United States Patent [19]

Yeager et al.

[11] **3,899,234**

[45] **Aug. 12, 1975**

[54] **LOW INSERTION FORCE CAM ACTUATED PRINTED CIRCUIT BOARD CONNECTOR**

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[73] Assignee: **AMP Incorporated,** Harrisburg, Pa.

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[21] Appl. No.: **453,116**

[52] **U.S. Cl.**..... **339/74 R;** 339/75 MP; 339/176 MP

[51] **Int. Cl.**[2]..... **H01R 13/62**

[58] **Field of Search**..... 339/74 R, 75 MP, 176 MP

[56] **References Cited**

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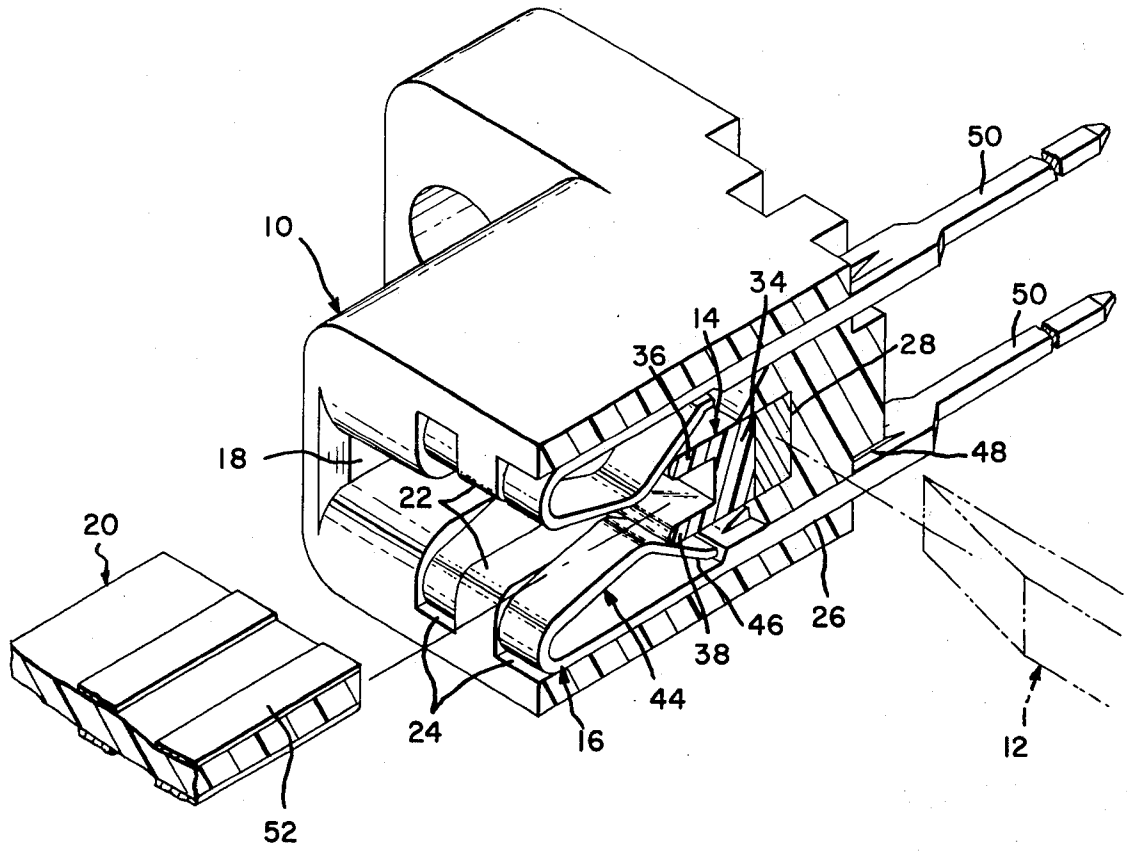
IBM Technical Bulletin, High-Density Card Edge Connector, Agard et al., Vol. 13, No. 9, p. 2612, Feb., 1971.

Primary Examiner—Roy Lake
Assistant Examiner—Neil Abrams
Attorney, Agent, or Firm—Russell J. Egan, Esq.

[57] **ABSTRACT**

A low insertion force connector is disclosed for mounting printed circuit boards and the like, the contacts of the connector being engaged with and disengaged from an edge of the board through cam actuation. The housing of the subject connector has an elongated board receiving aperture. An elongated contact drive member lies freely at the bottom of the aperture and a cam is arranged to move between the drive member and aperture bottom. A plurality of contacts are mounted in spaced apart parallel arrangement on both elongated walls of the aperture. The subject connector can be arranged for the cam movement to either drive the contacts into engagement with a board inserted in the aperture or to drive the contacts to a position where the aperture will be substantially cleared of contacts to allow insertion of a circuit board without force.

9 Claims, 13 Drawing Figures



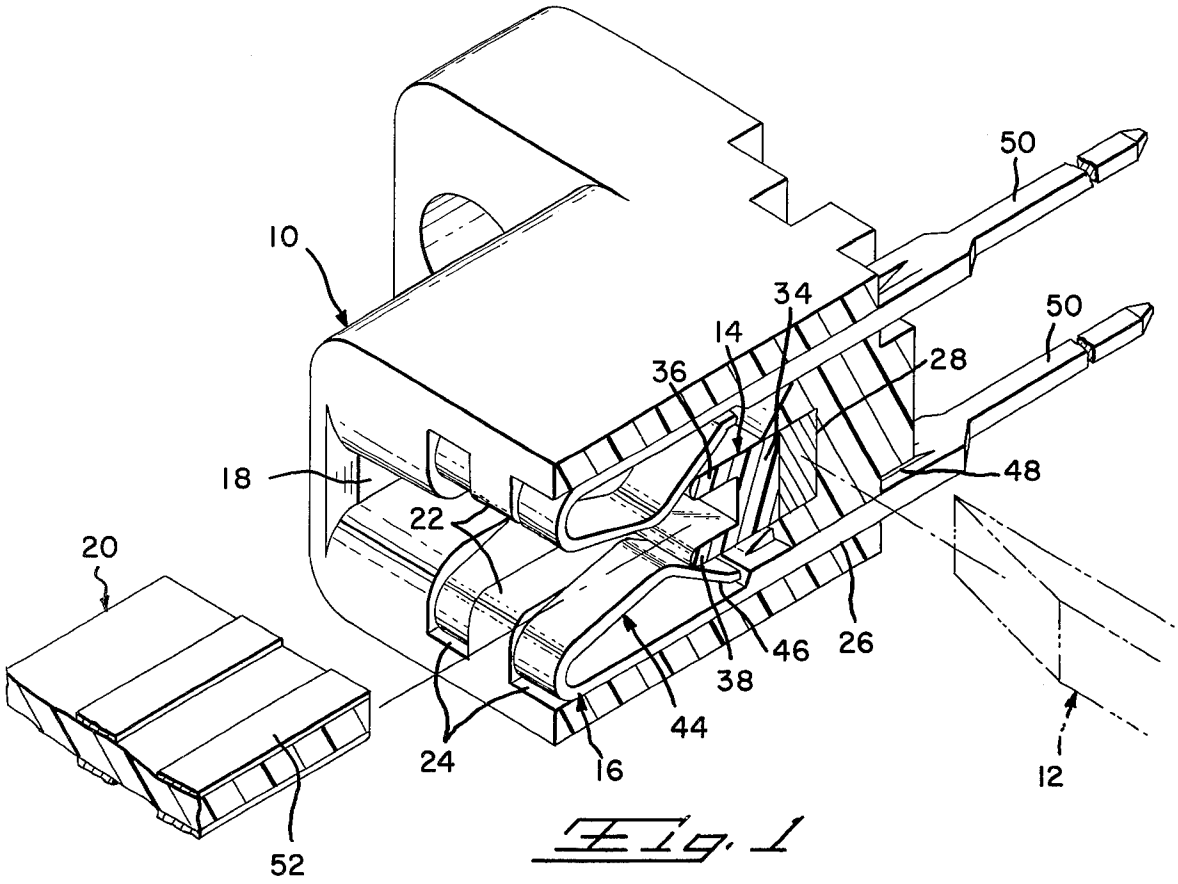

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Fig. 1

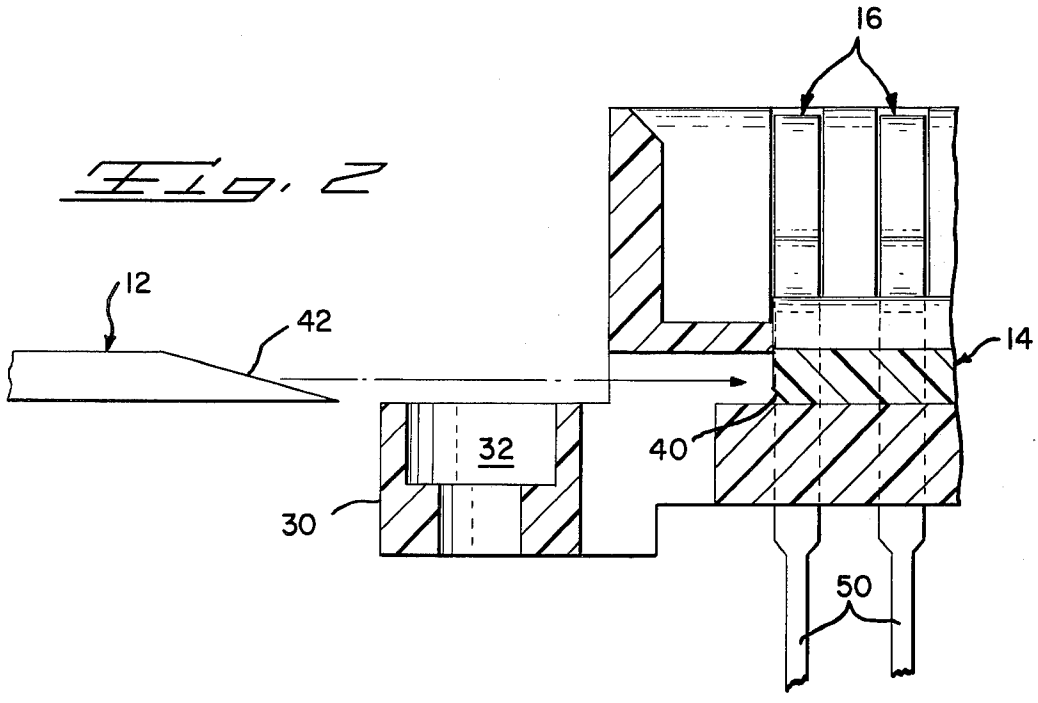

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Fig. 2

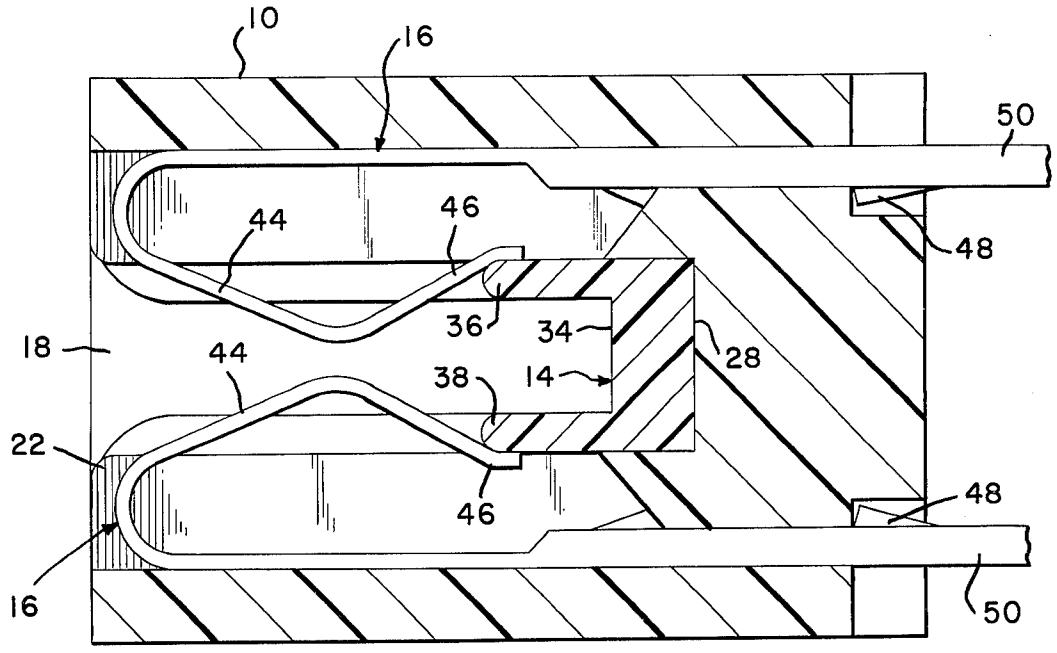

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Fig. 3

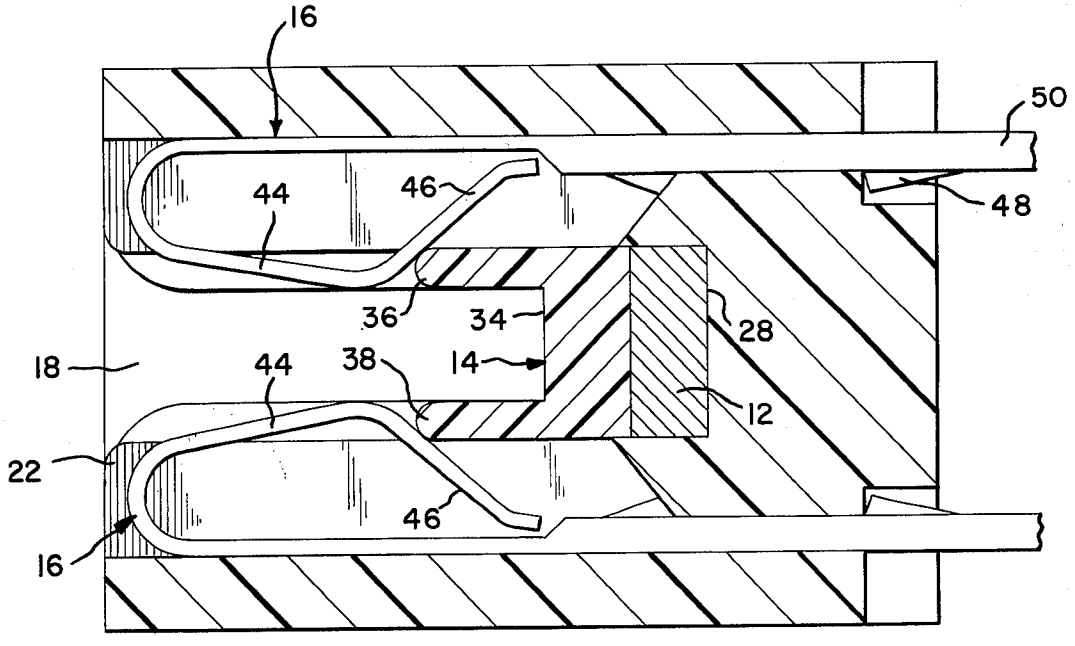

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Fig. 4

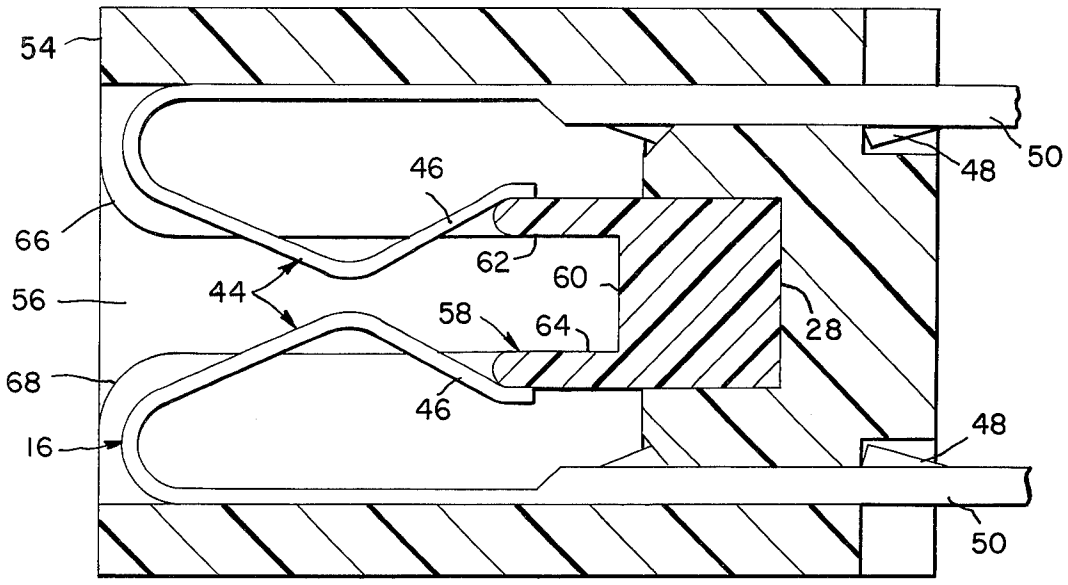

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Fig. 5

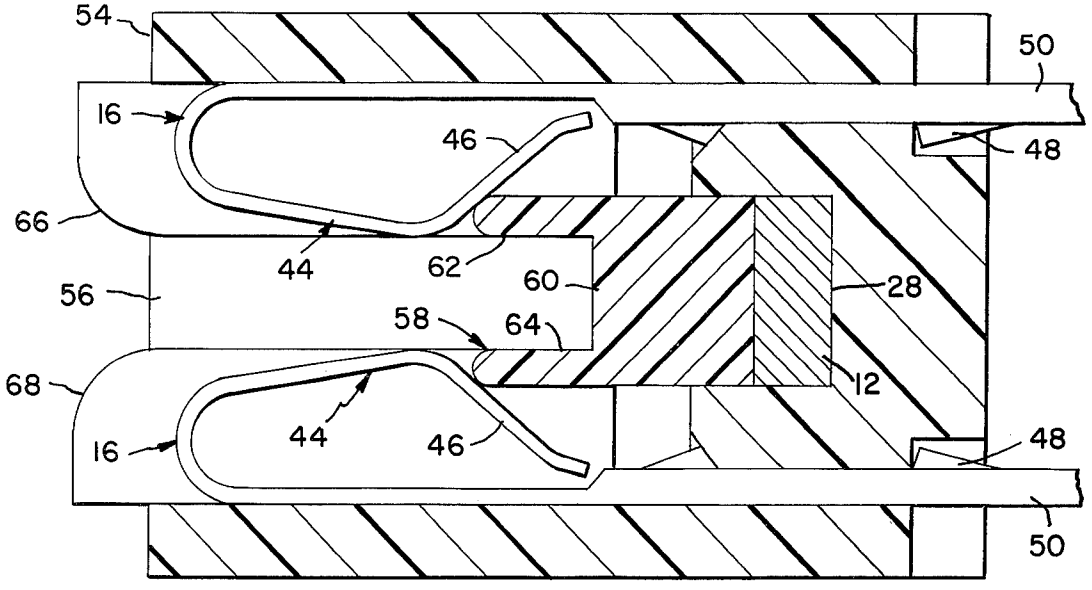

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Fig. 6

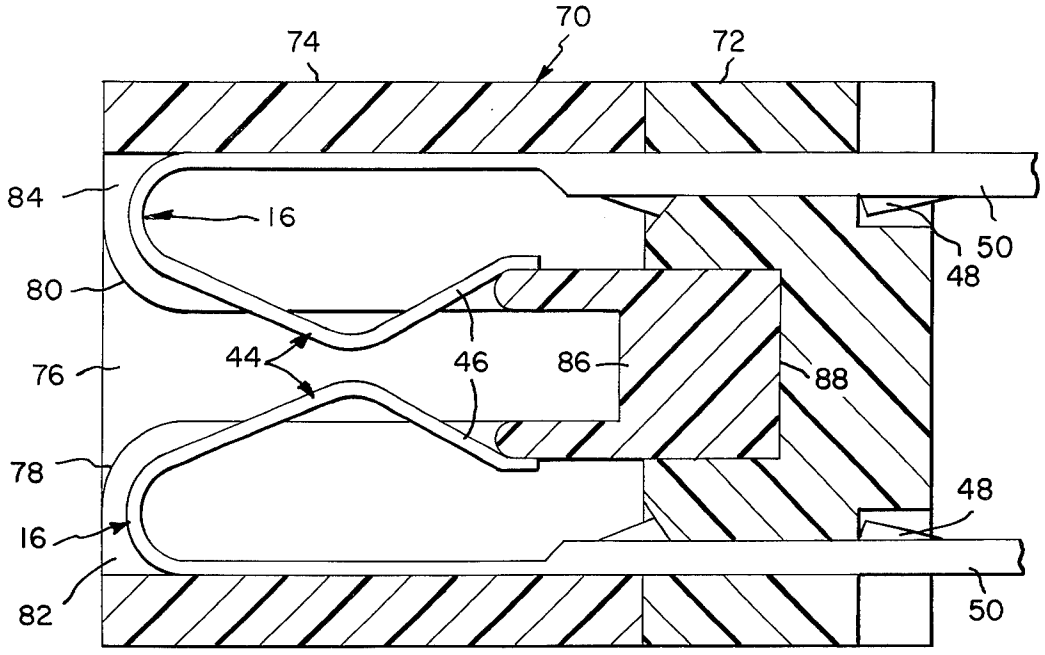

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Fig. 7

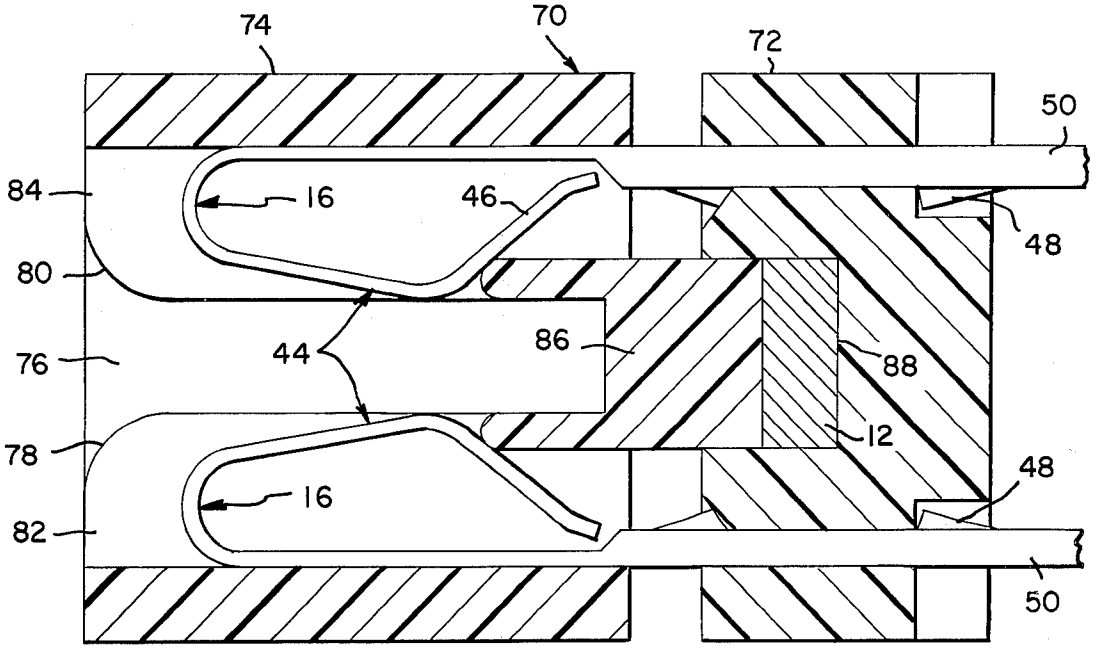

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Fig. 8

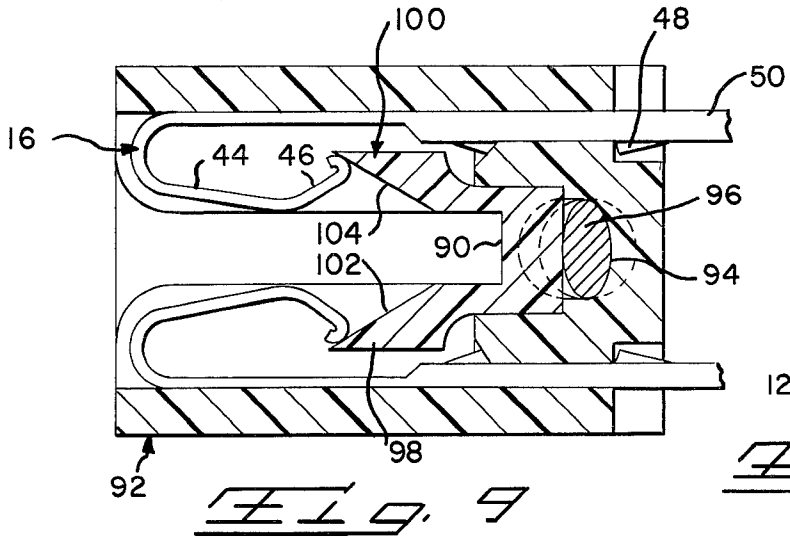


Fig. 9

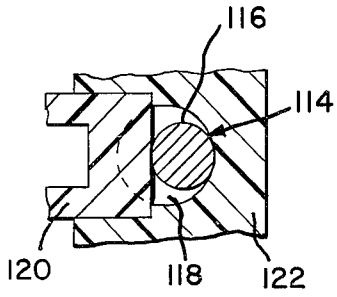


Fig. 12

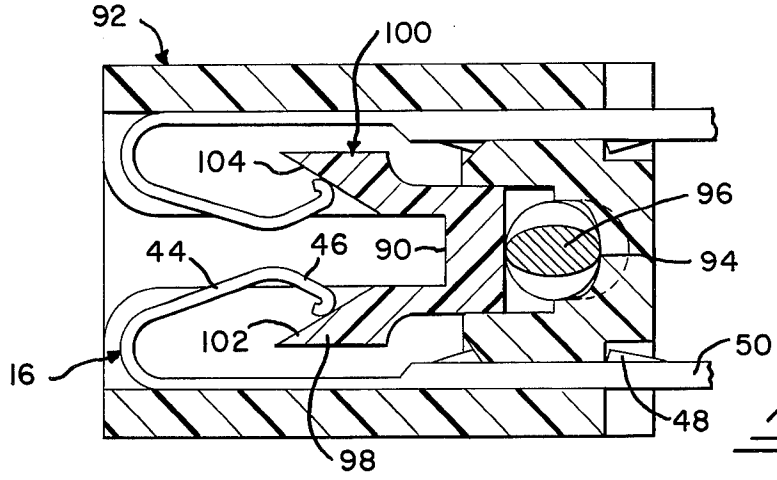


Fig. 10

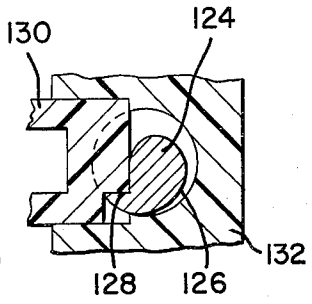
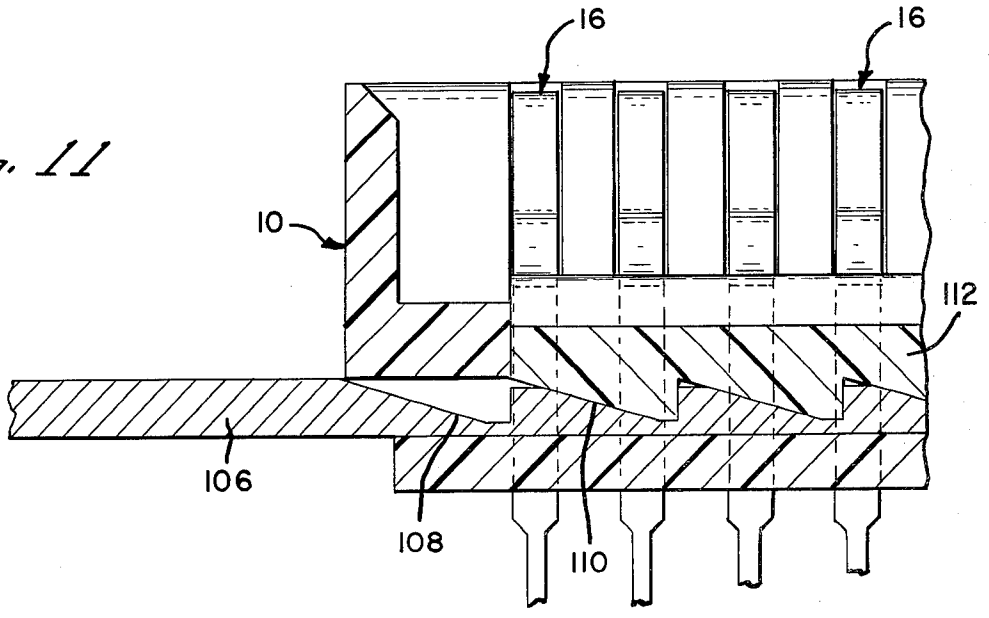


Fig. 13

Fig. 11



LOW INSERTION FORCE CAM ACTUATED PRINTED CIRCUIT BOARD CONNECTOR

BACKGROUND OF THE INVENTION

1. The Field of the Invention

The present invention relates to a zero or low insertion force corrector for mounting a printed circuit board or the like and in particular to a low insertion force connector utilizing a cam driven member for bringing a multiplicity of contacts into and out of engagement with the circuit board.

2. The Prior Art

Zero insertion force connectors are well known and come in a variety of configurations. Most of the zero insertion force connectors thus far produced have been relatively expensive to manufacture due to the relatively high number of parts involved and, in some instances, close tolerance parts requiring expensive manufacturing processes, such as machining. Other such connectors have intricate actuating mechanisms generally requiring two actuating members, one for each side of the circuit board or substrate.

An example of one type of known low insertion force connector can be found in U.S. Pat. Nos. 3,130,351 and 3,478,301. These patents show connectors having contacts which are normally positioned to be out of engagement with a circuit board. The contacts are brought into engagement with a board by pressing the board into the connector against cam members which bias the contacts into engagement with the board. While such an arrangement achieves a low wear on the pads of the board, it requires a substantial amount of effort to actuate the cam means.

Attempts have been made to use a fluid pressure inflatable member as the camming means to compress or spread contacts into or out of engagement with printed circuit boards. Examples of this type of low insertion force connector can be found in U.S. Pat. Nos. 2,978,666 and 3,366,916.

The more common approach to cam actuation has been to have a longitudinally extending cam mounted in the housing and to actuate the cam to apply force to the contacts either directly or through members moveable in the housing. Examples of this type of connector can be found in U.S. Pat. Nos. 3,495,132; 3,665,370; and 3,697,929.

Attempts have also been made to obviate the need for a separate cam and to use portions of the housing directly to act on the contacts to drive them into and out of engagement with the circuit board. Such teachings can be found in U.S. Pat. Nos. 2,857,577; 3,474,387; 3,475,717; and 3,639,888.

Most of the above mentioned connectors which employ cams rotate the cams about their own axial dimension. Others have taught using cams moved longitudinally of the connector member. Examples of such teachings can be found in U.S. Pat. Nos. 3,426,313 and 3,576,515.

SUMMARY OF THE INVENTION

The subject low insertion force edge board connector includes an elongated housing having an elongated board receiving aperture therein, a cam member adopted to be moved longitudinally of the housing along the bottom of the aperture, a contact drive moveable with respect to the base of the aperture in responsive to movement of the cam, and a plurality of

contacts mounted in the housing and responsive to movement of the contact drive member. The contacts of the subject connector are adapted to driven either into or out of engagement with the circuit board from a normal position. The contact drive member can be either a simple channel shaped configuration which acts on a free end of contacts or it can include a plurality of parallel spaced apart spacer members defining recesses in which the contacts lie. The cam member can have either a single camming surface or a plurality of camming surfaces adapted to coact with a like plurality of cam surfaces on the contact driving member.

It is therefore an object of the present invention to produce an improved can actuated low insertion force edge board connector in which contacts normally positioned spaced apart a distance greater than the thickness of a circuit board are driven into engagement with the circuit board through actuation of a contact drive member responsive to a cam member in the connector housing.

It is another object of the present invention to produce a low insertion force edge board connector having a plurality of contacts normally positioned to engage circuit board, the contacts being removed to a position remote from their normal position by a contact drive member responsive to the axial movement of the cam.

It is still another object of the present invention to produce a low insertion force edge board connector having a contact drive member which acts on the free ends of the contacts thus requiring only a relatively low cam force for operation.

It is a further object of the present invention to produce an improved low insertion force edge board connector having a contact drive member which both protects the contacts during actuation and moves the contacts from a position remote from a circuit board to a position engaging the pads of the circuit board.

It is yet another object of the present invention to produce an improved low insertion force edge board connector which can be readily and economically produced.

The foregoing and other objects of the present invention will become apparent to those skilled in the art from the following detailed description taken with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an end portion of the preferred embodiment of the subject low insertion force edge board connector;

FIG. 2 is a longitudinal vertical section through one end of the edge board connector shown in FIG. 1;

FIG. 3 is a vertical transverse section through the edge board connector shown in FIGS. 1 and 2 showing the position of the contacts with the cam removed;

FIG. 4 is a vertical transverse section, similar to FIG. 3, showing the subject edge board connector with the cam in place and the contacts positioned for receiving a circuit board;

FIG. 5 is a vertical transverse section through a first alternate embodiment of the subject edge board connector showing the contacts in an unbiased condition;

FIG. 6 is a vertical transverse section through the first alternate embodiment of FIG. 5 showing the contacts after actuation by the cam;

FIG. 7 is a vertical transverse section through a second alternate embodiment of the subject edge board

connector showing the contacts before being actuated by the cam;

FIG. 8 is a vertical transverse section, similar to FIG. 7, showing the second alternate embodiment after the contacts have been actuated by the cam;

FIG. 9 is a vertical transverse section through a third alternate embodiment of the subject edge board connector showing the contacts at rest;

FIG. 10 is a vertical transverse section similar to FIG. 9 showing the third alternate embodiment of subject edge board connector after actuation by an alternate cam;

FIG. 11 is a longitudinal vertical section through one end of the subject edge board connector showing another alternate arrangement of the cam and contact drive member;

FIG. 12 is a fragmentary vertical transverse section showing an alternate cam with eccentric camming surfaces; and

FIG. 13 is a fragmentary vertical transverse section showing another alternate cam having a spiral camming surface.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiment of the subject low insertion force edge board connector is shown in FIGS. 1 to 4. The connector includes four primary components, namely, housing **10**, cam member **12**, contact driving member **14**, and a plurality of contacts **16**.

The housing **10** has a longitudinally extending, elongated central aperture **18** in which the circuit board **20** is received. On both sides of the aperture **18** there are a plurality of parallel spaced apart spacer members **22** which define therebetween a plurality of contact recesses **24** in which each contact **16** is received. A passage **26** extends from the end of each recess **24** through the base of the housing. A longitudinally extending cam receiving groove **28** extends centrally of the base of the aperture **18**. The housing also includes conventional mounting flanges **30** having bores **32** therein for the passage of mounting means, not shown, such as bolts and screws.

The contact driving member **14** has a generally channel shape section with a thickened base portion **34** and two parallel side wall portions **36, 38**. The base of the member **14** lies within groove **28** where it can be engaged by the cam. The free edges of the side walls **36, 38** engage the free ends of the contacts **16**. The longitudinal ends of the base **34** include bevelled surfaces **40** which are initially engaged by the cam **12**.

The cam member **12** is an elongated member adapted to be passed through the cam receiving groove **28** and has an inclined forward cam surface **42** which initially engages a bevelled surface **40** of the contact driving member **14** to drive the member out of the groove **28**.

The contacts **16** are of strip form and extend through the passages **26** providing resilient contact portions **44** inside the housing. The free end **46** of each contact engages a side wall of the driving member **14**. Each contact is also provided with at least one locking lance **48** and a terminal portion **50** lying outside of the housing.

The preferred embodiment of the subject edge board connector is operated by inserting cam member **12** longitudinally into groove **28** through the housing **10**, as shown in FIGS. **1, 2** and **4**. With the cam **12** fully inserted, the side walls **36** and **38** of the contact driving member **14** the engage free ends **46** of the contacts and bias the contacts **16** to a position where they lie substantially fully within recesses **24** to clear aperture **18** and allow the insertion of the circuit board **20** without any wiping of the pads **52** on the circuit board by contacts **16** or force being applied to the board. When the circuit board **20** is fully inserted in aperture **18**, the cam member **12** is withdrawn allowing the driving member **14** to return to the position shown in FIG. 3 under the resilient force of the contacts, as well as possible continued insertion force of the circuit board. A particular advantage is achieved by this arrangement in that the contacts are engaged on their free ends thus requiring only a low cam force to move them to their biased position.

The first alternate embodiment of the subject edge board connector, as shown in FIGS. **5** and **6**, is quite similar to the preferred embodiment. The cam **12** and contacts **16** are substantially identical. The difference lies in the housing and the contact driving member. In this embodiment the housing **54** has an elongated central aperture **56** which has a smooth walled rectilinear configuration. The contact driving member **58** is an integral member which includes a base portion **60**, a pair of parallel side walls **62** and **64** and a plurality of parallel spaced apart spacers **66, 68** which are arranged in comblike fashion to define therebetween a plurality of channels in which the contacts **16** are mounted. Actuation of the driving member **58** by the cam **12** causes the entire contact drive member **58** to slide with respect to the housing **54** and the contacts **16**. This movement causes a contact displacing operation similar to that described with reference to the preferred embodiment.

The second alternate embodiment is shown in FIGS. **7** and **8**. In this embodiment the cam **12** and the contacts **16** are also identical with the preferred embodiment. The housing **70** is formed by two parts including a base portion **72** and upper portion **74**. The upper portion of the housing **74** includes an elongated aperture **76** having on each elongated side thereof a plurality of parallel spaced apart spacer members **78**, 80 defining therebetween contact recesses **82, 84**, respectively, similar to housing **10**. The contact driving member **86** is similar to member **14** but is integral with the upper portion **74** of housing **70**. The base portion **72** includes a cam receiving groove **88**. Means, not shown, are provided at each end of the connector housing **70** for restricting the movement of the upper housing portion **74** to a limited reciprocating movement with respect to the housing base portion **72**.

The third alternate embodiment of the subject edge board connector is shown in FIGS. **9** and **10**. This embodiment is distinguished from the previous embodiments primarily by operation. In the previous embodiments the contacts have all been cammed to positions out of engagement with the circuit board. In the third alternate embodiment the contacts are cammed into engagement with the circuit board. For this reason the contact driving member **90** has a somewhat different configuration from the previous embodiments. The housing **92** is substantially the same as housing **10**. However, the cam receiving groove **94** is modified to receive cam member **96**, which has an oval section and is freely rotated about its longitudinal axis, rather than being moved axially of the housing. The contact driving

member **90** is distinguished from the previous contact driving members in that the side walls **98, 100** include inclined cam surfaces **101, 104,** respectively, which engage the free ends of the contacts **16** to drive the contacts toward one another. It will be noted that the normal resiliency of the contacts will keep them in a position as shown in FIG. **9** wherein the circuit board receiving aperture is substantially clear of interference of the contacts. Movement of the driving member **90** is accomplished by rotating cam **96** approximately 90° about its own longitudinal axis to drive the contacts into engagement with the circuit board.

FIG. **11** shows another alternate arrangement of a cam and one in which the cam can be allowed to permanently remain in the connector. In this embodiment the cam **106** is provided with a plurality of cam surfaces **108** which with a plurality of similar but oppositely directed cam surfaces **110** formed in the base of driving member **112.** The operation of this embodiment is substantially identical with the previously described embodiments.

FIG. **12** shows another alternate cam arrangement. In this embodiment the cam **114** has a plurality of eccentric camming portions **116** spaced along an axial portion **118.** The operation of the subject edge board connector equipped with this cam is substantially the same as the other embodiments. Rotation of the cam **114** causes movement of the contact drive member **120** with respect to housing **122.**

Another alternate cam is shown in FIG. **13.** This cam **124** has a spiral camming surface **126** and locking step **128.** This cam is rotated approximately 360° to move the contact driving member **130** with respect to housing **132.**

It is contemplated that the present invention may be subject to many modifications and changes without departing from the spirit or essential characteristics thereof. The present embodiments are therefore intended in all respects as illustrative and not restrictive of the scope of the invention.

We claim:

1. A low insertion force edge board connector comprising:

a housing having a longitudinally extending, elongated circuit board receiving aperture, a plurality of contact passageways in parallel spaced apart relationship in rows on each longitudinal side of the bottom of said aperture extending through a base portion of said housing, and a cam receiving groove extending longitudinally and centrally of the bottom of said aperture and opening therein, the sides of said cam receiving groove being inwardly spaced from said passageways;

a single cam means mounted for movement in said groove;

contact driving means mounted in said circuit board receiving aperture lying between said passageways and at least partially within said cam receiving groove and adapted to be driven by said cam means in a direction normal to said cam receiving groove, and

a plurality of contacts each having a resilient board engaging portion, an integral terminal portion and at least one locking lance, each of said contacts being fixedly mounted in two parallel, spaced apart rows with said terminal portions thereof extending through said passageways and with free end portions of said resilient board engaging portions positioned to be engaged by opposite sides of said contact driving means whereby all of said contacts are driven between a first position in engagement with a circuit board positioned in said circuit board receiving recess and a second position disengaged from said circuit board by a single movement of said cam means.

2. A low insertion force edge board connector according to claim **1** wherein said housing further comprises;

a plurality of spaced apart parallel spacer walls extending integrally from each side wall of said aperture defining contact recesses therebetween, said contact driving member biasing said contacts to lie substantially completely within said recesses in said second position.

3. A low insertion force edge board connector according to claim **1** wherein said housing comprises:

a base portion having said cam groove and said passageways therein, and

an upper portion having said elongated aperture therein and said contact driving member integral therewith, said cam means driving said upper housing portion with respect to said lower housing portion whereby said contacts are driven between said first and second positions.

4. A low insertion force edge board connector according to claim **1** wherein said contact driving means further comprises:

an elongated channel shaped member, and

a plurality of parallel spaced apart spacer members extending in comb-like fashion from each side wall of said channel shaped member to define a plurality of contact slots therebetween, said contacts lying fully within said slots in said second position.

5. A low insertion force edge board connector according to claim **1** wherein said cam means comprises:

an elongated member having a cam surface on a free forward end thereof,

said contact driving means having an inclined surface on one end thereof adapted to initially engage said cam surface of said cam means.

6. A low insertion force edge board connector according to claim **1** wherein said cam means comprises:

an elongated member having a plurality of cam surfaces spaced therealong,

said contact driving means having a like plurality of cam surfaces spaced therealong and adapted to mate with said cam surfaces of said cam means.

7. A low insertion force edge board connector according to claim **1** wherein said cam means comprises:

an elongated member having an eliptical section, said cam member being mounted in said housing for rotation about its longitudinal axis.

8. A low insertion force edge board connector according to claim **1** wherein said cam means comprises:

an elongated member having a plurality of integral eccentric cam surfaces projecting therefrom, said cam member being mounted in said housing for rotation about its longitudinal axis.

9. A low insertion force edge board connector according to claim **1** wherein said cam means comprises:

an elongated member having a cam surface which, in section, has a spiral configuration terminating in a locking step, said cam member being mounted in said housing for rotation about its longitudinal axis for approximately 360° of rotation.

* * * * *