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(54) **Electrical connector for use in telephony.**

(57) An electrical connector including a housing of insulative material defining an elongated slot in its front face adapted to receive an edge of a printed circuit board and a socket in its rear face adapted to receive a multi-terminal telephone plug. A plurality of elongated electrical contacts of conductive springy material extend side by side within the housing generally between the housing slot and the housing socket. Each contact includes a circuit board engaging section, defining a generally flat wiping portion positioned at one side of the housing slot and operative to resiliently and wipingly engage a respective contact on the edge of a printed circuit board inserted into the slot, and a plug engaging section. Each plug engaging section extends rearwardly through a passage in the housing to a location on the rear face of the housing below the socket, thereafter bends upwardly through a right angle to the lower edge of the socket and thereafter bends forwardly in cantilever fashion into the socket toward the blind end of the socket and at an angle with respect to the line of action of the socket. The lateral spacing between each contact tail portion is significantly less than the lateral spacing between each contact wiping portion and the contacts are dissimilar and are configured so that, taken as a set, they neck down between the wiping portions and the tail portions to accommodate the disparity in lateral spacing.

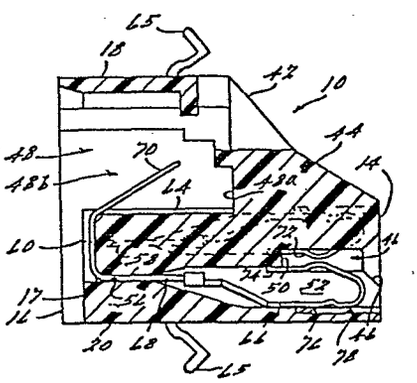

Fig. 2.

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ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

This invention relates to electrical connectors and, more particularly, to electrical connectors for use with printed circuit boards and telephone plugs.

It is often desired to provide a direct readily interchangeable electrical connection between external input devices, such as telephone plugs, and internal system devices, such as printed circuit boards. In the past such a connection has typically been accomplished by two connector assemblies individually mounted using a printed circuit back panel or a chassis/cabling interface. This arrangement is relatively expensive since two separate connector assemblies are required as well as interfacing hardware. This arrangement also creates a rather long electrical signal path, with consequent opportunity for signal degradation, and results in a rather high volume package, rendering it difficult to use where installation space is at a premium.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a compact and inexpensive electrical connector providing a direct readily interchangeable electrical hardware connection between telephone plugs and printed circuit boards.

The electrical connector according to the invention includes a housing of insulative material defining an elongated slot adapted to receive an edge of a printed circuit board and a socket adapted to receive an electrical plug having a plurality of electrical terminals. A plurality of elongated electrical contacts of conductive springy material extend side by side within the housing generally between the housing slot and the housing socket. Each contact includes a circuit board engaging section defining a generally flat wiping portion positioned at one side of the housing slot and operative to resiliently and wipingly engage a respective contact on the edge of a printed circuit board inserted into the slot, and a plug engaging section defining a tail portion projecting in cantilever fashion into the socket toward the blind end of the socket and at an angle with respect to the line of action of the socket. With this arrangement, printed circuit boards may be interchangeably inserted into the housing slot for resilient engagement by the wiping portions of the contacts and multi-terminal plugs may be interchangeably inserted into the housing socket for resilient wiping engagement by the tail portions of the contacts with the tail portions resiliently pivoting to a spring loaded contact position as the plug seats in the socket.

According to a further feature of the invention, the contacts include upper and lower contacts having the wiping portions of their circuit board enga-

ging sections respectively arranged to contact the upper and lower surfaces of an entering circuit board and the tail portions of all the contacts are arranged, cantilever fashion, in the housing socket in side-by-side lateral alignment.

According to another feature of the invention, the lateral spacing between each contact tail portion is significantly less than the lateral spacing between each contact wiping portion and the contacts are dissimilar and are configured so that, taken as set, they neck down between the wiping portions and the tail portions to accommodate the disparity in lateral spacing.

In the disclosed embodiment of the invention, the circuit board slot opens in the front face of the connector, the plug socket opens in the rear face of the connector at a location generally above the slot location, and the plug engaging sections of the contacts extend rearwardly through passages in the housing to a location on the rear face of the housing below the socket, thereafter bend upwardly through a right angle to the lower edge of the socket and thereafter bend forwardly in cantilever fashion into the socket.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a front view of an electrical connector according to the invention;

Figure 2 is a cross-sectional view taken on line 2-2 of Fig. 1;

Figure 3 is a rear view of the invention electrical connector;

Figure 4 is a somewhat schematic top view of the invention electrical connector; and

Figure 5 is a perspective view of the invention connector showing its interchangeable coaction with a phone plug and a printed circuit board.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

The invention electrical connector, broadly considered, comprises a housing 10 and a plurality of contact assemblies 12 extending within the housing.

Housing 10 is formed of an insulative material such, for example, as nylon 6/6 U.L. Rated 94 V-O, 30% glass filled; or Zytel FR 50 U.L. Rated 94 V-O. Housing 10 may be monolithic or multi-piece. In the disclosed monolithic form, housing 10 is bounded by a plurality of generally planar surfaces including a front surface 14, a rear surface 16, an inset rear surface 17, a top surface 18, a bottom surface 20, forward side surfaces 22, 24, rearward side surfaces 26, 28 and a plurality of chamfered surfaces 30, 32, 34, 36, 40, 42 and 44. A printed circuit board slot 46 opens in front housing face 14 and a telephone plug socket 48 opens in rear housing face 17. Slot 46 extends laterally across front face 14 and rearwardly within the housing to blind end wall 50. The entrance to slot 46 is chamfered at 46a to facilitate insertion of a printed circuit board. A series of lower notches 52 open in front housing face 14 at laterally spaced locations thereacross and a series of upper notches 54 open in front housing face 14 at laterally spaced locations

that are staggered with respect to lower notches 52. The foward portions of lower notches 52 open at their upper sides in slot 46 and the forward portions of upper notches 54 open at their lower sides in slot 46. The rearward portions of lower notches 52 pinch inwardly and terminate in rearwardly extending lower passages 56. The rearward portions of upper notches 54 pinch inwardly and terminate in rearwardly extending upper passages 58. Upper and lower passages 56, 58 open in the inset rear housing face 17. A plurality of parallel vertical open grooves 60 are formed in face 17. Each groove 60 communicates at its lower end with the rear end of a respective passage 56, 58 and opens at its upper end in the bottom wall 62 of socket 48. Since upper passages 58 open in rear face 17 at a location above the rear face opening of lower passages 56, the grooves 60 communicating with upper passages 58 are foreshortened relative to the grooves 60 communicating with lower passages 56. Grooves 60 respectively communicate at their upper ends with the rear ends of a plurality of parallel forwardly extending open grooves 64 formed in socket bottom wall 62. Integral pivotal latch members 65 of known construction are provided at the top and bottom of housing 10 to facilitate attachment of the housing to a suitable mounting surface or structure.

Each contact assembly 12 includes a circuit board engaging piece or section 66 and a plug engaging piece or section 68. Pieces 66 are formed of conductive resilient strip material and pieces 68 are formed

of conductive resilient rod or wire material. The inboard or rearward end of each strip piece 66 is joined to the inboard or forward end of each wire piece 68 by crimping or welding.

Four upper contact assemblies 12a, 12b, 12c, and 12d are provided as well as four lower contact assemblies 12e, 12f, 12g, and 12h. Upper contact assemblies 12a, 12b, 12c, and 12d are positioned in housing 10 with each strip piece 66 positioned in an upper notch 54 and each wire piece 68 extending rearwardly through an upper passage 58, then upwardly in a vertical groove 60, and then forwardly and upwardly to define a tail portion 70. Tail portions 70 project in cantilever fashion into socket 48 toward the blind end 48a of the socket and at an angle with respect to the line of action 48b of the socket. Lower contact assemblies 12e, 12f, 12g, and 12h are positioned in housing 10 with each strip piece 66 positioned in a lower notch 52 and each wire piece 68 extending rearwardly through a lower passage 56, then upwardly in a vertical groove 60, and then forwardly and upwardly in cantilever fashion into socket 48 to define a tail portion 70. The upwardly extending portions of the wire pieces of the upper contact assemblies are foreshortened relative to the corresponding portions of the wire pieces of the lower contact assemblies so that the tail portions 70 of all of the contacts are positioned side by side in lateral alignment within socket 48.

Each strip piece 66 includes a wiping portion 72 projecting upwardly or downwardly into slot 46. The

rearward tip 74 of each wiping portion 72 is spring loaded against the adjacent housing surface to provide a preload for the wiping portion. A tab 76, struck from each strip piece 66, seats in a groove 78 in the bottom or top, respectively, of each notch 52, 54 to limit rearward movement of the contact assembly within the housing.

The lateral spacing between the wiping portions of adjacent upper contact assemblies or between the wiping portions of adjacent lower contact assemblies (for example, as viewed in Fig. 1 between the centerline of the wiping portion of lower contact assembly 12e and the centerline of the wiping portion of lower contact assembly 12f) is significantly greater than the lateral spacing between the respective tail portions of these assemblies. For example, the spacing between adjacent tail portions 70 in socket 48 will typically correspond to the standard .040 inch spacing between adjacent terminals 80 on a standard telephone plug 82 so that the spacing between the tail portions of adjacent upper or adjacent lower contact assemblies will be .080 inches. By contrast, the spacing between adjacent upper or adjacent lower wiping portions will correspond to a standard spacing for the conductive strips 84 on a printed circuit board 86. Whereas various standards are used for the lateral spacing of the conductive strip on a printed circuit board, all of the common spacing standards (for example, .150 inches or .109 inches) exceed the spacing (that is, .080 inches) between every second terminal on a standard

phone plug.

To accommodate this spacing disparity, the contact assemblies are made in sets of dissimilar assemblies. Thus, as best seen in Fig. 4, the four upper contact assemblies each have a unique strip piece. Specifically, as viewed from the rear of the connector in Fig. 3, the center line of the wiping portion of the strip piece of assembly 12a is offset sharply to the right of the centerline of the inboard end of that strip; the centerline of the wiping portion of the strip piece of assembly 12b is offset slightly to the right of the centerline of the inboard end of that strip; the centerline of the wiping portion of the strip piece of assembly 12c is offset to the left of the centerline of the inboard end of that strip by a distance slightly greater than the opposite offset of the strip of assembly 12b; and the centerline of the wiping portion of the strip piece of assembly 12d is offset to the left of the centerline of the inboard end of that piece by a distance slightly greater than the opposite offset of the strip of assembly 12a. The upper contact assemblies, taken as a set, thus neck down between the wiping portions and the tail portions to accommodate the disparity in lateral spacing between the wiping portions and the corresponding tail portions. A matching set of dissimilar strip pieces, rotated 180°, is used as the strip pieces for the lower contact assemblies. Specifically, the contact strip for assembly 12a, when rotated 180°, is usable as the strip piece for assembly 12h. The strip pieces for

assemblies 12b and 12g, 12c and 12f, and 12d and 12e are similarly interchangeable.

The invention connector 10 allows ready and interchangeable electrical connection between any selected telephone plug 82 and any selected printed circuit board 86. Specifically, when it is desired to establish a direct electrical hardware connection between a selected telephone plug 82 and a selected printed circuit board 86, the plug assembly is plugged into socket 48 and the printed circuit board is plugged into slot 46. As the plug moves into socket 48 along line of action 48b, plug terminals 80 wipingly engage contact tail portion 70 and resiliently pivot the tail portions to their spring loaded contact positions as the plug seats in the socket. With plug 82 seated in socket 48, tail portions 70 seat in grooves 64 and shoulders 84 on a standard resilient latch 86 on plug 82 coact in known manner with shoulders on housing 10 to preclude inadvertent removal of the plug from the socket. As printed circuit board 86 enters slot 46, the wiping portions 72 of the upper and lower contacts resiliently and wipingly engage conductive strips 84 on the upper and lower surfaces, respectively, of board 86.

The invention connector will be seen to provide a compact and inexpensive device for providing direct and readily interchangeable electrical hardware connection between telephone plugs and printed circuit boards.

CLAIMS

1. An electrical connector comprising

A. a housing of insulative material defining

1. an elongated slot adapted to receive an edge of a printed circuit board and

2. a socket adapted to receive an electrical plug having a plurality of electrical terminals;

B. a plurality of elongated electrical contacts of conductive springy material extending side by side within said housing generally between said slot and said socket and each including

1. a circuit board engaging section defining a generally flat wiping portion positioned at one side of said slot and operative to resiliently and wipingly engage a respective contact on the edge of a printed circuit board inserted into said slot and

2. a plug engaging section defining a tail portion projecting in cantilever fashion into said socket towards the blind end of said socket and at an angle with respect to the line of action of said socket so that said

tail portion is wipingly engaged by a respective terminal on a plug entering said socket and resiliently pivoted to a spring loaded contact position as the plug seats in said socket.

2. An electrical connector according to claim 1 wherein

C. said contacts comprise upper and lower contacts having the wiping portions of their circuit board engaging sections respectively arranged to engage contacts on the upper and lower surfaces of an entering circuit board; and

D. the tail portions of all of said contacts are arranged, cantilever fashion, in said socket in side-by-side lateral alignment.

3. An electrical connector according to claim 1 wherein

C. said housing is bounded by a plurality of distinct surfaces;

D. said slot opens in one surface of said housing; and

E. said socket opens in a different surface of said housing.

4. An electrical connector according to claim 3 wherein

F. said plug engaging section of each contact includes a bend along its length;

G. said tail portion extends from said bend to the outboard tip of said plug engaging section; and

H. said tail portion resiliently pivots about said bend in response to wiping engagement by the terminal on the entering plug.

5. A connector according to claim 3 wherein

F. said plug engaging section of each contact joins at its inboard end with the inboard end of said circuit board engaging section, extends outwardly therefrom through a respective one of a plurality of passages in said housing, bends through essentially a right angle and thereafter bends through an acute angle and enters said socket to define the cantilevered tail portion.

6. A connector according to claim 5 wherein

G. said housing passages open in a rear face of said housing below said socket;

H. said slot opens in a front face of said housing;

I. said housing includes a plurality of parallel vertical open grooves formed in said rear housing face and each communicating at its lower end with the rear end of a respective one of said passages and at its upper end with said socket; and

J. each said contact extends essentially from front to rear of said housing with its plug engaging section extending rearwardly through one of said passages, then upwardly in one of said vertical grooves, and then forwardly and upwardly in cantilever fashion into said socket to define the cantilevered tail portion.

7. An electrical connector according to claim 6 wherein

K. said socket is defined in said rear face of said housing at a location generally above the location of said slot in said front face of said housing;

L. said contacts comprise upper and lower contacts having the wiping portions of their circuit board engaging sections respectively arranged to engage contacts on the upper and lower surfaces of an entering circuit board;

M. the passages receiving the rearwardly extending portions of the plug engaging sections of the upper contacts open in said rear face of said housing above the rear face openings of the passages receiving the corresponding portions of the lower contacts; and

N. the upwardly extending portions of the plug engaging sections of the upper contacts are foreshortened relative to the corresponding portions of the lower contacts so that the cantilevered tail portions of all of the contacts may be laterally aligned within said socket.

8. In a card edge connection of the type including an insulative housing defining a slot adapted to receive the edge of a printed circuit board and a plurality of elongated resilient electrical contacts extending within said housing with their one ends disposed in a position to establish electrical connection with the edge of a circuit board inserted into said slot, the improvement wherein

A. said housing further defines a socket adapted to receive a multi-terminal electrical plug;

B. the other ends of said contacts are configured to define tail portions extending side by side in cantilever fashion into said socket at an angle and disposition relative to the line of action of said socket so as to be resiliently bent over by the wiping contact of the respective terminals on a multi-terminal plug entering said socket.

9. A card edge connector according to claim 8 wherein

C. said card edge slot opens in a front face of said connector;

D. said socket opens in a rear face of said connector;

E. said contacts extend side by side from front to rear of said housing; and

F. each of said tail portions is bent forwardly relative to the main body of the contacts and extends forwardly in said socket toward the blind end of the socket.

10. An electrical connector according to claim 4 wherein

H. the lateral spacing between the tail portions of adjacent contacts is significantly less than the lateral spacing between the wiping portions of those contacts and

I. said contacts are dissimilar and are configured so that, taken as a set, they neck down between said wiping portions and said tail portions to accommodate the disparity in lateral spacing.

11. An electrical connector according to claim 2 wherein

E. the wiping portions of said upper and lower contacts alternate in laterally staggered fashion in said slot.

12. An electrical connector according to claim 11 wherein

F. the lateral spacing between successive wiping portions in said slot is significantly greater than the lateral spacing between successive tail portions in said socket; and

G. said contacts are dissimilar and are configured so that, taken as a total group, they neck down between said wiping portions and said tail portions to accommodate the disparity in lateral spacing.

13. An electrical connector according to claim 12 wherein

H. each contact comprises a two-piece assembly with said circuit board engaging section defined by a circuit board engaging piece and said plug engaging section defined by a separate plug engaging piece suitably connected to the circuit board engaging piece;

I. the upper circuit board engaging pieces are formed of a set of dissimilar pieces; and

J. the same set of dissimilar pieces, rotated 180 relative to the upper circuit board engaging pieces, is used for the lower circuit board engaging pieces.

14. An electrical connector according to claim 13 wherein

K. there are four pieces in each set of circuit board engaging pieces and eight pieces, and accordingly eight contacts, in total.

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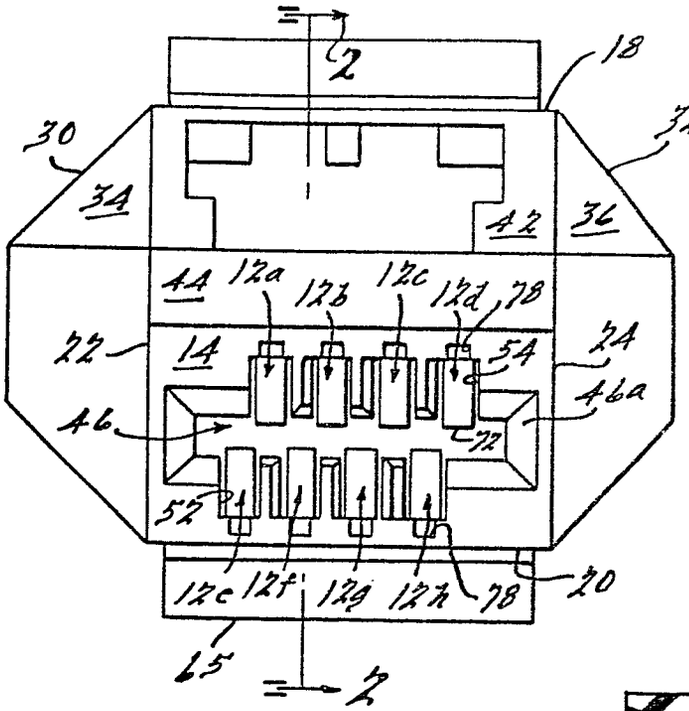

Fig.1.

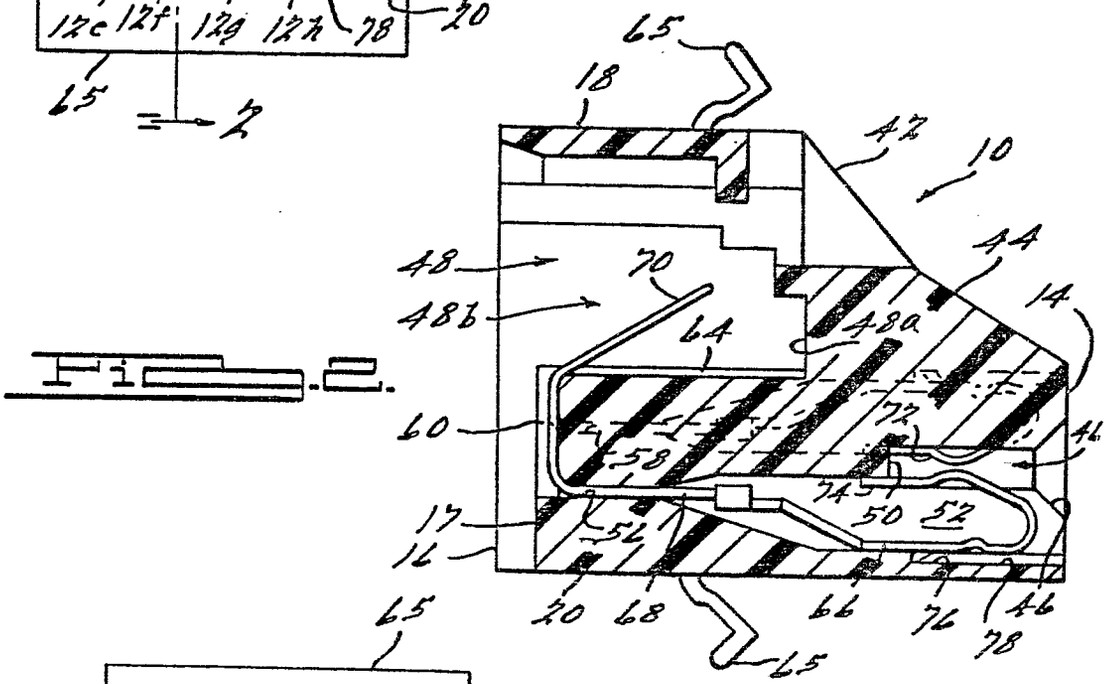

Fig.2.

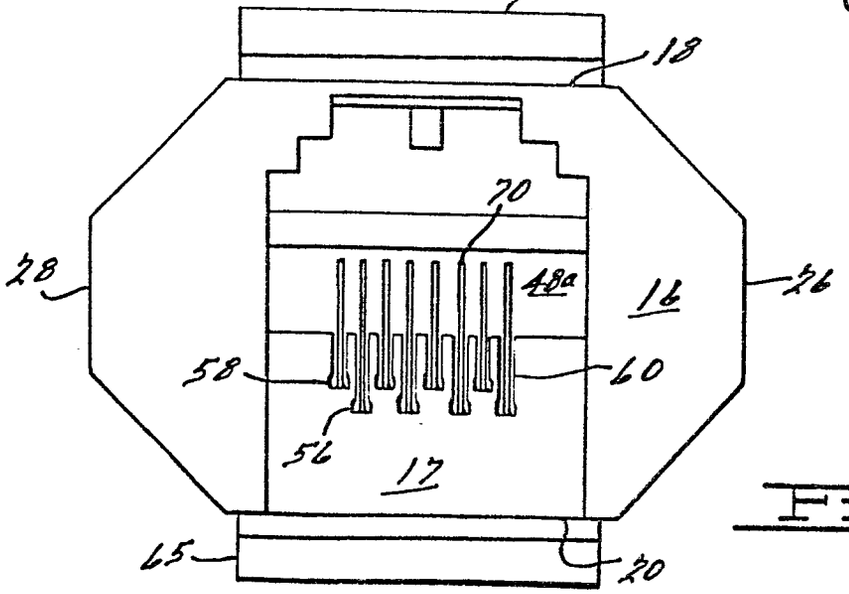

Fig.3.

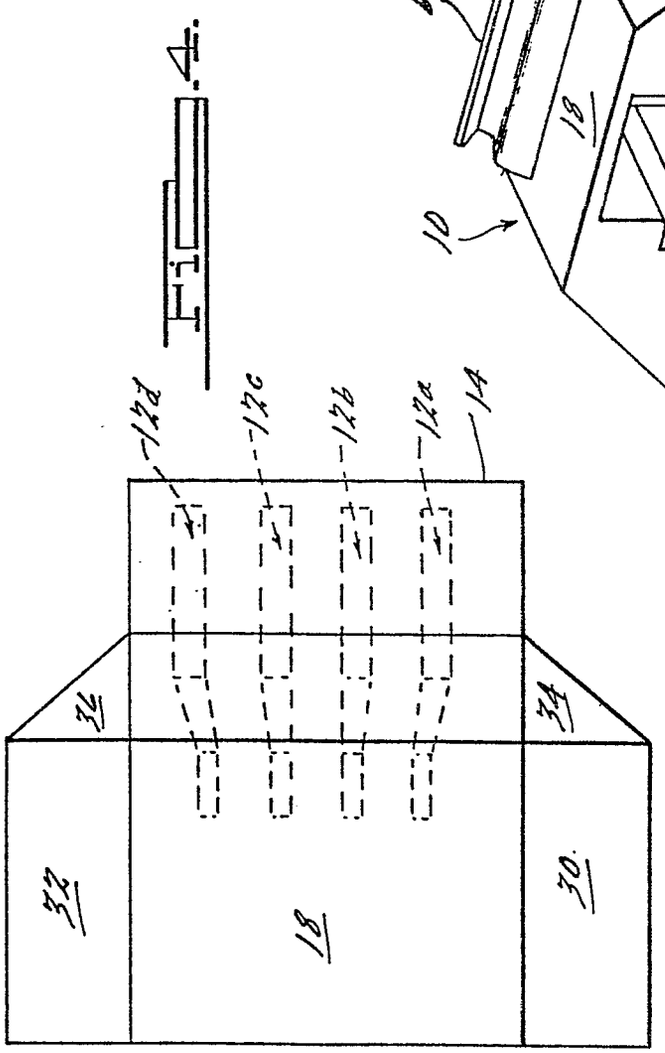
12d
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Fig. 4.

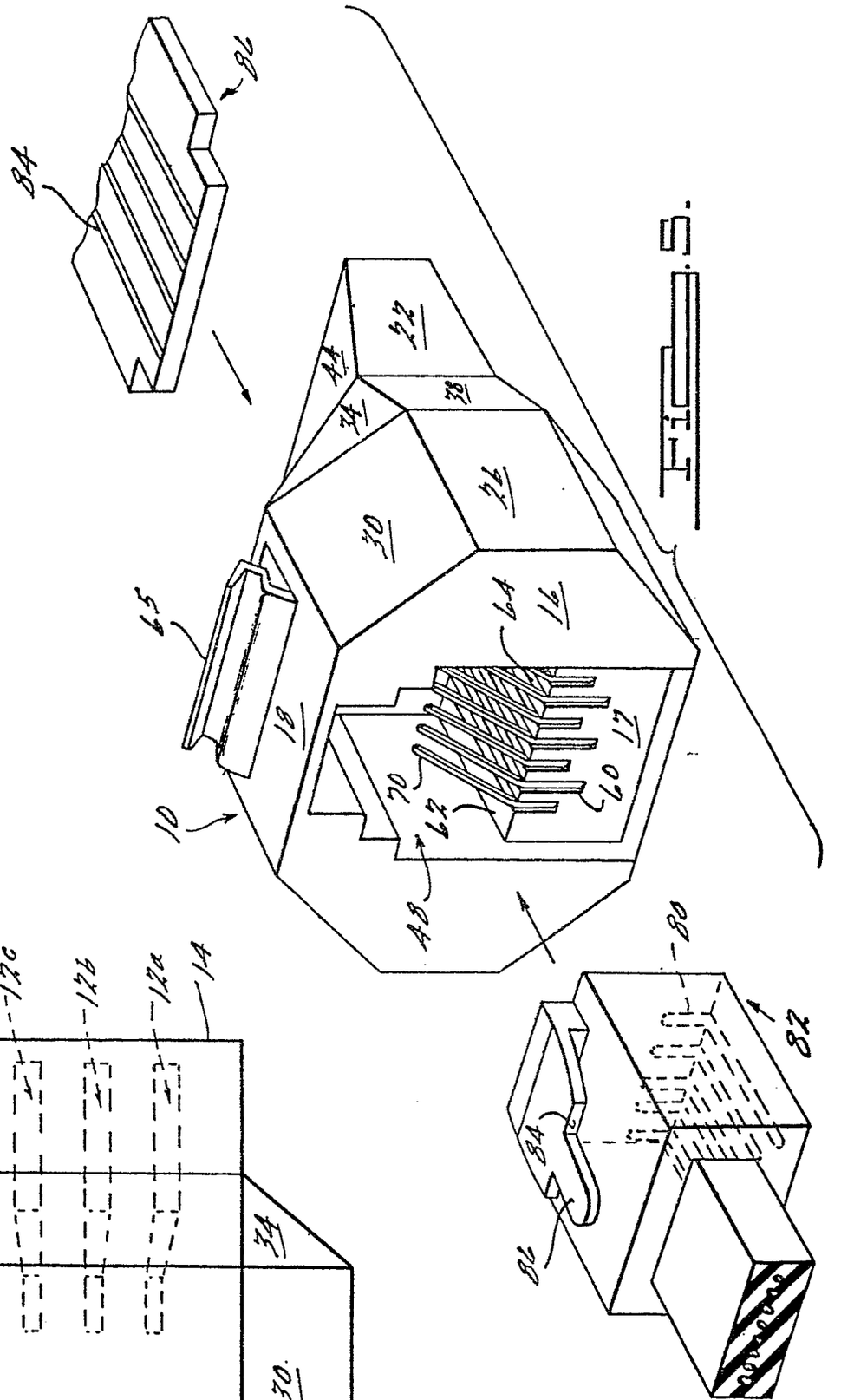
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Fig. 5.