June 12, 1945. G. HERBSTER 2,378,012

AIR DIFFUSING AND VENTILATING UNIT

Filed March 5, 1941 3 Sheets-Sheet 1

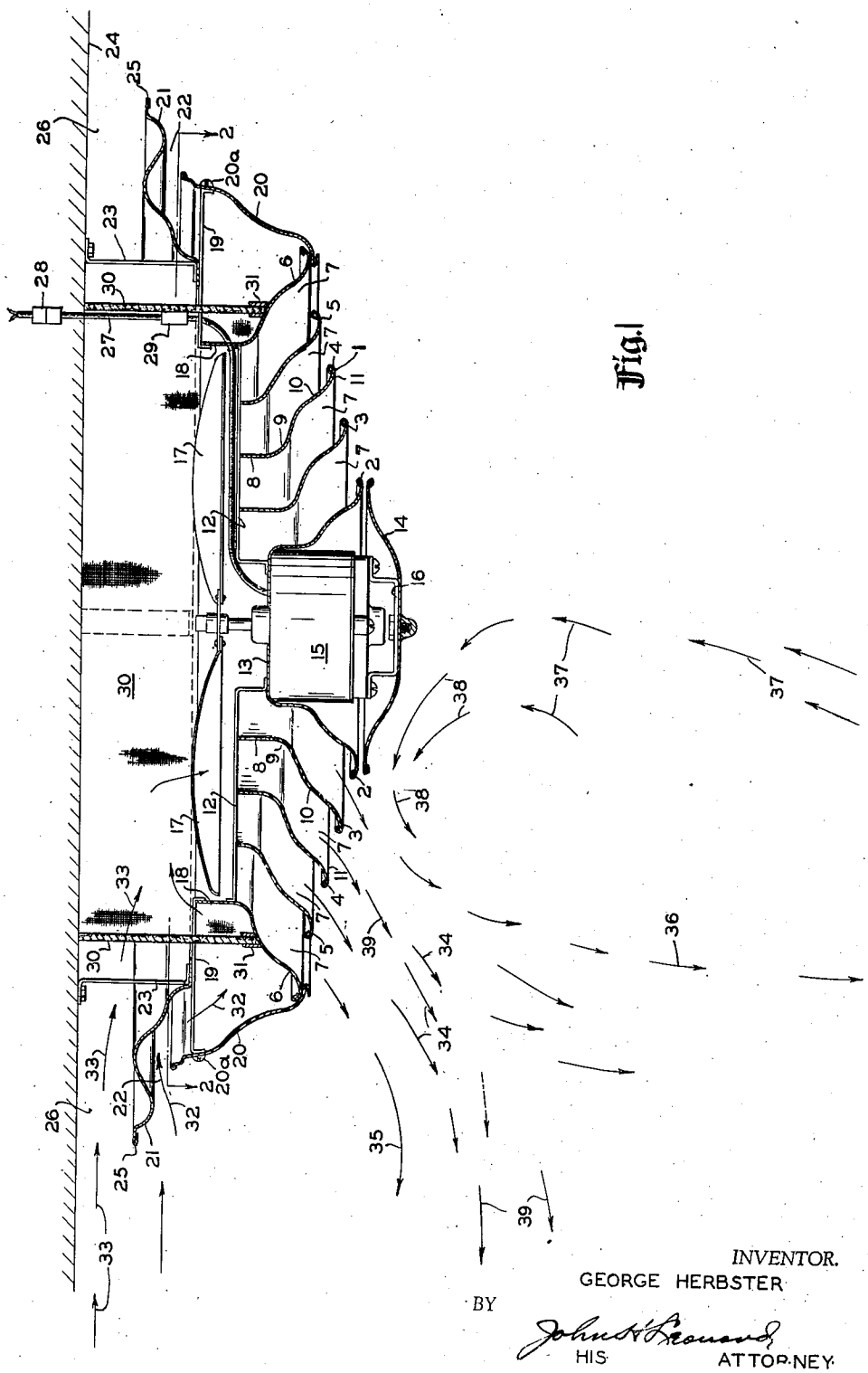

Fig. 1

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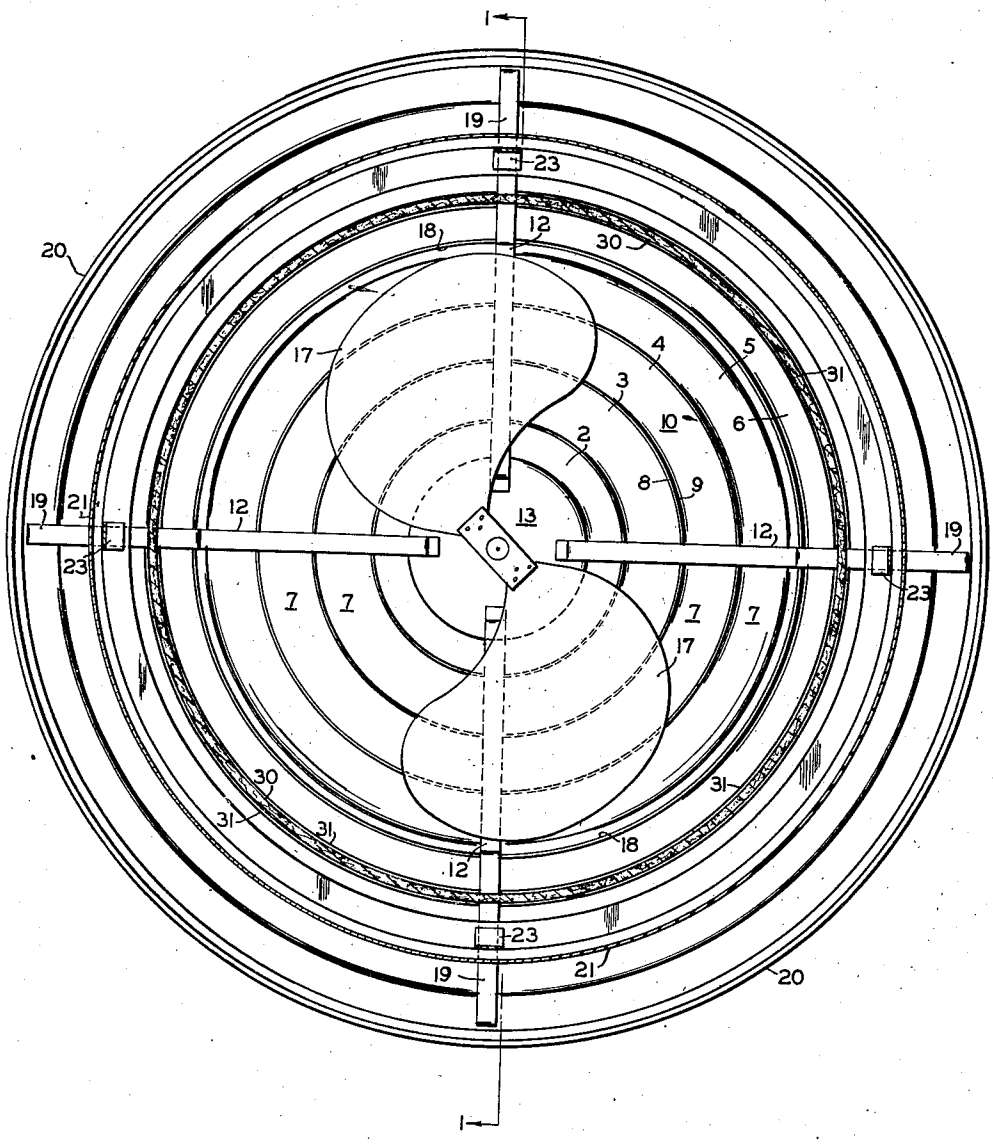

Fig. 2

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Fig. 3

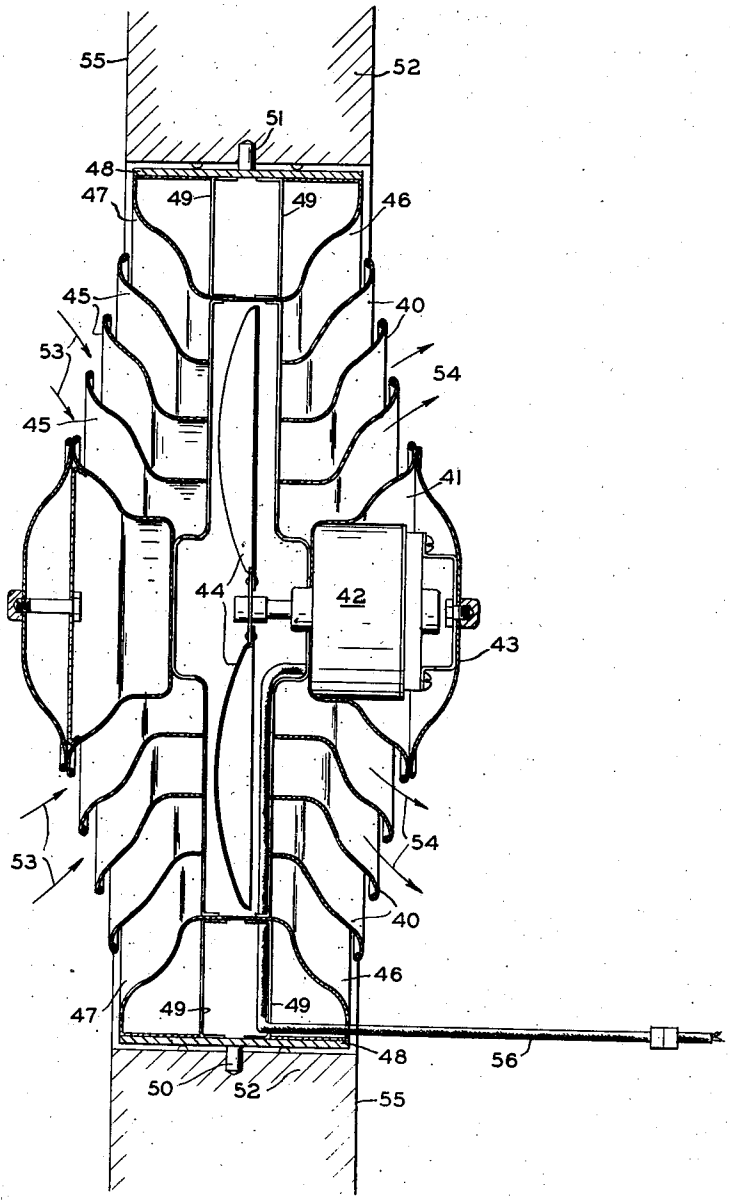
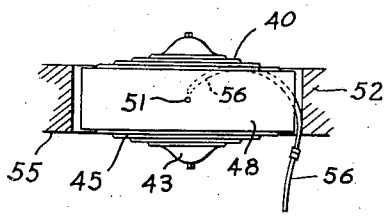


Fig. 4



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UNITED STATES PATENT OFFICE

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AIR DIFFUSING AND VENTILATING UNIT

George Herbster, Cleveland, Ohio

Application March 5, 1941, Serial No. 381,874

4 Claims. (Cl. 98—29)

This invention relates to an air circulator and diffuser for rooms and other enclosures, and particularly to a device for causing efficient diffusion of the heated air throughout a room without the production of drafts and air currents which would be objectionable to the occupants of the room.

One of the principal objects of the present invention is to re-circulate and diffuse the air in a room in a manner to prevent stratification of the air into layers or strata of different temperatures.

A correlative object is to withdraw the heated air in a room or enclosure from a region adjacent the ceiling thereof and diffuse it downwardly and outwardly so as to utilize more effectively the heat contained therein.

Another object is to withdraw warm air at the region of the ceiling of a room and recirculate it downwardly and outwardly toward the floor of the room while concurrently effecting admixture of the warm discharged air with other air below the level of the diffusing device before the discharged air reaches the occupied level of the room.

Still another object is to provide a device of this character which is complete in and of itself and which may be installed readily in properly spaced relation to the ceiling merely by fastening a supporting bracket of the device to a suitable supporting element in the ceiling, and which employs a diffusing grill shaped and arranged so that when the unit is suspended from the ceiling, relatively free passages of air thereinto adjacent the ceiling of the room and therefrom through the grill are provided, yet the operating parts of the device which are behind the grill are concealed and not visible through the grill openings.

Another object is to provide a device of this character employing a filter by which the recirculated air is filtered effectively prior to its diffusion throughout the enclosure.

Another specific object is to control the operation of the device in response to the temperature of the air stratum at the region of the ceiling of the room.

Still another object is to provide a device of the general character described which may be mounted for adjustment into positions in which, without objectionable drafts, it can withdraw the air from the room or deliver outside air into the room.

Other objects and advantages will become apparent from the following specification, wherein reference is made to the drawings, in which:

Fig. 1 is a vertical sectional view through the device embodying the principles of the present invention, showing its association with the ceiling of the room, and is taken on line 1—1 of Fig. 2;

Fig. 2 is a horizontal sectional view of the device taken on line 2—2 in Fig. 1,

Fig. 3 is a cross sectional view of a modified form of the device, and

Fig. 4 is a diagrammatic sectional view taken in a horizontal plane at right angles to Fig. 3, showing the relationship of the device according to Fig. 3 to an appropriate opening in a wall.

Referring to Figs. 1 and 2, the device comprises a grill, designated generally at 1, and composed of a plurality of annular deflecting vanes which are arranged concentrically about a common axis. For illustrative purposes, a grill formed of an inner vane 2, intermediate vanes 3, 4, 5, and an outer vane 6, is shown. The vanes are spaced apart from each other radially to provide air passages 7 therebetween. Since the vanes are substantially the same in shape, the vane 4 is described as typical. The vane 4 comprises an annular substantially cylindrical entrance portion 8 which joins by a rather abrupt outward curve portion 9 with a reverse curve portion 10, the outer free end portion 11 being directed at a very slight forward angle to a plane at right angles to the axis.

The vanes are connected at their inlet edges to coplanar supporting brackets 12 so that the inlet edges lie substantially in a common plane. The inlet portions, such as the portion 8 of vane 4, are of decrescent length, axially of the vanes, from the innermost vane outwardly except for the outermost vane. Thus, the lower or discharge ends of the vanes in Fig. 1 are offset successively upwardly, beginning with the innermost vane 2 and continuing to the outermost vane 6. The central or inner annular vane 2 is substantially the same as the vane 4 except that its inlet end is closed by a wall 13 which is located downwardly from the plane of the brackets 12. A cap 14 is mounted detachably in slightly spaced relation in front of the vane 2 so that the vane and cap form a housing for accommodating a motor 15 which is secured to the wall 13 and supports a bracket 16 which, in turn, supports the cap 14.

A propeller type fan 17 is mounted on the motor shaft for rotation in a plane above the plane of the bracket 7. The outermost vane 6,

though in general of the same shape as the vane 4, has its inlet portion 18 extended upwardly beyond the plane of the fan to provide a circumferential housing around the fan for reducing the radial slip of air from the fan. This inlet end of the vane 6 is connected to radial brackets 19. An annular housing 20 is connected to the brackets 19 by screws 20a and extends downwardly therefrom and generally inwardly toward the axis of the vanes, its lower end underlying the lower face of the vane 6 and forming therewith an apparently continuous surface.

Connected to the same brackets 19, inwardly from the upper edge of the housing 20, is a decorative inlet vane or shield 21, the vane 21 having its lower face spaced from the upper face of the vane 20 so as to define an air inlet passage 22.

Connected to the brackets 19 are supporting brackets 23 which are adapted to be secured to the ceiling of a room and space the fan and vanes the proper distance below the ceiling 24. The inlet edge 25 of the vane or shield 21 extends outwardly beyond the radial limits of the remainder of the device and is so positioned relative to the length of the brackets 23 that it is spaced from the ceiling 24 of the enclosure when the brackets 23 are secured in place. Thus a single air inlet passage 26 is provided between the inlet edge 25 of the vane or shield 21 and the ceiling 24, the passage 26 being from one to three inches.

The motor 15 is connected to a suitable source of power by the usual light cord 27, with a sabre plug-in connection 28. Connected in the cord 27 is a thermostatic switch 29 for making and breaking the circuit to the motor. This thermostatic switch is one which makes the circuit to the motor when the temperature of the surrounding air reaches a predetermined degree above the normal temperature desired at the occupied level of the room, and breaks the circuit to the motor when the air surrounding the thermostatic switch reaches a somewhat lower temperature. For example, in a room which is to be kept at a temperature of about 72° at the occupied level, it would be desirable to set the ceiling thermostatic switch 29 so that it would operate to start the motor at about 80° to 85°. The thermostatic switch preferably is of the snap action type and operates in a range of about five degrees.

Mounted between the ceiling 24 and the upper face of the vane 6 is an annular air filter screen 30, one edge of which abuts the ceiling and the other edge of which is engaged and held in place by suitable lugs 31 on the upper face of the vane 6. Upon operation of the fan, air can enter the annular passages 22 and 26, and in both instances must pass through the filter screen 30.

Assuming that the room temperature is about 70° at the occupied level and is about 80° at the ceiling, when this temperature condition arises, the switch 29 starts the fan, which draws air from the room through the passage 22, as indicated by the arrows 32, this air passing through the filter screen and then being discharged through the passages 7. Air is also drawn through the passage 26, as indicated by the arrows 33, this air also passing through the filter screen 30 and being discharged, with the air from the passages 22, through the passages 7.

Due to the shape of the annular vanes 2 to 6, inclusive, the air delivered by the fan is not forced into the room as a heavy directional blast but is diffused widely through the room so that a substantial volume of the air is moved but it is free from currents which would be objectionable to the occupants of the room. This air circulation generally may be described as a frusto-conical annulus of air issuing downwardly from the fan with its smaller diameter adjacent the vanes, as indicated by the arrow 34. Part way out from the vanes, however, the outer portion of this air stream tends to bend outwardly somewhat approaching the horizontal and part of it returns toward the ceiling 24, as indicated diagrammatically by the arrow 35, some portion of this returning air rather rapidly returning to the inlets 22 and 26. At the inner limit of the frusto-conical annulus of air, the air stream tends to bend inwardly toward the axis of the fan on a very gradual curve, as indicated by the arrow 36, and to progress substantially to the floor level and eventually to return toward the axis, as indicated by the arrow 37, and again swing outwardly to join the air issuing from the inner passage 7, as indicated by the arrow 38. This effect is due to the tendency toward subatmospheric pressure created within the frusto-conical annulus, or the annular frusto-conical body of air issuing from the passages 7. Toward the middle ones of the passages 7, for example, those between vanes 3, 4 and 5, there is less tendency of the air stream to bend toward the radial limits of the device, and this air travels somewhat more nearly in a straight line, as indicated by the arrow 39.

Due to the divergence of the inner and outer portions of this annular air stream and the tendency for portions thereof to spread away from the main body and return toward the vanes and inlet openings, the central portion of the main body of air tends to spread somewhat, and thus at the occupied level of the room, the draft is not concentrated but is in the form of gradual movement of substantially all of the air in the room. Experience has shown that the return of the air, as indicated by the arrow 37, is to a point at about six inches below the cap 14. By this arrangement, the air is filtered and the tendency toward stratification of the heated air in the region of the ceiling is eliminated, and as a result, much less heat is required to render the occupied portion of the room at the proper temperature for comfort of the occupants. Also, the air in the occupied level of the room is drawn gradually to the center of the device and is there mixed with the warmer air and a resultant volume of air of more uniform temperature is diffused throughout the room.

Referring next to Fig. 3, a double-faced device similar to that illustrated in Figs. 1 and 2 is disclosed. This device comprises the vanes 40, the inner vane 41 of which supports a motor 42, the motor being enclosed in the inner vane by a cap 43. The fan 44 is disposed at the inlet faces of the vanes 40. Beyond the fan in a direction away from the vanes 40 are corresponding vanes 45, each of which is concentric with a corresponding one of the vanes 40. The outer vanes 46 and 47, comparable to the vane 6 in the structure of Fig. 1, are fitted into a heavy sheet metal annulus 48 to which the supporting brackets 49 are connected.

The structure shown in Fig. 3 may be operated in upright position, as illustrated, or horizontally, and is to be used in a window or other opening in a wall, either for admitting fresh air, or for exhausting air from the room. In either event, the air passing from or to the device on

the room side is in the form of a gradually moving body of substantially the entire amount of air in the room and is free from objectionable draft, the same as in the case of the structure of Fig. 1.

Upright aligned pivots **50** and **51** are provided at diametrically opposite portions of the band **48** for supporting the device in a suitable window or other frame **52**. The wall portions of the opening in the frame **52** at opposite sides of the pivot axis are relieved as necessary in order to clear the band **48** as the latter is turned on the pivots. For example, the opposite sides of the opening in the frame **52** can be spaced sufficiently away from the band **48** to enable the band to clear the opening surfaces as suggested on Fig. 4 or, in order to minimize the gap between the band and frame opening, the walls of the frame opening can be concaved at opposite regions in the plane of swinging of the band.

The air is drawn into the device from the left in Fig. 3, as indicated by the arrows **53**, and is discharged at the right, as indicated by the arrows **54**. Assuming that the device is mounted in an opening, such as that indicated by comparison of Figs. 3 and 4, in a side wall **55** of a room, air is drawn from the outside and diffused into the room to the right. If it is desired to use the device for exhausting air from the room, the device is merely rotated on its pivots **50** and **51** through 180°, in which case the air will be withdrawn from the room at the right and discharged outwardly thereof to the left. Limit stops may be provided, if desired, to prevent rotation of the device more than 180° so as to prevent twisting of the electric cord **56** by which the motor is connected to a suitable source of power. Suitable clearance is also provided between the wall opening and band **48** for receiving the cord **56** when the device is turned 180° as described.

It has been found that with the present device and a fan having a diameter of about 18", the outer diameter of the device being 36", and other parts in the proportions shown, effective diffusion of the air, elimination of stratification, and ventilation can be obtained with a motor of as little as one-fortieth horsepower.

Having thus described my invention, I claim:

1. A ventilating unit comprising a pair of upright grills, each of a plurality of concentric annular vanes spaced apart radially about a common axis, the grills being coaxial and spaced apart axially, a motor carried in the central vane of one grill and lying outside of the space between the grills and having its shaft extending coaxially of the grills into the space between the grills, a propeller fan between the grills on the motor shaft, and means for supporting the grills for adjustment about an axis intersecting the common axis of the grills and lying in a plane normal to the grill axis whereby the unit can be made to introduce or to exhaust air from an enclosure by adjusting its position without reversing the fan.

2. The combination with a wall having an opening therethrough of a motor driven propeller fan arranged in the opening and normally having its axis at right angles to the wall, means supporting the fan for rotation 180° from said normal position about an axis intersecting the fan axis and lying in a plane parallel to the wall, and air directing grills having relatively broad air directing surfaces in fixed relation relative to the plane of the fan and at opposite sides of the fan and rotatable therewith about the axis of said means.

3. A vision obstructing ventilator for an opening in a wall and comprising a pair of grills, each grill comprising a plurality of generally frustoconical annular vanes arranged in coaxial relation to each other and spaced apart radially from each other to define annular passages for air between adjacent vanes, the vanes having their smaller bases at the inner end of the associated grill and their larger bases at the outer end, the radially outward edge of each vane lying radially outwardly beyond the radially inward edge of the next adjacent radially outward vane, said grills being adapted to overlie the opening when they are disposed in axial alignment with their inner ends facing each other, means connecting the two grills and securing the grills in axial alignment with their inner ends facing each other, and means extending from the connecting means and arranged to secure the ventilator to such wall opening.

4. A ventilating unit comprising a pair of upright grills having relatively broad overlapping air directing surfaces, said grills being in closely spaced relation and facing oppositely from each other and in alignment horizontally, a propeller fan between the grills with its common plane parallel to the plane of the respective grills, means supporting the grills in fixed relation to each other and for rotation in a wall opening about an upright axis, and means drivingly connected to the fan and operative to drive the fan in all rotated positions of said grills about said upright axis of rotation.

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