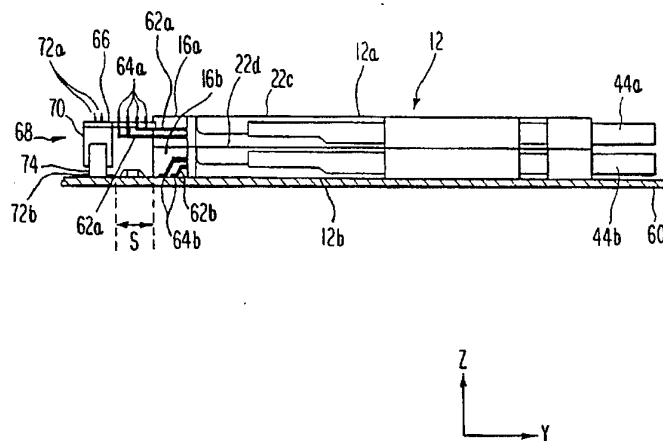




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<p>(21) International Application Number: PCT/US94/03135</p> <p>(22) International Filing Date: 23 March 1994 (23.03.94)</p> <p>(30) Priority Data: 5/13477 U 23 March 1993 (23.03.93) JP</p> <p>(71) Applicant (for all designated States except US): BERG TECHNOLOGY, INC. [US/US]; One East First Street, Reno, NV 89501 (US).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only): LWEE, Nai, Hock [SG/SG]; Block 56, West Coast Crescent, #03-12, Singapore 0512 (SG).</p> <p>(74) Agents: DONOHUE, John, P., Jr. et al.; Woodcock Washburn Kurtz Mackiewicz & Norris, One Liberty Place - 46th Floor, Philadelphia, PA 19103 (US).</p>		<p>(81) Designated States: US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</p> <p>Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</p>

(54) Title: CONNECTOR APPARATUS



(57) Abstract

A dual storage deck connector apparatus is provided that facilitates the soldering of connectors disposed in the respective storage decks (22a, 22b) to a main printed circuit board (60). Upturned solder tails (64a) of an upper header (16a) are inserted through an upper circuit board (66) and soldered thereto. Down-turned solder tails (64b) of a lower header (16b) are soldered to the main printed circuit board (60). A receptacle (70) of a vertical connector (68) is attached to the undersurface of the upper circuit board (66), and a header (74) of the vertical connector (68) is mounted on the main printed circuit board (60). Terminals of the vertical connector (68) header (74) are soldered to the lower circuit board (60). Upon assembly of the dual storage deck connector, the upper circuit board (66) is electrically connected to the main printed circuit board (60) via the vertical connector (68).

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CONNECTOR APPARATUS

BACKGROUND

Field of the Invention

The present invention relates to a connector
5 apparatus for memory cards, and more particularly, to a
connector apparatus having multiple storage decks and an
improved mechanism for connecting the respective contacts of
each storage deck to a printed circuit board.

Description of the Prior Art

10 Plate-like integrated circuit cards, commonly
referred to in the art as "memory cards", have become
increasingly popular for use in notebook, laptop and desktop
computers, as well as other consumer products. Standard
specifications from the Personal Computer Memory Card
15 International Association (PCMCIA) and the Japan Electronic
Industry Development Association (JEIDA) have helped to
expand this relatively new industry. Other standard
specifications have been developed by the Joint Electron
Device Engineering Council (JEDEC). Although commonly
20 referred to as "memory cards," these cards are by no means
limited to data storage applications. For example, some
cards may perform various I/O functions for modem and local
area network applications.

Currently, the PCMCIA/JEIDA standard cards
25 incorporate a 68-pin female connector at one end, and are
available in three formats. Type I houses SRAM, PSRAM, MROM,
OPTROM, and flash memory chips and only performs memory
functions. Type I cards have a thickness of 3.3 mm. Type II
cards perform I/O functions for modem and local area network
30 (LAN) applications. The side edges of Type II cards are 3.3

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mm thick, however, the main body of the cards is 5.0 mm thick. Type III cards are really not "cards," but rather 1.8 inch hard disk drives having a 10.5 mm thick housing. Again, however, these cards are equipped with outside edges of 3.3
5 mm.

Given the increasing popularity of these "memory cards," a need has arisen for suitable connector devices for connecting these cards to printed circuit boards in host devices, such as notebook, laptop and desktop computers. A
10 number of connector devices have appeared in the prior art. Prior art connector devices typically comprise some sort of frame or housing into which a memory card may be inserted. A contact header with an array of pin contacts is provided at the far end of the housing to connect with a corresponding
15 contact array disposed in the front end of the memory card. Typically, L-shaped pin contacts are employed in the connector to facilitate connection of each pin to a printed circuit board; one end of each pin extends into the storage space of the connector, while the other end extends
20 downwardly, external to the housing, for soldering to the printed circuit board.

Many prior art connector devices employ an ejection mechanism having a slide plate that engages with the memory card, a rotatable lever mounted on the housing and coupled at
25 one end to the slide plate, and a push rod coupled to the other end of the lever. To eject a memory card, the push rod is manually driven toward the contact header. Movement of the push rod toward the contact header is translated through the rotating lever into movement of the slide plate away from
30 the contact header. As the slide plate moves away from the contact header, it engages with the memory card thereby disconnecting the memory card from the array of contacts on the header and urging the memory card backward out of the connector device.

35 Some connector devices have multiple storage decks. For example, U.S. Patent No. 5,149,276 discloses a connector apparatus having upper and lower storage decks. Each deck

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has its own array of pin contacts. As is typical of prior art connector devices with multiple storage decks, L-shaped pins are employed in each deck. Thus, the external portions of both sets of pins extend downwardly for connection to a printed circuit board mounted underneath the connector apparatus. Of course, the upper set of contact pins must protrude further from the connector before extending downwardly to the printed circuit board so as to avoid interference with the lower set of contact pins. Each set of pins are connected to the printed circuit board by soldering.

Unfortunately, the use of L-shaped pins in each storage deck has proven to be disadvantageous when attempting to solder each set of contact pins to the same printed circuit board. In particular, it has been difficult to employ surface mount techniques to connect each set of contact pins to the circuit board. Consequently, high volume production of printed circuit boards with multiple storage deck connectors is difficult to achieve.

Generally, the upper and lower storage decks are separate units and are simply mounted on top of each other to form a dual storage deck apparatus. Unfortunately, because the L-shaped contact pins of the upper deck extend outward, effectively covering the contact pins of the lower deck, surface mount techniques for soldering the respective sets of contact pins to a circuit board are difficult; the contact pins of the upper storage deck prevent easy access to the contact pins of the lower deck.

One solution to this problem is to solder the contact pins of the lower deck to the circuit board in a first soldering step prior to mounting the upper storage deck. Once the lower storage deck is secure, the upper storage deck may be mounted on the lower storage deck, and the contact pins of the upper storage deck may be soldered to the circuit board in a second soldering step. Unfortunately, however, the second soldering step can effect the hardened solder joints of the lower contact pins in such a way that stress may occur in the hardened solder joints, in components

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already attached to the circuit board, and in the circuit board itself. Moreover, if one of the lower contact pins breaks free during the second soldering step, resoldering is extremely difficult since the upper contacts are now in the way.

SUMMARY OF THE INVENTION

It is accordingly an object of the present invention to provide a multi-storage deck connector apparatus that avoids the disadvantages that result from having to electrically connect the contact pins of each storage deck directly to a main printed circuit board.

According to the present invention, a multi-storage deck connector apparatus for memory cards comprises:

at least upper and lower frames coupled together in a stacked arrangement, each frame having opposing side rails spaced at an interval substantially equal to the width of a memory card, each frame defining a respective storage deck of the connector apparatus;

a first array of contact pins disposed in the upper storage space;

a second plurality of contact pins disposed in the lower storage space;

a first circuit board to which one of the upper and lower arrays of contact pins is directly electrically connected;

a second circuit board to which the other array of contact pins is directly electrically connected; and

a vertical connector arranged between the first circuit board and the second circuit board and adapted to electrically connect the first circuit board to the second circuit board, whereby one of the arrays of contact pins is directly electrically connected to the first circuit board and the other array of contact pins is indirectly electrically connected to the first circuit board via the second circuit board and the vertical connector. Preferably, the first and second arrays of contact pins are connected to

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their respective circuit boards using a surface mount soldering technique.

A method for assembling a multi-storage deck connector apparatus to a first printed circuit board in accordance with the present invention comprises the steps of:

- a) attaching the lower frame to the first printed circuit board;
- b) soldering to the first printed circuit board (i) the array of contact pins of the header of the lower frame and (ii) the terminals of the header of a vertical connector;
- c) assembling the upper frame of the connector apparatus to the lower frame;
- d) fitting a receptacle of the vertical connector over the header of the vertical connector, there being a second printed circuit board electrically connected to the terminals of said receptacle; and
- e) soldering the array of contact pins of the header of the upper frame to the second printed circuit board, whereby the array of contact pins of the header of the upper frame are indirectly electrically connected to the first printed circuit board via the second printed circuit board and the vertical connector. Prior to performing step (b), predetermined areas of the first printed circuit board are coated with a solder paste. Preferably, the soldering steps (b) and (e) are performed in accordance with a surface mount soldering technique.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing a connector apparatus according to one embodiment of the present invention;

Fig. 2 is a perspective view showing the connector apparatus together with two circuit boards; and

Fig. 3 is a perspective view showing the slide plate of the connector apparatus of Fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, wherein like numerals indicate like elements throughout, there is shown in Figures 1 and 2, a connector apparatus for memory cards in accordance with a preferred embodiment of the present invention. As used herein, the term "memory card" refers to any plate-like integrated circuit card regardless of function, including those specified by the PCMCIA, JEIDA and JEDEC associations.

As shown, the connector apparatus 12 of Figures 1 and 2 comprises upper and lower frames 12a and 12b which are coupled together in a stacked arrangement. Each frame 12a, 12b defines a respective storage deck 22a, 22b of the apparatus 12 and comprises a cross member 23a, 23b and a pair of side rails 13a, 13b that extend from the cross member and are spaced at an interval substantially equal to a width of a memory card. Preferably, the cross member 23 and side rails 13 of each frame 12a, 12b form a generally U-shaped structure, one end of each frame 12a, 12b being open. Upper and lower headers 16a and 16b are coupled at the other end of each frame 12a, 12b proximate the respective cross members 23a, 23b. Each header 16a, 16b carries a respective array of contact pins 64a, 64b. As can be appreciated, additional frames (not shown) can be stacked on top of frames 12a and 12b to form additional storage decks.

Slots 24a, 24b are formed in the inner surfaces of the respective side rails 13a, 13b of each frame 12a, 12b to guide memory cards 20a into and out of the respective storage decks 22a, 22b via the open ends thereof. Alternatively, one hard disc drive (HDD) package 20b, such as, for example, a type III PCMCIA card, may be stored in the connector device 12. As shown in Figure 1, the HDD package 20b has a thickness t_2 and comprises a base plate section 20c, and a housing 20d containing the actual hard disk drive (not shown). The housing 20d has a width smaller than that of the base plate section 20c. The base plate section 20c has substantially the same width and height as one of the memory cards 20a.

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When the HDD package 20b is inserted into the connector apparatus 12, the base plate section 20c is guided along the slots 24b in the side rails 13b of the lower frame 12b. Due to its thickness t_2 , the HDD package will occupy
5 both the upper and lower storage decks 22a,b when fully inserted into the connector apparatus 12. An I/O socket is disposed in the forward end 20e of each memory card 20a and the HDD package 20b for connecting to the contact pins 64a,b of the respective headers 16a,b.

10 Upper and lower ejecting mechanisms 40a and 40b are coupled to the upper and lower frames 12a, 12b, respectively. Preferably, the upper and lower ejecting mechanisms 40a,b are identical. As shown in Fig. 1, the upper ejecting mechanism 40a has a lever 42a pivotally supported on the cross member
15 23a of the upper frame 12a. One end of the lever 42a is coupled to a push rod 44a. The push rod 44a is inserted into a guide frame 46a mounted on an outer side surface of the upper frame 12a and is slidable along the Y direction. The other end of the lever 42a has a claw 46a which, through an
20 opening 44a in the cross member 23a, engages with a slide plate 48a (Fig. 3) as described below.

Fig. 3 is a bottom view showing the slide plate 48a. In the present embodiment, the slide plate 48a is disposed below the cross member 23a of the upper frame 12a
25 and has a substantially U-shaped configuration with a pair of legs 50a. Each leg 50a has a claw 52a extending substantially perpendicular thereto. The claws 52a of the slide plate 48a are guided in corresponding grooves formed in the upper surface of the side rails 13a of the upper frame
30 12a proximate the cross member 23a. The slide plate 48a has a pair of hooks 56a near its forward end that engage with the forward end 20e of a memory card inserted into the upper storage deck 22a. The slide plate 48a has a claw 58a at its middle that engages with the claw 46a of the lever 42a.

35 When a memory card, e.g. memory card 20a, is inserted into the upper deck 22a, its forward end 20e engages with the hooks 56a of the slide plate 48a causing the slide

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plate 48a to slide toward the header 16a. As the memory card moves further into the storage deck 12a, the I/O socket in the forward end 20e of the memory card electrically connects to the contact pins 64a of the upper header 16a.

- 5 To eject the card, the push rod 44a is pushed toward the header 16a causing the lever 42a to pivot about its midpoint such that the claw 46a of the lever 42a engages with the claw 58a of the slide plate 48a thereby urging the slide plate 48a toward the open end of the upper frame 12a.
- 10 As the slide plate 48a moves toward the open end of the frame 12a, the hooks 56a of the slide plate 48a engage with the forward end 20e of the memory card thereby forcing the card backward out of the upper storage deck 22a.

- Similar component parts (not shown) of the lower
15 ejecting mechanism 40b are arranged between the upper and lower frames 12a, 12b. The lower ejecting mechanism 40b operates to eject memory cards from the lower deck 22b. When, an HDD package 20b is inserted in the apparatus 12, the lower ejecting mechanism 40b is used to eject the HDD
20 package.

- As shown in Fig. 2, the lower frame 12b of the dual storage deck apparatus 12 is mounted on a printed circuit board 60 which is omitted in Fig. 1 for convenience of illustration only. Respective interface circuits (not shown)
25 for the upper and lower headers 16a and 16b may be printed on the printed circuit board 60.

- The upper header 16a of the connector apparatus 12 has a plurality of L-shaped contact pins 62a with upturned solder tails 64a. According to the present invention, the
30 solder tails 64a of upper array of contact pins 62a are inserted through corresponding solder holes in a small printed circuit board 66 and are soldered thereto. A receptacle 70 of a surface mount vertical connector 68 is mounted on the lower surface of the small printed circuit
35 board 66. Terminals 72a of the receptacle 70 are soldered to the small printed circuit board 66. The small printed circuit board 66 connects each terminal 72a to a respective

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one of the solder tails 64a, in a one-to-one correspondence. Essentially, therefore, each terminal 72a is an extension of a respective one of the contact pins 62a of the upper header 16a.

5 A mating header 74 of the face mount vertical connector 68 is mounted on the printed circuit board 60. Mating terminals 72b of the header 74 are soldered to the printed circuit board 60. Like the upper header 16a, the lower header 16b of the connector apparatus has a plurality
10 of contact pins 62b. Down-turned solder tails 64b of the contact pins 62b of the lower header 16b are soldered directly to their corresponding connection points on the main printed circuit board 60. When the upper housing 12a is assembled on the lower housing 12b, as described hereinafter
15 in greater detail, the receptacle 70 and header 74 of the vertical connector 68 are connected together to form an electrical connection between each of the contact pins 62a of the upper header 16a and corresponding connection points on the main printed circuit board 60. That is, the small
20 printed circuit board 66 and vertical connector 68 serve to connect each of the contact pins 62a of the upper header 16a to respective signal traces on the main printed circuit board 60. Thus, whereas the contact pins 62b of the lower header 16b are directly connected to the circuit board 60, the
25 contact pins 62a of the upper header 16a are indirectly connected to the circuit board 60 via the small circuit board 66 and vertical connector 68.

A space S is defined between the lower header 16b of the connector apparatus and the header 74 of the vertical
30 connector 68. Various circuit components may be mounted to the printed circuit board in space S.

According to a method of the present invention, the connector apparatus is assembled to the printed circuit board 60 as follows:

35 (i) predetermined areas on the printed circuit board 60 are coated with a solder paste;

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(ii) the lower housing 12b, lower header 16b and vertical connector header 74, but not the lower ejecting mechanism 40b, are arranged on the printed circuit board 60 (these component parts can be located manually or by a mechanical means);

(iii) the contact pins 62b of the lower header 16b and the terminals of the header 74 of the vertical connector 68 are then connected to the printed circuit board 60 by soldering;

(iv) the lower ejecting mechanism 40b is then fixed to the lower housing frame 12b with suitable hardware;

(v) the upper housing 12a and the upper ejecting mechanism 40a are then assembled on the lower housing 12b (the upper and lower ejecting mechanisms 40a and 40b may be connected by a proper screw/nut combination or a locking pin);

(vi) the receptacle 70 of the vertical connector 68, which is pre-mounted on a small circuit board 66, is then fitted over the header 74; and finally,

(vii) the solder tails 64a of the upper header 16a are soldered to the small printed circuit board 66.

As can be appreciated, the lower header 16b is directly connected to the printed circuit board 60 and the upper header 16a is indirectly connected to the printed circuit board 60 via the small printed circuit board 66 and vertical connector 68. Thus, the upper and lower headers 16a and 16b are both connected to the circuit board 60 without the disadvantages that result from having to directly solder both headers to that circuit board 60.

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WHAT IS CLAIMED IS:

1. A multi-storage deck connector apparatus for memory cards comprising:
 - at least upper and lower frames coupled together in
 - 5 a stacked arrangement, each frame having opposing side rails spaced at an interval substantially equal to the width of a memory card, each frame defining a respective storage deck of said connector apparatus;
 - a first array of contact pins disposed in said
 - 10 upper storage space;
 - a second plurality of contact pins disposed in said lower storage space;
 - a first circuit board to which one of said upper and lower arrays of contact pins is directly electrically
 - 15 connected;
 - a second circuit board to which the other array of contact pins is directly electrically connected; and
 - a vertical connector arranged between the first circuit board and the second circuit board and adapted to
 - 20 electrically connect the first circuit board to the second circuit board, whereby one of said arrays of contact pins is directly electrically connected to the first circuit board and the other array of contact pins is indirectly electrically connected to the first circuit board via the
 - 25 second circuit board and the vertical connector.
2. A connector apparatus according to claim 1 wherein said first array of contact pins are electrically connected to said first circuit board by a soldering process.
3. A connector apparatus according to claim 2
- 30 wherein said soldering process comprises a surface mount technique.
4. A connector apparatus according to claim 1 wherein said second array of contact pins are electrically

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connected to said second circuit board by a soldering process.

5. A connector apparatus according to claim 4 wherein said soldering process comprises a surface mount
5 technique.

6. A method for assembling a multi-storage deck connector apparatus to a first printed circuit board, wherein the connector apparatus comprises at least upper and lower frames coupled together in a stacked arrangement, each of the
10 frames defining a respective storage deck and having a header coupled at one end thereof, each header having an array of contact pins disposed therein, said method comprising the steps of:

a) attaching the lower frame to the first printed
15 circuit board;

b) soldering to the first printed circuit board (i) the array of contact pins of the header of the lower frame and (ii) the terminals of the header of a vertical connector;

c) assembling the upper frame of the connector
20 apparatus to the lower frame;

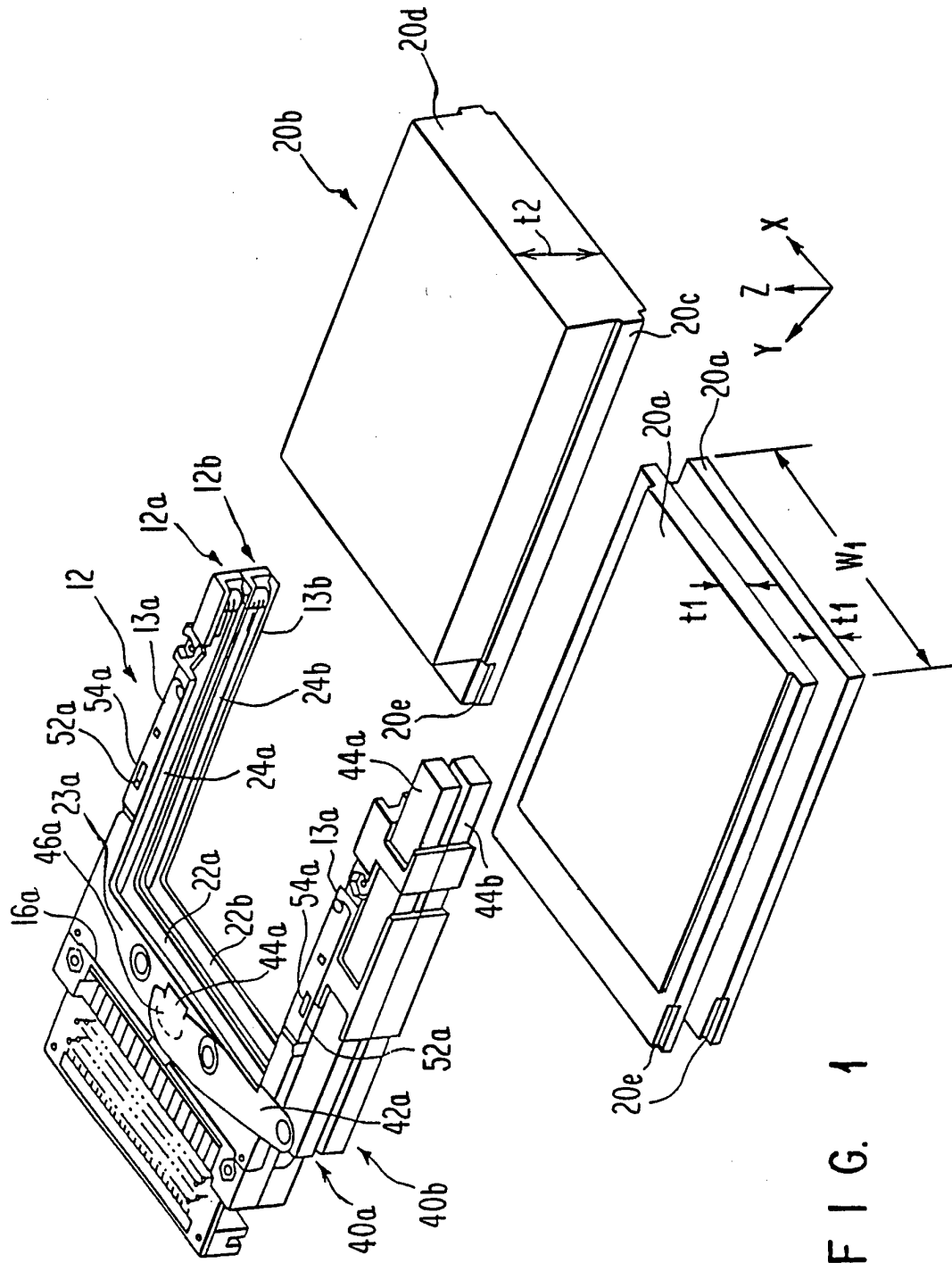
d) fitting a receptacle of the vertical connector over the header of the vertical connector, there being a second printed circuit board electrically connected to the terminals of said receptacle; and

25 e) soldering the array of contact pins of the header of the upper frame to the second printed circuit board, whereby the array of contact pins of the header of the upper frame are indirectly electrically connected to the first printed circuit board via the second printed circuit
30 board and the vertical connector.

7. A method according to claim 6 further comprising the step of coating predetermined areas of the first printed circuit board with a solder paste prior to performing step (b).

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8. A method according to claim 6 wherein at least one of said soldering steps (b) and (e) is performed in accordance with a surface mount soldering technique.



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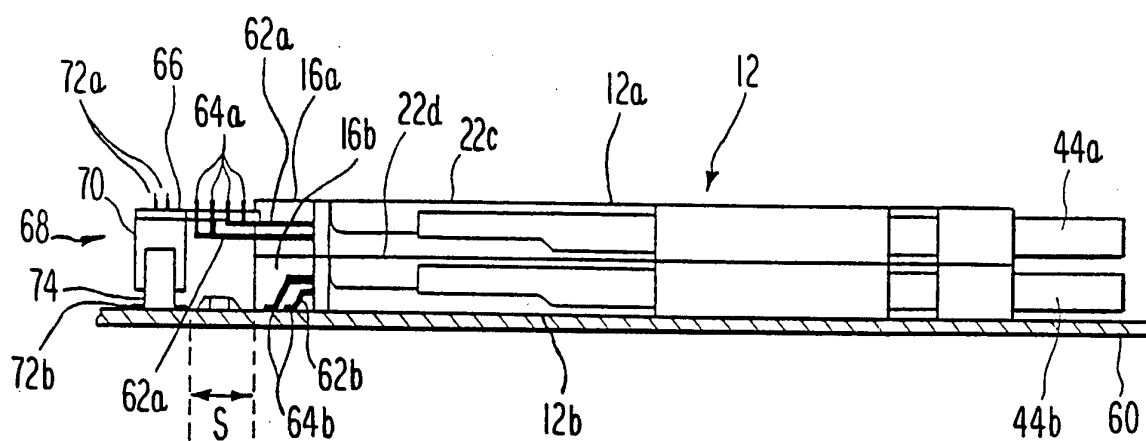


FIG. 2

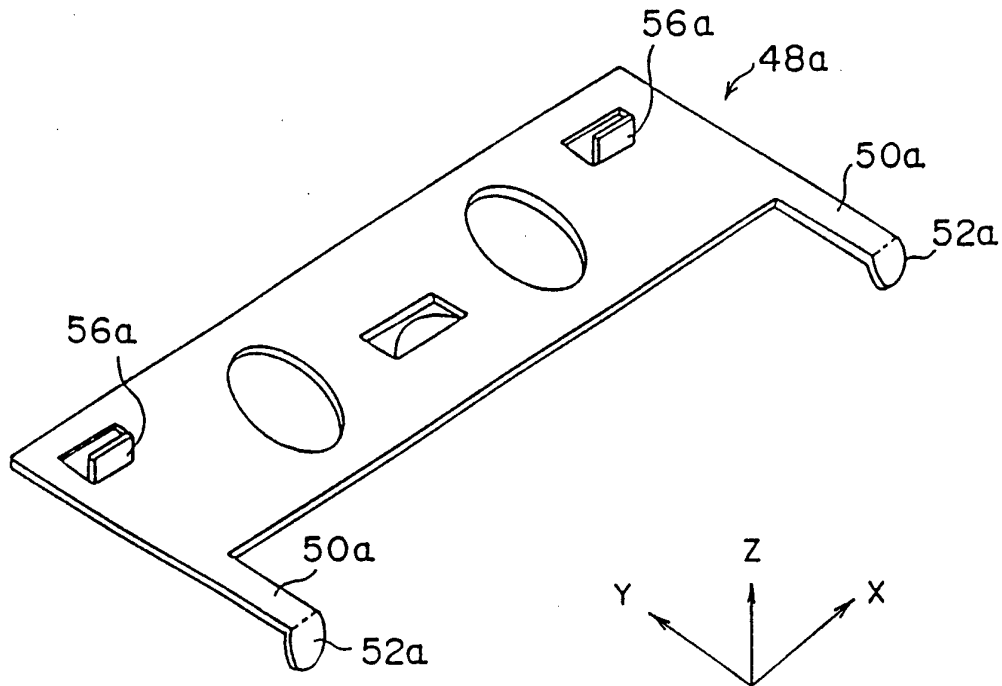


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/03135

A. CLASSIFICATION OF SUBJECT MATTER IPC(5) : H01R 9/09 US CL : 439/64 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 439/64, 65, 62, 80, 153, 157, 876 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,E	US, A, 5,318,452 (BRENNIAN, JR. ET AL.) 07 June 1994, whole document	1-8
A,P	US, A, 5,283,713 (NAGAFUJI ET AL.) 01 February 1994, whole document	1-8
A	US, A, 5,140,501 (TAKAHASHI ET AL.) 18 August 1992, whole document	1-8
A	US, A, 4,789,352 (KREINBERG ET AL.) 06 December 1988, whole document	1-8
A	US, A, 4,996,631 (FREEHAUF) 26 February 1991, whole document	1-8
A	US, A, 4,445,740 (WALLACE) 01 May 1984, whole document	1-8
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
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Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230		Authorized officer DAN WITTELS <i>Joni Hill</i> Telephone No. (703) 308-1148

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/03135

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 3,767,974 (DONOVAN, JR. ET AL.) 23 October 1973, whole document	1-8