

PATENT SPECIFICATION

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(54) ELECTRICAL CONTACTS

(71) We, E.I. DU PONT DE NEMOURS AND COMPANY, a corporation organised and existing under the laws of the State of Delaware, United States of America, of Wilmington, State of Delaware, 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 electrical contacts for example, for use in the electrical connection of conductive pads on a printed circuit (PC) board to wiring.
 Although it is known in the art that solderless connections can be established between a PC board and related wiring (e.g. see U.S. Patent specification No. 3,069,652) available connectors either require high forces to insert the board into the connector block or exert low normal forces on the conductive pads or suffer from both deficiencies.
 According to the invention there is provided an electrical contact comprising a base portion and first and second cantilever spring arms extending in substantially opposite directions towards one another from said base portion, the free end of the first spring arm overlying the free end of the second spring arm whereby, at least when the first spring arm is urged toward the base, the free end of the second arm engages the free end of the first arm to bias the first arm away from the base.
 In a preferred embodiment a plurality of contact members are lodged in a dielectric block of an edge board connector. The second spring arm of each contact is prefer-

ably work-hardened to increase its spring properties, thereby resulting in a total spring system wherein both arms materially contribute to the contact pressure. The force required to insert a PC board into the connector is reduced by locating the end of the first spring arm in the path of the board and thereby reducing the extent of beam deflection.

An embodiment of the invention will hereinafter be described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a side view of an electrical connection system;

Fig. 2 is an elevational view taken along line 2-2 of Figure 1.

Figure 3 is an enlarged sectional view taken along line 3-3 of Fig. 1.

Fig. 4 is a fragmentary, sectional view taken along line 4-4 of Fig. 3;

Figs. 5, 5A and 6 are views of the terminal used in the edge board connector shown in Fig. 3;

Fig. 7 is a sectional view taken along line 7-7 of Fig. 6

An electrical connection system 10 that includes an edge board connector 12 is shown in Figs. 1-4. Connector 12 is mounted on a multi-layer circuit board 14, conventionally referred to as a motherboard. Elongate contract members in the form of wire wrap tails 16, 16' extend from contacts 18 in the edge board connector through openings in a support shroud 20. Contact members in a cable connector 22 held by the shroud mate with the ends of the wrap tails 16, 16' extending through the shroud to form electrical connections between contacts 18 and the individual con-

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ductors in a signal distribution cable 16.

The edge board connector 12 includes an elongate dielectric block 28 having a longitudinally extending daughter board slot 30 on one side with a row of contacts 18 on each side of the slot, each located in an individual terminal recess 32 formed in the block. Block 28 is moulded from a polyester reinforced with glass fibres.

The wire wrap tails 6, 16' of adjacent terminals in each row are laterally offset, as indicated in Figs. 3, 5 and 5A and extend through four rows of spaced plated holes 34 in mother board 14. Rounded stand-offs 35 space the block 28 a slight distance from the adjacent surface of board 14. Bolts 37 hold the block to the board.

Contacts 18 are preferably stamp-formed from a flat sheet of a half-hardened, brass alloy. Each contact includes a flat base 36 having a reverse bend cantilever spring arm 38 extending from one end of the base and bent back over the side facing the daughter board slot 30. A gold contact point 40 on the end of the arm improves the electrical connection with a contact pad 42 on a daughter board 44 inserted into slot 30. A second cantilever spring arm 46 extends from a tab 48 located adjacent tail 16 and outwardly from the base so that the free end of the arm 46 is located beneath and backs up the free end of arm 38. The free ends of arms 38, 46 have complementary, arcuate configurations. Tab 48 is integrally connected to base 36 through bend 50 at one side of the base, as illustrated in Fig. 7. During manufacture of the contact 18, the tab and second spring arm are swaged to reduce thickness, thereby work-hardening the second spring arm and improving its spring properties.

When the contacts 18 are inserted into block 28 of connector 12, the contact surfaces on arms 38 project into slot 30. Upon insertion of the daughter board 44, the spring arms of each contact are forced into their respective recesses 32 and cooperate in holding the contact points 40 in electrical connection against pads 42 on the daughter board. Because of the high spring force for the dual-beam spring system, the arms generate the required high pressure contact force although deflected only a short distance. The spring system is not easily overstressed. The work-hardened, relatively stiff, secondary beam 46 may provide as much as twice the contact pressure provided by the primary beam 38. This high contact pressure provides reliable electrical connections between the terminals and the circuit lines on the daughter board.

A locking detent 52 extends from the side of each base 36 away from the spring arms. The detents snap behind locking shoulders 54 in recesses 32 of block 28 to secure the terminals in the recesses.

The edge board connector 12 is positioned on mother board 14 with the terminal tails extending through their respective holes 34 in board 14. The board is then soldered to form connections between the tails and the printed circuitry in the holes. As shown in Fig. 3, the mother board 14 includes a number of integral metal conductive layers 58 which form electrical paths between selected wire wrap tails extending from connector 12 or adjacent components or contacts on the board.

During insertion of the daughter board 44 into slot 30, the edge of the daughter board is moved toward the bottom of the slot past the first length 60 of the spring arm 38 to engage the second length 62 which projects away from base 36 at a sharper angle than length 60 to present a cam surface extending into the slot 30 for engagement by the edge of the circuit board. The location of the cam surface on the second length 62 away from the junction between the arm and the base 36 reduces the insertion force over that for conventional folded cantilever contacts because of the longer length of the arm being flexed. The requisite level of insertion force is reduced further by the arcuate configurations at the ends of arms 38, 46 which, like a ball and socket joint, engage in a low friction fit. Additionally, the cam surface is close enough to the end of the second arm 46 to prevent buckling of the first arm 38 as the arms are stressed.

Rails 64 located on both sides of base 36 extend along the base between the ends supporting the two cantilever spring arms and are bent up at 90° to stiffen the base and prevent buckling during stressing of the spring arms.

As shown in Fig. 6, contacts 18 may be manufactured in strip form with the square wire wrap tails 16 joining carrier strip 66 and the bases 36 secured together by links 68. The strip and links are blanked away prior to insertion of the contacts 18 into the insulating body 28.

Following mounting of the edge board connector 12 on mother board 14 and soldering of the tails 16, 16' in the circuit board holes 34, the ends of insulated wires 70 may be secured to the exposed tails. Wires 70 are used to provide electrical connections between selected tails of a given connector and other contacts where such connections cannot be provided through the internal conductive layers 58 in the mother board 14. While it is intended that wires 70 be secured to the tails by conventional wire wrap connections, other types of connections, including soldered connections, may be used as desired. In some applications there may be no need to connect any wires to some tails. In other applications, more than one wire may be connected to an individual tail.

Plastic cable connector shroud 20 includes a base 72 having a series of openings 74 extending therethrough arranged in the same pattern as the holes 34 in mother board 14. Stiffening ribs 76 extend along the length of base 72 between adjacent rows of holes 74 on the side of the base facing the mother board. Conical support legs 78 at the corners of the base extend past the support ribs and are tapered down to rounded free ends facing away from the base. Individual L-shaped brackets 80 project away from the corners of the base on the side opposite from legs 78 to define a rectangular cable connector-receiving recess. Flexible plastic latch arms 82 extend away from the base between the brackets 80 at each end of the base and include latches 84 for retaining the cable connector 22 in the recess defined by the brackets and manually engageable portions 85 projecting away from the recess to permit outward flexing of the arms as desired so that the cable connector can be removed from the recess.

The shroud 20 is positioned on the wire wrap tails 16, 16' as shown in Fig. 3 with the ends of the tails extending through the holes 74 and with legs 78 engaging the adjacent surface of the mother board 14. The rounded ends of the legs force wires 70 out of the path of movement as the shroud is positioned on the tails to prevent pinching and possible injury to the wires or the connections between the wires, the tails, and the plated holes. Further, the rounded ends ensure that during insertion a wire is not trapped between the end of a leg and the circuit board, thus permitting proper mounting of all the legs on the board without stressing the exposed tails. With the shroud in this position, lock washers 86 are pushed onto the ends of selected tails extending from base 72 and are seated against the base. The washers lock against the tails to prevent withdrawal of the base 72 away from the mother board. While a pair of washers 86 may be used at each end of the shroud, as illustrated in Fig. 3 the shroud may be locked in position on the mother board by use of a single washer or a washer at each end of the shroud.

Following mounting of the shroud on the mother board, the cable connector 22 is moved into the recess defined by brackets 80 and is locked in the recess by the latches 84 on flexible arms 82. During insertion of the cable connector, the arms 82 are forced away from the recess and snap back when the connector is seated in the shroud. The cable connector 22 is conventional in design and includes a number of contacts 88 confined within an insulating block each having a connector 90 engageable with the end of a wire wrap tail and a cable pierce contact 92 engageable with a conductor in distribution

cable 26. The connectors 90 are located in openings in the cable connector facing the base of the shroud arranged in the same pattern as the wire wrap ends extending through the base. When the cable connector is mounted on the shroud the brackets 80 align the connectors with the tails so that when the connector is fully seated, the tails extend into the openings and form electrical connections with the contacts 88. Signal distribution cable 26 extends through stress relief slot 94 in the connector 22 and into contact slot 96. During assembly of the cable connector the pierce contacts 92 form electrical connections with the individual conductors in the cable.

With the dual-beam contact disclosed herein, only a low level of force is required to insert a board because of the low angles of beam deflection. Although a low angle of beam deflection results in a lower normal force on the board by the primary beam, the loss is more than compensated by the secondary beam. Frictional effects of the secondary beam do not add appreciably to the requisite level of insertion force because of the complementary, arcuate configurations at the ends of the beams. With the contacts between beams and with pads on a PC board all located at the ends of the beams, full advantage of both springs is realized and a high level of normal force is obtained from the system.

WHAT WE CLAIM IS:-

1. An electrical contact comprising a base portion and first and second cantilever spring arms extending in substantially opposite directions towards one another from said base portion, the free end of the first spring arm overlying the free end of the second spring arm whereby, at least when the first spring arm is urged toward the base, the free end of the second arm engages the free end of the first arm to bias the first arm away from the base.

2. A contact as claimed in claim 1, wherein the free ends of the first and second spring arms have complementary arcuate configurations.

3. A contact as claimed in claim 1 and 2, wherein said second spring arm is work-hardened so that its spring constant is greater than that of said first spring arm.

4. A contact as claimed in any preceding claim, wherein a contact point is formed on the surface of the free end of the first spring arm remote from the free end of the second spring arm.

5. A contact as claimed in any preceding claim, wherein the first spring arm has a cam surface adjacent the free end thereof.

6. A contact as claimed in claim 5, wherein the cam surface is at a greater angle with respect to said base portion than the remainder of said first spring arm.



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Plastic cable connector shroud 20 includes a base 72 having a series of openings 74 extending therethrough arranged in the same pattern as the holes 34 in mother board 14. Stiffening ribs 76 extend along the length of base 72 between adjacent rows of holes 74 on the side of the base facing the mother board. Conical support legs 78 at the corners of the base extend past the support ribs and are tapered down to rounded free ends facing away from the base. Individual L-shaped brackets 80 project away from the corners of the base on the side opposite from legs 78 to define a rectangular cable connector-receiving recess. Flexible plastic latch arms 82 extend away from the base between the brackets 80 at each end of the base and include latches 84 for retaining the cable connector 22 in the recess defined by the brackets and manually engageable portions 85 projecting away from the recess to permit outward flexing of the arms as desired so that the cable connector can be removed from the recess.

The shroud 20 is positioned on the wire wrap tails 16, 16' as shown in Fig. 3 with the ends of the tails extending through the holes 74 and with legs 78 engaging the adjacent surface of the mother board 14. The rounded ends of the legs force wires 70 out of the path of movement as the shroud is positioned on the tails to prevent pinching and possible injury to the wires or the connections between the wires, the tails, and the plated holes. Further, the rounded ends ensure that during insertion a wire is not trapped between the end of a leg and the circuit board, thus permitting proper mounting of all the legs on the board without stressing the exposed tails. With the shroud in this position, lock washers 86 are pushed onto the ends of selected tails extending from base 72 and are seated against the base. The washers lock against the tails to prevent withdrawal of the base 72 away from the mother board. While a pair of washers 86 may be used at each end of the shroud, as illustrated in Fig. 3 the shroud may be locked in position on the mother board by use of a single washer or a washer at each end of the shroud.

Following mounting of the shroud on the mother board, the cable connector 22 is moved into the recess defined by brackets 80 and is locked in the recess by the latches 84 on flexible arms 82. During insertion of the cable connector, the arms 82 are forced away from the recess and snap back when the connector is seated in the shroud. The cable connector 22 is conventional in design and includes a number of contacts 88 confined within an insulating block each having a connector 90 engageable with the end of a wire wrap tail and a cable pierce contact 92 engageable with a conductor in distribution

cable 26. The connectors 90 are located in openings in the cable connector facing the base of the shroud arranged in the same pattern as the wire wrap ends extending through the base. When the cable connector is mounted on the shroud the brackets 80 align the connectors with the tails so that when the connector is fully seated, the tails extend into the openings and form electrical connections with the contacts 88. Signal distribution cable 26 extends through stress relief slot 94 in the connector 22 and into contact slot 96. During assembly of the cable connector the pierce contacts 92 form electrical connections with the individual conductors in the cable.

With the dual-beam contact disclosed herein, only a low level of force is required to insert a board because of the low angles of beam deflection. Although a low angle of beam deflection results in a lower normal force on the board by the primary beam, the loss is more than compensated by the secondary beam. Frictional effects of the secondary beam do not add appreciably to the requisite level of insertion force because of the complementary, arcuate configurations at the ends of the beams. With the contacts between beams and with pads on a PC board all located at the ends of the beams, full advantage of both springs is realized and a high level of normal force is obtained from the system.

WHAT WE CLAIM IS:-

1. An electrical contact comprising a base portion and first and second cantilever spring arms extending in substantially opposite directions towards one another from said base portion, the free end of the first spring arm overlying the free end of the second spring arm whereby, at least when the first spring arm is urged toward the base, the free end of the second arm engages the free end of the first arm to bias the first arm away from the base.

2. A contact as claimed in claim 1, wherein the free ends of the first and second spring arms have complementary arcuate configurations.

3. A contact as claimed in claim 1 and 2, wherein said second spring arm is work-hardened so that its spring constant is greater than that of said first spring arm.

4. A contact as claimed in any preceding claim, wherein a contact point is formed on the surface of the free end of the first spring arm remote from the free end of the second spring arm.

5. A contact as claimed in any preceding claim, wherein the first spring arm has a cam surface adjacent the free end thereof.

6. A contact as claimed in claim 5, wherein the cam surface is at a greater angle with respect to said base portion than the remainder of said first spring arm.

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7. A contact as claimed in any preceding claim, wherein said base portion is substantially flat, elongate member and said first spring arms extends from one end thereof, and is bent back to overlie the base portion, and wherein a tab is integrally connected to a side of the base portion and is bent back to overlie the base portion, the second spring arm extending from said tab.

8. A contact as claimed in claim 7, wherein a respective stiffening rail extends along each side of said base portion between the ends thereof.

9. A contact as claimed in claim 6, further comprising an elongate contact member connected to one end of said base portion.

10. An edge board connector comprising an insulating block having a board receiving slot extending therein and at least one recess located at least on one side of the slot, and a respective electrical contact as claimed in any preceding claim being mounted in the or each said recess.

11. An edge board connector comprising an elongate insulating block having a board receiving slot extending longitudinally therein along a first side of the block, a plurality of recesses located on each side of the slot, each recess extending substantially perpendicularly to said first side of the block in communication with said slot and opening into a second side of the block opposite said first side, and a respective electrical contact as claimed in claim 9 located in each said recess, the contact member of each contact projecting from said side of the block, and the free ends of each first spring arm normally extending into said slot for engagement with a board received in the slot.

12. An electrical connection system comprising a first board having a plurality of openings arranged in a pattern extending therethrough, an edge board connector mounted on said first board, a plurality of electrical contacts, each as claimed in any of claims 1 to 9 mounted in said edge board connector, a second board inserted into said edge board connector in contact with the free end of each of said first spring arms of said contacts, each contact having an elongate contact member projecting from the edge board connector, each said contact member extending through a corresponding one of the openings in said first board and projecting outwardly from said first board away from said edge board connector.

13. An electrical connection system as claimed in claim 12, further comprising a shroud located on the side of the first board remote from said edge board connector, said shroud having a base and a plurality of openings extending through said base, the openings in the base being arranged in the same pattern as said openings in said first board, each contact member of said contacts

extending through a corresponding one of the openings in said base and projecting outwardly from said base away from said first board, and said base having a plurality of support legs extending therefrom towards said first board, said support legs engaging said first board and spacing the base a distance from said first board.

14. An electrical connection system as claimed in claim 13, further comprising locking means for preventing removal of the shroud from said first board, said locking means comprising at least one lock washer fitted over the end of a selected contact member and positioned against the surface of the base of the shroud remote from said first board.

15. An electrical connection system as claimed in claim 13 or 14 further comprising locating means extending from the shroud base away from said first board, said locating means defining a connector receiving recess; a cable and a cable connector secured to the cable, the cable connector including contact members engaging individual conductors in the cable, the contact members being arranged in the same pattern as the openings in said first board, said locating means surrounding the cable connector to locate the same in the recess in the shroud with the ends of the contact members of the contacts engaging the contact members of the cable connector for establishing electrical connection between the contact members and the conductors in the cable, the shroud including means for removably holding the cable connector in the recess.

16. An electrical connection system as claimed in claim 13, 14, or 15 wherein stiffening ribs extend along the surface of the shroud base facing the first board, said ribs being located between the openings in said base.

17. An electrical connection system as claimed in any of claims 13 to 16, further comprising at least one insulated wire having a stripped end, the or each stripped end being electrically connected to a portion of a selected contact member located between the shroud base and the first board.

18. An electrical connection system as claimed in any of claims 12 to 17 wherein said edge board connector is as claimed in claim 11.

19. An electrical contact substantially as hereinbefore described with reference to and as illustrated in Figures 3 to 7 of the accompanying drawings.

20. An edge board connector substantially as hereinbefore described with reference to and as illustrated in Figures 1 and 3 to 7 of the accompanying drawings.

21. An electrical connection system substantially as hereinbefore described with reference to and as illustrated in the accom-

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panying drawings.
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