

[54] AIR CIRCULATION DIFFUSER SYSTEM

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[58] Field of Search 98/40 D, 40 C, 40 DL

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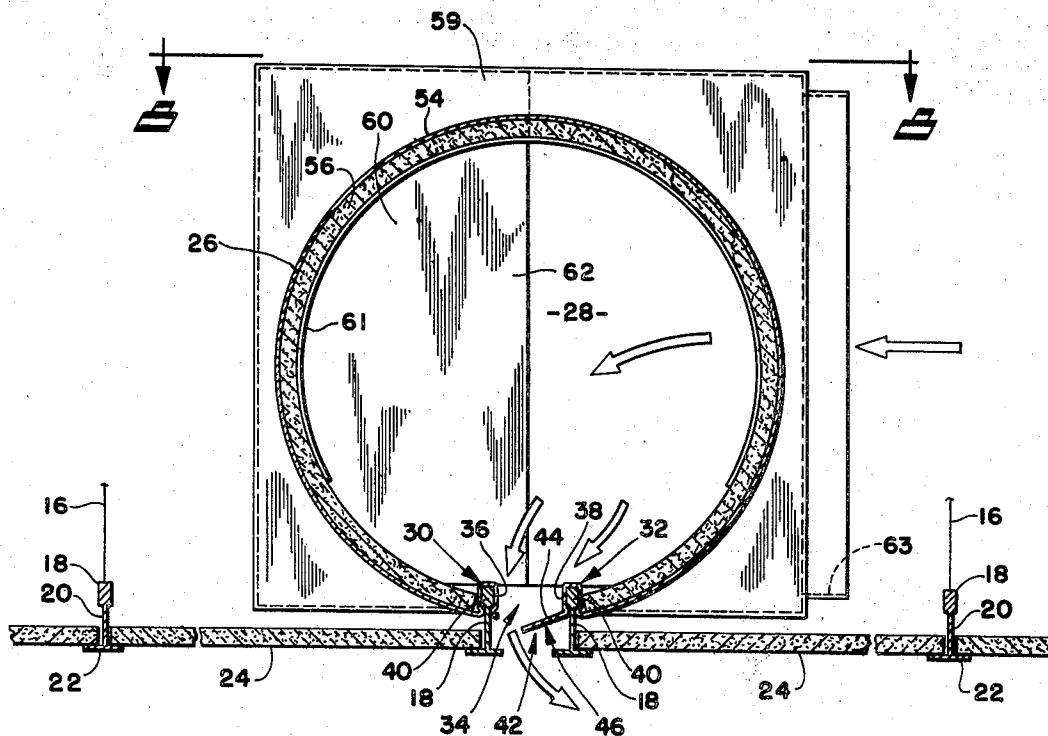
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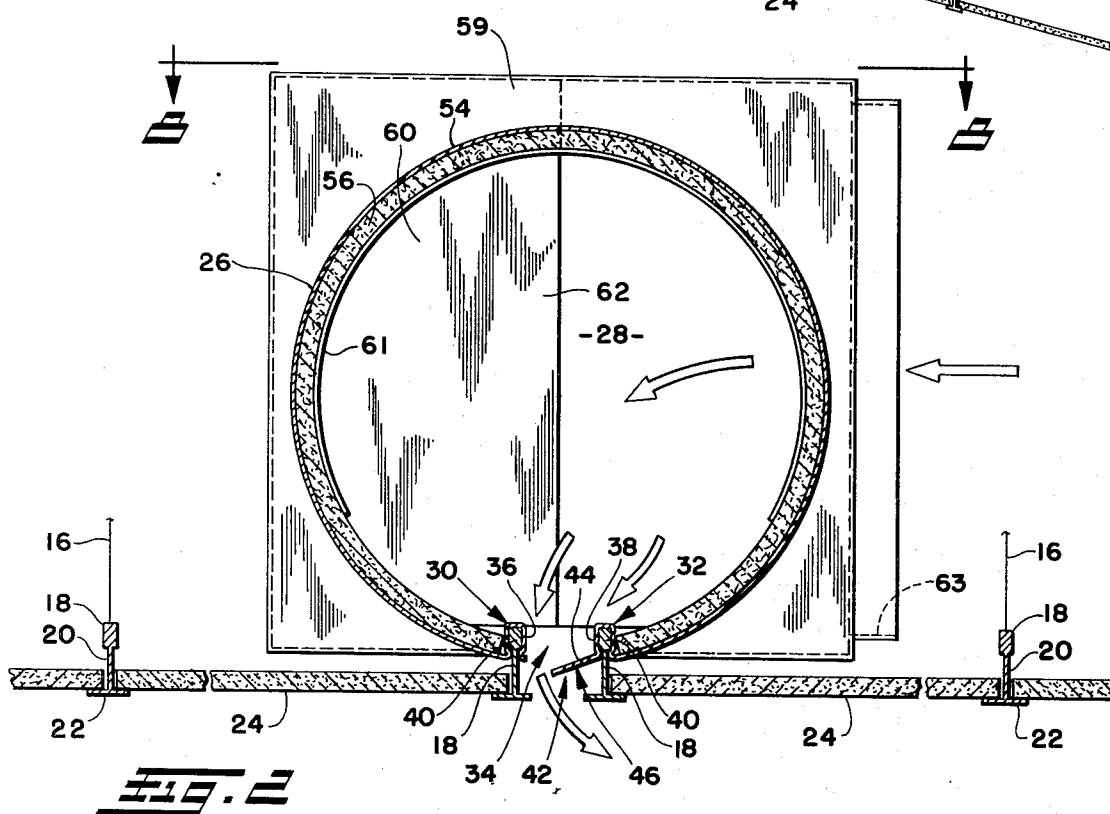
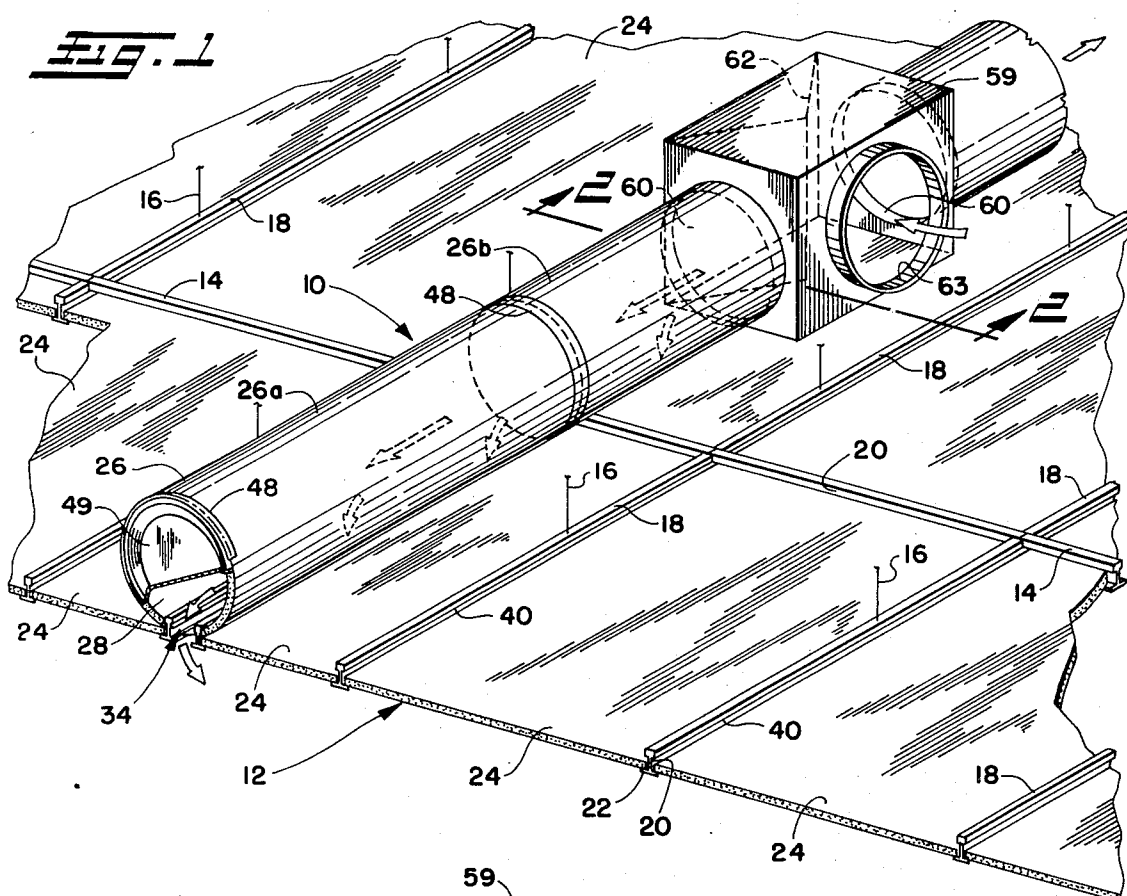
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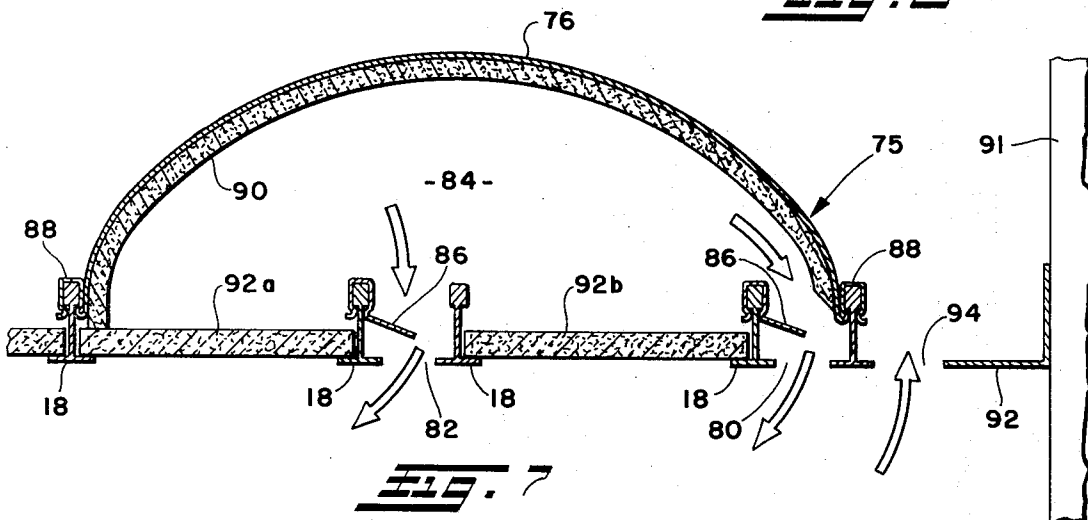
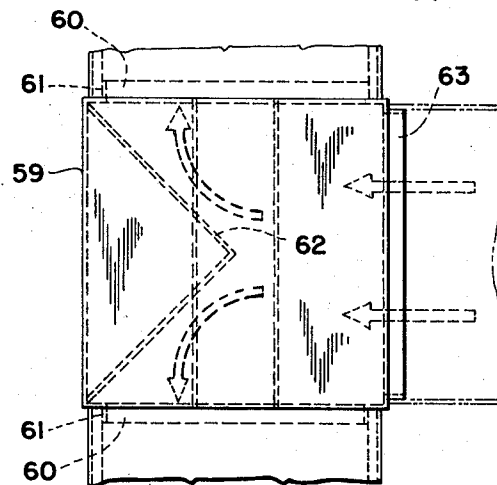
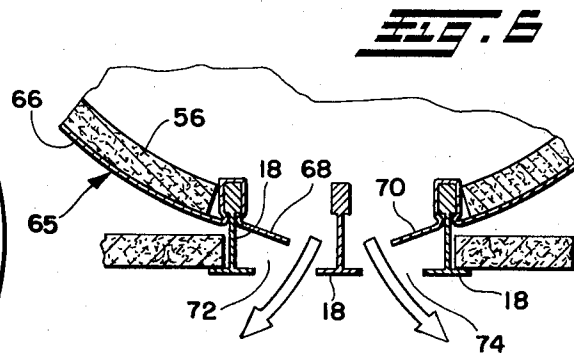
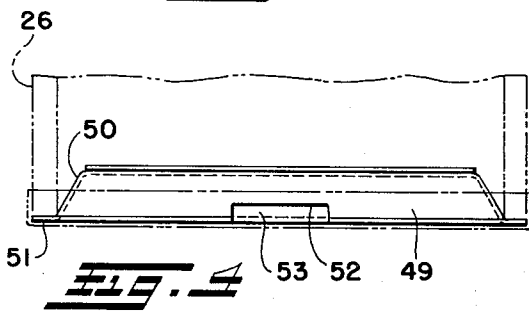
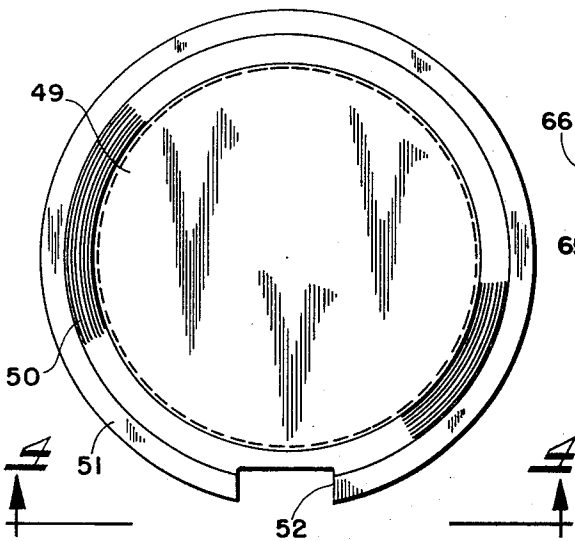
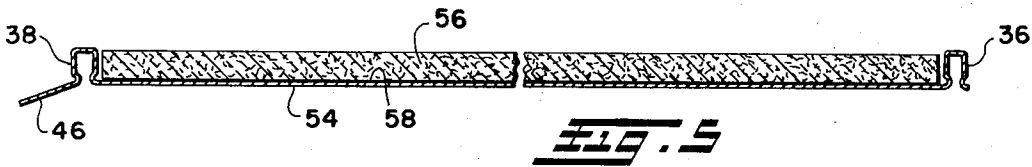
[57] ABSTRACT

An air circulation diffuser system for use with a ceiling grid structure comprising an inverted channel whose free edges are shaped to conform to the upper edges of the ceiling grid structure for support thereby. An opening is provided in the ceiling between the grid structure for flow of air from the channel, and a baffle or vane is also supported by the grid structure and positioned in the opening for controlling the rate and direction of air flow from the channel.

15 Claims, 8 Drawing Figures







AIR CIRCULATION DIFFUSER SYSTEM

BACKGROUND OF THE INVENTION

This invention relates generally as indicated to an air circulation diffuser system, particularly applicable for use with a standard drop ceiling grid structure in which the basic support for the drop ceiling may comprise plural spaced apart main runners or tees suspended by wires or straps from above, with cross tees extending between the main tees for engagement by the drop ceiling panels. It will be appreciated, however, that the invention may also be employed with other types of ceiling structures as long as a suitable support structure is provided for the air circulation diffuser system.

Heretofore, the usual room air distribution systems employed specially constructed air flow channels which also acted as main runners in the drop ceiling grid system, replacing one or more conventional grid runners at considerable expense. Such air flow channels included a special baffle construction, usually adjustable, for controlling the amount and direction of air flow from the channels.

Not only were such specially constructed air flow channels relatively expensive, but they also had to be stocked in various sizes which created inventory and storage problems and further added to their cost.

In addition, such specially constructed air flow channels could not readily be employed with existing drop-ceiling grid structures, or in the renovation of existing rooms of schools and office buildings, since one or more of the conventional grid runners usually had to be replaced with such special air flow channels. If the contractor who was to install the ceiling did not also install the air diffuser, they were not likely to fit together properly.

SUMMARY OF THE INVENTION

With the foregoing in mind, it is a principal object of this invention to provide an improved diffuser system for room air circulation which may readily be employed with conventional supporting grid structures for a drop ceiling.

Another object is to provide such an air circulation diffuser system which is of reduced cost and suitable for both new construction and renovation of older buildings such as schools and office buildings.

Still another object is to provide an air circulation diffuser system which will fit any standard ceiling grid.

These and other objects of the present invention may be achieved by providing an elongated inverted channel having lower longitudinally extending free edges which are shaped to conform to the basic supporting grid structure of a drop ceiling or a suitable grid structure for a plaster or other type ceiling. A longitudinal section of the ceiling beneath the diffuser channel is left open to permit air flow from the channel plenum chamber into the room. At least one longitudinally extending baffle or vane is also supported by one of the ceiling grid structure members and extends into the channel opening to control the direction of air flow from the channel.

Preferably, the diffuser channel is made of plural flexible sections of sheet metal or other suitable material of desired length which are laid end-to-end. Each section may be covered internally with insulation mate-

rial, and end caps are attached to the ends of the assembled channel sections to complete the diffuser enclosure.

The diffuser channel may be supported by adjacent parallel supporting tees of the grid structure, or by tees which are separated by one or more intervening tees. In the latter instance, the diffuser plenum chamber is defined by panels of the drop ceiling between the supporting tees in addition to the channel sections. Air deflecting baffles or vanes may also be supported by one or both of the channel supporting tees or by an intervening tee, depending upon the location of the ceiling opening through which the air flows from the diffuser.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

BRIEF DESCRIPTION OF THE DRAWINGS

In the annexed drawings:

FIG. 1 is a partial perspective view of a preferred form of forced air circulation diffuser system constructed in accordance with the present invention;

FIG. 2 is an enlarged transverse section through the forced air circulation diffuser system of FIG. 1, taken along the plane of the line 2—2 thereof;

FIG. 3 is an elevation view of one of the end caps for the diffuser channel of FIGS. 1 and 2;

FIG. 4 is a bottom plan view of the end cap of FIG. 3 as seen from the plane of the line 4—4;

FIG. 5 is a partial, enlarged section view through the diffuser member prior to bending to channel shape;

FIG. 6 is an enlarged partial transverse section through a modified form of air circulation diffuser system constructed in accordance with this invention;

FIG. 7 is an enlarged transverse section through still another air circulation diffuser system embodiment in accordance with the present invention; and

FIG. 8 is a top plan view of the air inlet box for the air circulation diffuser system of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now in detail to the drawings, and initially to FIGS. 1 and 2, there is schematically shown a preferred form of air circulation diffuser system 10 in accordance with the present invention which is especially suited for use with a standard grid structure for a drop ceiling 12 of the type including a plurality of parallel main tees 14 with cross tees 18 extending therebetween. The main tees may run the full width or length of the ceiling and are suspended from above by wires or straps 16. The cross tees 18, on the other hand, have formed ends which may be snapped into slots or the like in the upright web or stem portion 20 of the main tees for support thereby. Both the main and cross tees are provided with longitudinally extending lateral flanges 22 integral with the upright stem portions 20 for supporting a plurality of ceiling panels 24 between the main tees and cross tees seated on the flanges as shown.

In accordance with the concepts of the present invention, the air circulation diffuser system 10 desirably comprises an elongated inverted channel 26 which may be of a generally cylindrical shape to define a plenum chamber 28. The longitudinally extending lower free edges 30 and 32 of the channel 26 are shown slightly spaced apart to provide therebetween an elongated slot or opening 34 communicating and essentially coextensive with the plenum chamber 28. These edges 30 and 32 may be shaped by press brake dies or roll formed to provide elongated attachment clips 36 and 38, respectively, which are shaped to snap onto the upper ends 40 of the drop ceiling grid work tees 18. In the embodiment illustrated, the upper ends 40 of the tees 18 are slightly enlarged providing a generally bulbous shape, and the edge clips 36 and 38 are generally in the form of an inverted U with inwardly bent edges to retain the channel sections 26 in place on the upper ends 40. The clips 36 and 38 may be essentially coextensive with the channel 26 thereby providing with the supporting tees 18 an essentially airtight construction.

The two supporting cross tees 18 which support the channel 26 may be relatively closely spaced apart between the main tees of the ceiling grid structure, and the space 42 between the two supporting tees left open for flow of air from the plenum chamber 28 through the aligned openings 34 and 42 into the room.

Preferably, one of the attachment clips 38 has a projecting end portion 44 which is also shaped, as by roll forming or in a press brake die, to form a baffle or vane 46 which is integral with the channel 26 and which extends downwardly at an angle below the opening 34 into the space 42 between the supporting tees 18. The length of the baffle or vane 46 and its specific configuration may vary depending upon the direction of air flow desired. In the embodiment illustrated, the vane 46 extends at an angle across substantially three-fourths of the open space 42 between the two supporting tees 18 to restrict the flow path through which air is diffused from the plenum chamber 28 into the room to create a relatively uniform distribution of air along the length of the diffuser. The baffle configuration shown also has the effect of directing the air along the surface of the drop ceiling in the direction opposite the direction in which the baffle extends from the diffuser edge 32.

As shown in FIG. 1, the diffuser may be formed by end-to-end alignment of several channel sections 26a, 26b connected together at their ends by tape 48. End caps 49 such as shown in FIGS. 1, 3 and 4 may then be used to close the ends of the endmost channel sections. These end caps may be flat circular members having an intermediate frusto-conical portion 50 to facilitate insertion of the end caps into the ends of the channel sections and a radial outer flange portion 51 overlying the outer edge of the channel sections. Such end caps may also be provided with lower cutout areas 52 sized to receive the supporting tees 18 when the end caps are slipped into place or the cutout areas 52 may be omitted if sufficient clearance is provided for the end caps at the connections between the cross and main tees. The end caps 49 may also be insulated as shown at 53 in FIG. 4, and as with successive sections of the channel, the end caps may be taped to the channel end sections by tape 48 to retain them in place.

To facilitate manufacture as well as shipping and storage of the channel, the channel sections 26a, 26b

are desirably made from flexible, flat metal sheets 54 covered with insulation material 56 and cut to the desired lengths and widths. The insulation material is used to deaden sound and prevent condensation on the outer walls of the channel and may be fastened to the flat sheet material by a suitable adhesive 58. Of course, the edges of the metal sheet are also roll formed or die pressed to provide the inverted U-shaped attachment clips 36 and 38 as well as the baffle 46 on the end of one of the attachment clips 38, as explained above. To install the channel sections 26a and 26b, it is a simple matter to fold or bend the sections into generally cylindrical shape with the insulation 56 on the inside and to snap the attachment clips 36 and 38 onto the selected ceiling cross tees. For this purpose, the insulation material should be slightly compressible and sufficiently flexible to withstand the flexing or folding operation. Of course, if for example, the building codes required the use of heavier gauge metals which precluded forming the channel sections on the job site, such channel sections could be preformed as necessary.

Any suitable type of air blower may be employed with the air circulation diffuser system of the present invention, including, for example, the proportional blower illustrated in U.S. Pat. No. 3,625,629, assigned to the assignee of the present application. The blower may be connected with the air circulation diffuser system by means of a conduit connected to an air inlet box 59 having outlets 60 at opposite ends provided with semicircular flanges 61 for attachment of the channel sections thereto as shown in FIGS. 1, 2 and 8. A generally V-shape deflector plate 62 may be provided in the air inlet box 59, for deflecting the air entering through the side opening 63 out through the end outlets 60.

FIG. 6 illustrates a modified form of air circulation diffuser system 65 in accordance with this invention which is substantially identical to the air circulation diffuser system 10 previously described except that the channel sections 66 are attached to cross tees 18 which are separated from each other by one or more intervening tees, and baffles 68 and 70 are associated and integral with each edge of the channel sections. The spacing between the supporting tees and the intervening tee may be left open to provide parallel passages 72 and 74 for flow of air from the plenum chamber. Because of the extension of the baffles 68 and 70 into the passages 72 and 74 from opposite sides, the air flows in a diverging pattern from the channel as indicated by the arrows, resulting in a two-way throw of air from the channel plenum chamber, as compared to the one-way throw of the FIG. 2 embodiment. Of course, a two-way throw of air may also be obtained by reversing successive channel sections and thus the baffles of the air diffuser of FIG. 2 so that the flow of air from successive sections is directed in opposite directions.

A still further air circulation diffuser system embodiment 75 is illustrated in FIG. 7. In this embodiment, the diffuser channel 76 is supported on tees 18 which are spaced apart a substantial distance, with two or more intervening tees 18 between the supporting tees. The spacing 80 and 82 between any two closely adjacent tees 18 may be left open for discharge of air from the channel plenum chamber 84, and a clip-on baffle 86 may be mounted on one or the other tee of each pair depending upon the direction of air flow desired. In the embodiment of FIG. 7, the baffles 86 are not integral with either edge of the diffuser channel, and the chan-

nel edge clips 88 may either be on the outside as shown in FIG. 7 to facilitate attachment of the diffuser channel to supporting tees 18 which are more widely spaced apart, or on the inside as shown in FIGS. 2 and 6. In addition, the plenum chamber 84 of the diffuser channel 76 is defined not only by the channel itself, but also by the ceiling panels 92a, 92b which remain in place between the tees. The insulation 90 on the inner wall of the channel section 76 may also extend below one of the edge clips 88 on one side for engagement with one of the ceiling panels 92a to assist in preventing air leakage at the point where the ceiling panel is supported by one of the cross tees.

In the example of FIG. 7, the supporting tee 18 which defines on one side one of the air passages or spaces 80 may be located close to one wall 91 of the room to provide another passageway 94 on the other side for return air. This locates the return air flow path between the circulated air flow passage from the plenum chamber of the diffuser and the wall. The baffle 86 is purposely positioned on the other tee defining the air passage 80 rather than on the tee supporting the diffuser channel member so that the air flow is directed away from the return air passage as shown, causing a circular flow of air in the room along the ceiling, downwardly, and then back to the return air opening.

As will be apparent, other alternative arrangements of tees supporting the diffuser channel sections and air deflecting baffles are possible and within the scope of the present invention. In particular, it is apparent that the supporting tees may be located as close together or as far apart as desired, and the location of the air discharge passages for the plenum chamber and their sizing for the flow of air may be varied as desired depending upon the rate and direction of air flow desired.

Although the invention has been described with reference to supporting the diffuser channel sections on the cross tees of a conventional drop ceiling grid structure, it is apparent that the sections may also be supported on the main grid tees, or on grid structures attached to other types of ceilings. Also, the channel sections and baffle members may be fabricated from materials other than sheet metal, for instance, a flexible fiberboard which need not be insulated.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A forced air circulation diffuser system in combination with a conventional ceiling grid structure, said forced air circulation diffuser system comprising an elongated, inverted sheet material channel having free longitudinally extending edges, longitudinally extending attachment means integral with said edges, said ceiling grid structure comprising plural separate spaced apart generally tee-shape elements, said attachment means being of generally inverted U-shape for receipt over the upper ends of two of said tee-shape elements for support thereby, the spacing between said two tee-shape elements being readily adjustable to suit the desired spacing between said longitudinally extending edges of said inverted sheet material channel, means defining an opening communicating with said channel for passage of air therefrom, and baffle means supported by only one of said tee-shape elements adjacent said opening for controlling the rate and direction of flow of air from said channel.

2. The combination of claim 1 wherein the spacing between said two tee-shape elements defines the opening communicating with said channel.

3. The combination of claim 1 wherein said upper ends of said tee-shape elements are slightly enlarged providing a generally bulbous shape, and said generally inverted U-shape attachment means have inwardly bent edges to retain said inverted sheet material channel in place on said tee-shape elements.

4. The combination of claim 1 wherein said channel comprises a plurality of channel portions of the desired length connected end-to-end on the supporting grid elements.

5. The combination of claim 1 wherein said sheet material is flexible for attachment by said attachment means to grid elements of different spacing therebetween.

6. The combination of claim 1 further comprising a layer of insulation material on the inner wall of said sheet material.

7. The combination of claim 1 wherein said baffle means is integral with one of said attachment means and extends from said attachment means at an angle into the opening communicating with said channel.

8. The combination of claim 1 wherein said attachment means are received over the upper ends of tee-shape elements spaced apart by one or more intervening tee-shape elements.

9. The combination of claim 1 wherein there are at least two intervening tee-shape elements which define said opening therebetween for flow of circulated air from said channel, said baffle means being separately supported by one of said intervening tee-shape elements and extending into the ceiling opening for controlling the rate and direction of flow of air from the diffuser.

10. The combination of claim 9 wherein said baffle means is separately supported by one of said intervening tee-shape elements and extending into the ceiling opening for controlling the rate and direction of flow of air from the diffuser.

11. The combination of claim 1 wherein said generally inverted U-shape attachment means are on the outside of said inverted channel.

12. The combination of claim 11 further comprising a layer of insulation material on the inner wall of said sheet material, said insulation extending downwardly below one of said attachment means for engagement with a ceiling panel supported by said ceiling grid structure to assist in preventing air leakage.

13. A forced air circulation diffuser system in combination with a standard grid structure for a drop ceiling, said air circulation diffuser system comprising diffuser channel means defining at least in part an elongated plenum chamber, said channel means having longitudinally extending lower free edges defining a channel opening along the underside of said channel, longitudinally extending attachment means coextensive with and integral with said lower edges of said channel means attached to two separate spaced apart elements of the drop ceiling grid structure, the flow of air from said plenum chamber being through an elongated opening in the drop ceiling essentially coextensive with the channel opening, and baffle means also supported by said grid structure extending into the ceiling opening for controlling the rate and direction of flow of air from the diffuser, said baffle means being an integral exten-

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sion of one of said longitudinally extending attachment means on one edge of said diffuser channel means the spacing between said two elements of the drop ceiling grid structure to which said lower edges of said attachment means are attached defining the elongated opening in the drop ceiling which may be varied by varying the spacing between said two elements.

14. The combination of claim 13 wherein said channel means is made of sheet metal having formed edges

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providing said longitudinally extending attachment means.

15. The combination of claim 14 wherein said formed edges of said sheet metal channel means are on the inside of said channel and of a generally inverted U-shape for insertion over the upper ends of said parallel elements of the ceiling grid structure.

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