

PATENT SPECIFICATION

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(72) Inventors WILLIAM VITO PAUZA
EDWARD MICHAEL POLTONAVAGE



(54) ELECTRICAL CONNECTOR ASSEMBLY

(71) We, AMP INCORPORATED, a corporation organised and existing under the laws of the State of New Jersey, United States of America, of Eisenhower Boulevard, Harrisburg, Pennsylvania, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an electrical connector assembly capable of interconnecting a rectangular substrate to conductors on a printed circuit board.

Integrated circuit devices are commonly mounted on relatively thin ceramic plates, commonly referred to as substrates, which have conductors thereon extending from the integrated circuit device or "chip" to the edges of the substrate.

At the present time, ceramic substrates or the like carrying integrated circuit devices or the like, are commercially available in several type of "leadless" and "lead" arrangements.

A first type has two rows of spaced apart contact pads respectively disposed on two opposite side surfaces of a leadless substrate, which pads connect with conductors extending from a chip mounted on the substrate.

A second type has two rows of spaced apart leads respectively disposed on two opposite side surfaces of a substrate, which leads connect with conductors extending from a chip mounted on the substrate, and extend from the substrate in a substantially common direction.

A third type has one row of spaced apart contact pads disposed on one longitudinal edge margin of one face of a substrate, which pads connect with conductors extending from a chip mounted on the substrate.

The present invention is an electrical con-

necter assembly comprising an insulating housing having a first side, a second side and a plurality of cavities disposed in two parallel rows, the cavities extending through the housing from the first side to the second side; an individual elongate electrical terminal mounted in each cavity and comprising a spring contact arm projecting from the cavity at the first housing side and a contact portion projecting from the cavity at the second housing side, the contact arm having a contact surface which is disposed perpendicularly with respect to and proximate a support surface formed on the first side and facing generally inwardly of the housing, the spring contact arms being resiliently deformable such that the contact surfaces are movable generally parallel to the support surface outwardly of the housing; and an adaptor frame adapted to receive and hold a substrate of a type having contacts which are not formed as contact pads on its side surfaces, the adaptor frame having locking members engageable with complementary locking members on the housing such that the contacts of a substrate held by the adaptor frame engage individual ones of the contact surfaces of the spring contact arms.

Embodiments of the present invention will now be described, by way of example, with reference to the drawings in which:—

Figure 1 is a perspective exploded view showing a known electrical connector;

Figure 2 is a perspective view of the connector of Figure 1 and also showing the type of leadless substrate for which the connectors was originally designed, supported in the connector, and with the connector mounted on a circuit board;

Figure 3 is a cross-sectional view taken along line 3-3 in Figure 2;

Figure 4 is a cross-sectional view similar to that of Figure 3 but showing the substrate aligned with the connector prior to

insertion of the substrate into the connector;

Figure 5 is a perspective exploded view of an assembly comprising the connector of Figure 1 to 4 mounted on a circuit board 5 and an adaptor frame for adapting the connector to accommodate a leaded substrate which is also shown;

Figure 6 is a perspective view of the assembly of Figure 5 in an assembled state 10 and with the substrate mounted on the assembly—

Figure 7 is a cross-sectional view taken along line 7-7 in Figure 6;

Figure 8 is a cross-sectional view similar 15 to that of Figure 7 but showing the substrate in a position prior to mounting of the substrate on the connector assembly;

Figure 9 is a perspective exploded view of a further assembly comprising the connector of Figures 1 to 4 mounted on a circuit 20 board and on a adaptor frame for adapting the connector to accommodate a leadless substrate which has a row of contact pads along one edge of one major surface;

Figure 10 is a perspective view of the assembly of Figure 9 in the assembled state; 25 and

Figure 11 is a cross-sectional view taken along line 11-11 in Figure 10, but with one 30 of the substrates not fully plugged in.

Referring now to the drawings wherein like reference characters refer to like parts, Figures 1-4 show a known multi-contact electrical connector 10 as described in 35 British Patent Specification No. 1 442 339, comprising an insulating housing 12 and a plurality of electrical contacts arranged in two opposing rows in the housing 12.

The connector 10 was originally designed 40 to serve the function of electrically inter-connecting terminal contact pads 16 of a ceramic substrate 18 supported within the housing 12 between the rows of contacts 14 with external electrical circuitry such as 45 the conductors 20 on one side of a printed circuit board 22 as shown in Figure 3. The substrate 18, referred to hereinbefore as the first type of ceramic substrate, comprises a generally rectangular ceramic body 24 hav- 50 ing parallel faces 26,28, side surfaces 30,32, and end surfaces 34,36. Conductors (not shown) contained in the ceramic body 24 extend from the terminal contact pads 16 on the side surfaces 30,32 of the substrate 18. 55

As stated hereinbefore, the connector 10 is, in part, comprised by an insulating hous- 60 ing 12. The housing 12 may be manufactured by conventional injection moulding methods from any suitable dielectric material, such as polycarbonate or a glass filled nylon.

The housing 12 is generally rectangular 65 having a base wall 38 at a forward side 40 of the housing 12 and a pair of opposing,

elongate, parallelly-aligned side walls 42,44 and a pair of opposing, relatively short, parallelly-aligned end walls 46,48 extending from the base wall 38 toward a rearward side 50 of the housing 12. The housing 12 70 is mountable on the circuit board 22 at an exterior surface 52 of the base wall 38 of the housing 12. The base wall 38 of the housing 12 has two large openings 54 extending therethrough to facilitate dissipation of the 75 heat generated within the housing 12 and to minimise the amount of material in the housing 12.

A central substrate-receiving cavity 56 is defined within the housing 12 by the interior 80 surfaces 58,60,62,64,66 of the walls 38,42,44,46,48 of the housing 12. The interior surfaces 58 of the base wall 38 is capable of supporting the substrate 18 thereon at the face 28 of the substrate 18 in 85 a generally parallel relationship to, and spaced from, the circuit board 22 when the substrate 18 is received within the central cavity 56 and when the housing 12 is 90 mounted on the board 22 at the exterior surface 52 of the base wall 12 as shown in Figures 2 and 3.

As more clearly shown in Figures 3 and 4, a row of spaced apart contact-receiving cavities 68 extend through each of the side 95 walls 42,44 of the housing 12 from the forward side 40 to the rearward side 50 of the housing 12. The contact-receiving cavities 68 open into the central cavity 56 at the interior surfaces 60,62 of the side walls 100 42,44.

Still referring to Figures 3 and 4, a row of spaced apart recesses 76, the purpose for which will be explained hereinafter, is formed in the interior surface 58 of the base 105 wall 38 of the housing 12 along each of a pair of opposing longitudinal edge portions 78 of the base wall 38 which edge portions 78 are respectively located adjacent to the interior surfaces 60,62 of the side walls 110 42,44 of the housing 12. Each of the recesses 76 corresponds to, and open into, one of the contact-receiving cavities 68. Each of the recesses 76 have a floor 80 at a loca- 115 tion therein which is remote from the interior surface 58 of the base wall 38 of the housing 12. Further, each of the recesses 76 has a shoulder 82 at a location therein which is remote from the correspond- 120 ing contact-receiving cavity 68 and which adjoins the floor 80 of the recess 76 and faces in a direction generally toward the corresponding cavity 68.

The connector 10 is further comprised, as 125 stated hereinbefore, by a plurality of electrical contacts 14 arranged in two opposing rows in the housing 12. Each of the contacts 14 may be fabricated by a conventional stamping and forming operation from any suitable metal, such as pre-tin plated 130

stainless steel.

The contact 14 is basically comprised by a flat, central post portion 86, a resiliently flexible spring portion 88 which extends outwardly from one end of the flat post portion 86, and a terminal portion 100 which extends from the opposite end of the flat post portion 86. One contact 14 is retained in each of the contact-receiving cavities 68 of the housing 12.

The terminal portion 100 is capable of electrical and mechanical connection to the conductor 20 of the circuit board 22 when the housing 12 is mounted on the board 22 preferably by insertion of the terminal portion 100 through an aperture 102 formed through the circuit board 22. The preferred electrical and mechanical connection of the terminal portion 100 of the contact 14 to the conductor 20 of the board 22 is achieved by a solder 104.

With the contact in its fully inserted position and desired configuration as shown in Figures 3 and 4, the flexible spring portion 88 extends from its respective cavity 86 proximate the rearward side 50 of the housing 12 in an overlying relationship to the plane of the interior surface 58 of the base wall 38 and in a direction generally toward the corresponding one of the recesses 76 formed in the interior surface 58 of the base wall 38. During insertion of the contact 14 (prior to formation of a bent portion 96 in the post portion 86) into a contact-receiving cavity 86 from the rearward side 50 of the housing 12, the spring portion 88 is partially flexed or deflected in a direction generally toward its respective cavity 86 so that a terminating free end 94 of the spring portion 88 will extend into the corresponding one recess 76 upon continued insertion of the contact 14. Upon extension into the one recess 76, the free end 94 of the spring portion 88 is designed to abut the shoulder 82 of the one recess 76 at a location along the shoulder 82 which is spaced from the floor 80 of the one recess 76 to thereby provide the spring portion 88 of the contact 14 in a pre-loaded condition and also to avoid any tendency for the free end 94 to drag on the floor 80 of the recess 76 upon further deflection of the spring portion 88 toward its respective cavity 86.

The spring portion 88 of each contact 14 has a camming surface 106 thereon located remote from the free end 94 of the spring portion 88. The leading opposing longitudinal edges of the substrate 18 engage the camming surfaces 106 during insertion of the substrate 18 into the housing 12 and cause further flexing or deflection of each of the spring portions 88 toward its respective one of the contact-receiving cavities 86 until each of the spring portions 88 has deflected to its respective desired fully loaded

condition at which time the third type of substrate 18 is positioned upon the interior surface 58 of the base wall 38 between the rows of contacts 14.

The spring portion 88 of each contact 14 has a contact surface 108 thereon located adjacent to the free end 94 of the spring portion 88. When the contact 14 is in its fully inserted position as shown in Figure 4, the contact surface 108 of the spring portion 88 is disposed adjacent to, and in an overlying relationship to the plane of, the interior surface 58 of the base wall 38 and in a facing relationship toward the opposing row of contacts 14. In the preferred embodiment, the contact surface 108 is disposed generally perpendicular to the plane of the interior surface 58. The contact surface 108 preferably is on an embossment on the spring portion 88 as shown at 110 in order to define a precise contact area on the spring portion 88.

Therefore, as is readily illustrated in Figures 3 and 4, when the substrate 18 is placed in the substrate-receiving cavity 56 of the housing 12 and supported on the interior surface 58 of the base wall 38 of the housing 12 between the opposing rows of contacts 14 with the contact pads 16 of the substrate 18 respectively electrically engaging the contact surfaces 108 on the contacts 14 in the two opposing rows of contacts 14, the spring portion 88 of each of the contacts 14 will be additionally flexed or deflected toward its corresponding cavity 68 so as to displace the free end 94 of the spring portion 88 of each contact 14 away from the shoulder 82 of the corresponding recess 76. With the free end 94 of the spring portion 88 so displaced from the shoulder 82 of the recess 76 and from the floor 80 of the recess 76, as shown in Figure 3, a desired predetermined contacting pressure is achieved between the contact surface 108 and the contact pad 16 by substantially normal or perpendicular forces imposed on the pads by the spring portions 88 to provide a good electrical connection therebetween the contact surfaces 108 and the pads 16 having a desired low contact resistance characteristic.

Referring again to Figure 1, there is illustrated a slot 112 formed through each of the end walls 46,48 of the housing 12 at the forward side 40 of the housing 12 and also through each of a pair of opposite edge portions 114 of the base wall 38 respectively adjacent to the end walls 46,48. These slots 112 provide access by a conventional prying tool (not shown) to the face 28 of the substrate 18 on which face 28 the substrate 18 is mounted on the interior surface 58 of the base wall 38 in order to facilitate one manner of removal of substrate 18 from the housing 12.

Also shown in Figure 1, a strap 116 is provided for assembly to the housing 12 in an overlying relationship to the substrate 18 when the substrate 18 is supported on the interior surface 58 of the base wall 38. An interengaging means in the form of a slot 118 is disposed on each of the end walls 46,48 of the housing 12 for securing the strap 116 to the housing 12 as best shown in Figure 2. The slots 118 define shoulders 119 respectively in the interior surfaces 64 of the end walls 46,48 which face toward the plane of the interior surface 58 of the base wall 38 and engage with opposite end tabs 122 of the strap 116 to secure it to the housing 12 with the substrate 18 therebetween. Although the contact spring portion 88 provides adequate retention of the substrate 18 therebetween under most conditions, the strap 116 is an optional feature of the connector 10 which may be beneficial if the circuit board 22 on which the connector 10 and the substrate 18 are mounted is disposed in a vertical position or an inverted position instead of the horizontal position as shown in Figure 2. Also, the strap 116 may be of benefit when the connector 10 is used in an environment wherein severe vibrations may be encountered.

The strap 116 has a central recess 120 on its forward facing surface into which a prying tool (not shown) may be inserted in order to flex the strap 116 and thereby disengage opposing end tabs 122 of the strap 116 from shoulders 119 of the slots 118 of the end walls 46,48 of the housing 12 and thereby achieve disassembly of the strap 116 from the housing 12.

It is apparent from the drawings that the connector can be serviced from its rearward side; that is it can be assembled to the board and the substrate 18 can be "plugged" into, and "unplugged" from, the connector 10 from its rearward side.

Referring now to Figures 5 to 8, here is shown an assembly according to the invention in which, the connector 10 of Figures 1 to 4 is adapted to accommodate a leaded ceramic substrate, referred to hereinbefore as the second type of substrate, which is shown at 126 in Figure 5, by providing an adaptor frame 124 which is designed to be received within the connector 10 in place of the substrate 18 of Figures 1 to 4.

The substrate 126 comprises a generally rectangular ceramic body 128 having parallel faces 130,132, side surfaces 134,136, and end surfaces 138,140. Conductors (not shown) contained in the ceramic body 128 extend from electrical terminal leads 142 on the side surfaces 134,136 of the substrate 126. The leads 142 extend from the substrate 126 in a substantially common direction which is generally parallel to the side surfaces 134,136 and perpendicular to the

faces 130,132.

The frame 124 may be manufactured by conventional injection moulding methods from any suitable dielectric, insulating material, such as polycarbonate or a glass 70 filled nylon.

The frame 124 is generally rectangular having a pair of opposing, elongate, parallel-aligned side walls 144,146, a pair of opposing, relatively short, parallel-aligned end walls 148,150, and several spaced apart intermediate walls 152 which are parallel-aligned with each other and with the end walls 148,150 and interconnect the side walls 144,146. This arrangement of the side walls 144,146, end walls 148,150, and intermediate walls 152 together defines a body 154 of the frame 124 having four large openings 156 therethrough to facilitate dissipation of the heat generated within the connector 10 and the substrate 126 and to minimise the amount of material in the frame 124.

The body 154 of the frame 124 has, in general, a forward end 158 and a rearward end 160. The forward end 158 is capable of being received in the central cavity 56 of the housing 12 between the rows of contacts 14 retained in the housing 12 and capable of being supported on the interior surface 58 of the base wall 38 of the housing 12. When the forward end 158 of the body 154 is so received by, and supported in, the housing 12, as more clearly shown in Figure 8, the rearward end 160 of the body 154 extends from the housing central cavity 56 to a location beyond the rearward side 50 of the housing 12.

Two lateral portions 162,164 respectively extend outwardly from the two side walls 144,146 of the body 154 at the rearward end 160 thereof. Each of the lateral portions 162,164 overlies one of the two opposing rows of contacts 14 and one of the two rows of contact-receiving cavities 68 of the side walls 42,44 of the housing 12 at the rearward side 50 thereof when the forward end 158 of the body 154 is received and supported in the housing central cavity 56, as shown in Figure 8.

A plurality of spaced apart apertures 166 are arranged in two rows and defined respectively in the two side walls 144,146 of the body 154 at the rearward end 160 thereof adjacent respectively to the two opposing lateral portions 162,164 of the frame body 154.

Edge surfaces of the side walls 144,146, end walls 148,150 and intermediate walls 152 at the rearward end 160 of the frame body 154 together define a mounting surface 168 on the rearward end 160 of the frame body 154 which is located between the rows of apertures 166. The mounting surface 168 is spaced from the rearward

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side 50 of the housing 12 when the forward end 158 of the body 154 is received and supported in the housing cavity 56, as shown in Figure 8. The mounting surface 168 on the frame body 154 will receive the substrate 126 thereon, as shown in Figure 7, in a spaced relationship to the rearward side 50 of the housing 12, and generally parallel, spaced relationship to the circuit board 22, after the housing 12 is mounted on the board 22 and the forward end 158 of the frame body 154 is received and supported in the housing cavity 56.

A plurality of spaced apart slots 170 are arranged in two rows and defined respectively in the exterior surfaces 172,174 of the side walls 144,146 of the frame body 154. As shown in Figure 8, the exterior surfaces 172,174 of the side walls 144,146 are disposed respectively adjacent to the two rows of contacts 14 and the interior surfaces 60,62 of the side walls 42,44 of the housing 12 when the forward end 158 of the body 154 is received and supported in the housing cavity 56. Each of the slots 170 is aligned with one of the apertures 166 at the rearward end 160 of the body 154 and extends therefrom to the forward end 158 of the body 154. Each of the slots 170 is capable of accommodating therein one of the contact spring portions 88 with the one aperture corresponding to each slot 170 aligned with one contact spring portion 88 being accommodated by each slot 170 when the forward end 158 of the frame body 154 is received and supported in the housing cavity 56. Each of the slots 170 have an interior surface portion 176 facing in a general direction toward the contact surface 108 on the contact spring portion 88 being accommodated in each slot 170 when the forward end 158 of the frame body 154 is received and supported in the housing cavity 56.

As shown in Figure 7, the portion of the forward end 158 of the frame body 154 between the interior surface portions 176 of the two rows of slots 170 is generally disposed between the rows of the terminal leads 142 of the substrate 126 with each of the interior surface portions 176 of the slots 170 accommodating therealong one of the terminal leads 142 and supporting the one lead 142 in electrical and mechanical contact with the corresponding one contact surface 108 of the contact spring portion 88 being accommodated in each slot 170 when the substrate 126 is mounted on the mounting surface 168 of the rearward end 160 of the frame body 154 after the forward end 158 of the body 154 is received and supported in the housing cavity 56. The interior surface portion 176 of each slot 170 supports the lead 142 as it is being inserted therealong and prevents deflection of the

lead 142 away from the respective contact spring portion 88. Therefore, as the lead engages the contact surface 108 of the contact spring portion 88, the contact spring portion 88 must flex or deflect in a general direction away from the interior surface portion 176 of the slot 170 in order to allow the lead 142 to pass therebetween since the lead 142 is not allowed to deflect and the contact surface 108 and the interior surface portion 176 are initially either disposed substantially in non-pressurised engagement with each other or only an extremely small gap exists therebetween.

Referring again to Figure 5, a ramped lug 178 is disposed on each of the exterior surfaces 180,182 of the end walls 148,150 of the frame body 154 (only the lug 178 on end wall 148 is shown) at the forward end 158 thereof and projects outwardly therefrom. The exterior surfaces 180,182 of the end walls 148,150 of the body 154 are located proximate to the interior surfaces 66,64 of the end walls 48,46 of the housing 12, with the lugs 178 respectively engaging the shoulders 119 in the interior surfaces 64,66 of the end walls 46,48 of the housing 12, when the forward end 158 of the body 154 is received and supported in the housing cavity 56 as shown in Figure 6. By means of the engagement between the lugs 178 of the frame body 154 and the shoulders 119 of the housing 12, the body 154 is retained in the housing cavity 56. The material of the housing 12, while forming a substantially rigid structure, is still sufficiently resiliently deformable to allow outward bowing of the mid-sections of the end walls 46,48 of the housing 12 in order to allow the lugs 178 of the frame 124 to pass by the end walls 46,48 to their desired position under the shoulders 119. Likewise, the edge of a thin knife or other suitable tool may be used to again bow the end walls 46,48 outwardly enough to allow the lugs 178 to pass by the end walls 46,48 during retraction of the frame 124 from the housing 12.

When the frame body 154 has been received in the housing cavity 56, as shown in Figure 8, the connector 10 is now adapted to receive the substrate 126. When the substrate 126 is "plugged" into the now adapted connector 10 by inserting the leads 142 of the two rows thereof respectively through the apertures 166 in the two rows thereof and along the interior surface portions 176 of the two rows of slots 170 until the substrate 126 is mounted on the mounting surface 168 at the rearward end 160 of the frame body 154, the leads 142 engage the contact surfaces 108 of the contacts 14 and thereby cause the pre-loaded contact spring portions 88 of the contacts 14 to become additionally flexed or deflected toward their respective

15 cavities 68, as shown in Figure 7. The desired predetermined contacting pressure is thereby achieved between the leads 142 and the contact surfaces 108 by the substantially normal or perpendicular forces imposed on the leads 142 by the additionally flexed and loaded spring portions 88 to provide a good electrical connection therebetween having a desired low contact resistance characteristic.

20 It is readily apparent that the substrate 126 may be "unplugged" from its position of Figure 7 by gripping the substrate 126 at its end surfaces 138,140 and retracting it back to its position of Figure 8.

25 Referring now to Figures 9 to 11, herein shown on assembly according to the invention, comprising a connector 10 as shown in Figures 1 to 4 adapted to accommodate two leadless substrates 182 as referred to hereinbefore as the third type of substrate, by the provision of an adaptor frame 180 which is designed to be received within the connector 10 in place of the substrate 18 of Figures 1 to 4.

30 Each substrate 182 comprises a generally rectangular ceramic body 184 having parallel faces 186,188, side surfaces 190,192, and end surfaces 194,196. Conductors (not shown) contained in the ceramic body 184 extend from spaced apart terminal contact pads 198 arranged in a row thereof and disposed on a longitudinal edge margin 200 of one face surface 186 of the substrate 182.

35 The frame 180 may be manufactured by conventional injection moulding methods from any suitable dielectric, insulating material, such as polycarbonate or a glass filled nylon.

40 The frame 180 is generally rectangular having a pair of opposing, elongate, parallelly-aligned side walls 202,204, a pair of opposing, relatively short, parallelly-aligned end walls 206,208, and several spaced apart intermediate walls 210 which are parallelly-aligned with each other and with the end walls 206,208 and interconnect the side walls 202,204. This arrangement of the side walls 202,204, end walls 206,208, and intermediate walls 210 together defines a body 212 of the frame 180 having five large openings 214 therethrough to facilitate dissipation of the heat generated within the connector 10 and to minimise the amount of material in the frame 180.

55 The body 212 of the frame 180 has, in general, a forward end 216 and a rearward end 218. The forward end 216 is capable of being received in the central cavity 56 of the housing 12 between the rows of contact surfaces 108 of the contacts 14 retained in the housing 12 and capable of being supported on the interior surface 58 of the base wall 38 of the housing 12. When the forward end 216 of the frame body 212 is so received by, and supported in, the housing

12, as more clearly shown in Figure 11, the rearward end 218 of the body 212 extends from the housing central cavity 56.

Ribs 220 interconnect two side walls 202, 204 at the forward end 216 of the frame body 212 and project therefrom. The ribs are received in the openings 54 of the base wall 38 of the housing 12 and engage with opposing side portions 222 of the openings 54 to thereby centre the frame body 212 between the rows of contact surfaces 108, as clearly shown in Figure 11, when the forward end 216 of the frame body 212 is received and supported in the housing central cavity 56.

80 Guide structures 224 are formed on the rearward end 218 of the frame body 212 at each of four corners 226 defined by the respective intersections between the side walls 202,204 and the end walls 206,208. Each of the guide structures 224 has a right-angled shape and project outwardly from the side walls 202,204. When the forward end 216 of the frame body 212 is received and supported in the housing central cavity 56, each of the guide structures 224 seats on respective corners 228 defined by the intersections between the respective side walls 42,44 and end walls 46,48 of the housing 12, as shown in Figure 10. The guide structures 224 may be viewed as two pairs respectively projecting from the side walls 202,204. First interior surface portions 230 of one of the two pairs of guide structures 224 are aligned parallel to, and generally face toward, each other as are the first interior surface portions 230 of the other of the two pairs of guide structures 224. Second interior surface portions 232 of one of the two pairs of guide structures 224 are aligned in the same plane as are the second interior surface portions 232 of the other of the two pairs of guide structures 224. Further, the second interior surface portions 230 of each of the two pairs of guide structures generally face toward their respectively adjacent one of the side walls 202,204. The first interior surface portions 230 of each respective pair of guide structures are spaced from each other through a distance slightly greater than the length of the substrate 182 whereby each of the pairs of guide structures is capable of receiving one of the substrates 182 therebetween.

120 Each of the side walls 202,204 of the frame body 212 preferably has a plurality of spaced apart rails 234 formed thereon which individually extend from the forward end 216 to the rearward end 218 of the frame body 212 and project outwardly from the respective side walls 202,204. Each of the rails 234 has an exterior surface portion 236. The exterior surface portions 236 of the respective rails 234 on one of the side walls 202,204 are aligned in the same plane as are

the exterior surface portions 236 of the respective rails 234 on the other of the side walls 202,204. Furthermore, the plane of the exterior surface portions 236 of the plurality of rails 234 disposed on one of the two side walls 202,204 is aligned generally parallel to the plane of the second interior surface portions 232 of the pair of guide structures 224 disposed on that same one of the two side walls 202,204 and is spaced therefrom through a distance slightly greater than the thickness of the substrate 182 to thereby, in effect, define a slot 238 through which one of the substrates 182 may be received, as shown in Figure 11. When the forward end 216 of the frame body 212 is received and supported in the housing cavity 56, as shown in Figure 11, the pre-loaded contact spring portions 88 of one of the rows of contacts 14 extends into the forward end of the slot 238 with the contact surfaces 108 on each of the contact spring portions 88 in that row thereof preferably being spaced from the plane of the exterior surface portions 236 of the rails 234 on the one of the side walls 202,204 adjacent to that row of contact spring portions 88 through a distance slightly less than the thickness of the substrate 182.

Figure 11 depicts the frame 180 received and supported in the housing cavity 56 with one of the substrates 182 fully inserted into the frame 180 to a desired final position. At this final position, the substrate 182 at its side surface 190 is supported on the interior surface 58 of the base wall 38 of the housing 12 between the exterior surface portions 236 of the rails 234 on the side wall 204 of the frame body 212 and the corresponding one of the rows of contact surfaces 108 in a generally perpendicular relationship to the plane of the interior surface 58 of the base wall 38 of the housing 12 and in a generally perpendicular, spaced relationship to the circuit board 22. As the substrate 182 is inserted to this final position, the leading edge margin of the substrate 182, with the row of contact pads 198 thereon in facing relationship to the contact surfaces 108, engages the contact spring portions 88 and flexes or deflects them in a general direction toward their respective contact-receiving cavities until the substrate 182 is seated on the interior surface 58 of the housing base wall 38. The desired predetermined contacting pressure is thereby achieved between the contact pads 198 and the contact surfaces 108 by the substantially normal or perpendicular forces imposed on the contact pads 198 by the additionally flexed and loaded spring portions 88 to provide a good electrical connection therebetween having a desired low contact resistance characteristic.

It is readily apparent that the substrate 182 may be readily "unplugged" from its

position within the connector and frame assembly as well as readily "plugged" therein. The right-hand portion of Figure 11 illustrates one of the substrates 182 in the process of being plugged into the assembly (by reversing the arrow, the substrate 182 may be viewed in the process of being unplugged from the assembly).

Referring again to Figure 9, each of the side walls 202,204 is partially discontinuous at a mid-section thereof. A resiliently flexible latch arm 240 is formed on each of the side walls 202,204 and extends through the discontinuous mid-section of each side wall and projects rearwardly from the rearward end 218 of the frame body 212. Each of the latch arms 240 has latching shoulder 242 projecting outwardly therefrom and facing toward the forward end 216 of the frame body 216. As illustrated in Figure 11, one latch arm 240 may be flexed toward the other when a substrate 182 is inserted into the slot 238 of the frame 180 adjacent thereto. After the substrate 182 is fully inserted to its resting position within the connector and frame assembly, the latch arm 240 is released and returns to its original unflexed condition, as illustrated in the left-hand portion of Figure 11, to thereby positively lock the substrate in the desired rested position within the assembly.

Referring again to Figure 9, a ramped lug 244 is disposed on each of the exterior surfaces 246,248 of the end walls 206,208 of the frame body 212 (only the lug 244 on end wall 206 is shown) at the forward end 216 thereof and projects outwardly therefrom. The exterior surfaces 246,248 of the end walls 206,208 of the body 212 are located proximate to the interior surfaces 66,64 of the end walls 48,46 of the housing 12, with the lugs 244 respectively engaging the shoulders 119 in the interior surfaces 64,66 of the end walls 46,48 of the housing 12, when the forward end 216 of the frame body 212 is received and supported in the housing cavity 56 as shown in Figure 10. By means of the engagement between the lugs 244 of the frame body 212 and the shoulders 119 of the housing 12, the body 212 is retained in the housing cavity 56. As stated hereinbefore, the material of the housing 12, while forming a substantially rigid structure, is still sufficiently resiliently deformable to allow outward bowing of mid-sections of the end walls 46,48 of the housing 12 in order to allow the lugs 244 of the frame 180 to pass by the end walls 46,48 to their desired position under the shoulders 119. Likewise, the edge of a thin knife or other suitable tool may be used to again bow the end walls 46,48 outwardly enough to allow the lugs 244 to pass by the end walls 46,48 during retraction of the frame 180 from the housing 12.

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WHAT WE CLAIM IS:—

1. An electrical connector assembly, comprising an insulating housing having a first side, a second side, and a plurality of
5 cavities disposed in two parallel rows, the cavities extending through the housing from the first side to the second side; an individual elongate electrical terminal mounted in each cavity and comprising a spring contact
10 are projecting from the cavity at the first housing side and a contact portion projecting from the cavity at the second housing side, the contact arm having a contact surface which is disposed perpendicularly with
15 respect to and proximate a support surface formed on the first side and facing generally inwardly of the housing, the spring contact arms being resiliently deformable such that the contact surfaces are movable generally
20 ally parallel to the support surface outwardly of the housing; and an adaptor frame adapted to receive and hold a substrate of a type having contacts which are not formed as contact pads on its side surfaces, the
25 adaptor frame having locking members engageable with complementary locking members engageable with complementary

locking members on the housing such that the contacts of a substrate held by the adaptor frame engage individual ones of the
30 contact surfaces of the spring contact arms.
2. An electrical connector assembly as claimed in Claim 1, in which the adaptor frame has two parallel rows of holes adjacent respective edges of the frame, the holes communicating with respective slots in the
sides of the frame.
3. An electrical connector assembly as claimed in Claim 1, in which the adaptor frame has two parallel guide channels extending along respective opposed sides of the
40 frame.
4. An electrical connector assembly substantially as described with reference to Figures 1 to 4 and Figures 5 to 8 of the
45 drawings.
5. An electrical connector assembly substantially as described with reference to Figures 1 to 4 and Figures 9 to 11 of the
50 drawings.

For the Applicants:
R. G. STUART-PRINCE,
Chartered Patent Agent.

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