

[54] **CONTROL MODULES FOR ELECTRONIC SYSTEMS AND CONSOLES FORMED THEREBY**

[75] Inventors: **Howard M. Layton**, Pound Ridge, N.Y.; **Kenneth T. Yocis**, New Milford, Conn.

[73] Assignee: **Interlab, Inc.**, Danbury, Conn.

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[51] Int. Cl. .... **H02b 1/04, H05k 7/16**

[58] Field of Search..... **317/101 CB, 117, 317/120, 99; 312/67, 108, 198, 263; 338/197, 128**

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*Primary Examiner*—Robert K. Schaefer

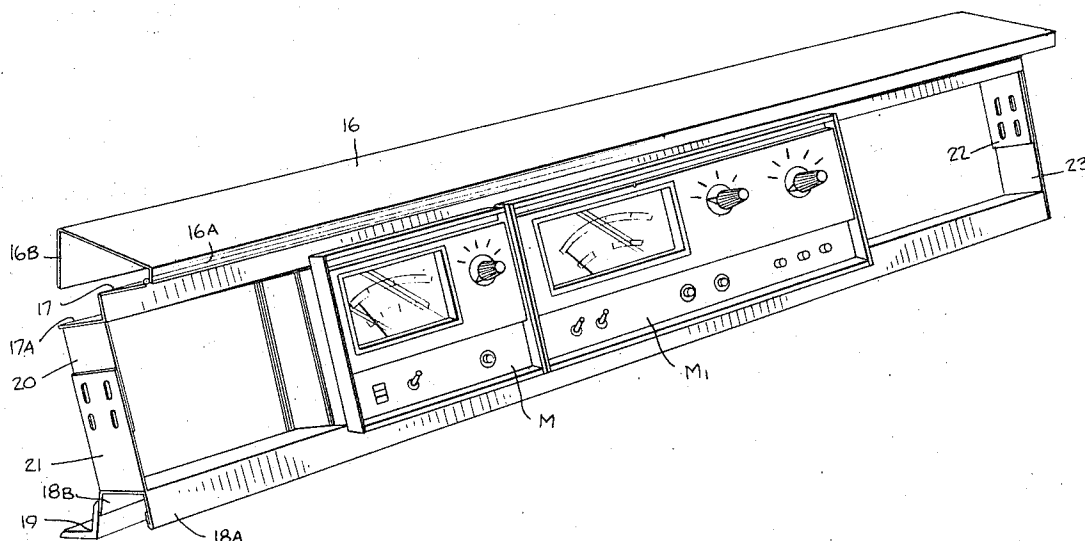
*Assistant Examiner*—Gerald P. Tolin

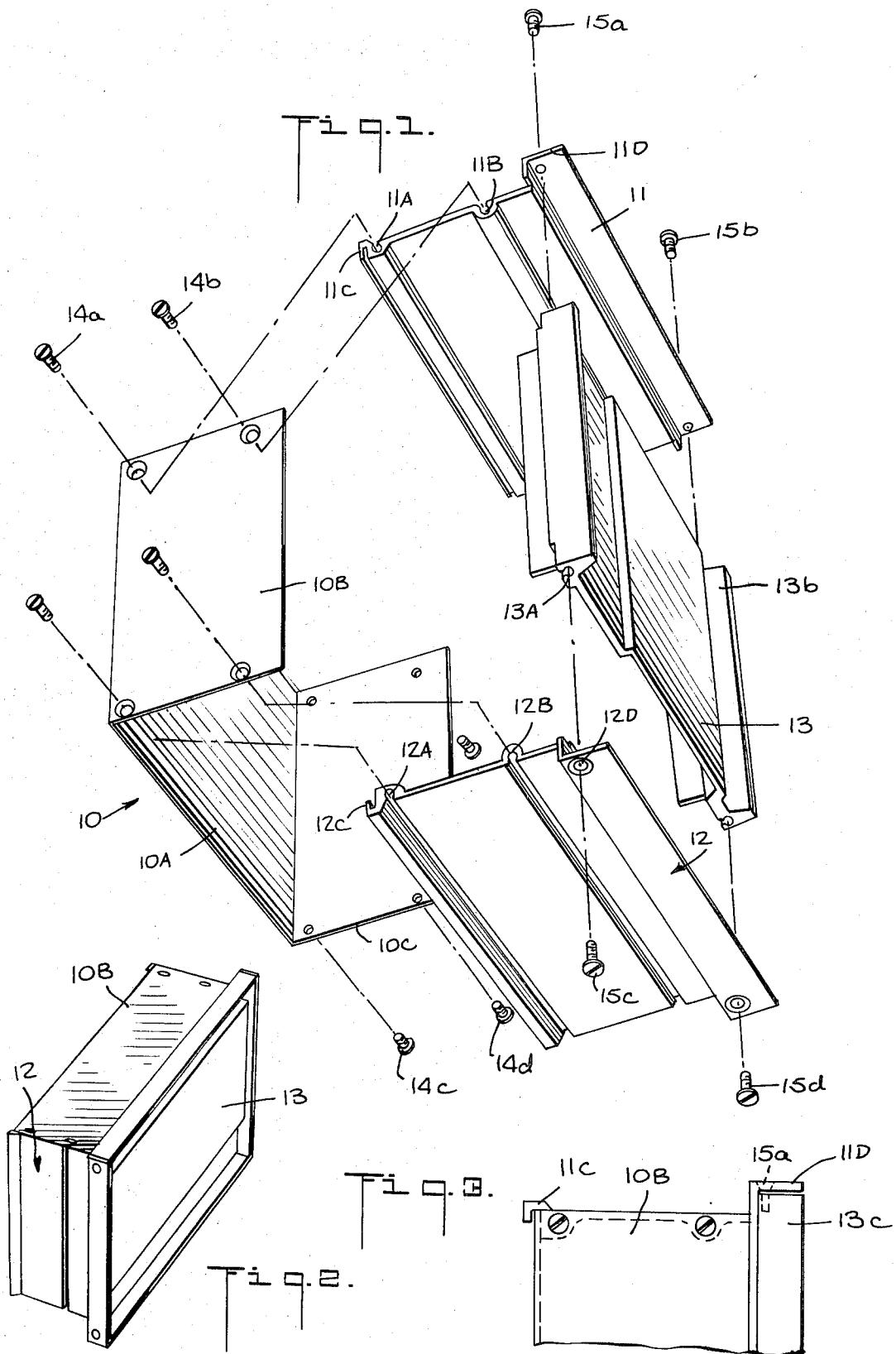
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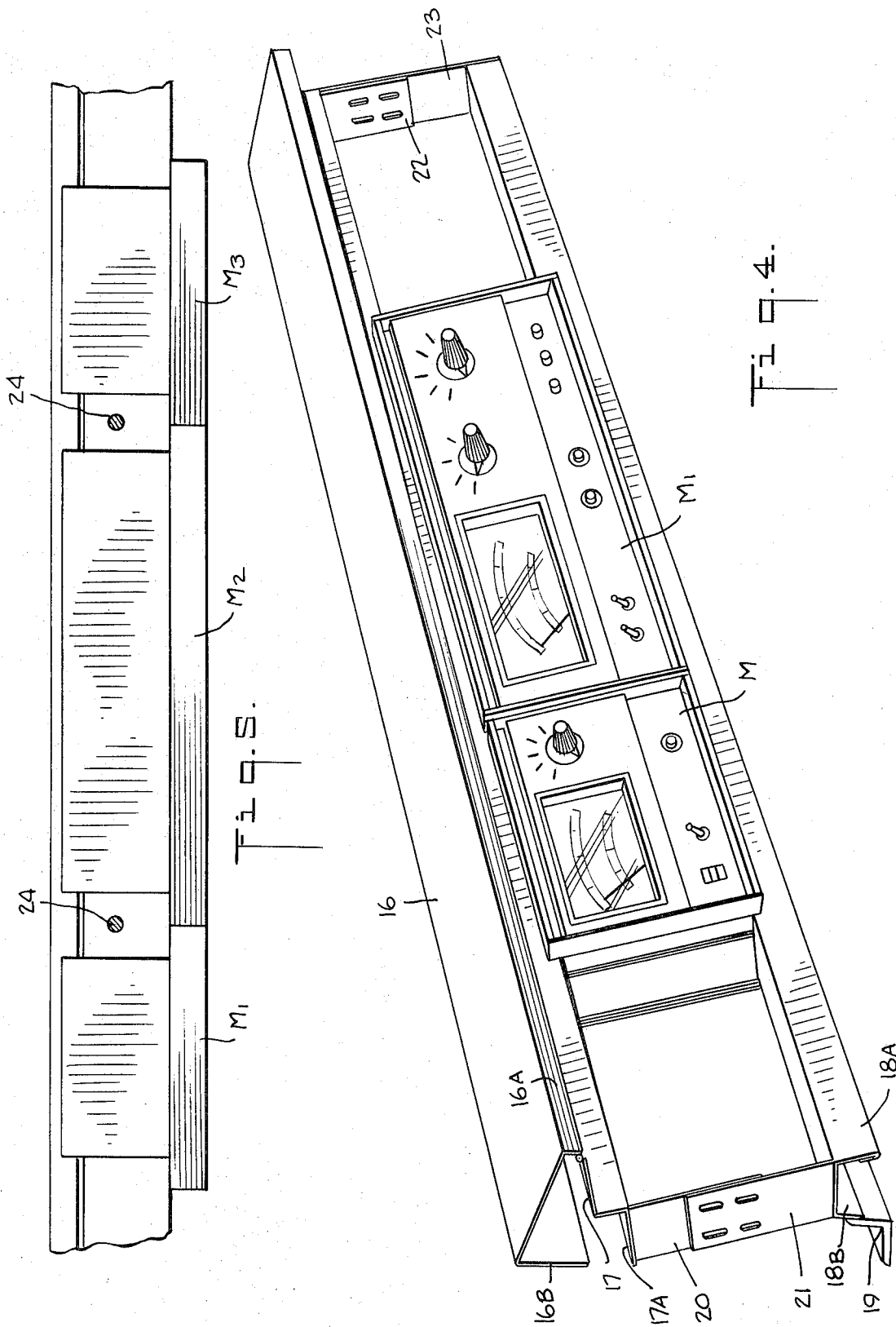
[57] **ABSTRACT**

A control console formed by a family of modular sub-sections, each including a box-like housing formed by four pieces, one of which is a flat sheet bendable into a channel to define the rear and the top and bottom walls, the second and third of which are identical end pieces to define the end walls, and the fourth of which is the front panel of the housing. All of these pieces are of the same width and may therefore be stocked in strip form, but the channel and panel pieces may be cut to different lengths, whereby housings formed by fastening the pieces together may differ in length but are otherwise of the same dimensions. When such modules of different length are arrayed in side-by-side relation, they present a continuous integrated appearance. A console skeleton is provided which is adapted to clamp together an array of modules, the clamp being releasable whereby individual modules may readily be removed and replaced.

**5 Claims, 7 Drawing Figures**



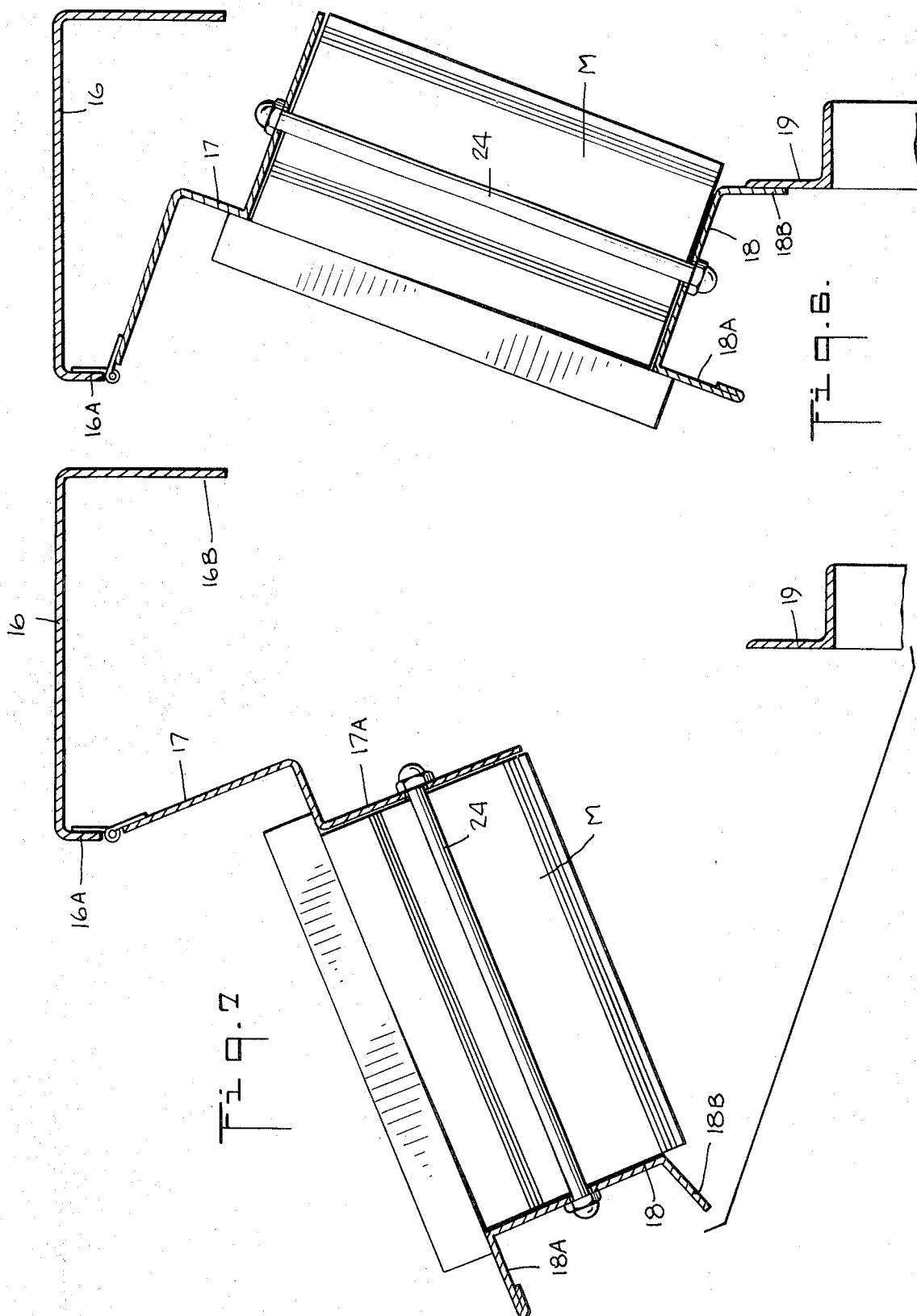




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3 Sheets-Sheet 3



# CONTROL MODULES FOR ELECTRONIC SYSTEMS AND CONSOLES FORMED THEREBY

## BACKGROUND OF THE INVENTION

This invention relates generally to control panels and consoles, and more particularly to a control console constituted by a family of modular sub-sections.

In electronically-controlled industrial systems, the various control knobs and dials, the push-button and toggle switches, and the indicators, are usually mounted on a common control panel or console. Similarly, in complex process control equipment, the usual practice is to group together on a single control panel, the various manually operated control dials as well as meters, pilot lights and other control and indicator elements.

By placing all of the control and indicating elements in one convenient location, operation of the system is facilitated and its installation and maintenance are simplified. In terms of human engineering and industrial design, centralization of all controls on a console control panel imparts a more pleasing appearance to the installation and makes possible more efficient supervision thereof.

When a company is engaged in manufacturing complex multi-stage process equipment in diversified forms intended for use at a single industrial location, manufacturing procedures and routine maintenance can be improved considerably by breaking down the central control panel into a family of sub-sections of standardized design.

For example, let us assume that at a given plant, parts are to be processed at a series of work stations, each carrying out a distinct function. Associated with each station are switches, dials, meters, and other control and indicating elements appropriate to the station's function.

Rather than merge all of the control and indicating elements related to the several stations on a single control panel, the better practice is to provide a separate control sub-section or module for each station, the module containing all of the control elements related to its associated station, and to then assemble a family of such modules on a common console.

With this modular approach, one can conveniently put together "custom" processing systems using standard control modules. For example, at one installation, the need may exist for cleaning, coating, heating and plating stations and control modules therefor, whereas in another installation, the need may be for cleaning, rinsing, and cooling stations. By using standard modules selected for the particular system, one may assemble a system meeting specified requirements. In a modular system of this type, control sub-sections or modules may be readily replaced in their entirety to avoid trouble-shooting control equipment failures at their point of use.

## SUMMARY OF THE INVENTION

The main object of this invention is to provide a module housing formed by four standardized pieces that may be stocked in flat form and readily converted into box-like enclosures when the need arises.

More specifically, it is an object of this invention to provide a housing for a module constituted by a flat sheet bendable to form a U-shaped channel piece defining the rear, top and bottom walls of the housing, a

pair of flat end pieces defining the end walls of the housing and a flat panel piece forming the front wall of the housing, the pieces being held together by self-tapping screws.

Also an object of the invention is to provide a module housing of the above type in which the channel and panel pieces may be cut to various lengths, the end pieces having a fixed length whereby module housings of different lengths may be assembled, all other dimensions thereof being unchanged.

Still another object of the invention is to provide a console frame adapted to bring together a family of module housings in a continuous array to form a control panel having a visually integrated form and a pleasing appearance.

Briefly stated, these objects are accomplished by housings for control modules formed by four flat pieces, one of which is a sheet bendable into a channel to define the rear and the top and bottom walls, the second and third of which are identical end-pieces to define the end walls of the housing, and the fourth of which defines the front panel thereof. All of the pieces have a fixed width, but the channel and panel pieces may be cut to different lengths, whereby the housings formed by fastening the pieces together may be of different length, but are otherwise of the same dimensions. When modules of different length are arranged in side-by-side relation, they present a continuous, visually integrated appearance. A console frame is provided which is adapted to clamp together an array of modules, the clamp being releasable whereby individual modules may readily be removed and replaced.

## OUTLINE OF DRAWING

For a better understanding of the invention, as well as other objects and features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawings, wherein:

FIG. 1 is an exploded view of a module housing in accordance with the invention;

FIG. 2 is a perspective view of the module housing; FIG. 3 is a partial side view of the module housing; FIG. 4 is a perspective view of a console formed by a family of modules;

FIG. 5 is a plan view of an array of modules in the console;

FIG. 6 is a transverse section taken through the console; and

FIG. 7 is the same as FIG. 6, except that the module is swung upwardly to obtain access to the rear thereof.

## DESCRIPTION OF THE INVENTION

Referring now to the drawing and more particularly to FIGS. 1, 2 and 3, there is shown a preferred embodiment of the housing of an individual sub-section or module in accordance with the invention. This housing, which has a box-like configuration, is constituted by four components, namely channel piece 10, a pair of end pieces 11 and 12, and a panel piece 13.

Channel piece 10 is U-shaped to define the rear wall 10A and the top and bottom walls 10B and 10C of the enclosure. This piece is made of sheet aluminum or other suitable metal that is bent to the desired shape. Since all modules in accordance with the invention have the same dimensions except as to their lengths, which may be varied to suit particular needs, all one need do in practice with respect to the channel piece

is to stock strips of aluminum sheeting all having the same width, and to cut these strips to the desired length. In this way, one can provide channel pieces 1 foot long, 15 inches long, or in whatever other length is specified.

Before the aluminum sheets are bent into the channel configuration, holes are drilled at points adjacent the corners of top wall 10B and bottom wall 10C. These holes are made to receive self-tapping screws 14a to 14d for attaching the end pieces 11 and 12 to the top and bottom walls.

End pieces 11 and 12 are identical extrusions, preferably of aluminum, which are so profiled as to include longitudinally-extending parallel grooves 11A-11B, and 12A-12B, respectively. These grooves are dimensioned to accept the self-tapping screws 14a to 14d for securing the end pieces to top and bottom walls 10A and 10B. At the lower edges of end pieces 11 and 12, there are formed grooves 11C and 12C, adapted to accommodate the opposite ends of rear wall 10A of the channel piece to provide a rigid support therefor. Ledges 11D and 12D are formed at the top of end pieces 11 and 12, respectively, to accommodate the edges of front panel piece 13.

Front panel piece 13, which is also an extrusion and which may be of plastic rather than aluminum, is provided with two longitudinally-extending grooves 13A and 13B adapted to receive self-tapping screws 15a and 15d, passing through holes drilled near the ends of ledges 11D and 12D on the end pieces. Front panel piece 13 is provided with upper and lower ridges 13C and 13D which form corners in conjunction with ledges 11D and 12D on the end pieces and which define therewith a rectangular frame enclosing the front panel. The dimensions of this frame are somewhat larger than that of the box, thereby forming a shoulder facilitating console mounting with only the frame of the module exposed.

Thus when the four pieces are assembled to create the box-like module housing as shown in FIG. 2, this housing is adapted to protectively enclose various mechanical and electronic components operating in conjunction with meters, dials, switches and other control and indicating elements mounted on the front panel of the housing.

End pieces 11 and 12 are always of the same size, regardless of the length of the module housing. Hence a stock of identical end pieces may be maintained to make boxes in various lengths. But channel piece 10 and panel piece 13, while always of the same width, have a length depending on the specified length of the module. Hence one need only stock long strips of the channel and panel pieces and cut them to the desired length as the demand for a particular length arises.

This assembly technique is highly flexible and lends itself to the low-cost production of a wide range of module-enclosure lengths, simply by cutting standard preformed pieces to the particular lengths specified for any given application. Thus an inventory for a substantial number of modules need consist only of an inventory of materials for the four pieces.

We shall now consider, in connection with FIGS. 4 to 7, a console or control panel made up of several modules, each of which is housed in a module box of the type illustrated in FIGS. 1 to 3.

In order to bring together a significant number of sub-section units or modules to form an unbroken array

thereof having an aesthetically satisfying appearance, one must be able to place the modules in a row in any desired order without any separation therebetween. In this way, despite the fact that each module is self-sufficient and may be replaced without disturbing the connections to the other modules, the continuous array thereof is visually integrated. Each module, regardless of length, has the same basic configuration, and the grouped modules create an attractive control console.

To accomplish this purpose, a console skeleton is provided, adapted to accommodate a continuous array of modules of the same or varying length, the modules being placed and securely held in side-by-side relation, without any separation therebetween. The console skeleton includes a horizontal main beam 16 having a small front flange 16A and a larger rear flange 16B, both being normal to the beam surface. Hinged to front flange 16A is a carrier strip 17 that is bent to define a section 17A adapted to rest in the shoulder behind the front frame of the module box (see FIGS. 6 and 7), and along the top wall thereof.

Also provided is a base strip 18 adapted to rest in the shoulder behind the front frame of the module box and along the bottom wall thereof, this strip having a downwardly extending front flange 18A and a rear flange 18B. Module M and all other modules in the array are firmly clamped between carrier strip 17 and base strip 18 in the manner to be later described.

Normally, the clamped modules, which swing from main beam 16, occupy a somewhat inclined position for improved viewability, as shown in FIG. 6, wherein the flange 18B of the lower strip 18 abuts a stationary angle beam 19. When, however, access to the rear of the modules is desired in order to make a change in connections, then one simply lifts up the modules in the manner shown in FIG. 7.

All cable connections are made at the rear of the module box; hence by the present invention, access thereto may be had from the front of the console without having to approach the connections from the rear of the console, which rear may be inaccessibly placed against a wall or other pieces of equipment. The modules themselves are free of protrusions of any kind at top or bottom, all plugs, sockets and cable entries being at the rear.

Referring now to FIG. 4, it will be seen that clamped between the strips 17 and 18 are two modules M and M<sub>1</sub>, the latter being longer than the former. In practice, the row of modules between the strips will usually extend the full length thereof to present a continuous integrated appearance.

In order to clamp the row of modules between the strips, clamping members are provided in the form of complementary plates 20 and 21, secured to the left end of strips 17 and 18, and complementary plates 22 and 23 secured to the right end thereof, the plates having elongated matching slots therein to receive bolts. The slots permit relative movement between the complementary plates for the purpose of adjusting the space between the carrier and base strips 17 and 18.

Because of the slots in the clamps, the strips may be loose-fitting when the modules are first placed therebetween. When all modules occupy their desired positions, the right and left end clamps are then tightened. Intermediate clamping force may be applied at intervals along the length of the console row by extending bolts 24 between strips 17 and 18 in the small clearing

between modules in the row, which clearing is created by the abutting module frames.

The clamping bolts are inserted in holes drilled in the strips after the modules are put into place between the strips 17 and 18, so that the modules may be freely slid into their proper position without such movement being obstructed. The clamping bolts completing the assembly are positioned after the module layout for a particular application has been determined.

While there has been shown and described a preferred embodiment of control module in accordance with the invention, it will be appreciated that many changes and modifications may be made therein without departing from the essential spirit of the invention.

What we claim is:

1. A control console comprising

- a. a console skeleton provided with a carrier strip supported from a horizontal beam and a base strip supported in parallel relation to the carrier strip to define a space receiving a row of control modules,
- b. a housing for each of said modules, said housings each being constituted by four pieces which are fastened together to form a box-like enclosure, said pieces consisting of a sheet bent into a channel piece defining the rear and the top and bottom walls of the enclosure, a pair of flat identical end pieces defining the end walls of the enclosure and a panel piece defining the front panel of the enclosure on which dials and other control elements are mounted, and
- c. means clamping said base strip to said carrier strip to hold said modules in said space, said carrier strip being hinged to said horizontal beam whereby said row of control modules may be raised to provide

access to the rear of the modules.

2. A console as set forth in claim 1, wherein said base strip is secured at its ends to said carrier strip by an adjustable clamp.

3. A console as set forth in claim 1, further including an angle beam disposed to abut the edge of said base strip to maintain said modules at an inclined position.

4. A control console comprising:

- a. a console skeleton provided with a carrier strip supported from a horizontal beam and a base strip supported in parallel relation to the carrier strip to define a space receiving a row of control modules, each of which includes a housing whose height is the same for all modules but whose length may be specified, and
- b. means to clamp said base strip to said carrier strip to hold said modules in said space, said carrier strip being hinged to said horizontal beam whereby said row of control modules may be raised to provide access to the rear of the modules.

5. A control console as set forth in claim 8 wherein said housing comprises four pieces which are fastened together to form a box-like enclosure, said pieces consisting of a sheet bent into a channel defining the rear and the top and bottom walls of the enclosure, a pair of flat identical end pieces defining the end walls, and a panel piece defining the front panel, said end pieces being provided with longitudinally-extending grooves receiving self-tapping screws passing through holes in said top and bottom walls, said panel piece being provided with longitudinally-extending grooves receiving self-tapping screws passing through holes in said end walls.

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