurality of pin terminals, said tail segments constructed and arranged for cooperatively engaging said plurality of recesses and being anchored thereby.

4. The plurality of pin terminals set forth in claim **2** including:

a tubular sleeve member formed intermediate said forward pin portion and said rearward portion, said sleeve member disposed in communication with the edge of said plurality of second insulation bodies and within said bores of said first insulation body.

5. The plurality of pin terminals set forth in claim **2** including:

at least a pair of leaf spring contact members constructed and arranged in opposed relationship and in convergingly and resiliently deformable relationship for engaging the extending terminals of the mating plug within said bores of said first insulation body.

6. An electrical connector capable of miniature construction for use with a mating plug having a plurality of closely adjacent socket terminals, said connector comprising:

a. a first insulation body having a cavity forming an end cap with a plurality of bores disposed in parallel juxtaposition and extending longitudinally through the end face of said end cap;

b. a second insulation body having an end portion of reduced cross sectional area constructed and arranged to lie within said cavity of said end cap;

c. a first plurality of grooves formed in a side face of said second insulation body including said end portion, said first plurality of grooves communicating with certain of said plurality of bores formed in said first insulation body;

d. a third insulation body having an end portion of reduced cross sectional area constructed and arranged to lie adjacent said end portion of said second insulation body and within said cavity of said end cap;

e. a second plurality of grooves formed in a side face of said third insulation body including said end portion, said second plurality of grooves communicating with the remainder of said plurality of bores distinct from those communicating with said first plurality of grooves;

f. a first plurality of pin terminals disposed in said first plurality of grooves, said pin terminals having a forward pin portion recessed within certain of said plurality of bores communicating with said first plurality of grooves, and having a rearward portion adapted to be connected to electrical conductors;

g. a second plurality of pin terminals disposed in said second plurality of grooves, said pin terminals having a forward pin portion recessed within the remainder of said plurality of bores distinct from those communicating with said first plurality of grooves, and having a rearward portion adapted to be connected to electrical conductors;

h. bonding material disposed between said second and third insulation bodies, and the end portion of said second and third insulation bodies and the inner communicating faces of said end cap thereby bonding said insulation bodies into an integral body.

7. The structure as set forth in claim **6** including:

i. an indentation formed in one side of said second insulation body, said third insulation body disposed in said second insulation body and filling said indentation.

8. The structure set forth in claim **7** including:

forming said first plurality of grooves in the bottom and edge portion of said indentation opposite said end portion of reduced cross sectional area, said second plurality of grooves being disposed in said third insulation body on the same side as said first plurality of grooves whereby said rearward portions of said first and second plurality of pin terminals are disposed on the same side of said integral body.

9. The invention as set forth in claim **6** including:

a tubular sleeve member formed integral and intermediate said forward and rearward portions of each of said first

and second plurality of pin terminals, said tubular sleeve member and said pin portion formed from single piece flat stock material.

10. In the method of manufacturing an electrical connector of miniature construction having a first insulation body with an end cap including a plurality of parallel bores disposed in multiple rows formed therein and a cavity adapted to receive a plurality of second insulation bodies equal in number to the number of said multiple rows in which a plurality of elongated pin terminals having solder pads are disposed, the steps which include:

a. securing the plurality of pin terminals to the plurality of second insulation bodies, the ends of said pin terminals extending beyond the edge of said plurality of second insulation bodies;

b. bonding said plurality of second insulation bodies to each other to form a subassembly;

c. pressing said subassembly into the cavity of the first insulation body and said pin terminals into the bores of said first insulation body;

d. bonding said subassembly to said first insulation body forming an electrical connector;

e. pressing said subassembly into said cavity of said first insulation body but stopping short of the full penetration of said cavity to expose a portion of said subassembly;

f. and applying adhesive to said exposed portion of said subassembly and pressing said subassembly into said cavity for full penetration thereof.

11. The method of manufacture as set forth in claim **10** including the steps of:

g. curing the adhesive for a predetermined period of time.

12. The method of manufacturing an electrical connector as set forth in claim **10** including the steps of:

orienting said plurality of second insulation bodies so that the solder pads are on the same side of said second insulation bodies, and tinning said solder pads with a coating of solder.

13. In the method of manufacturing an electrical connector of miniature construction having a first insulation body with an end cap including a plurality of parallel bores formed therein and a cavity adapted to receive at least a second and third insulation body in which a plurality of elongated pin terminals having solder pads are disposed, the steps which include:

a. securing certain of the plurality of pin terminals to the second insulation body, the ends of said pin terminals extending beyond the edge of said second insulation body;

b. securing certain of the plurality of pin terminals to the third insulation body, the ends of said pin terminals extending beyond the edge of said third insulation body;

c. bonding said second and third insulation bodies to each other to form a subassembly;

d. pressing said subassembly into the cavity of the first insulation body and said pin terminals into the bores of said first insulation body;

e. and bonding said subassembly to said first insulation body forming an electrical connector.

14. The method of manufacture as set forth in claim **13** including the steps of:

f. pressing said subassembly into said cavity of said first insulation body but stopping short of the full penetration of said cavity to expose a portion of said subassembly;

g. applying adhesive to said exposed portion of said subassembly and pressing said subassembly into said cavity for full penetration thereof.

15. The method of manufacture as set forth in claim **14** including the steps of:

h. curing the adhesive for a predetermined period of time.

16. The method of manufacturing an electrical connector as set forth in claim **13** including the steps of:

orienting said plurality of second and third insulation bodies so that the solder pads are on the same side of said second and third insulation bodies, and tinning said solder pads with a coating of solder.