Nov. 13, 1962 P. G. FITT 3,063,356

AIR DIFFUSOR

Filed April 29, 1960 2 Sheets-Sheet 1

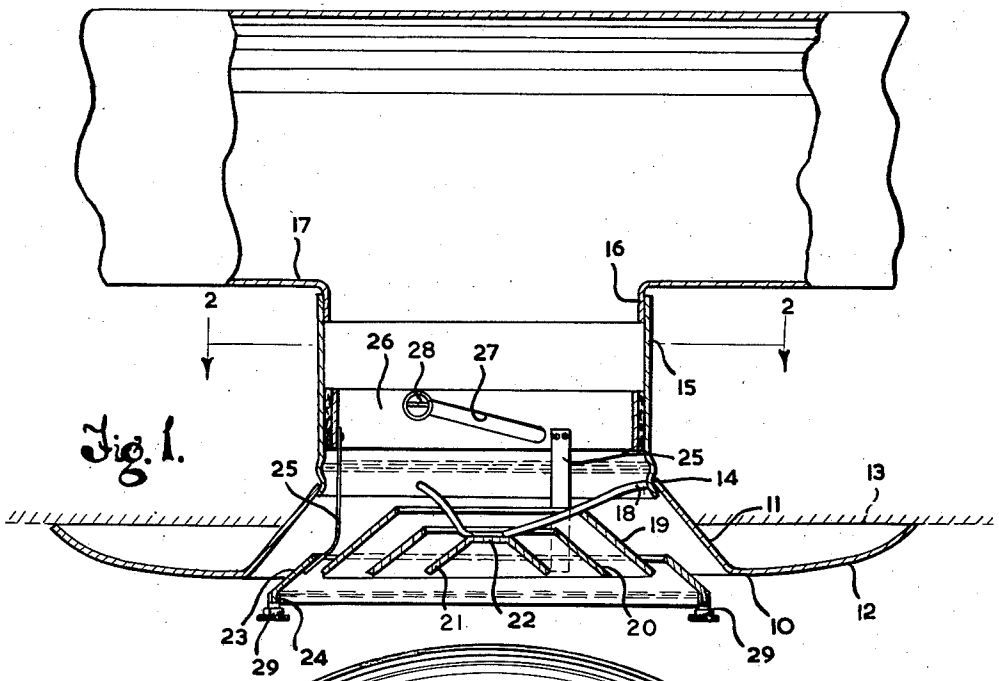


Fig. 1.

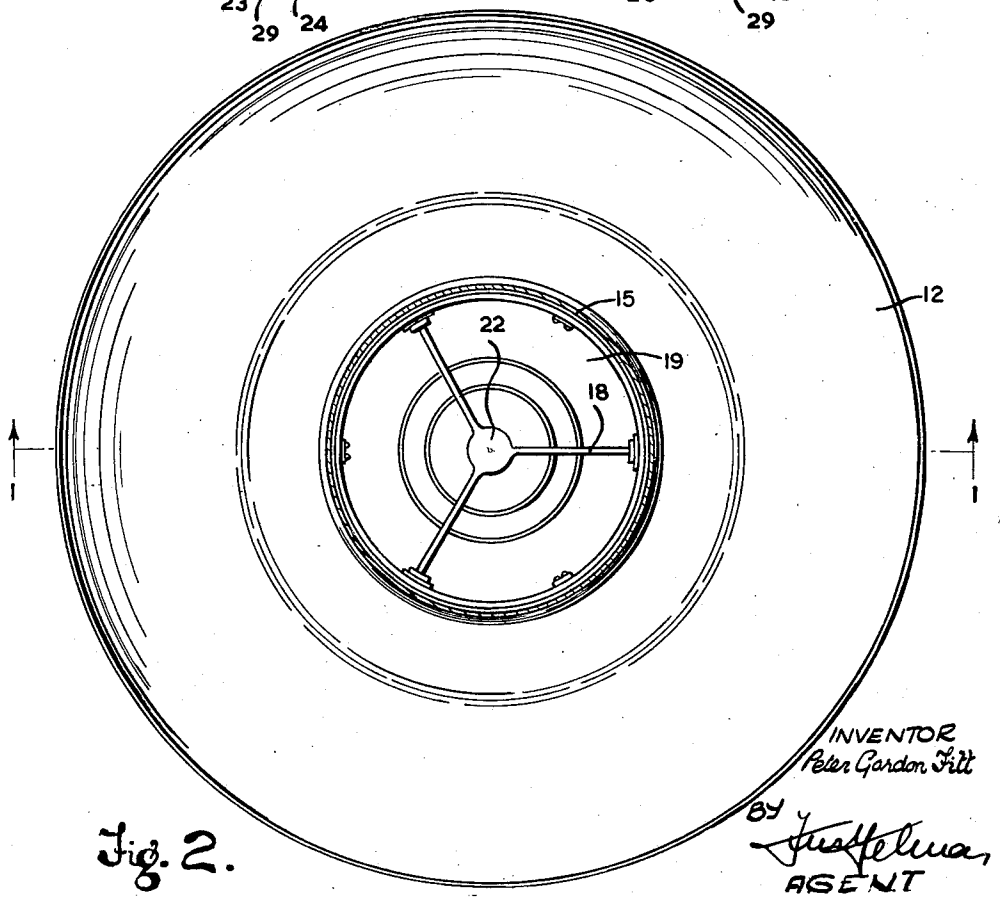


Fig. 2.

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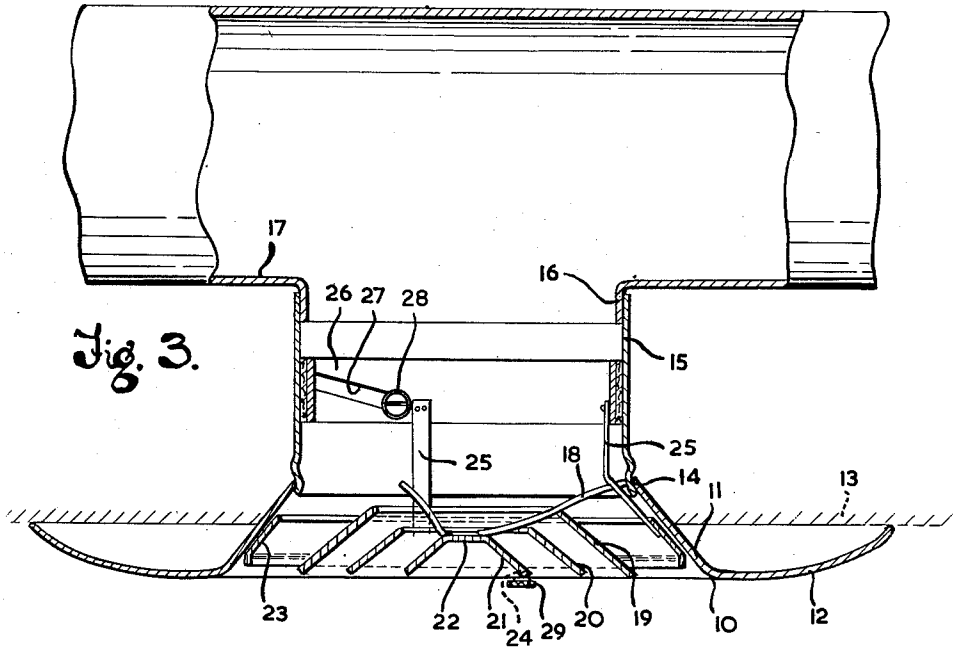


Fig. 3.

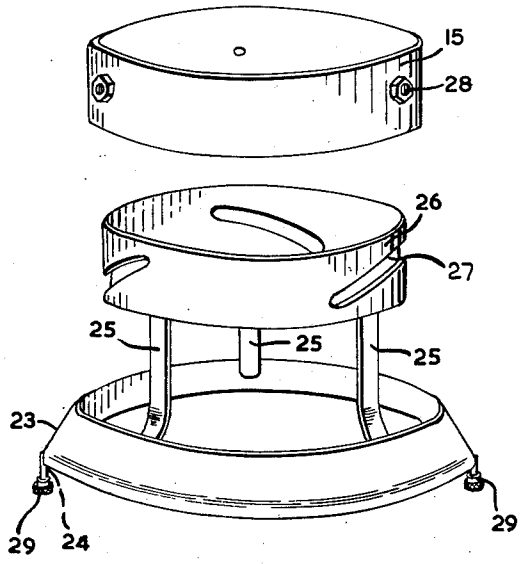


Fig. 4.

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AIR DIFFUSOR

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7 Claims. (Cl. 98—40)

This invention relates to ventilating equipment which comprises a diffuser embodying a series of discharge passages provided by one or a number of concentric partitions of laminar form disposed around the axis of symmetry extending from the inlet to the outlet end of the diffuser, the partitions being so arranged that the passages are of diverging form in cross section in a direction from the inlet to the outlet end of the diffuser. Ventilating equipment having the characteristics specified in this paragraph is herein referred to as ventilating equipment of the kind specified and an example of such equipment is described in United Kingdom patent specifications Nos. 566,605 and 633,591.

One of the disadvantages of ventilating equipment of the kind specified is that a specific construction of diffuser which is designed for warming a room cannot be used for cooling or refrigerating a room as, on reducing the temperature of the air supply from a warming temperature to a cooling temperature, draughts would be created. Furthermore, the temperature requirements for different rooms will differ and a specific construction of diffuser which is designed to provide a given temperature in a given room cannot be used to provide a different temperature in a similar room.

A still further disadvantage with ventilating equipment of the kind specified when the diffuser is arranged with its periphery flush with the surface of the ceiling or other part of the building on which the diffuser is mounted, as is necessary to provide a neat appearance to the interior of the room or the like, as opposed to the diffuser being projected into the interior of the room as by being mounted on the lower end of a projecting pipe, it has been found that the warm air at higher temperature than the ambient temperature within the room or equivalent tends to stratify adjacent the ceiling instead of becoming mixed with the ambient air in the room so that both the ventilating and the warming operation of the equipment is inefficient, the fresh and warm air remaining as a stratified layer of lesser density adjacent the ceiling.

The object of the present invention is to provide an improved construction of ventilating equipment of the kind specified which will eliminate the above disadvantages.

According to the present invention I provide ventilating equipment of the kind specified, wherein the diffuser, or a part associated therewith, is provided with an annular lip, said lip being disposed adjacent the periphery of the discharge outlet of the diffuser, said lip projecting in the direction along the axis of symmetry from the inlet to the discharge end, means being provided for adjusting said lip along the axis of symmetry between a position in which the free edge of the lip is flush with the discharge edge of the diffuser and a position in which it projects beyond the discharge edge, the maximum projection of the lip being sufficient to prevent or substantially prevent stratification of the air flowing into the interior of the room or the like and being insufficient to impair significantly the diffused discharge of the air from the diffuser.

Preferably the lip is carried by an entraining member of laminar form, the entraining member extending around the axis of symmetry of the diffuser and being inclined away from the axis of symmetry in the direction from the inlet to the outlet end of the diffuser.

Conveniently the lip is formed integrally with the entraining member and, in such an arrangement, the whole entraining member is displaceable along the axis of symmetry of the diffuser.

The laminar partitions are preferably of frusto-conical form and the entraining member will also be of frusto-conical form, the lip thereof being cylindrical.

The laminar partitions are preferably supported in a housing, the wall of which includes a portion of frusto-conical form, the entrainng cone being disposed between the housing and the outermost of the laminar partitions.

The frusto-conical portion of the housing is associated with a cylindrical portion which is disposed inwardly, that is to say, toward the inlet end of the diffuser of the frusto-conical portion, this cylindrical portion being adapted to be secured to the duct of the ventilating equipment.

Conveniently the entraining cone is carried by an annular collar which is disposed within the cylindrical portion of the housing, the annular collar being provided with one or more inclined slots which are adapted to engage over studs carried by the cylindrical portion, whereby rotation of the entraining cone and its supporting collar will cause displacement thereof in a direction axially of the diffuser.

One form of my invention is illustrated in the accompanying drawing wherein,

FIGURE 1 is a sectional view in side elevation taken on the line 1—1 of FIGURE 2,

FIGURE 2 is a plan view taken on the line 2—2 of FIGURE 1,

FIGURE 3 is a view similar to FIGURE 1 but showing the entraining cone in the closed position and

FIGURE 4 is a detail showing the entraining cone and its associated mounting ring.

In the construction illustrated in the accompanying drawing the invention is shown as applied to combined heating and ventilating equipment especially adapted for the heating and ventilating of rooms or public buildings wherein a neat and pleasing appearance is required. The diffuser comprises an outer housing 10 which includes a portion 11 of frusto-conical form formed integrally with a bowl shaped flange 12, the upturned lip of which is adapted to seat against the ceiling 13 of the room. The neck 14 of the frusto-conical portion 11 is welded or otherwise secured to one end of a cylindrical attachment portion 15, the other end of which is adapted to be secured over a flanged port 16 formed in the main ventilation duct 17.

Secured to the lower end of the cylindrical attachment portion 15 of the housing 10 is a three-arm spider 18, to the arms of which are welded or otherwise secured, three concentrically arranged diffusing cones 19, 20 and 21. These diffusing cones 19, 20 and 21 are not only concentric with one another but are also concentric with the housing 10 and the lower or discharge edge of each cone 19, 20 and 21 lies in the same horizontal plane as the lower face of the bowl shaped flange 12.

Each of the diffuser cones 19, 20 and 21 are formed of strip metal and are arranged so as to be of divergent form in a downward direction as clearly seen in FIGURE 1. The cone angle of each of the diffuser cones, as measured from the axis of symmetry, is the same. As clearly seen from FIGURES 1 and 2, the upper end of the inner cone 21 is closed, as shown at 22, so that the air passages provided by the several partition members are each of annular form.

The vertical depth of the diffuser cones increases progressively with increase in radial distance from the axis of symmetry of the diffuser, that is to say with the lower edges of the cones 19, 20 and 21 lying on a common horizontal plane, the upper edge of the cone 20 is nearer the inlet end of the diffuser than the upper edge of the cone 21 and the upper edge of the cone 19 is nearer the

inlet end of the diffuser than is the upper end of the cone **20**. Thus the arms of the spider **18** to which the upper edges of the cones are secured are inclined upwardly from their point of attachment to the inner cone **21** to their point of attachment to the cylindrical portion **15** of the housing **10**.

In one particular example, which is given by way of illustration and is in no way limitative, the three cone members have the following dimensions:

	Cone Angle, degrees	Vertical Depth, inches	Diameter of lower edge of partition member, inches
Inner cone	46	½	2
Middle cone	46	¾	3½
Outer cone	46	1	5½

The diameter of the aperture in the housing **10**, as measured across the junction between the frusto-conical portion **11** and the bowl shaped portion **12**, may, in such a particular example, be of the order of 7½" so as to leave an annular space of approximately 1" radius between the outer cone **19** and the frusto-conical portion **11** of the housing **10**.

Disposed within this annular space is a further frusto-conical member which constitutes an entraining member **23** which is mounted for vertical movement between an upper inoperative position in which it is substantially flush with the frusto-conical portion **11** of the housing **10**, as seen in FIGURE 3, and a lower operative position in which it projects below the discharge edge of the diffuser, as seen in FIGURE 1.

The lower edge of this frusto-conical entraining member **23** is formed with a lip **24** of cylindrical configuration having a vertical depth of approximately ⅛" to ⅜", and the entraining member **23** is provided at the edge thereof nearest the inlet end of the diffuser, with a series of supporting lugs **25** which extend parallel to the axis of symmetry of the diffuser, these lugs **25** at their ends remote from the entraining member **23**, being secured to a supporting sleeve **26** which is mounted for rotational movement within the cylindrical portion **15** of the housing **10**.

The said sleeve **26** is formed with three similar equally circumferentially spaced slots **27**, each slot **27** being inclined conveniently at an angle of the order of 70° or 80°, or any other convenient angle, to an axis parallel to the axis of symmetry. The cylindrical portion **15** of the housing within which the sleeve **26** extends is provided at a position corresponding to each of the said slots with a headed stud **28** extending through the slot **27**, the arrangement being such that by rotating the said sleeve **26**, and the entraining member **23** connected thereto, the entraining member **23**, by virtue of the inclined disposition of the said slots **27**, is displaced in a direction parallel to the axis of symmetry between its inoperative and operative positions.

Such displacement of the entraining member **23** is conveniently effected by providing the same on the lip **24** thereof at one or two diametrically spaced positions with a knob or handle **29**, whereby the entraining member **23** and associated sleeve **26** can be turned in relation to the housing **10** and to the cones **19**, **20** and **21** which are fixed to the housing **10**.

In the operative position of the entraining member **23**, shown in FIGURE 1, the lower or operative edge of the lip **24** thereof would depend by a distance of between ¼" to ⅜", in the example referred to, below the horizontal plane containing the lower edges of the three cones **19**, **20** and **21**.

In this operative position of the entraining member an annular air entraining space of a radial width of the order of ⅜" to ½" would be provided between the outer side of the frusto-conical entraining member **23** and the frusto-conical portion **12** of the housing **10**.

Insofar as the lip **24** on the entraining member **23** is of cylindrical form and is consequently inclined at a lesser angle to the axis of symmetry than is the case with the adjacent part of the entraining member, and is further less inclined to the axis of symmetry than the adjacent diffuser cone **19**, stratification of warm air adjacent the ceiling is prevented as the diffused air is directed in a downwards direction so that the spread, which leads to stratification, is prevented or reduced.

Insofar as this lip **24** is provided on the said entraining member **23** so that it can project below or beyond, in an outlet direction, the lower, i.e. outlet edges of each of the diffuser cones **19**, **20** and **21**, ambient air, i.e. air already present in the room or other space to be heated and ventilated, is found to flow upwardly through the said annular space between the entraining member **23** and the frusto-conical portion **11** of the housing **10** to the inlet side of the diffuser so as thereby to become mixed with the air which is being supplied from the supply duct **17** of the ventilating apparatus to the diffuser whereby a more rapid and efficient mixing of the supplied air with the ambient air in the room is achieved.

Thus the present invention provides a diffuser which is extremely efficient in operation in that mixing of the ambient air with the supplied air occurs in the diffuser itself as well as in the room.

At the same time the efficiency of the diffuser as such is in no way impaired as far as can be ascertained, i.e. the air is discharged into the room without the creation of draughts.

Insofar as the present invention ensures more efficient mixing of the supplied air with the ambient air, the present invention is applicable to pure ventilating apparatus in which the supplied air is not specially heated to a temperature above room temperature but the invention is of particular importance as applied to combined heating and ventilating equipment in that stratification of the heated air adjacent the ceiling or the like of the room is avoided whilst at the same time a diffuser of sightly appearance flush with the surface of the ceiling or the like is provided.

Insofar as the diffuser in accordance with the present invention is applicable to ventilating apparatus generally, it should, of course, be understood that the diffuser may be mounted in any position in relation to the interior of the room, for example, on a vertical wall or on the lower end of a pipe or duct which projects below the surface of the ceiling or roof, since, irrespective of the position and method of mounting of the diffuser the present invention ensures more efficient mixing by the entrainment action above referred to.

Whatever arrangement is adopted, I have found that it is desirable that the lower edge of the central opening in the housing adjacent to where the inner conical wall thereof merges with the base of the housing should be of smoothly convex as opposed to sharp configuration.

In addition to the advantages of the above described ventilating equipment in accordance with the present invention, a further very important advantage is that by reason of the provision in the preferred arrangement of adjustment in the position of the entraining member, the equipment is capable of operating efficiently with wide variations of temperature between the air supply and the ambient air.

For example, by suitably adjusting the position of the entraining member in relation to the cones of the diffuser in the manner earlier generally described, the same diffuser can operate efficiently without the production of draughts in the case where the air supply is at a temperature which may be as much as thirty to seventy degrees Fahrenheit higher than the ambient temperature or which may alternatively be as much as twenty to thirty degrees Fahrenheit below the ambient temperature.

Thus the same diffuser may be employed for efficiently heating and also for efficiently cooling, or if desired refrigerating, the interior of a room or other space merely by suitably adjusting the degree of projection of the discharge edge of the entraining member in relation to the discharge edges of the partition members.

In this respect the present invention presents important advantages over non-adjustable diffusers as described for example in the prior specifications aforementioned in which a specific construction of diffuser designed specifically for instance for use in the warming of a room is wholly unsuitable for use in cooling or refrigerating a room or other space in that on reduction of the air supply temperature from a warming temperature to a cooling temperature, for example, of the range above described, the creation of strong draughts can be expected, and these are avoided entirely by the preferred form of the present invention in which the position of the entraining member is adjustable in the manner above described.

By carrying the lip upon an adjustable entraining member one is enabled to use the same sized diffuser for differing sized or shaped rooms, since different positions of the entraining member result in different ventilating conditions. The present invention eliminates, therefore, the necessity for the manufacturer having to offer a very wide range of diffusers.

As the entraining member is moved from its operative, or maximum downwardly projecting position, to its inoperative position in which it is flush with the housing of the diffuser so the downward deflection of the diffused and mixed air is reduced from a maximum to a minimum.

In addition to being used as a ventilator for introducing hot or cold air into a room, such a diffuser can also be used as an extractor.

If desired, and if the required conditions are such that no variation is sought, the lip may be supported on the outer diffuser cone or upon the housing at the point where the frusto-conical portion joins the bowl shaped portion.

Although optimum results are obtained with the partitions of the diffuser of conical shape, it is within the scope of my invention for these partitions to be of other shape, the limiting characteristic being that the partitions taper outwardly from the inlet to the discharge end of the diffuser. Thus, as viewed in plan, the partitions may be of square form.

What I claim then is:

1. Ventilating equipment comprising an outer housing having an axis of symmetry, an inlet to and an outlet from said housing along said axis of symmetry, an air diffuser in the outlet of the housing, a support means supporting the diffuser along said axis of symmetry in said housing outlet, an air entraining member, a peripheral lip on said air entraining member, said lip projecting in the direction of the axis of symmetry, adjustable support means connecting said entraining member and said housing, said support means supporting the entraining member for movement within said housing along said axis of symmetry between a position in which a free edge of the lip is flush with the outlet and a position in which it projects beyond the outlet, the maximum projection of the lip being sufficient at least substantially to prevent stratification of air flowing through said outlet and being insufficient to impair significantly the diffused discharge of the air from the outlet.

2. Ventilating equipment as claimed in claim 1, wherein said adjustable support mean supports the entraining member between the diffuser and the outer housing.

3. Ventilating equipment as claimed in claim 2, wherein the diffuser includes a plurality of frusto-conical members each of laminar form and wherein the outer housing includes a frusto-conical portion.

4. Ventilating equipment as claimed in claim 3, wherein the entraining member is of frusto-conical form and wherein the peripheral lip is of cylindrical form.

5. Ventilating equipment as claimed in claim 4, wherein the frusto-conical part of the housing is secured to a cylindrical portion, and further comprising a main air duct in communication with the inlet, the cylindrical portion being adapted to be secured to the main duct.

6. Ventilating equipment as claimed in claim 5, wherein the entraining member supporting means comprises an annular sleeve, said sleeve being secured to the cylindrical portion of the housing.

7. Ventilating equipment as claimed in claim 6, wherein a plurality of studs or pins are mounted on the cylindrical portion of the housing and wherein the annular sleeve is formed with a corresponding number of inclined slots, each said stud or pin being adapted to engage in an inclined slot whereby rotation of the annular sleeve causes axial displacement of the sleeve and entraining member along the axis of symmetry of the housing.

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