United States Patent [19]

Mulvey

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[45] **Jan. 29, 1974**

[54] **MODULAR CEILING CONSTRUCTION**

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[52] **U.S. Cl.** ..... **98/40 DL,** 52/592, 240/9 A

[51] **Int. Cl.**..... **F21s 1/02**

[58] **Field of Search**.. 98/40 D, 40 DL; 52/484, 485, 52/592; 240/9 A, 47

[56] **References Cited**

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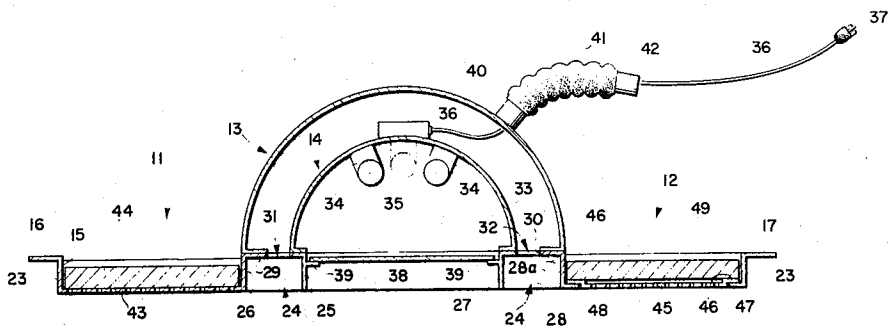
Primary Examiner—William E. Wayner

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[57] **ABSTRACT**

A modular construction unit for ceiling construction and having a unitary frame, ceiling fabric means supported by and incorporated in the frame, suspension attachment means defined by the frame, lighting fixture means attached to the frame and adapted to be supported thereby in position in the ceiling, and air handling means attached to said frame and adapted to be supported thereby when in position in the ceiling and electrical connection means and air handling connection means associated with the lighting fixture means and the air handling means for connection to services within the ceiling, and junction means formed on said frame means around the edges thereof for interfitting engagement with adjacent said units to form a complete ceiling.

9 Claims, 7 Drawing Figures



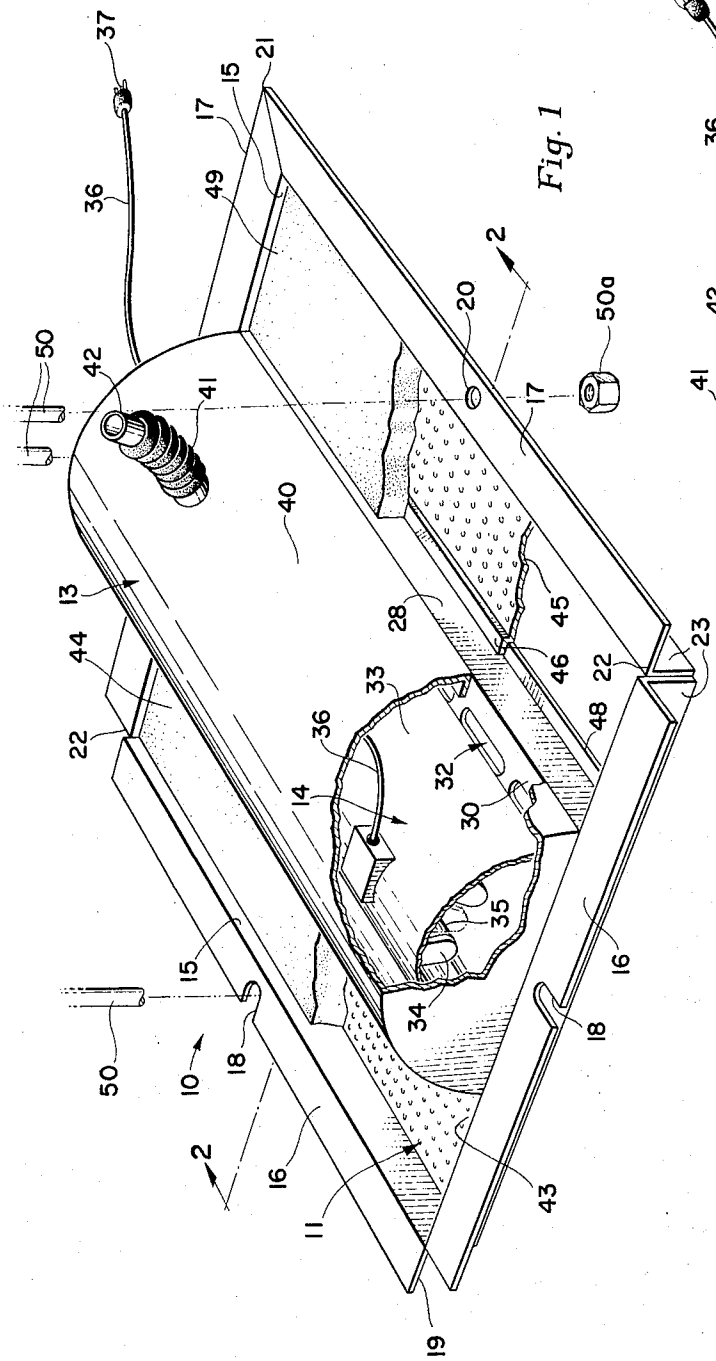


Fig. 1

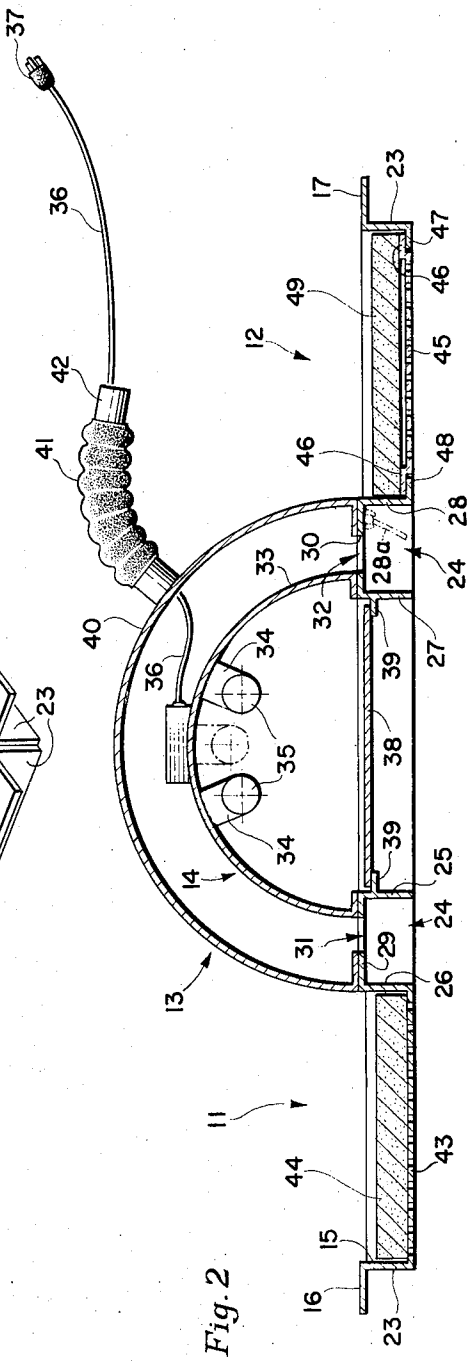


Fig. 2

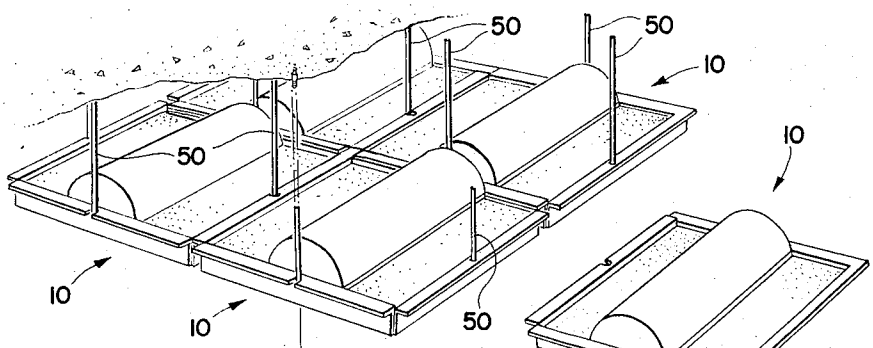


FIG. 3

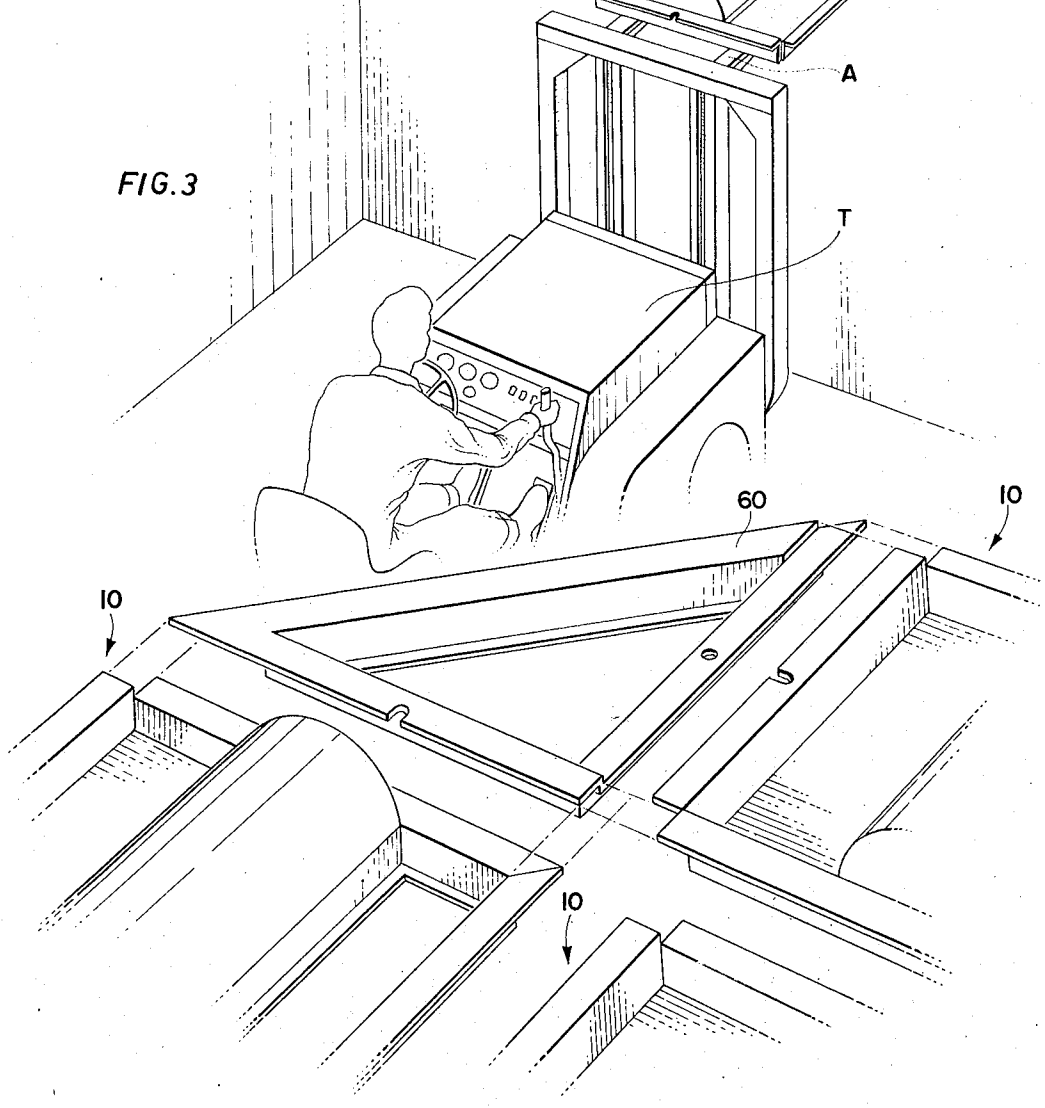


FIG. 4

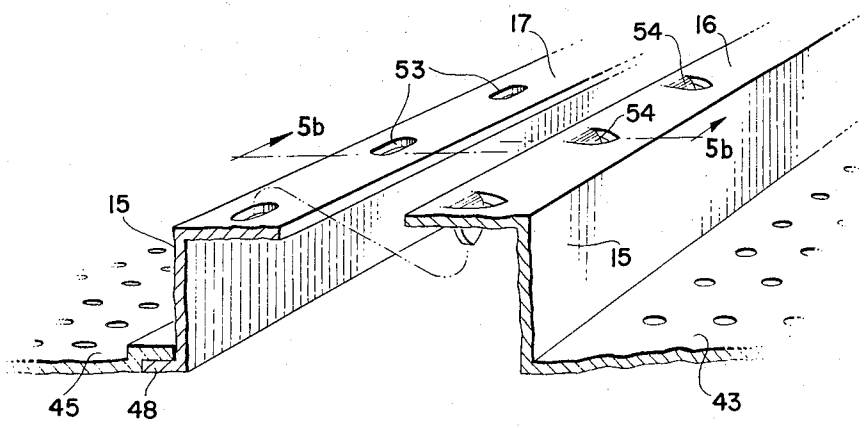


FIG.5a

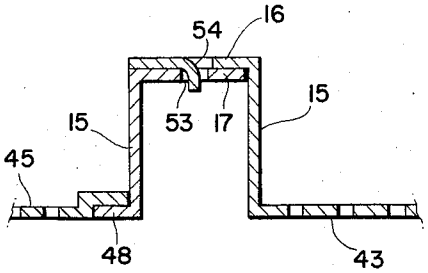


FIG.5b

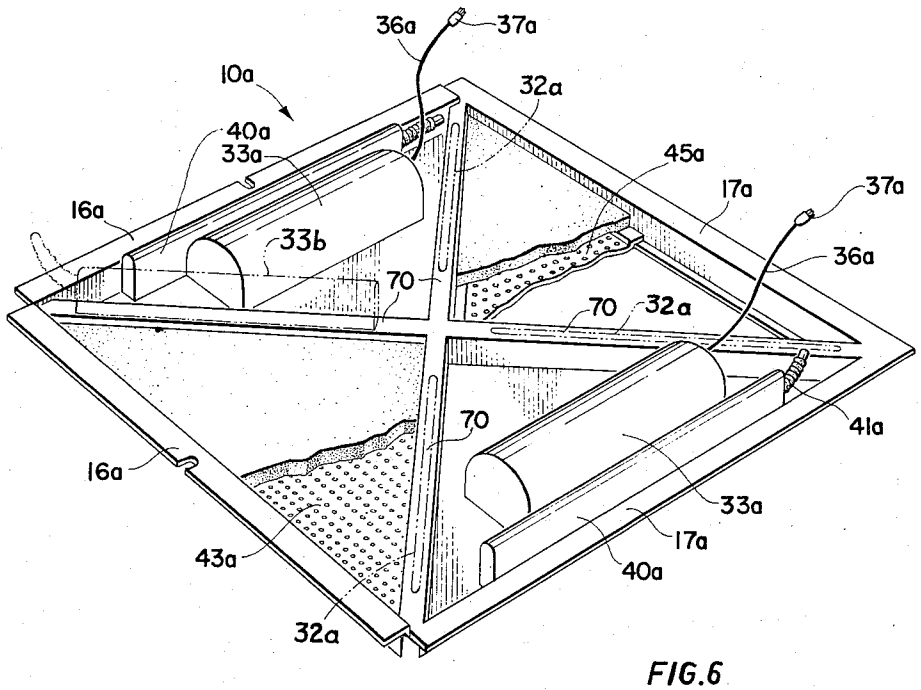


FIG.6

MODULAR CEILING CONSTRUCTION

The present invention relates to a modular construction unit for ceilings, and in particular to a modular construction unit incorporating lighting fixtures, air handling fixtures, and ceiling panel means in a single one piece module.

BACKGROUND OF THE INVENTION

The construction of so-called "dropped" ceilings such as are found in modern high rise construction, and institutional and industrial buildings and the like is now more or less standardized on the basis of the construction of a grid of so-called ceiling tees which are usually suspended from the building fabric, or for example the concrete forming the floor above, by means of bent wires or thin rods. The spaces formed within these grids are then filled in with panels of sound absorbent material. Lighting fixtures are usually supported between the ceiling tees at spaced intervals, and air handling fixtures may be provided separately from the lighting fixtures or along side the lighting fixtures. This type of construction requires a multiplicity of different operations by skilled tradesmen in different trades, all of which must be carried on at the building site itself and from floor to floor. Thus the arrangement of an orderly construction schedule for successive floors is absolutely essential in order to keep the various different skilled tradesmen working continuously without interruption. Any interruptions in their work schedule will of course lead to greatly increased costs. In addition, the requirement for such a multiplicity of different operations requires the delivery of a variety of different supplies from different manufacturers which must again be delivered according to a predetermined schedule to the building site so that they are available as needed, but are not delivered so far in advance that they must be stored for any length of time. Any mishap in the manufacture or delivery of any portion of the supplies required from any particular manufacturer will again interrupt the entire schedule and cause greatly increased costs.

Even assuming that the construction and installation of the ceiling and the various lighting and air handling fixtures is achieved according to the schedule, the labour costs of the various skilled tradesmen still amounts to a major proportion of the cost of the actual construction.

It is therefore desirable, and a principal general objective of the present invention, to provide a modular construction unit for a ceiling construction which can be premanufactured in large quantities in a factory, and shipped to the site as needed from time to time. Preferably, the modular unit will be of such a nature that it both provides its own supporting fabric, thereby doing away with the requirement for ceiling tees altogether, and also incorporates both lighting fixtures and air handling facilities and the fabric of the ceiling itself whether this be sheet metal, sound insulation material or panels of any other material. It is a further objective of the invention to provide a construction system for the construction of ceilings whereby the entire ceiling may be installed and erected in place within a building site using a minimum of labour, and reducing to a minimum the number of different tradesmen required.

BRIEF SUMMARY OF THE INVENTION

The invention therefore seeks to provide a modular construction unit for ceiling construction and having a unitary frame, ceiling fabric means supported by and incorporated in the frame, suspension attachment means defined by the frame, lighting fixture means attached to the frame and adapted to be supported thereby in position in the ceiling, and air handling means attached to said frame and adapted to be supported thereby when in position in the ceiling, and electrical connection means and air handling connection means associated with the lighting fixture means and the air handling means for connection to services within the ceiling, and an access hatchway opening defined in each module by said frame, and closure means therefor.

Preferably, the module will include supporting flange means formed integrally with said frame and extending outwardly therefrom into interlocking overlapping relation with adjacent said flange means on adjacent said modules.

The modular unit according to the invention may further incorporate additional sound absorbant baffle means within the module where desired.

Preferably, the design and shape of the frame of the module will be such as to define continuous interlocking recesses within the ceiling itself for reception of and connection with office partition means within a space beneath the ceiling, whereby to facilitate the erection and movement if desired of such partitions.

According to a further embodiment of the invention provision may be made for the use of lighting fixtures which are either of a standard rectangular shape, or alternatively are of a square or even triangular shape, without departing from the scope of the invention.

The foregoing and other advantages of the invention will become apparent from the following description of a preferred embodiment of the invention which is given with reference to the following drawings in which like reference to the devices refer to like parts thereof throughout the various views and diagrams.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows an upper perspective illustration of the modular construction unit according to the invention partially broken away to reveal its interior;

FIG. **2** is a section along the line **2—2** of FIG. **1**;

FIG. **3** is a schematic upper perspective illustration showing the installation of units of FIGS. **1** and **2**;

FIG. **4** is an enlarged upper perspective corresponding to FIG. **3** and showing an ultimate embodiment.

FIGS. **5***a* and **5***b* show modifications of FIGS. **1** and **2**, and,

FIG. **6** is an upper perspective illustration of al alternate embodiment showing different shapes of lighting fixtures.

DESCRIPTION OF A SPECIFIC EMBODIMENT

Referring now to FIG. **1**, it will be seen that this preferred embodiment of the invention comprises a construction module for a ceiling shown by the general reference **10**, in this case of square shape in plan for the sake of simplicity in construction and layout of the ceiling. Obviously, however, the module **10** could be rectangular or even triangular depending upon the requirements of the particular building.

The module **10** will be seen to be provided with a ceiling panel indicated generally as **11**, an access opening indicated by the general reference **12**, air handling facilities indicated by the general reference **13**, and a lighting unit indicated by the general reference **14**.

In order to support and locate the various constitutent parts of the module **10**, the module **10** is comprised of a framework **15** preferably formed in a square shapes as shown, and located in a more or less vertical plane.

Extending outwardly from the frame **15** a more or less horizontal plane are upper and lower supporting flange members **16** and **17** for interlocking with, and providing mutual interengaging support with adjacent said flanges **16** and **17** of adjacent said modules **10**. As shown, the upper flanges **16** are provided with open ended slots **18**, and at their mutually adjoining corner **19** they are cut square to provide a rectangular shaped notch or recess.

The lower flanges **17** are provided with attachment openings **20**, adapted to receive any suitable supporting system such as extended rods, as shown in FIG. **3**, fastened into the fabric of the building, or the poured concrete of the floor above in a manner to be described below.

The lower flanges **17** at their mutually adjoining corner **21** meet and form a mitred joint, or any other suitable corner formation.

At the corners **22** between respective upper flanges **16** and lower flanges **17** the respective flanges are again cut square so as to define rectangular notches or cutaways. It will be noted that the upper flanges **16** are in a plane spaced vertically above the plane containing the lower flanges **17**. Preferably, such spacing is equal to the thickness of the flanges **16** or **17**, whereby the upper flanges **16** of one said module may be placed in mutually overlying relationship with respect to the adjacent lower flanges **17** of two adjacent modules **10**. Again, preferably, the location of the slotted openings **18** is designed to register with the location of the attachment openings **20** when such flanges **16** and **17** are placed in the aforesaid overlying relationship.

In this way, when the modules **10** are arranged together to form a ceiling, the outwardly directed surfaces **23** of the vertical frames **15** will form the opposite sides of a continuous intersecting network of channels in the ceiling.

Preferably, according to the invention, the dimensions of such channels formed by the sides **23** will be such that they are adapted to receive the upper portions of building partition systems (not shown).

In order to provide the module **10** with air handling openings, either for delivery or return air, two air handling channels **24** are formed parallel to one another across the frame **15** spaced apart whereby to divide the frame **15** into three more or less equal rectangular portions, with the ceiling panel **11** at one end thereof, and the access opening **12** at the other end thereof. Between the two air handling channels **24** the lighting fixture unit **14** is located which will be described in greater detail below. Preferably, the air handling channels **24** are provided by respective pairs of inner and outer side walls **25** and **26** and **27** and **28**. The side walls **25, 26, 27** and **28** are preferably all formed integrally with the frame **15** out of a single piece of material, and lie in spaced apart vertical parallel planes. The side walls **25** and **26** are preferably provided with a discontinuous upper wall **29**, and the side walls **27** and **28** are provided with a similar discontinuous upper side wall **30**. The discontinuous upper walls **29** and **30** define spaced apart lengthwise slotted openings **31** and **32**, whereby to permit air to pass through the air handling channels **24**, either for delivery or return as desired. Air deflector vanes such as **28a** may be provided on side walls **25** and **27** to create desirable air flow patterns.

Preferably, according to the invention the lighting unit **14** consists of a conventional U shaped or rectangular shaped lighting troffer **33**, which may be attached to the upper surfaces of the discontinuous side walls **29** and **30**, in registration with the inner side walls **25** and **27** as shown in FIG. **2**. Alternatively, it may be formed integrally therewith of a single piece of material. The troffer **33** preferably is provided with lighting fixtures **34** for supporting lighting tubes **35** in known manner. A space may be provided therebetween for an additional lighting tube **35** if greater illumination is desired in any particular area of a building, such further tubes **35** being shown in phantom.

Connection may be made through a suitable "ballast" to a source of electrical supply by means of the electrical cable **35** and plug **37**.

A transparent or translucent lens or louver **38** is supported adjacent the lower end of the troffer **33**, preferably by means such as the supporting ribs **39** formed on the inwardly directed surfaces of the inner side walls **25** and **27** as shown, although of course, other support means may be provided if desired. The lens **38** is typically, in accordance with practice in the art removable whereby to permit access to the interior of the troffer **33** for re-lamping when necessary.

The air handling facilities **13** consist of a generally U shaped air housing **40**, such housing **40** being usually known as a "boot" in the trade. The housing **40** is closed at each end, and is preferably attached to the upper walls **29** and **32** of the channels **24**, preferably in registration with the outer side walls **26** and **28** as shown in FIG. **2**. Obviously other means of attachment could be provided, such as attaching directly to the frame **15**, and merely providing for a good snug fit between the housing **40** and the side walls **26** and **28**.

In either case, the air housing **40**, together with the exterior surface of the troffer **33**, will form a continuous chamber in communication with the air handling channels **24**, either for delivery or return of air within the building. The housing **40** is preferably provided with a conventional flexible air hose or duct **41**, provided with any suitable form of connection means such as the reduced diameter collar **42** by means of which it may readily be connected to overhead ducts (not shown) installed in position prior to the installation of the ceiling modules **10**.

Preferably, as shown in FIGS. **1** and **2** both the hose **41** and plug **47** are both located on the side of the air housing **40** which is adjacent the access opening **12** in the frame **15**, whereby a workman may readily reach through the access opening **12** for connection or disconnection of the electrical and air supply with a minimum of difficulty.

The ceiling panel **11** is preferably comprised of a sheet member **43**, formed of the same material as side wall **15**, and formed integrally therewith of a single piece of material, the sheet member **43** extending from frame **15** to outer side wall **26** of air handling channel

24, and extending end to end of the space therebetween between respective frames 15. Preferably, the sheet member 43 will be perforated with a large number of small openings, and a panel of sound absorbent material 44 such as cork or cork composition or the like or any other material such as is known in the art, may be fitted within the well formed over the sheet member 43 by the frame 15 and the side wall 26, whereby to absorb sound from the building space therebeneath.

Alternatively the material of which the sheet member 43 is formed may be such that it is inherently sound absorbing in which case no such a panel 44 will be required.

The access opening 12 is preferably formed by a sheet like trap door member 45, preferably formed of the same material as the frame 15, but in a separate piece, and being formed with upwardly offset supporting flanges 46 therearound. Preferably, the frame 15 is provided with a supporting lip 47, and the outer side wall 28 is provided with a similar supporting lip 48, whereby to interengage with said flange 46 and support said trap door 45 in position, with its lower surface coplanar with the lower surface of the lips 47 and 48 as shown in FIG. 2. If desired, any suitable form of hinging means can be provided on one or other side for the panel 46, although this is generally speaking, not necessary. Preferably, the trap door 45 is perforated with a large number of small openings in the same way as the sheet member 43 whereby to both provide it with a similar appearance thereto when viewed from below, and also whereby to permit passage of sound therethrough. A further sound absorbent panel or pad 49 may be placed over the trap door 45 for absorbing the sound in the building.

Preferably, the modules 10 are supported by means of four spaced apart rods or bolts 50, provided at their lower ends with any suitable form of supporting abutment, or releaseable attachment means such as a threaded fastener, for example, a nut, or a sheet metal type fastener, such as a "speed" nut or any other suitable form of fastener such as are well known in the fastener art, and is omitted for the sake of clarity.

The upper ends of the rods 50 may be secured directly in recesses formed in the concrete fabric of the building by any suitable means known in the art such as a collar (not shown) on a tapered upper end of the bolt 50 such as is employed on bolts manufactured by Isometric Limited of Toronto, Canada, under the Trade Mark "ISO-BOLT," or by any other means.

It will of course be understood that only two such bolts 50 are employed for each module 10.

With reference to FIG. 3, the mode of installation is shown, and it will be seen that a first module 10 may be installed along one side of the building by the installation of four bolts 50 in vertical alignment with the slotted recesses 18, and the attachment openings 20 of the flanges 16 and 17. Such first module 10 will then be raised into position by any suitable means such as a moveable hoist truck indicated as T having a pair of horizontal arms A upon which the module 10 may be supported and raised into position. A workman, working on the hoist or a suitable mobile platform (not shown) may then place himself immediately beneath the module 10 and introduce the lower ends of the bolts 50 through the slotted openings 18 and attachment openings 20, and fasten them in position.

The next and each subsequent module 10 in a row of modules 10 being erected across a building space will then be raised in position by the truck T, and the second workman will then slide the module 10 sideways in a diagonal manner until the slotted openings 18 are fitted around the two adjacent bolts 50 of the two adjacent modules 10. In this position, the upper flanges 16 will overly the lower flanges 17 of the adjacent module 10, and once slid into position the upper flanges 16 will obtain support from the bolts 50 extending through the slotted openings 18. The workman then introduces the lower ends of the rods 50 through the two remaining attachment openings 20 and fastens them as described above, after which he is free to proceed to the next module 10. As he installs and erects each module 10, the workman can simply reach through the access opening 12 and connect up the collar 42 of the flexible air hose 41, and connect up the plug 37 of the electrical cable 36 and that module is then both installed and connected to the electrical and air handling services and is ready for use without further attention.

These connection operations can of course be simplified to the point where they can be performed by suitable machinery as part of the installation operation, without requiring separate and distinct manual operations.

According to a further embodiment of the invention as shown in FIGS. 4*a* and 4*b* provision can if desired be made for interlocking between the flanges 16 and 17 by means such as the openings 53 formed in the lower flanges 17, and the downwardly struck out tongues 54 formed in the upper flanges 16. The tongues 54 are adapted to register with and enter the openings 53 when the flanges 16 and 17 are placed in overlying relationship as shown in FIG. 4*b*.

In some cases it may be desirable to provide modules 10 of different shapes for example hexagonal or triangular, as shown for example by module 60 in FIG. 4.

According to a further embodiment the invention, the entire module 10 may be adapted so as to accommodate lighting tubes of a different shape, for example U shaped lighting tubes may be desirable in some building locations to provide a more flexible arrangement of building partitions to be erected to divide the building space into separate offices.

Such a further embodiment is shown in FIG. 5. For the sake of simplicity, in this alternate embodimention the same reference numerals are used with the suffix *a*, to show the same physical features although of course, they are arranged in a different manner. Thus the module or unit is shown as 10*a*, and will again be seen to be provided with a square frame 15*a*, and side flanges 16*a* and 17*a*.

However, in order to accommodate a different layout or a different ceiling design the wall members 25*a*, 26*a*, 27*a* and 28*a* are arranged in a diagonal manner from the four corners of the frame 15*a*, whereby to intersect in the middle, thereby dividing the square defined by the frame 15*a* into four equal triangles.

A modified form of lighting troffer 33*a* is located and supported in one of the triangles, and contains a somewhat different form of fluorescent lighting tube (not shown), being obviously shorter than the two shown in FIGS. 1 and 2, and preferably being of the U-shaped design such as is currently available.

A somewhat modified form of air handling boot 40*a* is arranged separately from the troffer 33*a*, whereby to

provide for delivery of air along the length of the troffers 33*a* as shown, suitable delivery and return openings or slots (not shown) being provided as before.

In some ceiling designs the air delivery, or return, may be controlled by zones within the ceiling space, and air will be supplied directly into (or withdrawn from) such a zone without individual boots 33 or 33*a*. In such cases slots 32*a* may be provided as desired in the frame 17*a* or 70, and some of such slots 32*a* will be connected with boots 32*b* and others will be free, providing for air delivery in one set of slots, and air return in the others. Similarly the ceiling panel 43*a* can itself be permeable to air for the same purpose, the sound absorbent panel 44 being omitted where air flow is desired.

The foregoing is a description of a preferred embodiment of the inventor which is given here by way of example. The invention is not to be taken as limited to any of the specific features as described but comprehends all such changes as come within the scope of the claims.

I claim:

1. A modular ceiling construction unit for a ceiling construction of the type in which air handling and electrical supply facilities are concealed in the space between the ceiling and the building structure, said unit having an upper concealed side and a lower visible side, said construction unit comprising;

unitary frame means;

ceiling fabric means supported and incorporated in said frame means;

suspension attachment means on said frame means;

lighting fixture means attached to said frame means and supported thereby in position in said ceiling;

electrical connection means connected to said lighting fixture means, and adapted to make electrical connection with an adjacent electrical supply within said space;

air passage means formed in said construction unit for passage of air therethrough from one said side to the other thereof;

air handling means attached to said frame means and supported thereby when said unit is in position in said ceiling and in communication with said air passage means;

air handling connection means connected with said air handling means, and adapted to interconnect with air handling facilities adjacent to said unit within said space;

junction means formed on said frame means around the edges thereof for interfitting engagement with adjacent said units to form a complete ceiling, and,

access hatchway opening means defined in said unit, and closure means therefor whereby to permit access to the upper concealed side of said unit from the lower side thereof.

2. A modular ceiling construction unit as claimed in claim 1 wherein said frame means defines a recessed channel extending at least partially therearound, and wherein said air passage means includes slotted openings in said frame means opening into said recessed channel, and along at least part of the length of said channel.

3. A modular ceiling construction unit as claimed in claim 1 including edge flange means for interengagement with adjacent said flange means on adjacent said construction units for mutual interlocking supporting engagement between said units when in position in said ceiling.

4. A modular ceiling construction unit as claimed in claim 3 wherein said unit defines four sides, and including said edge flange means on all four sides thereof, arranged in pairs, one said pair of edge flange means being offset in a plane relative to the other said pair of edge flange means whereby the plane of one said pair is displaced vertically relative to the plane of the other said pair by an amount equal to about the thickness of said flange means.

5. A modular ceiling construction unit as claimed in claim 4 wherein said flange means define notched recesses at three corners, and wherein said flange means meet at a fourth corner.

6. A modular ceiling construction unit as claimed in claim 1 wherein said frame means and said ceiling fabric means are formed in one piece integrally with one another of a single sheet of material.

7. A modular ceiling construction unit as claimed in claim 1 including wall means traversing said frame side to side thereof, slotted opening means formed in at least some of said wall means, and forming said air passage means, and an air handling chamber, defining said air handling means, attached in registration with said slotted opening means for communication of air therethrough.

8. A modular ceiling construction unit as claimed in claim 1 including wall means traversing said frame means and defining a space therebetween, means for supporting a light trasnmitting panel member formed on said wall means, and a light transmitting member supported thereby, and said lighting fixture means being attached to said wall means in registration with said light transmitting panel.

9. A modular ceiling construction unit as claimed in claim 1 including means defining two channels spaced apart from one another and traversing said frame means, and attached thereto in mutually supporting relationship, slotted opening means within said channel means and forming said air passage means, said slotted opening means being recessed within and substantially obscured from view by said channel means, and including air deflector means within said channel means.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,788,206 Dated January 29, 1974

Inventor(s) Gerard Edmond Mulvey

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 46, cancel "Fig. 5" and insert -- Fig. 6 --;
Column 6, line 52, cancel "15a" and insert -- (unnumbered --;
Column 6, line 55, cancel "25a, 26a" and insert -- 25, 26 --;
Column 6, line 56, cancel "27a and 28a are" and insert -- are replaced by the channel frame portions 70 --; Column 6, line 56, after ...manner insert -- extending --; Column 6, line 57 and line 59, cancel "15a".
Column 7, line 7, cancel "33 or 33a";
Column 7, line 10, cancel "32b" and insert -- 40a or 33b --.

Signed and Sealed this

nineteenth Day of *August 1975*

[SEAL]

Attest:

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Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

USCOMM-DC 60376-P69
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