May 10, 1966 R. R. LAMBERT 3,250,205

STRIP-TYPE AIR DIFFUSER

Filed June 5, 1963 2 Sheets-Sheet 1

FIG. 1.

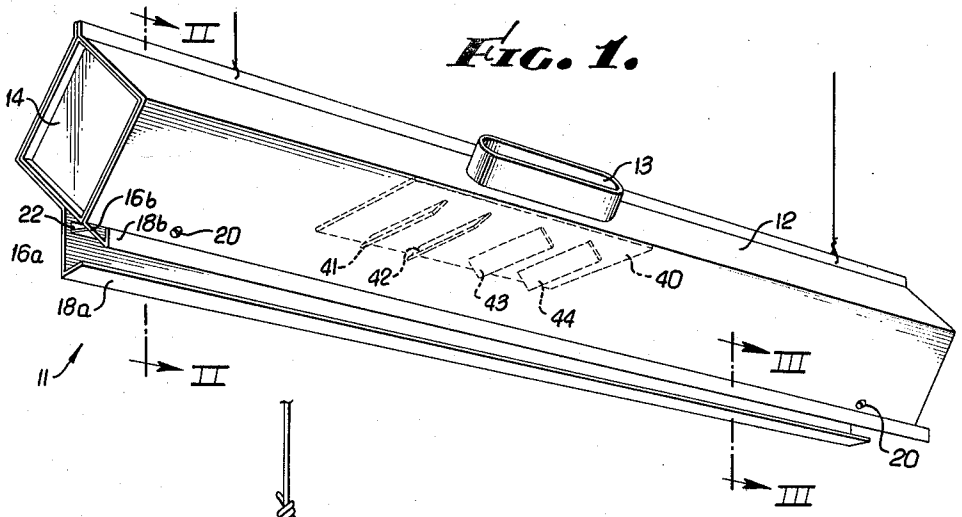


FIG. 2.

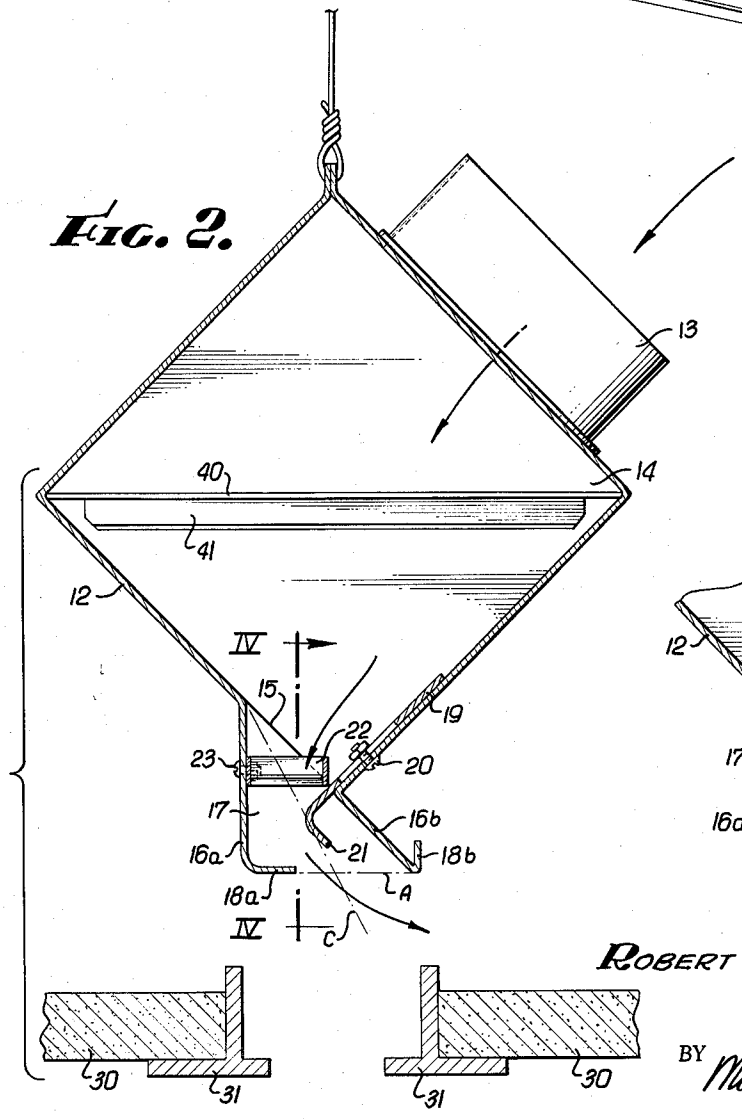
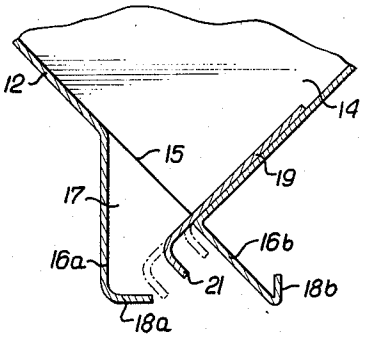


FIG. 3.



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FIG. 4.

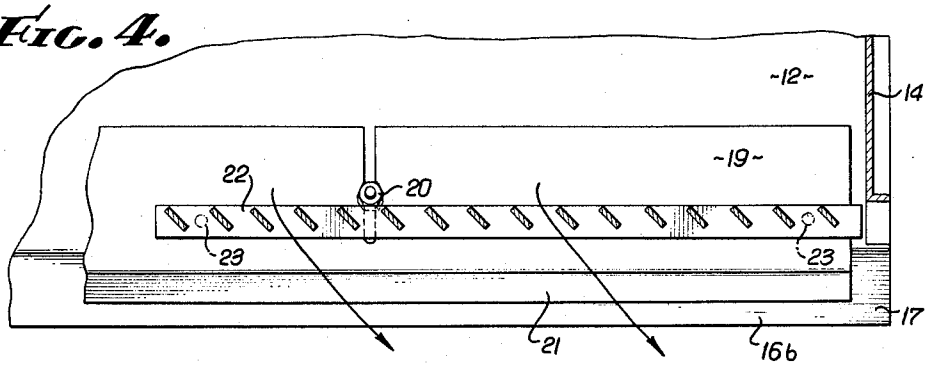


FIG. 5.

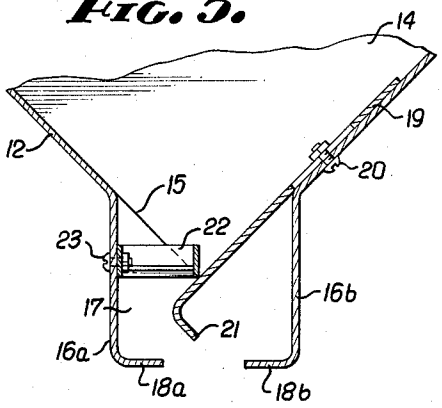


FIG. 7.

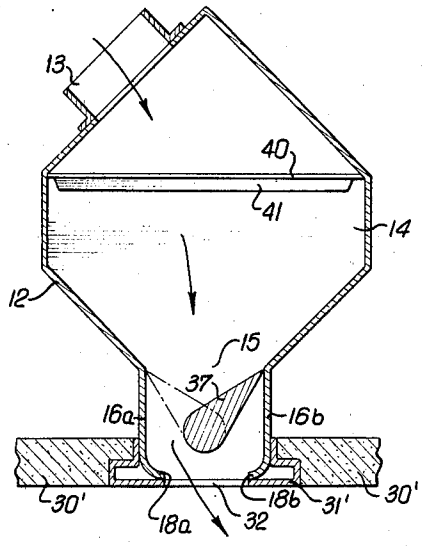
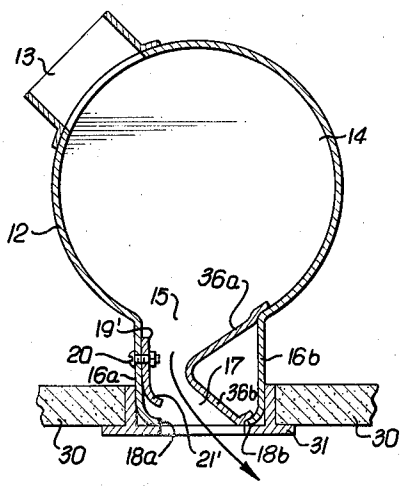


FIG. 6.



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United States Patent Office 3,250,205 Patented May 10, 1966

3,250,205

STRIP-TYPE AIR DIFFUSER

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Filed June 5, 1963, Ser. No. 285,667
12 Claims. (Cl. 98—40)

The present invention relates to an improved plenum air diffuser and more particularly to a plenum air diffuser that can be quickly and easily installed within a ceiling and not protrude into the room but can be easily controlled and adjusted from within the room yet will diffuse treated air in a thin, fan-shaped pattern creating a draftless blanket of air that effects a continuous air motion in the occupancy zone within low acceptable velocity limits.

There has long been a need in the heating and air conditioning industry and particularly by architects and engineers in designing residential as well as commercial buildings for a plenum air diffuser that may be quickly, easily and economically made and installed within the ceiling of a room, that does not detract from the aesthetic appearance of the ceiling yet will perform efficiently, quietly and draftlessly, with rapid temperature equalization. Designers of heating and air conditioning systems have long been plagued by the problem of inconspicuously introducing the treated air into the room or occupancy zone. It is important that such a unit should effectively diffuse the treated air so that it is not only inconspicuous from the aesthetic point but also that the occupants of the room are unaware of any rapid temperature differentials in various parts of the room. For comfort of the occupants, some provision should be made to permit the plenum air diffuser to be selectively adjustable from within the occupancy zone.

Although rectangular and circular diffusers have been provided heretofore, some of which were virtually flush with a ceiling and others projected downwardly only one or two inches, such prior diffusers did not answer all requirements. They constituted visible, unsightly knobs and areas which constituted objectionable excrescences and disfigurations which detracted from the uniformity, simplicity, or decorative lines of the ceiling. Also, the sound deadening characteristics of a ceiling can be greatly impaired by such prior devices. Modern ceilings are often of the soffit type, wherein decorative or sound absorptive tile or panels are supported by a series of T-bars from a structural ceiling, and designers, decorators and architects do not want the lines of a ceiling disfigured by projecting diffusers, lighting fixtures or other devices.

The plenum air diffuser of the present invention meets all the aforementioned requirements. The plenum air diffuser of the present invention may utilize the structure of the false ceiling without requiring any additional supports or construction, and presents a pleasing aesthetic appearance to the occupants of the room by being inconspicuously placed and hidden.

Whereas large rooms and halls ordinarily have their ceilings peppered with a plurality of individually large rectangular or circular air supply devices, the diffuser of this invention is substantially invisible, since in its preferred form it is long and narrow and a part of the T-bar ceiling supporting pattern. One of the distinguishing characteristics of this diffuser is that the outlet is long and narrow at the plane of the ceiling and in such plane presents a cross-sectional area which is but a fraction of the cross-sectional area of the plenum chamber associated with the outlet along a plane parallel to and slightly above ceiling level. Prior diffusers, on the other hand, presented visible outlets having an area substantially equal

to or even larger than the cross-section of the chamber associated with such outlet. The distinguishing characteristic, above noted, assists in permitting the diffuser of this invention to handle large volumes of air without objectionable noise. It may be positioned in the existing grid system of any false ceiling without securing it to any structural member or members as it is constructed to merely rest on existing grid members. Therefore, the plenum air diffuser of the present invention may be quickly and easily installed without the use of any bolts, clamps or drilling with an attendant saving in labor and material costs and with a higher degree of installation efficiency. The plenum air diffuser is adapted to selectively spray treated air in any direction at a preselected velocity whereby custom made air patterns can be created which will insure draftless diffusion and equalized temperatures for comfort conditioning of rooms, halls and enclosures of any shape or size. The plenum air diffuser of the present invention can be selectively adjusted from within the occupancy zone to create the exact air pattern and temperature desired.

Accordingly, it is a general object of the present invention to disclose and provide a unitary, self-supporting plenum air diffuser that satisfies all the architectural and engineering problems enumerated above.

An object of the present invention is to disclose and provide a plenum air diffuser with a long and narrow outlet that inconspicuously introduces treated air into a room or occupancy zone.

Another object of the present invention is to disclose and provide an inconspicuous plenum air diffuser unit which can be arranged to create custom made air patterns which will insure draftless diffusion and equalized temperatures for comfort conditioning throughout the occupancy zone.

A further object of the present invention is to disclose and provide an inconspicuous plenum air diffuser arranged to cooperate with a soffit ceiling grid or bar system and be easily adjusted from within the occupancy zone after installation.

Still another object of the present invention is to disclose and provide a plenum air diffuser that can be quickly, easily and economically installed without additional bolts, clamps or drilling.

Other objects and advantages of this invention will be readily apparent from the following description when considered in connection with the appended drawings.

In the drawings:

FIG. 1 shows a perspective view of an exemplary embodiment of the plenum air diffuser of the present invention.

FIG. 2 shows a transverse section in elevation of the device of the present invention taken along plane II—II of FIG. 1, the view showing the device above a grid-type ceiling in which the device is to be installed.

FIG. 3 shows a partial transverse section in elevation of the plenum air diffuser taken along plane III—III of FIG. 1.

FIG. 4 illustrates a partial longitudinal section in elevation of the device of the present invention taken along plane IV—IV of FIG. 2.

FIG. 5 illustrates a partial transverse section in elevation similar to FIG. 2 showing another embodiment of the present invention.

FIG. 6 is a transverse section in elevation of a modified form of device.

FIG. 7 is a transverse section of a still further modified form of device seated upon a different type of ceiling bar.

As best seen in FIG. 1, the strip type or plenum air diffuser 11 has an elongated hollow casing or plenum

chamber 12 with an air supply port 13 in a side of the plenum chamber 12. Material for the casing 12 may be selected from any light weight material such as sheet metal or plastic. The material of the casing 12 may be corrugated or embossed for added strength or may be planar for ease of construction. The inner surfaces of the hollow plenum chamber 12 may be coated or lined with a sound deadening material, such as fiber glass or resilient composition; however, since the plenum air diffuser of the present invention operates normally very quietly, this additional sound deadening material may easily be omitted without affecting the over-all performance of the unit.

The transverse cross-sectional configuration of the casing 12 may be square (FIG. 2) or it may take some other goemetric configuration such as rectangular, rhomboidal, elliptical, circular or any combination of two or more goemetric figures. The casing 12 has end portions 14 substantially the same size and shape as the cross-section of the casing12, and may have extensions which close the ends of distribution chamber 17. These ends 14 are easily removable so that two or more plenum air diffusers may be joined together to make a very long plenum chamber when the unit is to be used in larger than average rooms or halls. By joining several plenum air diffusers together, another advantage results in that only one supply duct connected to 13 (but not shown) need be used to supply treated air to an entire room. End portions 14 also serve in reinforcing the casing 12. Should additional reinforcing be desired, intermediate transverse reinforcing spiders may be added. Normally, however, the casing is durable enough to withstand continued use without additional supports.

Along one edge of the casing 12, preferably the lower edge or surface, is a longitudinally extending downwardly directed port 15. The port 15 may lie in one plane of the casing 12 (as best seen in FIG. 2) or it may lie in adjacent surfaces as seen in FIG. 5.

Adjacent the edges of the downwardly directed port 15, integral with the casing 12, are a pair of longitudinally extending, spaced webs 16*a* and 16*b*, the marginal portions of the webs adjoining the casing forming the port 15 therebetween. These webs 16*a* and 16*b* project downwardly from the lower portion of the casing 12. In the preferred embodiment as seen in FIGS. 1 and 2, one of the downwardly projecting webs 16*a* is substantially vertical. The other web 16*b* may be inclined with respect to web 16*a* (angles of 45° to 60° are recommended) so as to form an outwardly flaring distribution chamber 17. The longitudinal medial plane C of this outwardly flaring distribution chamber 17 forms an appreciable inclination to the plane of a ceiling 30 illustrated in FIG. 2 to cause air to be discharged at a slight angle to the plane of the ceiling. In this embodiment, the downwardly projecting webs 16*a* and 16*b* are of unequal length. The distribution chamber 17 is put in communication with the plenum chamber 12 by means of the downwardly directed port 15.

In an alternate embodiment as seen in FIG. 5, downwardly projecting web 16*b* may be virtually parallel to web 16*a*. The webs 16*a* and 16*b* in FIG. 5 then form a downwardly directed, but not outwardly flaring, distribution chamber, and other means are used to impart inclination to the discharged air.

At the outer edge portion of the downwardly directed webs 16*a* and 16*b* in both embodiments shown in FIGS. 2 and 5 are foot means or portions 18*a* and 18*b* provided to support the plenum air diffuser 11 on support bars 31 of a soffit type ceiling 30. One type of foot means 18*a* and 18*b* may be bent portions of the downwardly projecting webs 16*a* and 16*b*. It should be understood that other types of ceiling support bars (in the form of T's, angles, Z bars or the like) may be readily adapted to receive and support the plenum air diffuser and that those shown are merely illustrative. The entire weight of the plenum air diffuser 11 can rest on these ceiling support bars 31 without the use of any additional fastening means. Consequently, the device is merely set on the ceiling support bars 31 quickly and easily, which appreciably reduces installation and maintenance cost by eliminating the need for skilled workmen and additional equipment.

Along one edge of the downwardly directed port 15 is positioned adjustable weir means 19. One such weir means may be a piece of sheet material slidingly received by one surface of the casing 12 and may be frictionally held to that surface by means of a rivet, or machine bolt 20 slidable in a slot formed in the weir 19. The lower edge of the weir means 19 may be bent to form a downwardly extending leg 21 as seen in FIGS. 2 and 3. This leg 21 may be used to adjust the weir so that the desired amount and velocity of treated air will be diffused into the occupancy zone; the leg 21 also exerts a directional effect upon the stream of air. By opening the weir 19, the velocity of the air will be reduced if the quantity remains constant, and conversely, if the opening is closed, the velocity is increased if the quantity remains constant (Q=AV). Since the lower leg 21 of the weir means 19 is accessible from the distribution chamber 17, the flow of air may easily be adjusted from within the occupancy zone.

It should be noted that the operability or adjustability of the weir means 19 is not affected by changing the construction of the downwardly directed web 16*b*, as seen in FIG. 5.

Adjacent downwardly directed port 15 within the distribution chamber 17 there is positioned a set of diffusion vanes 22 transverse to the downwardly directed port 15 as best seen in FIGS. 2 and 4. These diffusion vanes may be of the type disclosed in United States Letters Patent 2,940,376 issued June 14, 1960. These diffusion vanes 22 may be secured to the downwardly projecting web 16*a* by a sheet metal screw 23 or by spot welding. Diffusion vanes may be provided throughout the entire length of the distribution chamber 17 or they may extend only part way as illustrated in FIG. 4. These diffusion vanes 22 may be easily adjusted from the distribution chamber to give any diffusion angle desired. When using a multiplicity of plenum air diffusers 11 in a series, it may be desirable to omit the diffusion vanes 22 entirely.

The long narrow outlet port A is extremely narrow with respect to the width of the plenum chamber or casing 12. The cross-sectional area of the outlet port A (which lies virtually in the plane of the ceiling) is preferably less than 30% of the cross-sectional area of the median plane B of the plenum chamber 12 parallel to the plane of the outlet port A. This unique feature allows a relatively narrow, virtually invisible, outlet port with respect to the plenum chamber 12. By providing a narrow outlet port A, all the unsightly appurtenances are hidden above the ceiling and only that much as absolutely required for a complete diffusion of treated air is visible from the occupancy zone.

Treated air, heated or cooled, is supplied from a duct (not shown) into the supply port 13. The treated air then circulates freely throughout the entire length of the casing 12 and passes downwardly through the port 15. If no diffusion vanes are used, the treated air then passes as a mass of air into the distribution chamber 17. The air then passes out of the distribution chamber as a diffused blanket of air virtually parallel to the ceiling 30 of the occupancy zone. By adjusting the weir means 19, the velocity of the diffused air can be easily controlled from within the occupancy zone. This blanket of diffused air will be approximately the width of the plenum chamber 12. However, should a wider blanket of diffused, treated air be desired, diffusion vanes 22 may be provided within the distribution chamber 17. Now when the treated air passes downwardly through port 15, it is dispersed in several directions by the diffusion vanes 22 to widen the blanket of diffused air. This produces a complete diffusion of treated air virtually parallel to the ceiling 30.

In some instances, in order to insure equal velocity

pressures throughout the length of outlet port A, it may be desirable to place a distribution plate **40** within the plenum chamber **12** in proximity to the supply port **13**. A form of distribution plate **40** is shown in phantom lines in FIG. 1 and an end elevation in FIG. 2. The plate **40** may be a sheet of metal having vanes **41**, **42**, **43** and **44** lanced therefrom, vanes **41** and **42** being inclined toward one end of the plenum and port **15** while vanes **43** and **44** are oppositely inclined. Plate **40** is preferably relatively short and not only distributes air towards the ends of the plenum chamber but also tends to strengthen the construction of the entire device.

FIG. 6 illustrates a modified form of the device, the plenum chamber being cylindrical in form and the weir **19'** being adjustably positionable on the inner surface of web **16***a*. It will be noted that in this form of device, the webs **16***a* and **16***b* are parallel and an outwardly flaring distribution chamber **17** is formed by a bent sheet metal means having portions **36***a* and **36***b*, this sheet metal means being either integral with web **16***b* or attached thereto. Lip **21'** of the weir exerts its effect on air passing between it and the element to affect the velocity and distribution of flow of such air.

The distribution of flow of air from the long and narrow outlet port may also be varied in the manner illustrated in FIG. 7. In this modification, the unitary plenum and diffuser is shown provided with a distribution plate **40** in the vicinity of inlet **13** only; the webs **16***a* and **16***b* are virtually parallel and are provided with an inwardly curving foot portion whose edges define the long and narrow outlet port. These portions are shown seated upon a long, preformed metal ceiling bar **31'** having reentrantly stepped, longitudinal outer edge portions adapted to receive and support ceiling tile **30'**. A series of openings **32** are formed in this strip-type ceiling bar **31'**. Pivotally supported upon a rod or other pivotal support so as to be adjustably positionable about an axis extending along the middle of distribution chamber **17**, is a directional vane **37**. Such vane is preferably delta-shaped or provided with a thin outer edge adapted to contact either web **16***a* or **16***b* at the installer's option, and a thick butt around the axis of pivotal rotation. It will be evident that the direction of air discharged through the outlet port may be varied by positioning the vane either in full line position or in dash line position, as indicated in FIG. 7.

The devices embraced by this invention provide a unitary plenum and diffuser which can be manufactured readily and inexpensively, which are self-supporting and which produce novel and advantageous results.

By completely diffusing the treated air virtually parallel to the ceiling **30**, the temperature within the occupancy zone may be controlled without subjecting the occupants to sudden temperature differentials or unnatural blasts of hot or cold air. Complete comfort conditioning is thus provided by this inconspicuous introduction of treated air into the occupancy zone. Consequently, a draftless diffusion of treated air is produced.

I claim:

1. A plenum air diffuser adapted to cooperate with a supporting bar system of a soffit type ceiling, comprising:
- an elongated, hollow casing provided with an air supply port in a side thereof,
- a pair of longitudinally extending, spaced webs, connected to and projecting downwardly from the lower portion of said casing, the outer edge portion of said webs being provided with foot means for cooperation with supporting bars to support the casing on such bars,
- one of said webs being inclined with respect to the other to form an outwardly flaring distribution chamber therebetween having a longitudinal medial plane at an appreciable inclination to the plane of a ceiling including such bars,
- a longitudinally extending downwardly directed port in said casing in communication with said distribution chamber,
- weir means located along one edge of said longitudinal, downwardly directed port means for adjustably positioning said wear means for controllably varying the width of said port to regulate the velocity of air passing from said casing into said distribution chamber,
- said weir means being accessible for adjustment from said chamber,
- whereby treated air may be introduced through said supply port to fill the casing and escape into a room through said downwardly directed port and distribution chamber at a predetermined velocity and direction.

2. A plenum air diffuser as described in claim **1** including a series of spaced diffusion vanes in planes transverse to the longitudinal downwardly directed port and inclined to the plane of a ceiling including such supporting bars,
- said diffusion vanes being positioned within said distribution chamber adjacent said port.

3. A plenum air diffuser adapted to cooperate with a grid system of a ceiling, comprising:
- a longitudinally elongated, hollow casing provided with an air supply port in one side thereof,
- a pair of longitudinally extending, spaced webs connected to and projecting downwardly from the lower portion of said casing, the outer edge portion of said webs being provided with foot means for cooperation with ceiling grids to support the casing on such grids,
- one of said webs being inclined with respect to the other to form an outwardly flaring distribution chamber therebetween having a longitudinal medial plane at an appreciable inclination to the plane of a ceiling including such grids, the outer edge portions of said webs defining an elongated outlet port materially narrower than the width of the hollow casing,
- and a longitudinally extending downwardly directed adjustable port in said casing between said webs and in communication with said distribution chamber.

4. A plenum air diffuser adapted to cooperate with and be supported upon a grid system of a ceiling, comprising:
- an elongated, hollow casing adapted to form a plenum chamber, said casing being provided with an air supply port in one side thereof,
- a pair of longitudinally extending, spaced webs projecting downwardly from and integral with the lower portion of said casing, said webs forming a longitudinally extending downwardly directed port in said casing and a downwardly directed distribution chamber, the outer edge portion of said webs being provided with foot means for cooperation with ceiling grids to support the casing on such grids,
- and means in said distribution chamber for modifying the direction of flow of air passing through the distribution chamber.

5. An efficient air diffusing unit adapted for use in soffit type ceilings including ceiling support bars comprising:
- an elongated hollow casing adapted to form a plenum chamber,
- an air supply port in a side of said casing,
- a pair of longitudinally extending spaced webs of unequal width connected to and projecting from the lower portion of said casing, marginal interportions of the webs adjoining the casing forming a port means in the casing, said webs defining walls of an outwardly flaring distribution chamber, said webs terminating in outer foot portions adapted to lie in the plane of a ceiling, said foot portions being adapted to cooperate with ceiling support bars to support the casing thereon,
- said foot portions cooperating with ceiling support bars

to provide a long and narrow air outlet in the plane of the ceiling,

the cross-sectional area of said outlet being less than 30% of the medial cross-section area of said plenum chamber in a plane parallel to said outlet.

6. An efficient air diffusing unit adapted for use in soffit type ceilings to provide a virtually invisible air diffusing outlet, comprising:

a longitudinally elongated hollow casing adapted to form a plenum chamber,

an air supply port in a side of said casing,

a pair of spaced, longitudinally extending webs integral with and extending from said casing, said webs defining therebetween a longitudinally extending downwardly directed air port and a distribution chamber adapted to be supplied with air from the plenum chamber through said air port,

said webs terminating in foot portions adapted to cooperate with ceiling support bars to support said casing thereon and define a long narrow outlet in the plane of the ceiling,

the cross-sectional area of said outlet at said foot portions being less than 30% of the medial cross-sectional area of said plenum chamber in a plane parallel to the plane occupied by said foot portions.

7. An efficient air diffusing unit as described in claim 6 including adjustably positionable weir means located along one edge of said longitudinal, downwardly directed air port for controllably varying the width of said port to regulate the velocity of air passing from said casing into said distribution chamber,

said weir means being accessible for adjustment from said distribution chamber.

8. An efficient air diffusing unit as described in claim 6 including a series of spaced diffusion vanes in planes transverse to the longitudinal downwardly directed port and inclined to the plane of a ceiling including such supporting bars,

said diffusion vanes being positioned within said distribution chamber adjacent said port.

9. A self-supporting unitary plenum diffuser comprising:

an elongated casing enclosing a plenum chamber, said casing being provided with an air supply port and a longitudinally extending downwardly directed port coextensive in length with said casing;

a pair of spaced webs connected to and projecting downwardly from the lower portion of said casing to form a distribution chamber and port, said distribution chamber being in communication with said port;

a foot portion carried by the lower edge of each web, said foot portions being adapted to support the plenum diffuser upon ceiling bars and define an elongated outlet port materially narrower than the width of the plenum chamber enclosed by said casing;

and means in said distribution chamber for modifying the direction of flow of air from said plenum through the outlet port.

10. A device as stated in claim 9 wherein the last said means include an adjustably positionable, longitudinally extending vane.

11. A device as stated in claim 9 wherein one internal wall surface of said distribution chamber is inclined with respect to the other to cause air discharged through the outlet port to be discharged at an angle.

12. A device as stated in claim 9 wherein a weir element is mounted in said distribution chamber for access through said outlet port in cooperative relation to one of said webs and means for adjustably positioning said weir element to selectively vary the velocity of air discharged through said outlet port.

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