

SPECIFICATION

Connector with spare contact adapter provision

5

Background of the Invention

1. Field of the Invention

10 This invention relates to the field of electrical connectors and more particularly to female type connectors which are referred to as jacks in the telephony art.

2. Description of the Prior Art

15 In the telephone connector art, a modular jack, such as disclosed in U. S. Patent No. 3,850,497 can be designed having any predetermined number of spring contact structures depending on the particular envisioned use. In some modular jack applications however, such as in a telephone handset, two electrical connections using spring contacts are usually needed though four such connections are occasionally required. Typically, in 20 such applications, modular jacks containing four spring contact structures are then used. This is wasteful because the spare contact structures are seldom used and add to the cost of the jack.

25 One alternative is to leave the spare contact structures out of the jack until they are needed in the field to reduce cost of the jack. However, their installation in the field is not usually desirable because it is a delicate operation due to the small size of the contact 30 structures and time-consuming as the contact structures must be inserted individually. Another alternative is to replace the installed jack with one having the needed number of spring contacts. This means disconnecting 35 completely the existing connections, which is even more time-consuming.

40 Thus, there is need for a modular jack which can be manufactured at a reduced cost and yet allows quick and easy installation of spare spring contacts when needed.

45 Also, increasingly telephone handsets and other devices are being made with electronic components mass soldered onto printed circuit boards. The modular jack disclosed in U. 50 S. Patent 3,850,497 is designed with spring contact structures having spade-tipped insulated conductors which are secured with screws to connect with the electronics in the 55 handset.

60 Desirably, a modular jack can be designed with spring contact structures which facilitate soldering onto the printed circuit board along with the other electronic components and reduce overall jack manufacturing cost at the same time.

Summary of the Invention

65 Pursuant to the invention, a modular jack has been developed which contains only the

usually needed number of spring contact structures and which is specifically configured for receiving a spare contact adapter when additional contacts are required.

70 In the illustrative embodiment, the modular jack comprises a dielectric enclosure having a plug receiving cavity that opens to the front of the enclosure and a top wall that forms one wall of the cavity. The top wall includes on its 75 front surface, a plurality of parallel first grooves that extend from spaced orifice openings in the front surface to the underside of the top wall, and a plurality of parallel second grooves that extend the entire height of the 80 front surface. The first grooves position corresponding front sections of spring contact structures in the jack. The second grooves are for positioning corresponding front sections of spare contact structures carried by the adapter 85 when the adapter is attached.

The top surface of the top wall forms with a pair of spaced vertical flanges an adapter-receiving channel extending from the front to the rear of the jack enclosure. On the vertical 90 flanges are ribs for guiding insertion of the adapter. The top surface of the top wall includes at least one slot for engaging a corresponding adapter surface to lock the adapter in place against forward movement of 95 the adapter, while the front end surfaces of the ribs engage other adapter surfaces to prevent rearward movement of the adapter.

Pursuant to another aspect of this invention, the spring contact structures in the jack 100 are each constructed of a unitary length of wire. Each such wire contact structure is formed with a rear section configured for positioning the jack with respect to a printed circuit board for soldering.

105 A middle section of each spring contact structure is formed with a plurality of undulations about the longitudinal axis of the middle section. Peaks made by the undulations are designed to firmly abut the interior surfaces of 110 an associated orifice, hence to help position and securely hold the contact structure in the associated orifice.

In the illustrative embodiment, the undulation-receiving section of each orifice is elliptical in cross section. Also, the undulations of 115 each contact structure occur in a common plane to define a transverse width larger than the diameter of the elliptical cross section along its major axis, hence ensuring an interference fit. At the same time, the configuration of the orifice prevents torsional movement of the contact structure by substantially 120 confining it in a plane made by the major axis.

125 A front section of each spring contact structure is unformed and substantially collinear with the longitudinal axis of the middle section until after insertion into the associated orifice. The front section is then deformed to 130 have a first portion which positions within a

first groove associated with the associated orifice and a second portion which extends in rearward cantilever fashion in the plug receiving cavity.

5 The invention and its objectives, features, and advantages will be readily discerned from a reading of the description to follow of an illustrative embodiment.

10 *Brief Description of the Drawing*

Figure 1 is a perspective view of the modular jack and the spare contact adapter made in accordance with this invention;

15 *Figure 2* depicts a partial rear elevation view of the Fig. 1 modular jack with the spring contact structures omitted;

20 *Figure 3* is a sectional view taken along line 3-3 in Fig. 4 (with the adapter omitted) showing in detail one of the spring contact structures in the modular jack;

Figure 4 depicts in front elevation the modular jack with the adapter mounted, the jack and adapter each shown as containing only one spring contact;

25 *Figure 5* is a sectional view taken along line 5-5 of the Fig. 4 assembly showing in detail the spare contact structure in the adapter; and

Figure 6 depicts a sectional view taken along line 6-6 of the Fig. 4 assembly.

30 *Detailed Description*

Shown in Fig. 1 are illustrative embodiments 100, 200 of the modular jack and spare contact adapter respectively, made in accordance with this invention.

35 The modular jack 100 comprises an enclosure 102 having a plug receiving cavity 104 open to the front thereof. The enclosure 102 can be molded from a dielectric material such as Acrylonitrile Butadiene Styrene. The cavity 104 is defined by a top wall 106, a bottom wall 108, sidewalls 110, a front wall 112 and a rear wall 114 (seen in Figs. 2, 3, and 4).

40 For descriptive purposes, the walls 106, etc. have been designated as top, etc. to correspond with the orientation given to the jack 100 in the FIGURES. The orientation is arbitrary and not meant to restrict the invention. It is apparent that the top wall 106 can appear as a sidewall or a bottom wall when the jack is rotated with respect to the position shown in the FIGURES.

45 The front wall 112, which connects to the bottom wall 108 has a notch 116 opening to the cavity 104. Inside of each sidewall 110, a ledge 118 extends from the front wall 112 to a stop shoulder 120 (Fig. 3) to define additional cavity surfaces. The cavity side of the bottom wall 109 is stepped and tapered as seen in Fig. 3. The illustrated modular jack 100 is adapted to mate with a plug similar to that disclosed in U. S. Patent No. 3,761,896. However, it is apparent that the plug-receiving cavity can be designed to receive other plugs.

50 Referring back to Fig. 1, projecting mem-

bers 122 on the exterior surfaces of the sidewalls 110 are for affixing the jack 110 to a supporting structure. Also, the sidewalls 110 indent along their lower exterior surfaces and the exterior surface of the bottom wall 108 has a downward extending protuberance 109.

55 An exterior front surface 124 of the top wall 106 comprises a plurality of substantially parallel first grooves 126 extending from front openings of contact-receiving orifices 128 to an interior cavity surface or underside 130 of the top wall 106. The front surface 124 also includes a plurality of substantially parallel second grooves 132 extending from the cavity surface to an exterior top surface 134 to form upper groove ends 136 open to the top surface 134.

60 A pair of spaced vertical flanges 140, projecting from and integrally attached to the top wall 106, define with the top surface 134 an adapter-receiving channel 142 extending from the front to the rear of enclosure 102. The sidewalls of the channel 142, formed by the facing surfaces 144 of the flanges 140, include a pair of laterally guiding ribs 146 with front end surfaces 148.

In the top surface 134 of the top wall 106 are a pair of slots 150. Each slot 150 extends from the rear of the enclosure 102, stopping short of the enclosure front to form a stop with its closed front end 152.

65 Referring to Figs. 2 and 3, each orifice 128, which extends from the front to the rear of the top wall 106, includes a front orifice section 160 which is circular in cross section and rear orifice section 162 which is elliptical in cross section. The diameter of the elliptical cross section along its minor axis, denoted by dotted line 161, approximates the diameter of the front orifice section 160 as seen in Fig. 2.

70 Shown in Fig. 3 is a spring contact structure 170 located in an associated orifice 128. The spring contact structure 170 is constructed by forming a unitary length of wire of high tensile strength spring material such as spring temper phosphor bronze, into a front, middle, and rear section 172, 180, and 182, respectively.

75 The front section 172 has a first portion 174 for positioning within the associated first groove 126 and a second portion 176 for extending in rearward cantilever fashion within the plug receiving cavity 104. During jack manufacture, the front section 172 is unformed, as denoted by dotted line 178, and not bent until the contact structure 170 has been inserted through the orifice 128 from the rear of the enclosure 102.

80 The middle section 180, which is located and supported in the orifice 128, is formed with undulations 184 about its longitudinal axis, which is denoted by line 185. The undulations 184 define a plurality of peaks 186 for abutting the interior surfaces of the

rear orifice section 162, which is substantially larger cross-sectionally than the wire of the contact structure 170.

Prior to insertion into the orifice 128, the undulations 184 have a nominal peak-to-peak amplitude which is greater than the distance between the opposing interior orifice surfaces they are to abut. During insertion into the orifice 128, the surfaces of the undulations 184 facing away from the longitudinal axis 185 act as cam surfaces for insertion, while the undulations 184 resiliently deflect toward the longitudinal axis 185 as needed to fit into the orifice 128. Upon insertion, the inherent resilience in the contact structure 170 from the undulations 184 acts to ensure a tight mechanical and frictional fit as the peaks 186 bias against the interior surfaces of the rear orifice section 162.

Advantageously, in the illustrative embodiment, the undulations 184 are contained in one plane (plane of Fig. 3) to simplify manufacture. The elliptical configuration of the rear orifice section 162 helps to guide and maintain the position of the contact structure 170 by containing the undulations 184 in a plane made by the major axis, denoted by dotted line 163 in Fig. 2, of the elliptical cross section.

Projecting from the associated orifice 128 the rear section 182 of the contact structure 170 includes a bend 190, substantially perpendicular to the longitudinal axis 185 of the middle wire section 182, to limit the extent to which the contact structure 170 can enter the orifice 128. The remaining bends 192 in the rear section 182 are designed to position the rear section 182 optimally for soldering onto a printed circuit board, the plane of which is represented by dotted line 194. Advantageously, the bends in the rear section 182 are also formed in the same plane as the undulations 184 of the middle section 180 during manufacture of the contact structure 170.

Referring back to Fig. 1, the adapter 200 comprises a substantially rectangular body 202 having side surfaces 204, a bottom surface 206, a front surface 208 having a beveled top portion 210, and a rear surface 212. The body 202 is made from a dielectric material. On either side surface 204 is a lateral groove 214 which opens to the rear surface 212 and has a closed front end 216 stopping short of the front surface 208. Each groove 214 corresponds to one of the laterally guiding ribs 146 in the modular jack 100.

Projecting from the bottom surface 206 are a pair of spaced latches 218 for engaging the slots 150 in the jack 100. Each latch 218 includes a cam surface 220, a flat bottom surface 222, and a trailing blocking surface 224, shown more clearly in Fig. 6.

Referring to Figs. 4 and 5, the adapter body 202 includes at least one orifice 226 which extends from the front 208 to the rear

212. Along the front surface 208, a groove 250 extends from the associated orifice 226 to the adapter bottom 206. Each groove 250 is spaced for alignment with an associated second groove 132 in the jack 100.

As seen in Fig. 5, each orifice 226 comprises a forward section 228, a middle section 230, and a rear section 232 for accommodating a spring contact structure 234. Each contact structure 234 comprises an insulated conductor 236 having a spade tip 238 at one end and being spliced at the other end to a wire spring contact 242 with a conductive splicing member 240. The wire spring contact 242 has a front section 244 which extends from the front of the orifice 226. The front section 244 includes a first portion 246 which is positioned within the associated groove 250, and a second portion 248.

The spring contact structure 234 is similar to the spring contact structure disclosed in the aforementioned patent No. 3,850,497. However, it is apparent that the spring contact structures 234 and their associated orifices 226 can also be made like the contact structures 170 and orifices 128 respectively.

When the adapter 200 is snap-mounted onto the jack 100 as seen in Fig. 5, a lower part of the portion 246 of each spring contact front section 244 positions into an associated second groove 132 in the jack 100, while the second portion 248 extends in rearward cantilever fashion within the plug receiving cavity 104 of the jack 100.

From Fig. 1, the adapter 200 is shown being mounted from the front end of the jack 100 by moving it in a direction denoted by arrow 10. The adapter 200 slides easily into the adapter-receiving channel 142, which is slightly larger than the adapter 200 cross-sectionally. As the adapter 200 is further inserted, the cam surfaces 220 make contact with the top surface 134 of the jack 100 to form a tight interference fit which releases when the latches 218 are positioned into the slots 150 of the channel 142 to snap mount the adapter 200 in place.

As depicted in Fig. 6, the latches 218 lock the adapter 200 in place against forward movement as the blocking surfaces 224 abut the closed front ends 152 of the slots 150 in the jack 100. The front closed ends 216 of the adapter grooves 214 also substantially abut the correspondingly front end surfaces 148 of the guiding ribs 146 to prevent rearward movement of the adapter 200.

CLAIMS

1. A connector comprising: a dielectric enclosure having a plug receiving cavity open to the front of the enclosure with a wall forming one wall of the cavity, the wall having a cavity surface, a front surface, and an exterior surface, the wall including a plurality of spaced orifices that extend from its front surface



rear orifice section 162, which is substantially larger cross-sectionally than the wire of the contact structure 170.

5 Prior to insertion into the orifice 128, the undulations 184 have a nominal peak-to-peak amplitude which is greater than the distance between the opposing interior orifice surfaces they are to abut. During insertion into the orifice 128, the surfaces of the undulations 10 184 facing away from the longitudinal axis 185 act as cam surfaces for insertion, while the undulations 184 resiliently deflect toward the longitudinal axis 185 as needed to fit into the orifice 128. Upon insertion, the inherent 15 resilience in the contact structure 170 from the undulations 184 acts to ensure a tight mechanical and frictional fit as the peaks 186 bias against the interior surfaces of the rear orifice section 162.

20 Advantageously, in the illustrative embodiment, the undulations 184 are contained in one plane (plane of Fig. 3) to simplify manufacture. The elliptical configuration of the rear orifice section 162 helps to guide and maintain the position of the contact structure 170 25 by containing the undulations 184 in a plane made by the major axis, denoted by dotted line 163 in Fig. 2, of the elliptical cross section.

30 Projecting from the associated orifice 128 the rear section 182 of the contact structure 170 includes a bend 190, substantially perpendicular to the longitudinal axis 185 of the middle wire section 182, to limit the extent to 35 which the contact structure 170 can enter the orifice 128. The remaining bends 192 in the rear section 182 are designed to position the rear section 182 optimally for soldering onto a printed circuit board, the plane of which is 40 represented by dotted line 194. Advantageously, the bends in the rear section 182 are also formed in the same plane as the undulations 184 of the middle section 180 during manufacture of the contact structure 170.

45 Referring back to Fig. 1, the adapter 200 comprises a substantially rectangular body 202 having side surfaces 204, a bottom surface 206, a front surface 208 having a beveled top portion 210, and a rear surface 50 212. The body 202 is made from a dielectric material. On either side surface 204 is a lateral groove 214 which opens to the rear surface 212 and has a closed front end 216 stopping short of the front surface 208. Each 55 groove 214 corresponds to one of the laterally guiding ribs 146 in the modular jack 100.

Projecting from the bottom surface 206 are a pair of spaced latches 218 for engaging the slots 150 in the jack 100. Each latch 218 60 includes a cam surface 220, a flat bottom surface 222, and a trailing blocking surface 224, shown more clearly in Fig. 6.

Referring to Figs. 4 and 5, the adapter body 202 includes at least one orifice 226 65 which extends from the front 208 to the rear

212. Along the front surface 208, a groove 250 extends from the associated orifice 226 to the adapter bottom 206. Each groove 250 is spaced for alignment with an associated 70 second groove 132 in the jack 100.

As seen in Fig. 5, each orifice 226 comprises a forward section 228, a middle section 230, and a rear section 232 for accommodating a spring contact structure 234. Each contact structure 234 comprises an insulated 75 conductor 236 having a spade tip 238 at one end and being spliced at the other end to a wire spring contact 242 with a conductive splicing member 240. The wire spring contact 80 242 has a front section 244 which extends from the front of the orifice 226. The front section 244 includes a first portion 246 which is positioned within the associated groove 250, and a second portion 248.

85 The spring contact structure 234 is similar to the spring contact structure disclosed in the aforementioned patent No. 3,850,497. However, it is apparent that the spring contact structures 234 and their associated orifices 90 226 can also be made like the contact structures 170 and orifices 128 respectively.

When the adapter 200 is snap-mounted onto the jack 100 as seen in Fig. 5, a lower part of the portion 246 of each spring contact 95 front section 244 positions into an associated second groove 132 in the jack 100, while the second portion 248 extends in rearward cantilever fashion within the plug receiving cavity 104 of the jack 100.

100 From Fig. 1, the adapter 200 is shown being mounted from the front end of the jack 100 by moving it in a direction denoted by arrow 10. The adapter 200 slides easily into the adapter-receiving channel 142, which is 105 slightly larger than the adapter 200 cross-sectionally. As the adapter 200 is further inserted, the cam surfaces 220 make contact with the top surface 134 of the jack 100 to form a tight interference fit which releases 110 when the latches 218 are positioned into the slots 150 of the channel 142 to snap mount the adapter 200 in place.

As depicted in Fig. 6, the latches 218 lock the adapter 200 in place against forward 115 movement as the blocking surfaces 224 abut the closed front ends 152 of the slots 150 in the jack 100. The front closed ends 216 of the adapter grooves 214 also substantially abut the correspondingly front end surfaces 120 148 of the guiding ribs 146 to prevent rearward movement of the adapter 200.

CLAIMS

1. A connector comprising: a dielectric enclosure having a plug receiving cavity open to the front of the enclosure with a wall forming one wall of the cavity, the wall having a cavity surface, a front surface, and an exterior surface, the wall including a plurality of spaced 130 orifices that extend from its front surface



toward its rear and a plurality of substantially parallel first grooves on its front surface which extend from the front end of an associated individual orifice to the cavity surface; and a plurality of first spring contact structures, each accommodated in an associated orifice and having a front spring contact section with a first portion positioned within an associated groove and a second portion extending in cantilever fashion within the plug receiving cavity; CHARACTERISED IN THAT: the front surface comprises at least one second groove, where the second groove extends from the exterior surface to the cavity surface; and that means are provided for mounting an adaptor having one or more spare second spring contact structures, each second contact structure having a front section with a first portion and second portion some part of which first portion positioned within an associated second groove and the second portion extending in cantilever fashion within the plug receiving cavity when the adaptor is mounted.

2. The connector in accordance with claim 1, CHARACTERISED IN THAT the mounting means comprises an adapter-receiving channel substantially adjacent the exterior surface of the wall; and locking means locking the adapter in place.

3. The connector in accordance with claim 2, CHARACTERISED IN THAT the mounting means further comprises guiding means for the insertion of the adapter.

4. The connector in accordance with any of claims 1-3, CHARACTERISED IN THAT the channel extends substantially from the front of the enclosure to its rear; and the guiding means further comprises a pair of lateral ribs projecting from one of a pair of facing surfaces defining sidewalls for the channel.

5. The connector in accordance with claims 2-4, CHARACTERISED IN THAT the locking means comprise at least one slot in one of the surfaces defining the channel and terminating short of the front surface of the wall defining a surface for blocking forward movement of the adapter; and means for blocking rearward movement of the adapter.

6. The connector in accordance with any of claims 1-5, CHARACTERISED IN THAT the first spring contact structure is constructed from a unitary length of wire.

7. The connector in accordance with claim 6, CHARACTERISED IN THAT the first spring contact structure includes a plurality of undulations assisting the positioning thereof.

8. The connector in accordance with claim 7, CHARACTERISED IN THAT the undulations are formed in a common plane; and the associated orifice has at least one section having a non-circular cross section with a major axis in the cross section substantially confining the undulations in a plane made by the major axis.

9. Connector in accordance with claim 1, CHARACTERISED IN THAT the adapter further comprises a dielectric body having a front surface, and a rear surface, the body including at least one orifice extending from the front to the rear surface; and a spare second spring contact structure accommodated in the orifice, the second spring contact structure having a front spring contact section with a first portion and a second portion, where the first portion positions substantially in an associated groove and the second portion extends in cantilever fashion within the plug receiving cavity when the adapter is mounted.

10. The connector in accordance with claim 8, CHARACTERISED IN THAT where the section is elliptical in cross section.

11. A connector substantially as hereinbefore described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd.—1982.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.