Dec. 19, 1961 Z. TARCZY-HORNOCH 3,014,161

MODULAR CONSTRUCTION

Filed June 2, 1959 2 Sheets-Sheet 1

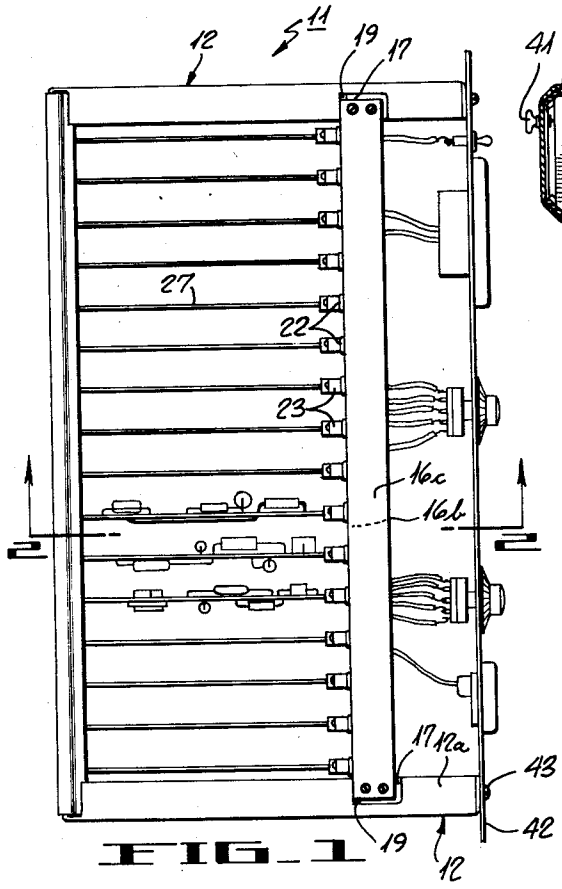


FIG_1

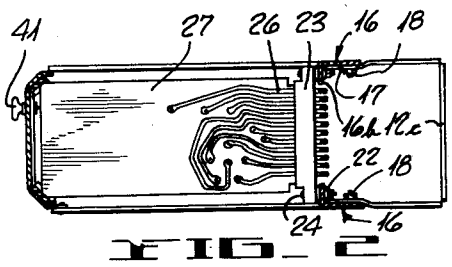


FIG_2

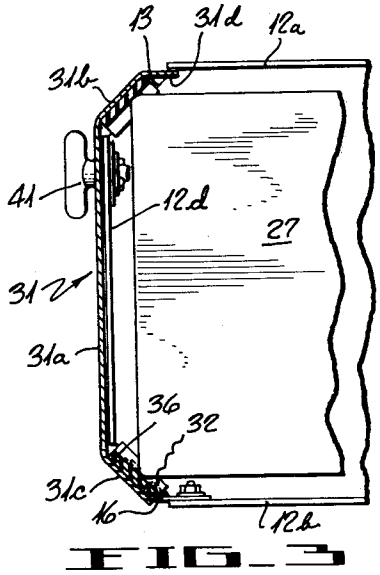


FIG_3

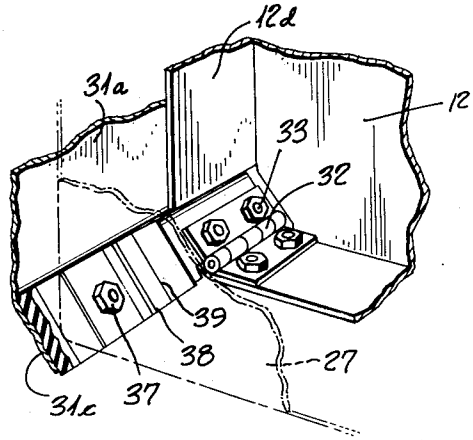


FIG_5

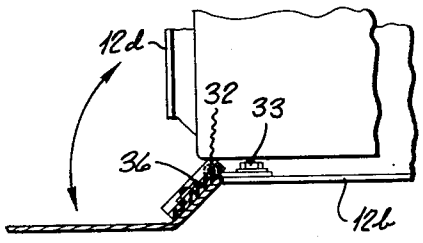


FIG4

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MODULAR CONSTRUCTION

Filed June 2, 1959 2 Sheets-Sheet 2

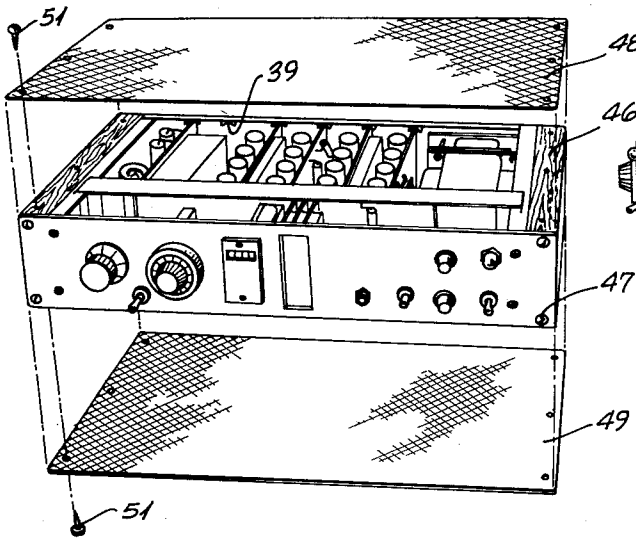


FIG_6

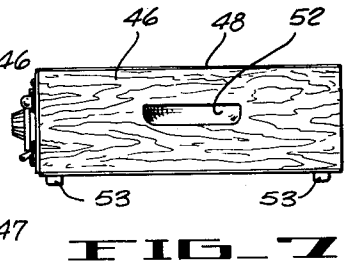


FIG_7

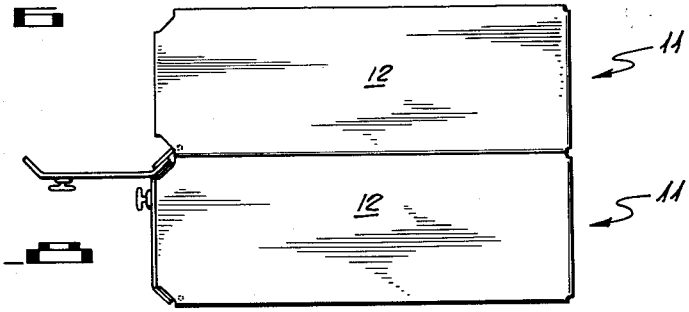


FIG_8

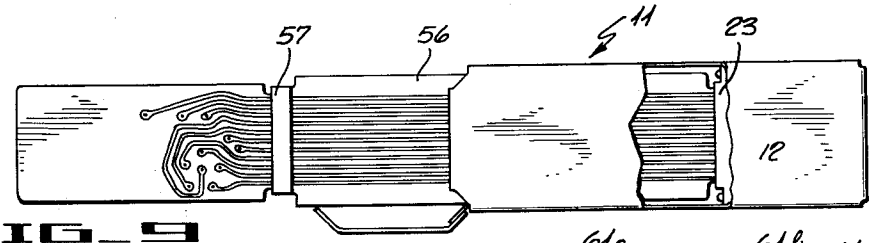


FIG_9

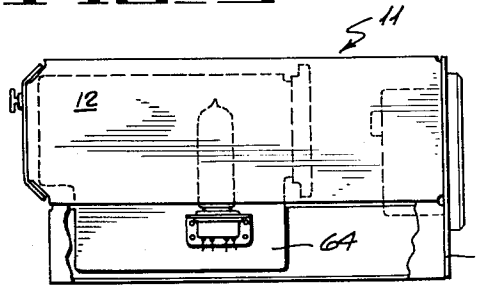


FIG_10

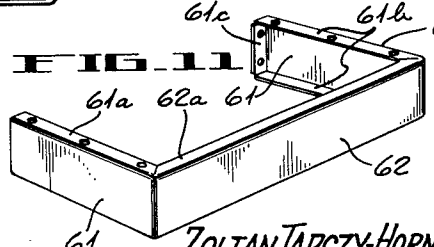


FIG_11

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3,014,161

MODULAR CONSTRUCTION

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Filed June 2, 1959, Ser. No. 817,589
16 Claims. (Cl. 317—101)

This invention relates to a modular construction and more particularly to a modular construction suitable for use with electronic and electrical apparatus.

Heretofore, a module type of construction has been utilized with individual plug-in cards having circuitry mounted thereon. However, in such modules, the cards are plugged in from the front of a cabinet or rack, making it difficult to provide the module with conventional instruments and controls mounted on a common front panel. Also, in such modules, the cards have been provided with top and bottom guides for the side edges which usually restrict the airflow through the modules and past the cards.

In general, it is an object of the present invention to provide a modular construction which overcomes the above named disadvantages.

Another object of the invention is to provide a modular construction of the above character that permits the use of a conventional front panel which permits integration with conventional panel and rack mounted construction.

Another object of the invention is to provide a modular construction of the above character which is particularly adaptable for rack mounting, cabinet mounting or a self-supporting desk top mounting.

Another object of the invention is to provide a modular construction of the above character which makes possible a high packaging density without the use of miniaturization techniques.

Another object of the invention is to provide a modular construction of the above character in which the cards or boards are slugged in or removed from the rear of the framework without disturbing the front panel.

Another object of the invention is to provide a modular construction of the above character which has a framework which firmly supports both ends of the cards.

Another object of the invention is to provide a modular construction of the above character in which the top and bottom sides of the cards are unsupported to facilitate the vertical flow of air past the cards.

Another object of the invention is to provide a modular construction of the above character in which the modules can be arranged one above the other to provide a continuous closed vertical air channel which is particularly adapted for natural air cooling because of the chimney effect created, or forced air cooling.

Another object of the invention is to provide a modular construction of the above character in which modules of one-half the width of the normal modules are provided to make possible the use of cards of greater width, the use of front panels of greater height, and the use of rear mounted controls.

Another object of the invention is to provide a modular construction of the above character which greatly facilitates maintenance because of the rear access to the cards.

Another object of the invention is to provide a modular construction of the above character in which the front panel can be used for conventional purposes such as the mounting of meters, outputs, inputs, controls and the like.

Another object of the invention is to provide a modular construction of the above character in which a swinging door or gate is utilized for supporting the rear ends of the cards and in which the door in a closed position positively locks the cards in the module and in an open position holds the rear ends of the cards in place.

Another object of the invention is to provide a modular construction of the above character in which the door when open is supported in a substantially horizontal position so that it can act as a shelf for extension cards to facilitate measurements and repairs.

Another object of the invention is to provide a modular construction of the above character in which the door when closed forms a part of the closed air channel.

Another object of the invention is to provide a modular construction of the above character in which particularly novel means is used for supporting the rear ends of the cards.

Additional objects and features of the invention will appear from the following description in which the preferred embodiment has been set forth in conjunction with the accompanying drawings.

Referring to the drawings:

FIGURE 1 is a top plan view of a modular construction incorporating the present invention.

FIGURE 2 is a cross sectional view taken along the line 2—2 of FIGURE 1.

FIGURE 3 is an enlarged view of a portion of the view shown in FIGURE 2.

FIGURE 4 is a view similar to FIGURE 3 but showing the swinging door in an open position.

FIGURE 5 is a partial perspective view of one of the corners of the modular construction.

FIGURE 6 is a perspective view, partially exploded, showing the modular construction adapted for a self-supporting desk top mounting.

FIGURE 7 is a side elevational view of the module shown in FIGURE 6.

FIGURE 8 is a side elevational view showing two of the modules arranged one above the other.

FIGURE 9 is a side elevational view showing a module in which an extension card is being utilized.

FIGURE 10 is a side elevational view of a modular construction in which an additional half module has been utilized to permit the utilization of a card of greater width.

FIGURE 11 is an isometric view of the half module.

In general, the present invention consists of a suitable framework in which a plurality of substantially uniform cards are removably mounted. The cards are normally in alignment and lie in substantially parallel planes. Connectors are normally used for mounting one end of each of the cards because the cards normally have electrical circuitry mounted thereon. A hinged door is pivotally mounted on the rear of the framework for movement about an axis which extends at right angles to the planes of the cards. When the door is in a raised or closed position, the door firmly engages the rear ends of the cards to hold the cards in place. When the door is lowered, the rear ends of the cards are still held in alignment by the lower margin of the door which remains in contact with the cards. The cards containing the electrical circuitry can be readily removed without disturbing the front panel when the door is in this position.

More in particular, the modular construction consists of a framework **11**. The framework **11** is comprised of a pair of side panels **12** which are each provided with in-turned top, bottom, front and rear edges **12***a*, **12***b*, **12***c* and **12***d*, respectively. Cut-outs **13** and **14** are provided in the rear end of each of the side panels at the top and bottom corners respectively.

The side panels **12** are connected by a pair of longitudinally extending angle members **16**. The angle members are mounted in recesses **17** provided in the in-turned top and bottom edges **12***a* and **12***b* and are secured therein by suitable means such as bolts **18**. The angle

members **16** are provided with two portions **16***a* and **16***b* with portion **16***b* extending at right angles to portion **16***a*. Portions **16***a* of both members **16** extend in planes which are parallel to the top and bottom edges **12***a* and **12***b* of the side panels. Portions **16***b* extend at right angles thereto and through slots **19** provided in the top and bottom edges **12***a* and **12***b*. Portions **16***a* are provided with a plurality of spaced openings (not shown) extending the length thereof which are adapted to receive grommets **22** of suitable material such as rubber.

Connectors **23** of any suitable type such as the female connectors shown are mounted between the spaced angle members **16** in any desired space relationship by suitable means such as bolts **24** extending through the grommets **22**. The connectors **23** are adapted to receive the male terminals **26** or other suitable connectors carried by cards **27**. The male terminals carried by the cards **27** are firmly engaged by the connectors **23**, that is, they are frictionally held within the connectors. The connectors **23**, the male terminals **26** and the cards **27** are substantially conventional and are well known to those skilled in the art.

The cards **27** are formed of a suitable insulating material and are adapted to have mounted thereon various types of electrical circuitry. For example, circuitry utilizing electron tubes or transistors may be utilized with or without the use of printed circuitry. By properly spacing the connectors **23** on the angle members **16**, it is possible to vary the spacing between the cards removably carried thereby so that the cards can have mounted thereon any type of circuitry desired.

With the arrangement shown, it will be noted that the connectors **23** are substantially vertical and that the cards carried thereby also lie in spaced parallel vertical planes. The cards may be of any desired configuration; however, as shown, they are conventionally rectangular and are provided with relatively square top and bottom corners on their rear ends.

Means is provided for engaging the rear ends of the cards to support the rear ends of the cards and consists of a hinged member **31** which forms a door or gate. The door or member **31** consists of a single unitary structure which is provided with a main planar portion **31***a* and upper and lower inclined portions **31***b* and **31***c* which incline inwardly from the main portion **31** and which preferably have an angle of inclination substantially of 45° for a purpose hereinafter described. The door is formed with an additional portion **31***d* which extends in a plane at right angles to the plane of the portion **31***a* and which rides under the top edges **12***a* of the side panels as shown particularly in FIGURE 3 when the door is closed.

The door or member **31** is pivotally mounted on the framework **11** by suitable means such as hinges **32** which have one leaf secured to the bottom edge **12***b* and the other leaf secured to the inclined portion **31***b* of the door **31** by suitable means such as bolts **33**. It will be noted that the hinges are mounted in such a manner that the axis upon which the door swings is at right angles to the planes of the cards **27** and is slightly forward and below the lower rear corner of each of the cards when the cards are in position for a purpose hereinafter described.

Means is provided on the angular portions **31***b* and **31***c* of the door to firmly grip the top and bottom rear corners of the cards **27** to hold the cards in place when the door is in a closed position and consists of strips **36** of a suitable resilient material such as plastic or rubber which are secured to the door by suitable means such as bolts **37**. Rivets or glue may be utilized if desired. The strips are provided with spaced raised portions **38** which are provided with substantially V-shaped recesses **39**. The V-shaped recesses **39** and the portions **38** are spaced in such a manner that the V-shaped recesses are in alignment with the openings in the angle members **16**.

Means is provided for retaining the door member **31** in closed position and consists of conventional thumb actuated twist lock devices **41** which engage the rear edges **12***d* of the side panels **12**.

A front panel **42** of a conventional type is shown mounted on the side panels **12** by suitable means such as screws **43**.

It will be noted that a considerable amount of space is provided between the longitudinal members **16***a* and the front panel **42**. This space is provided so that various types of controls can be mounted on the front panel if desired. As shown in FIGURE 1, the space is adequate so that the conventional type of front panel mounting may be utilized with my modular construction.

In FIGURES 6 and 7, a module of the type hereinbefore described has been adapted for desk top mounting by providiing a member **46** of suitable light material such as wood on each side of the module which is secured to the front panel by suitable means such as screws **47**. Top and bottom cover plates **48** and **49** formed of suitable screen-like material such as expanded metal are secured to the wooden side pieces **46** by suitable means such as screws **51**. The wooden side members **46** are provided with hand holes **52** to facilitate lifting of the desk top unit. Rubber feet **53** are provided on the bottom side of the module and serve to space the module from the desk top to facilitate circulation of air through the module.

In FIGURE 8 is shown an arrangement in which two of the modules have been arranged so that they are stacked one above the other.

In FIGURE 9 the module is being shown utilized with an extension card **56** which is provided with a female connector or receptacle **57** identical to the female connector or receptacle **23**.

In FIGURES 10 and 11 there is shown a modular construction which is one-half of the height of the modular construction hereinbefore described. As shown particularly in FIGURE 11, this modular construction consists of a pair of side walls **61** and a rear wall **62**. The side walls are spaced apart the same distance as the side panels **12** and are provided with inturned top and bottom edges **61***a* and **61***b* and an inturned end edge **61***c*. The rear wall **62** is likewise provided with inturned top edge **62***a* and an inturned bottom edge (not shown). This half module is of the same general overall shape as the module hereinbefore described so that it can be used in conjunction with such a module.

When a module of standard size as shown in FIGURES 1 to 5 is used with a module of a smaller size such as the half module shown in FIGURES 10 and 11, it is possible to use cards **64** which are of greater height than those shown in FIGURES 1 to 5. With such cards it is possible to use oversized tubes and other large electrical compartments. The utilization of such a half module in conjunction with a full-sized or standard module also makes possible the use of a larger front panel **66** so that large meters (see FIGURE 10) and other devices can be used.

Operation and use of the modular construction may now be briefly described. With the door **31** in its open or lowermost position, the cards **27** may be inserted and removed with ease from the connectors **23**. When the door is in its lowermost position, the lower rear corners of the cards are still supported by the portions **38** which serve to prevent sidewise movement of the rear ends of the cards. After the cards have all been placed in position, the door can be raised from the position shown in FIG. 4 to the position shown in FIGURE 3 in which both strips **36** engage the top and bottom rear corners of the cards **27**. As soon as the door is locked in position, the rear ends of the cards are firmly held in a fixed position by the door. The front ends of the cards are held by the connectors **23** carried by the angle members **16**.

Thus, it can be seen that a three point support is pro-

vided for each of the cards, one in front by the connector, and two in the rear by the door **31**. Even when the door is in a position to permit removal of the cards, each of the cards is supported at at least two points, one in front by the connector **23**, and one in the rear by the lowermost strip **36** mounted on the door **31**.

The arrangement of the cards in the module as shown is particularly advantageous in that it permits relatively free flow of air upwardly through the spaced vertical cards. The bottom and top sides of each of the modules are free of any obstructions. When the modules are arranged one above the other as shown in FIGURE 8, a closed continuous air channel is provided. This particularly adapts the assembly for natural air cooling because of the chimney effect created. It also adapts the assembly for forced air cooling of the vacuum or pressure type. The passage of air through the modules and past the cards is particularly facilitated because no guides or the like are provided for the top and bottom side edges of the cards.

The construction of the module is such that air cannot escape from the modules. The side walls, the front panel and the rear door of each of the modules form a closed four-sided enclosure which cooperate with the module immediately above and the module immediately below to provide a continuous channel so that the air moving into the lowermost or uppermost module is forced to pass thorugh all of the modules and cannot escape therefrom. By mounting a conventional forced air fan in the lowermost module of the stacked modules, it is possible to drive air through all of the modules to cool the electronic components carried by the cards in all of the modules.

In the desk top model shown in FIGURES 6 and 7, the module is provided with feet so that air can flow freely through the perforated top and bottom covers to cool the electronic components.

The arrangement of the cards in the manner shown makes possible a high packaging density without resorting to miniaturization techniques. Different types of circuitry may be used within the same module if desired. For example, as shown in FIGURE 6, certain cards may contain vacuum tube circuitry with conventional wiring, whereas others may contain transistorized circuitry. In addition, power supplies and the like may also be mounted within the modular construction merely by securing the same to the channel members **16**.

Access to the cards is facilitated by the rear door which swings open to permit free access to the cards while at the same time providing support for the rear end of the cards. As shown particularly in FIGURE 8, the door is provided with inclined portions having a 45° angle which when the door is opened causes the door to provide a substantially horizontal shelf-like surface which is firmly supported by the door immediately below. This opening of the door to the horizontal position is advantageous in that it facilitates the use of extension cards **56** because the door serves to support the outer ends of the extension cards as shown particularly in FIGURE 9. The card which is to be tested or repaired may then be inserted in extension card **56** so that it is readily accessible to the workman.

The use of the conventional front panels on the modules permits integration of the modules with conventional rack mounted equipment.

By utilizing resilient material for the strips **36** and the grommets **22**, shock mounting is provided for the cards while at the same time maintaining the cards in the desired position.

When it becomes necessary to utilize cards of a greater height than that which can be accommodated by the module, a module of reduced size such as the half module shown in FIGURE 11 is provided and secured to the frame of the full-sized or standard module. The use of this larger card permits the use of electronic components of a much greater size. The use of this half module also permits the use of a front panel of greater height so that larger instruments or control devices can be utilized if desired. The stationary rear wall **62** of the half module makes it possible to mount certain controls on the rear wall if desired. Certain controls also can be mounted on the swinging door of the standard module; however, this may be found to be undesirable since the leads leading to the controls must bend to accommodate the opening and closing of the swinging door.

It is apparent from the foregoing that I have provided a new and improved modular construction which is particularly advantageous in that it permits cards containing electrical circuitry to be readily removable for maintenance and replacement. The cards are supported in a particularly novel manner by means of a swinging door, when the door is in a closed position, and when the door is in a position to permit the removal of the cards.

I claim:

1. In a modular construction, a framework, a plurality of substantially uniform cards, means for mounting one end of each of the cards in the framework so that the cards are in alignment and lie in spaced substantially parallel planes, and a member pivotally mounted on said framework for movement about an axis which extends at right angles to the planes of the cards, said member being movable between open and closed positions whereby when said member is in a closed position it serves to hold the other ends of said cards in a relatively fixed position and when said member is in an open position it permits removal of the cards, said means for mounting one end of each of the cards and said member constituting the sole support for said cards in said framework.

2. A modular construction as in claim 1 wherein said member is provided with means for engaging the upper and lower corners of said other ends of said cards when said member is in a closed position and wherein when said member is in an open position to permit removal of the cards, the means engaging the lower corners is still in engagement with the lower corners.

3. A modular construction as in claim 1 wherein said framework consists solely of a pair of spaced, parallel side panels and a pair of longitudinal members secured to the upper and lower portions of the side panels perpendicular to the side panels and intermediate the ends thereof.

4. A modular construction as in claim 1 wherein the means for mounting one end of the cards in the framework comprises a plurality of connectors together with a front panel mounted on the framework and spaced from the connectors and lying in a plane parallel to the plane of the member when the member is in a closed position, electrical devices mounted on the front panel, and means connecting the electrical devices to the connectors.

5. In a modular construction, a pair of spaced, parallel side panels, a pair of spaced longitudinal members secured to upper and lower portions of the side panels perpendicular to the side panels and intermediate the ends thereof, a plurality of substantially uniform cards, means mounted on said pair of longitudinal members for mounting one end of each of the cards so that the cards are in alignment and lie in spaced substantially parallel planes parallel to the side panels, a door movable between open and closed positions pivotally mounted on the ends of said side panels and moving on an axis substantially at right angles to the planes of the side panels whereby when the door is in an open position, the cards can be removed, and means carried by the door for engaging the upper and lower corners of said other ends of said cards when the door is in a closed position, said door constituting with the mounting means the sole support for said cards.

6. A modular construction as in claim 5 wherein the means mounted on said pair of longitudinal members for mounting one end of each of the cards consists of

a plurality of connectors, a front panel mounted on the side panels perpendicular to the side panels and spaced from the connectors, electrical devices mounted on the front panel, and means connecting the electrical devices to the connectors.

7. A modular construction as in claim 5 wherein the axis of movement of the door is slightly below and forward of the lower corners of said other ends of said cards.

8. A modular construction as in claim 5 wherein said means mounted on the door and engaging the upper and lower corners of said other ends of said cards consists of strips of resilient material mounted on said door, said strips being provided with recesses whereby when said door is moved to a closed position said cards are firmly seated in said recesses, the lowermost corners of the cards remaining in engagement with the strip of material engaging the same as the door is moved between open and closed positions.

9. A modular construction as in claim 8 wherein said door is provided with upper and lower inclined portions having an angle of inclination of substantially 45°, said resilient strips being mounted on said inclined portions of the door.

10. In an assembly of the character described adapted for use with air cooling, a plurality of superposed frames, each of said frames having spaced, parallel side walls, a front panel secured to the side walls, a plurality of substantially uniform cards, mounting means for mounting one end of each of the cards in the frame so that the cards are in alignment and lie in spaced substantially parallel planes parallel to the side walls and a hinged rear door movable between open and closed positions secured to the side walls, said door when in a closed position engaging the other ends of the cards and serving to support said other ends of said cards, said mounting means and said door constituting the sole support for said cards, the side walls, the front panel and rear door of the frames forming a four-sided enclosure with open top and bottom sides, said superposed frames providing a continuous closed cooling air channel for the passage of air over the cards in said frames.

11. An assembly as in claim 10 wherein the mounting means in each frame are connectors together with electrical devices mounted on the front panel of the frame and means connecting the electrical devices to the connectors.

12. An assembly as in claim 10 wherein the door in each of said frames is provided with upper and lower inclined portions, the portions being inclined at an angle of substantially 45° so that when a door is in an open position, the lowermost inclined portion of the door is in engagement with the uppermost inclined portion of the door immediately below to thereby support the door in a substantially horizontal position.

13. In a modular construction adapted for desk top use, a pair of vertical spaced, parallel side panels, and a pair of longitudinal members secured to upper and lower portions of the side panels perpendicular to the side panels and intermediate the ends thereof, a plurality of cards, means mounted on said pair of longitudinal

members for mounting one end of each of the cards so that the cards are in alignment and lie in spaced substantially vertical parallel planes, a door movable between open and closed positions pivotally mounted on the ends of said members and moving on an axis substantially at right angles to the planes of the side panels whereby when the door is in an open position, the cards can be removed, means carried by the door for engaging the upper and lower corners of the other end of said cards when the door is in a closed position, said door in cooperation with the mounting means constituting the sole support for said cards, a pair of side members disposed adjacent the side panels, a front panel secured to the side panels and to the side members, perforated top and bottom cover plates secured to the side members to enclose the cards, and spacing means mounted on the bottom cover plate adapted to support the framework above the surface of the desk.

14. In an assembly of the character described, a first framework consisting of a pair of spaced, parallel side panels, a pair of longitudinal members secured to the upper and lower portions of the side panels perpendicular to the side panels and intermediate the ends thereof, a plurality of cards, means mounted on said pair of longitudinal members for supporting one end of each of the cards so that the cards are in alignment and lie in spaced substantially parallel vertical planes parallel to the side panels, a door movable between open and closed positions pivotally mounted on the ends of said side members and moving on an axis substantially at right angles to the planes of the side panels, and means carried by the door for engaging the other ends of the cards, said door and the mounting means constituting the sole support for said cards, and an additional framework secured to the first named framework, said additional framework having a height substantially less than that of the first named framework and consisting of a pair of spaced side walls and a rear wall, the side walls being spaced apart the same distance as the side panels of the first named framework, and being secured to the side panels and a front panel secured to the front ends of the first and last named frameworks.

15. An assembly as in claim 14 wherein the rear wall of the last named framework is disposed inwardly from the door of the first named framework to permit opening and closing of the door.

16. An assembly as in claim 14 wherein at least one of said cards has a portion which extends into the last named framework.

References Cited in the file of this patent

UNITED STATES PATENTS

2,077,160	Wilson	Feb. 21, 1956
2,832,013	Pedersen	Apr. 22, 1958
2,843,806	O'Neill	July 15, 1958
2,880,379	Stoddart	Mar. 31, 1959
2,893,137	Alling	July 7, 1959
2,951,185	Buck	Aug. 30, 1960

OTHER REFERENCES

Electrical Design News, April 1958, p. 15.