An electrical connector for use in conjunction with a printed circuit board having terminals on the surface thereof. The connector exerts minimal force on the circuit board terminals during insertion of the board into the connector and thereafter develops the contact forces required to maintain electrical continuity. The connector has a housing having a recess adopted to receive the terminal carrying portion of the circuit board. The recess is defined, in part, by a back wall and a bottom abutment and is of a size and shape such as to freely receive the board with the edge of the board engaging the abutment. A series of contacts are situated in the recess adjacent the wall in opposing relationship to the board terminals. The recess is so shaped relative to the board that the board may be received in the recess in an insertion position in which it is on the opposite side of the contacts from the back wall and relatively remote from the contact, and may be moved to a final position in which it is relatively close to the contacts and the back wall. The contacts are adopted to operatively engage the terminals as the board is moved to the final position but to make, at most, only minimal engagement with the terminals when the board is in the insertion position. Securing means on the housing are adopted to engage the board when the board is moved to the final position, and to retain the board in the final position.
LOW FORCE INSERTION CONNECTOR

This is a continuation of application Ser. No. 390,090 filed Aug. 23, 1973 now abandoned.

This invention relates to electrical connectors and more particularly to an electrical connector for use with a printed circuit board which exerts minimal force on the circuit board terminals during insertion but thereafter develops the normal contact forces required to insure good electrical continuity. Printed circuit boards are extensively used throughout the electronics industry. For convenience, printed circuit boards are usually made to plug in and out of the chassis of the electrical component to which they are attached, instead of being directly wired to the chassis. In this way, they can be removed for easy repair or replacement, or to change the operating characteristics of the device.

Generally, the printed circuit board is manufactured with a plurality of terminals on a surface thereof. A connector is utilized to connect the printed circuit board to the chassis. Normally, the connector is mounted on the chassis and has a series of wire connectors extending therefrom, each of which is wired to the appropriate portion of the chassis. The printed circuit board is plugged into the connector with each of its terminals making electrical contact with the corresponding contact of the connector to connect the board to the circuit of the chassis.

It is a requirement of such connectors that each of the contacts of the connector exert a prescribed amount of force on the printed circuit board terminal associated therewith such that electrical continuity is insured. This is generally accomplished by making the connector contacts of a resilient material which can be deflected as the circuit board is inserted into the connector, thus exerting the necessary force on the printed circuit board terminals. However, it has been found that if this contact force is exerted during the insertion of the board, the board terminals are scraped by the contacts as the board is inserted. Since the board terminals are generally made of a very thin coating of conductive material on the circuit board, after many insertions the terminal may have been scraped or marred to the point where appropriate electrical continuity can no longer be achieved between the terminal and the contact.

Previous attempts to overcome this problem have proven unsuccessful because these connectors require, after insertion, some device or method, apart from the connector housing itself, to develop the required force between the contacts and the terminals which are necessary for good electrical continuity. This, of course, is undesirable, because it adds to the complexity and cost of the device as well as the time necessary to complete the insertion.

It is, therefore, the prime object of the present invention to provide an electrical connector for use with a printed circuit board which exerts minimal force on the board terminals during insertion of the board into the connector.

It is another object of the present invention to provide an electrical connector for use with a printed circuit board wherein the normal forces between the connector contacts and the board terminals necessary for good electrical continuity are developed subsequent to board insertion without the use of devices or methods apart from the connector itself.

It is a further object of the present invention to provide an electrical connector for use with printed circuit boards which can be releasably mounted to a chassis or another printed circuit board, as desired.

It is still a further object of the present invention to provide an electrical connector for use with printed circuit boards which is made of reliable and sturdy parts and takes up a minimal amount of space, and can be inexpensively manufactured.

In accordance with the present invention the connector comprises a housing having a recess adopted to receive the terminal carrying portion of the printed circuit board. The recess is defined in part by a back wall and a bottom abutment and is of a size and shape to enable it to freely receive the circuit board with the edge of the board engaging the abutment. A series of resilient contacts are situated in the recess adjacent the back wall. The recess is so shaped relative to the circuit board that the board may be received therein in an insertion position in which it is on the opposite side of the contacts from the back wall and relatively remote from the contacts, the board then being movable, as by pivoting, to a final position in which it operatively firmly engages the contacts.

In the insertion position the contacts make, at most, only minimal engagement with terminals and therefore no scratching or marring of the contacts takes place. Once inserted, the board is pivoted about the abutment such that the terminals move toward the resilient contacts. The movement of the board deflects the contacts, thus developing the forces required for good electrical continuity. When the pivotal movement is complete, securing means provided on the housing engage the board to retain it in the final position.

Scraping of the terminals is prevented because the terminals are remote from the contacts during insertion. The forces on the contacts are not developed until after insertion, when movement to the final position takes place. However, during this movement no scraping of the terminals occurs as the forces used to deflect the contacts act substantially normal to the terminal surface.

To the accomplishment of the above, and to other aspects as they hereinafter appear, the present invention relates to an electrical connector for use with printed circuit boards, as defined in the appended claims and as described in the specification, taken together with the accompanying drawings, wherein like numerals refer to like parts and in which:

FIG. 1 is an isometric view of the connector as a printed circuit board is inserted therein;

FIG. 2 is a side cross-sectional view showing the printed circuit board in the insertion position;

FIG. 3 is a view similar to FIG. 2 showing the printed circuit board in the final position; and

FIG. 4 is a top cutaway view of the connector showing the securing means as the circuit board is moved to the final position.

The electrical connector of the present invention comprises a housing, generally designated A, into which a printed circuit board, generally designated B, is inserted. Printed circuit board B is of the type which has a plurality of terminals C on the surface thereof. Housing A has a recess D adopted to receive the terminal carrying portion of circuit board B. Recess D is defined, in part, by a back wall, generally designated E,
and a bottom abutment, generally designated F and is of a size and shape such as to freely receive board B with the edge of board B engaging abutment F.

A plurality of connector contacts, generally designated G, are situated in recess D adjacent back wall E. Recess D is shaped relative to board B such that board B may be received in recess D in an insertion position in which it is on the opposite side of the contacts G from back wall C and relatively remote from the contacts G, and may be moved, as by pivoting, to a final position in which it is relatively close to contacts G and back wall E.

Contacts G make, at most, only minimal engagement with terminals C on board B when the board is in the insertion position. However, those contacts G are adopted to operatively engage terminals C when the board B has been moved to the final position. This permits the insertion of the board without exertion of forces on the terminals. The force required to provide electrical continuity between terminals C and the connector contacts G is determined by the board B being moved to the final position. Securing means, generally designated H, are provided on housing A to engage board B when the board is moved to the final position. Means H will retain the board in the final position until the board is to be removed from the connector.

The connector of the present invention can be used in conjunction with a chassis or another printed circuit board. In order to mount the connector on the chassis or the printed circuit board, means, generally designated I, are provided for removable securing the connector to the chassis or the circuit board. Further, each of the contacts G is provided with a wire connecting member, generally designated J, which extends out the bottom of the housing. After the connector has been mounted, these members J will be wired or otherwise electrically connected into the circuit of the chassis or the printed circuit board to provide an electrical connection between the chassis and the printed circuit board B.

Referring now to FIG. 1, housing A is preferably produced of insulating material molded to form a single unit. A recess D adopted to accept the edge of the printed circuit board B is present along the length of housing A. The portion of board B which is inserted into recess D has terminals C situated thereon.

As can best be seen in FIGS. 2 and 3, recess D is defined by back wall E and a multilevel bottom portion consisting of bottom abutment F and level 10. The top of recess D is opened and the front is bound by a front wall 12 which is considerably shorter than back wall E to permit entry of board B into the recess at an angle with respect to back wall E. When board B is inserted into recess D, one corner of the leading edge thereof will rest on abutment F. Each terminal C will be oppositely disposed to bottom abutment F and will be relatively remote from opposing contact G.

Abutment F is a platform which forms a portion of the bottom of recess D. It acts as a fulcrum means about which the leading edge of board B pivots as it is moved from the insertion to the final positions. In the initial position board B makes an acute angle with the surface of abutment F. Board B is then pivoted about abutment F until it is substantially perpendicular to the surface thereof.

Back wall E is provided with a plurality of projections 14 which extend, within recess D, vertically from level 10 along the height of the wall E. Each pair of adjacent projections 14 forms a cavity in which one of the contacts G is situated.

Each contact G, because of the resilient characteristics of the material from which it is made, is movable between an extended position (FIG. 2) in which it protrudes beyond the surface of the projections 14 and a deflected position in which it is wholly within the cavity. The movement of contacts G is caused by the pivoting of board B about abutment F which acts as a fulcrum towards the final position (FIG. 3). The protrusion of contact G beyond the cavity in the extended position is limited by the interior corner of abutment F which is adjacent the bottom section of contact G and acts as a barrier to prevent contact G from extending too far beyond the surface projection 14 and thus interfering with the insertion of board B into recess D. In the final position the leading edge of board B will be flat on abutment F and the terminal side of board B will rest against the surfaces of projection 14 which act as a structural abutment to insure proper positioning of the board. In the final position each contact G is completely insulated from the remaining contacts by projections 14 which prevent any electrical shorting between adjacent contacts G.

As board B is pivoted about abutment F towards the final position, the terminals C thereon will approach the protruding portion of the corresponding contact G to deflect the contact. The deflection of the contact will develop the force necessary to insure proper electrical continuity between terminals C and the respective contacts G. However, this is accomplished with minimal scraping or marring of the terminal surface because the forces developed are substantially normal to the terminal surface throughout the movement of board B from the insertion to the final position, and there is substantially no relative longitudinal movement of the parts. When board B is in the final position it is substantially parallel to back wall E and resting against the surfaces of projections 14. The bottom edge of board B rests on abutment F.

Securing means H are provided to retain board B in this position until the board is removed from housing A. Each securing means H consists of a leaf 16, made of resilient material, and a snap head 18 both of which are situated on a projection 14. Preferably, leaf 16 and head 18 are integral with the projection 14 to which they are mounted. Although only two securing means H are shown in the drawings, it is obvious that as many as necessary may be utilized depending upon the size of the connector. For each securing means H utilized, a slot 20 is situated along the board B in alignment with the corresponding leaf 16. Slots 20 run from the leading edge of board B a length at least equal to the height of back wall E such that in the final position leaf 16 may be inserted therein to provide extra positional stability.

As seen in FIG. 4, snap head 18 is provided with an inclined surface such that the head 18 is cammed aside by the edge of slot 20 such that it passes through slot 20 as board B is moved into the final position. Once the board is in the final position, snap head 18 returns to its original position because of the resiliency of leaf 16 and the overhang thereon securely engages the edge of slot 20 and retains the board between head 18 and the surfaces of projection 14.

As can be seen in FIGS. 2 and 3, each head 18 has a lower beveled surface 22 which permits board B to be
inserted into recess D. Preferably, the inner corner of the front wall 12 is also beveled for the same reason. These beveled surfaces facilitate insertion of board B at the proper angle with respect to back wall E.

Extending from the bottom of each contact G through passages provided in level 10 is a connector J which permits electrical connection of the contact G to the circuit of the chassis to which housing A is mounted. This connection may be accomplished by wrapping wires about connector J or otherwise, as desired.

In order to mount housing A to a chassis or another circuit board, removable securing means are provided extending downward from each side of housing A. Each means I comprises a snap head 24 which fits into the appropriate opening in the chassis or circuit board to which housing A is mounted. The operation of snap head 24 is substantially the same as that described for snap head 16. Preferably, snap heads 24 are offset from each other, i.e. one placed near the front wall 12 and one towards back wall E so that several connectors can be used side by side without interference by heads 24, or to provide a polarizing control in conjunction with the panel on which they are mounted.

In operation, housing A is secured to a chassis by snap heads 24 and wired to the circuit by means of connectors J. The circuit board is inserted at an angle with respect to back wall E until the corner of the leading edge rests on abutment F. At this point terminals C are aligned with but remote from corresponding contacts G. The board B is then pivoted to the final position parallel to wall E thus deflecting the contacts, and thus developing the necessary contact forces between terminals C and contact G. In this position, contact G is in compression against the surfaces of projections 14. During pivoting, snap heads 18 pass through slots 20 and secure the board in the final position. In this mode of operation, it can be seen that there is little or no contact between the terminals on board B and contacts G as board B is inserted in the connector. While the board is pivoted from the insertion position to the final position, force is developed between the terminal C and contact G but it is normal to the surface of the terminal and therefore does not scratch or wear away the terminal. In this way, minimal force is exerted which can mar or scrape the terminal during insertion, and yet when the board is moved to the final position the necessary forces are developed between the terminal and the contact to insure electrical continuity.

It has been assumed during the explanation that the electrical connector itself has been fixed and the circuit board movable. However, in instances when the reverse situation occurs, i.e. that the circuit board is fixed and the connector is moved, the same mode of operation as described can be used equally successfully. Further, certain applications require fixed circuit boards and fixed connectors in a drawer-type relationship. The connector of the present invention can also be used in this situation, even though its non-scratching characteristic will not be utilized. In such a case instead of being inserted in the insertion position and then pivoted to the final position, the board slides directly into the final position by aligning slots 20 with leaves 16 and then relatively moving the board and the connector in parallel planes until the leading edge of board B rests on abutment F. Bevel 26 on the top of head 18 is utilized in this situation to facilitate entrance of board B directly into the final position. Some scraping force will be exerted by contacts G on the terminals C during this insertion. However, due to the shape of the outer surface of terminals G, which is inclined, the marring or scratching which occurs in this type of insertion is minimized.

A single preferred embodiment of the present invention has been specifically disclosed herein for purposes of illustration. It is apparent that many variations and modifications may be made upon the specific structure disclosed herein. It is intended to cover all of these variations and modifications which fall within the scope of this invention as defined by the appended claims.

We claim:

1. A low force insertion connector for use with a circuit board having a terminal on a surface thereof, said connector having a contact mounted thereon and being of the type in which the board is inserted into said connector in a first position wherein there is at most minimal engagement between said terminal and said contact and is movable to a second position wherein operative engagement between said terminal and said contact is achieved, said connector comprising a housing having a recess therein, said recess being defined, in part, by a back wall, a bottom wall, and a front wall, said contact being situated in said recess adjacent said back wall, and an abutment within said recess and integral with said bottom wall against which the bottom edge of said board is received, said abutment and another portion of said housing spaced forwardly of said contact defining a point facing said contact engaged by the corner of said board formed by the leading edge thereof and the surface thereof opposite the terminal carrying surface and about which said board pivots substantially on said corner as said board moves from the first position to the second position.

2. The connector according to claim 1 wherein said contact is movable between an extended position wherein it is relatively remote from the board and a deflected position wherein it engages said terminal by the movement of said board to said second position.

3. The connector according to claim 2 further comprising means for guiding the board into said first position.

4. The connector according to claim 1 wherein said recess is opened at the top and at least part of the front face to permit the board to be pivoted about said abutment between said first and said second positions.

5. The connector according to claim 4 wherein said contact engages said abutment so as to retain said contact in the extended position.

6. The connector according to claim 4 wherein said securing means is adapted to make a snap engagement with the board.

7. The connector according to claim 1 further comprising a securing means adapted to make a snap engagement with the board.

8. The connector according to claim 7 wherein said snap engagement is provided by a member projecting from said back wall.

9. The connector according to claim 8 wherein said member comprises a flexible leaf portion integral with said wall and a snap head, said head being mounted on said leaf.

10. The connector according to claim 9 wherein said head has a beveled portion for guiding the board into said first position.

11. The connector according to claim 1 further comprising a circuit board having a slot therein, and a securing means engaging the edge of said slot to retain
said board in said second position.

12. The connector according to claim 11 wherein said securing means makes a snap engagement with said slot edge.

13. The connector according to claim 11 wherein said securing means in insertable into said slot.

14. The connector according to claim 1 wherein the surface of said other portion of said housing adjacent said pivot point is inclined to permit insertion of said board such that said board corner is in proximity to said pivot point.

15. The connector according to claim 14 further comprising a securing means adapted to make a snap engagement with the board.

16. A low force insertion connector for use with a circuit board having a terminal on the surface thereof, said connector having a contact mounted thereon and being of the type in which the board is inserted into said connector in a first position wherein there is at most minimal engagement between said terminal and said contact and is movable to a second position wherein operative engagement between said terminal and said contact is achieved, said connector comprising a housing having a recess therein, said recess being defined, in part, by a back wall, a bottom wall, and a front wall, said contact being situated in said recess adjacent said back wall, and an abutment within said recess integral with said bottom wall, said abutment and another portion of said housing joining to form a point about which said board pivots as said board moves from the first to the second position, said pivot point being spaced from said contact along said abutment so as to form an unobstructed opening between said pivot point and said contact into which the board may be inserted, the pivot point engaging the board on the opposite side thereof from the contact-engaging side thereof.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,920,303
DATED : November 18, 1975
INVENTOR(S) : ROBERT B. PITTMAN and MICHAEL OFFERMAN

It is certified that error appears in the above-identified patent and that said Letters Patent
are hereby corrected as shown below:

Please change inventor's name from ROBERT D. PITTMAN
to ROBERT B. PITTMAN.

Signed and Sealed this
seventeenth Day of February 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks