

Oct. 4, 1966

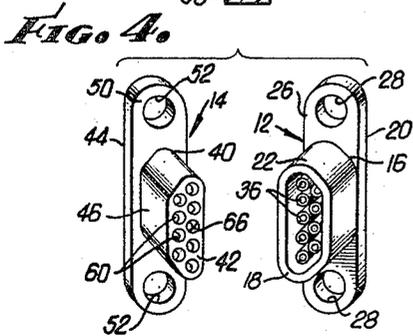
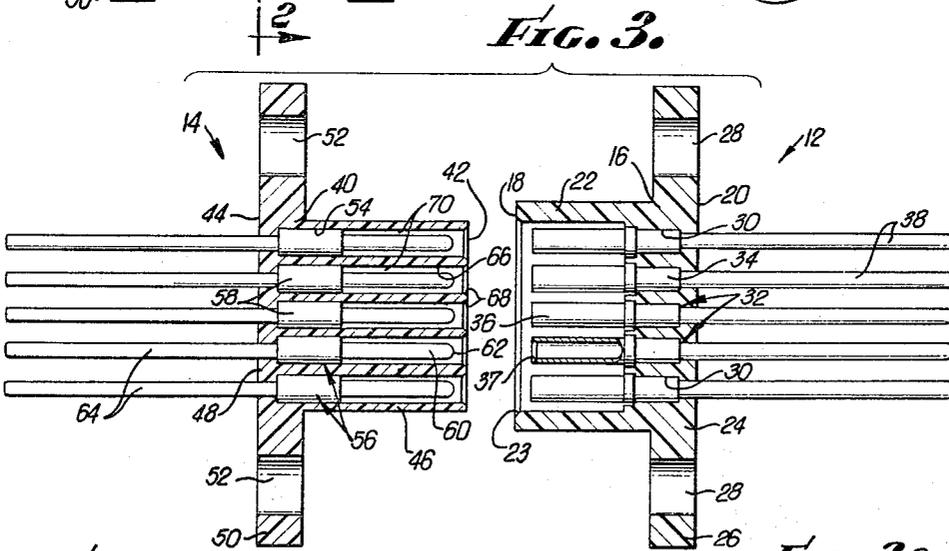
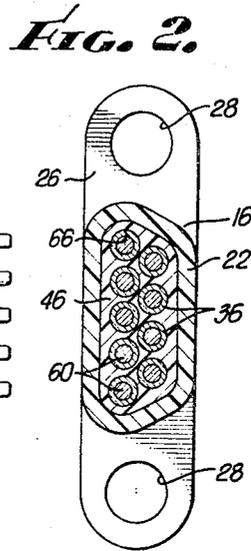
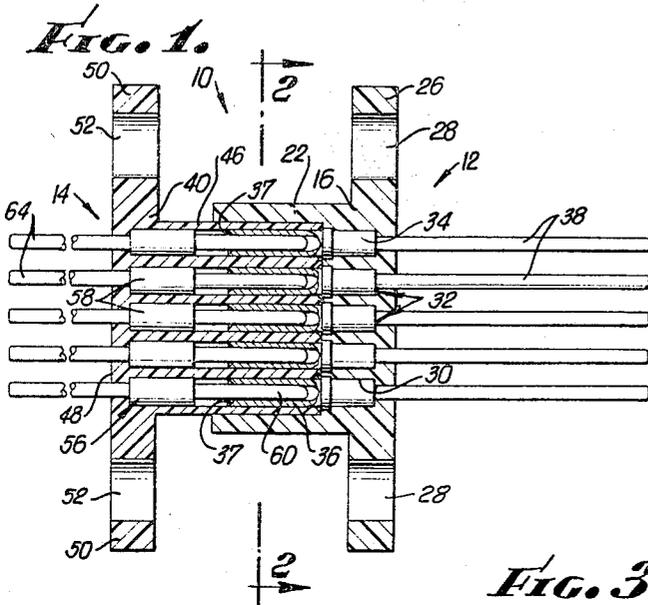
J. B. SHEVLIN

3,277,422

ELECTRICAL CONNECTOR HAVING SHROUDED PIN CONTACTS

Original Filed July 31, 1961

2 Sheets-Sheet 1



INVENTOR.
JOHN B. SHEVLIN.
 BY
Huebner & Worrel
 ATTORNEYS.

Oct. 4, 1966

J. B. SHEVLIN

3,277,422

ELECTRICAL CONNECTOR HAVING SHROUDED PIN CONTACTS

Original Filed July 31, 1961

2 Sheets-Sheet 2

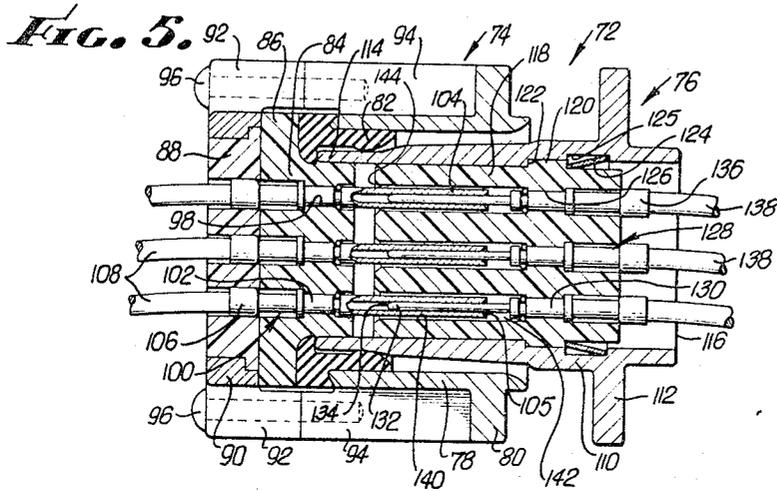


FIG. 6.

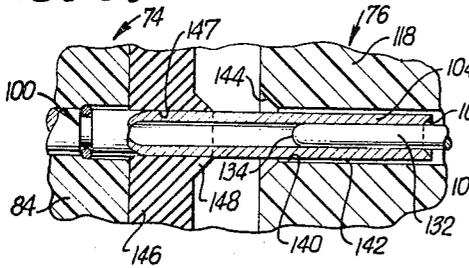


FIG. 7.

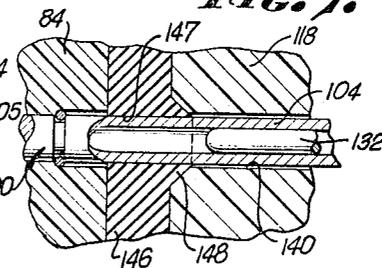


FIG. 9.

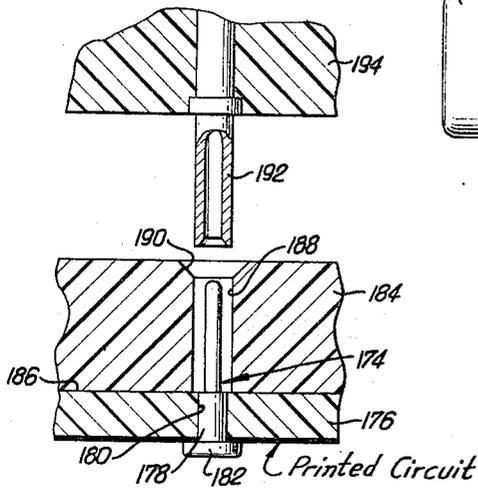
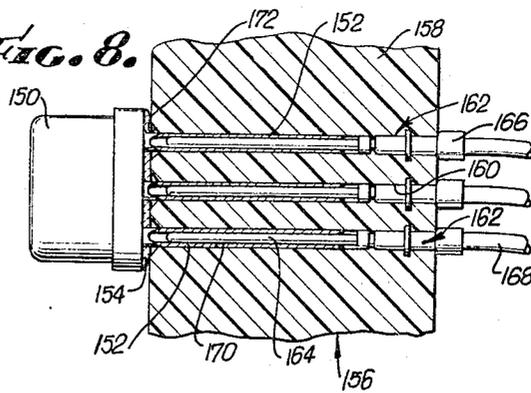


FIG. 8.



3,277,422

ELECTRICAL CONNECTOR HAVING SHROUDED PIN CONTACTS

John B. Shevlin, Santa Ana, Calif., assignor to International Telephone and Telegraph Corporation, New York, N.Y., a corporation of Maryland

Original application July 31, 1961, Ser. No. 128,137.

Divided and this application June 1, 1965, Ser. No. 460,145

3 Claims. (Cl. 339—65)

This application is a division of my copending application Serial No. 128,137, filed July 31, 1961, and now abandoned.

The present invention relates to electrical connectors of the type having one or more pin contact terminals in one connector member which are mateable with one or more socket contact terminals in another connector member when the connector members are interengaged, and the invention relates particularly to a novel electrical connector of this general type wherein the mating portions of the pin contact elements are completely recessed or shrouded within respective bores in an insulation body of one connector member, and the socket contact terminals have forward mating portions which are exposed forwardly of an insulation body in which they are supported in the other connector member, the exposed mating portions of the socket contact terminals being received within clearances in the pin bores about the respective pins when the contact terminals are mated upon interengagement of the connector members.

Conventional practice in connection with electrical connectors of the type having mating pin and socket contact terminals is to mount the pin terminals in an insulation body of one connector member so that the forward mating portions of the pin terminals extend forwardly out of the insulator, while the forward mating portions of the socket contact terminals are fully recessed within bores extending through their respective insulator. With this usual prior art construction the relatively weak, exposed pin terminals were often inadvertently bent out of proper alignment with their respective socket contact terminals, even where the forward openings of the sockets were internally chamfered or bevelled to provide a lead-in for the pins, and such bending of the pins frequently even resulted in shorting out of some of the contacts. This problem was particularly acute in the case of miniature and sub-miniature connectors where the pins are quite thin and relatively weak, and are therefore easily bent, and in rack and panel connectors where the pins are unusually long. Pin terminals are made even weaker and more bendable where they are hermetically sealed in glass at their bases.

In the case of small miniature and sub-miniature connectors, lateral shifting of the pins permitted by tolerance clearance in the mounting of the pins sometimes permitted such misalignment that a pin would not enter and mate with its respective socket. Similar misalignment also frequently resulted from wobbling of the pin contacts in connectors of the front tool release type wherein a clearance is provided about the terminal in the forward portion of the insulator body for insertion of a release tool from the front of the insulator.

Another problem which sometimes occurs as a result of exposed pins is that insulator bodies containing exposed pins are occasionally inadvertently mounted in the shells of both members of an electrical connector, and when the connector members are mated the rounded or bevelled forward tips of the pins will cause opposed pins to cam and bend each other aside so that the two shells can be engaged together. Electrical connection may be effected in this manner between respective pairs of opposed pins,

but such connection is poor and likely to completely fail, usually unexpectedly.

Where connector shells and their respective insulator bodies were so constructed that the insulator could be mounted in several different angular positions relative to the shell, in the case of relatively small and weak exposed pins, the pins would sometimes bend into alternate positions where the pin and socket insulators were inadvertently improperly oriented in unaligned positions in their respective shells.

An additional problem in connection with such prior art exposed pin contact terminals occurred during the testing of circuits in the unmated condition of the connector by engaging individual pin contacts with a socket probe. Manual manipulation of such a probe frequently resulted in bending of pin contacts.

In view of these and other problems in the art, it is an object of the present invention to provide a novel electrical connector construction wherein the pin contact terminals have their forward engaging portions fully recessed and shrouded within the respective terminal-receiving bores of the insulation body in which the pin terminals are mounted, with the socket contact terminals mounted in their respective insulation body so that the forward engaging portions thereof are exposed forwardly of their insulator, the exposed sockets entering the forward portions of the pin receiving bores when the respective pin and socket contacts are mated during interconnection of the two connector members.

Another object of this invention is to provide an electrical connector of the aforesaid character having recessed pin contacts and exposed socket contacts, wherein the openings of the pin recesses at the forward surface of the insulator containing the pin contacts are chamfered or bevelled so as to provide a lead-in for guiding the socket contacts into proper mating alignment with the recessed pins.

Another object of the present invention is to provide an electrical connector of the character described wherein the forward tips of the pins are rounded or bevelled, and the forward entry openings of the sockets are flared outwardly as by chamfers or bevels, so that even though a pin may be bent or may have a tolerance shifting the maximum possible amount with the forward end of the pin touching the wall of its bore, the flared forward end of the socket contact will pick up the rounded or bevelled forward tip of the pin and proper mating of the pin and socket will occur. Tolerances in connectors embodying the present invention are accordingly not nearly so critical as tolerances in prior art connectors which have exposed pin contacts and recessed socket contacts, which is an important factor in competitive production of small connectors.

Although the socket contact terminals of the present invention have their forward mating portions exposed, the tubular construction of the socket contact terminals and the considerably larger diameter thereof as compared with the pin terminals will normally result in socket terminals which have much greater strength than the pin terminals which are mateable therewith, so that the socket terminals are not likely to become bent like the exposed pin terminals of prior art connectors. In the situation where both connector members might inadvertently be provided with the exposed socket terminals, there is no possibility that opposed socket terminals would cam each other aside to permit engagement of the connector shells, both because of the rigidity of the socket terminals and because of the relatively wide annular front ends of the socket terminals which would merely abut against opposed socket terminals to prevent engagement of the connector shells.

The present invention, by embodying pin contacts which

are fully recessed in an insulator body, also permits the pin contacts to be designed of the desired materials and shapes for best electrical performance, without sacrificing these for the purpose of providing adequate strength. For example, longer pins may be provided where desirable, as in rack and panel type connectors.

Further objects and advantages of the present invention will appear during the course of the following part of the specification wherein the details of construction and mode of operation of preferred embodiments are described with reference to the accompanying drawings, in which:

FIG. 1 is a longitudinal, vertical section, partly in elevation, illustrating one form of electrical connector embodying the present invention, the portions of the connector being in their fully engaged relationship.

FIG. 2 is a transverse section along the line 2—2 of FIG. 1.

FIG. 3 is a longitudinal vertical section similar to FIG. 1, with portions in elevation, illustrating the connector members separated from each other.

FIGS. 3A and 3B are side elevation views showing stranded wire pin contact terminals which may alternatively be employed in the electrical connector shown in FIGS. 1-3.

FIG. 4 is a perspective view showing the separated connector portions of the electrical connector illustrated in FIGS. 1, 2 and 3.

FIG. 5 is a longitudinal vertical section illustrating another type of electrical connector embodying the present invention.

FIG. 6 is a fragmentary sectional view showing a portion of the connector illustrated in FIG. 5, including an additional sealing pad mounted against the forward face of the insulation body which supports the socket contacts, the connector members being in a partially engaged position.

FIG. 7 is a view similar to FIG. 6 but with the connector portions fully engaged.

FIG. 8 is a longitudinal vertical section, partly in elevation, illustrating a hermetically sealed type of connector structure embodying the present invention.

FIG. 9 is a fragmentary vertical section illustrating the manner in which the present invention is applicable to electrical connector means for a printed circuit board or the like.

Referring at first to FIGS. 1-4 of the drawings, the electrical connector 10 which is illustrated in these figures is of a type wherein the external and supporting structure of each of the two connector members comprises an integral part of the insulation body of the connector. This type of construction is particularly useful in small miniature and sub-miniature connectors.

Connector 10 includes a receptacle connector member 12 and a plug connector member 14, the forward portion of the plug member 14 being engageable within the forward portion of the receptacle member 12.

The receptacle connector member 12 includes a unitary body 16 of insulation material having a front end 18 and a rear end 20. The insulation body 16 includes a tubular forward skirt portion 22 for receiving the forward portion of the plug connector member 14. Although this forward skirt portion 22 of the receptacle member may have any desired cross-sectional shape, in the example shown the skirt portion 22 has a generally trapezoidal cross-section which serves the purpose of polarizing the plug and receptacle connector members when they are interengaged. The inside forward edge of skirt portion 22 is chamfered or bevelled at 23 as a lead-in for insertion of the plug connector member 14.

The rearward portion 24 of insulation body 16 includes an external mounting flange 26 having openings 28 there-through for receiving suitable fasteners. Extending axially through the rearward portion 24 of insulation body 16 are a plurality of terminal-mounting bores 30 within which a plurality of socket contact terminals 32 are re-

spectively supported. Each of the socket contact terminals 32 includes a body portion 34 which, in the form of connector shown in FIGS. 1-4, is molded into position within the bore 30, and each socket contact terminal 32 also includes a forward socket portion 36 which is chamfered at the inside of the front end to provide a lead-in flare 37 which assists pin and socket mating as the connector members are engaged. The body portion 34 of each of the socket contact terminals 32 is cupped at its rear end to receive the exposed end of a conductor 38 which may be crimped or soldered to the contact and which extends rearwardly out of the insulation body 16.

It will be noted that the entire forward socket portion 36 of each socket contact terminal 32, which is the mating portion of the terminal, is exposed forwardly of the forward surface 39 of the rearward portion 24 of the insulation body 16 and hence of the respective terminal mounting bore 30. Accordingly, the forward socket portions 36 of terminals 32 are not individually supported or shrouded within the insulation body, and resist bending only by their relatively large diameter and the inherent structural strength of their tubular construction.

Referring now to the plug connector 14, it includes a body 40 of insulation material having a front end 42 and a rear end 44. Insulation body 40 includes a forward body portion 46 of cylindrical configuration having an external cross-sectional shape like that of the forward skirt portion 22 of the receptacle insulation body 16 so that the forward plug body portion 46 is axially slidable into the receptacle skirt portion 22 and when inserted therein will be polarized.

The plug insulation body 40 also includes a rearward body portion 48 having an external mounting flange 50 thereon. The mounting flange 50 has fastener openings 52 therethrough. Extending axially through both the forward and rearward body portions 46 and 48, respectively, of insulation body 40 are a plurality of terminal-receiving bores 54, within which a plurality of pin contact terminals 56 are respectively supported. Each of the pin contact terminals 56 includes a rearward body portion 58 which is secured within the respective terminal receiving bore 54 in any desired manner, as by being molded therein, and each pin contact terminal 56 also includes a forward pin portion 60 which has a bevelled or rounded tip 62. The pin contact terminals 56 are cupped at their rearward ends to receive exposed ends of respective conductors 64 which may be crimped or soldered therein, the conductors 64 extending rearwardly out of the respective bores 54.

Each of the terminal-receiving bores 54 has a cylindrical forward portion 66 within which the respective forward pin portion 60 is completely recessed. At the forward ends of the bores the walls thereof are chamfered or bevelled to provide lead-in flares 68 which serve to guide the forward ends of the respective socket contact terminals 32 into the cylindrical forward bore portions 66 regardless of any misalignment or tolerance wobble of the socket contact terminals 32. The bevelled or rounded forward tips 62 of the pin contact terminals 56 are preferably recessed rearwardly of these lead-in flares 68 so that proper alignment of the forward ends of socket contact terminals 32 will be effected prior to entry of the forward tips 62 of the pin contacts into the tubular forward portions 66 of the socket terminals.

Clearance 70 is provided about the forward pin portions 60 of the pin contact terminals 56 within the forward cylindrical portions 66 of bores 54 so as to permit entry of the forward portions of the socket terminals into the cylindrical forward bore portions 66 for mating of the pin and socket terminals.

By combining the features of bevelling or rounding the forward tips 62 of the pin terminals 56 and of flaring the socket terminals 32 at their forward ends, when the receptacle and plug members are interengaged, the forward socket portions 36 of terminal 32 will pick up

the forward pin portions 60 of terminals 56 and guide the pins into aligned, mating engagement with the sockets, and this will be accomplished even though the forward pin portion 60 of one or more of the pin terminals is so far out of alignment or has so much tolerance shifting that it is all of the way over against the wall of the cylindrical forward bore portion 66.

FIGS. 3A and 3B illustrate modified pin contact terminals 56a and 56b, respectively, which may be employed in place of the pin terminals 56 in the connector shown in FIGS. 1-4. The pins 56a and 56b differ from pin 56 in that the respective forward pin portions 60a and 60b thereof each comprise a plurality of strands of spring-like wire. The wire strands may be in looped or doubled-back form as shown in FIG. 3A, or may be provided in the twisted or spiral form shown in FIG. 3B, or in other forms. Such stranded wire pins are not usually as rigid as solid pins as shown in FIGS. 1-3 and are therefore more easily damaged, so that the present invention has particular utility in connection therewith.

Referring now to FIGS. 5, 6 and 7 of the drawings, these figures illustrate a rack and panel connector with the receptacle and plug connector members in their fully engaged position. As heretofore stated, the present invention is particularly useful in this type of connector because of the fact that the pin contacts are substantially longer than those found in most types of connectors, and when exposed in the usual manner are relatively vulnerable to bending. This increased length also increases the amount of lateral displacement or misalignment of the forward tips of the pins for a given amount of tolerance movement of the pin contacts in their mountings.

The connector 72 of FIGS. 5, 6 and 7 includes receptacle member 74 and plug member 76. The receptacle member 74 has a shell 78 forming a forward skirt portion of the receptacle member, the shell 78 having an external mounting flange 80 thereon. The rearward portion of shell 78 is internally lined by a peripheral elastomer seal member 82 which extends outwardly around the rear end of shell 78. An insulation body 84 is disposed partially inside of seal member 82 and partially to the rear thereof, insulation body 84 having a rearward, outwardly extending flange 86 which extends behind the peripheral seal member 82. A flexible elastomer grommet member 88 is positioned to the rear of insulation body 84.

A rear end clamp 90 peripherally engages grommet 88, and is provided with side wings 92 which are aligned with similar wings 94 on shell 78, wings 92 being attached to wings 94 by suitable fasteners 96 for holding the aforesaid parts of the receptacle member 74 in assembled relationship as shown in FIG. 5.

A plurality of parallel, axially directed terminal-mounting bores 98 are provided through insulation body 84 and grommet 88 for receiving a plurality of respective socket contact terminals 100. The socket terminals 100 have body portions 102 that are secured within insulation body 84, and forward socket portions 104 which extend forwardly from and are exposed in front of the forward surface of insulation body 84. These forward socket portions 104 are internally bevelled or chamfered to provide lead-in flares 105 at their forward ends.

The contact terminals 100 are also provided with tubular portions 106 which extend rearwardly from the respective body portions 102 for receiving respective conductors 108 which may be soldered or crimped in the tubular portions 106, conductors 108 extending rearwardly out of the grommet 88.

The plug member 76 includes a shell 110 which has an external mounting flange 112 thereon, and which includes front and rear ends 114 and 116, respectively. An insulation body 118 is disposed within the plug shell 110, body 118 having an external flange 120 thereon which is engageable against a rearwardly facing shoulder 122 in shell 110 to limit forward positioning of insulation body 118 in the shell 110. A suitable locking ring 124 is

seated in a groove 125 in shell 110 behind the insulation body flange 120 to present abutment means limiting the rearward positioning of insulation body 118 in shell 110.

A plurality of axially directed bores 126 extend through insulation body 118, and a plurality of pin contact terminals 128 are mounted in the respective bores 126. The pin contact terminals 128 include body portions 130 which are secured within the rearward portion of insulation body 118, and forward pin portions 132 which are bevelled or rounded at their forward tips 134, the forward tips 134 being recessed within the bores 126 rearwardly of the forward face of insulation body 118 so that the entire forward pin portions 132 are shrouded by the forward portion of insulation body 118 within bores 126. The pin contact terminals 128 also include rearward tubular portions 136 which receive exposed ends of respective conductors 138 which are crimped or soldered therein.

The bores 126 include cylindrical forward portions 140 which have a substantially larger diameter than the forward pin portions 132 so as to provide the necessary clearance 142 within the cylindrical forward bore portions 140 to receive the respective forward socket portions 104 of socket terminals 100 when the pins and sockets are mated. Chamfers or bevels are provided at the forward ends of bores 126 to provide lead-in flares 144 which serve to guide the forward socket portions 104 into the cylindrical bore portions 140.

In FIGS. 6 and 7 a sealing pad 146 is mounted in the receptacle connector member 74 flush against the forward face of insulation body 84. Although such a sealing pad has heretofore normally been mounted against the face of the insulator which supports the pin contact terminals in prior art rack and panel type connectors, in the present invention where the exposed, forwardly projecting terminals are the socket terminals, it is necessary that the sealing pad be mounted at the base of the socket terminals. Sealing pad 146 has bores 147 extending therethrough through which the socket terminals 100 extend, with bevelled sealing projections 148 at the forward ends of the respective bores 147, sealing projections 148 entering into the lead-in flares 144 of insulation body 118 of the plug connector member as illustrated in FIG. 7 when the plug and receptacle members are fully engaged, so that the sealing pad 146 provides a complete interface moisture seal between the insulation bodies 84 and 118 of the receptacle and plug members respectively.

Referring now to FIG. 8, this figure illustrates advantages of the present invention where the connector unit requires hermetic sealing of terminals in glass. Heretofore, such hermetic sealing has been provided by flowing a layer of glass about the base portions of pin contact terminals, so that the pins project outwardly from the glass layer. This has been employed in electrical connectors which otherwise are of generally conventional nature, and is widely applied in the case of power receiving devices such as sealed relay cans, and in transistors, semiconductor diodes and the like.

When pin contact terminals are sealed in glass in accordance with conventional practice, the extreme heat involved causes the terminals to become quite soft, and readily bendable. Thus, in the case of hermetically sealed pin contacts, the bending problem is even more serious than usual. Where socket contact terminals were hermetically sealed about their bases in glass in prior art connectors of the usual type having recessed socket terminals, it was necessary to provide an additional insulator member which was positioned forwardly of the glass seal layer, with the socket terminals extending into bores in this additional insulating member, but this has the disadvantage of creating an undesirable moisture trap.

In the present invention, the socket contact terminals are the terminals which are hermetically sealed about their bases in glass, and the socket terminals are much stronger and more resistant to bending than pin terminals.

No additional insulation member need be provided forward of the glass seal layer. Where a power receiving member has exposed socket contacts in accordance with the present invention, the power providing connector member which has the electrically hot contacts will have pin contacts which are recessed completely within an insulator body so that they cannot be touched. This advantage of the invention obviously applies to any type of connector where one of the hot contacts is a pin.

Referring specifically to FIG. 8, a transistor 150 or the like has been illustrated, and includes three exposed socket contacts 152 which have a glass seal layer 154 about their bases. The mating plug member 156 is shown as comprising an extended insulation body 158, which may be in the form of a connector plug, or which may comprise a terminal board or the like. The insulation body 158 has a plurality of terminal receiving bores 160 therethrough within which are mounted a plurality of respective pin contact terminals 162. The pin terminals 162 have forward pin portions 164 which mate with the exposed socket contacts 152, and the pin terminals also have hollow rear portions 166 for receiving the exposed ends of respective conductors 168 which may be crimped or soldered therein. The forward pin portions 164 of terminals 162 are shrouded completely within cylindrical forward bore portions 170, with space provided about the pin portions 164 to receive the entering socket contacts 152. The bores are chamfered at 172 as a lead-in for the socket contacts 152.

Although the insulation bodies of the connectors in FIGS. 1-8 have been illustrated in unitary or monoblock form, it will be understood that the insulation body for either the pin or the socket contacts, or for both, may be provided in two or more parts if desired within the scope of the present invention.

Referring finally to FIG. 9, the present invention is illustrated in this figure in an application wherein a pin contact terminal 174 is mounted on a printed circuit board 176, the pin terminal 174 having an enlarged base portion 178 which is mounted in a bore 180 extending through the board 176. Connection to the printed circuit of board 176 may be provided by a solder button 182 at the rear end of the enlarged base portion 178 of the pin terminal. The upstanding pin member 174 is shrouded by providing an insulation body 184 which is attached to the surface 186 of the circuit board from which the pin projects, this insulation body 184 having cylindrical bore 188 within which the pin 174 is recessed, the bore 188 having lead-in chamfer 190 at its exposed end. The cylindrical bore 188 is sufficiently larger than pin 174 to receive a socket contact terminal 192 which projects outwardly from a connector member 194. It will be apparent that connector member 194 can be of any desired type, as for instance a transistor as illustrated in FIG. 8.

Although several forms of electrical connectors within which the present invention has particular utility have been illustrated in the drawings and hereinabove described, it is to be understood that these forms have been set forth by way of example only, and not of limitation, and that the present invention is adaptable for use in a wide variety of electrical connectors.

While the instant invention has been shown and described herein in what are conceived to be the most practical and preferred embodiments, it is recognized that departures may be made therefrom within the scope of the invention, which is therefore not to be limited to the details disclosed herein, but is to be accorded the full scope of the claims.

I claim:

1. An electrical connector adaptable to embodiment in minute size in which a plurality of closely adjacent pin terminals mate with a plurality of respectively aligned tubular socket terminals and comprising a first insulation body having a forward and a rearward face and a plu-

rality of closely adjacent parallel bores extending from the forward to the rearward face, one of said pin terminals being mounted in each of said bores, each of said pin terminals embodying a forward pin portion which is completely recessed within a forward portion of its respective bore, said forward bore portion being larger in diameter than the greatest diameter of the pin portion providing sufficient clearance in said forward bore portion for reception of a mating portion of a tubular socket terminal, a second insulation body operatively engageable with said first insulation body by relative advancement of the two bodies to final position of engagement, the second body having a forward face and a rearward face, a plurality of bores in the second body aligned with respective bores in the first body, one of said tubular socket terminals being mounted in each of said bores in the second body, said socket terminals each having a tubular forward individually unconfined socket portion with an open entrance at its forward end, said socket portions being relatively resistant to lateral bending, and said pin portions being relatively yieldable to lateral bending, said pin portions possessing relatively minor columnar strength and said socket portions possessing relatively major columnar strength, said pin portions being inherently susceptible to possible lateral misalignment in their bores, any lateral misalignment of the pin portions being limited by engagement of the pin portions with the wall of their respective bores, said pin portions each having a generally hemispherical forward end, said ends being formed integrally with the material of the pin portions, said socket portion entrances being chamfered from the outside diameters inwardly providing annular generally sharp single tapered entrance ramps, any lateral alignment necessary between a pin portion end and its mating socket portion upon relative advancement of the two insulation bodies being achieved by the wedging action of the socket entrance ramp intervening between the bore wall and the pin end exerting a transverse force component against the hemispherical end of the pin portion, the dimensional relationship between said pin portion end, the entrance ramp and the adjacent wall of the bore being such that if the socket portion enters the bore the pin portion is forced to align with the socket.

2. An electrical connector as defined in claim 1 in which the pin portions of the pin terminals each comprise a plurality of fine spring wires.

3. An electrical connector as defined in claim 1, wherein each of the bores in which the pin terminals are mounted has a chamfered entrance adapted to capture and guide the respective socket portion into the bore in which the pin terminal is mounted, and the forward end of each pin terminal is offset rearwardly from said forward face of the first insulation body a distance at least as great as the rearward end of said chamfered entrance whereby proper lateral orientation of the mating socket portion is established prior to engagement between the pin and socket portions.

References Cited by the Examiner

UNITED STATES PATENTS

2,047,126	7/1936	Hastings	-----	339-192 X
2,563,713	8/1951	Frei et al.	-----	339-63
2,658,182	11/1953	Jackson et al.	-----	339-64 X
2,787,770	4/1957	Arson	-----	229-63
2,881,406	4/1959	Arson	-----	339-59
2,984,814	5/1961	Scott	-----	339-66 X
3,017,605	1/1962	Platz et al.	-----	339-252
3,059,208	10/1962	Concelman	-----	339-65
3,065,447	11/1962	Maurer	-----	339-91 X
3,086,190	4/1963	Neidecker et al.	---	339-252 X

EDWARD C. ALLEN, *Primary Examiner*.

W. DONALD MILLER, PATRICK A. CLIFFORD,
Examiners.