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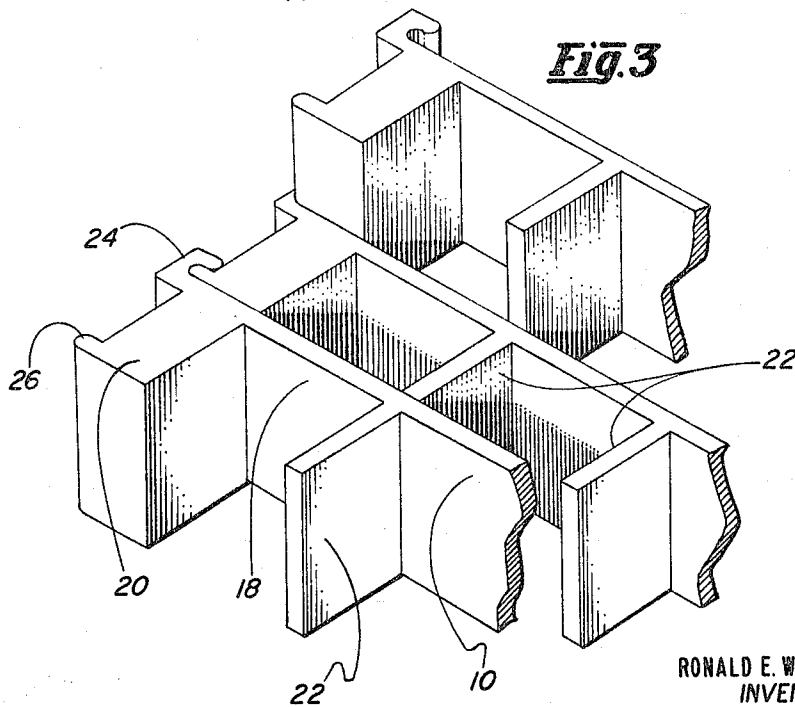
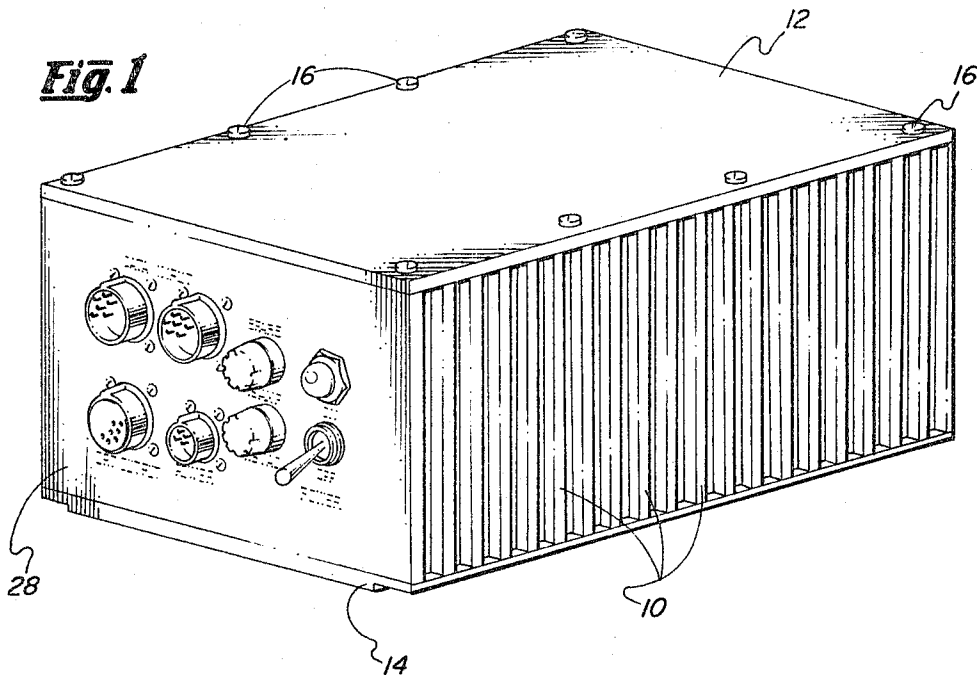
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MODULAR ELECTRONIC PACKAGING SYSTEM

Filed Oct. 3, 1963

2 Sheets-Sheet 1



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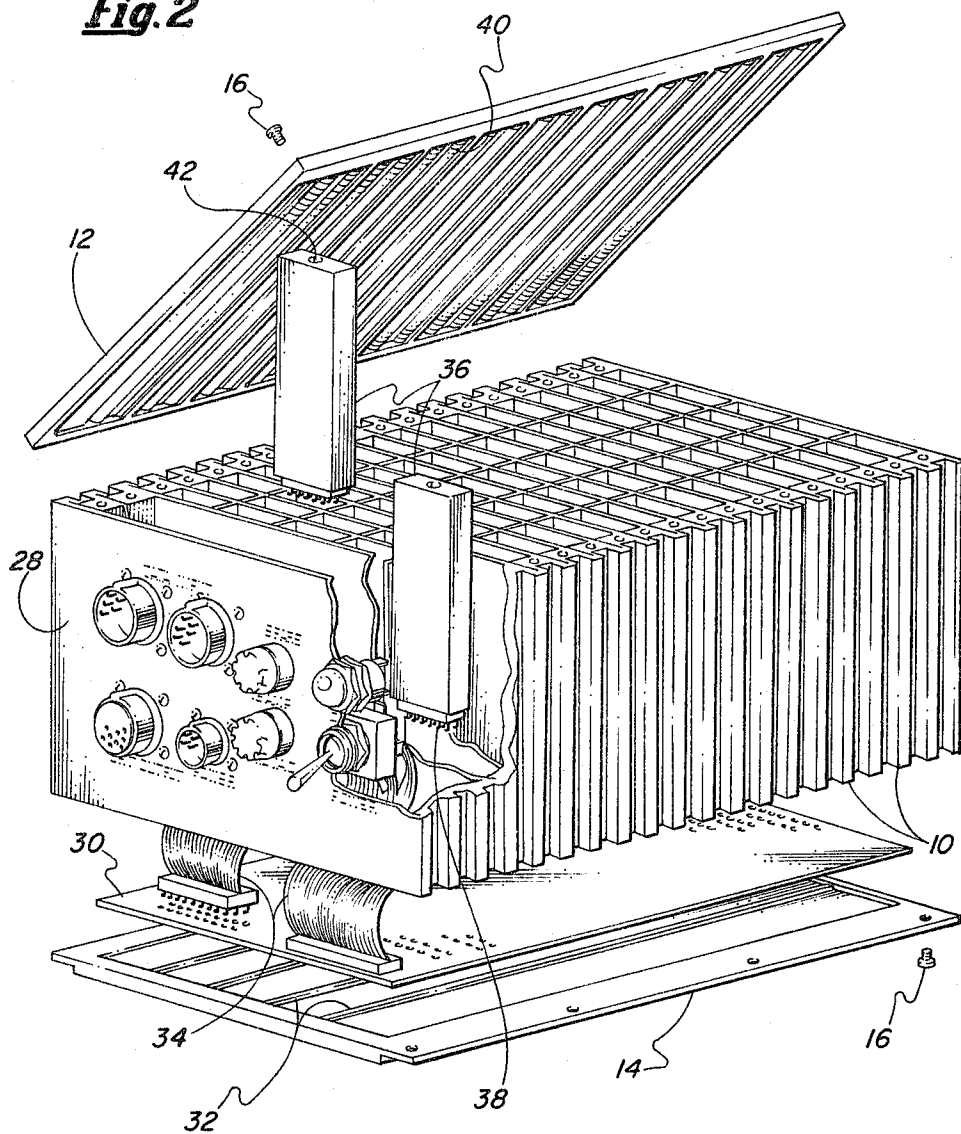
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Fig. 2



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MODULAR ELECTRONIC PACKAGING SYSTEM

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This invention relates generally to a modular electronic packaging system and more particularly to a multi-functional, extruded metal module support adapted to provide a compact, interlocking support unit for a plurality of modular electronic packages.

Many electrical circuits, particularly those relating to digital applications, are manufactured in modular form; that is, in some form of assembly having either one or both of the characteristics of standardized size or standardized electrical characteristics. The electrical circuits which may employ the packaging system of the present invention are legion; numerous industrial electrical devices, military devices, instruments and the like, including rectifiers, inverters, power sources, signal and pulse generators, voltage doublers, computers, logic elements, data recorders, servo system controls, switching circuits, etc., may advantageously be assembled using this system. The choice of modular packaging for these applications is usually partially dictated by characteristics in the circuit design itself but, modular packaging is also often chosen for its desirable service characteristic which permits defective circuits to be easily and rapidly restored to service by the replacement of individual modules.

Probably because the use of circuits amenable to modular packaging is increasing, this type of packaging of circuits is also increasingly prevalent. However, the advantages of modular packaging may easily be lost if the structures employed to support the modules fails to satisfactorily provide the functional characteristics required by modular construction. The functional characteristics required for the support structures commonly include low cost, rigidity, adaptability to various sizes of systems and proper heat transfer characteristics. In addition, for airborne applications, low weight and high packaging density are also desirable.

Heretofore, the support structures for modular construction have left something to be desired in achieving the above enumerated sought-after functional characteristics and the deficiencies have been particularly apparent in airborne applications. Accordingly, it is a general object of this invention to provide an improved and efficient lightweight support structure for electrical circuit modules which overcomes the various deficiencies of prior art devices and structures.

Another object of this invention is to provide an improved electronic circuit module support structure which, because it is manufactured from extruded sections, is inherently low in cost.

A still further object of this invention is to disclose and provide an improved electronic circuit module support which, by virtue of novel construction features, is capable of interlocking with others of its own kind in practically unlimited number to form a support structure for a very large number of modules.

Yet another object of the invention is to provide an improved interlocking fastening between adjacent ones of module supports, which fastening also functions as a radiating fin to improve the heat transfer characteristics of the inventive support structure.

An important object of the invention is to provide an improved module support structure having great rigidity; and still another object of the invention is to provide with a single size of module support, support for modules

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of varying lengths and widths. Still further objects and features of the invention pertain to the particular structure and arrangement whereby the above objects are attained.

Generally, stated, the invention contemplates an integral, extrusion formed module support which is adapted to receive one or more electrical circuit modules in a nesting relationship, in pocket like slots therein. Additionally, each of the extruded module supports is adapted to interlock with others of the same kind in series to provide support for almost any conceivable number of electronic circuit modules. As the individual module supports are interlocked, they form at their junctures a series of heat dissipating fins which aid in the transfer of heat from the electronic circuit modules to the ambient surround. The invention however, both to the structure and mode of operation, will be better understood by reference to the following disclosure and drawings forming a part thereof, wherein:

FIGURE 1 is a right-front perspective view of a completed module support system employing the construction features of the invention;

FIGURE 2 is a view similar to FIGURE 1 but is partially cut away and has the top and bottom covers removed to show inner construction details; and

FIGURE 3 is an enlarged perspective view showing certain construction details and the interlocking relationship of the module supports of the invention.

Referring now to the drawing and more particularly to FIGURE 1 thereof, there is shown an illustrative modular packaging unit embodying the system of the present invention. While the modular packaging system unit shown in FIGURE 1 and in the other detailed figures comprises a preferred embodiment of the invention, those skilled in the packaging art will appreciate that this preferred embodiment is merely illustrative of the novel features of the present invention and that other constructions embodying the invention may be made and used without departing from the novel principles thereof.

As shown in FIGURE 1, the modular packaging system comprises a unit whose principal component is a plurality of interlocking module supports 10. These module supports 10 are secured together in their interlocked relationship and maintained in alignment by a top cover 12 and a base plate 14 which they are secured between. Both the cover 12 and base 14 are secured to the module supports 10 by a number of screws or other suitable fasteners 16 in the manner illustrated.

How the main body of the modular packaging system unit is made up from a plurality of interlocking extrusion-formed module supports 10 is best illustrated in FIGURE 3 which shows in enlarged perspective certain construction details. The extruded module supports 10 are so designed that once they are cut to a required length, one module support can unite with another to provide an integral body which varies in length depending on the number of supports used and in height according to the cut length of the individual supports. The extrusion is ribbed and when two interlocking pieces are assembled, these ribs form heat sinked pockets into which electrical circuit modules can be positioned. Additionally, the interlocking flanges on the supports provide a finned outside surface to facilitate heat dissipation. In achieving these desirable characteristics, the module supports 10 are each comprised of a main plate 18 terminating in two upstanding flanges 20 at either end thereof. Intermediate the two flanges 20 there is usually provided a plurality of module separating ribs 22 upstanding from plate 18. Each of the ribs 22 in conjunction with either another of its kind or a flange 20 and the adjacent plate 18, serves to form a pocket into which electrical circuit modules may be inserted. As may be

obvious, embodiments of the invention can be constructed in which the number of ribs varies from none to a number limited only by extrusion press size.

In embodiments of the invention made to date, module supports 10 and the cover and base, 12 and 14 respectively, have been manufactured from aluminum. Aluminum was chosen for its desirable strength and extrusion properties coupled with high thermal conductivity and low cost. While metal, and aluminum in particular, has been used to date in the practice of the invention, the invention is not limited to use of a single material. As may seem obvious, any material may be used which has suitable parameters to fit the application.

An advantageous feature of the invention is achieved by terminating opposite extremities of each plate 13 in hook-like fins 24. The fins 24, by virtue of their hook-shaped construction, each act somewhat like a mortise in receiving a tenon-like projecting ridge 26 upstanding from flange 20 whenever adjacent ones of the module supports 10 are interlocked.

As illustrated in FIGURE 2, the inventive packaging system unit is ideally suited for accepting uniform module sizes. However, the module supports 10 can, with minimum modification, be made to accept many and varied module sizes. These variations in module can be accomplished for a given size module support extrusion either by cutting off the individual module supports 10 to a longer or shorter length, or alternately, by removing selected ones of the module separating ribs 22.

In fabricating the complete modular packaging system unit, a front panel is required to complete the unit. Advantageously, this front panel may be manufactured from the same basic extrusion as a module support 10 by cutting off both the flanges 20 and the module separating ribs 22.

The front panel may of course be blank. However, it is usually used to provide whatever input-output requirements and switching and indicator functions that are required of the unit. For this reason and to provide an example of the appearance of a complete unit, various receptacles, switches, etc., are shown in FIGURES 1 and 2.

A recess is provided in the unit's base plate 14 into which a module inter-connecting wiring means comprising a printed circuit board 30 may be assembled. Advantageously, the size of the recess is adjusted so that the board 30 achieves a flush relationship with the top surface of base 14. Printed circuit board 30 may be either a single layer or a multi-layer board as the occasion demands. The board 30 is normally supported in the recess in the base by means of a plurality of ribs 32. Obviously, however, in certain embodiments other modifications to replace the ribs 32 may equally well be employed or, in some instances, the ribs 32 may be dispensed with entirely.

To show one feasible means for inter-connecting printed circuit board 30 and the various connectors, switches, dials, fuses, etc., illustratively shown on the front panel 28, flexible printed circuits 34 are shown in FIGURE 2. These flexible printed circuits are shown terminating in connectors plugged into holes in the printed circuit board 30. However, this invention does not encompass any particular means of electrical connection between the front panel 28 and board 30 and connection means other than flexible printed circuits terminating in connectors could equally well be employed between the board and the various switches and connectors on the panel. Obviously, also, board 30 may employ pins or connectors for electrical connection in place of the holes shown. The board 30 is retained in position relative to the plurality of module supports 10, when the base into which it is recessed is secured to the module supports by screws 16.

Electrical circuit modules such as may be used with the inventive modular packaging unit are illustrated at 36 in FIGURE 2 of the drawing. The modules 36 are constructed in a size appropriate to fit into the pockets formed by extruded module supports 10. Details of the construction of modules 36 are outside the scope of this invention; they may be manufactured following any of the well

known construction techniques of the electronic arts. However, each of the electrical circuit modules 36 advantageously terminates in pins or some pin-like connector 38 adapted to be plugged into suitable connecting means on printed circuit board 30 which provides any necessary interconnections therefor.

To facilitate removal of each of the electrical circuit modules 36 for trouble shooting or any other purpose, an internally threaded insert 42 is assembled into each circuit module at or near the top surface thereof with the threaded portion of the insert accessible. This insert permits the assembly of a suitable handle to the module 36 to facilitate removal of the module from the pocket it occupies in the module support system unit of the invention.

It is an advantageous feature of the invention that each of the modules is positively biased toward printed circuit board 30 by spring pressure exerted on the top surface of each of the modules. This biasing action is achieved by spring strips 40 located in recesses in the top cover 12. Thus, when the cover 12 is secured to module supports 10, spring strips 40 bias the electrical circuit modules 36 downward towards their connection with printed circuit board 30.

From the foregoing description it will be perceived that the invention objectives of achieving a module support system unit having high packing density with corresponding low weight and with both low production and low tooling costs have been achieved. The system described represents an efficient compromise between the normally, mutually exclusive factors of high density and low cost. The extruded body pieces allow the realization of low tooling costs and permit very few pieces to be stocked. Additionally, packaging units made that follow the invention principles are modular in design and hence achieve a reduction in spare parts which must be stocked while concurrently simplifying maintenance.

While there has been shown and described a specific embodiment of the invention, it will of course be understood that this embodiment is merely illustrative and that various modifications and alternative constructions can be made without departing from the true spirit and scope of the invention. Therefore, it is intended by the appended claims to cover all of such modifications and alternative constructions as fall within their true spirit and scope.

What is claimed as the invention is:

1. A modular electronic packaging unit comprising a plurality of interlocking module supports, said module supports being interlocked to provide a plurality of pockets adapted to receive electrical circuit modules, a front panel assembled in interlocking relationship with the end one of said plurality of module supports, wiring means assembled adjacent to the open ends of the pockets formed by the plurality of interlocking module supports, a recessed base plate receiving and supporting said wiring means, said base plate being secured to said plurality of module supports to thereby align said supports and said wiring means, and a top cover securing said front panel and said plurality of module supports together in mutual alignment.
2. A modular electronic packaging unit comprising a plurality of interlocking module supports, said module supports being interlocked to provide a plurality of pockets adapted to receive electrical circuit modules, a front panel assembled in interlocking relationship with the end one of said plurality of module supports, wiring means assembled adjacent to the open ends of the pockets formed by the plurality of interlocking module supports, a recessed base plate receiving and supporting said wiring means, said base plate being secured to said

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- plurality of module supports and said front panel to thereby align and secure said supports, said front panel and said wiring means,
- a top cover securing said front panel and said plurality of module supports together in mutual alignment, and
- resilient means positioned in said top cover and adapted to bias electrical circuit modules positioned in the pockets formed between said plurality of module supports toward said wiring means.
3. A modular electronic packaging unit comprising
- a plurality of interlocking module supports, said module supports being interlocked to provide a plurality of pockets adapted to receive electrical circuit modules,
- a front panel assembled in interlocking relationship with the end one of said plurality of module supports,
- a printed circuit board assembled adjacent one of the open ends of the pockets formed by the plurality of interlocking module supports,
- a recessed base plate receiving and supporting said printed circuit board, said base plate being secured to said plurality of module supports to thereby align and secure said supports and said printed circuit board,
- a top cover securing said front panel and said plurality of module supports together in mutual alignment, and
- resilient spring means positioned in said top cover and adapted to bias electrical circuit modules positioned in the pockets formed between said plurality of module supports toward said printed circuit board.
4. A modular packaging unit for electrical circuit modules comprising
- a plurality of extruded comb-like interlocking module supports assembled together in interlocking relationship to form pockets for receiving said electrical circuit modules,
- a front panel interlockingly assembled to the end one of said plurality of extruded module supports, said front panel providing means fulfilling the output and input needs of electrical circuit modules assembled in said modular packaging unit,
- wiring means providing the electrical interconnections required between said electrical circuit modules and said front panel input and output means,
- a recessed base plate secured to said plurality of extruded interlocking module supports, said recess in said base plate receiving and aligning said wiring means in predetermined relationship adjacent the pockets formed by said module supports, and
- a top cover secured to said front panel and said module supports, said top cover being adapted to align and retain said front panel and said module supports.
5. A modular packaging unit for electrical circuit modules comprising
- a plurality of extruded comb-like interlocking module supports assembled together in interlocking relationship to form pockets for receiving said electrical circuit modules,
- a front panel interlockingly assembled to the end one of said plurality of extruded module supports, means on said front panel providing the output and input needs of electrical circuit modules assembled in said modular packaging unit,
- a printed circuit board providing the electrical interconnections required between said electrical circuit modules and said front panel input and output means,
- a recessed base plate secured to said plurality of extruded interlocking module supports, said recess in said base plate receiving and aligning said printed circuit board in predetermined relationship adjacent the pockets formed by said module supports,
- a top cover secured to said front panel and said module supports, and resilient means secured inside said top

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- cover adapted to bias electrical circuit modules towards said printed circuit board.
6. A modulator packaging unit for electrical circuit modules comprising
- a plurality of extruded comb-like interlocking module supports assembled together in interlocking relationship to form pockets for said electrical circuit modules,
- a front panel interlockingly assembled to the end one of said plurality of extruded module supports, printed circuit wiring means providing required electrical interconnections,
- a recessed base plate secured to said plurality of extruded interlocking module supports, said recess in said base plate receiving and aligning said printed circuit wiring means adjacent the pockets formed by said module supports, and
- a top cover secured to said front panel and said module supports,
- said top cover securing together and aligning said module supports and said front cover and retaining electrical circuit modules in said pockets.
7. A packaging unit for electrical circuit modules comprising
- a plurality of extruded comb-like interlocking module supports arranged in interlocking relationship to form a plurality of pocket-like recesses for receiving said electrical circuit modules,
- a front panel assembled in interlocking relationship to the end one of said plurality of extruded module supports, said front panel bearing output and input controls and connections for said electrical circuit modules,
- first wiring means assembled adjacent said plurality of pocket-like recesses formed by said plurality of module supports, said first wiring means having terminals adapted to connect with counterpart terminals on each of said electrical circuit modules,
- a recessed base plate secured to said front panel and said plurality of module supports, said recessed base plate supporting and aligning said first wiring means in position adjacent said pocket-like recesses formed by said plurality of module supports,
- second wiring means interconnecting said input and output controls and connections on said front panel with said first wiring means,
- a plurality of pluggable electrical circuit modules assembled into the pocket-like recesses formed by said module supports, said pluggable modules having terminals adapted to connect with the said terminals in said first wiring means, and
- top cover means securing said front panel and said module supports in aligned relationship.
8. A packaging unit for electrical circuit modules comprising
- a plurality of extruded comb-like interlocking module supports arranged in interlocking relationship to form a plurality of pocket-like recesses for receiving said electrical circuit modules,
- a front panel assembled in interlocking relationship to the end one of said plurality of extruded module supports,
- input and output control means and connection means secured to said front panel,
- a printed circuit board assembled adjacent said plurality of pocket-like recesses formed by said plurality of module supports,
- first terminal means on said printed circuit board adapted to connect with counterpart terminals on each of said electrical circuit modules,
- a recessed base plate secured to said front panel and said plurality of module supports, said recessed base plate supporting and aligning said printed circuit board in position adjacent said pocket-like recesses formed by said plurality of module supports,

wiring means connecting said input and output control means and said connection means with said printed circuit board,

a plurality of pluggable electrical circuit modules assembled into the pocket-like recesses formed by said module supports, said pluggable modules each having terminals adapted to engage said first terminal means, top cover means securing said front panel and said plurality of module supports in aligned relationship, and resilient means assembled interior of said top cover for biasing said plurality of pluggable electrical circuit modules towards said printed circuit board.

9. An extended metal module support adapted to be assembled in interlocking relationship with others of its same kind comprising

a generally rectangular plane sheet,

one or more module separating ribs arranged parallel to each other and upstanding from said plane sheet,

a pair of side flanges disposed at opposite edges of said plane sheet and parallel with said module separating ribs, each of said side flanges terminating in a tenon-like ridge projecting parallel to said rectangular plane sheet, and

a module interlocking hook-like fin extending from and secured to said plane sheet adjacent to each of said side flanges, each of said fins being formed in mortise-like fashion to receive in interlocking relationship the tenon-like ridge on an adjoining module support.

10. An extruded metal module support adapted to be assembled in interlocking relationship with others of its same kind comprising

a generally rectangular sheet,

one or more module separating ribs upstanding from said sheet,

a pair of side flanges disposed at opposite edges of said sheet and parallel with said module separating ribs, each of said side flanges terminating in a ridge projecting in tenon-like fashion therefrom parallel to said rectangular sheet, and

a mortise formed module interlocking hook shaped fin secured to said sheet adjacent to each of said side flanges upstanding therefrom, said formed fin being

adapted to receive in interlocking relationship the tenon-like ridge on an adjoining module support.

11. Module support means comprising

a generally rectangular plane sheet,

two side flanges arranged parallel to each other, each of said flanges being upstanding from the same surface and opposite edges of said rectangular sheet, at least one tenon-like ridge projecting from each of said side flanges parallel to said rectangular plane sheet,

one or more module separating ribs upstanding from the same surface of said sheet as said side flanges, said module separating ribs being parallel to each other and to said side flanges, and

module interlocking means comprising a hook-like grooved fin projecting from said sheet adjacent each of said side flanges for receiving in mortise-like interlocking relationship, the tenon-like ridge on an adjoining module support means.

12. Module support means comprising

a generally rectangular sheet,

two side flanges arranged parallel to each other, each of said flanges being upstanding from the same surface and opposite edges of said rectangular sheet,

at least one tenon-like ridge projecting from each of said flanges parallel to said rectangular sheet, and

module interlocking means comprising a mortise-like grooved fin projecting from said sheet adjacent each of said side flanges for receiving in interlocking relationship the tenon-like ridge on an adjoining module support means.

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