

Electrical Connector

This invention relates to a connector for making electrical contact with a printed circuit board. More particularly it relates to a progressively activated toggle link zero insertion force connector block.

5 Many attempts have been made to provide a connector block which eliminates the friction and consequent wear on terminal strips caused by insertion and removal of a circuit board from its connector. U. S. Patent Reissue 29,223 uses inclined planes in the connector to effect a
10 zero insertion force. U. S. Patent 4,085,990 employs a cam follower engaged to the internal electrical contact. A printed circuit board can be inserted into this connector without engaging the contacts as each cam follower engages the high point of its associated cam
15 surface.

U. S. Patent 3,793,609 obtains low insertion force using an actuator to retract the contacts prior to insertion of a circuit board.

20 U. S. Patent 3,744,005 employs a cam bar to engage each terminal serially and move the contact portions on the terminals into engagement with the circuit board contact. The following patents also employ various cam actions to achieve a zero insertion force connector:

25 U. S. Patent 4,060,300
 U. S. Patent 4,050,758
 U. S. Patent 3,980,377
 U. S. Patent 4,118,094
 U. S. Patent 3,818,419
 U. S. Patent 4,077,688

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British Patent Specification 1,498,611 discloses a connector which employs differentially resilient portions on the spring terminals to achieve a zero insertion force.

5 All of these inventions suffer from one or more of the following limitations:

- a) insufficient wiping movement on the contact surface,
- b) high inertial force needed to actuate the connector contacts,
- 10 c) complex construction required for making connector block,
- d) inability to program ground, power and signal terminals to actuate separately,
- e) inability to miniaturize connector block, and
- 15 f) insufficient force on contact surface.

According to the present invention there is provided a connector for making electrical contact with a printed circuit board, comprising a dielectric housing having an elongate slot for receiving a portion of said board, and
20 means for guiding said board into the interior of said housing, at least one toggle rod parallel to said slot in said housing, and a plurality of elongate curved resilient spring metal terminals having first and second ends and an intermediate portion, said first end of each terminal
25 being positioned within a channel in a said toggle rod and said second end of each terminal lying in a separate channel within said housing and being available for electrical contact with another electrical device, said intermediate portion of each said terminal being engage-
30 able and disengagable from electrical contact with said circuit board in the interior of said housing by rotation of its associated toggle rod to move said first end of the terminal and thereby cause over centre movement of the terminal spring.

The or each toggle rod has in one embodiment a single elongate channel for receiving the rounded first end or bearing end of a terminal spring. The first end of the terminal spring is a curved bearing engaging the channel of the toggle rod. The intermediate portion of the terminal spring is S-shaped with the outer surface of the upper loop being the contact surface with an electrical contact element in the circuit board. The second or bottom end of the terminal spring is fixed within the bottom of the housing and serves as an electrical contact with another electrical device. Rotational movement of the toggle rod causes the terminal spring to engage and wipe the circuit board contact and reversing the rotational movement causes the terminal spring contact surface to disengage from the circuit board. The toggle rod action causes the terminal spring to move over centre so that it locks in the desired open or closed position.

In the drawings wherein like reference characters denote corresponding parts throughout the several views:

FIG. 1 is a partially cutaway sectional view in perspective of an embodiment of a connector according to the invention involving a single channel in the toggle rod.

FIG. 1a is a partially cutaway sectional view in perspective of another embodiment of a connector of the present invention employing two channels and a travel plane between the two channels in the toggle rod.

FIG. 1b is a partially cutaway sectional view in perspective of still another embodiment of a connector of the present invention employing a pointed first end of the spring inserted into a groove in the toggle rod.

5 FIG. 2 is a sectional view along line 2-2 of FIG. 1a.

FIG. 3 a, b, c is a sectional view of the FIG. 1 embodiment showing several spring positions.

10 FIG. 4 a, b, c, d, and e are sectional views of the embodiment shown in FIG. 1a showing the several spring positions.

FIG. 5 is a partially sectional view of the FIG. 1a toggle rod showing the programmed spring positions.

Referring to FIG. 1, a housing 10 is made of a
15 moulded dielectric plastics material made from reinforced nylon, reinforced polyester or reinforced polyphenylene sulphide. The housing 10 has a slot 11 of appropriate size to receive a circuit board 18. The circuit board can be slid into the connector slot from above or from an
20 open side of the connector. The circuit board has contact strips 20 which will be aligned with contact springs 12 positioned within the housing. Parallel to the slot 11 of the housing 10 are one or more toggle rods 14. The or each toggle rod is made from a reinforced
25 nylon, polyester or polyphenylene sulphide which may be the same as the substance from which the housing is made.

The toggle rods of FIG. 1 each have a single channel 13 running along their entire length. A plurality of ^{terminal} springs 12 are inserted into this channel. Each of
30 the springs 12 is separated from the adjacent spring by

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a wall 32 in the dielectric housing. The guiding member 22 in the dielectric housing allows for the correct positioning of the printed circuit board 18 as it moves through the slot 11 into the housing 10. A stop 38 near the bottom of the housing prevents the circuit board from continuing its movement beyond the desired position.

Each spring has a curved surface on its upper or first end 40 which is a bearing surface in engagement with the channel 13 of the toggle rod 14. This bearing end 40 of the spring 12 rides within the channel 13 of the toggle rod 14 during actuation. The second end of the spring is a fixed end 44 and is inserted into a channel 26 in the bottom of the housing 10, and may exit from the housing through aperture 24. The second end of the spring 44 may be a pluggable electrical contact or a wire wrap that may be soldered to another circuit board or other electrical contact. The intermediate portion of the spring is S-shaped ^{at} 42 and its outer, upper loop 50 forms the contact surface with the contact strips 20 of the circuit board 18. The spring is made from brass, copper, phosphor-bronze, copper-nickel or other conventional resilient current-carrying substance.

Rotational movement of the toggle rod 14 about its axis causes the spring 12 to move in a longitudinal direction so that the upper loop 50 of its intermediate portion 42 touches (FIG. 3b) the contact strip 20 of the circuit board 18 and thereafter wipes down the surface of the contact strip 20 until such time as the spring moves over centre and thereby causes a slight upward movement of the upper loop 50 of the spring (FIG. 3c).

Reversing the rotational motion of the toggle rod 14 causes the intermediate portion 42 of the spring 12 to move in an opposite longitudinal direction so that there is disengagement from the circuit board 18.

5 After moving over centre, the spring is locked in the open position, FIG. 3a. The circuit board 18 can thereafter be removed from the housing 10 without any substantial frictional force affecting the circuit board 18 or its contact strips 20.

10 FIG. 1a shows an alternative embodiment of the invention. It differs from the FIG. 1 embodiment by having a modified toggle rod. The toggle rod 14 is programmed with two channels 13a and 13b together with a travel plane 15 between the two channels. Channel
15 13a is designated an activation channel since the bearing end 40 of the spring is located in this channel at the start of the cycle when the upper loop 50 of the intermediate portion 42 of the spring is not touching the circuit board, FIG. 4a. As the toggle rod 14 is rotated,
20 the spring intermediate portion 42 moves towards the circuit board and after touching the board, FIG. 4b, moves downward, FIG. 4c, thereby wiping the corresponding contact on the circuit board. As the toggle rod is moved further, the bearing end 40 of the spring moves over the
25 travel plane 15, FIG. 4d, and snaps into the channel 13b, FIG. 4e, to lock in place. There is a slight upward movement of 50 (back wipe) as the spring snaps into the locked position. Reversing the cycle, the toggle rod is rotated in the opposite direction and this causes the
30 spring bearing end 40 to move back across the plane 15 and snap into the channel 13a as the intermediate portion 42 of the spring moves away from the circuit board. The

second end 44 of the spring remains fixed in channel 26 during both cycles.

5 The toggle rod channels in this embodiment can be programmed so that a series of springs 12 snap over at different 10^0 increments (FIG. 5) during the rotation of the toggle rod. In this manner, ground, power and signal terminals can make contact at different times as desired and established by the program. This embodiment may require a metal rod such as a stiff steel or rigid
10 aluminium rod 16 to sustain a dielectric programmed changeable cover of the toggle rod. However the programmed rod could be premoulded in the desired program configuration and therefore would not require a rod.

15 FIG. 1b shows still another embodiment which differs from the previous devices only in the top portion or first end of the spring 12 and the shape of the toggle rod. In this embodiment the toggle rod has a channel 13, in which the first end 40a of the spring 12 rides. Rotation
20 of the toggle rod in a first direction, moves the spring over centre and causes the intermediate portion of the spring 42 to contact and wipe the circuit board contact strip. Reversing the direction of rotation of the toggle rod causes the spring to snap over centre in the opposite
25 direction and causes disengagement of the intermediate portion of the spring from the circuit board.

CLAIMS

1. A connector for making electrical contact with a printed circuit board, comprising a dielectric housing having an elongate slot for receiving a portion of said board, and means for guiding said board into the interior
5 of said housing, at least one toggle rod parallel to said slot in said housing, and a plurality of elongate curved resilient spring metal terminals having first and second ends and an intermediate portion, said first end of each terminal being positioned within a channel in a said
10 toggle rod and said second end of each terminal lying in a separate channel within said housing and being available for electrical contact with another electrical device, said intermediate portion of each said terminal being engageable and disengageable from electrical contact with
15 said circuit board in the interior of said housing by rotation of its associated toggle rod to move said first end of the terminal and thereby cause over centre movement of the terminal spring.
2. A connector according to claim 1 wherein the said
20 first end of each terminal spring engages a single channel in its associated toggle rod.
3. A connector according to claim 1 wherein the said first end of each terminal spring engages and moves over a travel plane between two channels in its associated
25 toggle rod upon rotation of said toggle rod.
4. A connector according to any preceding claim wherein the said intermediate portion of each terminal spring is arranged to wipe the surface of the circuit board as its associated toggle rod is rotated.
- 30 5. A connector according to claim 1, 3 or 4 wherein



the or each said toggle rod is made of a moulded dielectric plastics material having a travel plane between two channels in its outer surface to actuate terminal springs engaging with said toggle rod in a predetermined programmed order.

6. A connector according to claim 1, 3 or 4 wherein the or each said toggle rod consists of a metal rod encased in at least one dielectric cover, the cover having a surface adapted to actuate terminal springs engaging with said toggle rod in a predetermined programmed order.

7. A connector according to any preceding claim, comprising a pair of said toggle rods, one on each side of said slot.

8. Connectors for making electrical contact with a printed circuit board, substantially as herein described with reference to the accompanying drawings.

The text of the specification has been reproduced by photocopying the applicants original typescript. It may contain a few amendments which are difficult to read. The original typescript containing these amendments may be inspected on the premises of the Patent Office



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