

[54] **CEILING STRUCTURE WITH LIGHTS**

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[51] Int. Cl.F21s 3/14

[58] Field of Search52/28, 484, 495; 240/9 A, 51.11 R; 98/40 DL

[56] **References Cited**

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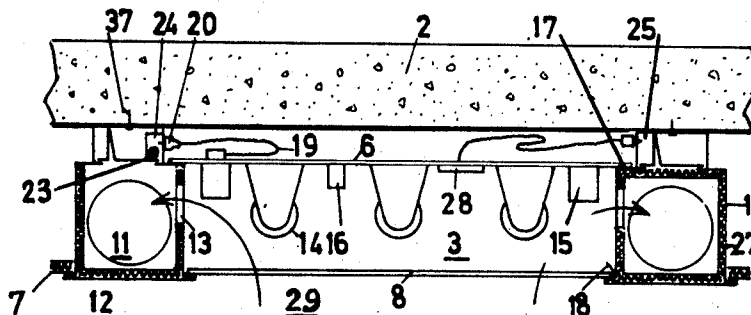
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Assistant Examiner—Henry E. Raduazo
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EXEMPLARY CLAIM

As a part of a ventilating or air conditioning system a plurality of parallel hollow carrier sections are arranged in spaced relation under a ceiling slab. Said hollow carrier sections are provided with upper and lower support means facing towards the space between said carrier sections. At least some of said upper means support carrier plates provided with lighting fixtures on the underside thereof. At least some of said lower means support transparent or translucent optical panels provided under and spaced from said carrier plates. Other of said lower means support acoustic panels, cover plates or the like. Air flow connection from the underlying room to the space between the carrier plates and the optical panels is ensured. The walls of the parallel hollow sections are provided with apertures being in air flow connection with the spaces between the carrier plates and the optical plates to cause the air flow from the underlying room when the ventilating system is in operation to ventilate the lighting fixtures on its way to the interior of the hollow section. The air flow stream may be reversed.

17 Claims, 8 Drawing Figures



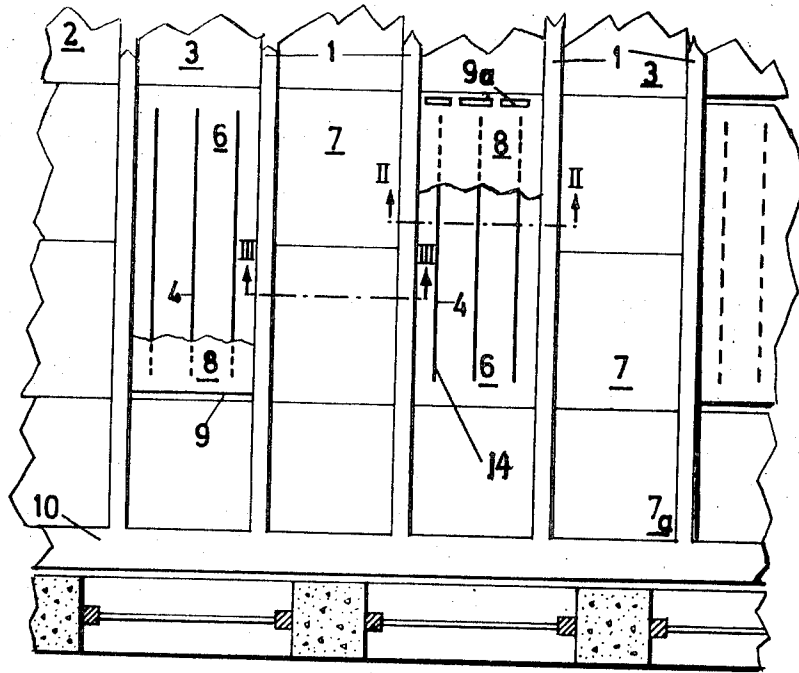


FIG. 1

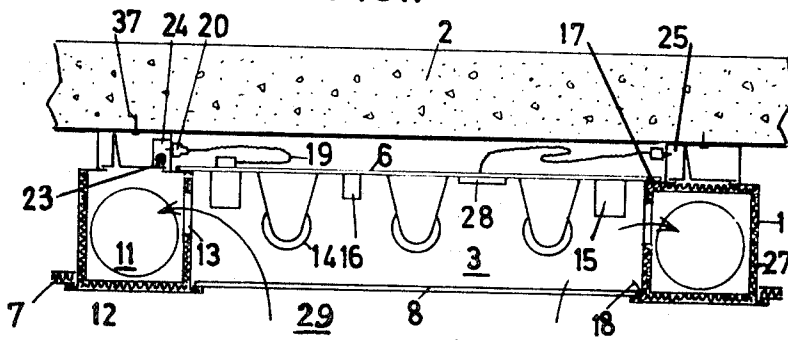


FIG. 2

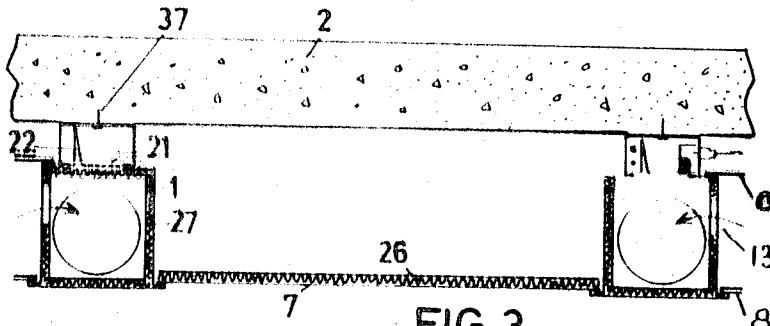


FIG. 3

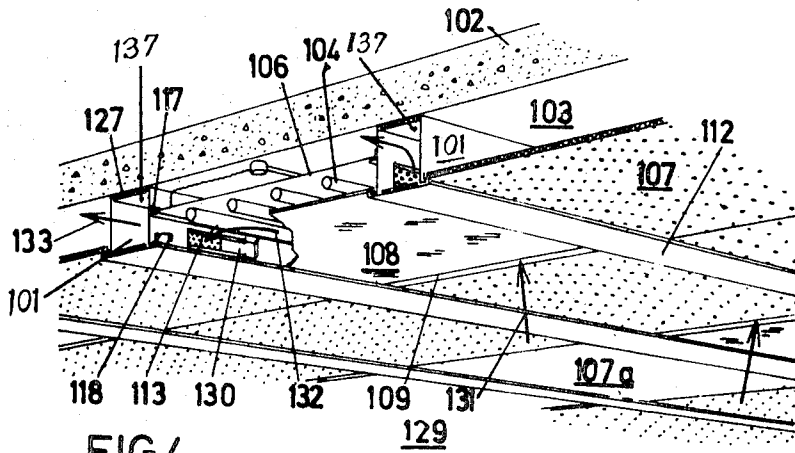


FIG. 4

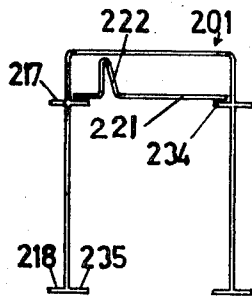


FIG. 5

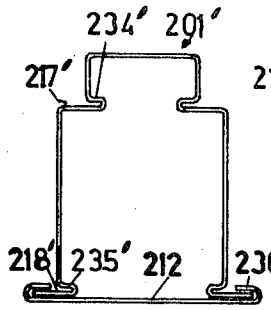


FIG. 6

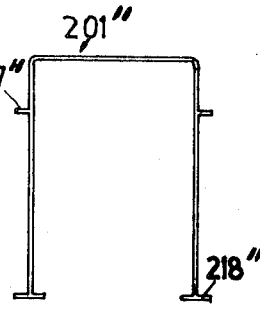


FIG. 7

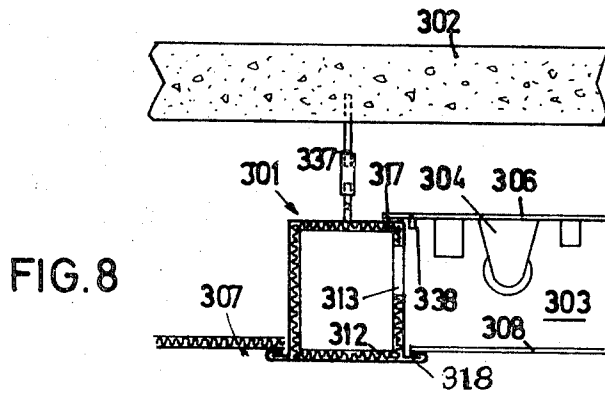


FIG. 8

CEILING STRUCTURE WITH LIGHTS

This invention relates to a ceiling structure with air ventilated lighting fixtures mounted therein in a system arranged for supply and/or removal of air to/from the room situated beneath.

Various so-called hung-ceiling structures are formerly known comprising a plurality of hollow sections mounted in spaced relation on the under-surface of the ceiling slab and serving as mounting means for plate-shaped panels. In some formerly known arrangements hollow sections are connected with a common collecting and distribution system to be employed in supplying and/or removal of conditioned/exhaust air to/from the underlying room.

In some other previously known arrangements channel sections have been suggested shaped with mounting means for supporting plates, e.g. for electrical lighting fixtures. Conduits, wires, cables and the like have been arranged in the interior of such channel sections.

Lighting fixtures mounted in hung-ceiling structures develop considerable amounts of heat. It has been found that, for example the optical efficiency of electric lighting tubes varies with the temperature of the tube, the maximal light output being obtained in a relatively limited temperature range. In order to increase the efficiency, the heat developed must be removed. The removed heat can be utilized to heat directly the underlying room, however, provided the amount of heat necessary to heat said room is not too large, it has shown to be more suitable to remove the heat from the lighting fixture by conducting the exhaust air from the room through the lighting fixture and thus out of the room, as the amount of heat being in circulation can be controlled better and less expensive in this way.

In ceiling structures regard must also be paid to the acoustic conditions. This is effectively done by suitable selection and location of so-called acoustic panels, fully or partly insulating of the channel sections, etc.

It happens that lighting fixtures as well as acoustic plates must be repositioned and/or replaced when the activity performed in such a room has changed its character. If the activity for instance changes from an office activity to a workshop activity, the location of the lighting fixtures and the acoustic panels must be re-arranged.

Previously known hung-ceiling structures have a considerable height dimension resulting into a considerable reduction of the available cubic volume of the underlying room.

In view of what has been mentioned above an object of the invention is to provide a so-called hung or dropped ceiling structure of the kind referred to, comprising a plurality of lighting fixtures mounted between said hollow sections, wherein an effective cooling or ventilating of the lighting fixtures is insured.

Another object of this invention is to provide a ceiling structure which allows for very simple mounting and demounting of the lighting fixtures with their attachments and of the acoustic elements without need of special tools and skilled labour.

A further object of this invention is to provide a hung-ceiling structure which allows for quick, simple and inexpensive re-arrangement of the location of the lighting fixtures and the acoustic underpanels and other underpanels, when necessary.

A further object of this invention is to provide a hung-ceiling having a substantially reduced height relatively to conventional structures of similar kind.

These and other objects of the invention will appear from the following description and the claims.

According to the invention a plurality of parallel hollow carrier sections are mounted in spaced relation under a ceiling slab, at least some of said sections serving as ventilation conduits being connected with a collection or distribution system and having in their walls apertures facing towards the space between said hollow sections. The hollow section walls facing towards said spaces have at least along a portion of their length upper support means supporting carrier plates being spaced from the ceiling slab and carrying lighting fixtures mounted on the underside thereof. Said section walls are also

provided with lower support means to support transparent or translucent optical underpanels provided at least at locations where said lighting fixtures are mounted and supporting at other locations acoustic underpanels, cover panels or the like.

The optical underpanels are arranged or made so that air flow connection is insured between the underlying room and the inclosure between the carrier plates and said optical underpanels wherein the lighting fixtures are arranged. Said flow connection can be insured by arranging at least the optical underpanels in spaced relation to each other and/or to adjacent other underpanels, so as the acoustic panels. Said inclosure is in air flow connection with the interior of the hollow section or sections through the said apertures in the hollow section walls.

The invention will be described more closely in the way of examples and in connection with the drawings, wherein:

FIG. 1 represents a schematic partial bottom view of a ceiling according to the invention.

FIGS. 2 and 3 are fragmentary schematic cross-sections in a larger scale substantially along the lines II—II and III—III, respectively on FIG. 1, according to one embodiment of the invention.

FIG. 4 is a schematic fragmentary perspective view with some portions broken away of a ceiling according to another embodiment of the invention.

FIGS. 5, 6 and 7 are end views of some channel sections with different forms.

FIG. 8 is a fragmentary schematic section corresponding substantially to the lefthand portion of FIG. 2 of a further embodiment of the invention.

According to FIG. 1 a plurality of parallel hollow channel sections 1 are mounted in spaced relation under the ceiling slab 2 to provide a number of longitudinal spaces 3 therebetween. In two of said spaces 3 carrier plates 6 are shown arranged between the channel sections 1 supporting electric lighting fixtures 4 which will be described more closely in the following. Acoustic panels 7 which will also be disclosed in detail in the following are also provided between said channel sections 1 at locations not occupied by the carrier plates 6. Under the lighting fixtures 4, on the side facing towards the underlying room, transparent or translucent panels 8 are provided between said channel sections 1. Portions of the panels 8 are broken away shown for the sake of clarity. Transverse spaces or slits 9 are provided between the panels 7 and 8, said panels being positioned substantially in the same plane. A distribution and/or collection channel section 10 extends along the wall of the room and is in air flow connection with some or all of the channel sections 1.

FIG. 2 shows in a larger scale a cross-section along the line II—II in FIG. 1. The channel sections 1 are shaped as shown in FIG. 6, which will be described later but other channel forms may be used. According to FIG. 2 the channel sections 1 are mounted directly on the under-surface of the ceiling slab 2, for instance by bolting by means of a bolting gun as shown at 37 in FIGS. 2 and 3. The channel sections 1 are connected through apertures 11 with a collection channel (so as 10 in FIG. 1). At their lower end the channel sections 1 are closed with a cover plate 12. The side wall of the channel section 1 is shaped with one or more apertures 13 (one is shown) connecting the space 3 between the channel sections with the interior of said sections, the arrangement being such that the aperture 13 is extending below and near the level of the carrier plate 6. The carrier plate 6 to support lighting fixtures is mounted between the channel sections 1. Three lighting fixtures are shown comprising lighting tubes 14, induction coils 15 and ignitors 16. Said carrier plate 6 bears also a fire alarm element 28. Instead of arranging the underlying panels 7, 8 with transversal slits 9 extending therebetween, optical panels 8 and/or the adjacent panels 7 may be provided having slits, apertures, etc. extending in generally transversal direction and preferably adjacent the transversal edges of the under panels as shown at 9a in the right hand portion of FIG. 1.

It will be evident that instead of bolts 37 other mounting elements may be used for instance suspension rods 337 as shown in FIG. 8 to support the ceiling construction in spaced relation from the ceiling slab.

In the upper part the channel sections 1 are provided with upper support shelves 17 for the carrier plates 6. At their lower ends the channel sections 1 have lower support shelves 18 to support optical panels 8 of glass or other transparent or translucent material. The glass panels 8 are arranged with transversal spaces 9 therebetween or shaped with perforations 9a arranged suitably along the transversal edges thereof to provide for air flow connection from the underlying room 29 to the space 3 between the glass panel 8, the carrier plate 6 and the inside walls of the channel sections 1.

The carrier plates 6 with lighting fixtures 14-16 and the necessary electrical equipment are delivered prefabricated from the supplier and provided with connection cables 19 and possibly also with contact plugs 20 for connection to the electric main line 23. The carrier plate 6 has the necessary stiffness and strength to support the lighting fixtures and their accessories. The width dimension of the carrier plate 6 in direction transversely to the longitudinal sections 1 is so that when mounting the plate the same can be moved obliquely upwardly inbetween the channel sections 1 and then laid down on the upper shelves 17 of said channel sections. The length of the carrier plate 6 is adapted to the length of the lighting fixtures 14.

As shown in FIGS. 2 and 3 in the upper part of the section 1 a partition plate 21 is arranged and provided with an upstanding rib 22, dividing the upper portion of the channel into two sections. One section can contain heavy current cables 23 and possibly plug boxes 24 for contact plugs 20, whilst the other section can contain weak current wires 25, for instance to be connected with a fire alarm element 28.

FIG. 3 shows in a larger scale a cross-section substantially along the line III-III in FIG. 1. The channel sections 1 are arranged as described in connection with FIG. 1. The space between the channel sections 1 is at the bottom end thereof covered with an acoustic panel 7 having on its upper surface a mat 26 of sound-absorbing material. Generally the panels 7 are perforated. The channel section 1 are on some inside portions thereof covered with insulating material 27.

FIG. 4 is a perspective partial view of a hung-ceiling in accordance with another embodiment of the invention. Two channel sections 101 with U-shaped cross-section as shown at 137 and with the open side thereof facing downwardly, are mounted to the underside of the hung-ceiling slab 102 and thus providing a longitudinally extending space 103 therebetween. However, mounting means as shown at 337 in FIG. 8 can be used. The bottom side of the channel sections 101 is closed with cover plates 112 of similar kind as shown in FIGS. 2, 3 and 5. The top and the bottom of the channel sections 101 are covered inwardly with a sound-absorbing material 127. The lateral walls of the channel sections facing towards the space 103 are provided with openings 113, located in the lower portion of the height dimension of the channel sections 101. According to the example in FIG. 4 the opening 113 comprises a group of smaller perforations and can be closed fully or partly by means of a slide plate 130 (control means thereto are not shown). The opening 113 is preferably arranged approximately in the middle of the length of the lighting fixtures. On the lateral walls of the channel sections in a height above the openings 113, L-shaped sections 117 are horizontally mounted, to support a carrier plate 106 carrying lighting fixtures 104 suspended therein (only the lighting tubes are shown). At their lower edges the U-shaped channel sections 101 are shaped with horizontal out-turned flanges 118 which support the channel cover plates 112 and the optical panels 108 of translucent material, located under and spaced from the lighting fixtures 104. In the remaining portions of the hung-ceiling the spaces 103 are closed downwardly with acoustic panels 107a, 107 or other panels of suitable kind. The optical panels 108 are arranged somewhat spaced in longitu-

dinal direction to provide transversal slits 109 to ensure proper air flow connection with the underlying room 129. However, instead of arranging the optical panels in spaced relation to the adjacent panels in longitudinal direction, optical panels may be used formed with a row of aligned slits or perforations extending adjacent the transversal edges of said panels to provide for said air flow connection. The acoustic panels 107 can be arranged in mutually abutting relation.

The air flow to cool or ventilate the lighting fixtures by the air exhausting from the underlying room is indicated with arrows 131-133 in FIG. 4 (see also the arrows in the embodiment FIG. 2). By means of a suitably ventilating or air-conditioning system air is sucked from the underlying room 129 through the gaps 109 as shown by 131 to pass along the lighting fixtures 104 and through the apertures 113 as shown by 132 into the channel sections 101 to be conducted (as shown by 133) to and collected in collecting channels (similar to the channel 10 in the embodiment of FIG. 1) to be delivered to an air-conditioning system or exhausted into the free. If it is desired to utilize the heat from the lighting fixtures 104 to heat the underlying room 129, the air flow circulation indicated above can be reversed.

FIG. 5 is an end view of a supporting U-shaped channel section 201 of the invention. At the lower ends of the legs of the U transversal flanges extend along the edges thereof to provide the lower support shelves. The flanges are made with an inner portion 235 and an outer portion 218 to provide a support for a cover plate. In the upper part of the channel section upper supporting shelves 217 are provided as shown. Upper inner shelves 234 provide supports for a partition wall 221 having a vertical rib 222, as described in connection with the embodiment of FIGS. 2 and 3. The lower inner flanges or shelves 235 may be useful to support some structural elements located in the channel section 201.

FIG. 6 is an end view of a channel section 201 of the kind similar to that described in connection with FIGS. 2 and 3. In some distance from the base of the U the legs of the U are folded inwardly and then rebated outwardly to provide inner shelves 234' and then turned downwardly to provide the outer shelves 217' intended to support the carrier plates of the lighting fixtures. At their lower ends the legs of the U are turned inwardly and then outwardly to provide inner and outer shelves 235', 218', respectively. The outer shelves 218 serve to support the optical panels, acoustical panels and other underpanels, as described hereinbefore. FIG. 6 shows also a cover plate 212 with inturned flanges 236 to close the lower open end of the U.

FIG. 7 shows another embodiment 201' resembling that used in connection with the structure in FIG. 4. The upper and lower shelves are illustrated at 217'' and 218'', respectively.

FIG. 8 represents a further embodiment of the invention and corresponds substantially to the left hand portion of FIG. 2. A channel profile section 301 with cross-section of an inverted U is suspended in spaced relation from the ceiling slab 302 by means of a conventional and therefore not described suspending means 337 with adjustable length fixedly mounted at its upper end in said ceiling slab. At its lower end the channel section is provided with lower support means in shape of outwardly facing flanges 318 extending horizontally along the section edge. The horizontal edge portions 317 of the top of the channel section (or of the base of the U) constitute the upper support means to support a carrier plate 306 with lighting fixtures 304 (only one is shown) as described above. The flanges 318 support an optical underpanel 308, an acoustic underpanel 307, and a channel cover plate 312, respectively, as illustrated. At either transversal ends (one is shown) of the carrier plate 306 suitable stops 338 are provided to keep the carrier plate in correct position in transversal direction. The interior of the channel section 301 communicates through an aperture 313 in the channel section wall with the cavity 303 defined by the carrier plate 306, the optical panel 308 and the lateral walls of the adjacent channel sections 301. As for the rest the arrangement is as described in connection with the FIGS. 1-4.

The U-shaped channel sections may be manufactured by folding suitable metal sheet material or by extruding light metal material from a suitable die. Suitable plastic materials can also be used. In the case of a U-shaped channel section, made by folding a sheet material, the upper and lower support members can also be provided by metal strips, L-shaped profiles or the like connected to the legs of the U in any suitable manner.

In the embodiment described above it is not necessary that the upper and lower support means such as the shelves 17, 117, 217; 18, 118, 218; 234, 235 extend continuously along the whole length of the channel sections. Thus, said support means comprise protrusions, pins, short profile sections secured to or formed integrally with the channel sections in a suitable manner, such as by adhesive, welding, riveting or the like.

The present invention has been described above for the purpose of illustration only and it is not intended to be limited by this description or otherwise except as defined in the appended claims. Thus, it should particularly be noted that according to the invention the under surface of the ceiling structure can comprise translucent and/or transparent panels only suitably supported by the channel sections.

The carrier panels can be manufactured of steel sheet material or plastic material. The under cover panels can be made of any suitable material such as wood, plywood, fibrous plastic, sheet metal, etc. The optical panels can be made of glass sheet, plastic sheet material, combination of glass and metal, etc. Any other suitable material may be used.

What is claimed is:

1. A hung ceiling construction embodying a lighting and air conditioning system comprising a plurality of inverted substantially U-shaped elongated channel sections having upright walls; mounting supports disposing said sections in horizontally spaced relation; cover means closing the under side of said inverted substantially U-shaped channel sections to form at least one ventilation conduit of said air conditioning system; an upper support member in the form of at least one upper support panel disposed substantially horizontal between adjacent channel sections and extending at least partially along the length thereof; electric lighting fixtures mounted on the underside of said upper support panel; upper support means on the channel sections mounting said support panels and lighting fixtures above the level of said cover means; lower support means adjacent the lower end of said upright walls of said channel sections; a plurality of under panels supported on said lower support means in coplanar relation to define the interior ceiling surface, the under panel underlying said lighting fixtures comprising an optical panel; said upper support panels, said ceiling surface and the upright walls of said channel section therebetween defining a cavity above said optical panel; the upright wall of said ventilation conduit having means defining at least one ventilation passage therein affording air flow between said cavity and the interior of the channel section, and means providing an air flow passage through said ceiling surface, through said cavity, and through said ventilation passage.
2. A ceiling construction according to claim 1, in which the ceiling surface comprises a plurality of optical panels spaced longitudinally from one another to provide said air flow passage between said panels in the bottom of said cavity.
3. A ceiling construction according to claim 1, in which said optical panel is spaced from the adjacent under panels, and

said air flow passage are transverse slits between the optical under panels and the adjacent under panels.

4. A ceiling construction according to claim 1, in which the under panels have apertures adjacent the ends thereof, to define said air flow passage.

5. A ceiling construction according to claim 1 wherein said lighting fixtures are lighting tubes with induction coils, ignitors and standard attachment thereto, in which the lighting tubes are arranged parallel to the channel sections and wherein the ventilation passage in the channel section walls is located about in the middle of the lighting tubes.

6. A ceiling construction according to claim 1 in which the U-shaped channel sections terminate in horizontal-spaced lower edges, said cover means comprising a plate spanning between said edges coplanar with said under panels, the lower support means comprising horizontal flanges extending outwardly from the lower edges of the channel sections.

7. A ceiling construction according to claim 6, in which the upper support means are flanges extending horizontally from said channel sections in vertically-spaced relation from the lower support means.

8. A ceiling construction according to claim 6, in which the bases of said inverted U-shaped channel sections provide flat surfaces constituting the upper support means, the width dimension of the upper support panel members being greater than that of space between adjacent channel sections, the mounting supports for the channel section includes a ceiling slab disposed above the top of the channel section.

9. A ceiling construction according to claim 8, in which the mounting supports include adjustable length suspension means.

10. A ceiling construction according to claim 1 including sound absorbing material supported by the under panel.

11. A ceiling construction according to claim 10, in which at least some portions of the inner surface of the channel sections are covered with sound absorbing material.

12. A ceiling construction according to claim 1 including means to close the ventilation passage in the channel section wall.

13. A ceiling construction according to claim 1 in which at least some of the under panels are acoustic sound absorbing panels.

14. A ceiling construction according to claim 1 in which the channel sections are at least partly insulated with heat-absorbing material.

15. A ceiling construction according to claim 1 wherein said inverted U-shaped channel section has a plane top base that along the sides thereof merges into downwardly turned upper side wall portions, which portions at a distance from the top are turned inwardly and then under themselves and outwardly to provide said upper support means and then are turned downwardly to provide said upright walls which are mutually spaced to a greater extent than the upper side wall portions, said upright walls being turned at their lower ends inwardly under themselves and outwardly to provide said lower support means.

16. Channel section according to claim 15, including a horizontal partition wall resting on the upper inturred surfaces and dividing the channel into a lower and an upper channel portion.

17. Channel section according to claim 16, including a vertical partition rib on the partition wall.

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