

- 3,711,922 1/1973 Busler 29/203 B

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[57] **ABSTRACT**

[21] Appl. No.: 269,094

ABSTRACT

A plurality of electrical connector terminals are formed as part of a common metal strip. The terminals are first inserted into prepunched holes in a mounting board while they are still attached to one another as part of the strip. The terminals are next all press fit simultaneously into the mounting board holes. The strip which connects them together is then broken free and discarded to separate the terminals from one another and leave the individual connector terminals mounted in the board.

[51] **Int. Cl.** **H05k 13/04**

[58] **Field of Search** 29/203 B, 203 R,

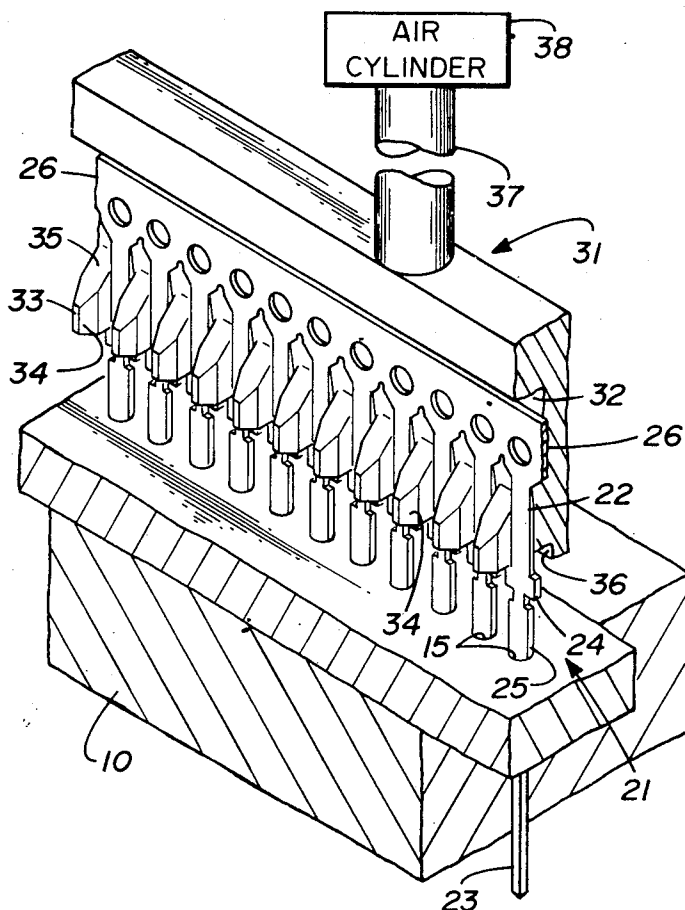
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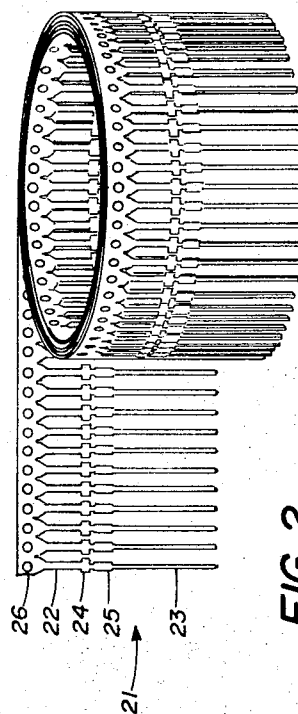
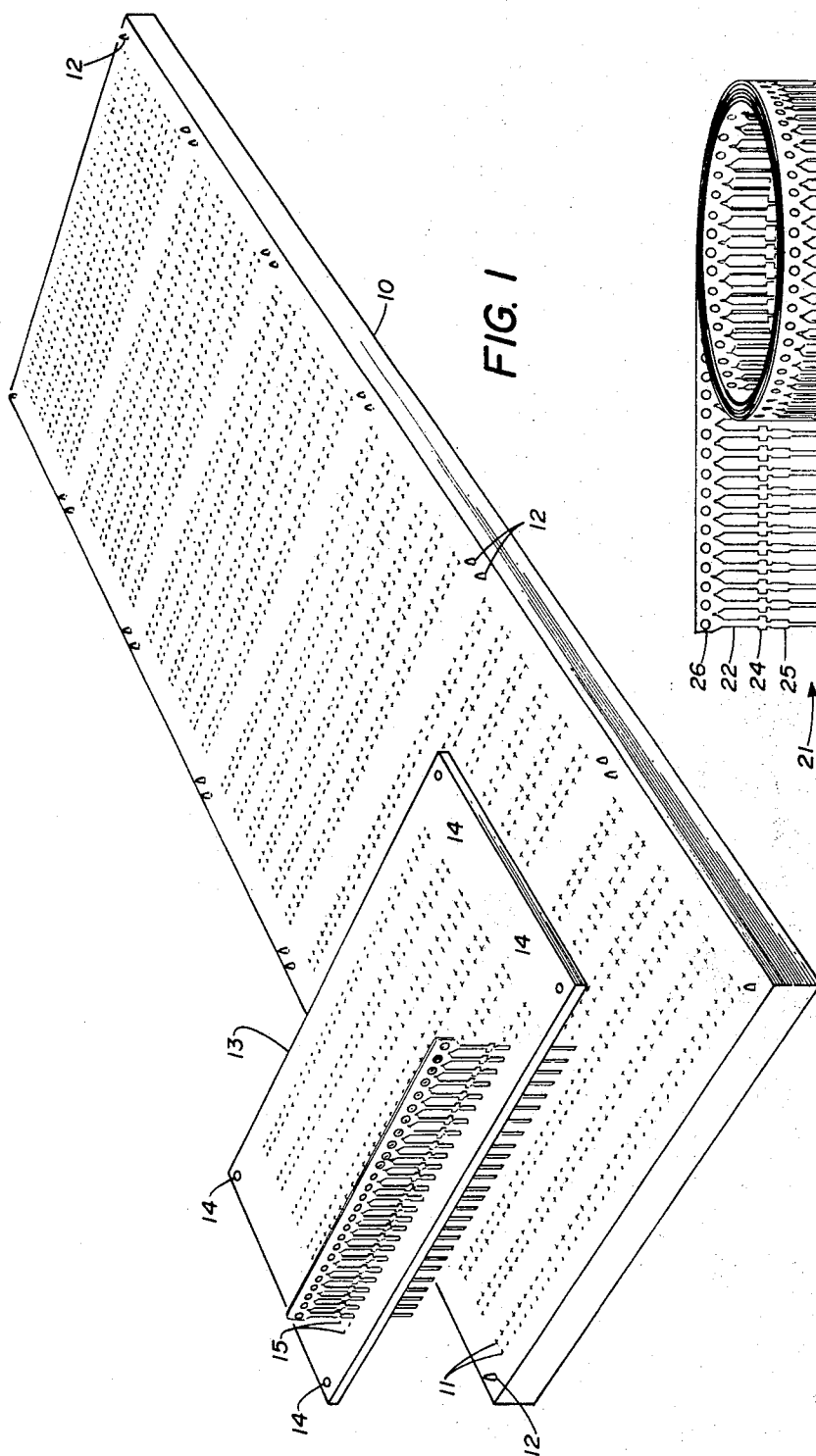
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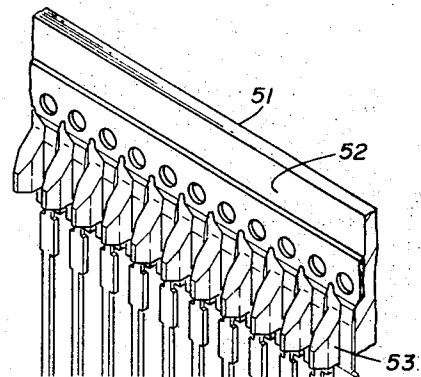
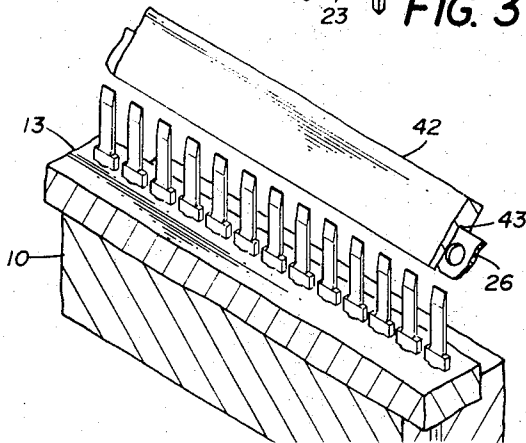
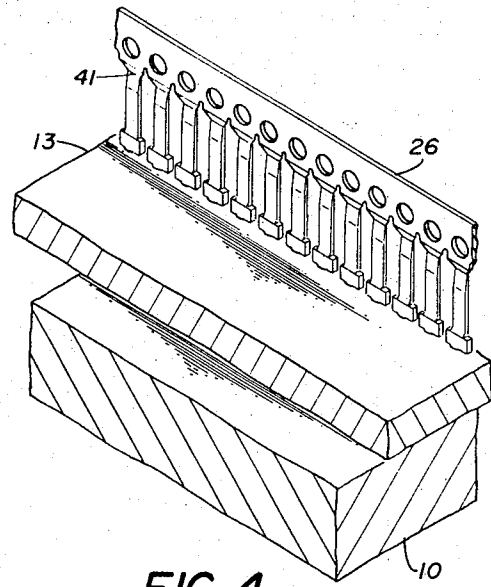
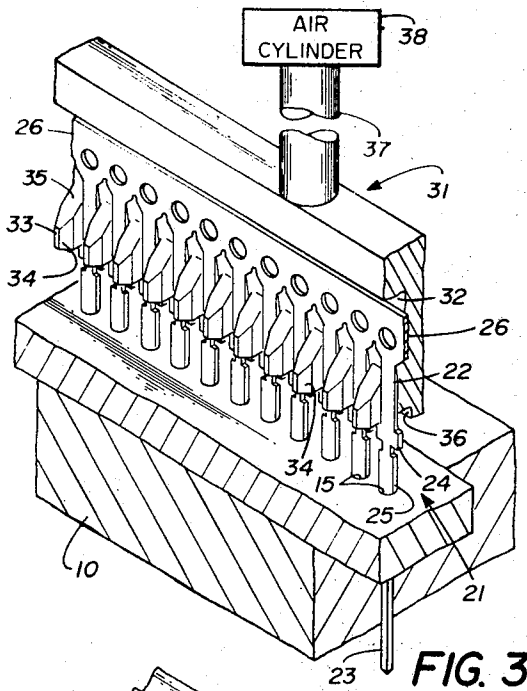
UNITED STATES PATENTS

3,676,926 7/1972 Kendall 29/203 B X

4 Claims, 7 Drawing Figures







APPARATUS FOR MANUFACTURING CONNECTOR TERMINALS

This is a division of application Ser. No. 039,089, filed May 20, 1970, now U.S. Pat. No. 3,676,926.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to apparatus for mounting a plurality of connector terminals on a board and, more particularly, to a rapid and inexpensive technique for simultaneously press fitting a plurality of contacts into prepunched holes in a circuit board.

2. History of the Prior Art

In the past, the principal way in which electrical connector terminals have been manufactured and inserted into circuit boards is by first stamping the terminals from a sheet of metal and separating them from one another. The terminals are then barrel plated and ready for insertion into holes in a board. At this point, the loose terminals may be handled in one of several manners. First, the terminals may be fed to an automatic machine which collects and orientates the terminals and then inserts them one at a time into holes in a circuit board. The disadvantages of this first method is that the automatic machinery is very complex and extremely expensive. Further, these machines are also relatively slow in performing the insertion process. For example, one such machine which is presently in common use in the industry inserts and press fits terminals into prepunched printed circuit boards at a rate of 100 terminals per minute.

A second method of handling loose terminals is that of first loading them into a workholding fixture prior to insertion. This loading is done either by hand or by an automatic machine. The manual loading process is extremely slow and therefore costly in terms of labor. The automatic loading technique requires a relatively complex and costly piece of machinery and even then does not perform the task very quickly.

Once the loose terminals have been loaded into holding fixtures, they may be inserted into a circuit board one at a time by an automatic machine or may all be inserted simultaneously. Additionally, the terminals held in alignment in a fixture may all be bonded to a plastic strip for subsequent simultaneous insertion into a board or shipment prior to insertion.

As can be seen once the terminals are separated from one another for plating, or other reasons, a great deal of processing is required to place and hold the terminals in an array for simultaneous insertion into a circuit board.

The apparatus of the present invention overcomes the disadvantages of prior art terminal handling and insertion techniques by forming the terminals on a separable common support strip and not separating them from one another until the insertion step has been completed. The method thereby eliminates the unnecessary and expensive process of placing the individual terminals in a workholding fixture and the expensive equipment necessary for individual insertion into a board.

While techniques for plating terminals while they are attached to a common strip and then simultaneously processing a plurality of the terminals is known, these methods have generally been of the type which mold a plurality of connected terminals into an insulative housing and then clip away the interconnecting metal portions to separate the terminals from one another.

Other methods have sought to simultaneously separate and crimp finished terminals onto wires to form cable connectors. These techniques for group bonding of joined terminals are relatively slow and cannot be adapted to the problems of press fitting contacts into a circuit board.

SUMMARY OF THE INVENTION

The invention relates to apparatus for simultaneously inserting a plurality of electrical terminals formed on a common support strip into preformed holes in a printed circuit board, press fitting those contacts into the board and then removing the common strip. More particularly, one aspect of the invention pertains to a method for inserting terminals into holes in a circuit board including the step of forming a long strip of connector terminals from a common sheet of conductive material. The terminals are formed joined together by a common support strip left intact on the sheet and joined to each of the terminals by a narrow reduced section. A preselected number of contact terminals to be inserted is severed from the long strip and then press fitted into the holes in the circuit board. The support strip is then flexed while holding the terminals stationary to sever the reduced section and remove the support strip to separate each of the terminals from one another.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and for further objects and advantages thereof, reference may now be had to the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of a backing board and a circuit board having a plurality of common connected terminals inserted through the board;

FIG. 2 is a perspective view of a strip of common connected terminals used in conjunction with the invention;

FIG. 3 is a perspective view of a plurality of common connected terminals being press fitted into holes in a printed circuit board;

FIG. 4 is a perspective view of common connected terminals which have been press fit into the circuit board showing the reduced portion adjacent the common connecting strip;

FIG. 5 is a perspective view showing the press fitted terminals being separated from one another by breaking away the common connecting strip;

FIG. 6 is a plurality of connector terminals which have been press fitted into the board and then separated from one another to form finished separate terminal array; and

FIG. 7 is a perspective view of a plurality of common connected terminals being held in alignment with one another prior to insertion.

DETAILED DESCRIPTION

Referring to FIG. 1, there is shown a backing plate 10 having a plurality of guide holes 11 drilled there-through and a number of upstanding alignment pins 12 mounted along the edge. A circuit board 13 into which terminals are to be inserted is placed upon the surface of the backing plate 10. The board 13 is preferably formed of a G-10 material such as a fiberglass impregnated with epoxy resin. The backing plate 10 may also be made of G-10 material or any other fairly durable

substance. The plate has a thickness greater than the length of the shanks of the terminals to be inserted in the circuit board. The circuit board 13 has alignment holes 14 formed along its edges which are located to receive the alignment pins 12 and hold the board 13 in proper alignment upon the backing. The board 13 has a plurality of apertures or holes 15 formed therein by punching or drilling at preselected locations where connector terminals are to be mounted. When the board 13 is properly positioned on the surface of the backing plate 10 by the engagement of the alignment holes 14 with the pins 12, the holes 15 in the circuit board 13 are in alignment with the guide holes 11 in the backing plate 10. As is shown in FIG. 1, the backing plate 10 is capable of accommodating either six boards of the size and configuration as that shown or it can accommodate fewer boards of larger size. Of course, a backing plate of any configuration could be used to support other sizes and arrangements of printed circuit boards preparatory to insertion of terminals. Its principal functions are to serve as a workholding surface for the circuit boards and provide guide holes for the contact shanks during insertion.

Referring now to FIG. 2, a strip of contact terminals 21 are shown formed into a roll. The contact terminals are preferably made from a single long thin strip of metal such as a phosphor-bronze. Finished terminals are formed by next plating them first with a layer of nickel and then with a layer of gold. The contacts may be stamped or pressed into the proper shape and configuration. The stamped contacts, while still on the strip, are plated and then conveniently rolled up for easy shipping and storage as shown in FIG. 2. When the terminals are to be inserted, a section of the strip is unrolled and the proper number is cut from the roll by severing the edge of the support strip 26 which holds the contacts together.

Each one of the metal contact terminals 21 comprises a connector portion 22 and a shank portion 23 which are separated by a shoulder 24 and an enlarged neck section 25. The neck section is greater in width than the shank portion. The contact receiving holes 15 in the board 13 are slightly larger than the shank portion 23 so that it will readily pass into a mounting hole. The neck section 25 is enlarged to such a width that when longitudinal force is applied and the contact is stacked or press fitted down into a hole, there is a snug, rigid engagement between the neck section and the walls of the hole. The shoulder 24 limits the depth to which a contact 21 may be pressed into a hole in a board. The shank portion 23 of the contact 21 is substantially square in cross section to permit termination by such techniques as wire wrapping. The connector portion 22 of the contact is preferably recessed from one surface of the contact by coining. The upper end of the connector portion 22 is slightly beveled as will be more fully explained below.

Referring now to FIG. 3, there is shown a plurality of contact terminals which have been unrolled and cut from the coil of contact terminals shown in FIG. 2. A circuit board 13 in which the contacts are to be inserted has been placed down upon the backing plate 10 so that the holes 15 are in alignment with the guide holes 11 in the backing plate. The strip of contacts 27 which is to be inserted has been placed so that the shank portions 23 of the contacts 21 pass through the holes 15 and extend down into the guide holes 11 in the

backing plate 10. Because the enlarged neck sections 25 are slightly larger than the holes 15, the contacts come to rest in the position shown in FIG. 3 with the terminals supported by engagement of the enlarged neck sections 25 with the edges of the holes 15.

When the contact strip 21 is in place, insertion tool 31 is brought into engagement. The insertion tool 31 has a plurality of fingers 33 which extend from a recessed section 32. Each of the fingers 33 is of a slightly smaller width than the distance between adjacent contact portions 22 of the contact terminals 21. The fingers also have beveled faces 34 so that the tool may be readily inserted between adjacent ones of the contact terminals 21. Additionally, each of the fingers 33 have beveled top sections 35, the function of which will be explained more fully later. The bottom sections of the fingers 33 are flat so that each finger engages the upper edge of the shoulders 24 of the contact terminals 21. That is, each finger engages one upper edge of one shoulder of one contact and the other upper edge of the shoulder of the next adjacent contact. The insertion tool 31 has an additional lower recessed portion 36 which prevents the lower edge of the tool from damaging the contacts. The height of the recessed portion 36 is slightly greater than the height of the contact shoulders 24 so that the recessed portion provides an abutting surface against the board 10 and stops the downward movement of the tool 31 when the contacts are fully inserted.

When the insertion tool 31 is in place, the recessed section 32 fits adjacent the surface of the contacts and the support strip 26. The fingers 33 of the insertion tool engage the shoulders 24 of the contacts 21. The insertion tool 31 is connected to the piston 37 of an air cylinder 38. When force is applied to the insertion tool 31 by the cylinder 38, longitudinal force is applied to the contacts 21 and the neck sections 25 are press fit down into the receiving holes 15 in the circuit board 13. The lower edges of the shoulders 24 of the contact terminals 21 limit the depth to which the contact terminals are inserted down into the holes 15 of the board 13. Tight frictional engagement between the enlarged neck sections 25 and the inside walls of the holes 15 firmly hold the contacts in position with the body of the circuit board 13.

When the piston 37 is withdrawn again into the air cylinder 38, the upper beveled edges 35 of the finger sections 33 serve as camming surfaces and force the support strip 26, along with the contacts 21, away from the insertion tool 31 so that the fingers are automatically removed from the interstices between the terminals 21.

FIG. 4 shows the contact terminals which are still joined to the support strip 26 after insertion into the holes 15 of the circuit board 13. FIG. 4, however, shows the reverse side of the contact terminals and support strip from that shown in FIG. 3. From this view of the back side, it can be seen that the upper edges of the contact portions 22 of the terminals 21 are slightly beveled to a reduced section 41 where the contact terminals are connected to the support strip 26. It is this reduced section 41 by which each of the contact terminals 21 are connected to the support strip 26.

After the contacts 21 have been press fit into the circuit board, the support strip 26 is no longer needed and must be removed in order to electrically and physically disconnect each one of the contact terminals from the

others. Referring to FIG. 5, there is shown a breaking tool which comprises a flat metal strip 42 having a groove 43 cut along the length of one edge. The width of the groove is slightly larger than the thickness of the support strip 26 and the depth of the groove is approximately the same as that from the edge of the support strip 26 to the reduced section 41. The tool 42 is used by placing it over the array of contact terminals so that the support strip 26 is received up within the groove 43. By flexing the tool 42 about an axis parallel to that of the strip 26, the reduced sections 41 are fatigued and severed and the strip is detached from the contact terminals. As can be seen in FIG. 6, what remains is a plurality of individual, electrically isolated contact terminals 21 mounted in circuit board 13.

The separation of the support strip 26 could be accomplished, of course, in other fashions. For example, the reduced section 41 could be eliminated and the strip cut away to separate the contacts. As can be seen, one of the principal advantages of the present method is that terminals can be inserted quickly since a plurality of terminals are placed in at once. For example, a rate of 200-300 terminals per minute is achieved with relative ease. Automation of the present process should increase the speed of insertion even more. Further, the equipment required to practice the method of the present invention is much simpler and more trouble-free than the individual insertion machines of the prior art.

Since the contact terminals are formed in a long strip and often coiled or rolled for packaging purposes, there may be a slight warp or bow in the strip of terminals after it has been cut from the long row. In this event, there will be a slight misalignment of the shank portions 23 of the terminals and they will not precisely fit into the holes of the circuit board 13. A tool 51 is shown which is used to align warped terminals prior to inserting them into the holes of the circuit board. The tool 51 comprises a flat portion 52 having fingers 53 extending therefrom which pass in the interstices between adjacent ones of the terminals 21. The tool 51 is utilized by pressing the support strip 26 up adjacent the flat surface 52 so that any bow or warp in the terminal strip is removed. The shank portions 23 of the terminals 21 are now in an evenly spaced, linear array and may be easily inserted into the receiving holes 15 in the circuit boards 13. In addition to straightening warped terminal strips, the tool 51 speeds the insertion process even for straight strips.

As can be seen by the above description, the method of the invention comprises forming a plurality of electrical connector terminals on a common support strip,

plating the contacts and then press fitting those contacts into receiving holes in a circuit board. Once the contacts are mounted in the circuit board, the support strip is broken away to leave electrically isolated contact terminals.

This technique can be readily applied to the manufacture of a number of different electrical devices. For example, the contact terminals utilized in the integrated circuit connector shown in application Ser. No. 9,611, filed Feb. 9, 1970, in the name of Frederick T. Inacker, or in the application on a printed circuit board connector filed in the names of Frederick T. Inacker and John Preston Ammon on even date herewith can be inserted using the method of the present invention.

Having described the invention in connection with certain specific embodiments thereof, it is to be understood that further modifications may now suggest themselves to those skilled in the art and it is intended to cover such modifications as fall within the scope of the appended claims.

What is claimed is:

1. An apparatus for inserting contact terminals into receiving apertures in a circuit board comprising:

means for press fitting a selected number of terminals joined to one another as part of a common support strip of terminals into receiving apertures in a circuit board; and

means for severing said common support strip from said terminals to separate the terminals from one another.

2. An apparatus for inserting contact terminals into receiving apertures in a circuit board as set forth in claim 1 wherein:

said means for press fitting said strip of contacts includes an air cylinder.

3. An apparatus for inserting contact terminals into receiving apertures in a circuit board as set forth in claim 1 which also includes:

means for supporting said circuit board and guiding the shanks of said contact terminals during insertion.

4. An apparatus for inserting contact terminals into receiving apertures in a circuit board as set forth in claim 1 wherein said press fitting means includes an insertion tool which comprises:

means for engaging the common support section of said contacts; and

finger means extending into the interstices between adjacent contact terminals to press the terminals into the receiving apertures.

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