

-1-

THIS SHEET HAS BEEN
REPLACED

9605579-3

IPDS
copySPECIFICATION**MODULAR ELECTRICAL CONNECTOR**Field of the Invention

5 This invention generally relates to the art of electrical connector assemblies and, particularly, to a modular telephone connector, although various aspects of the invention are applicable to connectors, in general.

Background of the Invention

10 A common type of female electrical connector or receptacle is referred to in the industry as a telephone jack or "modular jack". Such a modular telephone connector includes a dielectric housing defining a standard telephone receptacle jack. A plurality of terminals are mounted in the housing, and each terminal includes a resilient
15 cantilever jack contact portion projecting into a plug-receiving cavity or opening in the housing for engaging contacts of a standard telephone plug. Most often, the terminals are stamped and formed of sheet metal material and include terminating portions, such as wire insulation
20 displacement portions, opposite the resilient cantilever jack contact portions. The wire insulation displacement portions receive insulated telephone wires.

This Sheet Has Been Replaced



88

A wide variety of designs for modular telephone connectors have been proposed to facilitate field installation. Any design should maximize ease of manipulation of the telephone wires and ease of assembly and termination of the connector. Unfortunately, heretofore, even with all of the various design proposals, such modular jacks still employ too many components which are difficult to manipulate and assemble, particularly with the every-increasing miniaturization of such components. Problems still are encountered with various designs of field installable modular telephone connectors because of their size, the assembly manipulations required and the difficulty of terminating the telephone wires to the connector.

This invention is directed to solving these problems by providing a unique modular electrical connector, particularly adaptable as a modular telephone connector or jack, which includes a one-piece molded housing which has various integral, relatively movable portions for effecting complete assembly and termination of the connector without any extraneous components or tools.

Summary of the Invention

An object, therefore, of the invention is to provide a new and improved modular electrical connector, in



-3-

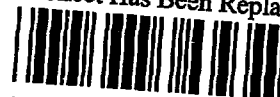
THIS SHEET HAS BEEN
REPLACED

general, and to provide a unique modular telephone connector or jack, in particular.

5 In the exemplary embodiment of the invention, the modular telephone connector includes a housing defining a standard telephone jack. A plurality of stamped metal terminals are mounted in the housing, and each terminal has a resilient cantilever jack contact portion, a wire insulation displacement portion and an intermediate portion between the cantilever jack contact portion and the wire insulation displacement portion. The housing is provided in the form of a one-piece structure overmolded about the intermediate portions of the stamped metal terminals, with the wire insulation displacement portions of the terminals exposed for receiving insulated telephone wires. The housing includes a cavity or opening for receiving a standard telephone plug. The cantilever jack contact portions of the terminals are exposed adjacent the cavity, whereby the contact portions can be bent into the cavity for engaging contacts of the telephone plug upon insertion of the plug into the cavity.

15 A feature of the invention is directed to providing at least one wire-driving portion of the connector housing molded integrally therewith by a living hinge, whereby the wire-driving portion is movable into engagement with at least some of the insulated telephone wires to

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

drive the wires into the insulation displacement portions of the terminals. As disclosed herein, the wire insulation displacement portions of the terminals project from opposite sides of the housing, and a pair of the wire-driving portions are molded integrally with opposite sides of the housing by a pair of living hinges.

Another feature of the invention involves forming the wire insulation displacement portions of the terminals with closed keyhole-shaped insulation displacement slots defining enlarged slot portions sized for receiving the insulated telephone wires, along with narrow slot portions communicating with the enlarged slot portions for piercing the insulation of the telephone wires. The wire-driving portions of the housing are effective to drive the telephone wires into the narrow slot portions of the keyhole-shaped slots.

Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

This Sheet Has Been Replaced



-5-

THIS SHEET HAS BEEN REPLACED

Brief Description of the Drawings

5 The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with its objects and the advantages thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

10 FIGURE 1 is a perspective view of a fully assembled modular telephone jack incorporating the concepts of the invention;

15 FIGURE 2 is a plan view of a fragmented portion of a continuous metal strip from which the terminals of the connector are stamped, illustrating two sets of terminals for a pair of connectors;

FIGURE 3 is a view similar to that of Figure 2, illustrating a pair of one-piece housing structures overmolded about intermediate portions of the terminals;

20 FIGURE 4 is a view of only one of the overmolded housing structures and a single set of terminals, as depicted in Figure 3;

FIGURE 5 is a horizontal section taken generally along line 5-5 of Figure 4;

25 FIGURE 6 is a sectional view similar to that of Figure 5, during a step of manufacture wherein the canti-

This Sheet Has Been Replaced

THIS SHEET HAS BEEN REPLACED

lever jack contact portions of the terminals have been bent into the housing cavity, and the base portion of the housing structure has been pivoted to a latched condition, versus the initial overmolded condition shown in Figure 5;

5 FIGURE 7 is a front elevational view, looking toward the right-hand end of Figure 6, with the wire-driving portions of the housing structure in inoperative positions;

10 FIGURE 8 is a vertical section taken generally along line 8-8 of Figure 6, again showing the wire-driving portions of the housing structure in inoperative positions, as depicted in Figure 7;

15 FIGURE 9 is a view similar to that of Figure 8, with the wire-driving portions pivoted to their wire terminating positions;

FIGURE 10 is a vertical section through the fully assembled and terminated modular connector, as taken generally along line 10-10 of Figure 1, in conjunction with a standard telephone plug; and

20 FIGURE 11 is a view similar to that of Figure 10, showing the connector mounted within a particular housing environment.



Detailed Description of the Preferred Embodiment

Referring to the drawings in greater detail, and first to Figure 1, the concepts of the invention are illustrated in a modular telephone connector or jack, generally designated 12, which includes a one-piece housing, generally designated 14. The housing is unitarily molded of dielectric material, such as plastic or the like, and will be described in greater detail hereinafter. Generally, a portion of the housing is overmolded about portions of a plurality of stamped metal terminals, generally designated 16, and the terminals are insulation-displacement-terminated to a plurality of telephone wires of a telephone cable 19, all of which will be described in greater detail hereinafter. At this point, it should be understood that, although the concepts of the invention are disclosed herein embodied in a modular telephone connector or jack, various aspects of the invention are equally applicable for other types of electrical connectors.

The following detailed description is being presented in a step-by-step fashion involving initial manufacturing steps, initial sub-assembly steps prior to providing or shipping the pre-assembled connector to a user, and finally the telephone wire termination steps carried out by the user. This approach is believed to be most advanta-



-8-

THIS SHEET HAS BEEN
REPLACED

geous in presenting various aspects of the invention in a precise and understandable description.

More particularly, referring first to Figure 2, terminals 16 first are stamped from a continuous strip of sheet metal material to a blank configuration including a pair of continuous carrier strips 18 which carry the terminals in stamped form through an appropriate stamping machine. Of course, the terminals are in a flat or planar configuration in the stamped blank of Figure 2. It can be seen that the terminals are joined by web portions 20 and transverse webs 22 to carrier strips 18. It also can be seen that the terminals are stamped on opposite sides of a transverse center line 23, with four terminals on each side of the center line for a total "terminal cluster" of eight terminals for each telephone connector 12 (Fig. 1).

Each stamped metal terminal 16 includes a resilient cantilever jack contact portion 24, a wire insulation displacement portion 26 and an intermediate portion 28, although the right-hand terminals shown in Figure 2 have no distinct intermediate portion except integral areas of wire insulation displacement portions 26. Eventually, cantilever jack contact portions 24 of the terminals will be severed from the right-hand carrier strip 18 and bent into the connector housing 14, as will be described in greater detail hereinafter.

This Sheet Has Been Replaced

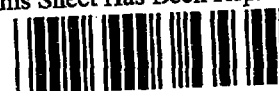


THIS SHEET HAS BEEN
REPLACED

The next step in fabricating modular telephone connector 12 is shown in Figures 3-5 and, generally, involves overmolding a one-piece housing subassembly structure about portions of terminals 16, generally about the intermediate portions of at least some of the terminals. More particularly, an overmolded housing structure or subassembly, generally designated 30, includes a top or center overmolded portion 32, a main housing portion 34, a latch portion 35 and a pair of wire-driving portions 36. It can be seen that the top or center overmolded portion 32 is molded about portions of terminals 16 such that wire insulation displacement portions 26 of the terminals are exposed exteriorly on opposite sides of the center overmolded portion of the housing subassembly structure. It also can be seen that latch portion 35 is overmolded about inner areas of cantilever jack contact portions 24, leaving considerable areas of the contact portions exposed for bending purposes, as described herein-after.

Main housing portion 34 includes an opening or cavity 38 which is provided for receiving a standard telephone plug, as will be more apparent hereinafter. The main housing portion is molded integral with top or center overmolded portion 32 by a living hinge 40. Each wire-driving portion 36 also is molded integral with top or

This Sheet Has Been Replaced



center overmolded portion 32 by a living hinge 42. Each wire-driving portion also includes slots or grooves 44 in the top thereof for effecting insulation displacement termination of telephone wires to the wire insulation displacement portions 26 of terminals 16, again as will be described in greater detail hereinafter.

Lastly, at this point, in order to better understand the following detailed description, it should be noted in Figure 5 that main housing portion 34 and wire-driving portions 36 depend downwardly from top or center overmolded portion 32 of the housing. Living hinges 40 and 42 also are clearly visible in this figure. After housing subassembly structure 30 (Figs. 3 and 4) is overmolded about portions of terminals 16, as described above, webs 20 (Fig. 2) then are severed from wire insulation displacement portions 26 of the terminals, and cantilever jack contact portions 24 are severed from the right-hand carrier strip 18 of the stamped metal blank described above in relation to Figure 2. The cantilever jack contact portions now are rendered flexible or resilient because of their becoming free from the carrier strip.

After all of the extraneous webs and carrier strips have been removed from the stamped metal blank, cantilever jack contact portions 24 then are formed or bent, and overmolded housing subassembly 30 is assembled



THIS SHEET HAS BEEN
REPLACED

into a subassembly for shipping to and/or use by an ultimate user. Of course, the entire modular telephone connector 12 can be fully assembled in a manufacturing environment, if such an application is desirable. In
5 either event, reference is made to Figures 6 and 7, particularly in conjunction with Figure 5. Cantilever jack contact portions 24 first are bent downwardly in the direction of arrow "A" (Fig. 5) to the configuration shown in Figure 6, whereby the contact portions now are disposed
10 within cavity or opening 38. Main housing portion 34 then is pivoted about living hinge 40 in the direction of arrow "B" (Fig. 5). As seen in Figure 7, the main housing portion will move upwardly between the side wire-driving portions 36. When the main housing portion is moved to its
15 fully assembled position as shown in Figure 6, the main housing portion is latched in that position by a pair of latch bosses 46 (Fig. 3) snapping into a pair of latch grooves 48 (Fig. 5) on the inside of latch portion 35 of the overmolded housing structure. When in the assembled
20 condition, cantilever jack contact portions are disposed within a comb structure 50 (Fig. 4) and seat on top of ledges 52 (Fig. 6) of the comb structure. When a standard telephone plug is inserted into opening 38, the resilient cantilever jack contact portions engage contacts on the

This Sheet Has Been Replaced



THIS SHEET HAS BEEN ^{92-109 EP} REPLACED

plug as the jack contact portions are biased upwardly in the direction of arrow "C" (Fig. 6).

Wire-driving portions 36 of overmolded housing structure 30 are used to drive insulated wires of telephone cable 18 (Fig. 1) into insulation displacement condition with wire insulation displacement portions 26 of terminals 16. Before proceeding, however, reference is made back to Figures 2-4 where it can be seen that each wire insulation displacement portion 26 of each terminal 16 includes a pair of keyhole-shaped slots, each slot including an enlarged slot portion 54 communicating with a narrow slot portion 56. The enlarged slot portions 54 are sized sufficiently larger than the insulated wires of the telephone cable so that the wires can be inserted easily into the enlarged slot portions. The narrow slot portions 56 are sufficiently narrow to cut through or pierce the insulation of the telephone wires to establish conductivity with the cores of the wires.

With the above understanding, and with reference to Figures 8 and 9, it can be seen in Figure 8 that wire-driving portions 36 project outwardly of the center or top portion 32 of the overmolded housing structure 30, with the wire-driving portions being interconnected to the center portion by living hinges 42. Therefore, the wire-driving portions can be pivoted upwardly in the direction of arrows

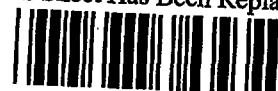
This Sheet Has Been Replaced


THIS SHEET HAS BEEN
REPLACED

"D" (Fig. 8). It also should be noted that slots 44 in the wire-driving portions have widths which are at least slightly larger than the thickness of the metal material from which insulation displacement portions 26 of terminals 16 are fabricated. Therefore, wire-driving portions 36 can be pivoted upwardly in the direction of arrows "D", about living hinges 42, whereupon wire insulation displacement portions 26 of the terminals enter into slots 44 as shown in Figure 9. Since the enlarged slot portions 54 are disposed transversely outwardly relative to narrow slot portions 56, as seen clearly in Figure 4, if insulated wires are located in the enlarged slot portions, wire-driving portions 36 will drive the wires into the narrow slot portions 56, as indicated by arrows "E" in Figure 9. Therefore, wire-driving portions 36 of the overmolded housing structure are effective to terminate the telephone wires to the terminals. Slots 44 in the wire-driving portions should be of widths to establish an interference fit with insulation displacement portions 26 of the terminals, so that the wire-driving portions remain in their terminating positions as shown in Figure 9.

Figure 10 shows modular telephone connector 12 fully terminated to a plurality of insulated wires 60 of telephone cable 19. This depiction corresponds to the "subassembly" illustration of Figures 6 and 7, except that

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

the insulated wires 60 are shown terminated to insulation displacement portions 26 of terminals 16, as described above in relation to Figures 8 and 9. It can be seen that telephone cable 19 can be inserted through a recessed area 62 of main housing portion 34, and insulated wires 60 simply are fed upwardly through enlarged slot portions 54 (Fig. 4), whereupon wire-driving portions 36 of the over-molded housing structure can be used to drive the insulated wires into the narrow slot portions 56, as described above.

The modular telephone connector now is fully assembled and ready to receive a standard telephone plug 64 insertable into opening 38 in the direction of arrow "F", as shown in Figure 10.

Lastly, Figure 11 illustrates an application of using modular telephone connector 12 within a particular housing 66 which includes a front aperture 68 through which telephone plug 64 can be inserted into opening 38 in the modular telephone connector. Appropriate contacts on the plug (not shown) will engage resilient cantilever jack contact portions 24 and bias the contact portions upwardly in the direction of arrow "C".

It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered

This Sheet Has Been Replaced

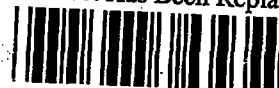


-15-

THIS SHEET HAS BEEN
REPLACED

in all respects as illustrative and not restrictive, and
the invention is not to be limited to the details given
herein.

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

92-109 EP

CLAIMS



1. In a modular telephone connector (12) which includes a housing (14) defining a standard telephone jack, and a plurality of stamped metal terminals (16) each having
5 a resilient cantilever jack contact portion (24) and a wire insulation displacement portion (26), wherein the improvement comprises said housing being a one-piece structure overmolded about portions of the stamped metal terminals with the wire insulation displacement portions
10 thereof exposed for receiving insulated telephone wires (60), the housing including a cavity (38) for receiving a standard telephone plug (64), and the cantilever jack contact portions (24) of the terminals being exposed by the overmolded housing adjacent the cavity whereby the contact
15 portions can be bent into the cavity.

2. In a modular telephone connector as set forth in claim 1, wherein said wire insulation displacement portions (26) of the terminals (16) include closed keyhole-shaped insulation displacement slots defining enlarged slot
20 portions (54) sized for receiving the insulated telephone wires (60), and narrow slot portions communicating with the enlarged slot portions (56) for piercing the insulation of

This Sheet Has Been Replaced





92-109 EP

-17-

THIS SHEET HAS BEEN
REPLACED

the telephone wires when the wires are moved from the enlarged slot portions with the narrow slot portions.

5 3. In a modular telephone connector as set forth in claim 2, wherein said housing (14) includes at least one wire-driving portion (36) molded integrally therewith and movable into engagement with at least some of the insulated telephone wires to drive the wires into the narrow slot portions (56) of at least some of the insulation displacement slots.

10 4. In a modular telephone connector as set forth in claim 3, including a living hinge portion (42) integrally connecting the wire-driving portion to afford driving movement thereof.

15 5. In a modular telephone connector as set forth in claim 4, wherein the wire insulation displacement portions (26) of some of the terminals (16) project from opposite sides of the housing, and including a pair of said wire-driving portions (36) integrally connected on opposite sides of the housing.

20 6. In a modular telephone connector as set forth in claim 1, wherein said housing (14) includes at least one

This Sheet Has Been Replaced





-18-

THIS SHEET HAS BEEN
REPLACED

92-109 EP

5 wire-driving portion (36) molded integrally therewith and
movable into engagement with at least some of the insulated
telephone wires (60) to drive the wires into insulation-
piercing condition with at least some of the insulation
displacement portions (26) of the terminals (16).

7. In a modular telephone connector as set forth
in claim 6, including a living hinge portion (42)
integrally connecting the wire-driving portion to afford
driving movement thereof.

10 8. In a modular telephone connector as set forth
in claim 7, wherein the wire insulation displacement por-
tions (26) of some of the terminals (16) project from
opposite sides of the housing, and including a pair of said
wire-driving portions (36) integrally connected on opposite
15 sides of the housing.

20 9. In a modular telephone connector as set forth
in claim 1, wherein said one-piece housing structure in-
cludes a center portion (32) overmolded about portions of
the stamped metal terminals, a main housing portion (34) at
one end of the center portion defining said cavity and
molded integrally with the center portion and movable into
an assembled condition, a latch portion (35) at an opposite

This Sheet Has Been Replaced





92-109 EP

-19-

THIS SHEET HAS BEEN
REPLACED

5 end of the center portion for latching engagement with the main housing portion, and at least one wire-driving portion (36) molded integrally with the center portion and movable into engagement with at least some of the insulated telephone wires to drive the wires into the insulation displacement portions (26) of the terminals (16).

10 10. In a modular telephone connector as set forth in claim 9, including a living hinge portion (42) integrally molded between the center portion (32) and the wire-driving portion (36) to afford driving movement thereof.

15 11. In a modular telephone connector as set forth in claim 10, wherein the wire insulation displacement portions (26) of the terminals (16) project from opposite sides of the center portion (32) of the housing, and including a pair of said wire-driving portions (36) molded integrally with the center portion on opposite sides thereof.

20 12. In a modular telephone connector as set forth in claim 9, including a living hinge portion (42) integrally molded between the main housing portion (34) and

This Sheet Has Been Replaced





92-109 EP

-20-

THIS SHEET HAS BEEN
REPLACED

the center portion (32) of the housing to afford movement therebetween.

13. A method of fabricating and assembling a modular telephone connector (12), comprising the steps of:

5 stamping a plurality of terminals (16) from sheet metal material, each terminal having a resilient cantilever jack contact portion (24) and a wire insulation displacement portion (26);

10 overmolding a one-piece housing structure (14) about areas of the terminals, the housing structure being molded with a center portion (32) overmolded about said areas of the terminals, exposing said cantilever jack contact portions (24) and said wire insulation displacement portions (26), a main housing portion (34) molded by a
15 living hinge (40) integral with the center portion and defining a cavity (38) for receiving a standard telephone plug (64), and at least one wire-driving portion (36) molded integrally with the center portion by a living hinge (42);

20 moving said main housing portion (34) about its living hinge (40) into juxtaposition with the center portion (32) of the housing;

This Sheet Has Been Replaced





92-109 EP

-21-

THIS SHEET HAS BEEN
REPLACED

inserting a plurality of insulated telephone wires (60) into the insulation displacement portions (26) of the terminals (16); and

5 moving the wire-driving portion (36) of the housing about its living hinge (42) into engagement with the insulated telephone wires to drive the wires into the insulation displacement portions of the terminals.

10 14. The method of claim 13, including the step of stamping the insulation displacement portions (26) of the terminals (16) with closed keyhole-shaped insulation displacement slots having enlarged slot portions (54) sized for receiving the insulated telephone wires and narrow slot portions (56) communicating with the enlarged slot portions for piercing the insulation of the telephone wires, whereby
15 said wire-driving portion (36) of the housing is effective to move the insulated telephone wires from the enlarged slot portions into the narrow slot portions of the closed keyhole-shaped slots.

20 15. In a modular electrical connector (12) which includes a housing (14), and a plurality of terminals (16) mounted in the housing and having exposed wire insulation displacement portions (26), wherein the improvement

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

comprises said housing being a one-piece molded structure including an integral wire-driving portion (36) movable into engagement with a plurality of insulated wires (60) to drive the wires into the insulation displacement portions of the terminals.

16. In a modular electrical connector as set forth in claim 15, including a living hinge portion (42) integrally connecting the wire-driving portion to afford driving movement thereof.

17. In a modular electrical connector as set forth in claim 16, wherein the wire insulation displacement portions (26) of some of the terminals (16) project from opposite sides of the housing, and including a pair of said wire-driving portions (36) integrally connected on opposite sides of the housing.

18. In a modular electrical connector as set forth in claim 15, wherein said wire insulation displacement portions (26) of the terminals (16) include closed keyhole-shaped insulation displacement slots defining enlarged slot portions (54) sized for receiving the insulated wires (60), and narrow slot portions (56) communicating with the enlarged slot portions for piercing





92-109 EP

-23-

THIS SHEET HAS BEEN
REPLACED

the insulation of the wires when the wires are moved from the enlarged slot portions with the narrow slot portions.

19. In a modular telephone connector (12) which includes a housing (14) defining a standard telephone jack, and a plurality of stamped metal terminals (16) each having a resilient cantilever jack contact portion (24) and a wire insulation displacement portion (26), wherein the improvement comprises said wire insulation displacement portions (26) of the terminals including closed keyhole-shaped insulation displacement slots defining enlarged slot portions (54) sized for receiving the insulated telephone wires and narrow slot portions communicating with the enlarged slot portions (56) for piercing the insulation of the telephone wires when the wires are moved from the enlarged slot portions into the narrow slot portions.

This Sheet Has Been Replaced

THIS SHEET HAS BEEN REPLACED

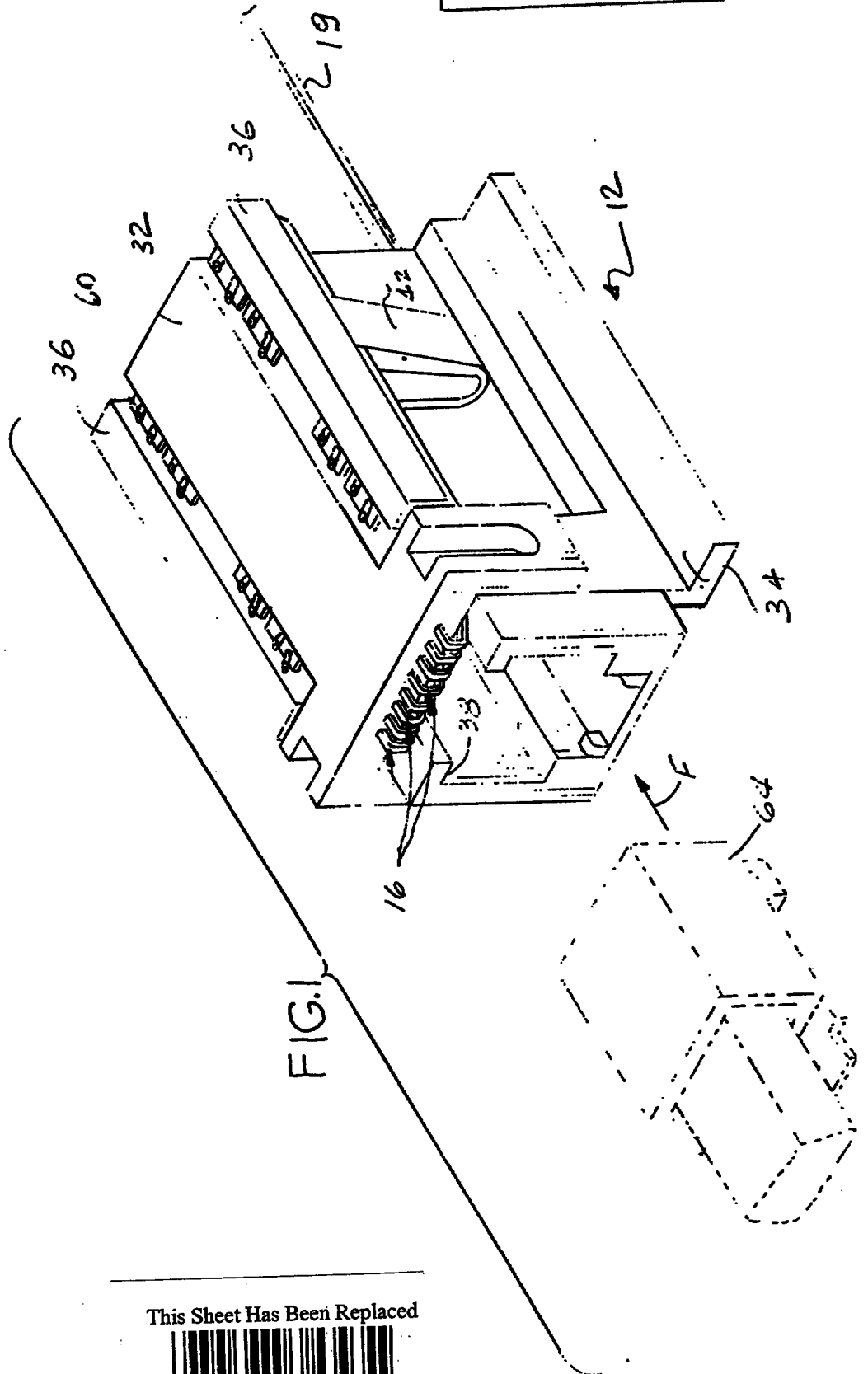
ABSTRACT**MODULAR ELECTRICAL CONNECTOR**

An electrical connector (12) is disclosed in a modular telephone connector configuration and includes a housing (14) defining a standard telephone jack. A plurality of stamped metal terminals (16) each have a resilient cantilever jack contact portion (24), a wire insulation displacement portion (26) and an intermediate portion (28) between the cantilever jack contact portion and the wire insulation displacement portion. The housing is a one-piece structure overmolded about portions of the stamped metal terminals, with the wire insulation displacement portions exposed for receiving insulated telephone wires (60). The housing includes a cavity (38) for receiving a standard telephone plug (64). The cantilever jack contact portions of the terminals are exposed by the overmolded housing adjacent the cavity, whereby the contact portions can be bent into the cavity. The housing includes at least one wire-driving portion (36) molded integrally therewith by a living hinge (42) and movable into engagement with the insulated telephone wires to drive the wires into the insulation displacement portions of the terminals.

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED



This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

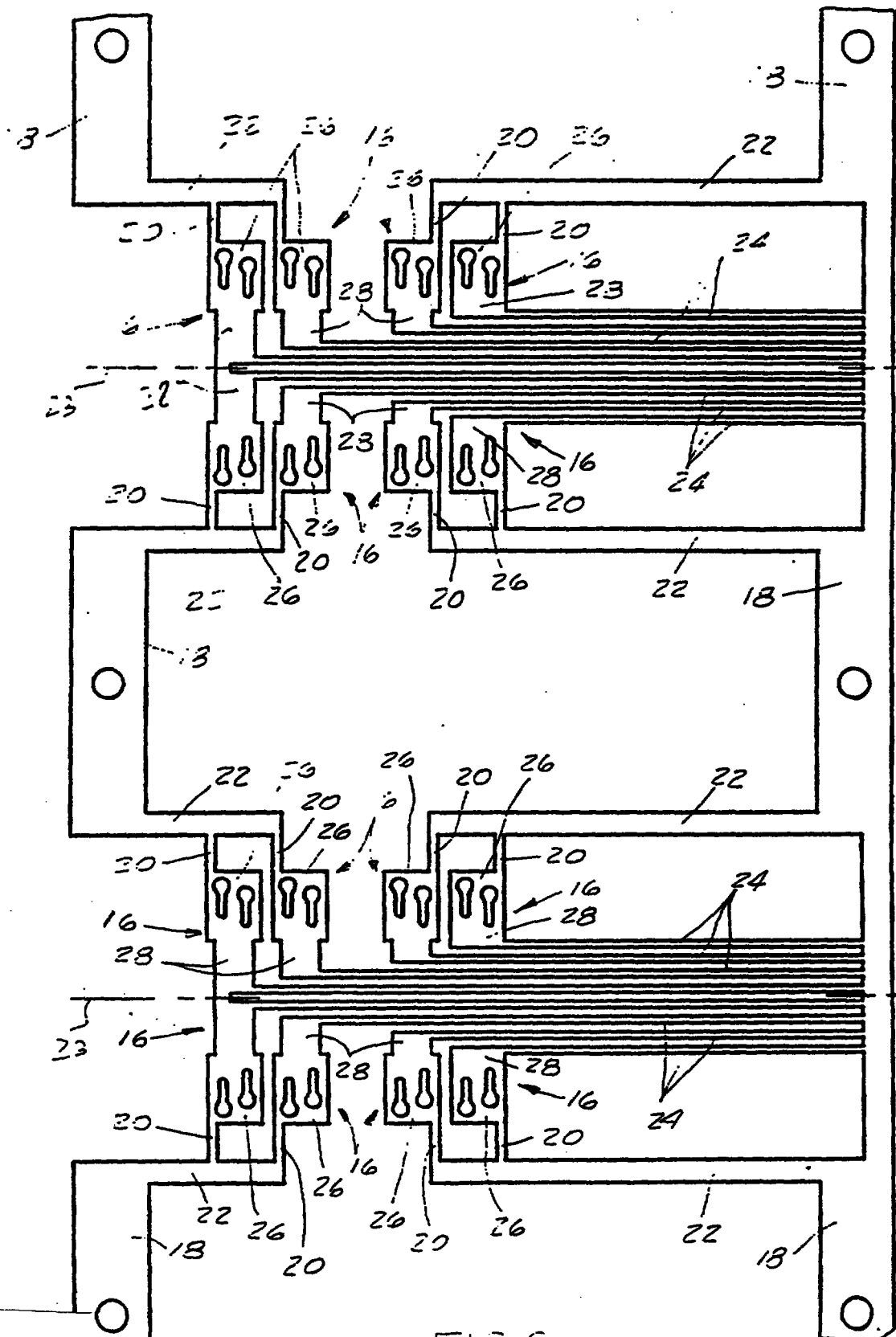


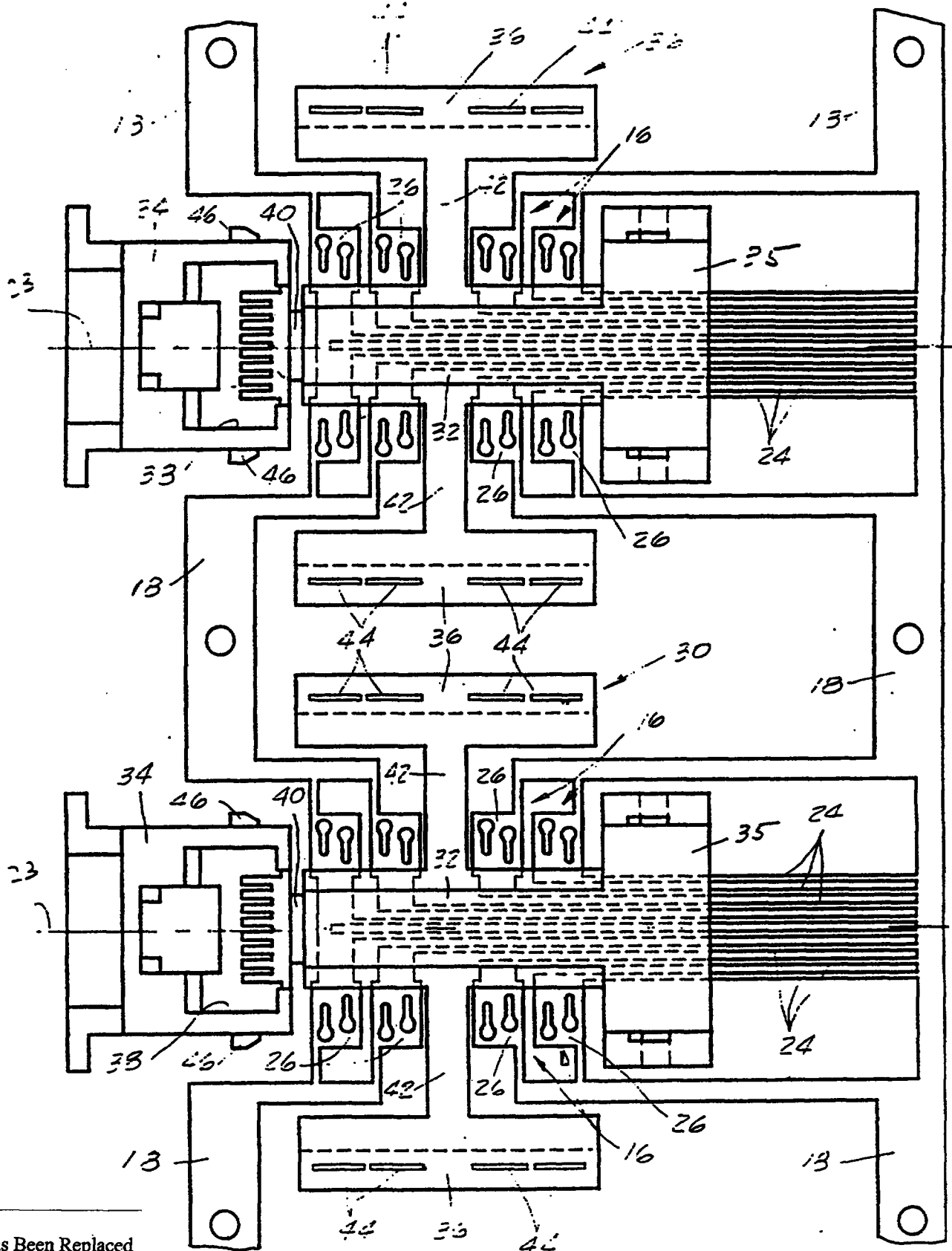
FIG. 2

This Sheet Has Been Replaced



3-6)

THIS SHEET HAS BEEN
REPLACED



This Sheet Has Been Replaced

FIG. 3



4-6

THIS SHEET HAS BEEN
REPLACED

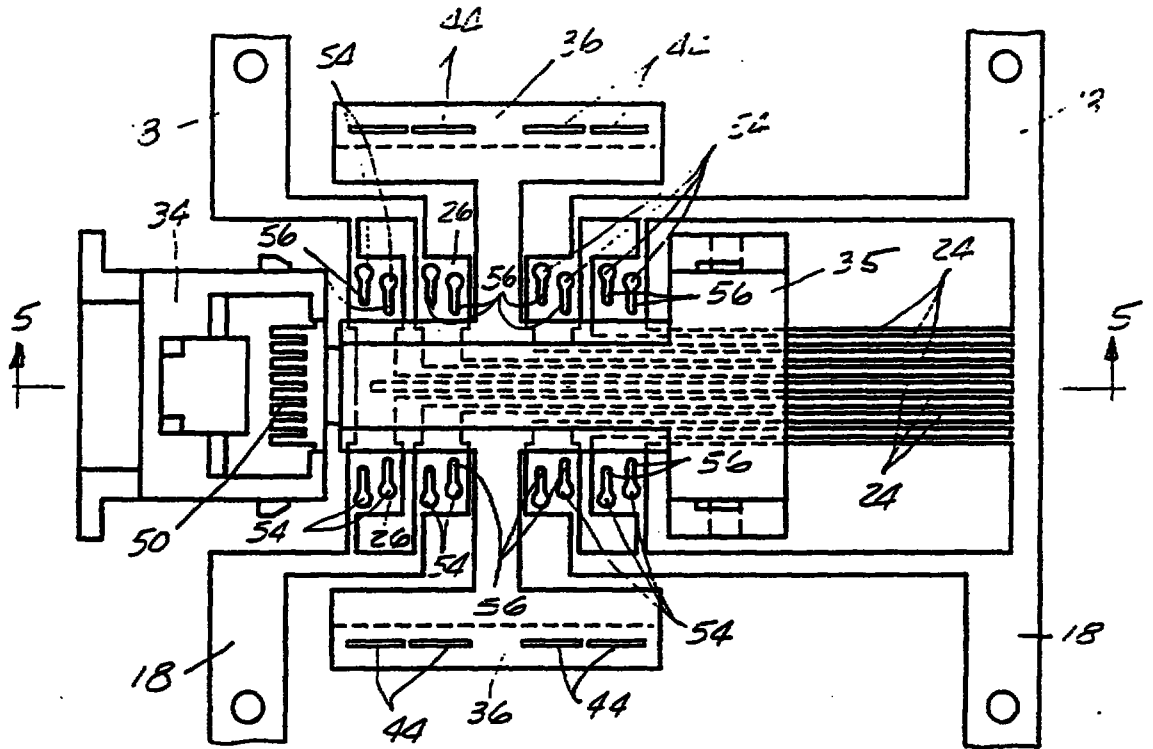


FIG. 4

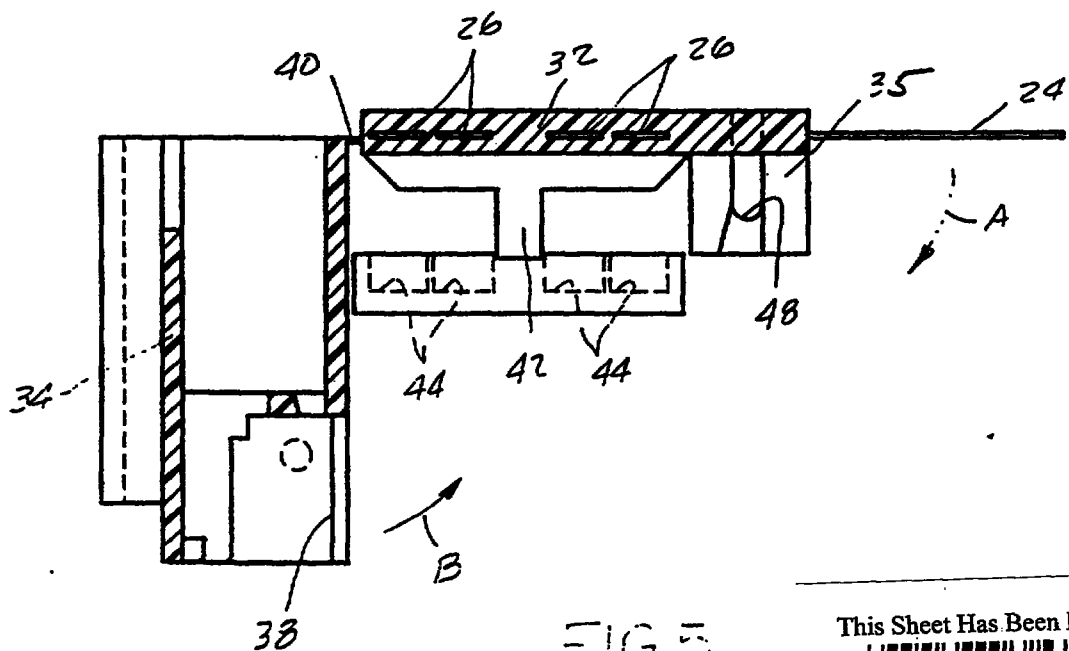
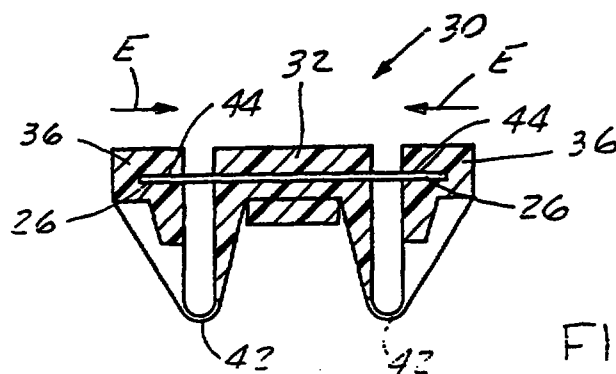
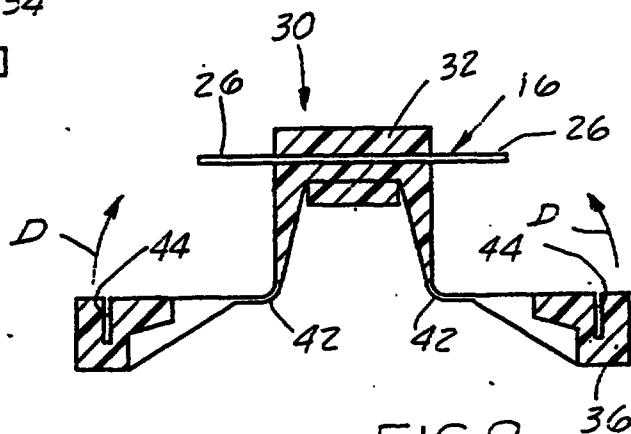
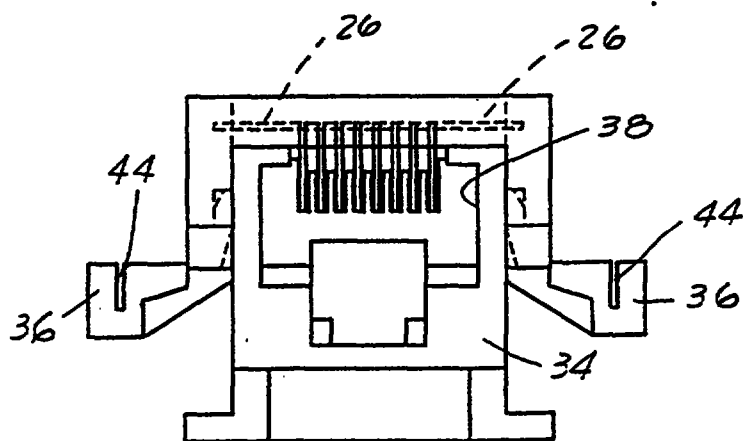
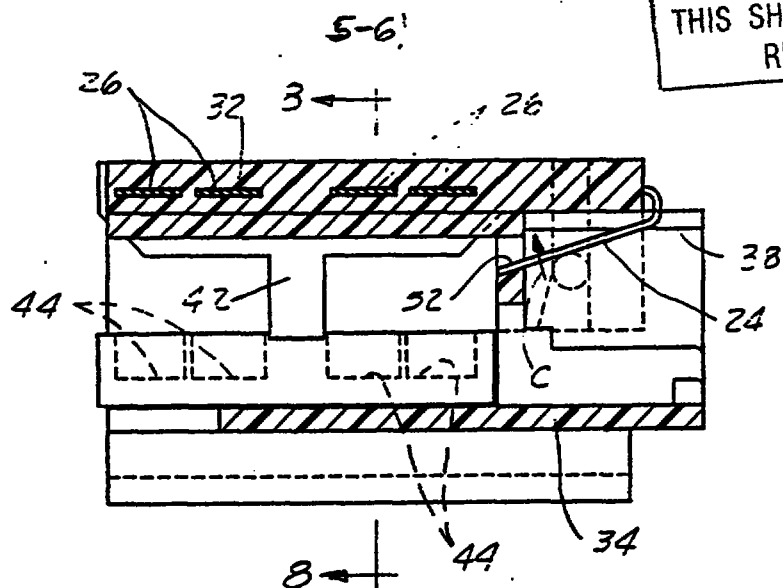


FIG. 5

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED



This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

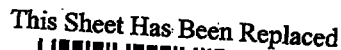


FIG. 11

23 JAN 68

9605779-3

-1-

IPO's
copy

REPLACEMENT SHEET

14 MAR 1997

THIS SHEET HAS BEEN
REPLACED**MODULAR ELECTRICAL CONNECTOR****Field of the Invention**

This invention generally relates to the art of electrical connector assemblies and, particularly, to a modular telephone connector, although various aspects of the invention are applicable to connectors, in general.

Background of the Invention

A common type of female electrical connector or receptacle is referred to in the industry as a telephone jack or "modular jack". Such a modular telephone connector includes a dielectric housing defining a standard telephone receptacle jack. A plurality of terminals are mounted in the housing, and each terminal includes a resilient cantilever jack contact portion projecting into a plug-receiving cavity or opening in the housing for engaging contacts of a standard telephone plug. Most often, the terminals are stamped and formed of sheet metal material and include terminating portions, such as wire insulation displacement portions, opposite the resilient cantilever jack contact portions. The wire insulation displacement portions receive insulated telephone wires.

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-2-

A wide variety of designs for modular telephone connectors have been proposed to facilitate field installation. Any design should maximize ease of manipulation of the telephone wires and ease of assembly and termination of the connector. Unfortunately, heretofore, even with all of the various design proposals, such modular jacks still employ too many components which are difficult to manipulate and assemble, particularly with the every-increasing miniaturization of such components. Problems still are encountered with various designs of field installable modular telephone connectors because of their size, the assembly manipulations required and the difficulty of terminating the telephone wires to the connector.

This invention is directed to solving these problems by providing a unique modular electrical connector, particularly adaptable as a modular telephone connector or jack, which includes a one-piece molded housing which has various integral, relatively movable portions for effecting complete assembly and termination of the connector without any extraneous components or tools.

Summary of the Invention

An object, therefore, of the invention is to provide a new and improved modular electrical connector, in

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-3-

general, and to provide a unique modular telephone connector or jack, in particular.

In the exemplary embodiment of the invention, the modular telephone connector includes a housing defining a standard telephone jack. A plurality of stamped metal terminals are mounted in the housing, and each terminal has a resilient cantilever jack contact portion, a wire insulation displacement portion and an intermediate portion between the cantilever jack contact portion and the wire insulation displacement portion. The housing is provided in the form of a one-piece structure overmolded about the intermediate portions of the stamped metal terminals, with the wire insulation displacement portions of the terminals exposed for receiving insulated telephone wires. The housing includes a cavity or opening for receiving a standard telephone plug. The cantilever jack contact portions of the terminals are exposed adjacent the cavity, whereby the contact portions can be bent into the cavity for engaging contacts of the telephone plug upon insertion of the plug into the cavity.

A feature of the invention is directed to providing at least one wire-driving portion of the connector housing molded integrally therewith by a living hinge, whereby the wire-driving portion is movable into engagement with at least some of the insulated telephone wires to

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-4-

drive the wires into the insulation displacement portions of the terminals. As disclosed herein, the wire insulation displacement portions of the terminals project from opposite sides of the housing, and a pair of the wire-driving portions are molded integrally with opposite sides of the housing by a pair of living hinges.

Another feature of the invention involves forming the wire insulation displacement portions of the terminals with closed keyhole-shaped insulation displacement slots defining enlarged slot portions sized for receiving the insulated telephone wires, along with narrow slot portions communicating with the enlarged slot portions for piercing the insulation of the telephone wires. The wire-driving portions of the housing are effective to drive the telephone wires into the narrow slot portions of the keyhole-shaped slots.

Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED.

REPLACEMENT SHEET

14 MAR 1997

-5-

Brief Description of the Drawings

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with its objects and the advantages thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

FIGURE 1 is a perspective view of a fully assembled modular telephone jack incorporating the concepts of the invention;

FIGURE 2 is a plan view of a fragmented portion of a continuous metal strip from which the terminals of the connector are stamped, illustrating two sets of terminals for a pair of connectors;

FIGURE 3 is a view similar to that of Figure 2, illustrating a pair of one-piece housing structures overmolded about intermediate portions of the terminals;

FIGURE 4 is a view of only one of the overmolded housing structures and a single set of terminals, as depicted in Figure 3;

FIGURE 5 is a horizontal section taken generally along line 5-5 of Figure 4;

FIGURE 6 is a sectional view similar to that of Figure 5, during a step of manufacture wherein the canti-

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-6-

lever jack contact portions of the terminals have been bent into the housing cavity, and the base portion of the housing structure has been pivoted to a latched condition, versus the initial overmolded condition shown in Figure 5;

FIGURE 7 is a front elevational view, looking toward the right-hand end of Figure 6, with the wire-driving portions of the housing structure in inoperative positions;

FIGURE 8 is a vertical section taken generally along line 8-8 of Figure 6, again showing the wire-driving portions of the housing structure in inoperative positions, as depicted in Figure 7;

FIGURE 9 is a view similar to that of Figure 8, with the wire-driving portions pivoted to their wire terminating positions;

FIGURE 10 is a vertical section through the fully assembled and terminated modular connector, as taken generally along line 10-10 of Figure 1, in conjunction with a standard telephone plug; and

FIGURE 11 is a view similar to that of Figure 10, showing the connector mounted within a particular housing environment.

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

-7-

REPLACEMENT SHEET

14 MAR 1997

Detailed Description of the Preferred Embodiment

Referring to the drawings in greater detail, and first to Figure 1, the concepts of the invention are illustrated in a modular telephone connector or jack, generally designated 12, which includes a one-piece housing, generally designated 14. The housing is unitarily molded of dielectric material, such as plastic or the like, and will be described in greater detail hereinafter. Generally, a portion of the housing is overmolded about portions of a plurality of stamped metal terminals, generally designated 16, and the terminals are insulation-displacement-terminated to a plurality of telephone wires of a telephone cable 19, all of which will be described in greater detail hereinafter. At this point, it should be understood that, although the concepts of the invention are disclosed herein embodied in a modular telephone connector or jack, various aspects of the invention are equally applicable for other types of electrical connectors.

The following detailed description is being presented in a step-by-step fashion involving initial manufacturing steps, initial sub-assembly steps prior to providing or shipping the pre-assembled connector to a user, and finally the telephone wire termination steps carried out by the user. This approach is believed to be most advanta-

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-8-

geous in presenting various aspects of the invention in a precise and understandable description.

More particularly, referring first to Figure 2, terminals 16 first are stamped from a continuous strip of sheet metal material to a blank configuration including a pair of continuous carrier strips 18 which carry the terminals in stamped form through an appropriate stamping machine. Of course, the terminals are in a flat or planar configuration in the stamped blank of Figure 2. It can be seen that the terminals are joined by web portions 20 and transverse webs 22 to carrier strips 18. It also can be seen that the terminals are stamped on opposite sides of a transverse center line 23, with four terminals on each side of the center line for a total "terminal cluster" of eight terminals for each telephone connector 12 (Fig. 1).

Each stamped metal terminal 16 includes a resilient cantilever jack contact portion 24, a wire insulation displacement portion 26 and an intermediate portion 28, although the right-hand terminals shown in Figure 2 have no distinct intermediate portion except integral areas of wire insulation displacement portions 26. Eventually, cantilever jack contact portions 24 of the terminals will be severed from the right-hand carrier strip 18 and bent into the connector housing 14, as will be described in greater detail hereinafter.

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-9-

The next step in fabricating modular telephone connector 12 is shown in Figures 3-5 and, generally, involves overmolding a one-piece housing subassembly structure about portions of terminals 16, generally about the intermediate portions of at least some of the terminals. More particularly, an overmolded housing structure or subassembly, generally designated 30, includes a top or center overmolded portion 32, a main housing portion 34, a latch portion 35 and a pair of wire-driving portions 36. It can be seen that the top or center overmolded portion 32 is molded about portions of terminals 16 such that wire insulation displacement portions 26 of the terminals are exposed exteriorly on opposite sides of the center overmolded portion of the housing subassembly structure. It also can be seen that latch portion 35 is overmolded about inner areas of cantilever jack contact portions 24, leaving considerable areas of the contact portions exposed for bending purposes, as described hereinafter.

Main housing portion 34 includes an opening or cavity 38 which is provided for receiving a standard telephone plug, as will be more apparent hereinafter. The main housing portion is molded integral with top or center overmolded portion 32 by a living hinge 40. Each wire-driving portion 36 also is molded integral with top or

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-10-

center overmolded portion 32 by a living hinge 42. Each wire-driving portion also includes slots or grooves 44 in the top thereof for effecting insulation displacement termination of telephone wires to the wire insulation displacement portions 26 of terminals 16, again as will be described in greater detail hereinafter.

Lastly, at this point, in order to better understand the following detailed description, it should be noted in Figure 5 that main housing portion 34 and wire-driving portions 36 depend downwardly from top or center overmolded portion 32 of the housing. Living hinges 40 and 42 also are clearly visible in this figure. After housing subassembly structure 30 (Figs. 3 and 4) is overmolded about portions of terminals 16, as described above, webs 20 (Fig. 2) then are severed from wire insulation displacement portions 26 of the terminals, and cantilever jack contact portions 24 are severed from the right-hand carrier strip 18 of the stamped metal blank described above in relation to Figure 2. The cantilever jack contact portions now are rendered flexible or resilient because of their becoming free from the carrier strip.

After all of the extraneous webs and carrier strips have been removed from the stamped metal blank, cantilever jack contact portions 24 then are formed or bent, and overmolded housing subassembly 30 is assembled

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-11-

into a subassembly for shipping to and/or use by an ultimate user. Of course, the entire modular telephone connector 12 can be fully assembled in a manufacturing environment, if such an application is desirable. In either event, reference is made to Figures 6 and 7, particularly in conjunction with Figure 5. Cantilever jack contact portions 24 first are bent downwardly in the direction of arrow "A" (Fig. 5) to the configuration shown in Figure 6, whereby the contact portions now are disposed within cavity or opening 38. Main housing portion 34 then is pivoted about living hinge 40 in the direction of arrow "B" (Fig. 5). As seen in Figure 7, the main housing portion will move upwardly between the side wire-driving portions 36. When the main housing portion is moved to its fully assembled position as shown in Figure 6, the main housing portion is latched in that position by a pair of latch bosses 46 (Fig. 3) snapping into a pair of latch grooves 48 (Fig. 5) on the inside of latch portion 35 of the overmolded housing structure. When in the assembled condition, cantilever jack contact portions are disposed within a comb structure 50 (Fig. 4) and seat on top of ledges 52 (Fig. 6) of the comb structure. When a standard telephone plug is inserted into opening 38, the resilient cantilever jack contact portions engage contacts on the

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-12-

plug as the jack contact portions are biased upwardly in the direction of arrow "C" (Fig. 6).

Wire-driving portions 36 of overmolded housing structure 30 are used to drive insulated wires of telephone cable 18 (Fig. 1) into insulation displacement condition with wire insulation displacement portions 26 of terminals 16. Before proceeding, however, reference is made back to Figures 2-4 where it can be seen that each wire insulation displacement portion 26 of each terminal 16 includes a pair of keyhole-shaped slots, each slot including an enlarged slot portion 54 communicating with a narrow slot portion 56. The enlarged slot portions 54 are sized sufficiently larger than the insulated wires of the telephone cable so that the wires can be inserted easily into the enlarged slot portions. The narrow slot portions 56 are sufficiently narrow to cut through or pierce the insulation of the telephone wires to establish conductivity with the cores of the wires.

With the above understanding, and with reference to Figures 8 and 9, it can be seen in Figure 8 that wire-driving portions 36 project outwardly of the center or top portion 32 of the overmolded housing structure 30, with the wire-driving portions being interconnected to the center portion by living hinges 42. Therefore, the wire-driving portions can be pivoted upwardly in the direction of arrows

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-13-

"D" (Fig. 8). It also should be noted that slots 44 in the wire-driving portions have widths which are at least slightly larger than the thickness of the metal material from which insulation displacement portions 26 of terminals 16 are fabricated. Therefore, wire-driving portions 36 can be pivoted upwardly in the direction of arrows "D", about living hinges 42, whereupon wire insulation displacement portions 26 of the terminals enter into slots 44 as shown in Figure 9. Since the enlarged slot portions 54 are disposed transversely outwardly relative to narrow slot portions 56, as seen clearly in Figure 4, if insulated wires are located in the enlarged slot portions, wire-driving portions 36 will drive the wires into the narrow slot portions 56, as indicated by arrows "E" in Figure 9. Therefore, wire-driving portions 36 of the overmolded housing structure are effective to terminate the telephone wires to the terminals. Slots 44 in the wire-driving portions should be of widths to establish an interference fit with insulation displacement portions 26 of the terminals, so that the wire-driving portions remain in their terminating positions as shown in Figure 9.

Figure 10 shows modular telephone connector 12 fully terminated to a plurality of insulated wires 60 of telephone cable 19. This depiction corresponds to the "subassembly" illustration of Figures 6 and 7, except that

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-14-

the insulated wires 60 are shown terminated to insulation displacement portions 26 of terminals 16, as described above in relation to Figures 8 and 9. It can be seen that telephone cable 19 can be inserted through a recessed area 62 of main housing portion 34, and insulated wires 60 simply are fed upwardly through enlarged slot portions 54 (Fig. 4), whereupon wire-driving portions 36 of the over-molded housing structure can be used to drive the insulated wires into the narrow slot portions 56, as described above. The modular telephone connector now is fully assembled and ready to receive a standard telephone plug 64 insertable into opening 38 in the direction of arrow "F", as shown in Figure 10.

Lastly, Figure 11 illustrates an application of using modular telephone connector 12 within a particular housing 66 which includes a front aperture 68 through which telephone plug 64 can be inserted into opening 38 in the modular telephone connector. Appropriate contacts on the plug (not shown) will engage resilient cantilever jack contact portions 24 and bias the contact portions upwardly in the direction of arrow "C".

It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-15-

in all respects as illustrative and not restrictive, and
the invention is not to be limited to the details given
herein.

This Sheet Has Been Replaced





THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-16-

CLAIMS

1. In a modular telephone connector (12) which includes a housing (14) defining a standard telephone jack, and a plurality of stamped metal terminals (16) each having a resilient cantilever jack contact portion (24) and a wire insulation displacement portion (26), wherein the improvement comprises said housing being a one-piece structure overmolded about portions of the stamped metal terminals with the wire insulation displacement portions thereof exposed for receiving insulated telephone wires (60), the housing including a cavity (38) for receiving a standard telephone plug (64), and the cantilever jack contact portions (24) of the terminals being exposed by the overmolded housing adjacent the cavity whereby the contact portions can be bent into the cavity.

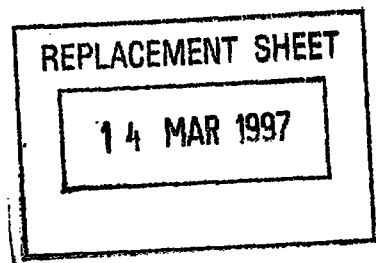
2. In a modular telephone connector as set forth in claim 1, wherein said wire insulation displacement portions (26) of the terminals (16) include closed keyhole-shaped insulation displacement slots defining enlarged slot portions (54) sized for receiving the insulated telephone wires (60), and narrow slot portions communicating with the enlarged slot portions (56) for piercing the insulation of

This Sheet Has Been Replaced





THIS SHEET HAS BEEN
REPLACED



-17-

the telephone wires when the wires are moved from the enlarged slot portions with the narrow slot portions.

3. In a modular telephone connector as set forth in claim 2, wherein said housing (14) includes at least one wire-driving portion (36) molded integrally therewith and movable into engagement with at least some of the insulated telephone wires to drive the wires into the narrow slot portions (56) of at least some of the insulation displacement slots.

4. In a modular telephone connector as set forth in claim 3, including a living hinge portion (42) integrally connecting the wire-driving portion to afford driving movement thereof.

5. In a modular telephone connector as set forth in claim 4, wherein the wire insulation displacement portions (26) of some of the terminals (16) project from opposite sides of the housing, and including a pair of said wire-driving portions (36) integrally connected on opposite sides of the housing.

6. In a modular telephone connector as set forth in claim 1, wherein said housing (14) includes at least one

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-18-

wire-driving portion (36) molded integrally therewith and movable into engagement with at least some of the insulated telephone wires (60) to drive the wires into insulation-piercing condition with at least some of the insulation displacement portions (26) of the terminals (16).

7. In a modular telephone connector as set forth in claim 6, including a living hinge portion (42) integrally connecting the wire-driving portion to afford driving movement thereof.

8. In a modular telephone connector as set forth in claim 7, wherein the wire insulation displacement portions (26) of some of the terminals (16) project from opposite sides of the housing, and including a pair of said wire-driving portions (36) integrally connected on opposite sides of the housing.

9. In a modular telephone connector as set forth in claim 1, wherein said one-piece housing structure includes a center portion (32) overmolded about portions of the stamped metal terminals, a main housing portion (34) at one end of the center portion defining said cavity and molded integrally with the center portion and movable into an assembled condition, a latch portion (35) at an opposite

This Sheet Has Been Replaced





THIS SHEET HAS BEEN
REPLACED
-19-

REPLACEMENT SHEET
14 MAR 1997

end of the center portion for latching engagement with the main housing portion, and at least one wire-driving portion (36) molded integrally with the center portion and movable into engagement with at least some of the insulated telephone wires to drive the wires into the insulation displacement portions (26) of the terminals (16).

10. In a modular telephone connector as set forth in claim 9, including a living hinge portion (42) integrally molded between the center portion (32) and the wire-driving portion (36) to afford driving movement thereof.

11. In a modular telephone connector as set forth in claim 10, wherein the wire insulation displacement portions (26) of the terminals (16) project from opposite sides of the center portion (32) of the housing, and including a pair of said wire-driving portions (36) molded integrally with the center portion on opposite sides thereof.

12. In a modular telephone connector as set forth in claim 9, including a living hinge portion (42) integrally molded between the main housing portion (34) and

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

-20-

REPLACEMENT SHEET

14 MAR 1997

the center portion (32) of the housing to afford movement therebetween.

13. A method of fabricating and assembling a modular telephone connector (12), comprising the steps of:

stamping a plurality of terminals (16) from sheet metal material, each terminal having a resilient cantilever jack contact portion (24) and a wire insulation displacement portion (26);

overmolding a one-piece housing structure (14) about areas of the terminals, the housing structure being molded with a center portion (32) overmolded about said areas of the terminals, exposing said cantilever jack contact portions (24) and said wire insulation displacement portions (26), a main housing portion (34) molded by a living hinge (40) integral with the center portion and defining a cavity (38) for receiving a standard telephone plug (64), and at least one wire-driving portion (36) molded integrally with the center portion by a living hinge (42);

moving said main housing portion (34) about its living hinge (40) into juxtaposition with the center portion (32) of the housing;

This Sheet Has Been Replaced





THIS SHEET HAS BEEN
REPLACED

-21-

REPLACEMENT SHEET

14 MAR 1997

inserting a plurality of insulated telephone wires (60) into the insulation displacement portions (26) of the terminals (16); and

moving the wire-driving portion (36) of the housing about its living hinge (42) into engagement with the insulated telephone wires to drive the wires into the insulation displacement portions of the terminals.

14. The method of claim 13, including the step of stamping the insulation displacement portions (26) of the terminals (16) with closed keyhole-shaped insulation displacement slots having enlarged slot portions (54) sized for receiving the insulated telephone wires and narrow slot portions (56) communicating with the enlarged slot portions for piercing the insulation of the telephone wires, whereby said wire-driving portion (36) of the housing is effective to move the insulated telephone wires from the enlarged slot portions into the narrow slot portions of the closed keyhole-shaped slots.

15. In a modular electrical connector (12) which includes a housing (14), and a plurality of terminals (16) mounted in the housing and having exposed wire insulation displacement portions (26), wherein the improvement

This Sheet Has Been Replaced





THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

-22-

comprises said housing being a one-piece molded structure including an integral wire-driving portion (36) movable into engagement with a plurality of insulated wires (60) to drive the wires into the insulation displacement portions of the terminals.

16. In a modular electrical connector as set forth in claim 15, including a living hinge portion (42) integrally connecting the wire-driving portion to afford driving movement thereof.

17. In a modular electrical connector as set forth in claim 16, wherein the wire insulation displacement portions (26) of some of the terminals (16) project from opposite sides of the housing, and including a pair of said wire-driving portions (36) integrally connected on opposite sides of the housing.

18. In a modular electrical connector as set forth in claim 15, wherein said wire insulation displacement portions (26) of the terminals (16) include closed keyhole-shaped insulation displacement slots defining enlarged slot portions (54) sized for receiving the insulated wires (60), and narrow slot portions (56) communicating with the enlarged slot portions for piercing

This Sheet Has Been Replaced





THIS SHEET HAS BEEN
REPLACED

-23-

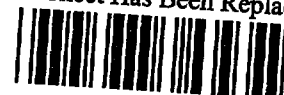
REPLACEMENT SHEET

14 MAR 1997

the insulation of the wires when the wires are moved from the enlarged slot portions with the narrow slot portions.

19. In a modular telephone connector (12) which includes a housing (14) defining a standard telephone jack, and a plurality of stamped metal terminals (16) each having a resilient cantilever jack contact portion (24) and a wire insulation displacement portion (26), wherein the improvement comprises said wire insulation displacement portions (26) of the terminals including closed keyhole-shaped insulation displacement slots defining enlarged slot portions (54) sized for receiving the insulated telephone wires and narrow slot portions communicating with the enlarged slot portions (56) for piercing the insulation of the telephone wires when the wires are moved from the enlarged slot portions into the narrow slot portions.

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
-24- REPLACED

REPLACEMENT SHEET

14 MAR 1997

ABSTRACT

MODULAR ELECTRICAL CONNECTOR

An electrical connector (12) is disclosed in a modular telephone connector configuration and includes a housing (14) defining a standard telephone jack. A plurality of stamped metal terminals (16) each have a resilient cantilever jack contact portion (24), a wire insulation displacement portion (26) and an intermediate portion (28) between the cantilever jack contact portion and the wire insulation displacement portion. The housing is a one-piece structure overmolded about portions of the stamped metal terminals, with the wire insulation displacement portions exposed for receiving insulated telephone wires (60). The housing includes a cavity (38) for receiving a standard telephone plug (64). The cantilever jack contact portions of the terminals are exposed by the overmolded housing adjacent the cavity, whereby the contact portions can be bent into the cavity. The housing includes at least one wire-driving portion (36) molded integrally therewith by a living hinge (42) and movable into engagement with the insulated telephone wires to drive the wires into the insulation displacement portions of the terminals.

FIGURE 1

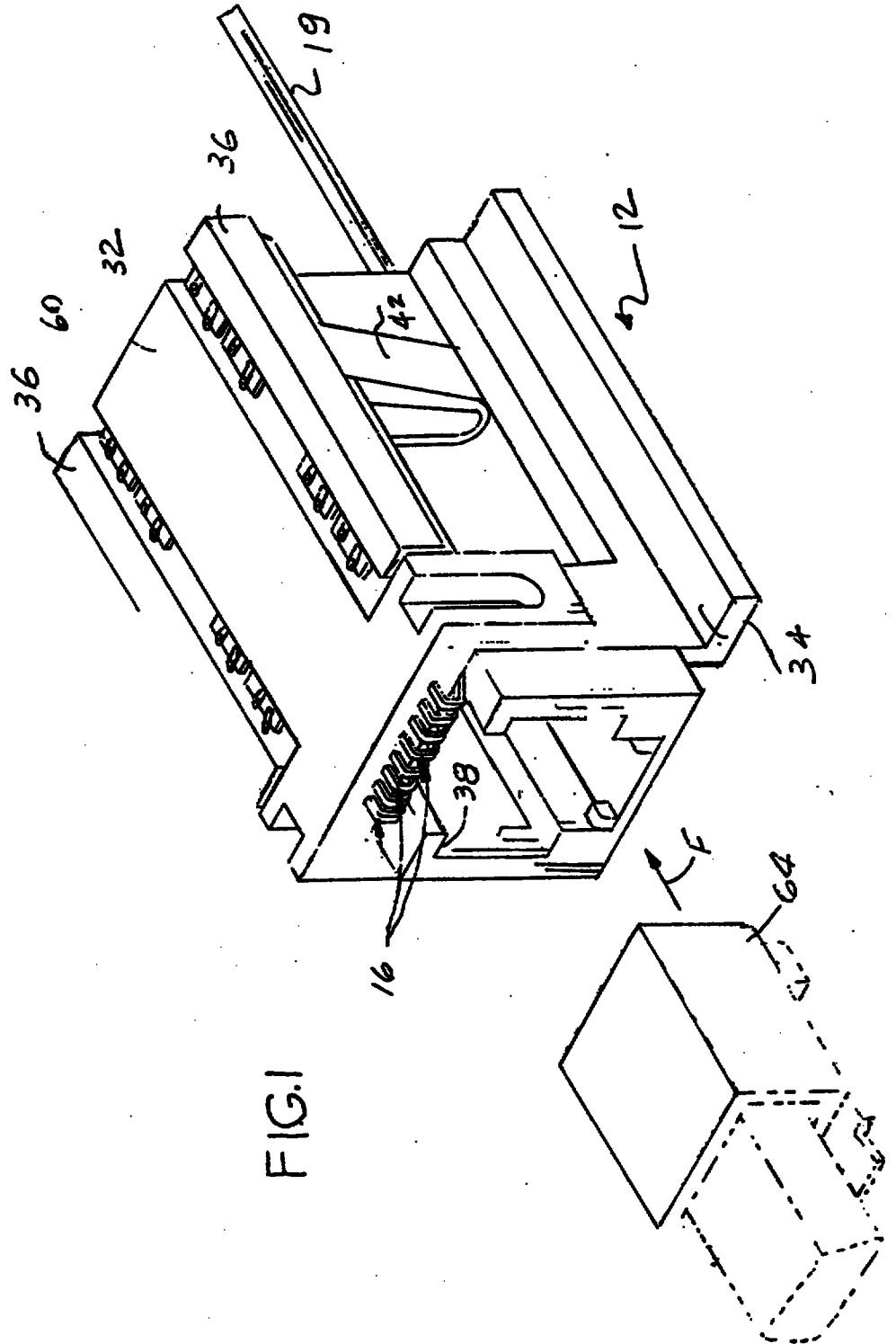
This Sheet Has Been Replaced



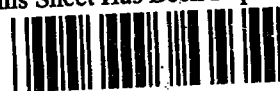
THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

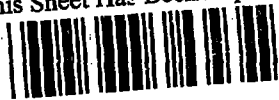
14 MAR 1997



This Sheet Has Been Replaced



This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

2

REPLACEMENT SHEET

14 MAR 1997

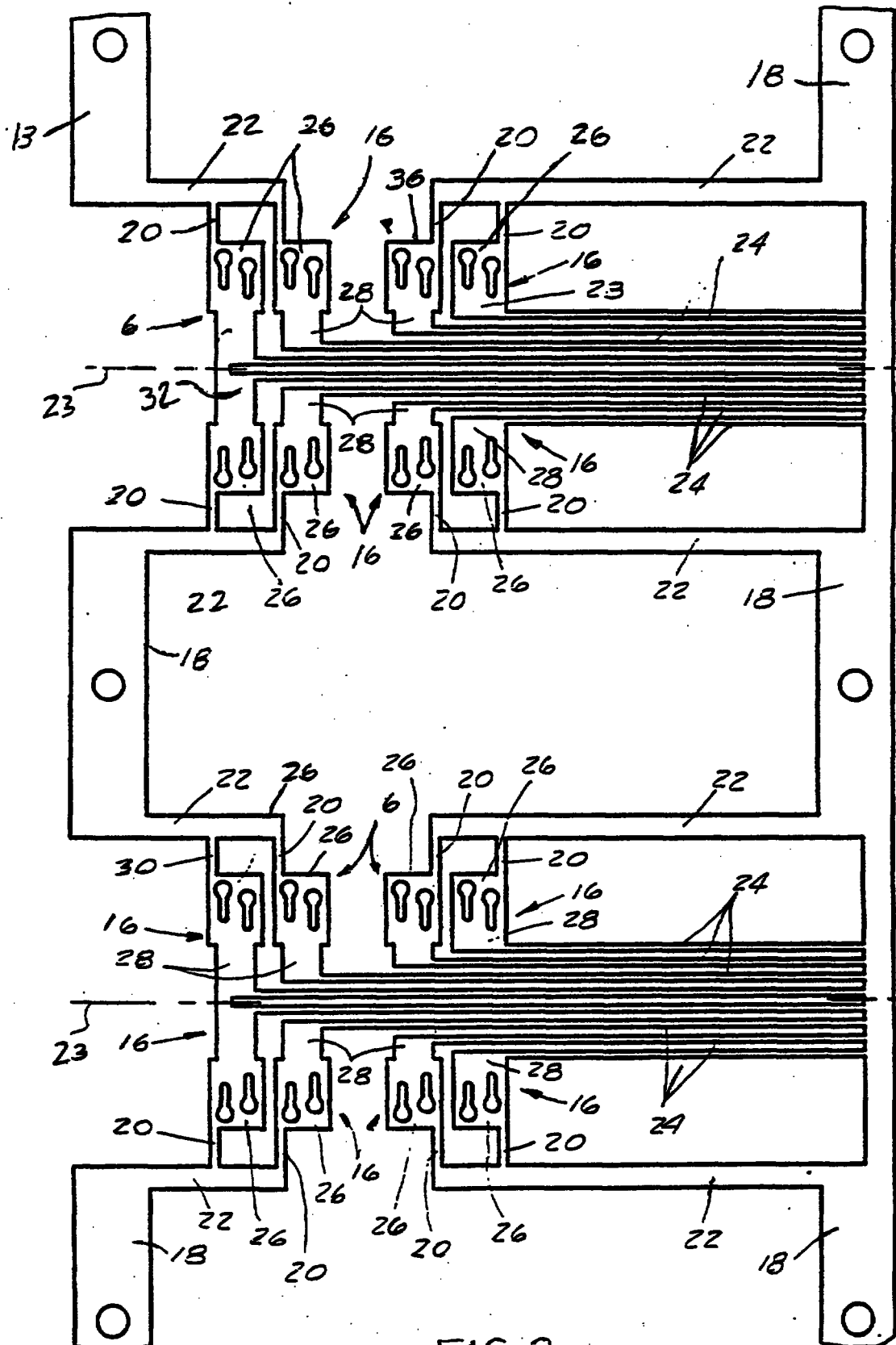


FIG.2

THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET
14 MAR 1997

3

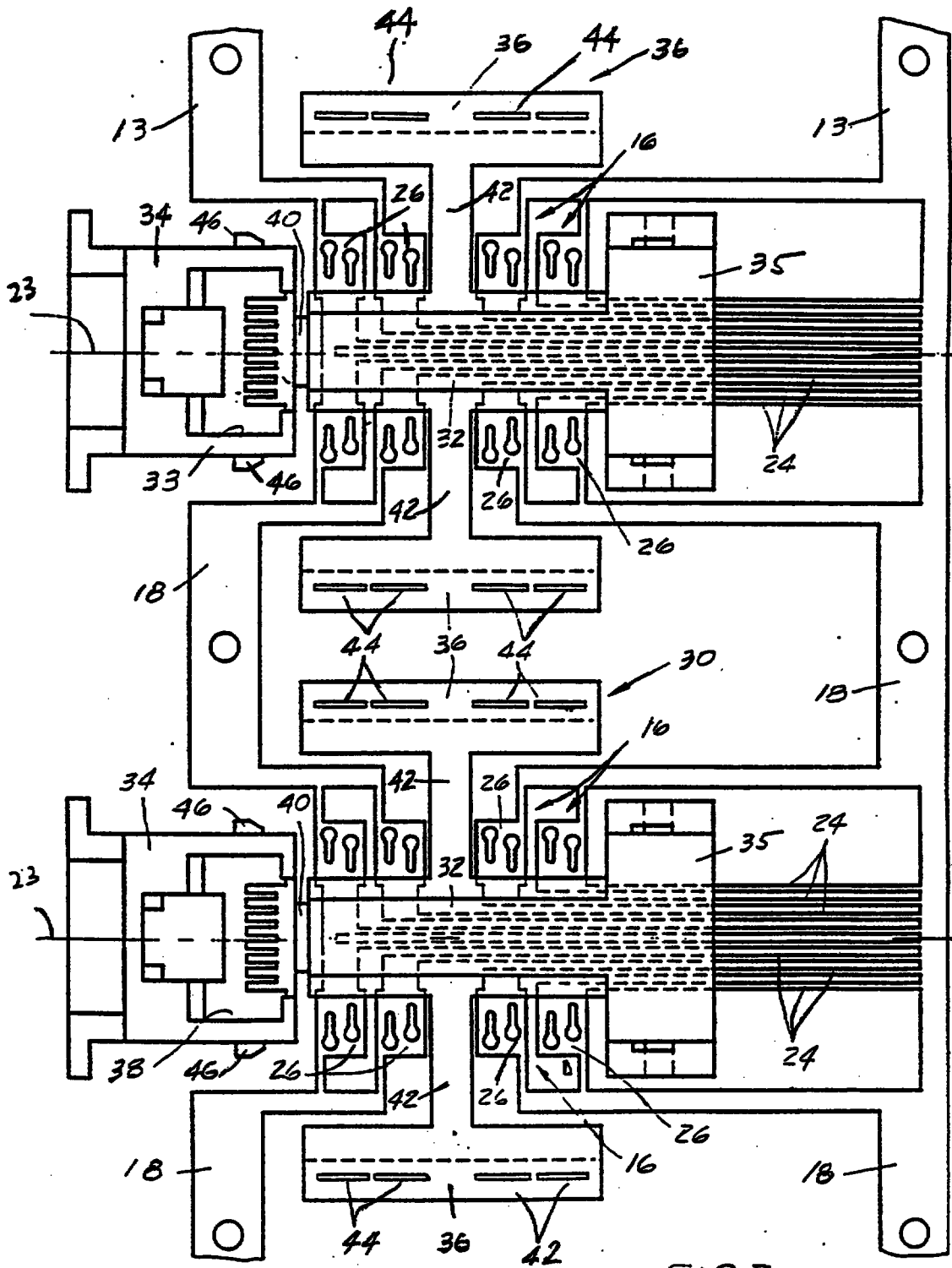


FIG. 3

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997

4

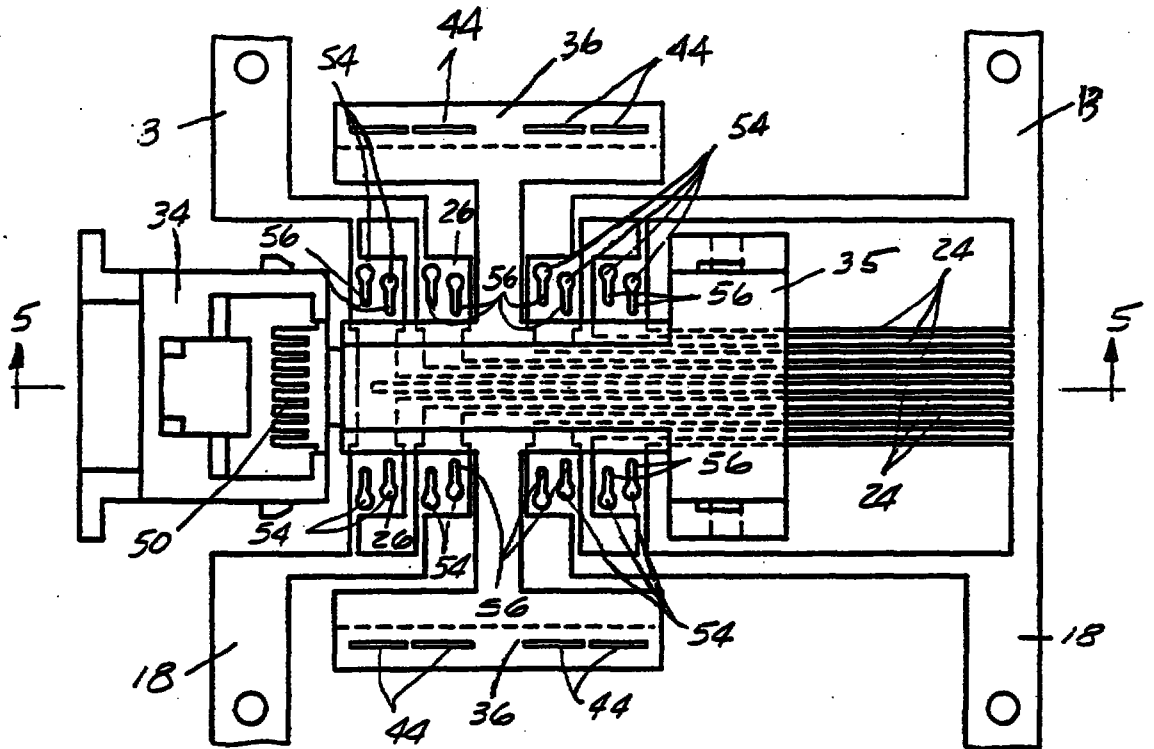


FIG. 4

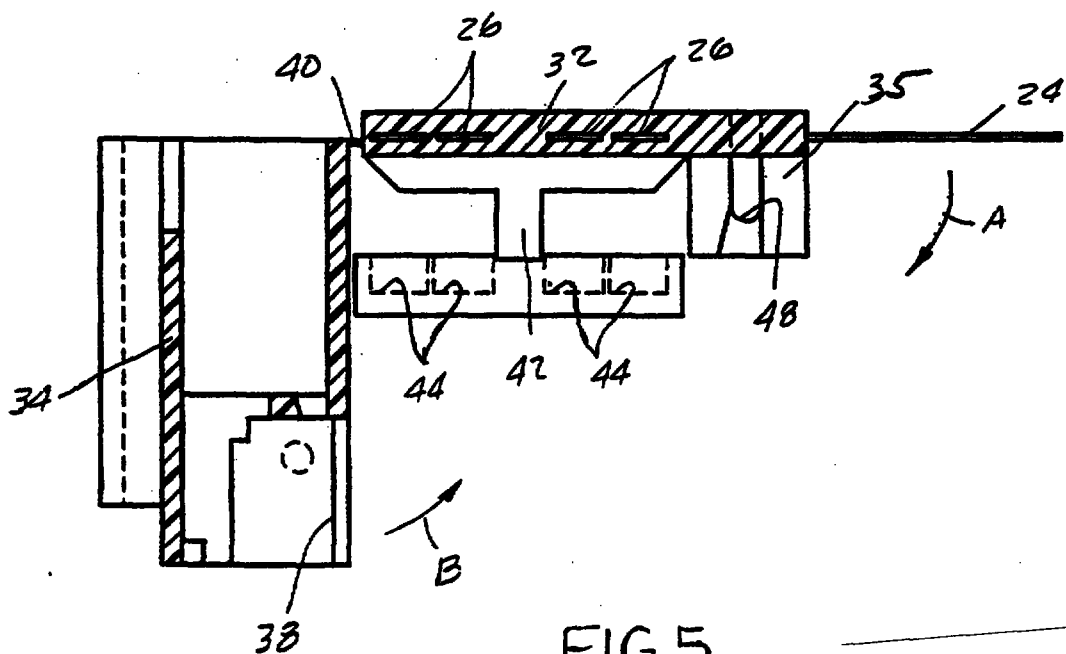
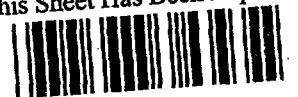


FIG. 5

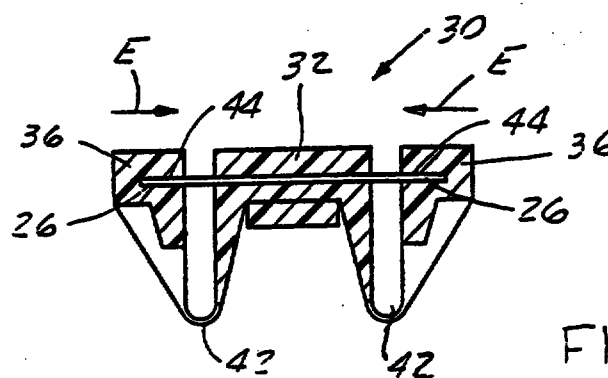
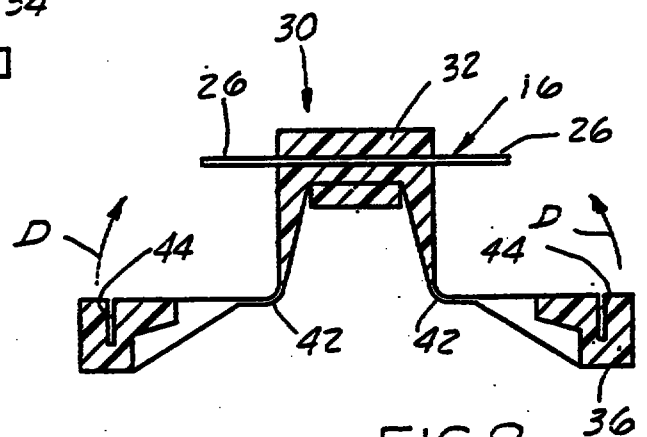
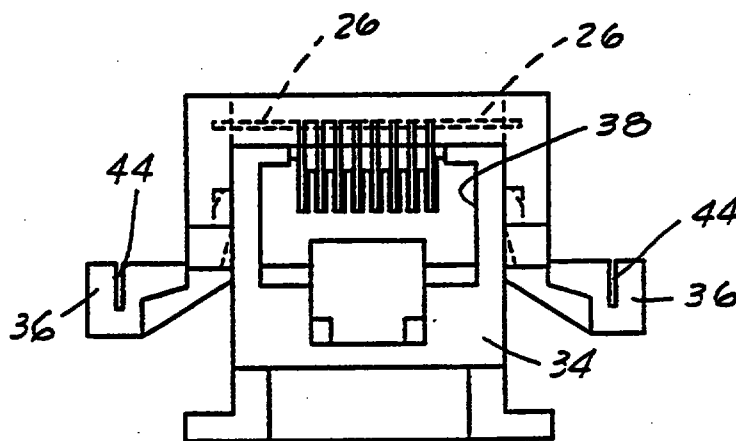
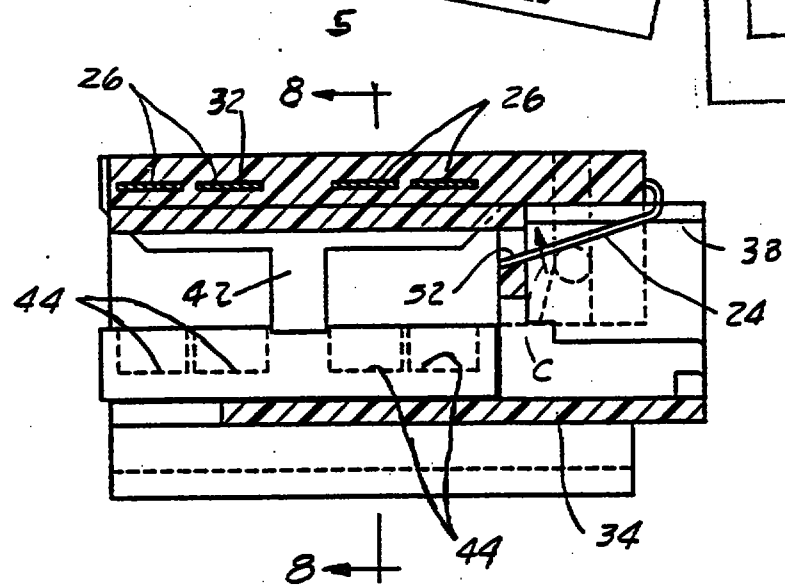
This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

REPLACEMENT SHEET

14 MAR 1997



This Sheet Has Been Replaced



6

14 MAR 1997

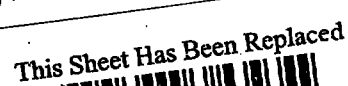


FIG 11

9605579-3

-1-

IPDS
copy

REPLACEMENT SHEET

12 SEP 1997

MODULAR ELECTRICAL CONNECTOR

Field of the Invention

This invention generally relates to the art of electrical connector assemblies and, particularly, to a modular telephone connector, although various aspects of the invention are applicable to connectors, in general.

Background of the Invention

A common type of female electrical connector or receptacle is known for example from US-A-4 269 467 referred to in the industry as a telephone jack or "modular jack". Such a modular telephone connector includes a dielectric housing defining a standard telephone receptacle jack. A plurality of terminals are mounted in the housing, and each terminal includes a resilient cantilever jack contact projecting into a plug-receiving cavity or opening in the housing for engaging contacts of a standard telephone plug. Most often, the terminals are stamped and formed of sheet metal material and include terminating portions, such as wire insulation displacement portions, opposite the resilient cantilever jack contact portions. The wire insulation displacement portions receive insulated telephone wires.

12 SEP 1997

-2-

A wide variety of designs for modular telephone connectors have been proposed to facilitate field installation. Any design should maximize ease of manipulation of the telephone wires and ease of assembly and termination of the connector. Unfortunately, heretofore, even with all of the various design proposals, such modular jacks still employ too many components which are difficult to manipulate and assemble, particularly with the every-increasing miniaturization of such components. Problems still are encountered with various designs of field installable modular telephone connectors because of their size, the assembly manipulations required and the difficulty of terminating the telephone wires to the connector.

This invention is directed to solving these problems by providing a unique modular electrical connector, particularly adaptable as a modular telephone connector or jack, which includes a one-piece molded housing which has various integral, relatively movable portions for effecting complete assembly and termination of the connector without any extraneous components or tools.

Summary of the Invention

An object, therefore, of the invention is to provide a new and improved modular electrical connector, in

12 SEP 1997

-3-

general, and to provide a unique modular telephone connector or jack, in particular.

The modular telephone connector according to the invention includes a housing defining a standard telephone jack. A plurality of stamped metal terminals are mounted in the housing, and each terminal has a resilient cantilever jack contact portion, a wire insulation displacement portion and an intermediate portion between the cantilever jack contact portion and the wire insulation displacement portion. The housing is provided in the form of a one-piece structure overmolded about the intermediate portions of the stamped metal terminals, with the wire insulation displacement portions of the terminals exposed for receiving insulated telephone wires. The housing includes a cavity or opening for receiving a standard telephone plug. The cantilever jack contact portions of the terminals are exposed adjacent the cavity, whereby the contact portions can be bent into the cavity for engaging contacts of the telephone plug upon insertion of the plug into the cavity.

A feature of the invention is directed to providing at least one wire-driving portion of the connector housing molded integrally therewith ~~by a living hinge~~, whereby the wire-driving portion is movable into engagement with at least some of the insulated telephone wires to

12 SEP 1997

-4-

drive the wires into the insulation displacement portions of the terminals. In a further embodiment of the invention, the wire insulation displacement portions of the terminals project from opposite sides of the housing, and a pair of the wire-driving portions are molded integrally with opposite sides of the housing by a pair of living hinges.

Another feature of the invention involves forming the wire insulation displacement portions of the terminals with closed keyhole-shaped insulation displacement slots defining enlarged slot portions sized for receiving the insulated telephone wires, along with narrow slot portions communicating with the enlarged slot portions for piercing the insulation of the telephone wires. The wire-driving portions of the housing are effective to drive the telephone wires into the narrow slot portions of the keyhole-shaped slots.

Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

12 SEP 1997

-5-

Brief Description of the Drawings

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with its objects and the advantages thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

FIGURE 1 is a perspective view of a fully assembled modular telephone jack incorporating the concepts of the invention;

FIGURE 2 is a plan view of a fragmented portion of a continuous metal strip from which the terminals of the connector are stamped, illustrating two sets of terminals for a pair of connectors;

FIGURE 3 is a view similar to that of Figure 2, illustrating a pair of one-piece housing structures overmolded about intermediate portions of the terminals;

FIGURE 4 is a view of only one of the overmolded housing structures and a single set of terminals, as depicted in Figure 3;

FIGURE 5 is a horizontal section taken generally along line 5-5 of Figure 4;

FIGURE 6 is a sectional view similar to that of Figure 5, during a step of manufacture wherein the canti-

12 SEP 1997

-6-

lever jack contact portions of the terminals have been bent into the housing cavity, and the base portion of the housing structure has been pivoted to a latched condition, versus the initial overmolded condition shown in Figure 5;

FIGURE 7 is a front elevational view, looking toward the right-hand end of Figure 6, with the wire-driving portions of the housing structure in inoperative positions;

FIGURE 8 is a vertical section taken generally along line 8-8 of Figure 6, again showing the wire-driving portions of the housing structure in inoperative positions, as depicted in Figure 7;

FIGURE 9 is a view similar to that of Figure 8, with the wire-driving portions pivoted to their wire terminating positions;

FIGURE 10 is a vertical section through the fully assembled and terminated modular connector, as taken generally along line 10-10 of Figure 1, in conjunction with a standard telephone plug; and

FIGURE 11 is a view similar to that of Figure 10, showing the connector mounted within a particular housing environment.

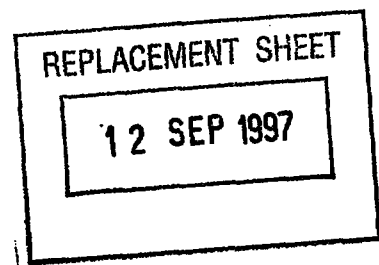
12 SEP 1997

-7-

Detailed Description of the Preferred Embodiment

Referring to the drawings in greater detail, and first to Figure 1, the concepts of the invention are illustrated in a modular telephone connector or jack, generally designated 12, which includes a one-piece housing, generally designated 14. The housing is unitarily molded of dielectric material, such as plastic or the like, and will be described in greater detail hereinafter. Generally, a portion of the housing is overmolded about portions of a plurality of stamped metal terminals, generally designated 16, and the terminals are insulation-displacement-terminated to a plurality of telephone wires of a telephone cable 19, all of which will be described in greater detail hereinafter. At this point, it should be understood that, although the concepts of the invention are disclosed herein embodied in a modular telephone connector or jack, various aspects of the invention are equally applicable for other types of electrical connectors.

The following detailed description is being presented in a step-by-step fashion involving initial manufacturing steps, initial sub-assembly steps prior to providing or shipping the pre-assembled connector to a user, and finally the telephone wire termination steps carried out by the user. This approach is believed to be most advanta-



-8-

geous in presenting various aspects of the invention in a precise and understandable description.

More particularly, referring first to Figure 2, terminals 16 first are stamped from a continuous strip of sheet metal material to a blank configuration including a pair of continuous carrier strips 18 which carry the terminals in stamped form through an appropriate stamping machine. Of course, the terminals are in a flat or planar configuration in the stamped blank of Figure 2. It can be seen that the terminals are joined by web portions 20 and transverse webs 22 to carrier strips 18. It also can be seen that the terminals are stamped on opposite sides of a transverse center line 23, with four terminals on each side of the center line for a total "terminal cluster" of eight terminals for each telephone connector 12 (Fig. 1).

Each stamped metal terminal 16 includes a resilient cantilever jack contact portion 24, a wire insulation displacement portion 26 and an intermediate portion 28, although the right-hand terminals shown in Figure 2 have no distinct intermediate portion except integral areas of wire insulation displacement portions 26. Eventually, cantilever jack contact portions 24 of the terminals will be severed from the right-hand carrier strip 18 and bent into the connector housing 14, as will be described in greater detail hereinafter.

12 SEP 1997

-9-

The next step in fabricating modular telephone connector 12 is shown in Figures 3-5 and, generally, involves overmolding a one-piece housing subassembly structure about portions of terminals 16, generally about the intermediate portions of at least some of the terminals. More particularly, an overmolded housing structure or subassembly, generally designated 30, includes a top or center overmolded portion 32, a main housing portion 34, a latch portion 35 and a pair of wire-driving portions 36. It can be seen that the top or center overmolded portion 32 is molded about portions of terminals 16 such that wire insulation displacement portions 26 of the terminals are exposed exteriorly on opposite sides of the center overmolded portion of the housing subassembly structure. It also can be seen that latch portion 35 is overmolded about inner areas of cantilever jack contact portions 24, leaving considerable areas of the contact portions exposed for bending purposes, as described hereinafter.

Main housing portion 34 includes an opening or cavity 38 which is provided for receiving a standard telephone plug, as will be more apparent hereinafter. The main housing portion is molded integral with top or center overmolded portion 32 by a living hinge 40. Each wire-driving portion 36 also is molded integral with top or

12 SEP 1997

-10-

center overmolded portion 32 by a living hinge 42. Each wire-driving portion also includes slots or grooves 44 in the top thereof for effecting insulation displacement termination of telephone wires to the wire insulation displacement portions 26 of terminals 16, again as will be described in greater detail hereinafter.

Lastly, at this point, in order to better understand the following detailed description, it should be noted in Figure 5 that main housing portion 34 and wire-driving portions 36 depend downwardly from top or center overmolded portion 32 of the housing. Living hinges 40 and 42 also are clearly visible in this figure. After housing subassembly structure 30 (Figs. 3 and 4) is overmolded about portions of terminals 16, as described above, webs 20 (Fig. 2) then are severed from wire insulation displacement portions 26 of the terminals, and cantilever jack contact portions 24 are severed from the right-hand carrier strip 18 of the stamped metal blank described above in relation to Figure 2. The cantilever jack contact portions now are rendered flexible or resilient because of their becoming free from the carrier strip.

After all of the extraneous webs and carrier strips have been removed from the stamped metal blank, cantilever jack contact portions 24 then are formed or bent, and overmolded housing subassembly 30 is assembled

12 SEP 1997

-11-

into a subassembly for shipping to and/or use by an ultimate user. Of course, the entire modular telephone connector 12 can be fully assembled in a manufacturing environment, if such an application is desirable. In either event, reference is made to Figures 6 and 7, particularly in conjunction with Figure 5. Cantilever jack contact portions 24 first are bent downwardly in the direction of arrow "A" (Fig. 5) to the configuration shown in Figure 6, whereby the contact portions now are disposed within cavity or opening 38. Main housing portion 34 then is pivoted about living hinge 40 in the direction of arrow "B" (Fig. 5). As seen in Figure 7, the main housing portion will move upwardly between the side wire-driving portions 36. When the main housing portion is moved to its fully assembled position as shown in Figure 6, the main housing portion is latched in that position by a pair of latch bosses 46 (Fig. 3) snapping into a pair of latch grooves 48 (Fig. 5) on the inside of latch portion 35 of the overmolded housing structure. When in the assembled condition, cantilever jack contact portions are disposed within a comb structure 50 (Fig. 4) and seat on top of ledges 52 (Fig. 6) of the comb structure. When a standard telephone plug is inserted into opening 38, the resilient cantilever jack contact portions engage contacts on the

12 SEP 1997

plug as the jack contact portions are biased upwardly in the direction of arrow "C" (Fig. 6).

Wire-driving portions 36 of overmolded housing structure 30 are used to drive insulated wires of telephone cable 18 (Fig. 1) into insulation displacement condition with wire insulation displacement portions 26 of terminals 16. Before proceeding, however, reference is made back to Figures 2-4 where it can be seen that each wire insulation displacement portion 26 of each terminal 16 includes a pair of keyhole-shaped slots, each slot including an enlarged slot portion 54 communicating with a narrow slot portion 56. The enlarged slot portions 54 are sized sufficiently larger than the insulated wires of the telephone cable so that the wires can be inserted easily into the enlarged slot portions. The narrow slot portions 56 are sufficiently narrow to cut through or pierce the insulation of the telephone wires to establish conductivity with the cores of the wires.

With the above understanding, and with reference to Figures 8 and 9, it can be seen in Figure 8 that wire-driving portions 36 project outwardly of the center or top portion 32 of the overmolded housing structure 30, with the wire-driving portions being interconnected to the center portion by living hinges 42. Therefore, the wire-driving portions can be pivoted upwardly in the direction of arrows

11 2 SEP 1997

-13-

"D" (Fig. 8). It also should be noted that slots 44 in the wire-driving portions have widths which are at least slightly larger than the thickness of the metal material from which insulation displacement portions 26 of terminals 16 are fabricated. Therefore, wire-driving portions 36 can be pivoted upwardly in the direction of arrows "D", about living hinges 42, whereupon wire insulation displacement portions 26 of the terminals enter into slots 44 as shown in Figure 9. Since the enlarged slot portions 54 are disposed transversely outwardly relative to narrow slot portions 56, as seen clearly in Figure 4, if insulated wires are located in the enlarged slot portions, wire-driving portions 36 will drive the wires into the narrow slot portions 56, as indicated by arrows "E" in Figure 9. Therefore, wire-driving portions 36 of the overmolded housing structure are effective to terminate the telephone wires to the terminals. Slots 44 in the wire-driving portions should be of widths to establish an interference fit with insulation displacement portions 26 of the terminals, so that the wire-driving portions remain in their terminating positions as shown in Figure 9.

Figure 10 shows modular telephone connector 12 fully terminated to a plurality of insulated wires 60 of telephone cable 19. This depiction corresponds to the "subassembly" illustration of Figures 6 and 7, except that

12 SEP 1997

-14-

the insulated wires 60 are shown terminated to insulation displacement portions 26 of terminals 16, as described above in relation to Figures 8 and 9. It can be seen that telephone cable 19 can be inserted through a recessed area 62 of main housing portion 34, and insulated wires 60 simply are fed upwardly through enlarged slot portions 54 (Fig. 4), whereupon wire-driving portions 36 of the over-molded housing structure can be used to drive the insulated wires into the narrow slot portions 56, as described above. The modular telephone connector now is fully assembled and ready to receive a standard telephone plug 64 insertable into opening 38 in the direction of arrow "F", as shown in Figure 10.

Lastly, Figure 11 illustrates an application of using modular telephone connector 12 within a particular housing 66 which includes a front aperture 68 through which telephone plug 64 can be inserted into opening 38 in the modular telephone connector. Appropriate contacts on the plug (not shown) will engage resilient cantilever jack contact portions 24 and bias the contact portions upwardly in the direction of arrow "C".

~~It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered~~

REPLACEMENT SHEET

12 SEP 1997

-15-

in all respects as illustrative and not restrictive, and
the invention is not to be limited to the details given
herein.



12 SEP 1997

Claims

1. A modular telephone connector (12) which includes a housing (14) defining a standard telephone jack, and a plurality of stamped metal terminals (16) each having a resilient cantilever jack contact portion (24) and a wire insulation displacement portion (26), said housing being a one-piece structure molded onto portions of the stamped metal terminals (16) with the wire insulation displacement portions (26) thereof exposed for receiving insulated telephone wires (60), the housing (14) including a cavity (38) for receiving a standard telephone plug (64), and the cantilever jack contact portions (24) of the terminals (16) being exposed by the housing adjacent the cavity (38) and being bent into the cavity (38), characterized in that said housing (14) includes at least one wire-driving portion (36) molded integrally therewith and movable into engagement with at least some of the insulated telephone wires (60) to drive the wires into the insulation displacement portions of the terminals (16).
2. A modular telephone connector as set forth in claim 1, wherein said wire insulation displacement portions (26) of the terminals (16) include closed key-hole-shaped insulation displacement slots defining enlarged slot portions (54) sized for receiving the insulated telephone wires (60), and narrow slot portions communicating with the enlarged slot portions (56) for piercing the insulation of the telephone wires (60) when the wires are moved from the enlarged slot portions (54) with the narrow slot portions.



12 SEP 1997

3. A modular telephone connector as set forth in claim 1 or 2, including a living hinge portion (42) integrally connecting the wire-driving portion (36) to afford driving movement thereof.
4. A modular telephone connector as set forth in one of claims 1-3, wherein the wire insulation displacement portions (26) of some of the terminals (16) project from opposite sides of the housing (14), and including a pair of said wire-driving portions (36) integrally connected on opposite sides of the housing (14).
5. A modular telephone connector as set forth in one of claims 1-4, wherein said one-piece housing (14) includes a center portion (32) molded onto portions of the terminals (16), a main housing portion (34) at one end of the center portion (32) defining said cavity (38) and molded integrally with the center portion (32) and movable into an assembled condition, a latch portion (35) at an opposite end of the center portion (32) for latching engagement with the main housing portion (34), the at least one wire-driving portion (36) molded integrally with the center portion (32).
6. A modular telephone connector as set forth in claim 5, wherein the living hinge portion (42) being integrally molded between the center portion (32) and the wire-driving portion (36) to afford driving movement thereof.
7. A modular telephone connector as set forth in claim 6, wherein the wire insulation displacement portions (26) of the terminals (16) project from opposite sides of the center portion (32) of the housing.



12 SEP 1997

8. A method of fabricating and assembling a modular telephone connector (12), according to one of claims 1-7 comprising the steps of:

stamping a plurality of terminals (16) from sheet metal material, each terminal (16) having a resilient cantilever jack contact portion (24) and a wire insulation displacement portion (26);
molding a one-piece housing structure (14) onto areas of the terminals (16), the housing structure (14) being molded with a center portion (32) molded onto said areas of the terminals (16), exposing said cantilever jack contact portions (24) and said wire insulation displacement portions (26), a main housing portion (34) molded by a living hinge (40) integral with the center portion (32) and defining a cavity (38) for receiving a standard telephone plug (64), and at least one wire-driving portion (36) molded integrally with the center portion by a living hinge (42);
moving said main housing portion (34) about its living hinge (40) into juxtaposition with the center portion (32) of the housing;
inserting a plurality of insulated telephone wires (60) into the insulation displacement portions (26) of the terminals (16); and
moving the wire-driving portion (36) of the housing about its living hinge (42) into engagement with the insulated telephone wires (60) to drive the wires into the insulation displacement portions (26) of the terminals (16).

9. The method of claim 8, including the step of stamping the insulation displacement portions (26) of the terminals (16) with closed keyhole-shaped insula-



12 SEP 1997

tion displacement slots having enlarged slot portions (54) sized for receiving the insulated telephone wires (60) and narrow slot portions (56) communicating with the enlarged slot portions (54) for piercing the insulation of the telephone wires (60), whereby said wire-driving portion (36) of the housing (14) is effective to move the insulated telephone wires (60) from the enlarged slot portions (54) into the narrow slot portions (56) of the closed keyhole-shaped slots.

12 SEP 1997

ABSTRACT

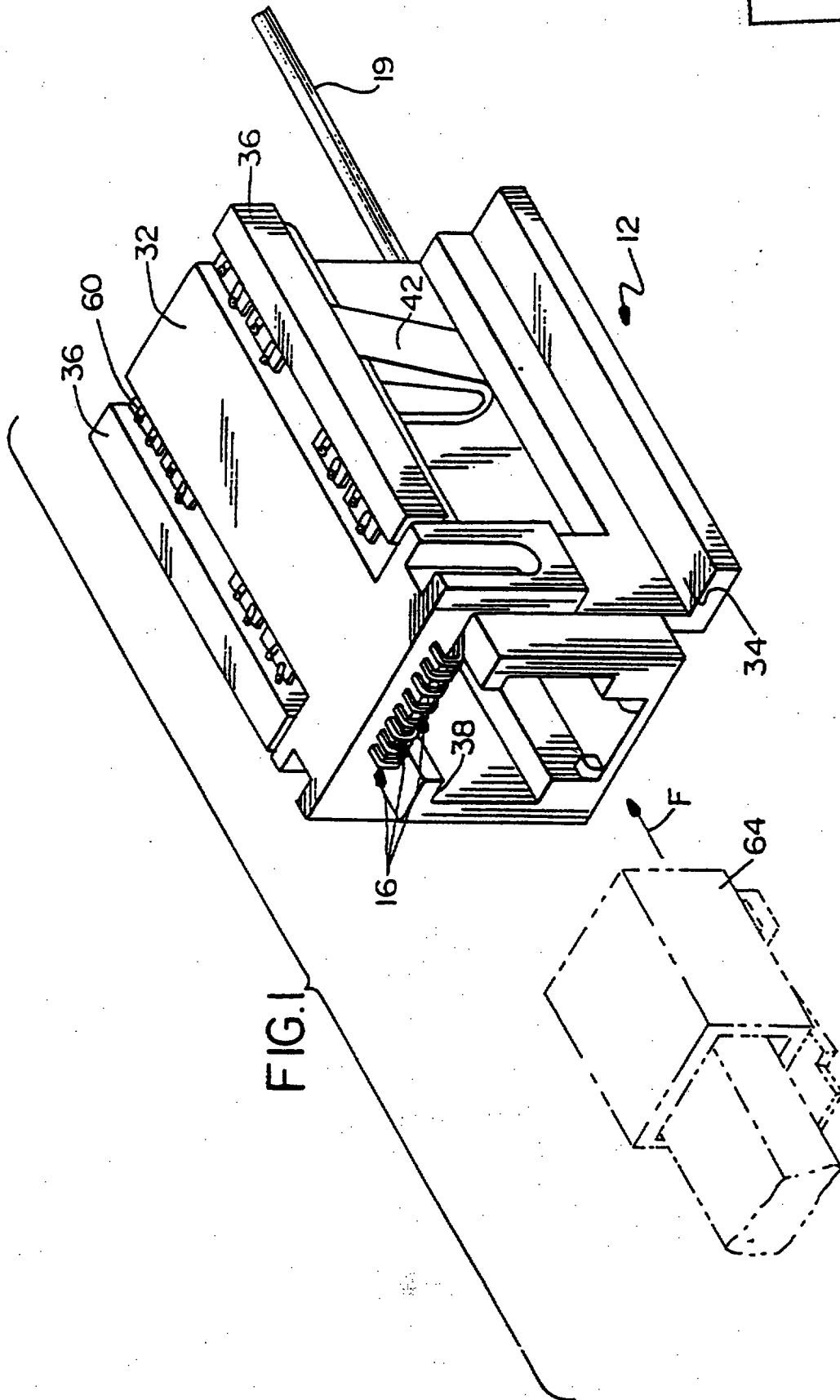
MODULAR ELECTRICAL CONNECTOR

An electrical connector (12) is disclosed in a modular telephone connector configuration and includes a housing (14) defining a standard telephone jack. A plurality of stamped metal terminals (16) each have a resilient cantilever jack contact portion (24), a wire insulation displacement portion (26) and an intermediate portion (28) between the cantilever jack contact portion and the wire insulation displacement portion. The housing is a one-piece structure overmolded about portions of the stamped metal terminals, with the wire insulation displacement portions exposed for receiving insulated telephone wires (60). The housing includes a cavity (38) for receiving a standard telephone plug (64). The cantilever jack contact portions of the terminals are exposed by the overmolded housing adjacent the cavity, whereby the contact portions can be bent into the cavity. The housing includes at least one wire-driving portion (36) molded integrally therewith by a living hinge (42) and movable into engagement with the insulated telephone wires to drive the wires into the insulation displacement portions of the terminals.

FIGURE 1

12 SEP 1997

- 1 -



12 SEP 1997

- 2 -

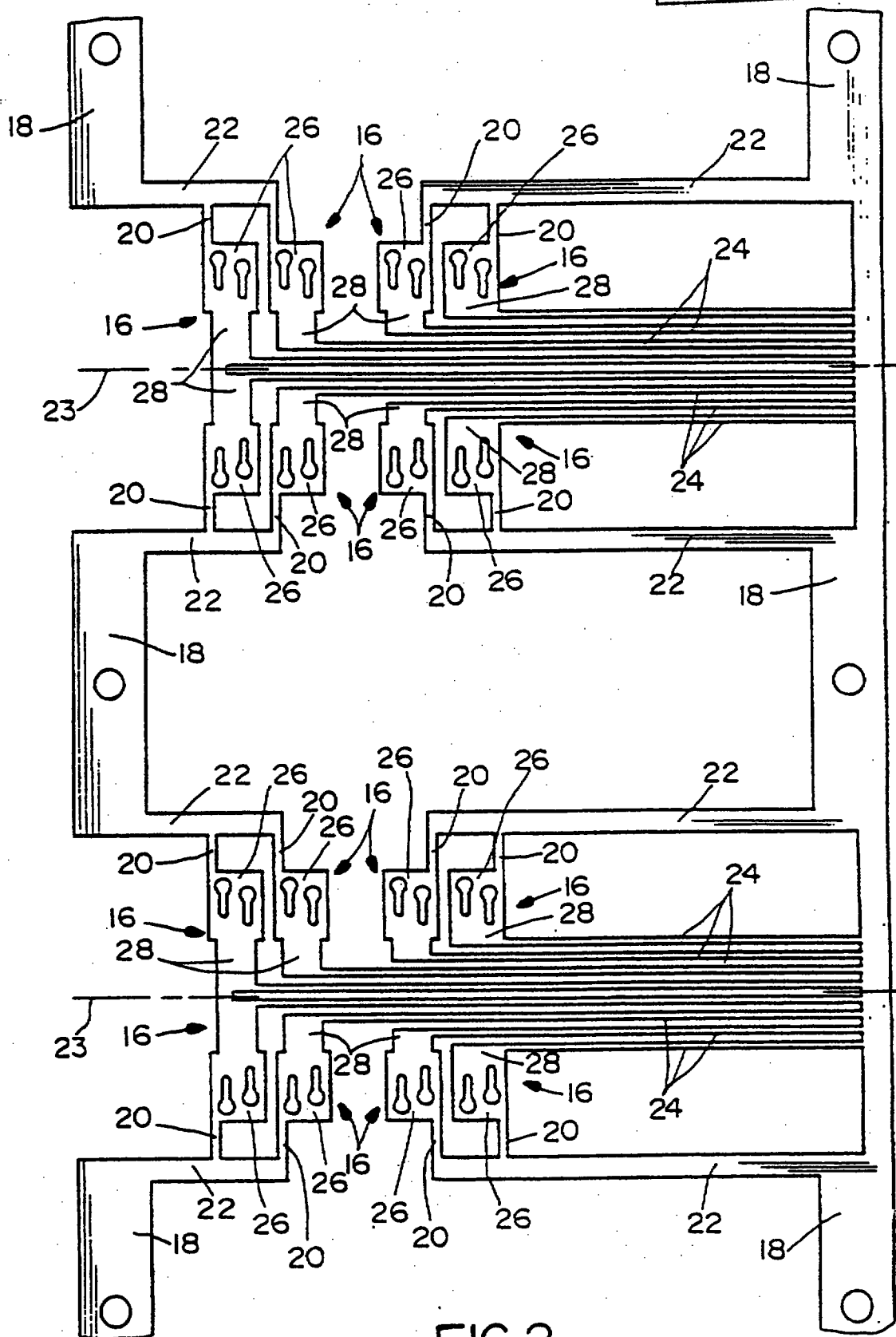


FIG. 2

12 SEP 1997

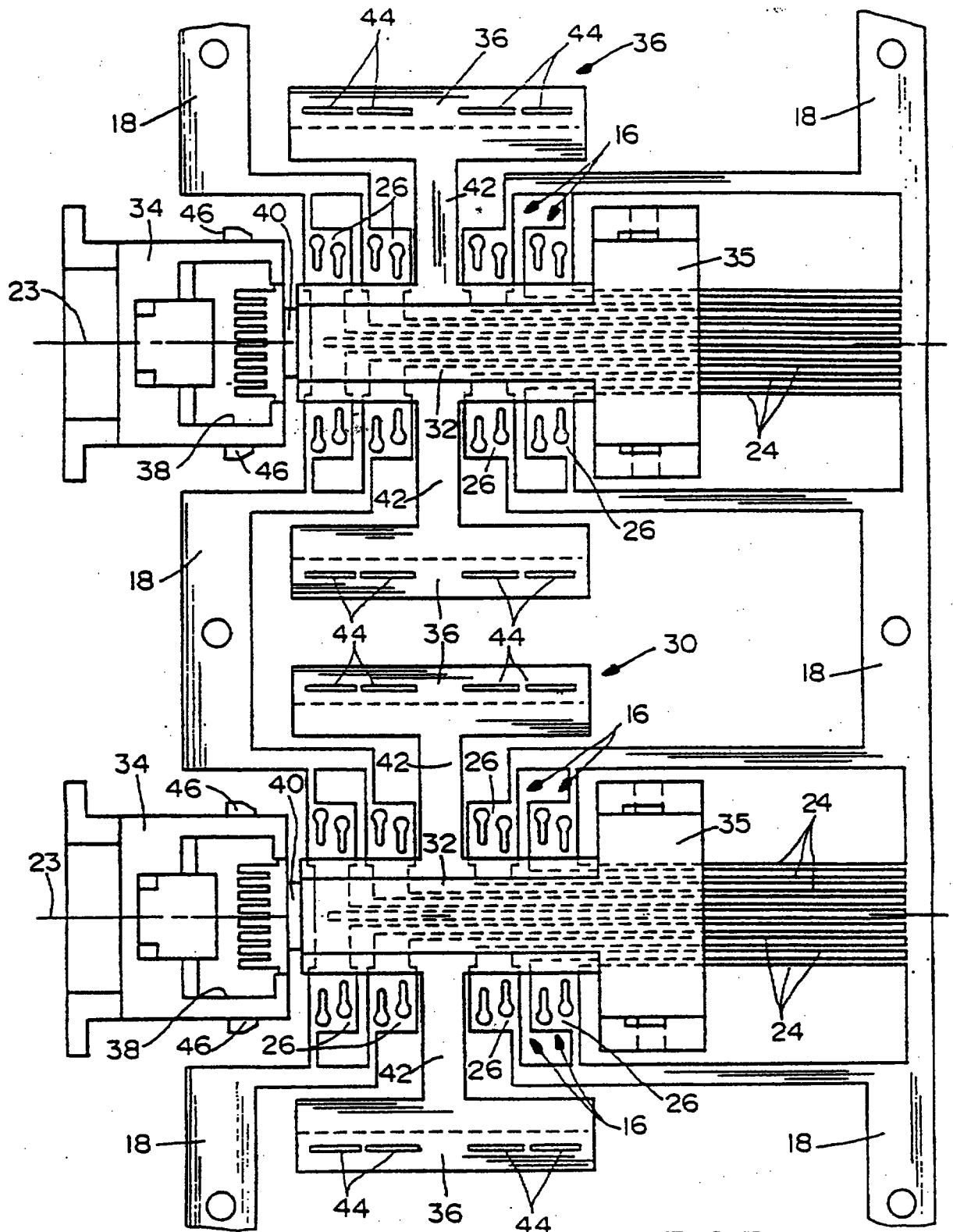


FIG.3

12 SEP 1997

- 4 -

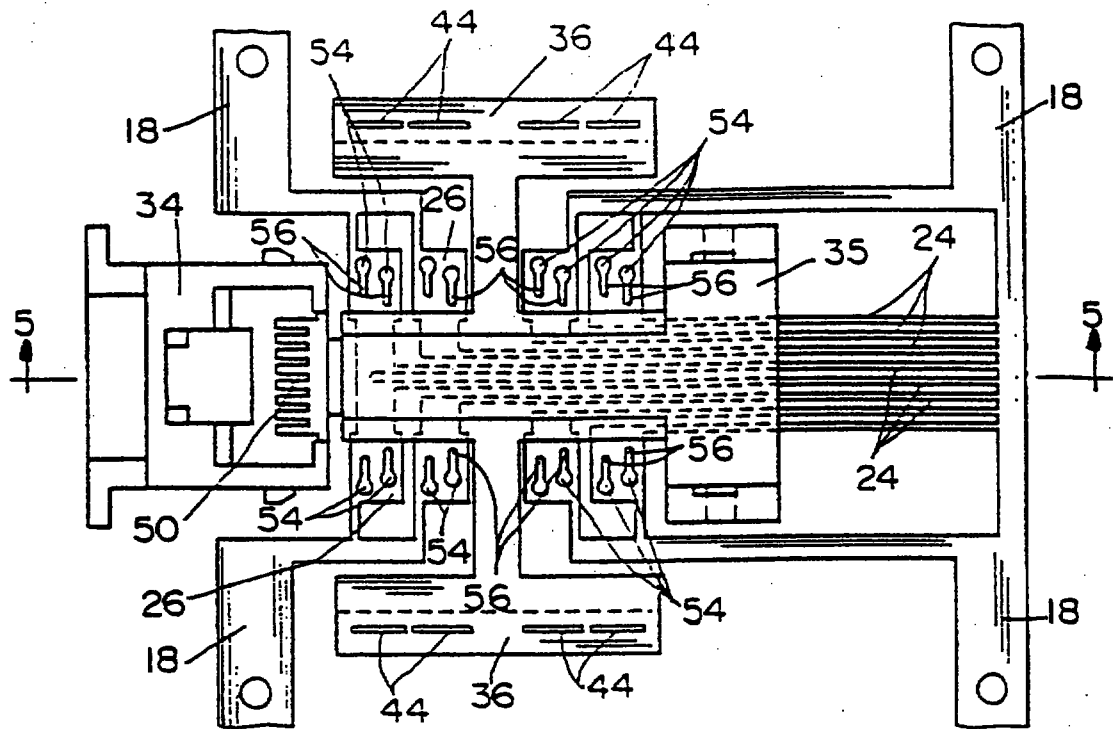


FIG. 4

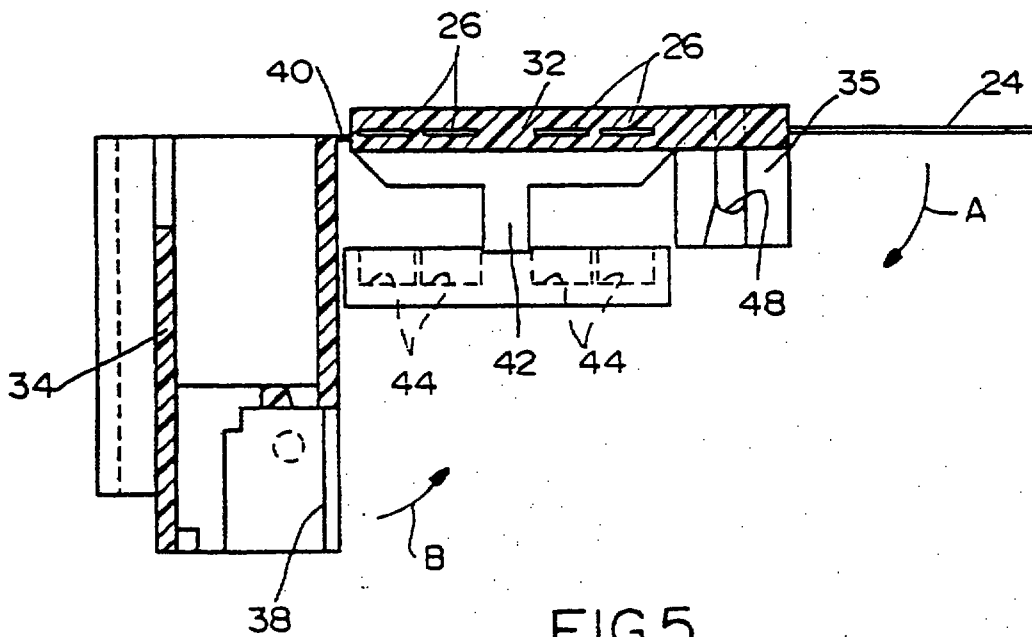


FIG. 5

12 SEP 1997

- 5 -

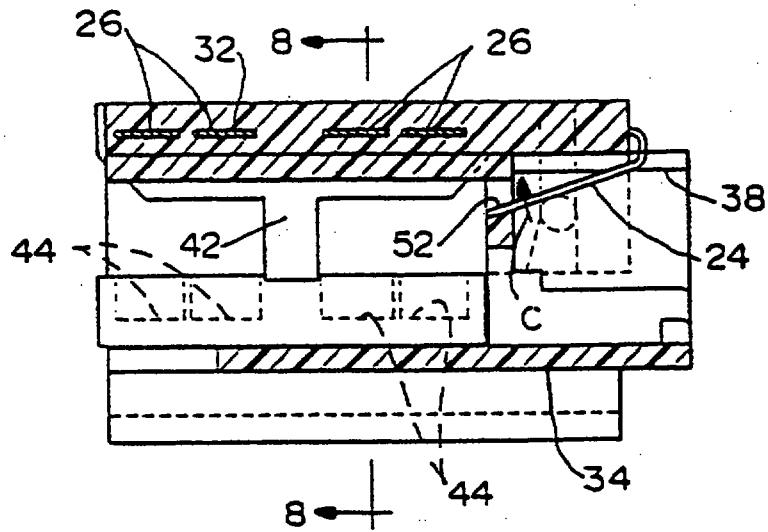


FIG. 6

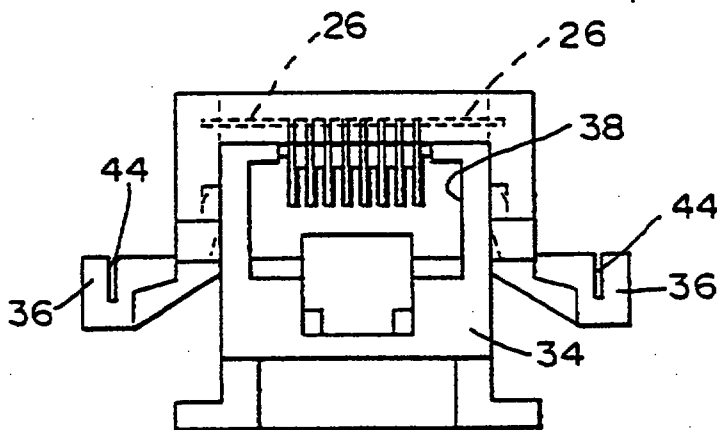


FIG. 7

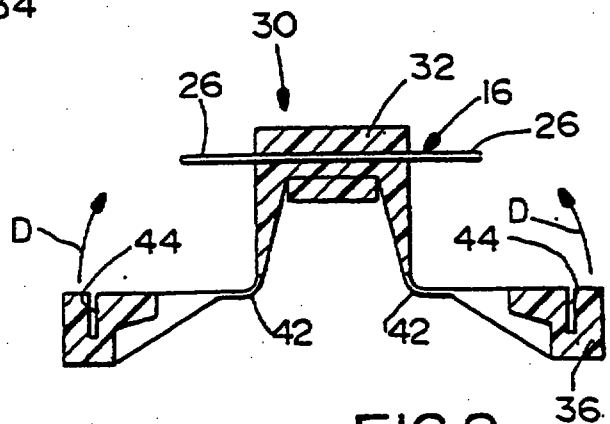


FIG. 8

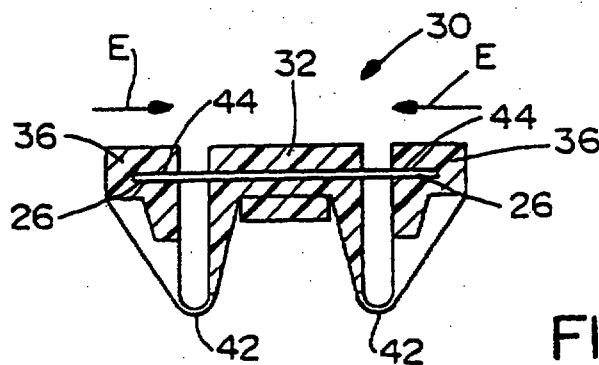


FIG. 9

12 SEP 1997

- 6 -

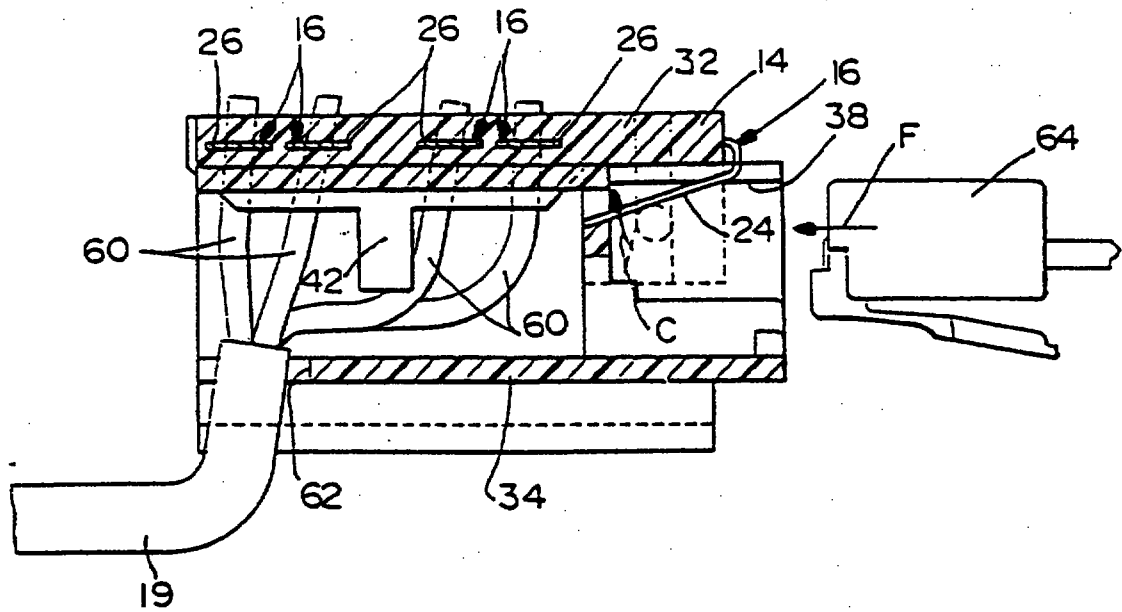


FIG. 10

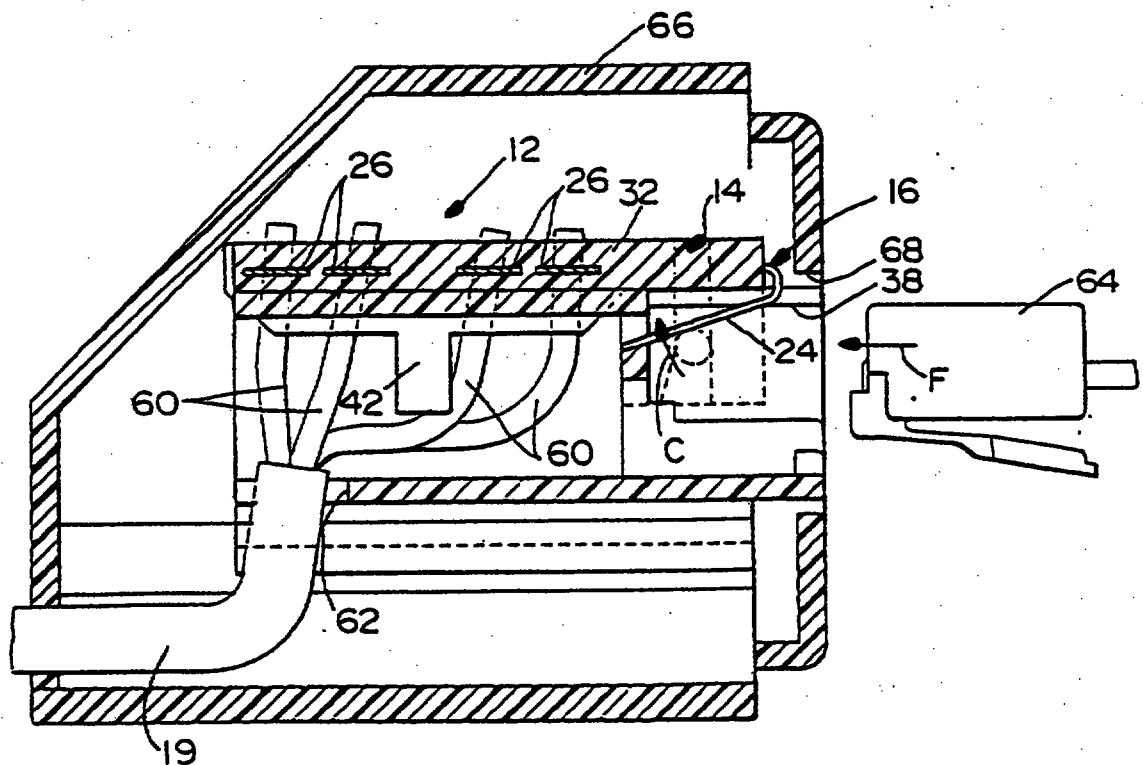


FIG. 11