Dec. 26, 1967 P. T. HAURY 3,360,689

MODULAR PLUG-IN COMPONENT WITH IMPROVED SUPPORT ELEMENT

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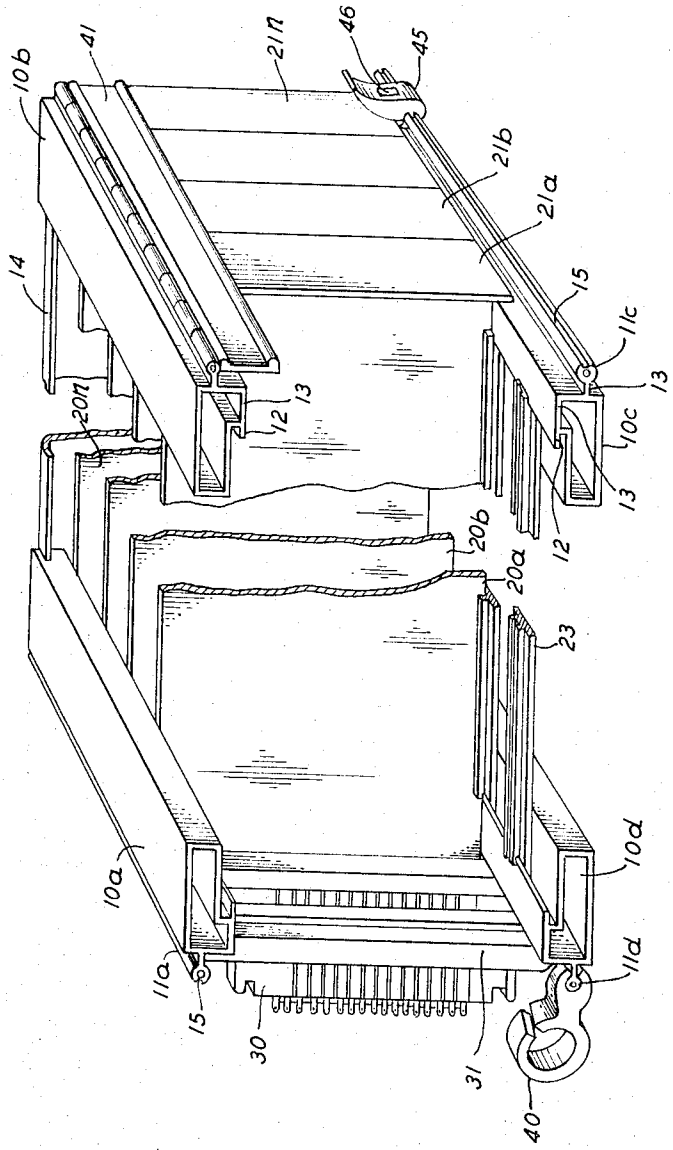


FIG. 1

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FIG. 2

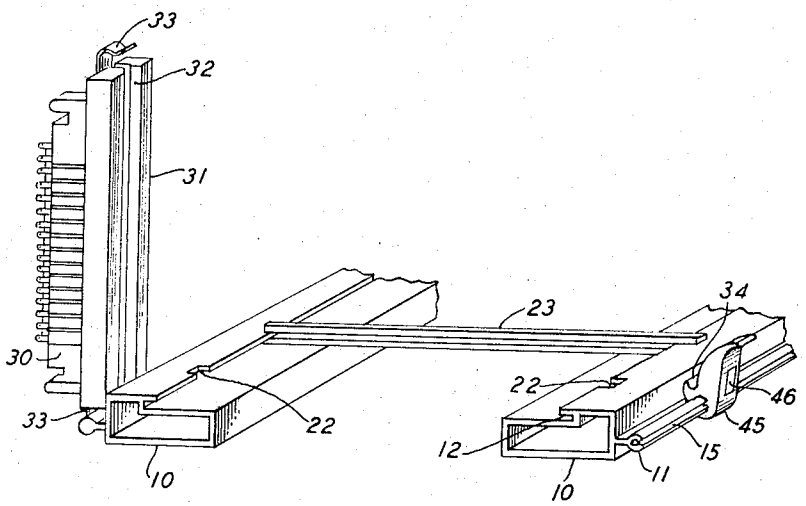
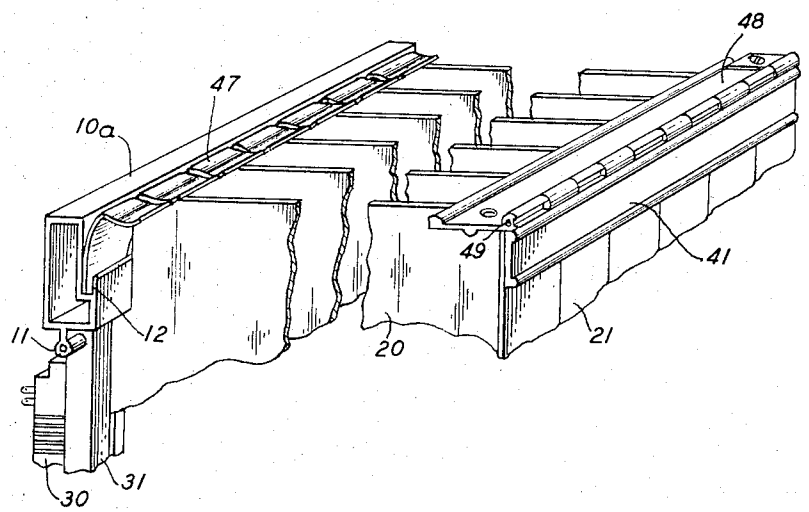



FIG. 3



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3,360,689

# MODULAR PLUG-IN COMPONENT WITH IMPROVED SUPPORT ELEMENT

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## ABSTRACT OF THE DISCLOSURE

The modular structure for printed circuit boards includes elongated members with cantilevered beads and undercut lip portions for retaining spring clips which hold the circuit boards in assembled relationship. A card ejector element is disposed on a cantilevered bead and performs the function of facilitating easy removal of a printed circuit card.

This invention relates generally to apparatus for supporting plug in circuit board components of electrical systems, or the like, and more particularly to simplified modular hardware from which a great variety of different structures may be assembled. The principal object of the invention is to reduce the number of different hardware members that must be stocked for a reasonably large variety of support assemblies.

A large electrical equipment installation, packaged for the most part as a collection of printed circuit cards, generally requires a variety of racks and enclosures, of different sizes and configurations, for containing the cards. As a result, a large stock of different mounting equipment must be available, both during initial construction and for subsequent maintenance and modification. Moreover, since various accessories are often used with certain members of a modular structure, e.g., cable clamps, card ejectors and the like, a stock of equivalent members must be maintained to accommodate such elements. Even if an entire electrical installation is to be manufactured at one location for delivery, in completed form, to the ultimate user, a reduction in the number of different structural elements used in fabrication is desirable.

These diverse requirements are, in large measure, met with the modular hardware apparatus of the present invention. According to the invention, an elongate member is uniquely shaped so that it may be used in the construction of a large variety of different structures. The member, characterized by a substantially rectangular cross section with a rounded bead cantilevered along one of its narrow faces and an undercut lip along one of its broad faces, constitutes stock for all of the major support members of a structure. It is normally stocked in convenient lengths, cut to size, and assembled as required for a particular application. Its universality thus reduces inventory requirements. By altering the orientation of sections of the member, the bead may be exposed to support connector mounting sections, sliding card ejectors, fanning clips, door hinges and the like. The undercut lip may be used to receive flexible track-like card guides. Complete assemblies, in a large variety of different sizes and configurations, may thus be fabricated from a stock of the universal elongate member of the invention, and from a stock of cooperating accessories.

In practice, sections of the elongate member are secured in parallel spaced-apart relation to form a box-like structure. A preferred structure requires that pairs of parallel members be oriented with the undercut lips facing one another and with the cantilevered beads outwardly disposed. For a structure to support cards in the vertical



plane and with access from one side, one pair of members constitutes the top, front and back, of the structure; the other, the bottom, front and back, members. Hence, all slots face inward, all beads face outward. The lips are then preferably notched to receive flexible track members which bridge the facing bottom members to guide and hold circuit cards. The track members are conveniently formed of plastic with a slight longitudinal curvature. Hence, a slight convex platform is created by the track members in bridging the facing elongate supports. A circuit card slipped into the track is then frictionally held secure. Generally, the circuit cards are unframed boards of an epoxy material or the like.

Terminal receiving members with a sufficient number of electrical receptacles to accommodate the circuit card (the matching plug elements are generally printed on the card), are then bridged between the cantilevered beads of the top and bottom rear members. The receptacle members are aligned along the beads to match the track members, and locked to the beads with spring members or the like. Preferably, a support is used for the terminal receptacle which provides the bead receiving and spring lock action. The cross section of the support may then be shaped with a tapered throat to aid in guiding cards into a positive seat in the receptacle. This feature is especially useful for installations which do not use the track-like guide members.

Each circuit card is generally fitted with a face piece which abuts the edge of the card and supports external terminals, indicators, and so on, which must be readily available in the in-place position of the card. Removal of the card is ordinarily achieved by means of an ejector or handle associated with each card. In accordance with another feature of the invention, only one ejector is used for each frame of cards; the face piece of each card is unencumbered with ejector attachments. A sliding ejector member is, accordingly, accommodated by the cantilevered bead at the front of the support structure. It is held in place on the bead, for example, by a spring loaded ball detent which rides in a small groove cut longitudinally in the bead. In operation, the ejector is moved to alignment with the face piece of one of the cards, and then depressed to rotate about the bead as an axis. A finger portion of the ejector engages the face piece and withdraws it from the terminal receptacle to a point at which it may be conveniently removed by hand.

The features of the present invention, both with regard to construction and mode of operation, will be more fully apprehended from the following detailed description of an illustrative embodiment thereof, taken in connection with the appended drawings, in which:

FIG. 1 is a partial cutaway perspective view of a circuit card support arrangement constructed in accordance with the invention;

FIG. 2 illustrates in somewhat greater detail several elements of the support apparatus of the invention, and

FIG. 3 illustrates in a fragmentary perspective view an alternative arrangement of elements for supporting a plurality of circuit cards.

FIG. 1 illustrates a modular support structure for containing a plurality of printed circuit cards or the like. In accordance with a preferred form of the invention, a circuit card mounting system includes an arrangement of members **10** of unique cross section spaced apart in a box-like configuration to form the major supporting elements of the structure. Universal support member **10** has a generally rectangular cross section and is characterized by a rounded bead **11** which is cantilevered from its narrow face. Member **10** is further characterized by an undercut lip **12** supported on a riser portion **13** of the member. Each of the major support elements is thus identical in

basic cross section and each is equipped to accommodate a variety of different accessories and attachments. Because of this universality, only one form of major support member need be maintained in a stock of modular elements.

The dimensions of the lip width, the spacing of the lip from the major side wall of member **10** and, indeed, the overall dimensions of member **10** are largely a matter of choice. It has been found in practice, however, that a member with a side wall of approximately one and one-quarter inch, a depth at the beaded edge of approximately one-half inch, a depth at the other edge of approximately three-eighths inch, and a lip length of approximately one-half inch with an overhang of one-eighth inch is most suitable for assembling structures of convenient size. Bead **11** typically has a diameter of three-sixteenths of an inch and is supported by a cantilevered arrangement approximately one-quarter of an inch from the side wall. The bead preferably is provided with a small groove **15** running the length of the member and may be formed with, or subsequently drilled, to form an axially extending bore. Although member **10** may be formed of solid stock by casting, rolling, or a milling operation, it has been found advantageous to extrude the member from an aluminum melt. Relatively thin-walled members, formed by extrusion, are considerably lighter than the solid members and yet exhibit satisfactory structural rigidity.

In erecting the support apparatus, members **10***a*, **10***b*, **10***c*, and **10***d*, are aligned as shown in FIG. 1 and supported by end members (not shown) or between rack elements in any convenient manner. If desired, additional pieces of the stock of element **10** may be used for completing a box-like structure. However, in practice, it has been found convenient to employ side plates **14** secured to the ends of the structure. Spring clips or the like, formed on or attached to the side plates, which clip both the side plates and the interior walls of the extruded members, may be used. Similarly, wing sections may be formed on or attached to the side plates to facilitate assembly of the unit in a larger assembly.

The box-like frame is assembled in the fashion described above to accommodate a number of printed circuit cards $20_a$, $20_b$ . . . $20_n$. Typically, unframed epoxy boards are employed with a face plate **21** at one end and a printed circuit plug arrangement at the other. Each face plate **21** is proportioned to insure sufficient separation between adjacent boards, i.e., to insure adequate clearance for the board and the components attached to it. Although a vertical arrangement of boards as shown in FIG. 1 is commonly employed, a drawer-like arrangement of horizontal boards may of course be employed. Appropriate marks are made on the lips **12** of members **10** and the lips are notched at the indicated points. Notches **22** may be cut in the relatively thin-walled lip with any convenient cutting tool. Card guides **23**, formed preferably of extruded plastic such as nylon, are then cut to length and inserted in the notches **22** and under the lip. Guide members **23** are characterized by a flat bed and a pair of parallel rails longitudinally formed on the bed. By virtue of a slight curvature imparted to members **23** during extrusion, a slight bowing is provided which acts as a spring element in securing cards **20** in place, i.e., as a shock absorber. The several cards may then be inserted in the several tracks and securely held within the structure.

Terminal receptacle members **30**, of any desired design, are supported between members **10***a* and **10***d* to mate with the printed plugs on each of the circuit cards. A typical terminal receptacle member supported for assembly is shown in FIG. 2. Preferably, the receptacle element is strengthened by the longitudinal frame **31**, formed with a tapered throat **32**, which aids in guiding the circuit cards as they are inserted into the support structure. Throat **32** is particularly useful when the support structure is used without the benefit of guide tracks **23**. Frame **31** further supports a pair of spring members **33** which are shaped to engage beads **11***a* and **11***d* extending from members **10***a* and **10***d*. One such terminal assembly is snapped into blace between the beads in alignment with each circuit card. Appropriate connections may then be made to the plugs. Further, with a full frame of plugs, the arrangement is rigid and can withstand numerous changes of circuit cards without further adjustment.

By virtue of the exposed beads **11** at the edge of support members **10**, a variety of different accessories may be conveniently attached to the structure. For example, cable fanning loops **40**, one of which is shown in FIG. 1, may be attached to the bead to guide incoming leads to appropriate receptacle members. Similarly, hinged member **41**, formed with a bead which is bored to correspond to bead **11** on member **10***b*, may be attached at the front of the structure to act as a lock for the card members. Conveniently, sections of bead **11** on member **10***b* and the corresponding bead on member **41** are removed, the two members engaged, and a shaft inserted through the bore of the coupled bead sections to form a piano-type hinge, preferably of the tight joint variety. Thus, when placed in the upward position, member **41** stays in that position and cards may be readily inserted and removed from the structure. When placed in the downward position, the member is relatively tight and acts to prevent accidental disengagement of the cards, particularly in a vibration-prone environment. If desired, a positive lock may be achieved by providing retainers at each end of member **41**. For convenience, labels containing circuit board identification, instructions or the like may be placed on either the front or back of the face (or both) of hinge member.

To facilitate the removal of each individual card, it is in accordance with the present invention to provide a sliding ejector member **45** slidably affixed, in the illustrated structure, to bead **11***c* of member **10***c*. Ejector **45**, as shown in FIG. 2, comprises a generally S-shaped member with a hook facing member **10**. A ball detent is urged into the axial groove **15** of bead **11***c* by spring **46** so that, in the rest position, the ejector is held in the upright position. To withdraw a circuit card, ejector **45** is moved along bead **11** to alignment with the card to be withdrawn, and then depressed, i.e., rotated about bead **11** as an axis, to overcome the force of detent spring **46** and to lift the hook-like extension of the ejector beneath and behind face plate **21** of the circuit card. Consequently, the circuit card is lifted slightly and withdrawn sufficiently from the frame to facilitate easy removal. Only one ejector is needed per structure. This simplifies considerably the construction both of the circuit card and face plate (it need contain no ejection means) and the support structure. In the event that no face plate is employed, the lower edge of the circuit card may be notched, or provided with a slight lateral protrusion which may be gripped by the ejector hook.

An alternative structure which employs the basic extruded members **10** of the invention is shown in FIG. 3. It is useful in those installations in which rack height is at a premium and in which the spacing between adjacent layers of circuit cards must be held to a minimum. With the structure previously described, using elements of normal dimension, approximately one and one-half inches of rack height is consumed for each layer of card support. The loss per shelf can be appreciably reduced by omitting the support member at the top front of each frame and by placing the rear top member **10***a* with bead **11** in the downward position. The frame **10***a* continues to support terminal support block **30** as before, but provides no support for the cards at the upper portion. Accordingly, a fingered spring leaf **47** is employed to provide the necessary support. It may be formed to fit lip **12** in member **10***a*, or it may be secured to the side wall of the member. The front of the structure in this embodiment is secured by a flat member **48** formed with a bead **49** at one edge and preferably with longitudinal ribs to provide structural rigidity. Member **48** is then secured to the frame nearest each end and

used to support hinge member 41. In this embodiment, hinge member 41 is a weak member in its flat-out position, but provides more than adequate stiffness in the normal folded position.

It will be apparent to those skilled in the art that the common extruded member 10 may be employed in a variety of configurations to create numerous modular structures. Thus, the above-described arrangements are merely illustrative of the application of the principles of the invention. Numerous other arrangements may be devised without departing from the spirit and scope of the invention.

What is claimed is:

1. Modular apparatus for supporting plug-in units which comprises, in combination,

a plurality of elongate members, each of said members characterized (1) by a generally rectangular cross section, (2) by a rounded bead cantilevered along one of the narrow faces of said member, and (3) by an undercut lip along one of the broad faces of said member,

means for securing sections of said elongate members in parallel, spaced-apart relation to form a box-like structure, a first pair of parallel members being oriented with said lips of each facing the other,

a plurality of track members bridging said pair of parallel members for receiving thin plug-in boards, each of said track members being secured at each end normal to and within said members lips, and

means for securing a plurality of terminal receiving members between the bead of a first member of said first pair of parallel members and an elongate member spaced apart and parallel to said first member, said terminal receiving members being secured between the beads of said supporting members in alignment with and substantially at right angles to said track members.

2. Modular apparatus for supporting plug in units as defined in claim 1 wherein a second pair of elongate members in parallel spaced-apart relation are oriented with the lips of each facing the other, the second pair of parallel members being oriented in spaced-apart relation with the lips of each member facing said lips of said first pair of parallel members.

3. Modular apparatus for supporting plug in units as defined in claim 2 wherein said cantilevered bead associated with a second member of said first pair of members is characterized by an axially extending groove, and said cantilevered bead associated with a second member of said second parallel pair of members is characterized by an axially extending bore and a sequence of axial discontinuities.

4. Modular apparatus for supporting plug in units as defined in claim 3, in combination with ejector means comprising a generally S-shaped member slidably affixed to said bead associated with said second member of said first member pair, said ejector means including detent means for engaging said axially extending groove in said bead, said detent means having sufficient force to maintain said ejector in a selected orientation on said bead yet permitting rotation about the axis of said bead with an applied force greater than that afforded by said detent.

5. Modular apparatus for supporting plug in units as defined in claim 3 in combination with cable support means, said support means being equipped with a support arm containing an open sided bore whose diameter is nominally that of said bead so that said support means may be slidably affixed to one of said cantilevered beads.



6. Modular apparatus for supporting plug in units as defined in claim 3 in combination with an elongate thin plate member formed with discontinuous sections of bead on one edge thereof, each section of which is bored to correspond to said bead sections associated with said second member of said second parallel pair of members, and pin means extending through the bore of sections of said thin plate member and said second member to hinge said plate member tightly to said second member.

7. Modular apparatus for supporting plug in units as defined in claim 2 wherein said track members are formed of plastic material with a substantially rectangular bed and a pair of rails extending therefrom, said rails being separated by the nominal width of said plug in boards.

8. Modular apparatus for supporting plug in units as defined in claim 7 wherein said track members are characterized by a slight longitudinal bow so that pressure is exerted on a plug in board riding on said bed within said rails.

9. Modular apparatus for supporting plug in units as defined in claim 1 wherein a single elongate member is oriented with the lip thereof perpendicular to and facing away therefrom one member of said pair of parallel members, and wherein a relatively thin ribbed member characterized by a sectioned longitudinal bead with an axially extending bore is oriented with spaced-apart relation to said elongate member and to a second member of said first pair of members.

10. Modular apparatus for supporting plug in units as defined in claim 9 in combination with an elongate thin plate member formed with discontinuous sections of bead on one edge thereof, each section of which is bored to correspond to said bead sections associated with said thin ribbed member, and pin means extending through the bore of sections of said thin plate member and said ribbed member to hinge said ribbed member tightly to said second member.

11. Modular apparatus for supporting plug in units as defined in claim 1 wherein said means for securing a plurality of terminal receiving members comprises a plurality of frame members, each proportioned to support one of said terminal receiving members, each of said frame members being equipped at both ends with spring-loaded clipping means for engaging said beads of said first pair of elongate members, and each characterized by a tapered longitudinal throat for guiding plug in boards to said supported terminal receiving member.


**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,098,177 | 7/1963 | Bleier et al. | |
| 3,184,650 | 5/1965 | Ecker. | |
| 3,197,731 | 7/1965 | Beale et al. | |
| 3,271,626 | 9/1966 | Howrilka | 339—176 |



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