Sept. 12, 1967 O. C. JOACHIM 3,341,806

CONNECTOR DEVICE

Filed Oct. 23, 1965 3 Sheets-Sheet 1

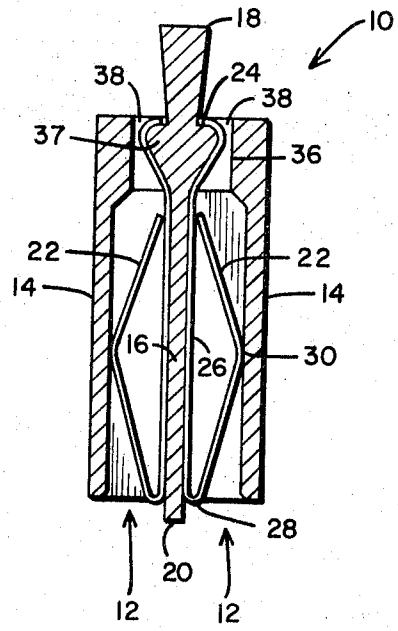


Fig. 1

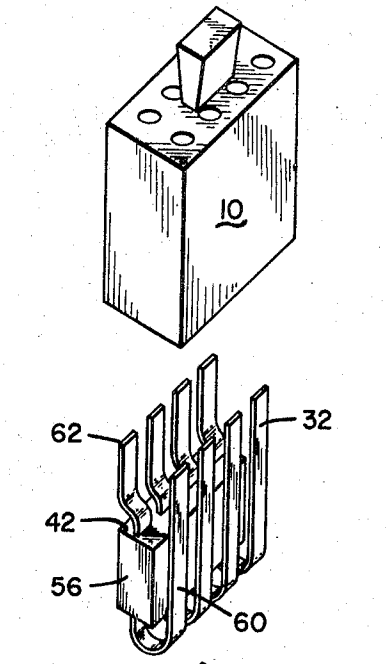


Fig. 2

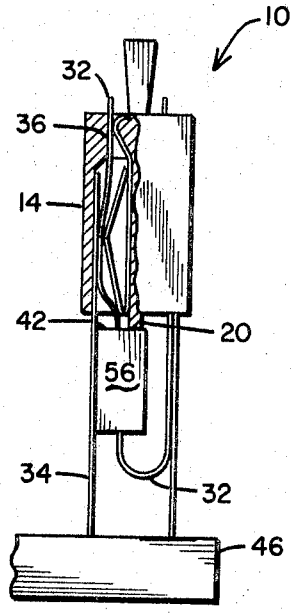


Fig. 3

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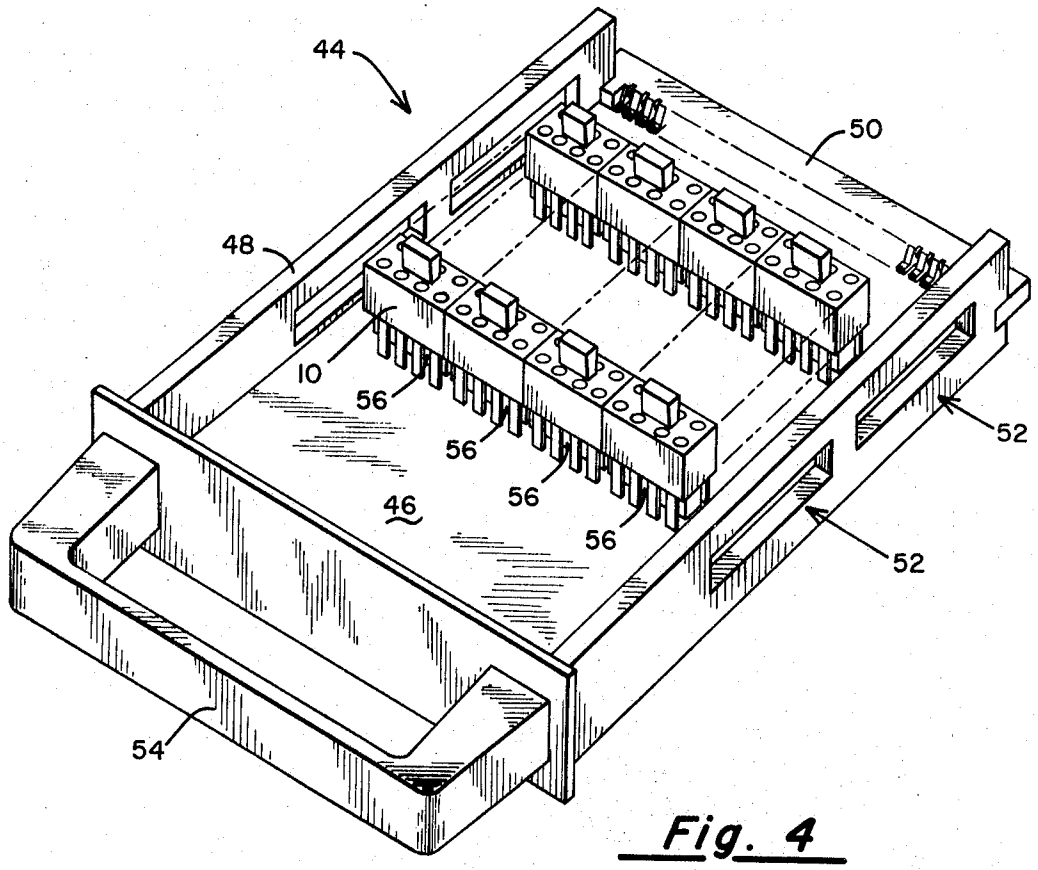


Fig. 4

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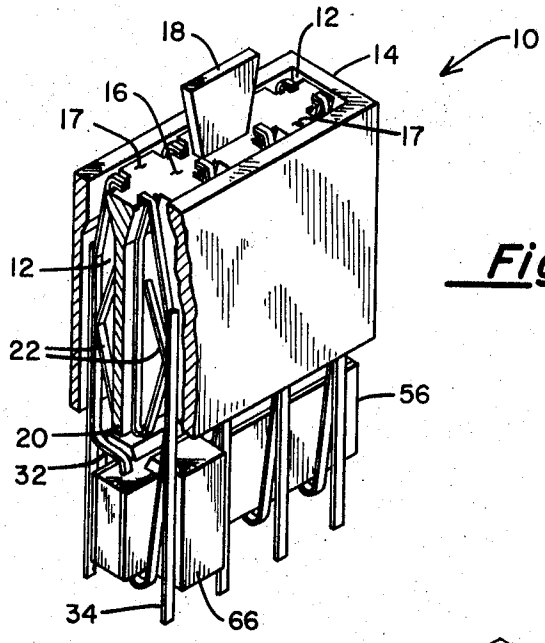


Fig. 5

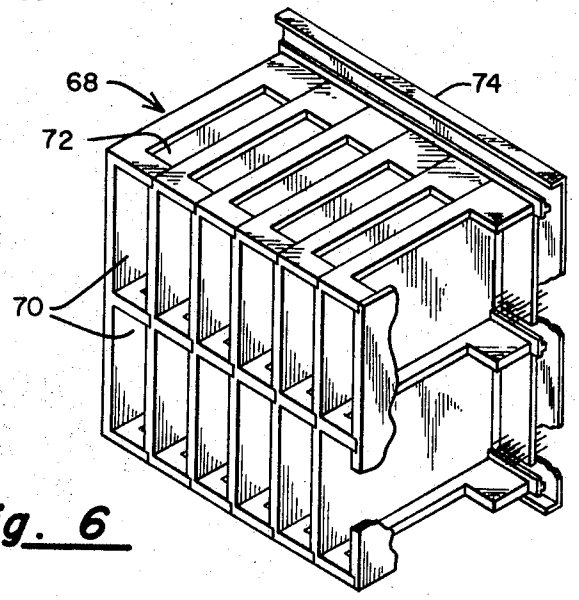


Fig. 6

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CONNECTOR DEVICE

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ABSTRACT OF THE DISCLOSURE

An electrical connector device and a modular grouping thereof for providing electrical interconnection between circuit elements is described. Each of the connectors mount therein spring contact elements for receiving and maintaining in contact the respective electrical circuit leads. A connector housing contains rows of mutually insulated multi-apertured spring contact areas. Leads extending from the circuit element extend into the respective cavity areas, and are maintained in contact with each other as a result of the application of spring contact force exerted by the internally mounted resilient spring members.

The present invention is directed to an electrical connector device and a modular grouping thereof for providing electrical and mechanical interconnection between electrical circuit elements.

More specifically, the present invention is directed to an electrical connector device and assembly and a modular arrangement thereof, with each of the connectors mounting therein spring contact elements for receiving and maintaining in contact with each other electrical circuit means. The connector housing contains rows of mutually insulated multi-apertured spring contact areas. Leads extending from circuit elements extend into the respective aperture or cavity areas and are maintained in mechanical and electrical contact with each other as a result of the application of contact force exerted by internally mounted resilient contact members.

Prior art electrical connectors are of such nature that the leads between electrical circuit elements are soldered together to provide electrical and mechanical interconnection. The disadvantage of this structural arrangement lies in the fact that the soldered junction areas must be mechanically desoldered in order to permit replacement of certain of the electrical circuit elements. The present invention overcomes the deficiencies of the prior art by permitting the insertion of a connector assembly which applies spring contact force to the leads of the various circuit elements in order to maintain connection therebetween. For replacement purposes, the connector assembly may be removed from the lead elements and the defective part change made with facility.

FIGURE 1 is an end view in section of the connector device portion of the present invention.

FIGURE 2 is an exploded view of the connector device portion of the present invention shown with the circuit leads which it maintains in electrical and mechanical contact.

FIGURE 3 is an assembled view of the connector assembly together with the circuit leads shown in FIGURE 2.

FIGURE 4 illustrates an arrangement mounting an array of connector assemblies on a pluggable module.

FIGURE 5 is a partially sectioned isometric view of the connector assembly of the present invention.

FIGURE 6 represents a housing configuration adapted to receive the modules illustrated in FIGURE 4.

Referring to FIGURES 1 and 5, the connector **10** contains parallel rows of individual cavity areas **12** defined by walls including outer walls **14** and common central

wall **16** of the housing separating the rows of cavities. Along the common central wall portion **16** integral therewith and transversely projecting therefrom are a plurality of rib wall portions **17** at spaced intervals which insulatively separate the individual cavities along a row. As shown in the figure, the ribs form T-shaped extensions with the central wall **16**. That is, as shown, the ribs in each row are aligned across the central wall. However, no intention is made in the present invention to an arrangement where the rib are spaced so as to define cavities of one row directly aligned across the central wall with respective cavities of another row. A staggered arrangement from one row to another could as well be accommodated without departing from the scope of the invention. As well, the cavities need not be of the same size. Integral with wall **16**, and projecting upwards therefrom, is an extension **18** forming a handle means to facilitate handling of the connector. Extending from a diametrically opposite surface of the wall **16** and integral therewith is another extension **20** functioning in the manner to be described below. Each of the apertures or cavity areas **12** has mounted therein continuous elongated spring contact elements **22** disposed therein in such a manner as to maintain contact between electrical circuitry leads **32** and **34** (see FIG. 2) received in the cavities between the elements **22** and outer walls **14**. The spring contact elements **22** are constructed of a suitable spring-like material capable of flexing to permit insertion of the leads of electrical circuitry elements intended to be maintained in contact. A first terminal portion **24** of a representative spring contact element has a bight as shown in FIGURE 1 in order to preclude displacement of the spring element in the cavity. Bight **24** may be affected by crimping, for example. Portion **26** of the spring contact extends substantially parallel to and in contact with the central wall **16**. The spring element has a bight at **28** exposed at the cavity opening as shown and another bight at **30** which functions as a pressure point against the leads. A second terminal portion extending back up into the cavity including the pressure point **30** resembles a V-shaped configuration. The electrical leads of a circuit device **56** are inserted into their respective cavities in the connector **10** and are disposed such that the leads project entirely through the top surface of the connector as shown in FIGURE 3. Subsequently, the leads are crimped over the terminal portion **24** of the resilient contacts. The extent to which the leads are inserted through the cavities is limited by the projection **20** on the connector central wall corresponding to the cavity side which abuts the surface **42** of the circuit device **56**. As a result, the circuit device **56** and connector form a single unit or assembly inasmuch as crimping of the leads precludes removal of the circuit device from the connector. This feature has significance in relation to assembly time requirements for inserting the connectors over the leads **34**. The devices **56** and connectors may be preassembled and set aside until needed. When ready for use, the connector assembly is inserted over the leads with which electrical interconnection is desired. Likewise, it is evident that the assembly facilities replacement of a faulty device **56**. Since the connector can be produced economically, it along with the attached device **56** permits pulling of the assembly from the circuit leads **34** for discarding. Referring back to FIGURES 2 and 3, it can be seen that the pressure point **30** applies force in order to maintain contact between the circuit leads inserted into the respective cavities **12**. When leads **32** from the circuit device **56** are inserted through the cavities, the spring contact elements **20** are deflected in an accommodating manner. Then upon insertion of the connector assembly, the contact elements **20** are further deflected. External walls **14** have a raised portion or shoulder **36** which is well illus-

trated in FIGURE 3 and will be described below. An inclined surface of the shoulder **36** serves to guide the leads **32** up and through the opening **38** while serving at the same time to limit the extent to which the connector assembly may be inserted over the leads **34**. That is, with both leads **32** and **34** projecting into the cavity area **12**, the amount of available space within the cavity is reduced. Accordingly, since lead **34** will be guided along the outside housing wall **14**, it will contact the leading projecting or leading edge **36** and limit the downward movement of the connector. The openings **38** are only sufficiently large to accommodate the leads **32**. Therefore, when leads **32** project through the openings, leads **34** will be maintained in substantially vertical relationship since leads **32** cannot be displaced horizontally. As a result, leads **34** will abut the leading edge **36** which functions therefore as a stop means and as a result causing cessation of insertion of the connector by the operator. Referring in greater detail to FIGURE 1, it can be seen that central wall **16** has integral therewith hip surfaces **37** around which curve the terminal portion **24** of the spring contact elements. The hip may have a gradual curve or a sharp corner. No limitation as to a curved surface is intended. As described above the contact elements are crimped at the upper portion **24**. As a result the terminal portion conforms to the hip-like surface curvature **37**. As is evident from the figure, the cavity opening **38** is reduced by the hip surface **37**, the contact element terminal portion **24**, and shoulder **36** to permit a just sufficient opening for lead **32** from the circuit element **56**. As is evident from the drawings, bight **30** of the spring contact element serves as a pressure point forcing the leads **32** and **34** in contact with each other. The spring contacts **22** deflect in the manner shown in FIGURE 3 when the leads are inserted into the cavities **12**.

Referring to FIGURE 5, there is shown a generally U-shaped guide element **66** which is adapted to clamp around a portion of the circuit device **56**. The function of the element is to guide the connector assembly (connector **10** with device **56**) down over the leads **34**. The guide occupies most of the available space between adjacent leads **34** such that same are accurately aligned with cavities **12**. In the absence of the guide, possibility of damage to the leads **34** or to the connector assembly may result from misalignment and consequent jamming of the various leads. FIGURES 2 and 3 are not shown with the guide element for clarity reasons; however, the circuit devices **56** therein illustrated will contain the guide element. As an alternative to a separate element snapped over the housing of the device **56**, the guide could as well be fabricated to contain integral therewith the guide feature.

By way of reference to FIGURE 4, there is shown in detail a module **44** incorporating a plurality of connector assemblies. In order to maintain clarity, only several of the connectors have been illustrated; however, it is to be understood that any number may be accommodated in the module. Module **44** has mounted therein a circuit board **46** within frame member **48** which may be removed and replaced as desired. A connector member **50** secured in a suitable manner to one end of the frame and electrically interconnected with the circuit board and circuitry elements thereon and with a back panel connector is adapted to be inserted into corresponding pins of a male connector associated with the back panel which is in turn electrically connected to external circuitry. Frame member **48** contains air vents or air passages **52** to permit circulation of a cooling medium around the circuit elements disposed below the connector elements **10** of the circuit board **48**. The frame **48** is provided with a handle **54** to facilitate insertion and removal of the modules from the back panel connection. Although the single module has been illustrated, it is to be understood that a plurality or group of modules may as well be utilized to provide, for example, a compact arrangement for the circuitry. As shown in FIGURE 6, a housing **68** is adapted to receive within the individual compartments **70**, the modules as above described and shown in FIGURE 4. The housing contains openings **72** for permitting circulation of the cooling medium passing through the modules as earlier described. The rear of the housing forms the aforementioned back panel having secured thereto a plurality of mole pin connectors **74**, with those leads projecting into the compartments **70** being received by the female connector **50** of the module in FIGURE 5. The oppositely extending pins may be wire wrapped for the external circuit connections. As is evident, the modules **44** are inserted into the compartments **70** and make electrical contact with the above mentioned male pins from the back panel connector. The modular arrangement provides a compact arrangement of electrical circuitry connections which greatly facilitates replacement and checking operations.

Referring to FIGURE 2, the terminal portion **24** of the spring contact elements, projecting through openings **38**, provide another feature of the present invention. By exposing the terminal portions, tests of the circuit may be effected without removing the connector itself. Test connections may be made at the terminal portions with facility, the apparent advantage of external testing being that it precludes breaking electrical contact between the circuits to be tested in the system.

Summary

To provide the specific electrical function that the present invention is to perform, the integrated circuit device **56** corresponding to the desired electrical function is located or disposed between the riser leads **34** projecting through the circuit board **46**, with each of the leads of the device extending substantially parallel and in contact with the riser leads **34**.

The method by which the riser leads **34** are fabricated through the circuit board is well known in the art and requires no explanation. The riser pin leads may be arranged in pairs of parallel rows as illustrated in FIGURE 4; however, no intention is made toward such limitation. As is evident from the figure, a plurality of circuit devices **56** are disposed between two rows of riser pin leads. Assuming for the moment that the devices are flat packaged integrated circuit chips, the leads from the package are bent as shown in FIGURE 2 so as to be aligned with the riser pin leads and extend in the same direction. Accordingly, the circuit in FIGURE 2 would continue through lead **58**, input lead **60** of the device, output lead **62**, and through riser pin lead **34***a* in the circuit board to the other circuitry in the system. It is to be understood that a single connector can be made to contain as many lead receiving cavities as desired, that is, there is no restriction placed on the physical size of the connector other than its size limitations for the specific application in the module. It is also to be understood that the connector may be utilized wherever circuit interconnections are to be made. In order to provide the electrical and mechanical junction between the circuit element leads from respectively the device and the riser pins, the electrical connector assembly is inserted over the riser leads so as to receive the leads in apertures **12**. By forcing the connector down over the leads, the electrical and mechanical junction between the leads is created as a result of the pressure point **30** of the spring contact elements forcing the leads in contact with each other. The extent to which the connector assembly is inserted over the leads **32** is determined by the projection **20** at the bottom portion thereof which in its ultimate excursion abuts the side of the integrated circuit element. Where external testing through the terminal portion of the spring contact elements indicates that a faulty circuit device is present in the circuit, the connector assembly is merely removed

from the leads 34 and the assembly replaced with another.

No intention is made to restrict the present invention to a particular configuration for the modular concept or to the number of cavities or the physical configuration thereof.

It is understood that suitable modifications may be made in the apparatus as disclosed provided that such modifications come within the spirit and scope of the appended claims. Having now, therefore, fully illustrated and described my invention, what I claim to be new and desire to protect by Letters Patent is set forth in the appended claims.

What is claimed is:

1. A connector assembly comprising: housing means having upper and lower portions and containing a plurality of rows of mutually insulated cavities for receiving circuit leads, said housing means including a common central wall having ribs projecting from both sides along the length thereof for forming rows of said cavities between adjacent ones of said ribs, said central wall further including hipped projections near said upper portion thereof extending into the respective ones of said cavities for forming an opening of said cavities at said upper portion of smaller dimension than an opening at said lower portion, and an external lateral wall encasing said ribs, said external lateral wall thereby forming one wall of each of said cavities wherein the cavity side of said external wall forms a shoulder projection in each of said cavities near said smaller dimension opening facing said hipped projection; resilent contact means disposed within selected ones of said cavities, each of said resilient contact means including a curved terminal portion conformed to said hipped projection and exposed externally of said housing, a substantially uncurved central wall portion lying parallel to and in contact with said central wall, and a substantially V-shaped terminal portion curved back up into the respective one of said cavities wherein a portion of said V-shaped terminal forms a pressure point for maintaining the circuit leads in contact.

2. The invention of claim 1 wherein a portion of the contact members are externally exposed at the receiving end of the cavities.

3. The invention of claim 2 wherein a plurality of removable connectors are disposed on a module, said module comprising:

(A) a frame member containing openings for permitting circulation of a cooling medium;

(B) a circuit board removably mounted in said frame member;

(C) a connector means disposed at one end of said circuit board and frame member;

(D) rows of riser circuit leads projecting transversely through said circuit board;

(E) logic elements disposed between said rows and having leads substantially in alignment with the riser circuit leads but having a greater length than the riser leads whereby said connector cavities receive said riser leads and element leads which are maintained in electrical contact by the resilient members.

4. A connector assembly as in claim 1 wherein said central wall includes a positioning surface extending below said lower portion for positioning circuit means.

5. A connector assembly as in claim 4 and further including in combination circuit means having a plurality of contact circuit leads arranged in selected ones of said cavities in electrical contact with said resilient contact means, said circuit means positioned at least in part by said positioning surface.

6. A connector assembly as in claim 5 wherein said circuit means is positioned between adjacent rows of said insulated cavities.

7. A connector assembly as in claim 6 wherein said contact circuit leads extend through said smaller dimension opening of said selected cavities beyond said upper portion, the extended ends of said contact circuit leads being bent over the edge of said upper portion to fixedly engage said circuit means to said housing means.

8. A connector assembly as in claim 7 and further including in combination circuit board means having a plurality of riser circuit leads arranged in rows and extending from one surface of said circuit board means, said riser circuit leads removably extending into said cavities to the respective ones of said shoulder projections, said circuit means being intermediate adjacent ones of said rows of riser circuit leads and intermediate said one surface of said circuit board means and said housing means, and the ones of said riser circuit leads and said contact circuit leads disposed within ones of said cavities maintained in electrical contact by associated ones of said resilient contact means.

9. A connector assembly as in claim 8 and further including guide means clamped on said circuit means for guiding adjacent ones of said riser circuit leads into predetermined ones of said cavities.

10. A connector for receiving and maintaining an electrical juncture conductive leads from electrical circuit members comprising: a housing containing a plurality of rows of mutually insulated cavities each having a lead receiving opening at a bottom surface of said housing larger than said cavity opening at the upper surface of said housing and mounted therein an electrically conductive contact member, said housing including a central wall containing along predetermined portions of the length thereof, rib portions extending at right angles therefrom, said ribs and said wall forming a cavity therebetween, and an outer wall laterally surrounding said central wall and rib portions; said central wall further having a hip projection in each of said cavities near an upper surface of said central wall, said hip projections partially restricting the openings of the cavities at an upper surface; and each of said contact members conforming along a portion thereof to the central wall and hipped projection.

11. The invention of claim 10 wherein each of said cavities contain along an outer wall portion an inclined stop shoulder for limiting insertion of predetermined ones of said circuit leads.

12. The invention of claim 11 wherein the conductive leads to be maintained in electrical junction comprise a first group of leads from a circuit device received in the respective cavities and projecting entirely through the cavity and terminating externally of the upper surface of said connector to form an assembly; a second group of leads being received in the respective cavities adjacent said first leads and between said first leads and the outer lateral wall, said second group of leads being received in the cavity to a point of contact with a projecting shoulder in each cavity integral with the lateral wall, said first group and second group of leads being maintained in electrical juncture by said contact members.

13. The invention of claim 12 including a plurality of connector assemblies mounted over predetermined ones of the second group of leads projecting from and through a printed circuit board mounted in a frame member forming a module, said frame member having secured to one end thereof a connector means whereby said module may be plugged into a module receiving electrical interface back panel, said panel being electrically connected to external circuitry.

14. A pluggable module for use with electrical apparatus comprising:

(A) a rectangular frame member having removably mounted therein a printed circuit board containing pairs of rows of electrically conductive riser leads extending transversely through said circuit board;

(B) a plurality of electrical circuit devices disposed between the leads of a pair of rows, said circuit devices having a plurality of electrical leads substan-

tially aligned with the riser leads, said electrical leads extending higher than said riser leads;

(C) a plurality of removable connectors, each containing a pair of rows of mutually insulated resilient electrical contact members mounted within individual cavity receiving areas, and being adapted to receive corresponding pairs of aligned ones of said riser leads and said circuit leads whereby said riser leads and circuit leads are maintained in electrical contact by said contact members;

(D) and a connector secured to said frame member at one end thereof having electrical connections to said circuit board to permit electrical interconnection of said module to external circuitry as a pluggable unit.

15. An electrical circuit module comprising:

(A) a frame member containing cooling medium passages;

(B) said frame member slidably receiving a printed circuit board;

(C) rows of electrically conductive riser leads projecting upwardly through said printed circuit board;

(D) electrical circuit elements disposed between rows

of said riser leads and having leads extending upward along said riser leads;

(E) and removably mounted connector means containing therein resilient contact means for maintaining associated ones of said leads and said riser leads in electrical contact.

References Cited

UNITED STATES PATENTS

2,505,979	5/1950	Martin.	
3,086,190	4/1963	Neidecker et al.	339—177
3,176,261	3/1965	Greco et al.	339—176
3,218,518	11/1965	Ashbridge et al.	317—101
3,289,048	11/1966	Allegretti et al.	317—101
3,293,590	12/1966	Woolsey, Jr.	339—192

FOREIGN PATENTS

1,078,627	11/1954	France.

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