United States Patent [19]

Garver

[11] **3,920,309**

[45] **Nov. 18, 1975**

[54] **STACKABLE ELECTRICAL CONNECTOR ASSEMBLY**

[75] Inventor: **William Joseph Garver,** Harrisburg, Pa.

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

[22] Filed: **Apr. 18, 1974**

[21] Appl. No.: **461,833**

[52] **U.S. Cl.** ..... **339/198 G;** 339/65; 339/107; 29/629

[51] **Int. Cl.²** **H01R 9/00**

[58] **Field of Search** ..... 339/198 R, 198 G, 198 H, 339/198 S, 198 P, 103 R, 103 M, 65, 66 M, 206 R, 206 P, 176 R, 176 M, 107; 29/629

[56] **References Cited**

UNITED STATES PATENTS

3,065,447	11/1962	Maurer	339/65
3,188,604	6/1965	Mogestad et al.	339/198 J
3,519,978	7/1970	Taormina et al.	339/192 R
3,569,900	3/1971	Uberbacke	339/217
3,627,942	12/1971	Bobb	339/198 G
3,652,977	3/1972	Feldberg	339/198 R
3,740,698	6/1973	Jerominek	339/103 M
3,854,787	12/1974	Snyder, Jr.	339/103 R
3,858,960	1/1975	Kunkle et al.	339/103 R
3,865,457	2/1975	Carter	339/176 M

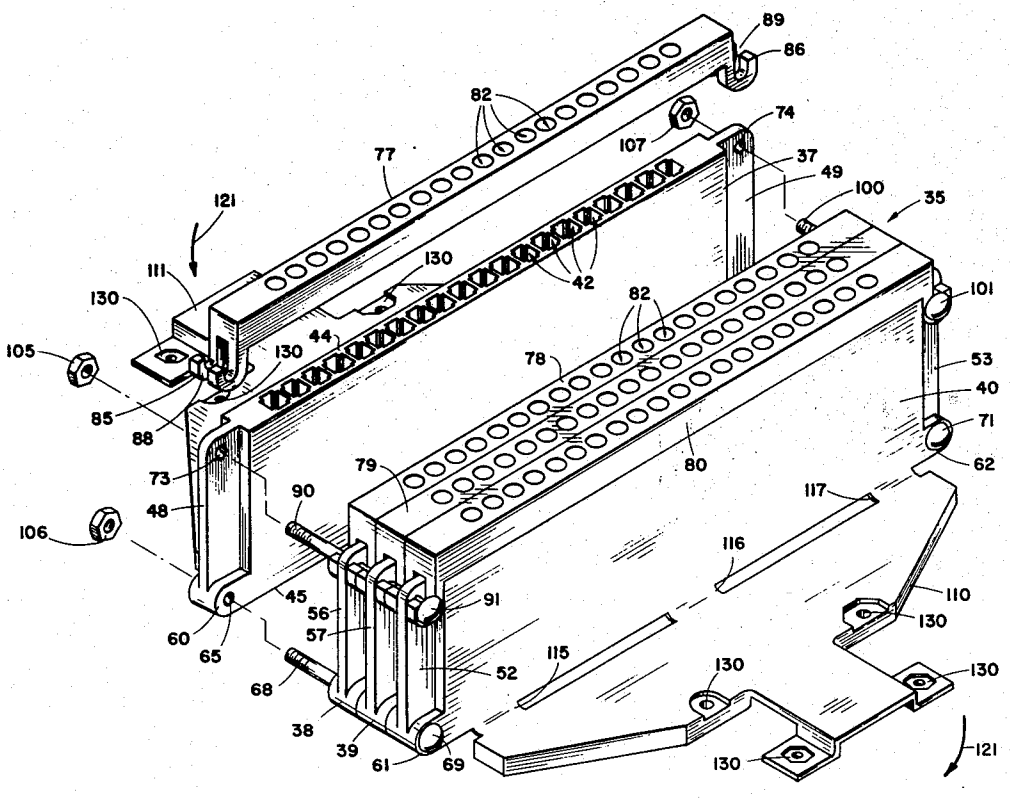
Primary Examiner—Joseph H. McGlynn
Assistant Examiner—James W. Davie
Attorney, Agent, or Firm—William J. Keating, Esq.; Donald W. Phillion, Esq.

[57] **ABSTRACT**

A plug or connector assembly includes a number of side-by-side housings for containing a predetermined number of electrical contacts, the number of housings employed determining the dimensions of a contact matrix presented by the connector assembly. Each of the housing assemblies includes a plurality of apertures of holes for receiving a corresponding plurality of electrical contacts. A plurality of faceplate members are located over respective housings, each engaging fins outwardly extending from each end of the housing with which it is associated and having a corresponding plurality of holes to enable access to the electrical contacts. The housings and faceplate members are secured in position by screws through the fins and a receiving portion of each of the faceplate members.

Strain relief means are also molded onto each of the identical side-by-side housings, the strain relief members intermediate the ends being selectively removeable to effect a pair of cooperating strain relief members to engage the conductors or wires which may be connected to the individual contacts of the connector assembly.

4 Claims, 5 Drawing Figures



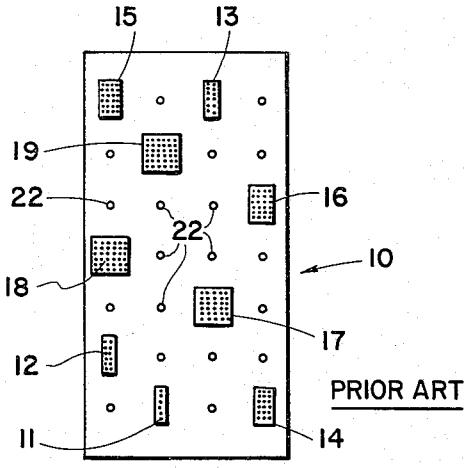


Fig. 1

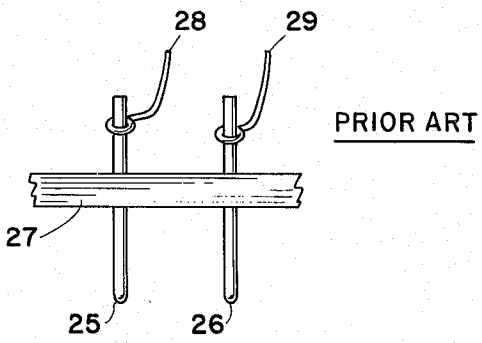


Fig. 2

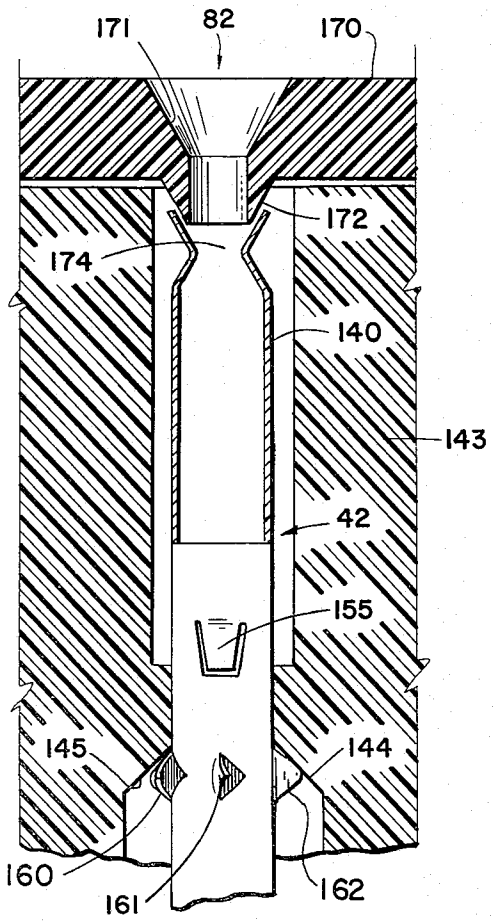


Fig. 4

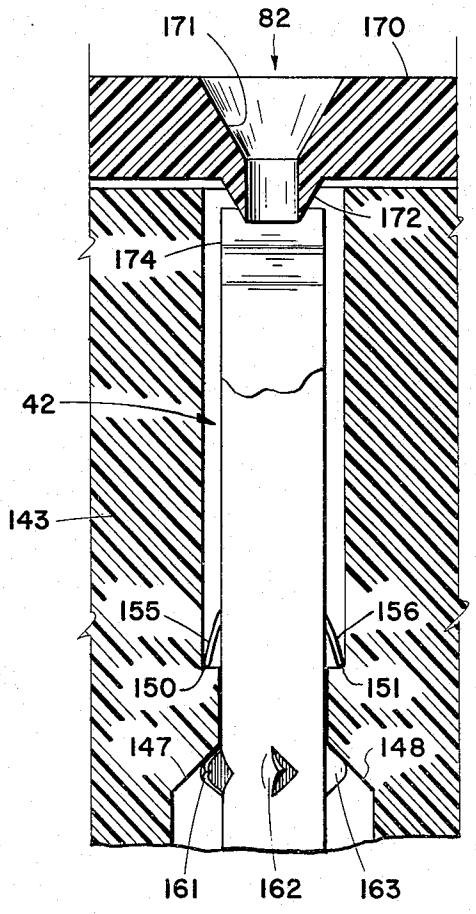


Fig. 5

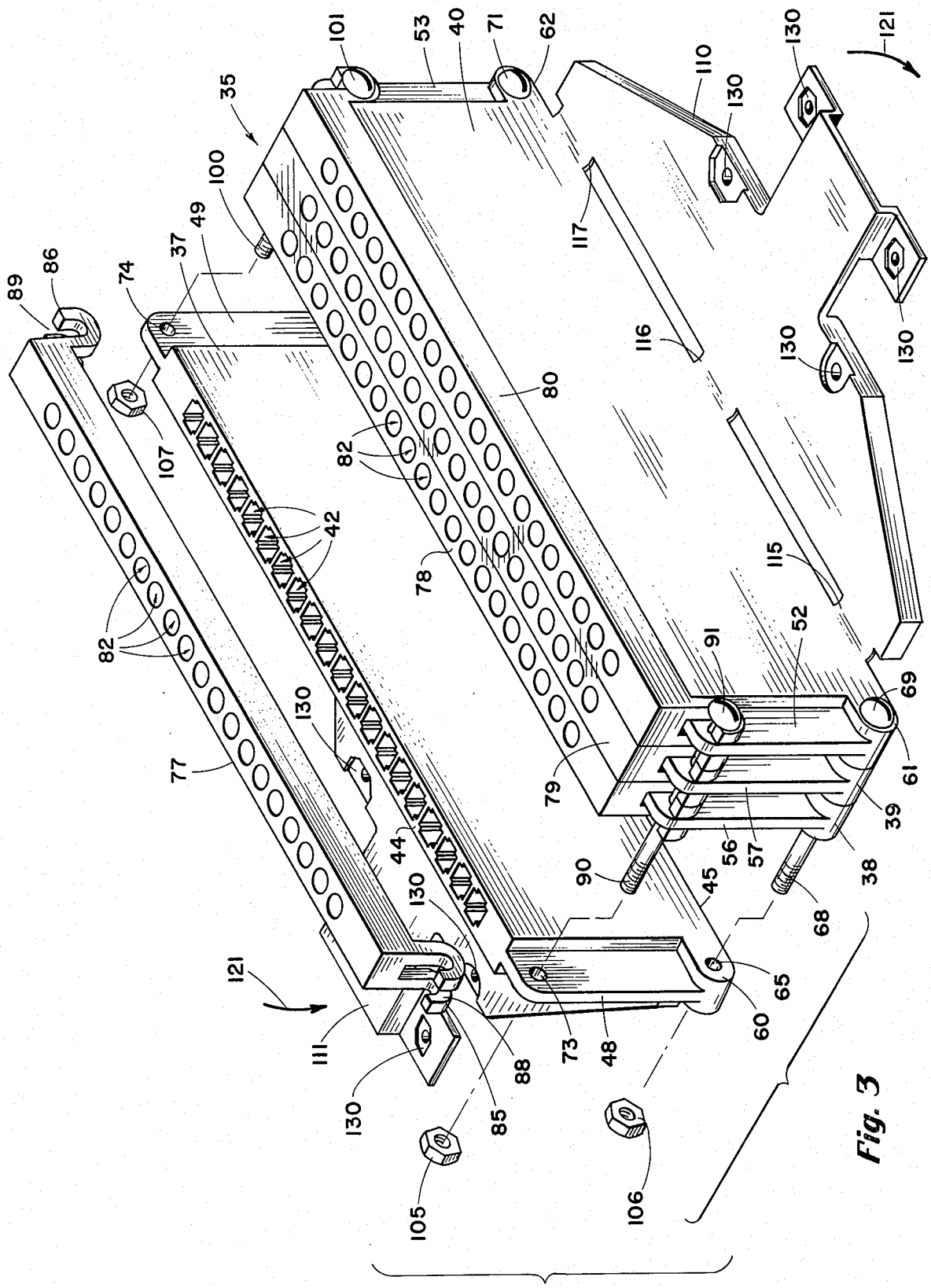

101
53
40
71
62
35
110
130
121
100
49
37
74
89
86
117
116
80
82
107
42
78
115
52
91
69
61
79
39
77
130
44
56
57
38
90
45
68
65
60
121
111
73
48
88
85
130
105
106

Fig. 3

STACKABLE ELECTRICAL CONNECTOR ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to electrical connector assemblies and more particularly to improvements in stackable electrical connector assemblies, and to methods for making same.

2. Description of the Prior Art

In many instances it is desireable to use a plug or connector assembly which is adapted to be modified to present a selected number of electrical contacts for connection to a mating plug or pins, for instance, in a matrix arrangement. More specifically, in many cases, it is desireable to provide a plug which can be selectively expanded by rows to achieve a plug having a predetermined number of electrical contacts, such as female plug contacts, in one matrix direction, for example, twenty, and having a selectable number of contacts in the other matrix direction, to provide a plug matrix of **20** × 2, 3, 4, 8, 10 or any other desired number.

Such connector can be particularly employed, for example, in effecting temporary connections to a number of corresponding electrical mating pins or contacts, such as on another plug, or individually mounted upon a panel or other like structure. For instance, in electronics testing, wires connected to the electrical circuit to be tested are commonly connected to pins to which electrical connection can be made by an appropriate testing apparatus. Often the pins are mounted in a configuration which facilitates making electrical connections simultaneously to a large number of the pins, for example in a male (or female) plug, or in a matrix configuration on a panel which can receive a mating plug or connector assembly. Then with the connector of the testing apparatus attached, various tests can be made among various combinations of contacts to the circuit under consideration. Typically, wires of the connector of the testing apparatus are connected to a data processor or computer, programmed to apply test voltages, or currents, test for shorts, measure responses among the various pins or contacts and so forth. The measured responses can then be compared by the data processor or computer to known proper responses, and the circuit under test accept or reject. In manufacturing complex electrical circuitry, commonly a very large number of test pins are employed, typically arranged in matrices to which connectors of the testing apparatus can be connected. However, often the matrices presented are of different dimensions, although usually the number of pins in one dimension of the matrix is made the same. Thus, in testing different sized matrix arrays, for example, some having dimensions of **20** × 2, some **20** × 4, some **20** × 8, etc., it can be seen that a number of different sized connectors or plugs, one for each particular matrix array, is required. This can be cumbersome, especially in the installation and replacement of the test plugs or connectors. For example, to replace a plug which is worn-out or otherwise unsuitable for use, the entire plug assembly must be unsoldered from the test equipment wires, then the replacement resoldered. The replacement of the entire plug additionally is expensive, since ordinarily the plugs used for such test uses are specially manufactured to accommodate the particular matrix array to be tested.

In the manufacture of the plugs, it is desireable that they be formed in as easy a manner as possible, ideally in a single mold, or in a minimum number of molds. Additionally it is desireable that the molds be as simple or uncomplicated as possible; ideally the molds used should be of the "single action" type, in which the mold motion is constrained to a single axis direction. Double or multiple action molds previously used are not particularly desireable since they are much more expensive, require much more elaborate and sophisticated tooling, and result in a plug or connector which is of significantly increased cost.

In the fabrication of a plug or connector assembly, it is desireable to provide a means for strain relief upon the connector which may be occasioned by forces upon wires soldered or attached to the individual contacts carried by the connector assembly. In the prior art, strain relief has been achieved in several ways. For example, strain relief members have been individually separately fabricated and subsequently attached to a plug housing. Strain relief members also have been molded as an integral part of the plug housing as a single unit. It can be seen that in the separate strain relief member fabrication method, an additional individual mold (if the members are molded) is needed for each desired connector dimension, and in the method in which the strain relief means are integrally molded as a part of the plug housing, the housings of different dimensions are already made in individual molds.

It is further desireable to be enabled to replace the connector in parts. Thus, in the prior art, if only a portion of the connector should wear-out, the entire connector assembly, including parts which may have additional life within them, must be replaced. This disadvantage is particularly significant in testing environments in which the connectors used with the testing apparatus are repeatedly plugged and unplugged, especially with pointed or sharp mating pins, which have a tendancy to wear-out primarily only the initial contacting portion or face of the connector.

SUMMARY OF THE INVENTION

In light of the above, it is an object of the invention to present a connector or plug assembly in which the rows, each of a fixed number of contacts, can be easily added or deleted to achieve a matrix array of desired width dimension.

It is another object of the invention to present a plug or connector assembly in which a number of identical contact housings can be stacked to provide a facility for increasing the number of contact rows of the connector.

It is still another object of the invention to present a plug or connector assembly having a replaceable faceplate facility.

It is still another object of the invention to present a stackable connector housing and faceplate assembly which is easily connectable in stacked relation to similar connector and faceplate assemblies.

It is yet another object of the invention to present a plug or connector assembly which can be fabricated from single action molds.

It is yet another object of the invention to present a connector or plug assembly which is fabricated from a plurality of connector housing units of identical construction, and which has a pair of strain relief members

to engage wires or conductors running to the individual contact of the plug or connector assembly.

It is another object of the invention to present a plug or connector assembly which can be modified to present any number of rows of a common number of connectors.

These and other objects, features, and advantages will become apparent to those skilled in the art from the following detailed description when read in conjunction with the accompanying drawing and appended claims.

The invention, in its broad aspect, presents a plug or connector assembly which includes a plurality of side-by-side housings each having a plurality of contact receiving holes therein. The number of side-by-side housings utilized determines the width of the matrix to which the connector presents. A plurality of faceplates, corresponding to the number of housings are included, each faceplate overlying a corresponding one of the housings, and having contact access holes therethrough. Screw means secure the housings and faceplates in the side-by-side and overlying positions.

The housings and overlying plates are each molded. Each of the housings have a strain relief means molded as an intregal part thereof, which is removeable, if desired, from the housings intermediate the first and last, to present a pair of complimentary strain relief means on the first and last housing to engage wires or conductors running to the individual contacts of the connector assembly.

In another apsect of the invention, the method of fabricating a connector assembly is presented. In the method, a plurality of housings are provided, each having a plurality of contact receiving holes or channels therein. The housings are located in a side-by-side relationship, and a plurality of faceplate members, each having contact access holes therethrough are located upon respective one of the housings. The housings and faceplate members are then secured in the located positions.

BRIEF DESCRIPTION OF THE DRAWING

The invention is illustrated in the accompanying drawing wherein:

FIG. **1** is a front elevation of a panel having a number of different pin matrix array configurations, illustrative of the type of environment in which the connector, in accordance with the invention, can be employed.

FIG. **2** is a side view of a portion of the panel of FIG. **1** showing two pin members and electrical connections thereto.

FIG. **3** is a perspective view of an exploded connector assembly, in accordance with the principles of the invention.

FIG. **4** is a cut-away portion of a part of the connector assembly of FIG. **3**, showing a single contact element located within one of the contact holes of the one of the connector housings.

And FIG. **5** is a side view of the located contact element within the hole of the housing, of FIG. **4**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As mentioned above, the connector assembly in accordance with the principles of the invention, is particularly useful in conjunction with plug or pin assemblies of different matrix dimensions. For example, in FIG. **1**, a panel **10** is shown on which a number of male plug or pin matrices are presented. The pin matrices each have the same number of pins in each row, but each of the matrices may have a different number of rows. For instance, the matrix **11** has one row of six pins, matrices **12** and **13** have two rows of six pins, matrix **14** has three rows of six pins, matrices **15** and **16** have four rows of six pins, matrix **17** has five rows of six pins, and matrices **18** and **19** have six rows of six pins. Other matrices of any number of rows of six pins (or other convenient number of pins per row) may be located at positions indicated generally by the dots **22.**

Each of the pin matrices can be fabricated by well known techniques. For example, as shown in FIG. **2,** a pair of pins **25** and **26** which form a part of one of the matrices of FIG. **1,** extend through an insulating substrate **27,** with appropriate electrical connection being made by wires **28** and **29** soldered or otherwise connected to pins **25** and **26.** The wires **28** and **29** are connected to any appropriate electronics, for example, to other pins, resistors, transistors, or other separate apparatus, as may be desired.

Thus, it can be seen that to effect connections to the pins of the matrices **11–19,** a plurality of plug or connector assemblies of various matrix dimensions are required. It is toward achieveing this goal, that is, to present an assembly formable into a plug or connector assembly of the desired matrix configuration, that the present invention is directed, although it should be emphasized that the connector assembly, in accordance with the invention, can be equally advantageously employed in other environments in which connection is to be made to any desired pin matrix, whether presented upon a panel, an individual plug, or otherwise.

With reference now to FIG. **3,** a connector assembly **35** is shown, partially exploded, which, upon assembly, presents a matrix of 4×20 individual contacts. The contact assembly **35** includes four identical contact blocks or housing **37, 38, 39** and **40,** which are arranged side-by-side in the stacked configuration shown. Each of the housings **37–40** has a number (**20** being illustrated) of side-by-side channels or apertures, such as the apertures **42** shown in the housing **37,** extending from the top face **44** to the bottom face **45,** each to receive a contact member, as below described in detail. The housings **37–40** are formed of an electrical insulation material, moldable plastic being particularly well suited.

Each of the housings **37–40** has a pair of fins or planar wing members extending outwardly from opposite ends to facilitate interconnection between the adjacent housings, and the faceplates located thereon, as below described. For example, the housing **37** has wings or fins **48** and **49** thereon, the housing **40** has wings or fins **52** and **53** thereon, and the intermediate housings **38** and **39** likewise have fins or wings, wings **56** and **57** being visible in the perspective view of FIG. **3.**

At the bottom face of each of the housings **37–40** are tab portions, for example, tab **60** on housing **37,** of width equal to that of the housing from which it extends. Similar tabs are located at opposite ends of the housings, as can be seen upon housing **40,** having tabs **61** and **62** at opposite bottom ends thereof. Each of the tabs upon the respective housings has a hole therethrough, such as the hole **65** through the tab **60** on housing **37,** to receive shaft of a screw to enable the side-by-side arranged or stacked housings to be fas-

tened togehter. For example, in the embodiment illustrated, the shaft **68** of the screw **69** extends through the hole **65**, and through the respective holes of the tabs of the intermediate housings **38, 39** and **40**, to secure the housings in their side-by-side or stacked relationship. Likewise, the shaft (not shown) of the screw **71** extends through the holes of the opposite tabs to secure the opposite ends of the housings **37–39.**

A hole, such as the holes **73** and **74** in the wings **48** and **49** of the housing **37**, is formed at the top portion of each of the wings extending from the ends of the housing **37–40.** The holes in the upper portions of the wing, similarly receive the shaft portion of a screw or other fastening means, as below described, to further maintain the side-by-side or stacked relationship of the housings **37–40.**

Located over each of the housings **37–40** is a respective top or faceplate member. In the embodiment illustrated, faceplate members **77, 78, 79,** and **80** are located respectively over housings **37, 38, 39,** and **40.** The faceplate members **77–80** each are of an insulation material, preferably plastic, or the like, and includes a number of holes **82** in an elongated planar portion, formed to align coaxially with the holes **42** in the housings upon which the faceplate member is located. Thus, the holes **82** provide access to the individual contact members located within the apertures or channels **42** within the respective housing.

The ends of the faceplate members **77–80** are formed into a "J" configuration, as shown by the end members **85** and **86** of the faceplate member **77.** Slots or channels **88** and **89** are provided in the "J" shaped members **85** and **86** to receive therewithin the fins **48** and **49,** respectively, of the housing **37** upon which the faceplate member is located. Similar "J" shaped members and slots are provided at each end of the faceplates **78–80** overfitting the respective fins of the housings upon which they are located. The width of the faceplate members **77–80** are approximately equal to the width of the housings on which they are located. Thus, the edges of the "J" shaped members at the ends of the faceplate members are juxtaposed to provide a tight fitting contact between the side-by-side or stacked housings. Additionally, the shaft of the screw located within the upper holes of the outstanding wings fits within the "J" shaped members, as shown, to maintain the location of the faceplate members **77–80** in their located positions. Thus, as can be seen, the shaft **90** of the screw **91** fits through the holes of the respective wings **52, 57, 56,** and **48,** and additionally engages the "J" shaped members of the faceplate members **80, 79, 78,** and **77.** Likewise, the shaft portion **100** of the screw **101** is located through corresponding holes in the wings opposite those above mentioned, and engages the "J" shaped portions of the faceplate members at the opposite sides. Thus, nuts **105, 106** and **107** can be threadably secured onto the shaft **90, 68,** and **100** (the nut for the screw **62** is not shown) to secure the housings **37–40** and faceplates **77–80** in their respective side-by-side and located positions.

Additionally, each of the housings **37–40** has formed at the bottom portion thereof a strain relief means, such as the members **110** and **111** illustrated. Each of the strain relief members **110** and **111** are molded at an integral part of the respective housing, and is attached thereto by tabs, for example, tabs **115, 116,** and **117,** attaching housing **110** to housing **42** its strain relief member **110.** Thus, in the fabrication of the contact assembly of desired matrix dimensions, such as the **4** × 20 matrix llustrated, the strain relief members of the intermediate housings **38** and **39** can be cut or removed at the tab portions corresponding to the tabs **115, 116,** and **117,** of the strain relief member **110.** The strain relief members **110,** and **111,** therefore, can be rotated towards each other in the direction of the arrows **120** and **121,** respectively, to ultimately come together and retain therebetween the wires or conductors (not shown) attached to the individual contacts (not shown) within the holes or apertures **42** of the housings **37–40.** It should also be noted that since the housings **37–40** are identical and symmetrical, it is necessary to reverse one or the other of the outside housings **37** or **40,** whereby the strain relief means **110** and **111** will be of mutually complimentary configuration to properly engage the conductors or wires to be positionally maintained thereby. The strain relief members **110** and **111** can be held in their wire or conductor maintaining relationship by bolts or screws (not shown) located within holes **130.**

With reference to FIGS. **4** and **5,** the interior construction of the holes or apertures **42** of the housings are shown, partially cut-away, with a contact member **140** located therewithin. The apertures **42** are formed within the housing **143** with shoulders **144** and **145** in the front aspect of FIG. **4,** on opposite sides of the aperture **42.** Likewise in the side aspect of FIG. **5,** shoulders **147** and **148** are provided. In the side apsect shown in FIG. **5,** additional horizontal shoulders **150** and **151** are provided. Thus, a contact **140** which can be, for example, of a stamped and formed single piece of a conductor material, can be inserted directly into the aperture **42.** To secure the position the contact member **140** within the aperture **42,** tangs **155** and **156** are provided on opposite sides of the contact **140.** The tangs **155** and **156** engage the inwardly extending shoulders **150** and **151** on the contact housing upon insertion of the contact **140** into the aperture **42,** thereby preventing its undesired withdrawal. Additionally, tangs or tabs **160,** 161, 162, and **163** are formed, such as by stamping a triangular portion outwardly, as shown, to engage the shouldered portions **145, 147, 144,** and **168,** respectively, of the housing thereby to limit the upward movement of the contact **140** within the channel **42.**

The faceplate member **170** is located upon the housing **143,** in the manner above described with reference to FIG. **3.** Each of the apertures **42** has an essentially truncated conical configuration, presenting walls **171** inwardly sloping to facilitate the insertion of a male contact pin and to direct it to within the female contact **140** within the aperture **42.** Additionally, a truncated conical or pyramidal shoulder portion **172** is provided on the underside of the hole **82** in the faceplate member **170,** extending partially within the opening **174** of the female contact **140** to provide stability of the contact **140** within the aperture **42.**

As mentioned above, each of the portions of the connector assembly **35** can be easily fabricated by molding in a single mold. For instance, the housings **37, 38, 39,** and **40,** of identical configuration, can be molded in a single mold, and, additionally, the faceplate members **77–80,** of identical configuration, can also be molded in another single mold, then the entire assembly fabricated to the desired matrix dimensions, as above described. Furthermore, it should be emphasized that the

housings **37–40**, can each be fabricated in a one or single-action mold by fabricating the strain relief member thereon at a right angle to the general plane of the housing, as shown in FIG. **3**. By molding the strain relief means at such right angle, the holes **130**, as well as the general features of the strain member **110**, can be easily created.

After the individual, identical housings and faceplates have been molded, as above described, they can be assembled to present the desired matrix array dimensions merely by stacking or arranging the desired number of housings and faceplate combinations. Thus, to form an array of 2×20, two housings and two faceplates can be attached together in a manner similar to the construction of the assembly of FIG. **3**. Likewise, if more rows are needed, the appropriate number of additional faceplate and housing combinations can be added by just placing them upon the screws as shown.

Furthermore, if, after considerable use, one or more of the faceplate portions of connector assembly becomes worn, for example, through frequent contact with sharp pins of the pin matrix, the worn faceplates can be easily replaced simply by removing the two screws at the top of the connector assembly, such as the screws **91** and **101** of the assembly **35** in FIG. **3**, removing and replacing the worn faceplate members, and reinserting the constraining screws.

Although the invention has been described and illustrated with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

I claim:

1. A connector assembly comprising:

a plurality of side-by-side housings each having a plurality of contact receiving holes therein;

a plurality of faceplates each overlying and engaging a corresponding one of said housings and having contact access holes therethrough;

means engaging said housings and faceplates for coupling each of said faceplates and its said corresponding housing and securing said housings in side-by-side positions; and

strain relief means attached to at least two of said housings moveable to a position adjacent each other to retain therebetween conductors running to said contacts.

2. A connector assembly for carrying a matrix array of electrically conducting female contacts comprising:

a plurality of side-by-side housings, carrying said contacts in said matrix array; and

a plurality of individually removeable faceplates, each fastenable to a respective one of said housings and having holes therethrough located to align with said contacts carried by its said respective one of said housings;

each of said plurality of housings being of insulative material and of identical configuration and each of said plurality of faceplates being of insulative material and of identical configuration; and

each of said housings further comprising a strain relief member integrally and removeably attached to a portion of said housing away from said faceplate.

3. A connector comprising:

at least two molded rectangular blocks of electrically insulating material placeable adjacent each other to form a stack, each having a plurality of holes, normal to the direction of stacking, and each for receiving therewithin an electrically conducting female contact,

each of said at least two blocks further comprising:

a pair of fins outstanding from opposite ends thereof, each having a screw receiving hole therethrough,

and a strain relief member adapted to be selectively separated from said block, whereby when the strain relief members of said blocks intermediate the ends of the stacks are separated from their respective blocks, the strain relief members upon the blocks at the ends of the stack are positionable to engage a wire bundle located therebetween,

at least two molded top members each locatable upon a respective one of said at least two blocks, each of said at least two top members comprising:

a planar member extending over the block and having a plurality of holes therethrough aligned with the contact receiving holes in said block,

a plurality of shoulders each adjacent a respective one of said holes in said planar member to extend partially into the aligned hole in said block to a position adjacent and inserted contact to maintain its axial position,

two pairs of fin engaging members, each located at an end of said planar member separated from each other to receive therebetween a fin of said block upon which said planar members located, and having a recess to align with the screw receiving hole in said fin, whereby a screw can be inserted into said hole in said fin and said recess in said engaging members to hold said planar member in position and to maintain the blocks in their stacked relationship.

4. The method of fabricating a connector assembly comprising:

providing a plurality of housings each having a plurality of contact receiving holes therein and a strain relief member integrally and removably attached to a side of each housing;

removing from each of a given group of one or more housings the strain relief member of each of said given group; locating the housings of said group of housings side-by-side;

locating on each end of said side-by-side group of housings one of said housings having a strain relief member attached thereon;

locating a plurality of faceplate members having contact access holes therein upon said side-by-side housings; and securing said housings and said faceplate members in said located positions.

* * * * *