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[54] **CEILING ASSEMBLY AND METHOD**

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[58] **Field of Search** ..... 98/40 D; 52/461, 465, 469, 52/484

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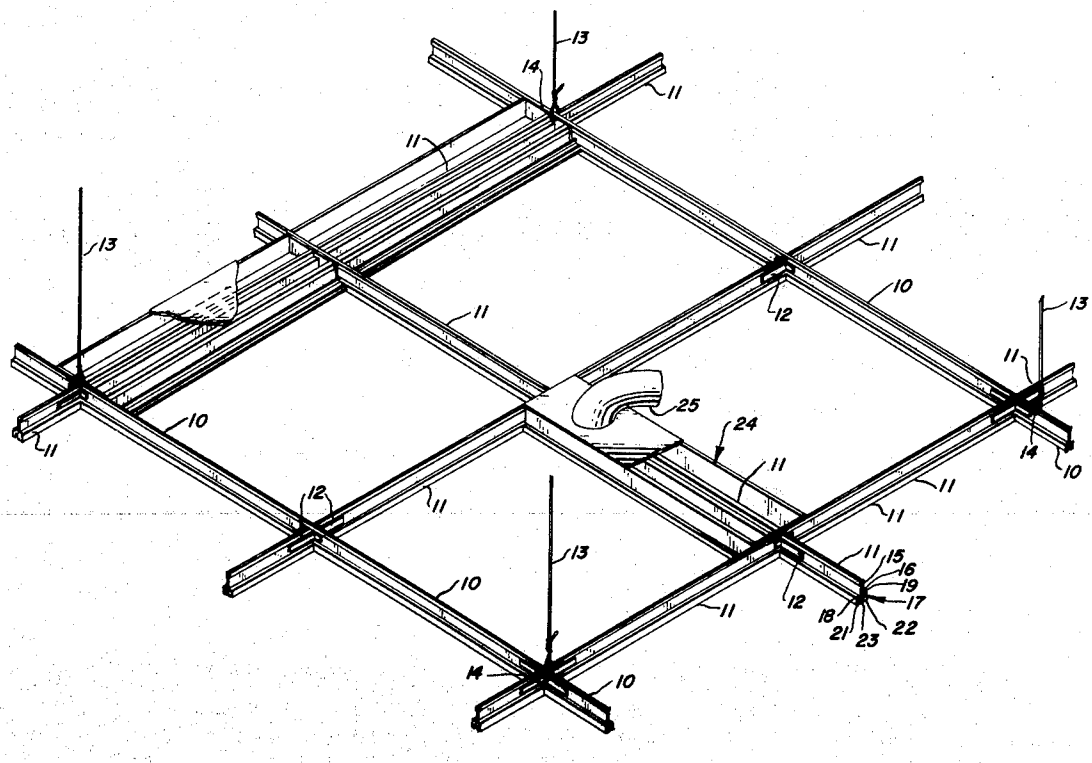
[57] **ABSTRACT**

A ceiling assembly including a grid of main and cross runners, an air diffuser disposed over a portion of the length of one of the runners for emitting air through a portion of the grid, and a removable cap member disposed over the one runner beneath the air diffuser to modify the air diffusion characteristics of the runner with respect to air emitted from the air diffuser. Methods for forming and for modifying ceiling assemblies using the above elements to provide the desired pattern of air diffusion which can be readily changed.

2 Claims, 3 Drawing Figures



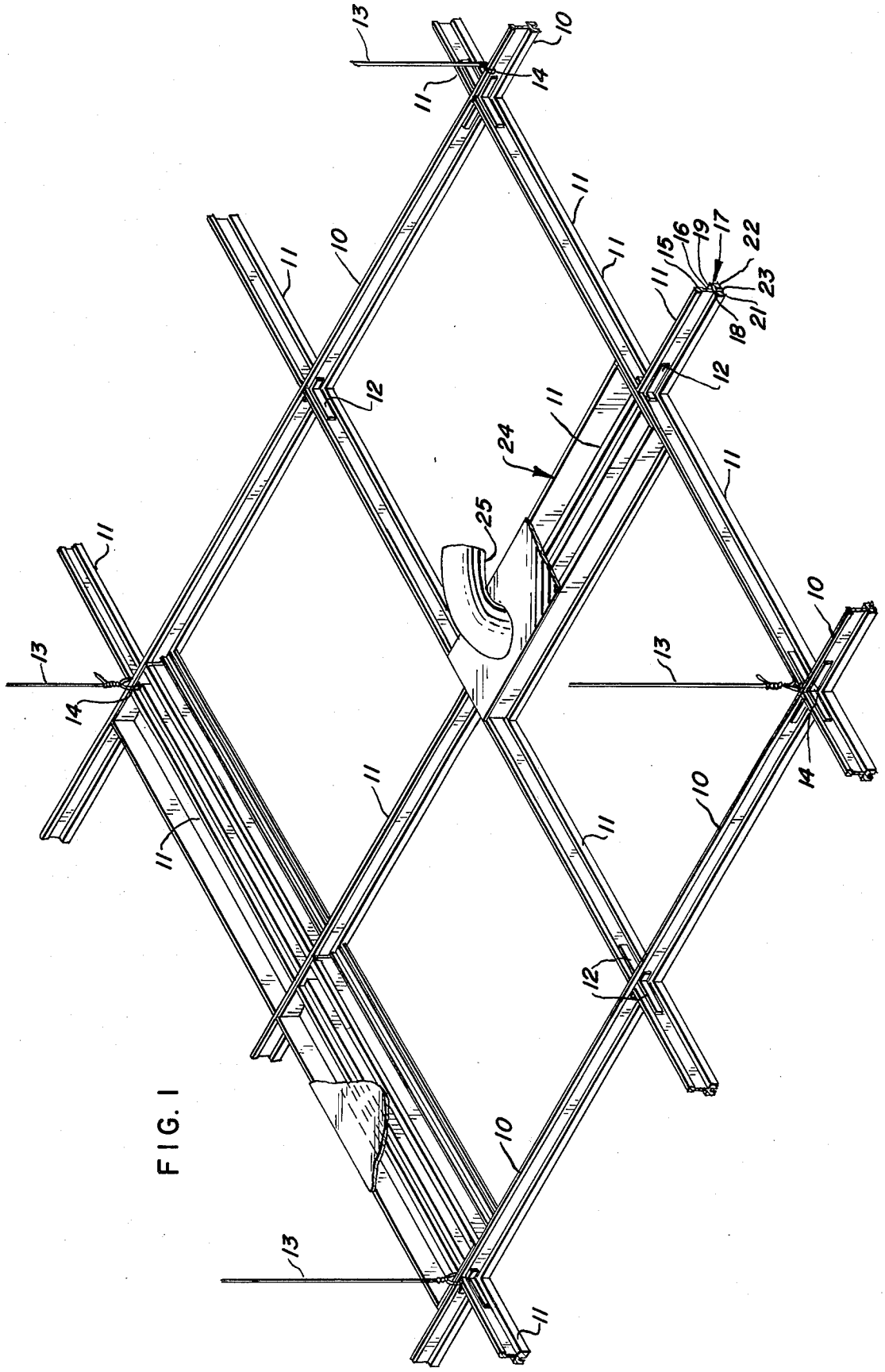


FIG. 1

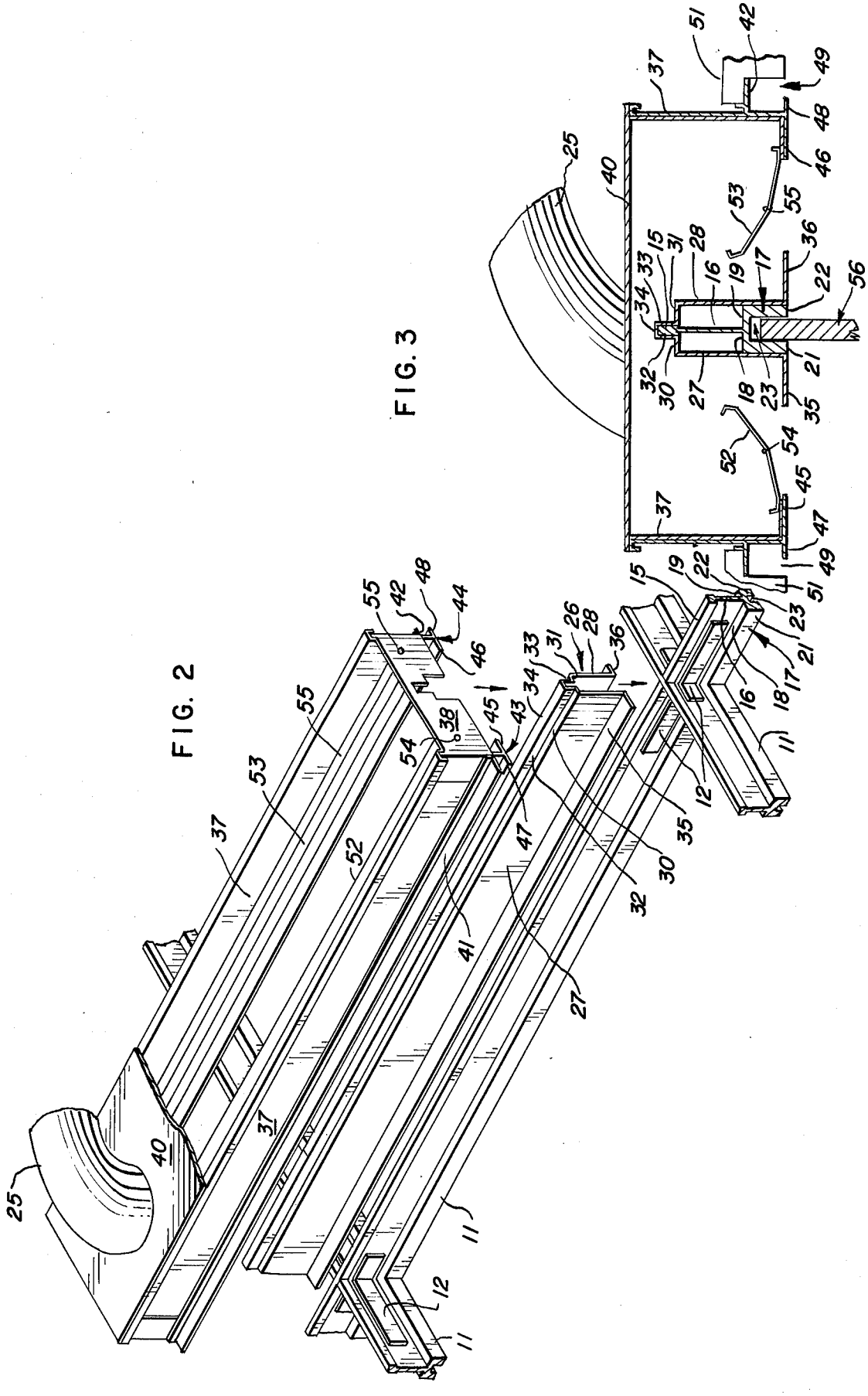


FIG. 2

FIG. 3

CEILING ASSEMBLY AND METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a ceiling assembly or system, generally of the suspended type, and particularly to a ceiling assembly or system which conveniently provides air diffusion capability in desired locations in the ceiling, whether provided as part of an original ceiling system or in the modification of a previously installed ceiling system.

2. Description of the Prior Art

In the past, many different types of ceiling assemblies or systems have been constructed and utilized. Some of the systems have been of the suspended type in which the ceiling grid is freely suspended by flexible hangers from the overlying building structure, while other systems have been fixed so that the ceiling grid is attached either directly to the overlying structure of secured thereto by rigid brackets of one type or another. In the course of the development of all of these different systems, a wide variety of ceiling runners or supporting bars and hardware for mounting these have been devised. In earlier years, these systems principally involved only ceiling tile, generally of the acoustical type, as a means of absorbing sound within a room. Generally the construction of such ceilings made modification quite difficult as often the acoustical ceiling tile were specifically constructed to cooperate with a certain size of grid and a certain shape of ceiling runner. Generally modification of such systems was performed by disassembling the entire ceiling system and reassembling it in accordance with a new plan, perhaps using new components. This is both time consuming and expensive.

In recent years, the trend has been to utilize integrated ceiling systems in which distribution of air, including both heating and cooling air, and lighting were provided by the ceiling system as well as the control of sound by the use of sound absorbing ceiling tile. Obviously the combination of such additional elements in the ceiling system has resulted in a much more complex structure. The very complexity of the structure made it more difficult to modify or change it should different elements be desired or a different pattern of air distribution or lighting be required. In addition, the very complexity of these systems has resulted in the design of a number of complex, highly specialized, integrated structures in which the components are made for use with one another and are not susceptible to convenient change or interchange with other components of other systems.

Many different systems have been proposed and utilized for the distribution of air through a ceiling into a room. The systems have varies from ventilation through apertures in the ceiling tile themselves to so-called "linear air" systems where air is emitted through elongate openings in the ceiling as defined by ducts or some of the supporting grid members themselves. Of course, the more conventional approach was widely used, involving the disposition of fixed outlets or air diffusers at precise spot locations in the ceiling from which air was emitted.

All of the above systems generally involve hardward elements mounted in fixed positions both above and as part of the ceiling, making it extremely difficult and expensive to alter the system and to relocate the positions from which air is emitted as the space utilization changes in the room below the ceiling. However, the ability to change systems in this way has become more important in recent years with the trend toward the creation of office structures with large spaces broken up by an ever-changing maze of demountable interior partitions which serve to define activity areas. It has been found particularly desirable to adjust air flow as well as light and sound absorption characteristics within such areas as the space utilization and the resulting office arrangement changes from time to time.

It is, therefore, a primary objective and advantage of the present invention to simplify the provision of flexible and adjustable air diffusion capabilities in a ceiling system.

It is a further object and advantage of the present invention to enable preexisting ceiling systems to be modified conveniently to incorporate air diffusion capabilities.

A particularly important object and advantage of the present invention is to provide a ceiling assembly in which air diffusers are readily movable from place to place, and which is capable of providing air diffusion in either spot or linear array.

SUMMARY OF THE INVENTION

The invention is a combination of elements in a ceiling assembly over a room, which provides air diffusion capability which is adjustable and interchangeable to any portion of the ceiling without major reconstruction thereof. The invention includes a plurality of main and cross runners which intersect to form a grid for supporting ceiling tile and air diffusers. At least one air diffuser is disposed over and extends along a portion of the length of one of the runners. The air diffuser is connectable to a source of air under differential pressure relative to that of the room and has a downwardly-directed, air-emitting opening. At least one removable cap member is disposed over at least a portion of the length of the one runner beneath the air-emitting opening of the air diffuser. The cap member has a shape and configuration which alters the air diffusion characteristics of the one runner with respect to air emitted from the air diffuser disposed above the runner. The assembly enables the location of the air diffuser in the ceiling assembly to be conveniently changed to alter as desired the emission location and the flow direction of air into the room.

In a typical embodiment of the invention, the greatest width of the removable cap member is greater than the greatest width of the runner on which the cap member is removably disposed. In this way, the cap member provides greater lateral deflection of air emitted from the air-emitting opening in the air diffuser than does the runner. In one embodiment, the removable cap member has oppositely-extending side flanges along its length which extend beyond the sides of the runner on which the cap member is removably disposed. The side flanges serve to influence the flow of air from the air diffuser. A typical form of the air diffuser includes walls defining a box-like chamber open on one side, and has spaced-apart downwardly-extending elongate inverted T-bars. The facing flanges of the T-bars serve to direct air from the air diffuser. In some embodiments, the air diffuser includes elongate vanes extending parallel to the facing flanges of the downwardly-extending inverted T-bars and to the side flanges of the cap member. The vanes have a width greater than the distance

between respective facing flanges of the inverted T-bar and side flanges of the cap member. Each of the vanes is pivotable about its elongate axis from a position where one side of the vane contacts the facing flange of the downwardly-extending inverted T-bar of the diffuser, closing off the passage of air therebetween, to a position where the other side of the vane contacts the corresponding side flange of the cap member, closing off the passage of air therebetween. The cap member may be separate, or integral with or attached to the air diffuser, alternatively.

The invention also is a method of modifying the ceiling assembly over a room to provide air diffusion. The method is applicable to a ceiling which comprises a plurality of main and cross runners which intersect to form a grid for supporting ceiling tile, in which ceiling tile are disposed in the grid. First, the ceiling tile are removed from adjacent sides of at least a portion of the length of one of the runners. A removable cap member is inserted over a portion of the length of the one runner from which tile has been removed. As described above, the cap member has a shape and configuration which alters the air diffusion characteristics of the one runner with respect to air flow from above the runner. An air diffuser is mounted upon the ceiling grid over the one runner and the removable cap member disposed thereon. Ceiling tile is then reinserted in the space remaining between the adjoining runners of the grid and the side edges of the air diffuser.

Similarly, the invention is a method of constructing a ceiling assembly over a room to provide air diffusion. In this instance, instead of requiring disassembly of a previously existing ceiling, the method involves the formation of a ceiling support grid by interlocking a plurality of intersecting main and cross runners. After inserting a cap member in the appropriate places and mounting an air diffuser thereover, ceiling tile are inserted into the remaining openings in the grid to form the ceiling assembly.

Both of the above methods eliminate any basic modification of ceiling elements and also eliminate any basic modification of ceiling elements in order to change the air diffusion characteristics of a ceiling in a room. Each of the methods can be performed using a basic set of reuseable standard ceiling components which require very little technical skill and mechanical ability to assemble into a ceiling or to reassemble at a later date into a modified ceiling. In addition, universal types of caps may be used to modify practically any existing ceiling system to accept diffusers in different locations so as to obtain the advantages of the present invention.

DESCRIPTION OF THE DRAWINGS

Additional objects and advantages of the present invention will become apparent from the following detailed description thereof, taken in conjunction with the following drawings, in which:

FIG. 1 is a fragmentary view of an overall ceiling assembly of the present invention;

FIG. 2 is an exploded perspective view of an air diffuser mounted upon one runner of the grid shown in FIG. 1, incorporating the cap member used in the present invention; and

FIG. 3 is a sectional view through an assembled section of the ceiling assembly of the present invention in which an air diffuser is incorporated, showing the manner in which the runner, the cap member, the air diffuser, and ceiling tile cooperate to form the ceiling assembly of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 of the drawings, a ceiling assembly of the present invention is shown. The ceiling assembly includes a plurality of main bars or runners **10** disposed in spaced parallel relationship to one another. A plurality of cross bars or runners **11** are disposed in both spaced-apart parallel relationship and perpendicular relationship to one another and to the main runners **10.** Respective ends of the cross runners **11** are connected as by fastener clips **12** to the spaced-apart main runners **10** so as to form a grid of uniformly sized squares. Obviously, the squares may be of any size but are normally designed and constructed to accept specifically sized and shaped ceiling tile which come in a variety of different "standard" sizes such as 24 inches square, 36 inches square, and the like as well as odd sizes made to special order. The above-described grid is secured to the overlying building structure (not shown) as by the suspension wires **13** which pass through holes **14** in the main runners **10** at spaced intervals.

Such bars or runners may take any one of a wide variety of cross sectional configurations. The particular bars or runners **10** and **11** shown in FIG. **1** of the drawings comprise those disclosed in U.S. Des. Pat. No. 223,235 issued on Apr. 4, 1972 to Busby et al. Thus the runners **10** and **11** each have an upper bulb **15,** an intermediate web **16,** and a lower bulb or inverted channel **17** which provides two spaced-apart upwardly-disposed shoulders **18** and **19** and two downwardly-depending spaced-apart flanges **21** and **22** defining a slot or groove **23** therebetween. The shoulders **18** and **19** serve to support tile when the runner is used in a grid, and the flanges **21** and **22** provide an attractive joint in the ceiling and also define the slot **23** which can be used to attach the upper edge of demountable partition assemblies **56** or other items.

However, very often esthetics of the overall ceiling require a ceiling runner of a specific design, and the present invention is applicable to ceiling runners of practically any conceivable type of design or cross section. Generally such ceiling systems have runners designed to engage the edges of lay-in panels or ceiling tile. In the case of the runner shown in FIG. **1,** the panels have a rabbeted edge so that the shoulder **18** or **19** of the runner **10** or **11** supports the tile so the surface of the tile is flush with the lower surface of the runner as is shown in FIG. **3.** The manner in which the cross bars **11** are connected to the main bars **10** is not critical to the invention, and any one of a number of other connection systems as well as clips **12** may be employed.

An air diffuser **24** is disposed over a portion of one of the main bars or runners **10** or **11.** In accordance with the invention, the air diffuser **24** may be located over any one or more of the main bars **10** or the cross bars **11** or portions thereof, and may be relocated at any time without requiring structural modification of the ceiling assembly other than interchange of components. The air diffuser **24** is connected by a flexible duct **25** to a source (not shown) of circulated air, normally at a slight pressure relative to the pressure of the air in the space beneath the ceiling assembly so as to create a flow of air into the room. Other means of supplying air to the diffuser **24** may also be employed including using the entire space above the ceiling as a

plenum chamber. The air diffusers **24** may be arranged serially and interconnected to provide linear air diffusion across the ceiling.

FIG. **2** illustrates in greater detail the manner in which the air diffuser **24** is constructed and disposed upon a section of the cross runner **11** in the ceiling grid. A removable cap member **26** is first inserted upon the portion of the runner **11** over which the air diffuser **24** is to be disposed. The cap member **26** serves not only to provide support for the air diffuser **24,** but also provides surfaces for assisting in the deflection and diffusion of air emitted from the air diffuser **24** as described below. It may be attached to or comprise an integral part of the air diffuser **24.** The removable cap member **26** comprises two spaced-apart side walls **27** and **28** which grip the outer sides of the inverted channel **17** of the ceiling runner **11** and extend above the shoulders **18** and **19** of the ceiling runner **11.** The cap member **26** then has inwardly depending shoulders **30** and **31** terminating in two upwardly depending walls **32** and **33** and the web **34** form an inverted channel which grips the upper bulb **15** of the runner **11** and stabilizes the cap member **26** on the runner **11.** The lower sides of the walls **27** and **28** of the cap member **26** have, respectively, oppositely-facing, outwardly-depending flanges **35** and **36** which extend to the distance desired, and which, in cooperation with other elements of the air diffuser **24** to be described, assist in the deflection and diffusion of air.

The air diffuser **24** is mounted over the cap member **26** and the ceiling runner **11** so as to straddle both of these with approximately one-half of the air diffuser **24** overhanging one side of the cap member **26** and ceiling runner **11** assembly while the other half of the air diffuser **24** overhangs the other side of the cap member **26** and the ceiling runner **11** assembly. The air diffuser **14** may take any one of a number of forms but, in the embodiment shown, comprises a generally box-like configuration formed by side walls **37,** end walls **38,** and top wall **40** and is generally open on one side to emit air. Air is supplied to the air diffuser **24** through flexible ducts **25** connecting to the air diffuser **24** through openings in the upper wall **40.**

The lower edges of the spaced-apart elongate side walls **37** of the air diffuser **24** have oppositely-facing laterally-depending upper flanges **41** and **42** and downwardly-extending elongate inverted T-bars **43** and **44.** The facing flanges **45** and **46** of the T-bars cooperate with the opposing flanges **35** and **36** of the cap member **26** to direct air emitted from the flanges **47** and **48** of the inverted T-bars **43** and **44** serve to provide an asthetic surface narrowing the gap **49** between the air diffuser **24** and the adjoining ceiling tile. The laterally-depending flanges **41** and **42** provide shoulders of a height equivalent to the shoulders **18** and **19** of the ceiling runners **11** so as to support lay-in tile in the manner desired. Obviously the disposition of these latter flanges might be altered depending upon the type of ceiling runners employed and the manner in which the ceiling tile engage the ceiling runners.

Referring now to FIG. **3** of the drawings, the cross section of a portion of the ceiling assembly taken through an air diffuser **24** indicates the manner in which the air diffuser **24,** the cap member **26,** and the ceiling runner **11** cooperate with other elements of the ceiling assembly to form the desired structure. In FIG. **3,** ceiling tile **51** have been illustrated in phantom outline to indicate the manner in which they connect the edges of the air diffuser **24** with the adjacent ceiling runners **11.** It can be seen that the air diffuser **24** includes two elongate vanes **52** and **53** which are disposed generally parallel to the facing flanges **45** and **46** of the downwardly-extending inverted T-bars **43** and **44** and to the side flanges **35** and **36** of the cap member **26.** The vanes **52** and **53** each have a width greater than the distance between respective facing flanges **45** and **46** of the inverted T-bars **43** and **44** and the side flanges **35** and **36** of the cap member **26.** In addition, each of the vanes **52** and **53** is rotatably mounted to pivot about their elongate axis **54** and **55** respectively so that they are rockable from a position where one side of the vane **52** contacts the facing flange **45** of the downwardly-extending inverted T-bar **43** of the diffuser **24,** whereby it reduces or closes off the opening therebetween and slows or prevents the passage of air therethrough, to a position where the other side of the vane **52** contacts the corresponding side flange **35** of the cap member **26,** where upon it reduces or closes off the opening therebetween and slows or prevents the passage of air through the opening. From the above it can be seen that the cap member **26** not only cooperates with the vanes **52** and **53** in the air diffuser **24** assembly, but also modifies the flow of air past the ceiling runner **11** from what it would otherwise have been.

The unique construction of the ceiling assembly of the present invention allows this affect to be achieved at any point or to any extent in the ceiling grid that may be desired. For example the diffusers **24** shown in the drawings may be serially aligned and arrayed to form linear air diffusion across the ceiling if this is desired. Or alternatively, they may be arranged in spaced areas or spots across the ceiling. The transformation from one to the other is done without difficulty and without structural modification of the elements thereof.

In constructing a ceiling assembly of the present invention over a room, a ceiling supporting grid is formed by interlocking a plurality of intersecting main and cross runners **10** and **11** as shown by FIG. **1** of the drawings. A plurality of the main runners **10** are first hung from the overlying supporting structure of the building by the wires **13.** Successive lengths of such main runners **10** are connected to one another at a splice joint by clips **12.** Then the remaining portion of the grid is formed by the insertion as needed by various cross runners **11,** some of which, in the grid of FIG. **1** extend parallel and intermediate the main runners **10** and some of which extend perpendicularly thereto. The cross runners **11** are attached to the main runners **10** and to one another by clips **12.** A removable cap member **26** is then disposed over a portion or all of the length of one of the runners **10** and **11.** The cap member **26** is designed to snugly fit the runner **10** and **11** so as to be retained thereon and to resist twisting about the axis of the runner. As pointed out above, the cap member **26** is designed to alter the air diffusion characteristics of the runner **10** or **11** over which it is disposed.

An air diffuser **24** is then mounted over a portion or all of the removable cap member **26** and the runner **10** or **11** on which it is disposed. The diffuser **24** may be either supported by the runner **10** or **11** and the associated grid or may be either independently supported by the overlying building structure in a manner similar to the grid itself. Conventional ceiling tile **51,** have an edge configuration adapted to the runners forming the supporting grid. is then inserted into the remaining

openings in the ceiling supporting grid. The ceiling tile which adjoins the side edges of the diffuser will, of course, be of lesser width and can either be specially made or field modified as required. Such tile are conventionally made of materials which can easily be cut on the job.

The above ceiling assembly can now be conveniently rearranged without altering any of the particular components thereof but merely by rearranging those components within the ceiling grid. For example, should it be desirable to locate the diffuser **24** over another runner **10** or **11** in the grid, it is necessary only to remove the ceiling tile from that portion of the grid, add a cap member **26** to that runner, insert the diffuser **24** onto that cap member **26,** and provide the proper size tile. If the unit is a new or additional diffuser, additional tile will have to be cut to lesser width, whereas if the unit is a relocated diffuser, the tile from the previous location may simply be transferred over to the new location. In this manner, the ceiling assembly of the present invention provides the utmost of convenience of rearrangement.

The present invention may also be applied to the modification of a ceiling assembly which presently exists over a room. This is true whether or not that present ceiling has air diffusion capability. Thus in the instance where it does not have air diffusion capability, it is simply necessary to remove the tile from adjacent sides of a runner **10** or **11** over which an air diffuser is to be located, place a cap member **26** over the runner **10** or **11** which will both snugly fit the runner to be removably disposed thereon, and will modify the air diffusion characteristics of the runner with respect to air flow from above the runner. An air diffuser **24** may then be mounted directly on the cap member **26** and the runner **10** or **11** supporting it and the ceiling tile trimmed to finish the ceiling.

From the above it can be seen that the present invention provides a ceiling assembly and method of forming it which make it possible to conveniently adjust the air diffusion capabilities of the ceiling system. It can also be seen that numerous changes may be made in the above system without departing from the spirit and scope of the present invention. For example the grid may comprise any type of system of runners or even a preformed grid where the main and cross runners are integral with one another. In addition, the cap member might be an integral part of the air diffuser rather than as a separate element. It can be seen that the present ceiling system is adaptable to both closing off air flow as well as adjusting air flow. Obviously lights and other ceiling functions may be incorporated in the ceiling assembly without losing the advantages of the present invention. In view of the above changes, the invention should not be limited or restricted in scope except as may be required by the following claims.

What is claimed is:

1. In a ceiling assembly over a room, the combination of:

a plurality of main and cross runners which intersect to form a grid for supporting ceiling tile and air diffusers,

at least one air diffuser being disposed over and extending along a portion of the length of one of said runners, said air diffuser being connectable to a source of air under differential pressure relative to that of said room and having a downwardly-directed, air-emitting opening, and

at least one removable cap member over at least a portion of the length of said one runner beneath said air-emitting opening of said air diffuser, said cap member being supported at least in part by the top of one said runner, said cap member being sufficiently continuous to prevent major amounts of air from going through the cap member, and said cap member having a shape and configuration which alters the air diffusion characteristics of said one runner with respect to air emitted from said air diffuser disposed above said runner, wherein said removable cap member has oppositely-extending side flanges along its length which extend beyond the sides of the runner on which said cap member is removably disposed, said side flanges serving to influence the flow of air from said air diffuser,

wherein said air diffuser includes walls defining a box-like chamber open on one side, and spaced-apart downwardly-extending elongate inverted T-bars, the facing flanges of which serve to direct air from said air diffuser,

wherein said air diffuser includes vanes extending parallel to the facing flanges of said downwardly-extending inverted T-bars and to said side flanges of said cap member, said vanes having a width greater than the distance between respective facing flanges of said inverted T-bar and side flanges of said cap member, each of said vanes being pivotable about its elongate axis from a position where one side of the vane contacts the facing flanges of the downwardly-extending inverted T-bar of said diffuser, closing off the passage of air therebetween, to a position where the other side of the vane contacts the corresponding side flange of the cap member, closing off the passage of air therebetween, and each of said vanes being bent upward from its elongate axis,

and wherein the main and cross runners have a slot running the length thereof for attaching the upper edge of a demountable partition assembly thereto, and said combination still being capable of diffusing air when a demountable partition is mounted therein,

whereby the location of said air diffuser in said ceiling assembly can be conveniently changed to alter the emission location and the flow direction of air into said room.

2. The combination as in claim **1** wherein the slot has a demountable partition attached in the slot.

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