An electrical connector for connecting conductors on a printed circuit mother board to conductors on a printed circuit daughter board is formed with a generally U-shaped spring metal channel. A separate flat flexible circuit is looped around the channel and held taut against it by a retaining nut which is provided along the base or bight of the channel. The nut has a series of spaced holes which are intended to align with holes in the channel base and in the mother board, and screws register with the aligned holes to hold the flexible circuit against the channel and also secure the connector to the mother board.

7 Claims, 5 Drawing Figures
PRINTED CIRCUIT ELECTRICAL CONNECTOR

This invention relates to an electrical connector for connecting a printed circuit daughter board to a printed circuit mother board.

The present invention is an electrical connector for connecting conductors on a printed circuit mother board to conductors on a printed circuit daughter board, the connector comprising a generally U-shaped spring supporting a separate flat flexible circuit wound round the U-shaped spring and held taut against the spring by a retaining member secured to the inside surface of the bight of the spring, the flat flexible circuit having spaced conductors extending from the mouth of the spring for engagement with the conductors of the daughter board along portions of the flexible circuit which are wound tight against the outer surface of the bight of the spring for engagement with the conductors on the mother board and means for mounting the connector on the mother board.

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

FIG. 1 is a perspective view of a connector according to the invention shown disposed on a printed circuit mother board and with end portions removed for clarity;

FIG. 2 is an exploded view of the connector omitting the flat flexible circuit;

FIG. 3 is a side view of the connector mounted on the mother board;

FIG. 4 is an end view of the connector of FIG. 3; and

FIG. 5 is a plan view of the flexible circuit which forms part of the connector.

The connector 10 comprises essentially a generally U-shaped spring 11 formed from resilient sheet metal, an elongate plastics nut 12 and a plurality of cooperating screws 13 for mounting the connector to a printed circuit mother board, and a flat flexible circuit 14 wound around the spring 11 and under the nut 12 which maintains the flexible circuit taut against the spring 11. The connector 10 also has a pair of elongate cams 17 and a pair of L-shaped end members 18.

The spring 11, as can be seen in FIGS. 2 and 4, has two spaced arms 20 and a bight portion 21 which is undulated in cross-section to provide a central raised portion or land 22, i.e. projecting in the direction of the arms, and two spaced downwardly projecting portions 23. The raised portion 22 is provided with a plurality of spaced holes 24.

The arms 20 of the spring converge in a direction away from the bight portion 21 to form a constricted mouth 26 at which the arms 20 are reversely bent away from each other to provide two approximately cylindrical ears 27.

The plastics nut 12 has two longitudinal sides 29 which separate a relatively wide base 30 from a relatively narrow top 31 from which a blind slot 32 extends towards the base 30. The base 30 has two rounded bead portions 34 located at the junctions of the base and the longitudinal sides 29 and extending the length of the sides 29. A pair of spaced pins 35 project parallel to the beads 34 from each end 36 of the nut 12. The base 30 has a plurality of downwardly projecting spaced bosses 37, one of which can be seen in FIG. 4, at each of which is located a tapped blind hole 38.

Each screw has a threaded shank 39 dimensioned for reception in a tapped hole 38 of the nut 12, and a head 40.

The flat flexible circuit 14 before assembly is shown in FIG. 5. It is rectangular and comprises a flat flexible dielectric substrate 41 on which is located, for example by an etching technique, a plurality of conductors 42 extending parallel to the longer sides of the substrate. The conductors are grouped in two equal zones 43 and 44 separated by a central empty band 45 extending parallel to the shorter sides of the substrate. Two further empty bands 46 are provided one adjacent each shorter side of the substrate. A plurality of spaced holes 47 is provided in each empty band, the holes of each band being aligned with corresponding holes in the other bands.

The flexible circuit of FIG. 5 is formed into a cylinder with the conductors on the outside by ultrasonically welding or bonding the two bands 46 together so that the two sets of holes on the bands 46 are superimposed.

Each cam 17 is cylindrical and has a short eccentric pin 50 extending from each end 51 of the cylinder, the two eccentric pins being aligned. At least one of the pins of each cam is provided with a slot 52 extending inwardly of its free end.

Each L-shaped end member 18 has two legs 53 and 54 joined at a right angle. The leg 53 has a rectangular recess 55 provided in the face 56 remote from the leg 54. A pair of oval section holes 57 extends through the leg 53 one on each side of the recess 55. The face 56 is also provided at the junction of legs 53 and 54 with a pair of spaced recesses 58. The leg 54 is provided with a central tapped through hole 59.

The connector 10 is assembled by slipping the cylindrical flexible circuit 14 over the spring 11 such that the holes 47 of the circuit 14 are aligned respectively with the holes 24 of the spring, and applying the nut 12 between the arms 20 of the spring 11 so that the bosses 37 of the nut are respectively force-fitted into the holes 24 of the spring and through the aligned holes 47 of the flexible circuit 14. The cams 17 may now be received respectively in the cylindrical ears 27 of the spring 11.

The connector is now ready for connection to a printed circuit mother board 60 which has a plurality of parallel copper tracks separated into two zones 61 and 62. A plurality of spaced through holes 63 is provided in the band 64 between the two zones 61 and 62. A further larger through hole 65 is provided at each end of the row of holes 63.

The partly assembled connector is then mounted on the board 60 by aligning the tapped holes 38 of the nut 12 respectively with the holes 63 in the board 60 and then applying the screws 13 via the underside of the board so that the threaded shanks 39 register with the holes 38. The studs 13 are then tightened so that their heads 40 bear hard up against the underside of the board 60.

Each L-shaped member 18 is then mounted to the board 60 by aligning the tapped through hole 59 with one of the larger holes 65 in the board 60. In order to align the L-shaped members 18 properly with respect to each other, the holes 65 and other parts of the connector, they are slid towards opposite ends of the partly assembled connector until the pins 50 of the cams 17 respectively pass through the oval holes 57 of the members 18 and the pins 35 of the nut 12 are received respectively in the recesses 58 of the members 18. At this
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position the holes 59 of the members 18 will be aligned with the holes 65 of the board 60. A suitable large screw 66 is then introduced into each tapped hole 59 via the underside of the board 60, and the screws are screwed up tight to secure the members 18 firmly to the board.

As can be seen in FIG. 4, when the connector 10 is assembled to the mother board 60, the downwardly projecting portions 23 of the spring 11 force the conductors 42 of zones 43 and 44 of the flexible circuit 14 respectively against the copper tracks of the zones 61 and 62 of the board 60 along two parallel contact lines. The conductors 42 of the zones 43 and 44 of the flexible circuit 14 can be seen to extend into the mouth 26 between the arms 20 of the spring 11.

Before insertion of a printed circuit daughter board 68 a screwdriver 69 as seen in FIG. 3 is used to rotate the cams 17 180° from the position shown in FIG. 4 by means of the eccentric slotted pin 50, the cams 17 in this position urging the ears 27 of the spring 11 away from each other to open the mouth 26. The daughter board 68 may now be inserted into the mouth without force, the leading edge of the board 68 being received in the slot 32 of the nut 14. After insertion the cams 17 are rotated to their former position, by means of the screwdriver, which has the effect of closing the mouth 26 and urging the conductors 42 into engagement with respective connectors 66 on both sides 70 and 71 of the board 68. The oval shape of the holes 37 in which the cam pins 50 are seated allows resilient deflection apart of the arms of the spring 11.

Thus, the conductors on the side 70 of the daughter board 68 are connected via the conductors in the zone 43 of the flexible circuit 14 to the conductors in the zone 61 of the mother board 60, and the connectors on the side 71 of the daughter board 68 are connected via the conductors in the zone 44 to the conductors in the zone 62 of the mother board 60.

It should be noted that a film of insulation 74 may be provided as shown over the conductors 42 on the flexible circuit over those areas which do not engage either the mother board or the daughter board. Furthermore, configurations other than the parallel spaced conductors 42 may be provided on the flexible circuit 14.

What is claimed is:

1. An electrical connector for connecting conductors on a printed circuit mother board to conductors on a printed circuit daughter board, the connector comprising a generally U-shaped spring having a bight portion and a mouth portion connected by arms, a separate endless flat flexible circuit wound round the U-shaped spring, said circuit covering substantially the entire inner and outer periphery of said spring, a retaining member for holding the circuit taut against the spring, said retaining member being secured to the bight of the spring along an inside surface of said spring, said circuit having spaced conductors extending from the portion of the circuit covering the mouth of the spring to the portion of the circuit covering the outer periphery of the bight of the spring, said mouth of the spring being for receiving the daughter board and the bight of the spring being for mounting on the mother board whereby conductors on the mother board are connected to conductors on the daughter board by the conductors on the flexible circuit, and means for mounting the bight of the spring and thereby the connector on the mother board.

2. An electrical connector as claimed in claim 1, in which the retaining member is an elongate nut which has a plurality of spaced tapped holes therein aligned with holes formed in the bight of the spring and holes formed in the flexible circuit, and the connector is provided with a plurality of screws arranged to pass through prepared holes in the mother board and mate with respective ones of said holes in the nut for securing the connector to the mother board.

3. An electrical connector as claimed in claim 2, in which the holes of the nut are provided at bosses on the nut force-fitted respectively into the holes in the bight of the spring.

4. An electrical connector as claimed in claim 3, in which the retaining member is provided with an elongate slot remote from the bosses and aligned with the mouth of the spring.

5. An electrical connector as claimed in claim 1, in which the bight of the spring is undulated in cross-section to provide a central land projecting in the direction of the mouth of the spring and two spaced curved portions defining two parallel contact surfaces between the conductors on the mother board and the conductors on the flexible circuit.

6. An electrical connector as claimed in claim 1, in which the arms of the spring converge from the bight to the mouth and are reversely bent at the mouth away from each other to form two generally cylindrical ears, an elongate cam member disposed in each said ear, the cam members being arranged for rotation between a first angular position in which the spring mouth is relatively closed and a second angular position in which the spring mouth is relatively open.

7. An electrical connector as claimed in claim 6, in which each cam member is provided with an eccentric pin extending from each axial end of the cam member, the two eccentric pins of each cam member being aligned, said connector further comprising two end members, each said end member having a pair of oval holes for receiving the eccentric pins of said cam members, at least one end of each pin having a slot for permitting rotation of said cam members.