

An electrical plug receptacle connector and a method of manufacturing such a connector

There is disclosed in US—A—3,850,497 an electrical plug receptacle connector comprising an insulating housing having a plug-receiving end and a rearward end, a plug-receiving opening extending into said plug-receiving end, such opening having opposed internal side walls and opposed internal end walls, the housing having opposed external side walls and opposed external end walls, a plurality of electrical contacts being arranged in juxtaposed spaced relationship with an intermediate portion of each contact received in a channel extending from adjacent the plug-receiving end of the housing towards the rearward end thereof and between the one internal side wall and the adjacent external side wall, each contact comprising a contact spring portion which has been bent so as to extend around an edge portion of the housing disposed between the one internal side wall and the adjacent external side wall and being located adjacent to the plug-receiving end, whereby the contact spring portion extends from one of the internal side walls at a position adjacent to the plug-receiving end, obliquely into the opening and towards the opposite internal side wall, the plug receiving opening being dimensioned to receive an electrical plug connector having spaced contact members therein for engaging the contact spring portions of the contacts of the receptacle connector.

The plug connector is described in detail in United States Patent Specification No. 3,860,316, for example.

Although this known receptacle connector is widely used in the telephone industry, it is being used to an increasing extent on equipment other than telephone equipment, for example, data processing equipment which may be installed adjacent to a telephone exchange, small computers and similar equipment.

It is a disadvantage of the known receptacle connector that the contact spring portions are in the form of circular cross-section wire springs connected to lead wires by means of ferrules crimped thereto and to the wire springs to splice them together, the ferrules being lodged in the said channels. The manufacture of the known receptacle connector includes the steps of crimping the ferrules to the wire springs and the lead wires, and of then inserting the individual ferrules into the bores, after which the springs are bent to extend obliquely into said opening. It is another disadvantage of the known receptacle connector that it is unadapted for mounting on a printed circuit panel as would be desirable for example where the receptacle connector is to be used in data processing equipment. Although the wire springs, which make only line contact with the contact members of the plug connector, are suitable for the transmission of audio frequency signals, larger areas of contact between the contact por-

tions of the receptacle connector contacts and the contact members of the plug connector would be desirable in the case of the more recent applications, mentioned above, of the receptacle connector.

The present invention is intended, according to one aspect thereof, to provide a simplified and more economical method of manufacturing a plug receptacle connector as defined in the first paragraph of this specification, the receptacle connector produced being more versatile in respect of its fields of use, than the known connector.

A method of manufacturing an electrical plug receptacle connector as defined in the first paragraph of the present specification, each contact of the connector to be manufactured being in addition in the form of a single elongate metal strip having a lateral projection by means of which the contact may be retained in assembled relationship with the housing, and a tail portion of the contact which may project from the intermediate portion, outwardly of the housing, is, according to one aspect of the invention, characterised by the steps of arranging a series of elongate metal strips connected together in juxtaposed relationship and from which the contacts are to be formed, so that an intermediate portion of each strip is disposed in said channel with one end portion of each strip projecting beyond the plug-receiving end of the housing and the opposite end portion of each strip projecting beyond the rearward end of the housing, employing tooling to bend, in co-operation with said edge portion, the one end portion of each strip back from the plug-receiving end of the housing to cause such one end portion to extend obliquely into the plug-receiving opening, and to bend the opposite end portion of the strip so that at least an extremity of such portion projects outwardly of the housing, the method also including the steps of severing the connections between the metal strips and producing an interference mechanical connection between said lateral projection on each strip, and the housing, to retain the strips in assembled relationship to the housing.

The series of elongate metal strips may be in the form of a continuous, substantially uniplanar band which can readily be produced by a simple stamping operation and which can be wound about an ordinary storage reel, as is usual in the case of terminals which are in the form of a band, without the risk of the strips in adjacent layers on the reel tangling, as the band is withdrawn from the reel, so as to interrupt the manufacturing process. The band can be fed directly from the reel to a station at which the strips are applied to the connector housings. The thin, and therefore easily bent, strips can, in the course of manufacture of plug receptacle connectors, readily be secured in the contact

printed circuit panel, in association with a mating electrical plug connector and a cover panel;

Figure 2 is a front elevation of the receptacle connector as seen in cross-section through the panel;

Figure 3 is a view taken on the lines III—III of Figure 1;

Figure 4 is an underplan view of the housing of the receptacle connector;

Figure 5 is a fragmentary underplan view of a printed circuit panel;

Figure 6 is a front elevational view, shown partly in section and showing the plug connector mated with the receptacle connector;

Figure 7 is a plan view of a metal blank illustrating steps in the manufacture of electrical contacts of the receptacle connector;

Figure 8 is an enlarged view taken on the lines VIII—VIII of Figure 7;

Figures 9 to 11 are sectional view illustrating successive stages in the use of tooling for the application of a section of the blank of Figure 7 to the housing of the receptacle connector to provide the housing with the contacts;

Figure 12 is a plan view shown partly in section illustrating the stage of Figure 9;

Figure 13 is a sectional view taken on the lines XIII—XIII of Figure 12;

Figure 14 is a sectional side view of an electrical receptacle connector according to a second embodiment of the invention;

Figure 15 is a perspective view of an electrical plug receptacle connector according to a third embodiment of the invention mounted on a printed circuit panel and in association with a mating electrical plug connector;

Figure 16 is a view taken on the lines XVI—XVI of Figure 15;

Figure 17 is a top plan view of the receptacle connector of the third embodiment;

Figure 18 is a front elevational view of the receptacle connector of the third embodiment;

Figure 19 is a view taken on the lines XIX—XIX of Figure 16;

Figure 20 is a front elevational view shown partly in section and showing the receptacle connector of the third embodiment mated with the plug connector;

Figure 21 is a plan view of a metal progression strip, illustrating steps in the manufacture of electrical contacts of the receptacle connector of the third embodiment;

Figure 22 is an end view of a partially formed contact;

Figure 23 is a view similar to that of Figure 16 but illustrating a step in the assembly of the contacts to the receptacle connector of the third embodiment;

Figure 24 is a fragmentary plan view illustrating a modification of the receptacle connector according to the third embodiment;

Figure 25 is a view taken on the lines XXV—XXV of Figure 24;

Figure 26 is a view similar to that of Figure 1

but showing an electrical plug receptacle connector according to a fourth embodiment of the invention;

Figures 27 and 28 are front elevational, and top plan views, respectively, of the receptacle connector according to the fourth embodiment;

Figure 29 is a view taken on the lines XXIX—XXIX of Figure 28;

Figure 30 is a sectional view showing a receptacle connector according to the first embodiment and a receptacle connector according to the fourth embodiment, mounted on a common printed circuit board;

Figure 31 is a fragmentary underplan view of the printed circuit board;

Figure 32 is a plan view of a metal blank illustrating steps in the manufacture of electrical contacts of the receptacle connector according to the fourth embodiment;

Figures 33 and 34 are sectional views illustrating the manner in which the receptacle connector of the fourth embodiment is provided with the electrical contacts;

Figure 35 is a view similar to those of Figures 1 and 26 but showing an electrical plug receptacle connector according to a fifth embodiment of the invention;

Figure 36 is a view of the receptacle connector taken on the lines XXXVI—XXXVI of Figure 35;

Figure 37 is a top plan view of the receptacle connector of the fifth embodiment;

Figure 38 is a view taken on the lines XXXVIII—XXXVIII of Figure 36;

Figure 39 is a fragmentary underplan view of a printed circuit board;

Figure 40 is an enlarged perspective view with parts omitted, illustrating the manner in which electrical contacts of the receptacle connector of the fifth embodiment are inserted into holes in the printed circuit board;

Figure 41 is a view taken on the lines XXXXI—XXXXI of Figure 36;

Figure 42 is an enlarged plan view of a metal blank;

Figures 43 and 44 are sectional views illustrating the assembly of electrical contacts to the housing of the receptacle connector of the fifth embodiment; and

Figure 45 is a view taken on the lines XXXXV—XXXXV of Figure 44.

Reference will now be made to Figures 1 to 13.

As shown in Figure 1 an electrical plug receptacle connector 2 is mounted on a printed circuit board 4, an electrical plug connector 68 being adapted to be mated with the receptacle connector 2. The receptacle connector 2 comprises an insulating housing 6 having a plug-receiving opening 12 extending through the housing 6 and between the ends 8 and 10. The opening 12 has opposed upper and lower internal side walls 14 and 16 (as seen in Figure 3) and opposed internal end walls 18 and 20, as best seen in Figure 2. The housing 6 has

printed circuit panel, in association with a mating electrical plug connector and a cover panel;

Figure 2 is a front elevation of the receptacle connector as seen in cross-section through the panel;

Figure 3 is a view taken on the lines III—III of Figure 1;

Figure 4 is an underplan view of the housing of the receptacle connector;

Figure 5 is a fragmentary underplan view of a printed circuit panel;

Figure 6 is a front elevational view, shown partly in section and showing the plug connector mated with the receptacle connector;

Figure 7 is a plan view of a metal blank illustrating steps in the manufacture of electrical contacts of the receptacle connector;

Figure 8 is an enlarged view taken on the lines VIII—VIII of Figure 7;

Figures 9 to 11 are sectional view illustrating successive stages in the use of tooling for the application of a section of the blank of Figure 7 to the housing of the receptacle connector to provide the housing with the contacts;

Figure 12 is a plan view shown partly in section illustrating the stage of Figure 9;

Figure 13 is a sectional view taken on the lines XIII—XIII of Figure 12;

Figure 14 is a sectional side view of an electrical receptacle connector according to a second embodiment of the invention;

Figure 15 is a perspective view of an electrical plug receptacle connector according to a third embodiment of the invention mounted on a printed circuit panel and in association with a mating electrical plug connector;

Figure 16 is a view taken on the lines XVI—XVI of Figure 15;

Figure 17 is a top plan view of the receptacle connector of the third embodiment;

Figure 18 is a front elevational view of the receptacle connector of the third embodiment;

Figure 19 is a view taken on the lines XIX—XIX of Figure 16;

Figure 20 is a front elevational view shown partly in section and showing the receptacle connector of the third embodiment mated with the plug connector;

Figure 21 is a plan view of a metal progression strip, illustrating steps in the manufacture of electrical contacts of the receptacle connector of the third embodiment;

Figure 22 is an end view of a partially formed contact;

Figure 23 is a view similar to that of Figure 16 but illustrating a step in the assembly of the contacts to the receptacle connector of the third embodiment;

Figure 24 is a fragmentary plan view illustrating a modification of the receptacle connector according to the third embodiment;

Figure 25 is a view taken on the lines XXV—XXV of Figure 24;

Figure 26 is a view similar to that of Figure 1

but showing an electrical plug receptacle connector according to a fourth embodiment of the invention;

Figures 27 and 28 are front elevational, and top plan views, respectively, of the receptacle connector according to the fourth embodiment;

Figure 29 is a view taken on the lines XXIX—XXIX of Figure 28;

Figure 30 is a sectional view showing a receptacle connector according to the first embodiment and a receptacle connector according to the fourth embodiment, mounted on a common printed circuit board;

Figure 31 is a fragmentary underplan view of the printed circuit board;

Figure 32 is a plan view of a metal blank illustrating steps in the manufacture of electrical contacts of the receptacle connector according to the fourth embodiment;

Figures 33 and 34 are sectional views illustrating the manner in which the receptacle connector of the fourth embodiment is provided with the electrical contacts;

Figure 35 is a view similar to those of Figures 1 and 26 but showing an electrical plug receptacle connector according to a fifth embodiment of the invention;

Figure 36 is a view of the receptacle connector taken on the lines XXXVI—XXXVI of Figure 35;

Figure 37 is a top plan view of the receptacle connector of the fifth embodiment;

Figure 38 is a view taken on the lines XXXVIII—XXXVIII of Figure 36;

Figure 39 is a fragmentary underplan view of a printed circuit board;

Figure 40 is an enlarged perspective view with parts omitted, illustrating the manner in which electrical contacts of the receptacle connector of the fifth embodiment are inserted into holes in the printed circuit board;

Figure 41 is a view taken on the lines XXXXI—XXXI of Figure 36;

Figure 42 is an enlarged plan view of a metal blank;

Figures 43 and 44 are sectional views illustrating the assembly of electrical contacts to the housing of the receptacle connector of the fifth embodiment; and

Figure 45 is a view taken on the lines XXXXV—XXXXV of Figure 44.

Reference will now be made to Figures 1 to 13.

As shown in Figure 1 an electrical plug receptacle connector 2 is mounted on a printed circuit board 4, an electrical plug connector 68 being adapted to be mated with the receptacle connector 2. The receptacle connector 2 comprises an insulating housing 6 having a plug-receiving opening 12 extending through the housing 6 and between the ends 8 and 10. The opening 12 has opposed upper and lower internal side walls 14 and 16 (as seen in Figure 3) and opposed internal end walls 18 and 20, as best seen in Figure 2. The housing 6 has

external side walls 22 and 24 and external end walls 26 and 28 which are adjacent to the internal side walls 14 and 16. The end walls 26 and 28 have extensions 30, which extend beyond the plug-receiving end 8, outwardly projecting flanges 32 being provided on the ends of the extensions 30. The housing 6 is mounted on the board 4 by means of locating pins 34 adjacent to the rearward end 10 of the housing 6, and which are received in circular openings 80 (Figure 5) in the board 4, and by latch arms 36 having enlarged ends 39 which are received in notches 78 (best seen in Figure 5) in an edge of the board 4. A cover panel 38 has an opening 40 shaped to receive the housing 6 when the panel 38 is moved downwardly from the position in which it is shown in Figure 1. The flanges 32 then extend laterally beyond the edges of the opening 40 and support the housing 6.

A plurality of spaced recesses 42 defining between them barriers 43, are provided in the plug-receiving end 8 of the housing 6, between the side walls 16 and 24, as best seen in Figure 3, each recess 42 merging with a slot 44 which extends partially along the side wall 16 from the plug-receiving end 8 of the housing 6. Each recess 42 also communicates with a narrow channel 46a or 46b in the external side wall 24. Each such channel has an inner closed end 48a or 48b the opposed sides of each channel having V-shaped recesses 50a or 50b, as best seen in Figure 4, the ends of the channels 46a being remote from the rearward end 10 of the housing 6 relative to ends 48b of the channels 46b and the recesses 50a being adjacent to the ends 48a. The ends of the channels 46b are proximate to the rearward end 10 of the housing 6, the recesses 50b being immediately adjacent to the ends of the channels 46b. The recesses 50a and 50b and the ends 48a and 48b are accordingly staggered with respect to the rearward end 10 of the housing. Barriers 51 of the housing material are defined between adjacent channels 46a and 46b.

A plurality of stamped and formed electrical contacts 52a and 52b are mounted in the housing 6, each such contact having an intermediate portion 54a or 54b which is located in one of the channels 46a or 46b, as the case may be, a bight 56 adjacent to the end 8 of the housing 6, and being located in the corresponding recess 42, and a contact spring portion 58 which extends obliquely into the opening 12 of the housing 6. A tail portion 60a or 60b of each contact extends normally of the portion 54a or 54b from its end remote from that from which the portion 58 extends, and downwardly, as seen in Figure 3, beyond the wall 24. The extremities 53 of these tail portions are dimensioned to be inserted into staggered holes 83 (Figure 5) in the board 4 to be soldered to conductors (not shown) on the underside of the board 4. Each contact 52a or 52b has outwardly extending barbs 62a or 62b which are force fitted into the recesses 50a and

50b, respectively, to retain the contacts 52a and 52b in the housing 6.

The plug connector 68 which is described in detail in United States Patent Specification No. 3,954,320, comprises an insulating housing having a recess therein which receives the end portion of an eight wire cable 70. The wires of the cable 70 are connected by means of insulation piercing connections (not shown) to blade-like terminals 74 (Figure 6) contained in the housing of the plug 68, edge portions of which terminals 74 are adjacent to the underside 72 of the plug housing. The edge portions of the terminals 74 thus engage the contact spring portions 58 when the plug 68 is inserted into the opening 12, as shown in Figure 6. The plug 68 is retained in the opening 12 by means of a latch arm 76 which extends from the upper (as seen in Figures 1 and 6) surface of the plug housing and which has shoulders 79 for engagement behind shoulders 66 (Figure 3) adjacent to the internal side wall 14, the opening 12 having an enlargement 64 to accommodate the latch arm 76.

In the course of their manufacture, the contacts 52a and 52b are stamped from a continuous length of metal sheet, for example of brass, or beryllium copper in the form of strips 52a' and 52b', to provide a blank 84 as shown in Figure 7, each such strip being integral with spaced carrier strips 86 and 88. As shown on the right hand side of Figure 7, each strip 52a' and 52b' has outward projections 62a' and 62b', which are coplanar with the remainder of the blank 84, the projections 62a' being nearer to the carrier strip 86 than the projections 62b'. The strips 52b' are connected to the carrier strip 86 by neck portions 90 which are nearer to the carrier strip 86, than neck portions 92 which connect the strips 52a' to the carrier strip 86. As will be explained below, the individual strips 52a' and 52b' are sheared from the carrier strip 86 at the respective neck portions 90 and 92. Prior to shearing the neck portions 90 and 92, the projections 62a' and 62b' are deformed upwardly very slightly (as seen in Figure 8), to provide the barbs 62a and 62b, such deformation serving to facilitate the engagement of the barbs 62a and 62b with the walls of the recesses 50a and 50b.

The strips 52a' and 52b' can be assembled to the housing 6 and formed to provide the contacts 52a and 52b by means of insertion tooling, in the manner illustrated in Figures 9 to 13. The tooling comprises a fixed shearing member 190 in the form of a shearing block, a movable shearing member 192 in the form of a shearing blade, an insertion and forming ram assembly 94 which comprises two ram parts 96 and 98, and an additional shearing member 99 (Figure 10), in the form of a shearing blade. The shearing members 190 and 192 serve to sever the strips 52a' and 52b' from the carrier strip 86 and, as shown in Figure 12, shearing edges 100 and 102 of the member 192 are offset

from each other so that the strips 52a' are sheared from the carrier strip 86 as the neck portions 92 and the strips 52b' are severed at the neck portions 90, the member 190 having shearing edges (not shown) which are complementary with the edges 100 and 102.

The ram part 96 has spaced-apart support surfaces 104 for the strips 52a' and 52b' and recesses 106 on each side of each support surface 104 to permit the support surfaces 104 to insert the strips 52a' and 52b' into the channels 46a and 46b on the underside of the housing 6, the barriers 51 being received in the recesses 106. As shown in Figure 12, the support surfaces 104 for the strips 52b' extend beyond the support surfaces 104 for the strips 52a' because the channels 46b are longer than the channels 46a. The working surface 112 of the ram part 98 is coplanar with the support surfaces 104 when the ram parts 96 and 98 are in their position of Figure 9, however, spaced openings 110 extend vertically through the ram part 98 between adjacent surfaces 104 as shown in Figure 12. The openings 110 provide clearance for the barriers 43 between adjacent recesses 42 in the housing 6.

With the housing 6 supported in an upper tooling member (not shown), the required number of strips 52a' and 52b', which are to be formed into the contacts 52a and 52b for the housing 6, are assembled to the housing 6 by positioning a section (see the left hand side of Figure 7) of the blank 84 on the tooling 96, 98, 190 as shown in Figure 9, with the housing 6 supported above the tooling and with the strips 52a' and 52b' in alignment with respective channels 46a and 46b of the housing 6. During the insertion of the strips 52a' and 52b', the shearing member 192 is first depressed from the position of Figure 9 to sever the strips 52a' and 52b' from the carrier strip 86. These strips may be held on the ram assembly 94 by the shearing member 99 or by other hold down means (not shown). The shearing member 192 is then raised from the position of Figure 9 and the ram assembly 94 is raised as a unit from the position of Figure 9 to that of Figure 10.

As a result of such movement of the assembly 94 the tail portions 60a and 60b of the contacts 52a and 52b are formed by bending the corresponding end portions of the strips 52a' and 52b', as such end portions are pushed by the part 96 past rounded corners 101 at the closed ends of the channels 46a and 46b. The shearing member 99 then descends from the position of Figure 10, and in co-operation with the right hand (as seen in Figure 10) edge of the ram part 98 shears the carrier strip 88 from the strips 52a' and 52b'. The part 98 is then moved upwardly relative to the part 96, which remains stationary, partially to form the contact spring portions 58 of the contacts, as shown in Figure 11. The housing 6 is then removed from the tooling and the partially formed portions 58 are fully formed by bending

them inwardly to their final positions (Figure 3), by inserting a gauging tool (not shown) into the opening 12 of the housing 6.

In the embodiment of Figure 14, i.e. the second embodiment, the extremities 53c of the tail portions of the contacts extend through shallow extensions 125 of the channels 46a and 46b, beyond the rearward end 10 of the housing. The housing of Figure 14 is intended to be mounted on a printed circuit board (not shown) with the rearward end 10 on the surface of the board. If desired, the extremities 53c may be offset from each other for insertion into holes in the printed circuit board arranged according to the pattern of the holes 83 of Figure 5.

A receptacle connector as described above can be readily mounted on the printed circuit board and its contacts soldered to conductors on the board without the use of intervening connecting devices of conductors. The tail portions of the contacts may otherwise be shaped, for example, so that their extremities can be made with terminal receptacles (not shown) crimped to the ends of wires, or such extremities can be formed each with a slot (not shown) for receiving an insulated wire upon movement of the wire laterally of its axis and into the slot.

It is advantageous that the receptacle connector can be produced by injection moulding a one-piece housing, stamping the individual contacts, and inserting all of them into the housing in a single insertion operation.

The fact that the contacts of the receptacle connector are stamped and formed and have a substantial width, as illustrated in Figure 6, results in improved electrical characteristics in that the edge portions of each terminal of the plug connector bear against a flat surface of a contact member of the receptacle connector. It will be apparent from Figure 6 that slight misalignment of the terminals of the plug connector relative to the contacts of the receptacle connector will not affect the quality of the electrical connections, which always consist of two flat surfaces disposed against each other.

Reference will now be made to Figures 15 to 23.

The receptacle connector 202 according to the third embodiment is intended to be mated with a plug connector 68' (identical with the connector 68 described above excepting that it is for a four wire cable 70' instead of for an eight wire cable), to connect the wires 70' to conductors 207 (Figures 16 and 20) on the underside of a printed circuit board 210. As shown in Figures 15 and 16, the connector 202 comprises an insulating housing 212 of plastics material, for example a filled nylon, having a rearward end 214, a plug-receiving end 216, and a plug-receiving opening 218 extending through the housing 212 and between the ends 214 and 216. The opening 218 has upper and lower (as seen in Figure 16) internal side walls 220 and 222 and internal end walls 224 and 226 (Figure 18), the housing 212 having ex-

ternal side walls 228 and 230, external end walls 232 and 234 and support feet 236 which extend outwardly from the external end walls 232 and 234. The feet 236 are provided with locking lugs 237 on their undersides, which lugs are dimensioned to be received in holes in the board 210 to retain the housing 212 on the board 210 prior to soldering the electrical contacts 260 in the housing 212 to the conductors 207 of the board 210. The external side wall 230 is supported above the board 210 by the feet 236 to facilitate the soldering operation. The feet 236 merge with a rearward apron 238 of the housing 212.

A contact-receiving opening 240 extends through the housing 212 parallel to, and adjacent to, the opening 218 and between the internal side wall 222 and the adjacent external side wall 230, as best seen in Figure 16. This opening 240 extends rearwardly through a recessed surface 242 below the portion 241 of the plug-receiving end 216 which is adjacent to the internal side wall 222. As best seen in Figure 19, the entrance to the opening 240 in the surface 242 is of restricted width and the sides of the opening 240 diverge rearwardly as shown at 244. This divergent portion of the opening 240 merges with a wider portion 246 which extends to the rearward end 214 of the housing 212. An entrance 248 at such rearward end is flared, as shown in Figure 16, to facilitate assembly of the contacts 260 to the housing 212, as described below.

A ramp 250 extends down from the entrance 248 of the opening 240 to the upper surface 252 of the apron 238, spaced barriers 254 being provided on the ramp 250 and on the surface 252 to define a separate stall for each contact 260. Additionally, spaced V-shaped notches 256 extend inwardly from the rearward edge 258 of the apron 238 to receive the contacts 260 with an interference fit, also as described below.

The contacts 260 each comprise, as shown in Figure 16, an intermediate portion 262 which is contained in the opening 240 with a force fit afforded by dimples 264 on the portion 262. Adjacent to the end 216 of the housing 212, each contact 260 has a bight 266 received in one of a plurality of spaced notches 270, defining barriers 241 at the end 216 of the housing 212. Contact spring portions 268 of the contacts 260 which extend obliquely from the wall 222 into the opening 218, are deflected by the edge portions of the terminals 74' of the plug connector 68' when it is inserted into the opening 218 (Figure 20).

Tail portions 272 of the contacts 260 extend over the ramp 250 as shown in Figure 16, across the adjacent surface 252 of the apron 238 and through the notches 256, offset parts 274 of the portions 272 abutting the surface 252. The notches 256 are dimensioned to receive the portions 272 with an interference fit securely to anchor the ends of the portions 272

to the housing 212, the barriers 254 serving to restrain lateral movement of the contacts 260 towards or away from each other. Extremities 281 of the tail portions 272 extend downwardly beyond the wall 230 and are soldered at 280 to the conductors 207. Enlarged arcuate parts 278 of the tail portions 272, beneath the apron 238 provide the interference fit mentioned above and contribute to the stability of the contacts 260 with respect to the housing 212.

Shoulders 290 (Figures 16 and 23) in the opening 218 serve to engage the shoulder 79' of the latch arm 76' of the plug connector 68' to retain the latter in the housing 212.

The contacts 260 are manufactured from a progression strip 249 of spring metal (Figure 21). The strip 249 is prepared by punching suitable pilot holes 300 (for locating the strip) in the edge of the strip 249 and blanking the strip 249 to produce groups 309 of four contact blank strips 260'. The parts of each strip 260' are identified in Figure 21 by the same reference numerals, differentiated by "prime" symbols, as those used in the above description of the contacts 260. The strips 260' extend between, and are formed integrally with, spaced carrier strips 302 and 304. Sections 306 of the strips 304 between adjacent groups 309 of strips 260' at end portions 268' thereof, are first removed as shown in Figure 21. A forming operation can then be carried out to produce the offset parts 274 of the contact 260 and to produce the dimples 264 (Figure 22). A finished group of strips 260' then comprises a section 310 of the carrier strip 302 with groups of four partially formed contacts 260 extending there from and with the ends of the portions 268' of each such group connected by a remanent 308 of the carrier strip 304. Each of these groups 309 is assembled to a housing 212 after severing the section 310 of the carrier strip 296 from the strip 249 while leaving the remanents 308 of the carrier strip 304 and section 310 of the carrier strip 302, still connected to the strips 260'. The group 309 is then inserted into the rearward entrance 248, with the remanent 308 leading, to extend beyond the plug-receiving end 216 of the housing 212, as shown in Figure 23, diverging portions 243 of the blanks 260' being received in the enlarged portion 246 of the opening 240. Thereafter, the remanent 308 and section 310 of the carrier strips are severed from the strips 260' and final forming of these blanks is carried out by bending the portions 268' so as to extend obliquely into the opening 218, and bending down the portions 272' of the strips 260' so as to extend over the ramp 250, across the surface 252 and through the notches 256. The enlarged parts 278' are now located adjacent to the lower surface of the apron 238 as shown in Figures 18 and 20 in which the enlarged portions are referenced 278 as being parts of the finished contacts. The parts 278 thereby assist in stabilizing the contacts 260 in the

housing 212 and also restrain the portions 272 against upward movement through the notches 256 when the extremities 281 are inserted into the openings in the board 210 prior to the soldering operation.

According to the modification of Figures 24 and 25 extremities 322 and 324 of the tail portions of the contacts 260a and 260b are offset from each other so that the width of the housing at the rearward end thereof can be substantially reduced. It will be appreciated that in this case it is unnecessary for the intermediate portions of the contacts to be divergent, the contact-receiving opening 240a being of uniform width. Slots 316 and 318 extend inwardly from the rearward edge of the apron 238a, the slots 316 which receive the end portions of the contacts 260a being relatively deeper than the slots 318 which receive the end portions of the contacts 260b. All of the slots 316 and 318 have bases formed by ramps 250a which slope downwardly from the upper surface of the apron 238a, as shown in Figure 25, the contacts 260a and 260b extending across the ramps 250a and downwardly beyond the lower surface of the apron 238a, as seen in Figure 25. The contacts are also provided with outwardly extending barbs 326 which gouge into the side walls of the slots 316 and 318 when the contacts 260a and 260b are assembled to the housing and assist in retaining the contacts in assembled relationship. The modification of Figures 24 to 25 can thus be used under circumstances where it is desired to have a housing of reduced width and where the printed circuit board has staggered holes therein for reception of the extremities 324 and 322.

As in the case of the first and second embodiments, the receptacle connector of the third embodiment can be produced at a minimum of cost by automatic assembly tooling, as will be apparent from Figures 21 to 23 and the description relating thereto. The contacts 260 can be produced at a very low cost by virtue of their simplified construction and the absence of a requirement for crimped connections in the housing, as described in United States Patent Specification No. 3,850,497. Moreover, the assembly of the contacts to the housing is carried out by inserting all of the strips 260' in a single insertion operation. The forming of the strips 260' after their insertion can also be carried out with simple assembly tooling (not shown) and at a very low production cost.

Although the receptacle connector 202 is intended to be mounted on a printed circuit board with the openings 218 and 240 extending parallel to the surface of the board, it will be apparent that the housing could be adapted to be mounted on the board with these openings extending normally of the surface of the board. For example, extensions could be provided on the rearward end 214 for

supporting that end of the housing above the surface of the board, the tail portions of the contacts being formed so as to extend into openings in the board.

Reference will now be made to Figures 26 to 31. As shown in Figure 26, an electrical plug receptacle connector 403 according to the fourth embodiment of this invention is mounted on a printed circuit board 404 and serves to connect the wire of an eight wire cable 70 connected to a plug connector 68 identical with that described above with reference to the first embodiment, to conductors 90 (Figure 31) on the underside of the board 404. The connector 403 comprises a moulded insulating housing 406 of thermoplastics material, for example a filled nylon, having a plug-receiving end 408, a rearward end 410, and a plug-receiving opening 412 extending into the plug-receiving end 408. The opening 412 has lower and upper (as seen in Figures 27 and 29) internal side walls 414 and 416, and opposed internal end walls 418 and 420. The external surface of the housing 406 comprises lower and upper external side walls 422 and 424, respectively, and external end walls 426 and 428. The end walls 418 and 420 and the side wall 414 extend beyond the internal side wall 416 at the plug-receiving end 408 as shown at 430 in Figure 26, flanges 432 being provided on the end walls 426 and 428 and on the side wall 424. Integral mounting pins 434 which extend from the side wall 422 are dimensioned to be received for mechanical mounting purposes, in openings 488 in the board 404 (see Figures 27, 29, 31). Additionally, stand off bosses 436 are provided on the side wall 422 to support it slightly above the surface of the board 404 when it is mounted thereon.

The connector 403 is mounted adjacent to an edge of the board 404 so that a cover panel 438 engages this edge, when the connector 403 has been engaged in an opening 440 in the panel 438, with the flanges 432 engaging the rearward surface of the panel 438.

A plurality of juxtaposed recesses 442 (best seen in Figure 30) provided in the mating end 408 of the housing 406 between the side walls 416 and 424 merge with spaced grooves 444 in the side wall 414 and with spaced channels 446 in the side wall 424. Adjacent channels 446 are separated by barriers 448, the channels 446 and the barriers 448 extending downwardly, as seen in Figure 29, over the rearward end of the housing 406 to the lower external side wall 422.

As best seen in Figure 29, the upper portion of the opening 412 extends entirely through the housing 406 but a web 449 is provided at the rearward end of the housing 406, which extends between the lower portions of the internal end walls 418 and 420, the channels 446 and the barriers 448 being provided on the external surface of the web 449. Retaining shoulders 476 are provided in the opening 412.

Staggered recesses 450 communicating with the channels 446, are provided in the side wall 424, in the web 449 as shown at 463, and in the lower portion of the rearward end of the housing 406 as shown at 470 (Figure 29). The recesses 450 extend into the barriers 448 on each side of each channel 446.

The housing 406 is provided with spaced parallel electrical contacts 452 each having an elongate intermediate portion 454 extending across the side wall 424 (see Figure 30) and which is bent downwardly at 464, and which has a tail portion 466 extending downwardly across the rearward end 410 of the housing 406. A contact spring portion 458 of each contact 452 extends from a bight 456 disposed in one of the recesses 442 and projects obliquely into the opening 412.

The tail portion 466 of each contact 452 has an extremity 460 projecting beyond the side wall 422 for soldering to a conductor 490 on the board 404. Retaining barbs 463 on the contacts 452 are received in the recesses 450, these barbs being similar to the barbs 62a and 62b described above with reference to the first embodiment.

A central, downwardly (as seen in Figure 26) inclined recess 474, is provided in the internal side wall 414 and extends to the mating end 408 of the housing 406. Spaced shoulders 476 on each side of the recess 474, which shoulders face towards the rearward end 410 of the housing 406, are provided for co-operation with the shoulders 79 (Figure 30) on the latch arm 76 of the plug connector 68.

The conductors 490 of the board 404 extend, as shown in Figure 31, to holes 492 in the board 404, arranged in two rows with the holes of one row staggered with respect to those of the other row. The extremities 460 of the contacts 452 are therefore correspondingly staggered with respect to each other, by making the channels 446 on the rearward end 410 of the housing 406 of different depths; alternate channels 446 being deeper than the remaining channels 446 so that the extremities 460 of the contacts 452 in the deeper channels 446 form one row and the extremities 460 of the contacts 452 in the shallow channels 446 form another row, the extremities 460 of the one row being offset from, and staggered with respect to, the extremities 460 of the other row.

Figure 32 shows a sheet metal blank 494 comprising spaced strips 452' for assembly to housing 406, the blank 494 being shown as being unformed on the right hand side of Figure 32, a short section of the blank as formed, being shown on the left hand side of that Figure. The blank 494 comprises spaced continuous carrier strips 496 and 498 with the strips 452' extending there between. Each strip 452' has a reduced width neck 500 adjacent to the carrier strip 496, which neck 500 is severed from the carrier strip at the time of assembly of the strips 452' to the housing 406. The barbs 463 on the

conductors are relatively staggered as shown in Figure 32.

The formed strips 452' can be assembled to the housing 406 in a similar manner to that described above with reference to the first embodiment. A formed section of the strip 494 having the required number of strips 452' for the housing 406 is severed from the strip 494 and each strip 452' of the severed section is placed in alignment with one of the channels 446 in the external side wall 424 (see Figure 33). The formed section is then moved downwardly (Figure 34) so that the strips 452' enter the channels 446. Thereafter, the carrier strip 498 is severed from the section of the strip 494 and the end portions of the strips 452', which extend beyond the plug-receiving end 408 of the housing 406 are bent downwardly and into the plug-receiving opening 412. The bending of these end portions may be carried out in two steps, namely a first step in which such end portions are bent downwardly so that they extend normally of the intermediate portions of the strips 452' and across the plug-receiving opening 412, and a second step in which said end portions are bent so as to extend obliquely into the opening 412 to form the contact spring portions 458.

After the portions 458 have been so formed, the carrier strip 496 is severed from the strips 452' and the ends thereof which project beyond the rearward end 410 of the housing 406 are bent downwardly, to enter the channels 446 in the rearward end 410. Tooling for carrying out these insertion, bending and severing steps may be of the general type used with the first embodiment.

The receptacle connector 403 is mounted on the board 404 merely by aligning the extremities 460 of the contacts 452 with the holes 492 and aligning the pins 434 with the holes 488 and inserting the pins 434 and the extremities 460 into the respective holes until the bosses 436 abut the surface of the board 404. The extremities 460 can then be soldered to the conductors 490.

Figure 30 shows a connector 403 on the right side of the board 404 and a connector 2 in accordance with the first embodiment, on the left hand side of the board 404. It will be readily apparent that the latch member 76 of the plug connector 68 on the left hand side of the board 404 is readily accessible so that the connector 68 can be removed from the receptacle connector 2 with ease. However, the latch member 76 of the plug connector 68 which is mated with the receptacle connector 403 is on the underside of the body of that connector 68 so that while such connector can, if necessary, be withdrawn from the connector 403, it cannot readily be so withdrawn, for example by a small child.

As shown in Figures 35 to 39, an electrical plug receptacle connector 502, in accordance with the fifth embodiment of the invention,

serves to connect the wires of a six wire cable 70" to conductors 506 (Figure 39) on the underside of a printed circuit board 510, by way of an electrical plug connector 68" identical with the connectors 68 and 68' mentioned above, excepting that it has six contacts 74", instead of four or eight such contacts as in the case of the plug connectors described above. The conductors 506 extend to holes 507 (Figure 39) in the board 510, which receive extremities 556 and 556' of electrical contacts 544 of the connector 502 so that the contacts can be soldered to the conductors 506.

The connector 502 comprises a one-piece moulded insulating housing 518 made for example of a filled nylon, and having a plug-receiving end 520, a rearward end 522, and a plug-receiving opening 524 extending into the plug-receiving end 520. The opening 524 has upper and lower (as seen in Figure 36) internal side walls 526 and 528 and opposed end walls 530 (Figure 38). The housing 518 has upper and lower external side walls 532 and 534 which are proximate to the internal side walls 526 and 528 respectively, and oppositely directed external end walls 536. Mounting feet 538 extending from the lower external side wall 534 are dimensioned to enter spaced holes 540 in the circuit board 510, stand off bosses 542 being provided on the side wall 534 to elevate it above the board 510 when the housing 518 is mounted thereon.

The contacts 544 are contained in and on, the housing 518. As best seen in Figure 40, each contact 544 has a contact spring portion 546 having a free end 566 and extending from a bight 548, an intermediate portion 550 which extends, as seen in Figure 40, back from the bight 548, a further bight 552, and downwardly extending tail portions 554 and 554'. The lower extremities 556 and 556' of the portions 554 and 554' are intended for insertion into the holes 507 of the board 510 and are offset from each other so that they can be received in the holes 507.

The portions 550 are disposed in parallel juxtaposed channels 558 in the upper external side walls 532. The channels 558 extend from the rearward end 522 of the housing 518 to spaced apertures 560 which are adjacent to, but are spaced from, the plug-receiving end 520. The bights 548 of the contacts 544 extend through the apertures 560 and about conforming surfaces of the housing 518, as shown in Figure 36. The internal side wall 526 has spaced recesses 562 dimensioned to receive the contact spring portions 546 of the contacts 544 when the plug connector 68" is mated with the connector 502. Upon insertion of the plug connector 68" into the opening 524, the portions 546 are flexed upwardly as indicated by the arrow "A" in Figure 36 and resiliently engage the exposed contacts 74" of the plug connector 68". The recesses 562 are enlarged at 564 adjacent to the apertures 560, to permit

such flexure.

A plurality of parallel spaced barriers 568 extend downwardly into the opening 524 from the upper side wall 526 adjacent to the rearward end 522, to define stalls which receive the free ends 566 of the contact spring portions 546. Additionally, a backwall 570 extends across the opening 524 as shown in Figure 36, partially enclosing the opening 524 at its rearward end. The barriers 568 render it impossible for a small child to insert a finger into the plug-receiving opening 524 to a point beyond the free ends 566 of the contact spring portions 546 in such a way that when the finger is withdrawn it is impaled on the ends 566. The back wall 570 reinforces the barriers 568 and also serves to prevent shorting circuiting between the contacts 544, as described below.

As will appear from Figures 37, 41 and 45, channels 572 and 572' are provided in the outwardly sloping rearward end of the housing 518 adjacent to the external side wall 532', additional contact-receiving channels 576 and 576' (Figure 41) being provided in the rearward end of the housing 518 adjacent to the lower external side wall 534. The channels 576' are deeper than the channels 576.

The contacts 544 extend from the upper external side wall 532 into the channels 572 and 572' and downwardly beyond the lower external side wall 534. The downwardly extending portions of the contacts 544 are spread apart in two senses, the centre-to-centre spacing between the contacts 544 (x in Figure 40) is increased and additionally the extremities 556 are offset from the extremities 556' to enable all these extremities to be received in the holes 507 which are arranged according to triangular patterns. The deeper channels 576' receive the portions 554' which extend across the rearward surface of the wall 570 while the portions 554 extend outwardly from the wall 570 in the shallower channels 576. Retaining barbs 578 (Figure 42) on the contacts 544 adjacent to their extremities 556 and 556' are received in recesses in the side walls of the channels 576 and 576' to retain the contacts 544 in the channels 576 and 576'. The lances 578 are not shown in Figure 40.

The centre-to-centre spacing of the contact spring portion 546 in the connector 502 are required, according to current specifications, to be 0.04" (the spacing in Figure 40). This spacing of the contacts and thus of the holes 507 is close enough to give rise to dielectric problems in the absence of measures being taken to avoid this. The provision of the channels 576 and 576' on centres x , which is greater than the spacing y , overcomes this problem and improved dielectric characteristics are achieved when the connector 502 is put to use. As mentioned above, the back wall 570 prevents short circuiting between the contacts 544, in that the ends 566 are separated by an insulating wall from the portions 554 and 554'.

of the contacts 544. In the absence of the wall 570, the insertion of a mis-dimensioned plug connector might cause the end 566 of a contact 544 to be pushed against the portion 554 or 554' of an adjacent contact 544.

The plug-receiving end 520 of the housing 518 has a continuous frame 580 surrounding the plug-receiving opening 524, a continuous flange 582 extending from the frame 580. When the connector 502 is mounted as shown in Figure 35, on the board 510, a cover panel 594 can be located against the forward edge of the board 510, with the frame 580 received in a rectangular opening 596 in the panel 594, the flange 582 hiding the edges of opening 596.

The opening 524 has an upwardly inclined ramp 590 at its mating end, which extends to spaced shoulders 592 which co-operate with the shoulders of the latch arm 76" of the plug connector 68" to retain it in the opening 524.

In the manufacture of the receptacle connector 502, the contacts 544 are produced from a continuous blank strip 601, as shown in Figure 42, by stamping the strip 601, as shown in Figure 42, by stamping the strip 601 and forming it as shown. The barbs 578 on individual strips 603 from which the contacts 544 and 544' are to be formed, are offset from each other in view of the close spacing of the contacts in the housing 518, and additional barbs 579 are provided to secure the portions 550 of the contacts in the channels 558. The strip 601 comprises a carrier strip 598 at its edge nearest to the lances 578 and a narrower carrier strip 600 at its opposite edge.

The contacts are assembled to the housing 518, as shown in Figures 43 and 44, after first removing the carrier strip 600 from a section of the strips 601, forming a right angle bend 548' therein, and positioning the section of the strip 601 above the housing 518, as shown in Figure 43, with the downwardly (as seen in Figure 43) extending portions 546' of the strip 601 each in alignment with one of the apertures 560.

The section of the strip 601 is then moved downwardly to the position of Figure 44 so that the portions 550 of the contacts to be formed lie in the channels 558. At this stage, the free ends of the portion 546' are adjacent to the shoulders 592, the opening 524 being dimensioned so that there is sufficient clearance between the side wall 528 and the free ends of the portions 546'. The contact spring portions 546 of the contacts 544 and 544' can then be formed by bending the portions 546' inwardly by means of a gauge tool (not shown). The portions of the strip 603 which extend to the left (as seen in Figure 44) are moved downwardly and are moved laterally by varying amounts to position them in the respective channels 572, 572', 576 and 576' in the rearward end of the housing 518, the carrier strip 598 being removed before this final step is carried out.

Another advantage of this embodiment is

that the apertures 560 are spaced from the plug-receiving end 520 of the housing 518 by a distance which is greater than the corresponding distance in the case of the other embodiments, whereby the contact spring portions of the contacts are shorter, than in the other embodiments. Since these shorter contact spring portions are stiffer, the contacts may be made of a thinner gauge material without sacrifice of contact force.

A further advantage of this embodiment is that notwithstanding the fact that the extremities 556 of the contacts are offset from the extremities 556' thereof, the contacts themselves can all be of the same length as shown in Figure 42. In the present embodiment, the slope of the portions 554 of the contacts 544 is relatively gentle, the extremities 556 of the contacts not being located in the same planes as the lower extremities 556'. The extremities 556 are, in practice, slightly above the extremities 556'. Such difference in level is, however, very slight and all the extremities 556 and 556' extend below the underside of the board 510 so that they can be soldered to the conductors 506 thereon.

According to a modification of the present embodiment, the blank for producing the contacts may be of the same general shape as the blank shown in Figure 21, the housing being suitably modified to accommodate the divergent portions of the contacts.

Claims

1. A method of manufacturing an electrical plug receptacle connector (2, 202, 403 or 502) comprising an insulating housing (6, 212, 406 or 518) having a plug-receiving end (8, 216, 408 or 520) and a rearward end (10, 214, 410 or 522), a plug-receiving opening (12, 218, 412 or 524) extending into said plug-receiving end, such opening having opposed internal side walls (14 and 16, or 220 and 222, or 414 and 416, or 526 and 528) and opposed internal end walls (26 and 28, or 232 and 234, or 426 and 428, or 536), the housing having opposed external side walls (22 and 24, or 228 and 230, or 422 and 424, or 532 and 534) and opposed external end walls (26 and 28, or 232 and 234, or 426 and 428, or 536), a plurality of electrical contacts (52, 260, 452 or 544) being arranged in juxtaposed spaced relationship, with an intermediate portion (54, 262, 454 or 550) of each contact (52, 260, 452 or 544) received in a channel extending from adjacent the plug-receiving end (8, 216, 408 or 520) of the housing towards the rearward end (10, 214, 410 or 522) thereof and between the one external side wall and the adjacent internal side wall, each contact (52, 260, 452 or 544) comprising a contact spring portion (58, 268, 458 or 546) which has been bent so as to extend around an edge portion of the housing (6, 212, 406 or 518) disposed between the

of the contacts 544. In the absence of the wall 570, the insertion of a mis-dimensioned plug connector might cause the end 566 of a contact 544 to be pushed against the portion 554 or 554' of an adjacent contact 544.

The plug-receiving end 520 of the housing 518 has a continuous frame 580 surrounding the plug-receiving opening 524, a continuous flange 582 extending from the frame 580. When the connector 502 is mounted as shown in Figure 35, on the board 510, a cover panel 594 can be located against the forward edge of the board 510, with the frame 580 received in a rectangular opening 596 in the panel 594, the flange 582 hiding the edges of opening 596.

The opening 524 has an upwardly inclined ramp 590 at its mating end, which extends to spaced shoulders 592 which co-operate with the shoulders of the latch arm 76" of the plug connector 68" to retain it in the opening 524.

In the manufacture of the receptacle connector 502, the contacts 544 are produced from a continuous blank strip 601, as shown in Figure 42, by stamping the strip 601, as shown in Figure 42, by stamping the strip 601 and forming it as shown. The barbs 578 on individual strips 603 from which the contacts 544 and 544' are to be formed, are offset from each other in view of the close spacing of the contacts in the housing 518, and additional barbs 579 are provided to secure the portions 550 of the contacts in the channels 558. The strip 601 comprises a carrier strip 598 at its edge nearest to the lances 578 and a narrower carrier strip 600 at its opposite edge.

The contacts are assembled to the housing 518, as shown in Figures 43 and 44, after first removing the carrier strip 600 from a section of the strips 601, forming a right angle bend 548' therein, and positioning the section of the strip 601 above the housing 518, as shown in Figure 43, with the downwardly (as seen in Figure 43) extending portions 546' of the strip 601 each in alignment with one of the apertures 560.

The section of the strip 601 is then moved downwardly to the position of Figure 44 so that the portions 550 of the contacts to be formed lie in the channels 558. At this stage, the free ends of the portion 546' are adjacent to the shoulders 592, the opening 524 being dimensioned so that there is sufficient clearance between the side wall 528 and the free ends of the portions 546'. The contact spring portions 546 of the contacts 544 and 544' can then be formed by bending the portions 546' inwardly by means of a gauge tool (not shown). The portions of the strip 603 which extend to the left (as seen in Figure 44) are moved downwardly and are moved laterally by varying amounts to position them in the respective channels 572, 572', 576 and 576' in the rearward end of the housing 518, the carrier strip 598 being removed before this final step is carried out.

Another advantage of this embodiment is

that the apertures 560 are spaced from the plug-receiving end 520 of the housing 518 by a distance which is greater than the corresponding distance in the case of the other embodiments, whereby the contact spring portions of the contacts are shorter, than in the other embodiments. Since these shorter contact spring portions are stiffer, the contacts may be made of a thinner gauge material without sacrifice of contact force.

A further advantage of this embodiment is that notwithstanding the fact that the extremities 556 of the contacts are offset from the extremities 556' thereof, the contacts themselves can all be of the same length as shown in Figure 42. In the present embodiment, the slope of the portions 554 of the contacts 544 is relatively gentle, the extremities 556 of the contacts not being located in the same planes as the lower extremities 556'. The extremities 556 are, in practice, slightly above the extremities 556'. Such difference in level is, however, very slight and all the extremities 556 and 556' extend below the underside of the board 510 so that they can be soldered to the conductors 506 thereon.

According to a modification of the present embodiment, the blank for producing the contacts may be of the same general shape as the blank shown in Figure 21, the housing being suitably modified to accommodate the divergent portions of the contacts.

Claims

1. A method of manufacturing an electrical plug receptacle connector (2, 202, 403 or 502) comprising an insulating housing (6, 212, 406 or 518) having a plug-receiving end (8, 216, 408 or 520) and a rearward end (10, 214, 410 or 522), a plug-receiving opening (12, 218, 412 or 524) extending into said plug-receiving end, such opening having opposed internal side walls (14 and 16, or 220 and 222, or 414 and 416, or 526 and 528) and opposed internal end walls (26 and 28, or 232 and 234, or 426 and 428, or 536), the housing having opposed external side walls (22 and 24, or 228 and 230, or 422 and 424, or 532 and 534) and opposed external end walls (26 and 28, or 232 and 234, or 426 and 428, or 536), a plurality of electrical contacts (52, 260, 452 or 544) being arranged in juxtaposed spaced relationship, with an intermediate portion (54, 262, 454 or 550) of each contact (52, 260, 452 or 544) received in a channel extending from adjacent the plug-receiving end (8, 216, 408 or 520) of the housing towards the rearward end (10, 214, 410 or 522) thereof and between the one external side wall and the adjacent internal side wall, each contact (52, 260, 452 or 544) comprising a contact spring portion (58, 268, 458 or 546) which has been bent so as to extend around an edge portion of the housing (6, 212, 406 or 518) disposed between the



one internal side wall (16, 222, 414 or 526) and the adjacent external side wall (24, 230, 424 or 532) and being located adjacent to the plug-receiving end (8, 216, 408 or 520), whereby the contact spring portion extends from one (16, 222, 414 or 526) of the internal side walls at a position adjacent to the plug-receiving end, obliquely into the opening 12, 218, 412 or 524) and towards the opposite internal side wall (14, 220, 416 or 528), the plug-receiving opening (12, 218, 412 or 524) being dimensioned to receive an electrical plug connector (68, 68' or 68'') having spaced contact members (74, 74' or 74'') therein for engaging the contact spring portions (58, 268, 458 or 546) of the contacts of the receptacle connector (2, 202, 403 or 502); each contact (52, 260, 452 or 454) being in the form of a single elongate metal strip having a lateral projection (62a, 278, 463 or 578) by means of which the contact may be retained in assembled relationship with the housing (6, 212, 406 or 518), and a tail portion (60a, 272, 466 or 554) of the contact which may project from the intermediate portion, outwardly of the housing; the method being characterised by the steps of arranging a series of elongate metal strips (52a', 260', 452' or 603) connected together in juxtaposed relationship and from which the contacts (52, 260, 452 or 454) are to be formed, so that an intermediate portion (54, 262, 454 or 550) of each strip is disposed in said channel (46, 240, 442 or 576) with one end portion of each strip projecting beyond the plug-receiving end (8, 216, 408 or 520) of the housing and the opposite end portion of each strip projecting beyond the rearward end (10, 214, 410 or 522) of the housing, employing tooling to bend, in co-operation with said edge portion, the one end portion of each strip back from the plug-receiving end (8, 216, 408 or 520) of the housing to cause such one end portion to extend obliquely into the plug-receiving opening (12, 218, 412 or 524), and to bend the opposite end portion of the strip so that at least an extremity (53 or 53c, or 281 or 460 or 556) of such portion projects outwardly of the housing (6, 212, 406 or 518), the method also including the steps of severing the connections between the metal strips and producing an interference mechanical connection between said lateral projection (62a, 278, 463 or 578) on each strip, and the housing, to retain the strips 52a', 260', 452' or 603) in assembled relationship to the housing.

2. A receptacle connector which has been manufactured by means of the method claimed in Claim 1, characterised in that each contact (52, 452 or 544) is received in one of a plurality of juxtaposed channels (46a, 446 or 572) in the adjacent external side wall (24, 424 or 532), the lateral projections comprising barbs (62a, 463 or 579) on the intermediate portion (54, 454 or 550) of each of the contacts (52, 454 or 544), the barbs extending into the walls of the

channels 46a, 446 or 572), and the barbs on each contact being offset with respect to the barbs (46b, 446 or 572) on the adjacent contacts, in the direction from the plug-receiving end (8, 408 or 520) towards the rearward end (10, 410 or 522), of the housing.

3. A receptacle connector which has been manufactured by means of the method claimed in Claim 1, characterised in that the housing (212) has a single contact-receiving channel (240) extending there through from adjacent the rearward end (214) to adjacent the plug-receiving end (216), the channel (240) being defined between the one internal side wall (222) and the adjacent external side wall (230), and being of a width sufficient to receive the intermediate portions (262) of the contacts (260) in juxtaposed coplanar relationship, the contacts (260) being stamped and formed from sheet metal, contact positioning and retaining means (256) being provided at the rearward end of the adjacent external side wall (230), and being effective to secure said tail portions (272) of the contacts (260) against lateral movement towards each other, whereby, the intermediate portions (262), the contact spring portions (268), and the tail portions (272) of the contacts (260) are maintained in spaced relationship at predetermined positions in the contact receiving channel (240) and the plug-receiving opening (218).

4. A receptacle connector which has been manufactured by means of the method claimed in Claim 1, characterised in that the rearward end (410) of the housing (406) has a plurality of juxtaposed contact-receiving channels (446) therein, the channels (446) in such rearward end (410) being in alignment with the channels (446) in the adjacent external side wall (424), each contact 452 comprising a single elongate strip of stamped and formed sheet metal, the intermediate portion (454) of each contact (452) being disposed in one of the channels (446) in the adjacent external side wall (424), the contact (452) having been bent at the rearward end (410) of the housing (412) and extending across such rearward end (410) in one of the channels (446) in the rearward end (410).

5. A receptacle connector which has been manufactured by means of the method claimed in Claim 1, characterised by a plurality of spaced barriers (568) extending from one of the internal side walls (526) at a location adjacent to the rearward end (522) of the housing (518) towards the opposite internal side wall (528), the contact spring portions (546) of the contacts (544) having free end portions (566), each positioned between an adjacent pair of the barriers (568).

6. receptacle connector according to Claim 5, characterised by a back wall (570) at the rearward end (522) of the housing (518), extending from one of the internal side wall (526) towards the opposite internal side wall



(528), the contacts (544) extending from the adjacent external side wall (532) across the back wall (570) and beyond the other external side wall (534) in mutually staggered relationship.

7. An electrical plug receptacle connector (2, 403 or 502) comprising an insulating housing (6, 406 or 518) having a plug-receiving end (8, 408 or 520) and a rearward end (10, 410 or 522), a plug-receiving opening (12, 412 or 524) extending into the plug-receiving end, such opening having opposed internal side walls (14 and 16, or 414 and 416, or 526 or 528) and opposed internal end walls (18 and 20, or 418 and 420, or 530), the housing having opposed external side walls (22 and 24, or 422 and 424, or 532 and 534) and opposed external end walls (26 and 28, or 426 and 428, or 536), a plurality of electrical contacts (52, 452 or 544) being arranged in juxtaposed spaced relationship, each comprising a contact spring portion (58, 458 or 546) which has been bent so as to extend around an edge portion of the housing (6, 406 or 518) disposed between the one external side wall (16, 414 or 526) and the adjacent external side wall (24, 424 or 532) and being located adjacent to the plug-receiving end (8, 408 or 520), whereby the contact spring portion extends from one (16, 414 or 526) of the internal side walls at a position adjacent to the plug-receiving end, obliquely into the opening (12, 412 or 524) and towards the opposite internal side wall (14, 416 or 528), and each contact having an intermediate portion (54, 454 or 550) extending from adjacent the plug-receiving end through an individual contact-receiving channel (46, 442 and 576) in the housing, each such channel extending between the one internal side wall (16, 414 or 526) and the adjacent external side wall (24, 424 or 532), in the same direction as these side walls, and towards the rearward end of the housing, the plug-receiving opening (12, 412 or 524) being dimensioned to receive an electrical plug connector (68, 68' or 68'') having spaced contact members (74, 74' or 74'') therein for engaging the contact spring portions (58, 458, or 546) of the contacts of the receptacle connector (2, 403 or 502); characterised in that the contact-receiving channels (46, 442 and 576) are formed in the adjacent external side wall (24, 424 or 532) and are open lengthwise thereof for receiving the contacts, each of the contacts (52, 452 or 544) having been formed from a single elongate, flat strip of metal 52a' 452' or 603), an intermediate portion (54, 454 or 550) of such strip being disposed in said contact-receiving channel (46, 442 and 576), a portion (58, 458 or 546) of the strip extending from one end of the intermediate portion having been bent back in co-operation with said edge portion of the housing adjacent the plug-receiving end (8, 408 or 526), to provide the contact spring portion (58, 458 or 546), a tail portion (60a, 466 or 554) of each

strip extending from the other end of the intermediate portion (54, 454 or 550) and beyond the housing, barbs (62a, 463 or 578) extending laterally from the contacts (52, 452 or 544) projecting into the side walls of the channels (46, 442 and 576) to maintain the contacts in assembled relationship to the housing, and the barbs on each contact being offset with respect to the barbs (46b, 446 or 572) on the next adjacent contacts, in the direction from the plug-receiving end (8, 408 or 520) towards the rearward end (10, 410 or 522) of the housing.

8. A receptacle connector according to Claim 7, characterised in that the connector (2) is adapted to be mounted on a printed circuit board (4), the housing (6) having projecting from the adjacent external side wall (24), locating pins (34) for reception in openings (80) in the board (4) and latch arms (36) for reception in notches (78) in an edge of the board (4), the tail portion (60a) of each of contact (52) projecting laterally of the housing (6) in mutually staggered relationship.

9. A receptacle connector according to Claim 7, characterised in that the rearward end (410) of the housing (406) has a plurality of juxtaposed contact-receiving channels (446) therein, the channels (446) in such rearward end (410) constituting extensions of the channels (446) in the adjacent external side wall (424), each contact (452) having been bent at the rearward end (410) of the housing (412) and extending across such rearward end (410) in one of the channels (446) in the rearward end (410), staggered recesses (450) being provided in the walls of the channels (446) in the adjacent external side wall (424) and in the rearward end (410) for receiving the barbs (463) on the contacts (452).

10. A receptacle connector according to Claim 7, characterised by a back wall (570) at the rearward end (522) of the housing (518) extending from one of the internal side wall (526) towards the opposite internal side wall (528), the contacts (544) extending from the adjacent external side wall (532) across the back wall (570) and beyond the other external side wall (534), the rearward end of the housing (518) being formed with further channels (576 and 576') which are of different depths and which receive portions (554 and 554') of the contacts (544) adjacent to the tail portions (566) thereof, whereby these tail portions (566) are offset from one another in two directions, for reception in holes (507) on a printed circuit board (510), which holes (507) are arranged according to triangular patterns.

Patentansprüche

1. Verfahren zum Herstellen eines elektrischen Steckeraufnahmeverbinders (2, 202, 403 oder 502) mit einem Isoliergehäuse (6, 212, 406 oder 518), welches ein Steckeraufnahmeende (8, 216, 408 oder 520) und ein



hinteres Ende (10, 214, 410 oder 522) hat, wobei sich in das Steckeraufnahmeende eine Steckeraufnahmeöffnung (12, 218, 412 oder 524) erstreckt, die einander gegenüberliegende innere Seitenwände (14 und 16 oder 220 und 222 oder 414 und 416 oder 526 und 528) und einander gegenüberliegende innere Stirnwände (26 und 28 oder 232 und 234 oder 426 und 428 oder 536) hat, wobei das Gehäuse einander gegenüberliegende äußere Seitenwände (22 und 24 oder 228 und 230 oder 422 und 424 oder 532 und 534) und einander gegenüberliegende äußere Stirnwände (26 und 28 oder 232 und 234 oder 426 und 428 oder 536) hat, einer Vielzahl von elektrischen Kontakten (52, 260, 452 oder 544), die nebeneinanderliegend in Abständen voneinander angeordnet sind, wobei ein Zwischenbereich (54, 262, 454 oder 550) jedes Kontaktes (52, 260, 452 oder 544) in einem Kanal aufgenommen ist, der sich aus der Nähe des Steckeraufnahmeendes (8, 216, 408 oder 520) des Gehäuses zum hinteren Ende (10, 214, 410 oder 522) desselben und zwischen der einen äußeren Seitenwand und der benachbarten inneren Seitenwand erstreckt, wobei jeder Kontakt (52, 260, 452 oder 544) einen Kontaktfederbereich (58, 268, 458 oder 546) aufweist, der so gebogen ist, daß er sich um einer Kantenbereich des Gehäuses (6, 212, 406 oder 518) erstreckt, welcher zwischen der einen inneren Seitenwand (16, 222, 414 oder 526) und der benachbarten äußeren Seitenwand (24, 230, 424 oder 532) angeordnet ist und in der Nähe des Steckeraufnahmeendes (8, 216, 408 oder 520) vorgesehen ist, wodurch sich der Kontaktfederbereich von einer (16, 222, 414 oder 526) der inneren Seitenwände an einer Stelle in der Nähe des Steckeraufnahmeendes weg geneigt in die Öffnung (12, 218, 412 oder 524) und zu der gegenüberliegenden inneren Seitenwand (14, 220, 416 oder 528) erstreckt, wobei die Steckeraufnahmeöffnung (12, 218, 412 oder 524) so bemessen ist, daß sie einen elektrischen Steckverbinder (68, 68' oder 68'') aufnimmt, in welchem im Abstand voneinander angeordnete Kontaktglieder (74, 74' oder 74'') zum Eingriff mit den Kontaktfederbereichen (58, 268, 458 oder 546) der Kontakte des Aufnahmeverbinders (2, 202, 403 oder 502) vorhanden sind, wobei jeder Kontakt (52, 260, 452 oder 545) in Form eines einzigen langgestreckten Metallstreifens vorliegt, der einen seitlichen Vorsprung (62a, 278, 463 oder 578) hat, mittels dem der Kontakt mit dem Gehäuse (6, 212, 406 oder 518) zusammengesetzt gehalten werden kann, und einen Schwanzbereich (60a, 272, 466 oder 554) des Kontaktes, der vom Zwischenbereich außerhalb des Gehäuses vorstehen kann, wobei das Verfahren gekennzeichnet ist durch die Schritte, daß eine Serie von langgestreckten Metallstreifen (52a', 260', 452' oder 603), die nebeneinanderliegend miteinander verbunden sind und aus denen die Kontakte (52, 260, 452 oder

454) geformt werden sollen, so angeordnet wird, daß ein Zwischenbereich (54, 262, 454 oder 550) jedes Streifens in dem Kanal (46, 240, 442 oder 576) angeordnet wird, wobei ein Endbereich jedes Streifens über das Steckeraufnahmeende (8, 216, 408 oder 520) des Gehäuses vorsteht und der entgegengesetzte Endbereich jedes Streifens über das hintere Ende (10, 214, 410 oder 522) des Gehäuses vorsteht, daß eine Werkzeugeinrichtung benutzt wird, um im Zusammenwirken mit dem Kantenbereich den einen Endbereich jedes Streifens von dem Steckeraufnahmeende (8, 216, 408 oder 520) des Gehäuses zurückzubiegen, um zu bewirken, daß sich dieser eine Endbereich geneigt in die Steckeraufnahmeöffnung (12, 218, 412 oder 524) erstreckt, und den entgegengesetzten Endbereich des Streifens so zu biegen, daß mindestens ein äußerstes Ende (53 oder 53c oder 281 oder 460 oder 556) dieses Bereichs aus dem Gehäuse (6, 212, 406 oder 518) vorsteht, und daß zu dem Verfahren auch die Schritte des Trennens der Verbindungen zwischen den Metallstreifen und der Schaffung einer mechanischen Eingriffverbindung zwischen den Metallstreifen und der Schaffung einer mechanischen Eingriffverbindung Gehäuse gehören, um die Streifen (52a', 260', 452' oder 603) mit dem Gehäuse zusammengesetzt zu halten.

2. Ein nach dem Verfahren gemäß Anspruch 1 hergestellter Aufnahmeverbinder, dadurch gekennzeichnet, daß jeder Kontakt (52, 452 oder 544) in einem von mehreren nebeneinanderliegenden Kanälen (46a, 446 oder 572) in der benachbarten äußeren Seitenwand (24, 424 oder 532) aufgenommen ist, daß die seitlichen Vorsprünge Stachel (62a, 463 oder 579) am Zwischenbereich (54, 454 oder 550) jedes der Kontakte (52, 454 oder 544) haben, die sich in die Wände der Kanäle (46a, 446 oder 572) erstrecken, wobei die Stachel an jedem Kontakt gegenüber den Stacheln (46b, 446 oder 572) an den benachbarten Kontakten in Richtung vom Steckeraufnahmeende (8, 408 oder 520) zum hinteren Ende (10, 410 oder 522) des Gehäuses versetzt sind.

3. Nach dem Verfahren gemäß Anspruch 1 hergestellter Aufnahmeverbinder, dadurch gekennzeichnet, daß das Gehäuse (212) einen einzigen Kontaktaufnahmekanal (240) hat, der sich durch das Gehäuse aus der Nähe des hinteren Endes (214) desselben bis in die Nähe des Steckeraufnahmeendes (216) erstreckt, wobei der Kanal (240) zwischen der einen inneren Seitenwand (222) und der benachbarten äußeren Seitenwand (230) begrenzt ist und eine Breite hat, die ausreicht, um die Zwischenbereiche (262) der Kontakte (260) nebeneinanderliegend in der gleichen Ebene aufzunehmen, wobei die Kontakte (260) aus Metallblech ausgestanzt und geformt sind und Einrichtungen (256) zur Lagebestimmung und zum Halten der Kontakte am hinteren Ende der benachbarten äußeren Seitenwand (230)



vorgesehen sind, die bewirken, daß die Schwanzbereiche (272) der Kontakte (260) gegen eine seitliche Bewegung zueinander gesichert sind, wodurch die Zwischenbereiche (262), die Kontaktfederbereiche (268) und die Schwanzbereiche (272) der Kontakte (260) in vorherbestimmten Stellungen in Abständen voneinander in dem Kontaktaufnahmekanal (240) und der Steckeraufnahmeöffnung (218) gehalten sind.

4. Ein nach dem Verfahren gemäß Anspruch 1 hergestellter Aufnahmeverbinder, dadurch gekennzeichnet, daß im hinteren Ende (410) des Gehäuses (406) mehrere nebeneinanderliegende Kontaktaufnahmekanäle (446) vorgesehen sind, wobei die Kanäle (446) in diesem hinteren Ende (410) mit den Kanäle (446) in der benachbarten äußeren Seitenwand (424) ausgerichtet sind, jeder Kontakt (452) einen einzigen langgestreckten Streifen aus gestanztem und geformtem Metallblech aufweist, der Zwischenbereich (454) jedes Kontaktes (452) in einem der Kanäle (446) in der benachbarten äußeren Seitenwand (424) angeordnet ist, der Kontakt (452) am hinteren Ende (410) des Gehäuses (412) gebogen ist und sich quer über das hintere Ende (410) in einem der Kanäle (446) in dem hinteren Ende (410) erstreckt.

5. Eine nach dem Verfahren gemäß Anspruch 1 hergestellter Aufnahmeverbinder, gekennzeichnet durch mehrere in Abständen voneinander vorgesehene Stege (568), die sich von einer der inneren Seitenwände (526) an einer Stelle in der Nähe des hinteren Endes (522) des Gehäuses (518) zur gegenüberliegenden inneren Seitenwand (528) erstrecken, wobei die Kontaktfederbereiche (546) der Kontakte (544) freie Endbereiche (566) haben, die jeweils zwischen einem benachbarten Paar der Stege (568) angeordnet sind.

6. Ein Aufnahmeverbinder gemäß Anspruch 5, gekennzeichnet durch eine Rückwand (570) am hinteren Ende (522) des Gehäuses (518), die sich von einer der inneren Seitenwände (526) zur gegenüberliegenden inneren Seitenwand (528) erstreckt, wobei die Kontakte (544) sich von der benachbarten äußeren Seitenwand (532) quer über die Rückwand (570) und über die andere äußere Seitenwand (534) hinaus in im Verhältnis zueinander versetzter Anordnung erstrecken.

7. Ein elektrischer Steckeraufnahmeverbinder (2, 403 oder 502) mit einem Isoliergehäuse (6, 406 oder 518), welches ein Steckeraufnahmeende (8, 408 oder 520) und ein hinteres Ende (10, 410 oder 522) hat, wobei sich eine Steckeraufnahmeöffnung (12, 412 oder 524) in das Steckeraufnahmeende erstreckt, die einander gegenüberliegende innere Seitenwände (14 und 16 oder 414 und 416 oder 526 und 528) und einander gegenüberliegende innere Stirnwände (18 und 20 oder 418 und 420 oder 530) hat, wobei das Gehäuse einander gegenüberliegende äußere

Seitenwände (22 und 24 oder 422 und 424 oder 532 und 534) und einander gegenüberliegende äußere Stirnwände (26 und 28 oder 426 und 428 oder 536) hat, eine Vielzahl von elektrischen Kontakten (52, 452 oder 544) nebeneinanderliegend in Abständen voneinander angeordnet ist, die jeweils einen Kontaktfederbereich (58, 458 oder 546) aufweisen, der so gebogen ist, daß er sich um einen Kantenbereich des Gehäuses (6, 406 oder 518) erstreckt, der zwischen einer äußeren Seitenwand (16, 414 oder 526) und der benachbarten äußeren Seitenwand (24, 424 oder 532) liegt und in der Nähe des Steckeraufnahmeendes (8, 408 oder 52) angeordnet ist, wodurch sich der Kontaktfederbereich von einer (16, 414 oder 526) der inneren Seitenwände an einer Stelle in der Nähe des Steckeraufnahmeendes geneigt in die Öffnung (12, 412 oder 524) und in Richtung zur gegenüberliegenden inneren Seitenwand (14, 416 oder 528) erstreckt und jeder Kontakt einen Zwischenbereich (54, 454 oder 550) hat, der sich aus der Nähe des Steckeraufnahmeendes durch einen individuellen Kontaktaufnahmekanal (46, 442 und 576) im Gehäuse erstreckt, wobei sich jeder Kanal zwischen der einen inneren Seitenwand (16, 414 oder 526) und der benachbarten äußeren Seitenwand (24, 424 oder 532) in der gleichen Richtung wie diese Seitenwände und zum hinteren Ende des Gehäuses erstreckt, die Steckeraufnahmeöffnung (12, 412 oder 524) zur Aufnahme eines elektrischen Steckverbinders (68, 68' oder 68'') bemessen ist, in welchem in Abständen voneinander angeordnete Kontaktglieder (74, 74' oder 74'') zum Eingriff mit den Kontaktfederbereichen (58, 458 oder 546) der Kontakte des Aufnahmeverbinders (2, 403 oder 502) vorgesehen sind, dadurch gekennzeichnet, daß die Kontaktaufnahmekanäle (46, 442 und 576) in der benachbarten äußeren Seitenwand (24, 424 oder 532) ausgebildet und in Längsrichtung derselben zur Aufnahme der Kontakte geöffnet sind, wobei jeder der Kontakte (52, 452 oder 544) aus einem einzigen langgestreckten flachen Metallstreifen (52a', 452' oder 603) geformt ist, ein Zwischenbereich (54, 454 oder 550) jenes Streifens in dem Kontaktaufnahmekanal (46, 442 und 576) angeordnet ist, ein Bereich (58, 458 oder 546) des Streifens, der sich von einem Ende des Zwischenbereichs erstreckt, in Zusammenwirken mit dem Kantenbereich des Gehäuses in der Nähe des Steckeraufnahmeendes (8, 408 oder 526) zurückgebogen ist, um den Kontaktfederbereich (58, 458 oder 546) zu schaffen, ein Schwanzbereich (60a, 466 oder 544) jedes Streifens sich vom anderen Ende des Zwischenbereichs (54, 454 oder 550) und über das Gehäuse hinaus erstreckt, Stachel (62a, 463 oder 578), die sich seitlich von den Kontakten (52, 452 oder 544) erstrecken, in die Seitenwände der Kanäle (46, 442 und 576) ragen, um die Kontakte mit dem Gehäuse zusammen-



gesetzt zu halten, und die Stachel an jedem Kontakt gegenüber den Stacheln (46b, 446 oder 572) an den unmittelbar benachbarten Kontakten in Richtung vom Stecker-aufnahmeende (8, 408 oder 520) zum hinteren Ende (10, 410 oder 522) des Gehäuses versetzt sind.

8. Ein Aufnahmeverbinder gemäß Anspruch 7, dadurch gekennzeichnet, daß der Verbinder (2) geeignet ist, an einer gedruckten Schaltungstafel (4) angebracht zu werden, wobei das Gehäuse (6) von der Benachbarten äußeren Seitenwand (24) vorstehende, der Lagebestimmung dienende Stifte (34) zur Aufnahme in Öffnungen (80) in der Tafel (4) und Einrastarme (36) zur Aufnahme in Kerben (78) in einer Kante der Tafel (4) hat, der Schwanzbereich (60a) jedes der Kontakte (52) seitlich vom Gehäuse (6) in im Verhältnis zueinander versetztem Verhältnis vorsteht.

9. Ein Aufnahmeverbinder gemäß Anspruch 7, dadurch gekennzeichnet, daß in hinteren Ende (410) des Gehäuses (406) mehrere nebeneinanderliegende Kontaktaufnahmekanäle (446) angeordnet sind, wobei die Kanäle (446) im hinteren Ende (410) Verlängerungen der Kanäle (446) in der benachbarten äußeren Seitenwand (424) darstellen, jeder Kontakt (452) am hinteren Ende (410) des Gehäuses (412) gebogen ist und sich quer über das hintere Ende (410) in einem der Kanäle (446) im hinteren Ende (410) erstreckt, wobei versetzte Ausnehmungen (450) in den Wänden der Kanäle (446) in der benachbarten äußeren Seitenwand (424) und im hinteren Ende (410) vorgesehen sind, die die Stachel (463) an den Kontakten (452) aufnehmen.

10. Ein Aufnahmeverbinder nach Anspruch 7, gekennzeichnet durch eine Rückwand (570) am hinteren Ende (522) des Gehäuses (518), die sich von einer der inneren Seitenwände (526) zur gegenüberliegenden inneren Seitenwand (528) erstreckt, wobei die Kontakte (544) sich von der benachbarten äußeren Seitenwand (532) quer über die Rückwand (570) und über die andere äußere Seitenwand (534) hinausrecken, im hinteren Ende des Gehäuses (518) weitere Kanäle (576 und 576') ausgebildet sind, die unterschiedliche Tiefen haben und den Schwanzbereichen (566) benachbarte Bereiche (554 und 554') der Kontakte (544) aufnehmen, wodurch diese Schwanzbereiche (566) in zwei Richtungen im Verhältnis zueinander versetzt sind, um in Löchern (507) an einer gedruckten Schaltungstafel (510) aufgenommen zu werden, die in dreieckigen Mustern angeordnet sind.

Revendications

1. Procédé de fabrication d'un connecteur femelle pour fiche électrique (2, 202, 403 ou 502) comprenant un boîtier isolant (6, 212, 406 ou 518) ayant une extrémité de réception d'une fiche (8, 216, 408 ou 520) et une extrémité

arrière (10, 214, 410 ou 522), une ouverture de réception d'une fiche (12, 218, 412 ou 524) pénétrant dans ladite extrémité de réception d'une fiche, cette ouverture ayant des parois latérales internes opposées (14 et 16, ou 220 et 222, ou 414 et 416, ou 526 et 528) et des parois extrêmes internes opposées (26 et 28, ou 232 et 234, ou 426 et 428, ou 536), le boîtier ayant des parois latérales externes opposées (22 et 24, ou 228 et 230, ou 422 et 424, ou 532 et 534) et des parois extrêmes externes opposées (26 et 28, ou 232 et 234, ou 426 et 428, ou 536), plusieurs contacts électriques (52, 260, 452 ou 544) ayant des positions juxtaposées et espacées, une partie intermédiaire (54, 262, 454 ou 550) de chaque contact (52, 260, 452 ou 544) étant logée dans une rainure qui s'étend à partir de l'extrémité adjacente de réception d'une fiche (8, 216, 408 ou 520) du boîtier vers l'extrémité arrière (10, 214, 410 ou 522) de celui-ci et entre une première paroi latérale externe et la paroi latérale interne adjacente, chaque contact (52, 260, 452 ou 544) comprenant une partie à ressort de contact (58, 268, 458 ou 546) qui a été pliée afin de passer autour d'une partie de bord du boîtier (6, 212, 406 ou 518) disposée entre la première paroi latérale interne (16, 222, 414 ou 526) et la paroi latérale externe adjacente (24, 230, 424 ou 532) et étant placée à proximité immédiate de l'extrémité de réception d'une fiche (8, 216, 408 ou 520), de manière que la partie à ressort de contact s'étende à partir de l'une (16, 222, 414 ou 536) des parois latérales internes, en une position adjacente à l'extrémité de réception d'une fiche, obliquement dans l'ouverture (12, 218, 412 ou 524) et vers la paroi latérale interne opposée (14, 220, 416 ou 528), l'ouverture de réception d'une fiche (12, 218, 412 ou 524) étant dimensionnée pour recevoir un connecteur à fiche électrique (68, 68' ou 68'') renfermant des éléments de contact espacés (74, 74' ou 74'') destinés à s'enclencher avec les parties à ressort de contact (58, 268, 458 ou 546) des contacts connecteurs femelles (2, 202, 403 ou 502); chaque contact (52, 260, 452 ou 454) étant sous la forme d'une seule bande métallique allongée ayant une saillie latérale (62a, 278, 463 ou 578) au moyen de laquelle le contact peut être retenu en relation d'assemblage avec le boîtier (6, 212, 406 ou 518), et une partie arrière (60a, 272, 466 ou 554) du contact qui peut faire saillie de la partie intermédiaire, vers l'extérieur du boîtier; le procédé étant caractérisé par les étapes qui consistent à disposer une série de bandes métalliques allongées (52a', 260', 452' ou 603) connectées les unes aux autres, juxtaposées et à partir desquelles les contacts (52, 260, 452 ou 454) peuvent être formés, afin qu'une partie intermédiaire (54, 262, 454 ou 550) de chaque bande soit disposée dans ladite rainure (46, 240, 442 ou 576), un premier tronçon extrême de chaque bande faisant saillie



au-delà de l'extrémité de réception d'une fiche (8, 216, 408 ou 520) du boîtier et le tronçon extrême opposé de chaque bande faisant saillie au-delà de l'extrémité arrière (10, 214, 410 ou 522) du boîtier, à utiliser un outillage pour plier, en coopération avec ladite partie de bord, le premier tronçon extrême de chaque bande en arrière à partir de l'extrémité de réception d'une fiche (8, 216, 408 ou 520) du boîtier pour que ce premier tronçon extrême pénètre obliquement dans l'ouverture de réception d'une fiche (12, 218, 412 ou 524), et à plier le tronçon extrême opposé de la bande afin qu'au moins une extrémité (53, 53c, ou 281 ou 460 ou 556) de ce tronçon fasse saillie vers l'extérieur du boîtier (6, 212, 406 ou 518), le procédé comprenant également les étapes qui consistent à sectionner les connexions entre les bandes métalliques et introduire une liaison mécanique serrée entre ladite saillie latérale (62a, 278, 463 ou 578) de chaque bande et le boîtier, pour retenir les bandes (52a', 260', 452' ou 603) en relation d'assemblage sur le boîtier.

2. Connecteur femelle qui a été fabriqué au moyen du procédé selon la revendication 1, caractérisé en ce que chaque contact (52, 452 ou 544) est logé dans l'une de plusieurs rainures juxtaposées (46a, 446 ou 572) ménagées dans la paroi latérale externe adjacente (24, 424 ou 532), les saillies latérales comprenant des ardillons (62a, 463 ou 579) sur la partie intermédiaire (54, 454 ou 550) de chacun des contacts (52, 454 ou 544), les ardillons pénétrant dans les parois des rainures (46a, 446 ou 572), et les ardillons de chaque contact étant décalés par rapport aux ardillons (46b, 446 ou 572) des contacts adjacents, dans la direction partant de l'extrémité de réception d'une fiche (8, 408 ou 520) et s'étendant vers l'extrémité arrière (10, 410 ou 522) du boîtier.

3. Connecteur femelle qui a été fabriqué au moyen du procédé selon la revendication 1, caractérisé en ce que le boîtier (212) présente une seule rainure (240) de réception de contacts la traversant d'un côté de l'extrémité arrière (214) au côté de l'extrémité (216) de réception d'une fiche, la rainure (240) étant définie entre la première paroi latérale interne (222) et la paroi latérale externe adjacente (230), et étant d'une largeur suffisante pour recevoir les parties intermédiaires (262) des contacts (260) en une disposition coplanaire juxtaposée, les contacts (260) étant réalisés par emboutissage et formage d'une feuille de métal, des moyens (256) de positionnement et de retenue de contacts étant prévus à l'extrémité arrière de la paroi latérale externe adjacente (230) et ayant pour effect de fixer lesdites parties arrière (272) des contacts (260) pour les empêcher de se rapprocher latéralement les uns des autres, de manière que les parties intermédiaires (262), les parties à ressort de contact (268) et les parties arrière (272) des contacts (260) soient maintenues espacées

dans des positions prédéterminées dans la rainure (240) de réception de contacts et dans l'ouverture (218) de réception d'une fiche.

4. Connecteur femelle qui a été fabriqué au moyen du procédé selon la revendication 1, caractérisé en ce que l'extrémité arrière (410) du boîtier (406) présente plusieurs rainures juxtaposées (446) de réception de contacts, les rainures (446) ménagées dans cette extrémité arrière (410) étant en alignement avec les rainures (446) ménagées dans la paroi latérale externe adjacente (424), chaque contact (452) comprenant une seule bande allongée de métal en feuille emboutie et formée, la partie intermédiaire (454) de chaque contact (452) étant disposée dans une des rainures (446) de la paroi latérale externe adjacente (424), le contact (452) ayant été plié à l'extrémité arrière (410) du boîtier (412) et s'étendant sur cette extrémité arrière (410) dans l'une des rainures (446) de l'extrémité arrière (410).

5. Connecteur femelle qui a été fabriqué au moyen du procédé selon la revendication 1, caractérisé par plusieurs cloisons espacées (568) qui s'étendent de l'une des parois latérales internes (526) en un point adjacent à l'extrémité arrière (522) du boîtier (518), vers la paroi latérale interne opposée (528), les parties à ressort de contact (546) des contacts (544) ayant des tronçons extrêmes libres (566) positionnés chacun entre deux cloisons adjacentes (568).

6. Connecteur femelle selon la revendication 5, caractérisé par une paroi arrière (570) à l'extrémité arrière (522) du boîtier (518), s'étendant de l'une des parois latérales internes (526) vers la paroi latérale interne opposée (528), les contacts (544) s'étendant à partir de la paroi latérale externe adjacente (532) à travers la paroi arrière (570) au-delà de l'autre paroi latérale externe (534), en étant décalés mutuellement.

7. Connecteur femelle (2, 403 ou 502) pour fiche électrique, comprenant un boîtier isolant (6, 406 ou 518) ayant une extrémité (8, 408 ou 520) de réception d'une fiche et une extrémité arrière (10, 410 ou 522), une ouverture (12, 412 ou 524) de réception d'une fiche s'étendant dans l'extrémité de réception d'une fiche, cette ouverture ayant des parois latérales internes opposées (14 et 16, ou 414 ou 416, ou 526 et 528) et des parois extrêmes internes opposées (18 et 20, ou 418 et 420, ou 530), le boîtier ayant des parois latérales externes opposées (22 et 24, ou 422 et 424, ou 532 et 534) et des parois extrêmes externes opposées (26 et 28, ou 426 et 428, ou 536), plusieurs contacts électriques (52, 452 ou 544) étant agencés en relation espacée et juxtaposée, comprenant chacun une partie à ressort de contact (58, 458 ou 546) qui a été pliée afin de passer autour d'une partie de bord du boîtier (6, 406 ou 518) disposée entre la première paroi latérale externe (16, 414 ou 526) et la paroi latérale externe adjacente (24, 424 ou 532) et



étant placée à proximité immédiate de l'extrémité de réception d'une fiche (8, 408 ou 52), de manière que la partie à ressort de contact fasse saillie de l'une (16, 414 ou 526) des parois latérales internes, en une position adjacente à l'extrémité de réception d'une fiche, obliquement vers l'intérieur de l'ouverture (12, 412 ou 524) et vers la paroi latérale interne opposée (14, 416 ou 528), et chaque contact ayant une partie intermédiaire (54, 454 ou 550) qui fait saillie d'un côté de l'extrémité de réception d'une fiche en passant par une rainure individuelle (46, 442 et 576) de réception de contacts dans le boîtier, chaque rainure s'étendant entre la première paroi latérale interne (16, 414 ou 526) et la paroi latérale externe adjacente (24, 424 ou 532), dans la même direction que ces parois latérales, et vers l'extrémité arrière du boîtier, l'ouverture (12, 412 ou 524) de réception d'une fiche étant dimensionnée pour recevoir un connecteur à fiche électrique (68, 68' ou 68'') renfermant des éléments de contact espacés (74, 74' ou 74'') destinés à s'enclencher avec des parties à ressort de contact (58, 458 ou 546) des contacts du connecteur femelle (2, 403 ou 502); caractérisé en ce que les rainures (46, 442 et 576) de réception de contacts sont formées dans la paroi latérale externe adjacente (24, 424 ou 532) et sont ouvertes sur leur longueur, pour recevoir les contacts, chacun des contacts (52, 452 ou 544) ayant été formées à partir d'une seule bande allongée et plate de métal (52a', 452' ou 603), une partie intermédiaire (54, 454 ou 550) de cette bande étant disposée dans ladite rainure (46, 442 et 576) de réception de contacts, une partie (58, 458 ou 546) de la bande, faisant saillie d'une extrémité de la partie intermédiaire, ayant été repliée en arrière en coopération avec ladite partie de bord du boîtier, à proximité immédiate de l'extrémité (8, 408 ou 526) de réception d'une fiche, pour constituer la partie à ressort de contact (58, 458 ou 546), une partie arrière (60a, 466 ou 554) de chaque bande s'étendant à partir de l'autre extrémité de la partie intermédiaire (54, 454 ou 550) et au-delà du boîtier, des ardillons (62a, 463 ou 578) faisant saillie latéralement des contacts (52, 452 ou 544) et pénétrant dans les parois latérales des rainures (46, 442 et 576) pour maintenir les contacts en relation assemblée sur le boîtier, et les ardillons de chaque contact étant décalés par rapport aux ardillons (46b, 446 ou 572) des contacts

adjacents suivants, dans la direction orientée de l'extrémité de réception d'une fiche (8, 408 ou 520) vers l'extrémité arrière (10, 410 ou 522) du boîtier.

8. Connecteur femelle selon la revendication 7, caractérisé en ce que le connecteur (2) est destiné à être monté sur une plaquette (4) à circuits imprimés, le boîtier (6) comportant, faisant saillie de la paroi latérale externe adjacente (24), des pieds (34) de positionnement destinés à se loger dans des ouvertures (80) de la plaquette (4) et des bras (36) de verrouillage destinés à se loger dans des encoches (78) d'un bord de la plaquette (4), la partie arrière (60a) de chaque contact (52) faisant saillie latéralement du boîtier (6) et étant décalée par rapport aux parties arrière des autres contacts.

9. Connecteur femelle selon la revendication 7, caractérisé en ce que l'extrémité arrière (410) du boîtier (406) présente plusieurs rainures juxtaposées (446) de réception de contacts, les rainures (446) de cette extrémité arrière (410) constituant des prolongements des rainures (446) ménagées dans la paroi latérale externe adjacente (424), chaque contact (452) ayant été plié à l'extrémité arrière (410) du boîtier (412) et s'étendant en travers de cette extrémité arrière (410) dans une des rainures (446) de l'extrémité arrière (410), des évidements décalés (450) étant ménagés dans les parois des rainures (446), dans la paroi latérale externe adjacente (424) et dans l'extrémité arrière (410) pour recevoir les ardillons (463) des contacts (452).

10. Connecteur femelle selon la revendication 7, caractérisé par une paroi arrière (570) à l'extrémité arrière (522) du boîtier (518), s'étendant de l'une des parois latérales internes (526) vers la paroi latérale interne opposée (528), les contacts (544) faisant saillie de la paroi latérale externe adjacente (532) à travers la paroi arrière (570) et au-delà de l'autre paroi latérale externe (534), l'extrémité arrière du boîtier (518) étant formées avec d'autres canaux (576 et 576') qui sont de différentes profondeurs et qui reçoivent des parties (554 et 554') des contacts (544), à proximité immédiate des parties arrière (566) de ces derniers, afin que ces parties arrière (566) soient décalées les unes par rapport aux autres dans deux directions pour se loger dans des trous (507) d'une plaquette (510) à circuits imprimés, lesquels trous (507) sont disposés suivant des configurations triangulaires.

