United States Patent [19]

Pauza et al.

[11] **3,846,734**

[45] **Nov. 5, 1974**

[54] **FRAMES FOR ADAPTING A MULTI-CONTACT ELECTRICAL CONNECTOR TO ELECTRICALLY CONNECT WITH VARIOUS STYLES OF SUBSTRATES**

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

[22] Filed: **Feb. 6, 1973**

[21] Appl. No.: **330,158**

[52] **U.S. Cl.... 339/17 CF,** 174/DIG. 3, 317/101 CP, 339/91 R, 339/174, 339/176 MP

[51] **Int. Cl.** **H01r 13/54,** H05k 1/02

[58] **Field of Search** ..... 339/17, 14, 75, 174, 176, 339/65, 66, 91, 192, 217, 92, 256, 99; 317/101 CP, 101 CC, 101 DH, 101 C; 174/DIG. 3

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Primary Examiner—Paul R. Gilliam
Assistant Examiner—Terrell P. Lewis
Attorney, Agent, or Firm—William J. Keating; Jay L. Seitchik; Frederick W. Raring

[57] **ABSTRACT**

Frames are provided to adapt a multi-contact electrical connector to be electrically connectable with more than one style of ceramic substrate or the like. The connector is originally designed to accommodate therein a leadless ceramic substrate having two rows of spaced apart electrical terminal contact pads respectively disposed on two opposite side surfaces of the substrate. By insertion of either one of two different frames into the connector instead of the leadless substrate, the connector will be adapted to receive a corresponding one of two other styles of substrates.

1 Claim, 11 Drawing Figures

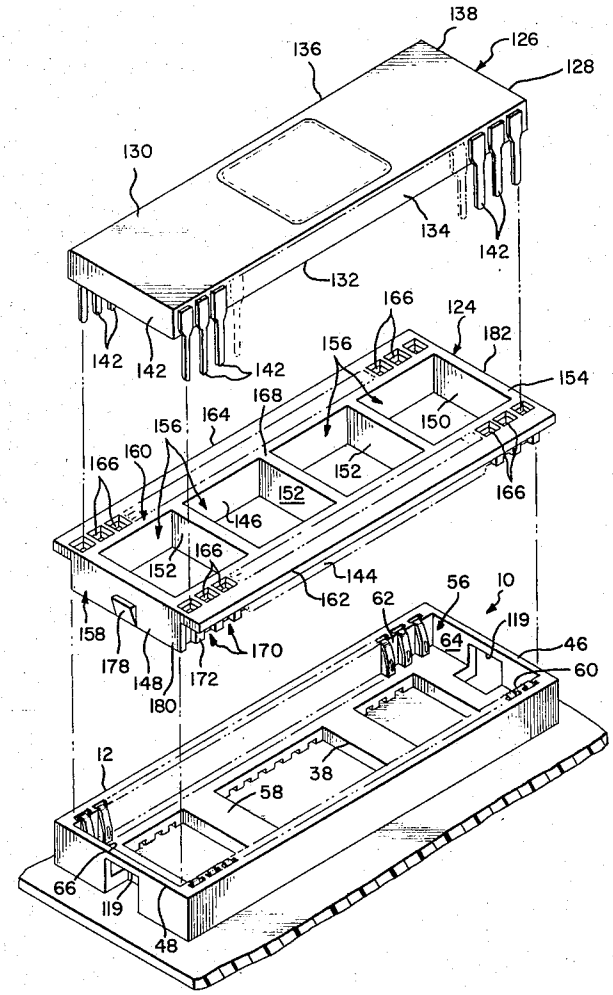

Fig. 1

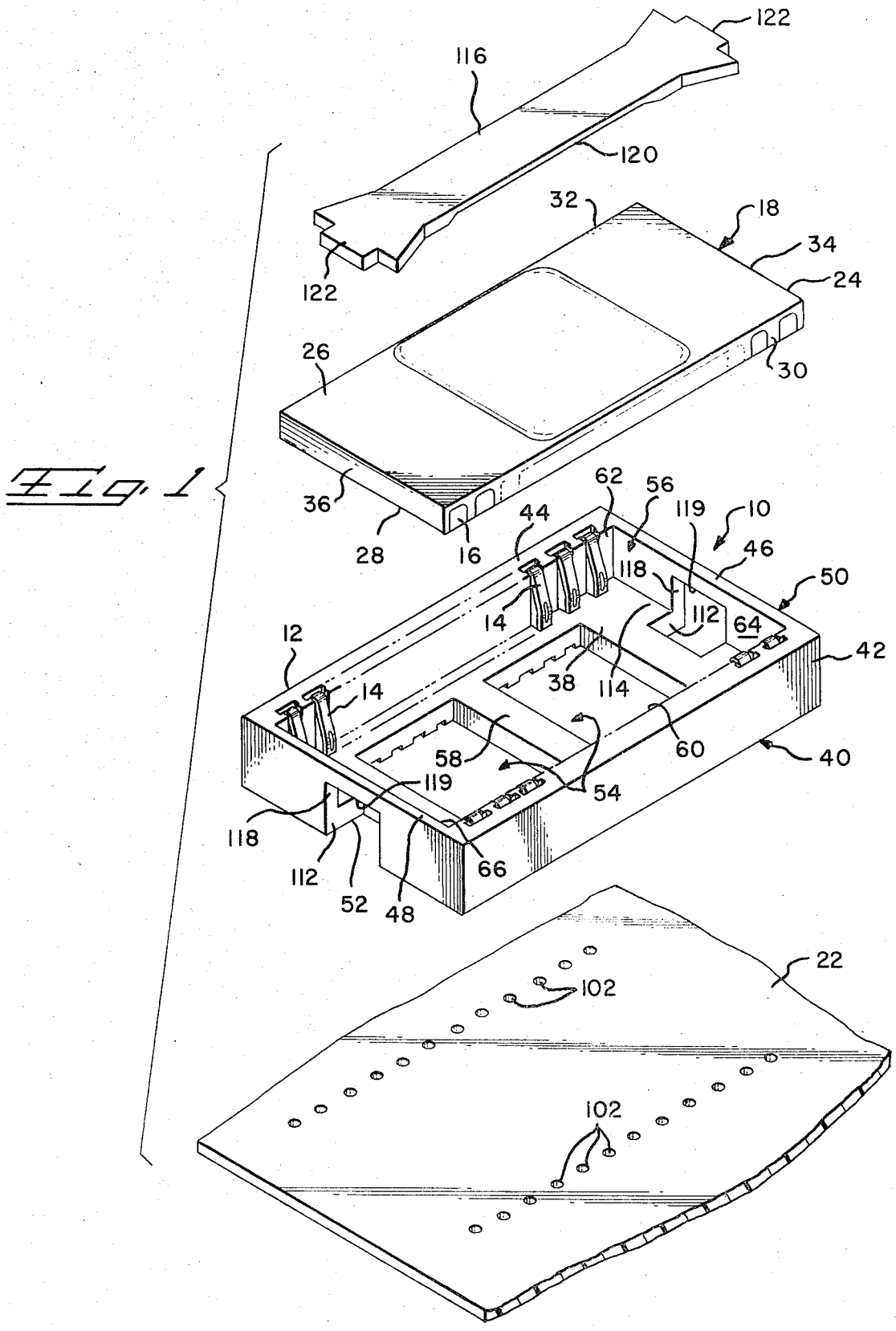
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Fig. 2

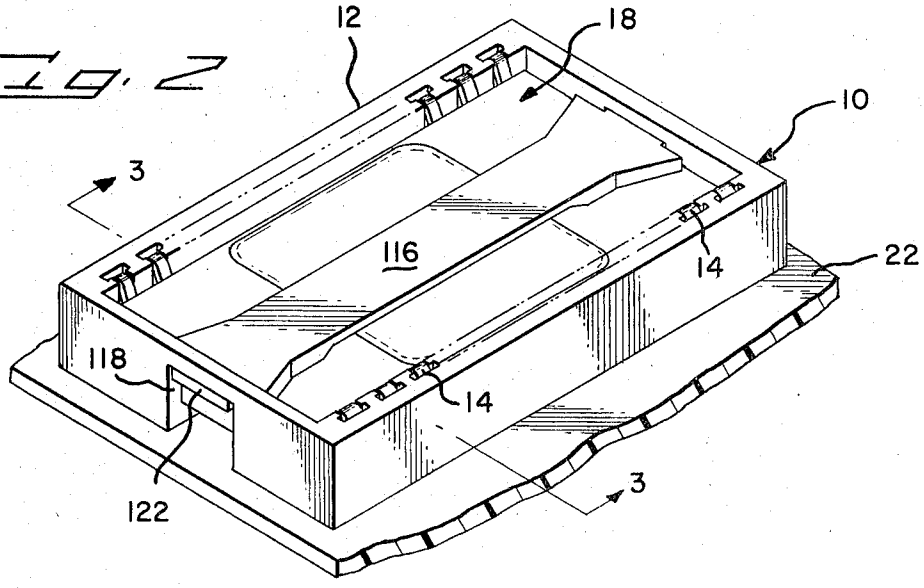
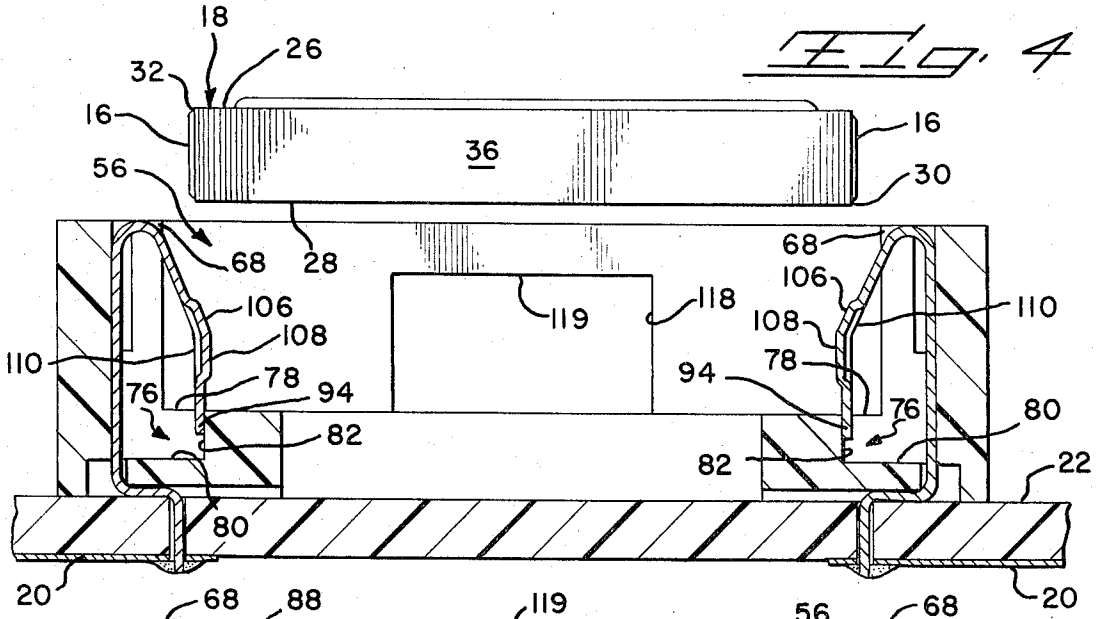


Fig. 4



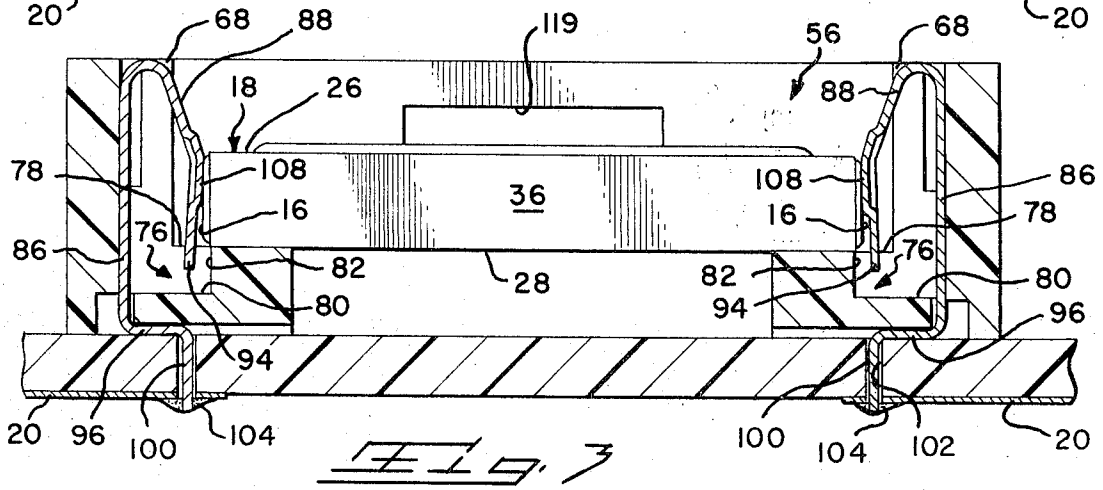


Fig. 3

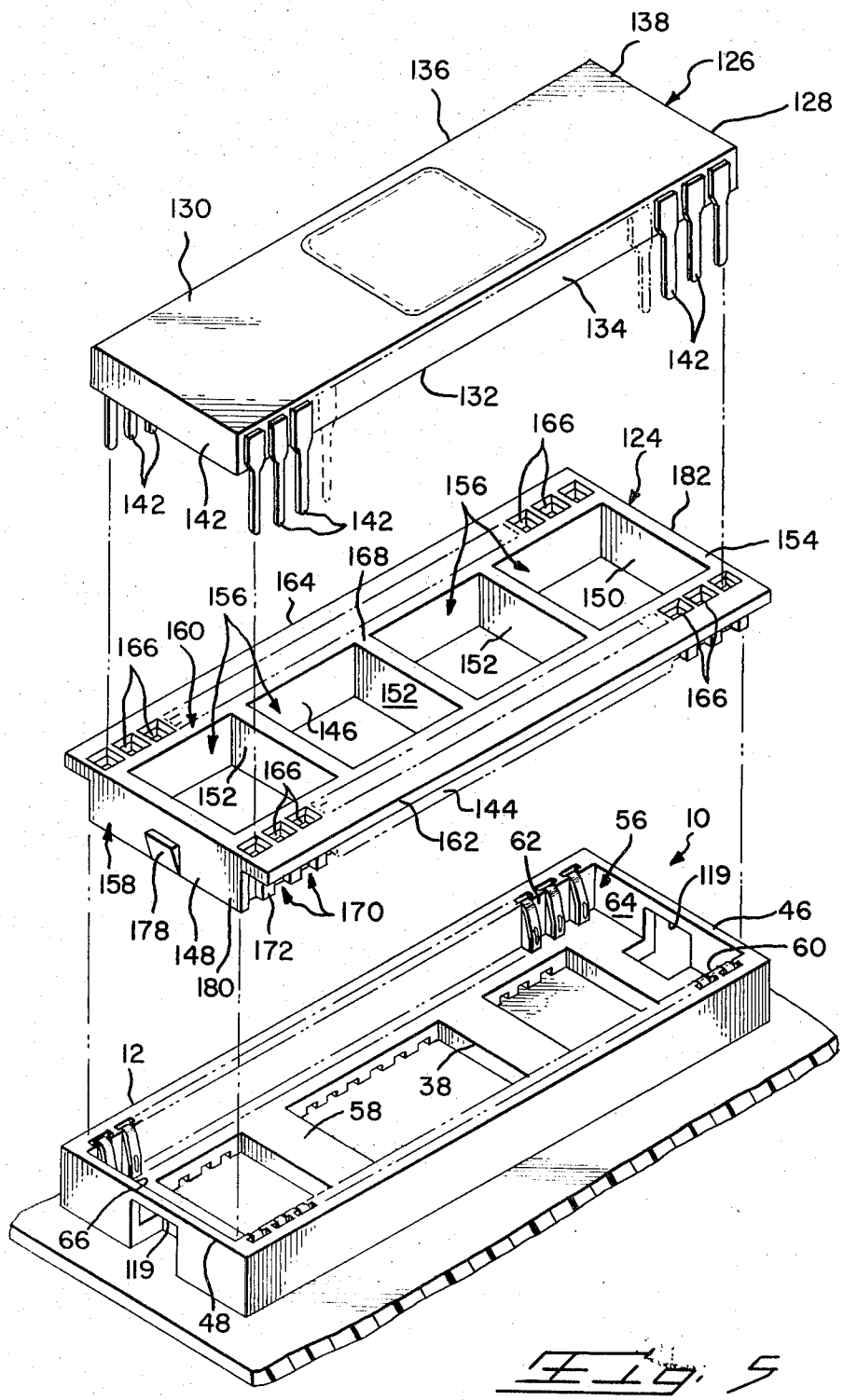

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Fig. 5

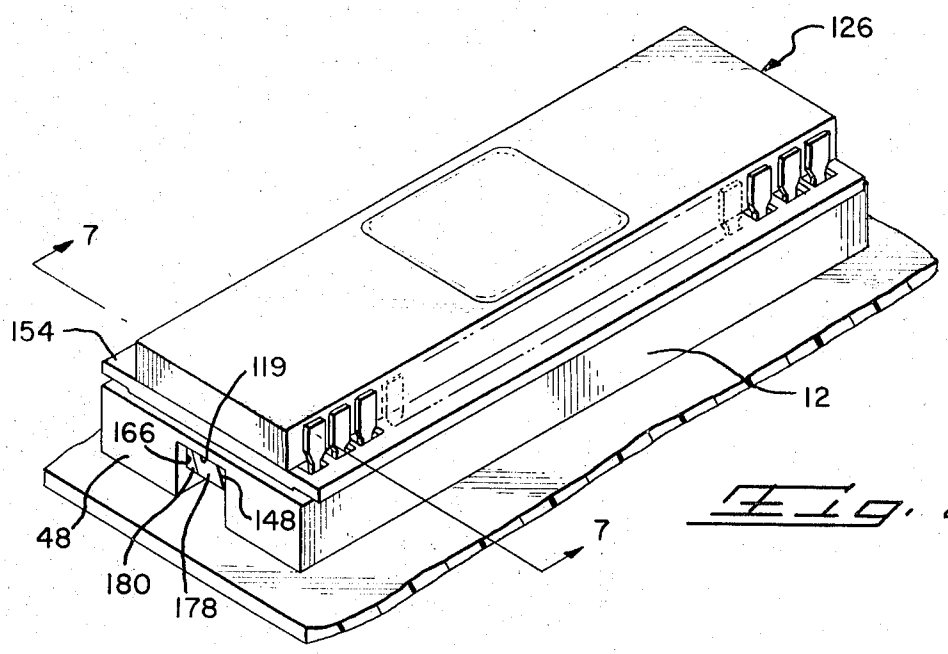
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Fig. 6

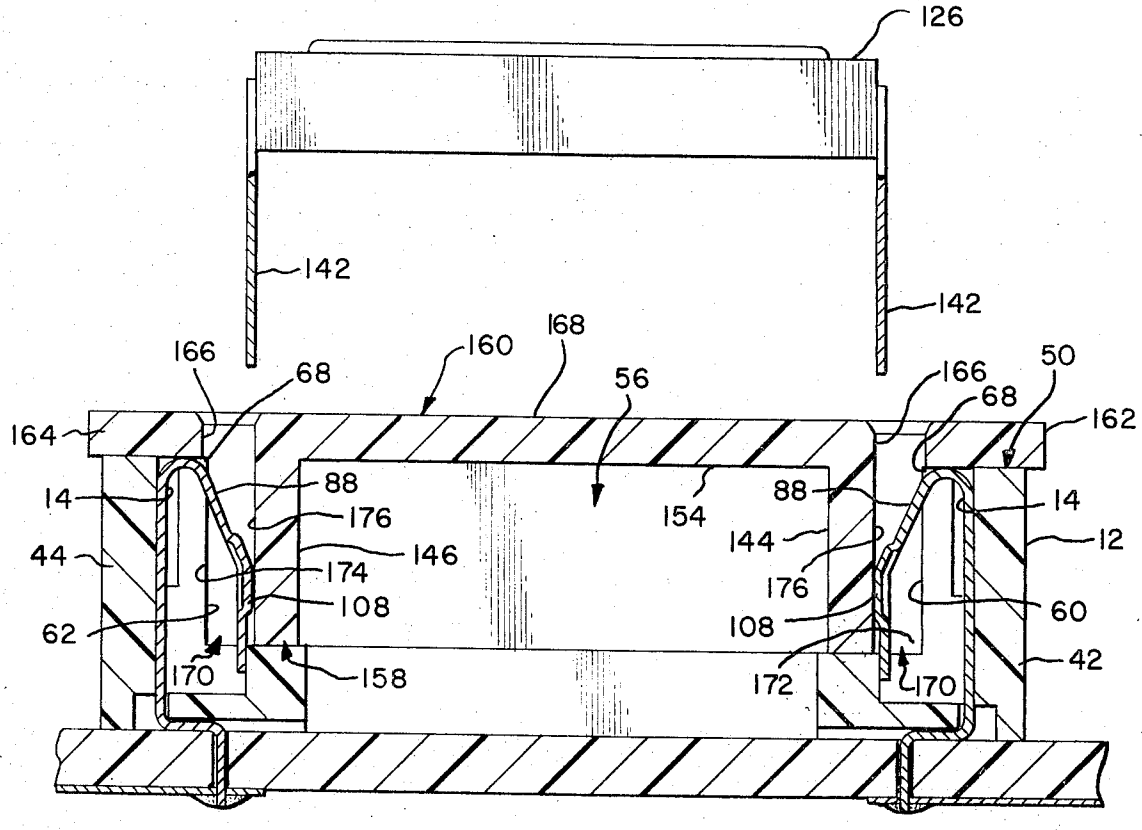
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Fig. 8

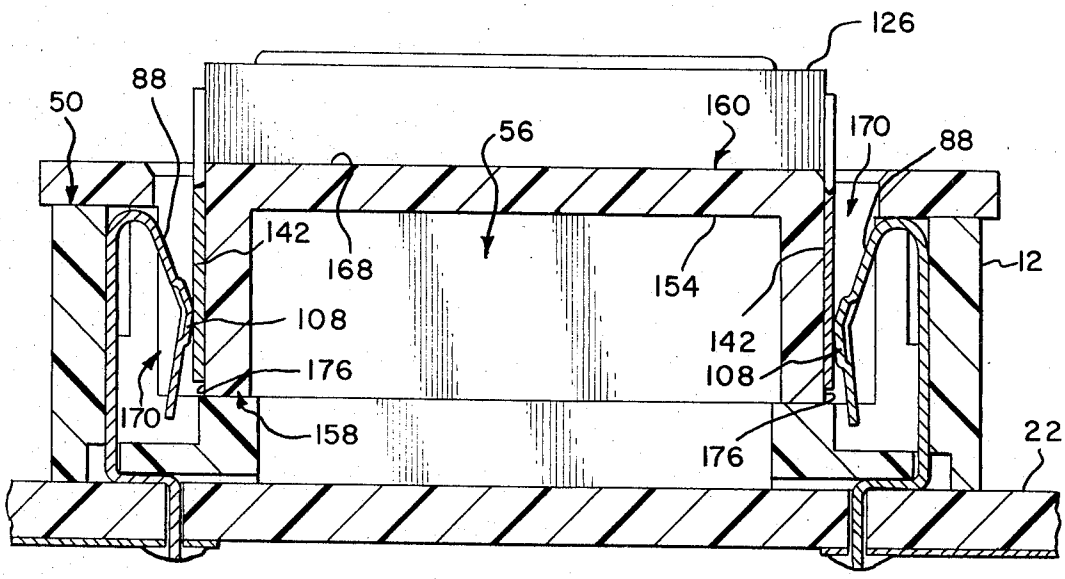
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Fig. 7

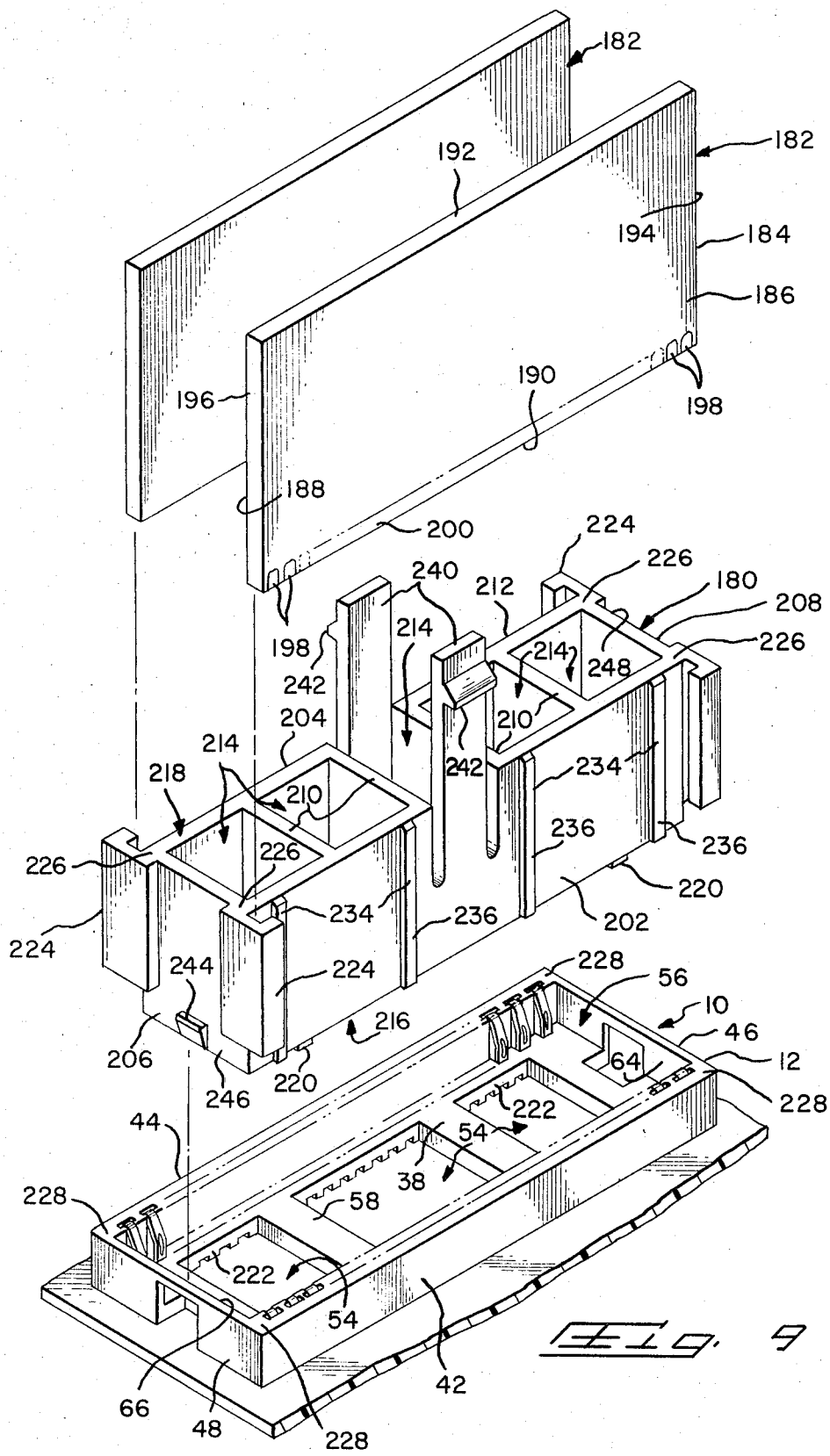
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Fig. 9

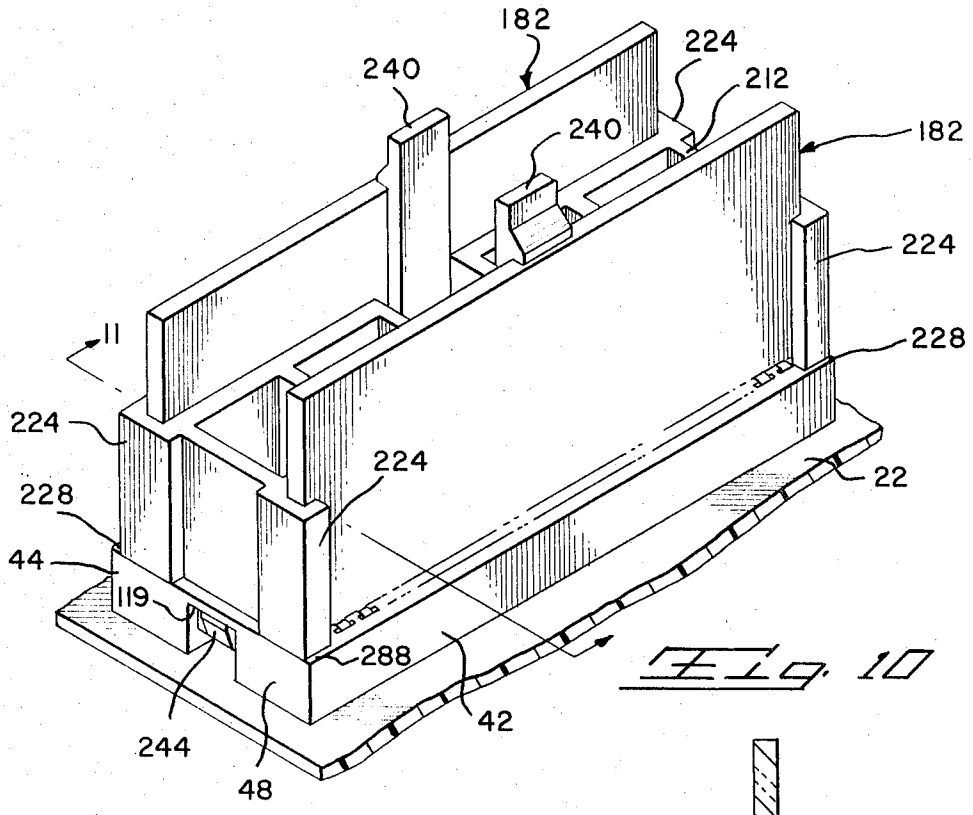
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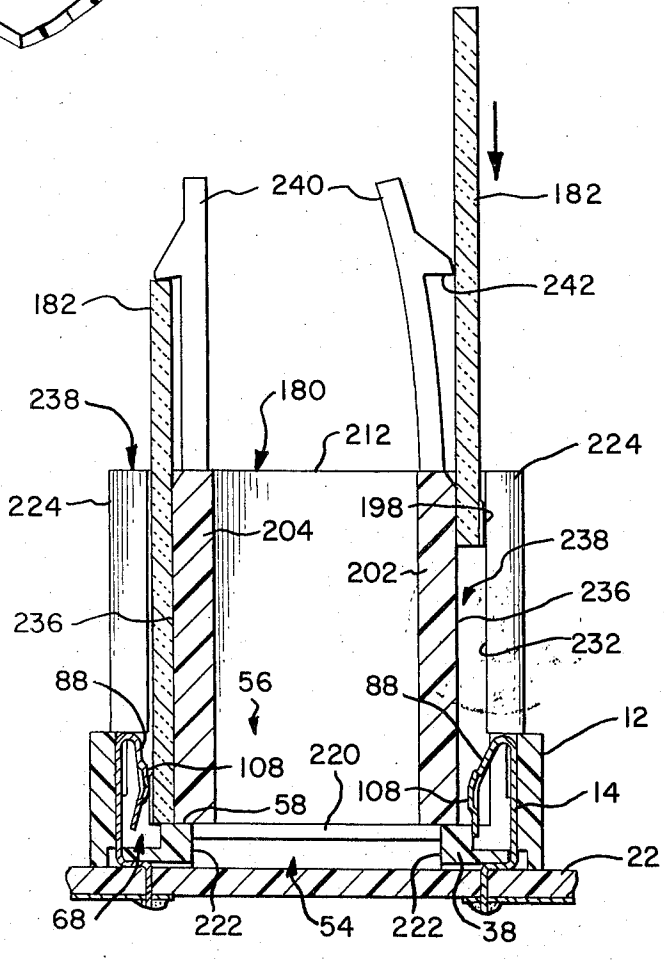
Fig. 10

Fig. 11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FRAMES FOR ADAPTING A MULTI-CONTACT ELECTRICAL CONNECTOR TO ELECTRICALLY CONNECT WITH VARIOUS STYLES OF SUBSTRATES

BACKGROUND OF THE INVENTION

1. Field Of The Invention

The present invention broadly relates to multicontact electrical connectors for interconnecting ceramic substrates or the like with external electrical circuitry and more particularly is concerned with a method of, frames useful for, and multi-contact electrical connector assemblies which result from, adapting a multi-contact electrical connector, of the general type mountable on a circuit board or the like, from being one only of a first connector class capable of electrically interconnecting external circuitry of the circuit board with two rows of spaced apart terminal contact pads disposed respectively on two opposing side surfaces of a leadless ceramic substrate, to one of a second connector class capable of electrically interconnecting the external electrical circuitry of the circuit board with two rows of spaced apart electrical terminal leads disposed respectively on two opposing side surfaces of a leaded ceramic substrate which leads extend therefrom in a substantially common direction, or to one of a third connector class capable of electrically interconnecting external circuitry of the circuit board with one row of spaced apart terminal contact pads disposed respectively on one longitudinal edge margin of one of the face surfaces of another leadless ceramic substrate.

2. Description Of The Prior Art

Integrated circuit devices or similar devices are commonly mounted on relatively thin ceramic plates, commonly referred to as substrates, which have conductors thereon extending from the integrated circuit device or "chip" to the marginal portions of the substrate. At the present time, ceramic substrates or the like packaging integrated circuit devices or the like are commercially available in several stypes of "leadless" and "leaded" substrates.

A first style is a leaded ceramic substrate or the like which has two rows of spaced apart terminal leads respectively disposed on two opposite side surfaces of the leaded substrate which leads connect with the conductors extending from the chip being packaged by the substrate and extend from the substrate in a substantially common direction.

A second style is a leadless ceramic substrate or the like which has one row of spaced apart electrical terminal contact pads respectively disposed on one longitudinal edge margin of one of the face surfaces of the leadless substrate which pads connect with the conductors extending from the chip being packaged by the substrate.

A third style is another leadless ceramic substrate or the like which has two rows of spaced apart electrical terminal contact pads respectively disposed on two opposite side surfaces of the leadless substrate which pads connect with the conductors extending from the chip being packaged by the substrate.

Heretofore, it has been the common practice to design a different multi-contact electrical connector for electrically interconnecting each of the styles of leaded and leadless ceramic substrates with external electrical circuitry.

One connector designed for the aforementioned first style of ceramic substrate or the like, that being the leaded substrate, is illustrated and described in U.S. Pat. No. 3,696,323. Other connectors are illustrated and described in U.S. Pat. Nos. 3,573,617, 3,602,874, 3,602,875, and 3,701,077.

Another connector designed for the aforementioned second style of ceramic substrate or the like, that being a leadless substrate, is illustrated and described in U.S. Pat. No. 3,601,751.

A further connector designed for the aforementioned third style of ceramic substrate or the like, that being another, different leadless substrate, is illustrated and described in a copending U.S. patent application, Ser. No. 186,876, filed Oct. 6, 1971. An improvement upon the connector described in the aforementioned application for Letters Patent is the connector illustrated and described in our copending U.S. patent application, Ser. No. 321,106, filed Jan. 4, 1973. The latter connector, originally designed for use in conjunction with the aforementioned third style of substrate, has two rows of pre-loaded electrical contacts retained therein which impose high normal contact forces upon the contact pads of the third style of substrate even though only a relatively slight deflecting of the spring portions of the contacts by the substrate occurs when the substrate is positioned in the connector between the two rows of contacts.

While the latter connector does not per se form the invention disclosed by the instant application, the principle of the present invention is directly applicable, although not so limited in its application, to the latter connector. The principle which broadly characterizes the present invention is the adaptation of a connector from being one of a first connector class intended only for utilization with one style of substrate to one of a second or third connector class available for utilization with a selected one of the other styles of substrates. This principle represents a rather substantial departure from the aforementioned common practice of designing a different connector for each of the different styles of substrates.

OBJECTS AND SUMMARY OF THE INVENTION

An object of the invention, therefore, is to substantially eliminate the need for a different multicontact electrical connector for each of the various styles of leadless and leaded ceramic substrates or the like by adapting a connector normally only used in conjunction with a leadless substrate having contact pads on its opposing side surfaces to additionally accommodate a leadless substrate having contact pads on a edge margin of its face surface or a leaded substrate having leads extending from its opposite side surfaces.

Another object of the invention is to provide frames to be selectively used in conjunction with the connector to adapt the connector to accommodate the aforementioned additional substrates.

A yet another object of the invention is to provide the capability of interchanging between the styles of substrates used with a connector after the connector has been mounted on a circuit board with its multiple contacts soldered to the external electrical circuitry of the board.

A further object of the invention, therefore, is to provide adapting frames which are both insertable into, and removable from, the connector after the connector

has been mounted on the circuit board with its multiple contacts soldered to the circuitry of the board.

A still further object of the invention is to provide connector assemblies, comprised by the connector in combination with separate frames, into and from which the additional styles of substrates may be readily plugged and unplugged.

These and other objects of the invention are achieved in a preferred embodiment thereof wherein a method is provided for adapting a multi-contact electrical connector, of the general type mountable on a circuit board or the like, from being one of only a first connector class, capable of receiving and supporting therewithin in a generally parallel, spaced relationship to the board a leadless ceramic substrate or the like having two rows of spaced apart electrical terminal contact pads respectively disposed on two opposite side surfaces of the leadless substrate and capable of electrically interconnecting external electrically circuitry of the board with the contact pads of the leadless substrate, to being a selected one of second and third connector classes, wherein a connector of the second class is capable of supporting in a spaced relationship to the connector and in a generally parallel, spaced relationship to the board a leaded ceramic substrate or the like having two rows of spaced apart electrical terminal leads respectively disposed on two opposite side surfaces of the leaded substrate which leads extend therefrom in a substantially common direction and capable of electrically interconnecting the external electrical circuitry of the board with the terminal leads of the leaded substrate, and wherein a connector of the third class is capable of supporting in a generally perpendicular, spaced relationship to the board another style of a leadless substrate or the like having a row of spaced apart electrical terminal contact pads disposed on a longitudinal edge margin of one face surface of the leadless substrate and capable of electrically interconnecting the external electrical circuitry of the board with the contact pads of the leadless substrate. Two separate frames are provided by the adapting method, each of which being capable of being separately received within the connector in place of the leadless substrate for which the connector was originally designed. After one of the frames is inserted into the connector, the one of the two substrate styles for which the connector has now been adapted to accommodate by the one frame may be readily plugged or inserted into the connector.

Other objects and attainments of the invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there is shown and described an illustrative embodiment of the invention; it is to be understood, however, that this embodiment is not intended to be exhaustive nor limiting of the invention but is given for purpose of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

BRIEF DESCRIPTION OF THE DRAWINGS

In the course of the following detailed description reference will be frequently made to the attached drawings in which:

FIG. **1** is a perspective exploded view showing the multi-contact electrical connector, originally illustrated and described in our aforementioned copending patent application, Ser. No. 321,106, filed Jan. 4, 1973, which forms the preferred embodiment of the connector to be adapted to accommodate other styles of ceramic substrates according to the principle of the present invention;

FIG. **2** is a perspective view of the connector of FIG. **1** showing the style of leadless substrate, for which the connector was originally designed, supported in the connector and the connector mounted on the circuit board;

FIG. **3** is a cross-sectional view taken along line **3—3** of FIG. **2**; FIG. **4** is a cross-sectional view similar to that of FIG. **3** but showing the substrate aligned with the connector prior to insertion of the substrate into the connector;

FIG. **5** is a perspective exploded view showing the connector mounted on the circuit board and aligned with a frame for adapting the connector to accommodate another style of substrate, that being a leaded substrate, which is illustrated in the view in alignment with the frame;

FIG. **6** is a perspective view of the frame assembled to the connector with the leaded substrate plugged into the assembled connector and frame;

FIG. **7** is a cross-sectional view taken along line **7—7** of FIG. **6**;

FIG. **8** is a cross-sectional view similar to that of FIG. **7** but showing the leaded substrate aligned with the assembled connector and frame prior to plugging of the substrate into the assembly;

FIG. **9** is a perspective exploded view showing the connector mounted on the circuit board and aligned with another frame for adapting the connector to accommodate a different style of leadless substrates which are illustrated in the view in alignment with the frame;

FIG. **10** is a perspective view of the frame of FIG. **9** assembled to the connector with both of the leadless substrates of FIG. **9** plugged into the assembled connector and frame; and

FIG. **11** is a cross-sectional view of the assembled connector and frame with one of the leadless substrates plugged therein taken along line **11—11** of FIG. **10**, further showing the other of the same style of leadless substrates in the process of being plugged into the assembly.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in greater detail to the various figures of the drawings wherein like reference characters refer to like parts, there is shown at **10** in FIGS. **1** and **2** a multi-contact electrical connector which, as stated hereinbefore, is also illustrated and described in our aforementioned copending patent application. The connector **10** forms the preferred embodiment of the connector to be adapted to accommodate other styles of ceramic substrates or the like according to the principle of the present invention. A substantial portion of the description of the connector **10** contained in our aforementioned patent application will be repeated hereinafter in order that the principle of the present invention and its practical applications will be readily understood upon a reading of the instant application.

However, reference may be made to our aforementioned patent application for a complete, detailed description of the connector **10**, which description is incorporated herein by reference thereto.

The connector **10** is generally comprised by an insulating housing **12** and a plurality of electrical contacts **14** arranged in two opposing rows in the housing **12**.

The connector **10** was originally designed to serve the function of electrically interconnecting terminal contact pads **16** of a ceramic substrate **18** supported within the housing **12** between the rows of contacts **14** with external electrical circuitry such as the conductors **20** on one side of a printed circuit board **22** as shown in FIG. **3**. The substrate **18**, referred to hereinbefore as the third style of ceramic substrate, comprises a generally rectangular ceramic body **24** having parallel faces **26, 28**, side surfaces **30, 32**, and end surfaces **34, 36**. Conductors (not shown) contained in the ceramic body **24** extend from the terminal contact pads **16** on the side surfaces **30, 32** of the third style of substrate **18**.

As stated hereinbefore, the connector **10** is, in part, comprised by an insulating housing **12**. The housing **12** may be manufactured by conventional injection molding methods from any suitable dielectric material, such as polycarbonate or a glass filled nylon.

The housing **12** is generally rectangular having a base wall **38** at a forward side **40** of the housing **12** and a pair of opposing, elongated, parallelly-aligned side walls **42, 44** and a pair of opposing, relatively short, parallelly-aligned end walls **46, 48** extending from the base wall **38** toward a rearward side **50** of the housing **12**. The housing **12** is mountable on the circuit board **22** at an exterior surface **52** of the base wall **38** of the housing **12**. The base wall **38** of the housing **12** has two large openings **54** extending therethrough to facilitate dissipation of the heat generated within the housing **12** and to minimize the amount of material in the housing **12**.

A central substrate-receiving cavity **56** is defined within the housing **12** by the interior surfaces **58, 60, 62, 64, 66** of the walls **38, 42, 44, 46, 48** of the housing **12**. The interior surface **58** of the base wall **38** is capable of supporting the third style of substrate **18** thereon at the face **28** of the third style of substrate **18** in a generally parallel relationship to, and spaced from, the circuit board **22** when the third style of substrate **18** is received within the central cavity **56** and when the housing **12** is mounted on the board **22** at the exterior surface **52** of the base wall **12** as shown in FIGS. **2** and **3**.

As more clearly shown in FIGS. **3** and **4**, a rwo of spaced apart contact-receiving cavities **68** extend through each of the side walls **42, 44** of the housing **12** from the forward side **40** to the rearward side **50** of the housing **12**. The contact-receiving cavities **68** open into the central cavity **56** at the interior surfaces **60, 62** of the side walls **42, 44**.

Still referring to FIGS. **3** and **4**, a row of spaced apart recesses **76**, the purpose for which will be explained hereinafter, is formed in the interior surface **58** of the base wall **38** of the housing **12** along each of a pair of opposing longitudinal edge portions **78** of the base wall **38** which edge portions **78** are respectively located adjacent to the interior surfaces **60, 62** of the side walls **42, 44** of the housing **12**. Each of the recesses **76** correspond to, and open into, one of the contact-receiving cavities **68**. Each of the recesses **76** have a floor **80** at a location therein which is remote from the interior surface **58** of the base wall **38** of the housing **12**. Further, each of the recesses **76** have a shoulder **82** at a location therein which is remote from the corresponding contact-receiving cavity **68** and which adjoins the floor **80** of the recess **76** and faces in a direction generally toward the corresponding cavity **68**.

The connector **10** is further comprised, as stated hereinbefore, by a plurality of electrical contacts **14** arranged in two opposing rows in the housing **12**. Each of the contacts **14** may be fabricated by a conventional stamping and forming operation from any suitable metal, such as pre-tin plated stainless steel.

The contact **14** is basically comprised by a flat, central post portion **86**, a resiliently flexible spring portion **88** which extends outwardly from one end of the flat post portion **86**, and a terminal portion **100** which extends from the opposite end of the flat post portion **86**. One contact **14** is retained in each of the contact-receiving cavities **68** of the housing **12**.

The terminal portion **100** is capable of electrical and mechanical connection to the conductor **20** of the circuit board **22** when the housing **12** is mounted on the board **22** preferably by insertion of the terminal portion **100** through an aperture **102** formed through the circuit board **22**. The preferred electrical and mechanical connection of the terminal portion **100** of the contact **14** to the conductor **20** of the board **22** is achieved by a solder **104**.

With the contact in its fully inserted position and desired configuration as shown in FIGS. **3** and **4**, the flexible spring portion **88** extends from its respective cavity **86** proximate the rearward side **50** of the housing **12** in an overlying relationship to the plane of the interior surface **58** of the base wall **38** and in a direction generally toward the corresponding one of the recesses **76** formed in the interior surface **58** of the base wall **38**. During insertion of the contact **14** (prior to formation of a bent portion **96** in the post portion **86**) into a contact-receiving cavity **86** from the rearward side **50** of the housing **12**, the spring portion **88** is partially flexed or deflected in a direction generally toward its respective cavity **86** so that a terminating free end **94** of the spring portion **88** will extend into the corresponding one recess **76** upon continued insertion of the contact **14**. Upon extension into the one recess **76**, the free end **94** of the spring portion **88** is designed to abut the shoulder **82** of the one recess **76** at a location along the shoulder **82** which is spaced from the floor **80** of the one recess **76** to thereby provide the spring portion **88** of the contact **14** in a pre-loaded condition and also to avoid any tendency for the free end **94** to drag on the floor **80** of the recess **76** upon further deflection of the spring portion **88** toward its respective cavity **86**.

The spring portion **88** of each contact **14** has a camming surface **106** thereon located remote from the free end **94** of the spring portion **88**. The leading opposing longitudinal edges of the third style of substrate **18** engage the camming surfaces **106** during insertion of the substrate **18** into the housing **12** and cause further flexing or deflection of each of the spring portions **88** toward its respective one of the contact-receiving cavities **86** until each of the spring portions **88** has deflected to its respective desired fully loaded condition at which time the third style of substrate **18** is positioned upon

the interior surface **58** of the base wall **38** between the rows of contacts **14.**

The spring portion **88** of each contact **14** has a contact surface **108** thereon located adjacent to the free end **94** of the spring portion **88.** When the contact **14** is in its fully inserted position as shown in FIG. **4,** the contact surface **108** of the spring portion **88** is disposed adjacent to, and in an overlying relationship to the plane of, the interior surface **58** of the base wall **38** and in a facing relationship toward the opposing row of contacts **14.** In the preferred embodiment, the contact surface **108** is disposed generally perpendicular to the plane of the interior surface **58.** The contact surface **108** preferably is on an embossment on the spring portion **88** as shown at **110** in order to define a precise contact area on the spring portion **88.**

Therefore, as is readily illustrated in FIGS. **3** and **4,** when the third style of substrate **18** is placed in the substrate-receiving cavity **56** of the housing **12** and supported on the interior surface **58** of the base wall **38** of the housing **12** between the opposing rows of contacts **14** with the contact pads **16** of the third style of substrate **18** respectively electrically engaging the contact surfaces **108** on the contacts **14** in the two opposing rows of contacts **14,** the spring portion **88** of each of the contacts **14** will be additionally flexed or deflected toward its corresponding cavity **68** so as to displace the free end **94** of the spring portion **88** of each contact **14** away from the shoulder **82** of the corresponding recess **76.** With the free end **94** of the spring portion **88** so displaced from the shoulder **82** of the recess **76** and from the floor **80** of the recess **76,** as shown in FIG. **3,** a desired predetermined contacting pressure is achieved between the contact surface **108** and the contact pad **16** by substantially normal or perpendicular forces imposed on the pads by the spring portions **88** to provide a good electrical connection therebetween the contact surfaces **108** and the pads **16** having a desired low contact resistance characteristic.

Referring again to FIG. **1,** there is illustrated a slot **112** formed through each of the end walls **46, 48** of the housing **12** at the forward side **40** of the housing **12** and also through each of a pair of opposite edge portions **114** of the base wall **38** respectively adjacent to the end walls **46, 48.** These slots **112** provide access by a convention prying tool (not shown) to the face **28** of the third style of substrate **18** on which face **28** the substrate **18** is mounted on the interior surface **58** of the base wall **38** in order to facilitate one manner of removal of substrate **18** from the housing **12.**

Also shown in FIG. **1,** a strap **116** is provided for assembly to the housing **12** in an overlying relationship to the third style of substrate **18** when the substrate **18** is supported on the interior surface **58** of the base wall **38.** An interengaging means in the form of a slot **118** is disposed on each of the end walls **46, 48** of the housing **12** for securing the strap **116** to the housing **12** as best shown in FIG. **2.** The slots **118** defined shoulders **119** respectively in the interior surfaces **64, 64** of the end walls **46, 48** which face toward the plane of the interior surface **58** of the base wall **38** and engage with opposite end tabs **122** of the strap **116** to secure it to the housing **12** with the substrate **18** therebetween. Although the contact spring portion **88** provide adequate retention of the third style of substrate **18** therebetween under most conditions, the strap **116** is an optional feature of the connector **10** which may be beneficial if the circuit board **22** on which the connector **10** and the third style of substrate **18** are mounted is disposed in a vertical position or an inverted position instead of the horizontal position as shown in FIG. **2.** Also, the strap **116** may be of benefit when the connector **10** is used in an environment wherein severe vibrations may be encountered.

The strap **116** has a central recess **120** on its forward facing surface into which a prying tool or the like (not shown) may be inserted in order to flex the strap **116** and thereby disengage opposing end tabs **122** of the strap **116** from shoulders **119** of the slots **118** of the end walls **46, 48** of the housing **12** and thereby achieve disassembly of the strap **116** from the housing **12.**

It is apparent from the drawings that the connector can be serviced from its rearward side; that is it can be assembled to the board and the third style of ceramic substrate **18** can be "plugged" into, and "unplugged" from, the connector **10** from its rearward side.

As stated hereinbefore the principle which broadly characterizes the present invention is the adaptation of a connector from being one of a first connector class intended only for utilization with one style of substrates to one of a second or third connector class available for utilization with a selected one of other styles of substrates. FIG. **5** through **8** and **9** through **11** respectively illustrate two embodiments of the present invention which represent physical applications of the aforementioned principle.

Referring now generally to FIGS. **5** through **8,** and more particularly to FIG. **5,** there is shown at **124** an adapter frame forming one embodiment of the present invention. As stated hereinbefore, the connector **10** was originally designed to accommodate therein only one style of a ceramic substrate or the like, that being the leadless substrate **18** referred to hereinbefore as the third style of ceramic substrate. However, according to the principle of the present invention, the connector **10** may be adapted to accommodate a leaded ceramic substrate or the like, referred to hereinbefore as the first style of ceramic substrate, which is shown at **126** in FIG. **5,** by providing the frame **124** which is designed to be received within the connector **10** in place of the third style of substrate **18** and by inserting the frame **124** therein, preferably, prior to the mounting of the first style of substrate **126** thereon.

The first style of ceramic substrate **126** comprises a generally rectangular ceramic body **128** having parallel faces **130, 132,** side surfaces **134, 136,** and end surfaces **138, 140.** Conductors (not shown) contained in the ceramic body **128** extend from the electrical terminal leads **142** on the side surfaces **134, 136** of the first style of substrate **126.** The leads **142** extend from the substrate **126** in a substantially common direction which is generally parallel to the side surfaces **134, 136** and perpendicular to the faces **130, 132.**

The frame **124** may be manufactured by conventional injection molding methods from any suitable dielectric, insulating material, such as polycarbonate or a glass filled nylon.

The frame **124** is generally rectangular having a pair of opposing, elongated, parallelly-aligned side walls **144, 146,** a pair of opposing, relatively short, parallelly-aligned end walls **148, 150,** and several spaced apart intermediate walls **152** which are parallelly-aligned with each other and with the end walls **148, 150** and interconnect the side walls **144, 146.** This arrangement

of the side walls **144, 146,** end walls **148, 150,** and intermediate walls **152** together defines a body **154** of the frame **124** having four large openings **156** therethrough to facilitate dissipation of the heat generated within the connector **10** and the substrate **126** and to minimize the amount of material in the frame **124.**

The body **154** of the frame **124** has, in general, a forward end **158** and a rearward end **160.** The forward end **158** is capable of being received in the central cavity **56** of the housing **12** between the rows of contacts **14** retained in the housing **12** and capable of being supported on the interior surface **58** of the base wall **38** of the housing **12.** When the forward end **158** of the body **154** is so received by, and supported in, the housing **12,** as more clearly shown in FIG. **8,** the rearward end **160** of the body **154** extends from the housing central cavity **56** to a location beyond the rearward side **50** of the housing **12.**

Two lateral portions **162, 164** respectively extend outwardly from the two side walls **144, 146** of the body **154** at the rearward end **160** thereof. Each of the lateral portions **162, 164** overlie one of the two opposing rows of contacts **14** and one of the two rows of contact-receiving cavities **68** of the side walls **42, 44** of the housing **12** at the rearward side **50** thereof when the forward end **158** of the body **154** is received and supported in the housing central cavity **56,** as shown in FIG. **8.**

A plurality of spaced apart apertures **166** are arranged in two rows and defined respectively in the two side walls **144, 146** of the body **154** at the rearward end **160** thereof adjacent respectively to the two opposing lateral portions **162, 164** of the frame body **154.**

Edge surfaces of the side walls **144, 146,** end walls **148, 150** and intermediate walls **152** at the rearward end **160** of the frame body **154** together define a mounting surface **168** on the rearward end **160** of the frame body **154** which is located between the rows of apertures **166.** The mounting surface **168** is spaced from the rearward side **50** of the housing **12** when the forward end **158** of the body **154** is received and supported in the housing cavity **56,** as shown in FIG. **8.** The mounting surface **168** on the frame body **154** will mount the third style of substrate **126** thereon, as shown in FIG. **7,** in a spaced relationship to the rearward side **50** of the housing **12,** and generally parallel, spaced relationship to the circuit board **22,** after the housing **12** is mounted on the board **22** and the forward end **158** of the frame body **154** is received and supported in the housing cavity **56.**

A plurality of spaced apart slots **170** are arranged in two rows and defined respectively in the exterior surfaces **172, 174** of the side walls **144, 146** of the frame body **154.** As shown in FIG. **8,** the exterior surfaces **172, 174** of the side walls **144, 146** are disposed respectively adjacent to the two rows of contacts **14** and the interior surfaces **60, 62** of the side walls **42, 44** of the housing **12** when the forward end **158** of the body **154** is received and supported in the housing cavity **56.** Each of the slots **170** is aligned with one of the apertures **166** at the rearward end **160** of the body **154** and extends therefrom to the forward end **158** of the body **154.** Each of the slots **170** is capable of accommodating therein one of the contact spring portions **88** with the one aperture corresponding to each slot **170** aligned with the one contact spring portion **88** being accommodated by each slot **170** when the forward end **158** of the frame body **154** is received and supported in the housing cavity **56.** Each of the slots **170** have an interior surface portion **176** facing in a general direction toward the contact surface **108** on the contact spring portion **88** being accommodated in each slot **170** when the forward end **158** of the frame body **154** is received and supported in the housing cavity **56.**

As shown in FIG. **7,** the portion of the forward end **158** of the frame body **154** between the interior surface portions **176** of the two rows of slots **170** is generally disposed between the rows of the terminal leads **142** of the first style of substrate **126** with each of the interior surface portions **176** of the slots **170** accommodating therealong one of the terminal leads **142** and supporting the one lead **142** in electrical and mechanical contact with the corresponding one contact surface **108** of the contact spring portion **88** being accommodated in each slot **170** when the first style of substrate **126** is mounted on the mounting surface **168** of the rearward end **160** of the frame body **154** after the forward end **158** of the body **154** is received and supported in the housing cavity **56.** The interior surface portion **176** of each slot **170** supports the lead **142** as it is being inserted therealong and prevents deflection of the lead **142** away from the respective contact spring portion **88.** Therefore, as the lead engages the contact surface **108** of the contact spring portion **88,** the contact spring portion **88** must flex or deflect in a general direction away from the interior surface portion **176** of the slot **170** in order to allow the lead **142** to pass therebetween since the lead **142** is not allowed to deflect and the contact surface **108** and the interior surface portion **176** are initially either disposed substantially in non-pressurized engagement with each other or only an extremely small gap exists therebetween.

Referring again to FIG. **5,** a ramped lug **178** is disposed on each of the exterior surfaces **180, 182** of the end walls **148, 150** of the frame body **154** (only the lug **178** on end wall **148** is shown) at the forward end **158** thereof and projects outwardly therefrom. The exterior surfaces **180, 182** of the end walls **148, 150** of the body **154** are located proximate to the interior surfaces **66, 64** of the end walls **48, 46** of the housing **12,** with the lugs **178** respectively engaging the shoulders **119** in the interior surfaces **64, 66** of the end walls **46, 48** of the housing **12,** when the forward end **158** of the body **154** is received and supported in the housing cavity **56** as shown in FIG. **6.** By means of the engagement between the lugs **178** of the frame body **154** and the shoulders **119** of the housing **12,** the body **154** is retained in the housing cavity **56.** The material of the housing **12,** while forming a substantially rigid structure, is still sufficiently resiliently deformable to allow outward bowing of the mid-sections of the end walls **46, 48** of the housing **12** in order to allow the lugs **178** of the frame **124** to pass by the end walls **46, 48** to their desired position under the shoulders **119.** Likewise, the edge of a thin knife or other suitable tool may be used to again bow the end walls **46, 48** outwardly enough to allow the lugs **178** to pass by the end walls **46, 48** during retraction of the frame **124** from the housing **12.**

When the frame body **154** has been received in the housing cavity **56,** as shown in FIG **8,** the connector **10** is now adapted to receive the first style of leaded substrate **126.** When the first style of leaded substrate **126** is "plugged" into the now adapted connector **10** by in-

serting the leads **142** of the two rows thereof respectively through the apertures **166** in the two rows thereof and along the interior surface portions **176** of the two rows of slots **170** until the first style of substrate **126** is mounted on the mounting surface **168** at the rearward end **160** of the frame body **154**, the leads **142** engage the contact surfaces **108** of the contacts **14** and thereby cause the pre-loaded contact spring portions **88** of the contacts **14** to become additionally flexed or deflected toward their respective cavities **68**, as shwon in FIG. **7**. The desired predetermined contacting pressure is thereby achieved between the leads **142** and the contact surfaces **108** by the substantially normal or perpendicular forces imposed on the leads **142** by the additionally flexed and loaded spring portions **88** to provide a good electrical connection therebetween having a desired low contact resistance characteristic.

It is readily apparent that the first style of substrate **126** may be "unplugged" from its position of FIG. **7** by gripping the substrate **126** at its end surfaces **138, 140** and retracting it back to its position of FIG. **8**.

Referring now generally to FIGS. **9** through **11**, and more particularly to FIG. **9**, there is shown at **180** another adapter frame forming another embodiment of the present invention. According to the principle of the present invention, the connector **10** may also be adapted to accommodate preferably two of another leadless ceramic substrate or the like, referred to hereinbefore as the second style of ceramic substrate, which is shown at **182** in FIG. **9**, by providing the frame **180** which is designed to be received within the connector **10** in place of the third style of substrate **18** and by inserting the frame **180** therein, preferably, prior to the supporting of the second style of substrate **182** therein.

The second style of ceramic substrate **182** comprises a generally rectangular ceramic body **184** having parallel faces **186, 188**, side surfaces **190, 192**, and end surfaces **194, 196**. Conductors (not shown) contained in the ceramic body **184** extend from spaced apart terminal contact pads **198** arranged in a row thereof and disposed on a longitudinal edge margin **200** of one face surface **186** of the second style of substrate **182**.

The frame **180** may be manufactured by conventional injection molding methods from any suitable dielectric, insulating material, such as polycarbonate or a glass filled nylon.

The frame **180** is generally rectangular having a pair of opposing, elongated, parallelly-aligned side walls **202, 204**, a pair of opposing, relatively short, parallelly-aligned end walls **206, 208**, and several spaced apart intermediate walls **210** which are parallelly-aligned with each other and with the end walls **206, 208** and interconnect the side walls **202, 204**. This arrangement of the side walls **202, 204**, end walls **206, 208**, and intermediate walls **210** together defines a body **212** of the frame **180** having five large openings **214** therethrough to facilitate dissipation of the heat generated within the connector **10** and to minimize the amount of material in the frame **180**.

The body **212** of the frame **180** has, in general, a forward end **216** and a rearward end **218**. The forward end **216** is capable of being received in the central cavity **56** of the housing **12** between the rows of contact surfaces **108** of the contacts **14** retained in the housing **12** and capable of being supported on the interior surface **58** of the base wall **38** of the housing **12**. When the forward end **216** of the frame body **212** is so received by, and supported in, the housing **12**, as more clearly shown in FIG. **11**, the rearward end **218** of the body **212** extends from the housing central cavity **56**.

Ribs **220** interconnect the two side walls **202, 204** at the forward end **216** of the frame body **212** and project therefrom. The ribs are received in the openings **54** of the base wall **38** of the housing **12** and engaged with opposing side portions **222** of the openings **54** to thereby center the frame body **212** between the rows of contact surfaces **108**, as clearly shown in FIG. **11**, when the forward end **216** of the frame body **212** is received and supported in the housing central cavity **56**.

Guide structures **224** are formed on the rearward end **218** of the frame body **212** at each of four corners **226** defined by the respective intersections between the side walls **202, 204** and the end walls **206, 208**. Each of the guide structures **224** have a right-angled shape and project outwardly from the side walls **202, 204**. When the forward end **216** of the frame body **212** is received and supported in the housing central cavity **56**, each of the guide structures **224** seats on respective corners **228** defined by the intersections between the respective side walls **42, 44** and end walls **46, 48** of the housing **12**, as shown in FIG. **10**. The guide structures **224** may be viewed as two pairs respectively projecting from the side walls **202, 204**. First interior surface portions **230** of one of the two pairs of guide structures **224** are aligned parallel to, and generally face toward, each other as are the first interior surface portions **230** of the other of the two pairs of guide structures **224**. Second interior surface portions **232** of one of the two pairs of guide structures **224** are aligned in the same plane as are the second interior surface portions **232** of the other of the two pairs of guide structures **224**. Further, the second interior surface portions **230** of each of the two pairs of guide structures generally face toward their respectively adjacent one of the side walls **202, 204**. The first interior surface portions **230** of each respective pair of guide structures are spaced from each other through a distance slightly greater than the length of the second style of substrate **182** whereby each of the pairs of guide structures is capable of receiving one of the substrates **182** therebetween.

Each of the side walls **202, 204** of the frame body **212** preferably have a plurality of spaced apart rails **234** formed thereon which individually extend from the forward end **216** to the rearward end **218** of the frame body **212** and project outwardly from the respective side walls **202, 204**. Each of the rails **234** have an exterior surface portion **236**. The exterior surface portions **236** of the respective rails on one of the side walls **202, 204** are aligned in the same plane as are the exterior surface portions **236** of the respective rails **234** on the other of the side walls **202, 204**. Furthermore, the plane of the exterior surface portions **236** of the plurality of rails **234** disposed on one of the two side walls **202, 204** is aligned generally parallel to the plane of the second interior surface portions **232** of the pair of guide structures **224** disposed on that same one of the two side walls **202, 204** and is spaced therefrom through a distance slightly greater than the thickness of the second style of substrate **182** to thereby, in effect, define a slot **238** through which one of the substrates **182** may be received, as shown in FIG. **11**. When the forward end **216** of the frame body **212** is received and supported in the housing cavity **56**, as shown in FIG.

11, the pre-loaded contact spring portions **88** of one of the rows of contacts **14** extends into the forward end of the slot **238** with the contact surfaces **108** on each of the contact spring portions **88** in that row thereof preferably being spaced from the plane of the exterior surface portions **236** of the rails **234** on the one of the side walls **202, 204** adjacent to that row of contact spring portions **88** through a distance slightly less than the thickness of the second style of substrate **182.**

FIG. **11** depicts the frame **180** received and supported in the housing cavity **56** with one of the substrates **182** fully inserted into the frame **180** to a desired final position. At this final position, the substrate **182** at its side surface **190** is supported on the interior surface **58** of the base wall **38** of the housing **12** between the exterior surface portions **236** of the rails **234** on the side wall **204** of the frame body **212** and the corresponding one of the rows of contact surfaces **108** in a generally perpendicular relationship to the plane of the interior surface **58** of the base wall **38** of the housing **12** and in a generally perpendicular, spaced relationship to the circuit board **22.** As the substrate **182** is inserted to this final position, the leading edge margin of the substrate **182,** with the row of contact pads **198** thereon in facing relationship to the contact surfaces **108,** engages the contact spring portions **88** and flexes or deflects them in a general direction toward their respective contact-receiving cavities until the substrate **182** is seated on the interior surface **58** of the housing base wall **38.** The desired predetermined contacting pressure is thereby achieved between the contact pads **198** and the contact surfaces **108** by the substantially normal or perpendicular forces imposed the contact pads **198** by the additionally flexed and loaded spring portions **88** to provide a good electrical connection therebetween having a desired low contact resistance characteristic.

It is readily apparent that the second style of substrate **182** may be readily "unplugged" from its position within the connector and frame assembly as well as readily "plugged" therein. The right-hand portion of FIG. **11** illustrates one of the substrates **182** in the process of being plugged into the assembly (by reversing the arrow, the substrate **182** may be viewed in the process of being unplugged from the assembly).

Referring again to FIG. **9,** each of the side walls **202, 204** is partially discontinuous at a midsection thereof. A resiliently flexible latch arm **240** is formed on each of the side walls **202, 204** and extends through the discontinuous mid-section of each side wall and projects rearwardly from the rearward end **218** of the frame body **212.** Each of the latch arms **240** has latching shoulder **242** projecting outwardly therefrom and facing toward the forward end **216** of the frame body **216.** As illustrated in FIG. **11,** one latch arm **240** may be flexed toward the other when a substrate **182** is inserted into the slot **238** of the frame **180** adjacent thereto. After the substrate **182** is fully inserted to its resting position within the connector and frame assembly, the latch arm **240** is released and returns to its original unflexed condition, as illustrated in the left-hand portion of FIG. **11,** to thereby positively lock the substrate in the desired rested position within the assembly.

Referring again to FIG. **9,** a ramped lug **244** is disposed on each of the exterior surfaces **246, 248** of the end walls **206, 208** of the frame body **212** (only the lug **244** on end wall **206** is shown) at the forward end **216** thereof and projects outwardly therefrom. The exterior surfaces **246, 248** of the end walls **206, 208** of the body **212** are located proximate to the interior surfaces **66, 64** of the end walls **48, 46** of the housing **12,** with the lugs **244** respectively engaging the shoulders **119** in the interior surfaces **64, 66** of the end walls **46, 48** of the housing **12,** when the forward end **216** of the frame body **212** is received and supported in the housing cavity **56** as shown in FIG. **10.** By means of the engagement between the lugs **244** of the frame body **212** and the shoulders **119** of the housing **12,** the body **212** is retained in the housing cavity **56.** As stated hereinbefore, the material of the housing **12,** while forming a substantially rigid structure, is still sufficiently resiliently deformable to allow outward bowing of mid-sections of the end walls **46, 48** of the housing **12** in order to allow the lugs **244** of the frame **180** to pass by the end walls **46, 48** to their desired position under the shoulders **119.** Likewise, the edge of a thin knife or other suitable tool may be used to again bow the end walls **46, 48** outwardly enough to allow the lugs **244** to pass by the end walls **46, 48** during retraction of the frame **180** from the housing **12.**

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the adapter frames described without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the forms hereinbefore described being merely the preferred embodiments thereof.

What is claimed is:

1. In combination, a printed circuit board having an electrical circuit thereon, apertures in said board, a ceramic substrate having a plurality of electrical contacts exposed to one side of said substrate, said contacts on the substrate comprising electrical leads extending at an angle to the plane of the substrate, and a housing for connecting said substrate to said board, said housing comprising:

a member having a pair of opposed parallel sides,

electrically conductive spring members positioned in said parallel sides to accomodate the ceramic substrate and effect an electrical connection with the contacts,

means on the spring members for electrically attaching them to the circuitry of a printed circuit board,

and locking means to retain said substrate in electrically conductive relationship with said housing, said locking means comprising a frame with slots therein that receive the leads and wedge them against the spring members, and a detent on the frame that snaps into a slot in the housing.

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