

Sept. 10, 1946.

W. W. KENNEDY

2,407,284

AIR DISTRIBUTION OUTLET

Filed June 20, 1942

4 Sheets-Sheet 1

Fig. 2.

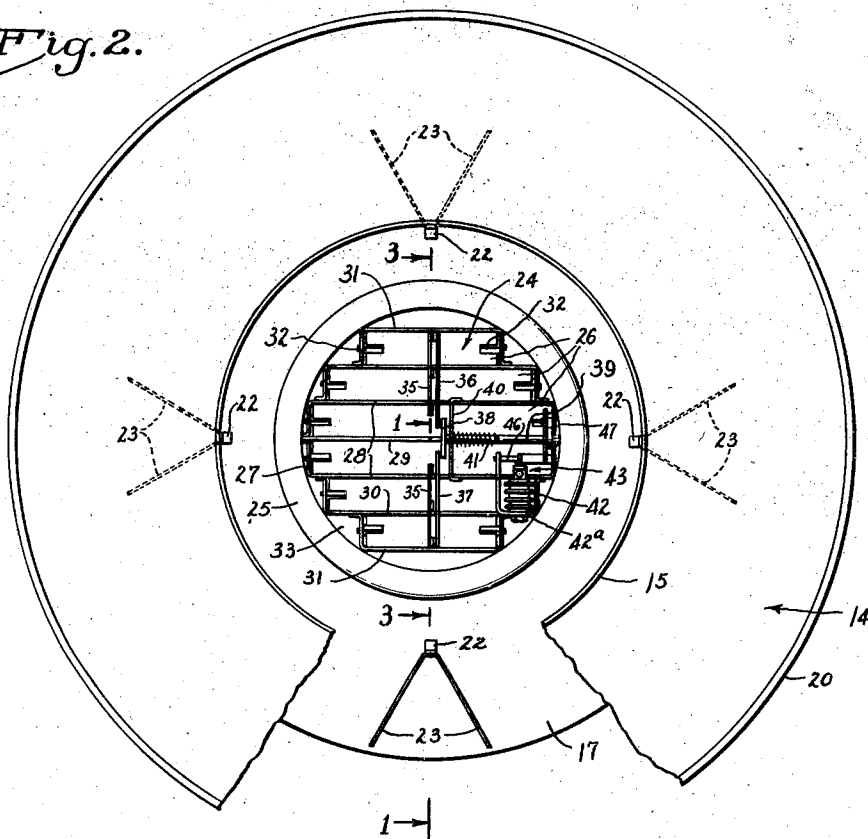
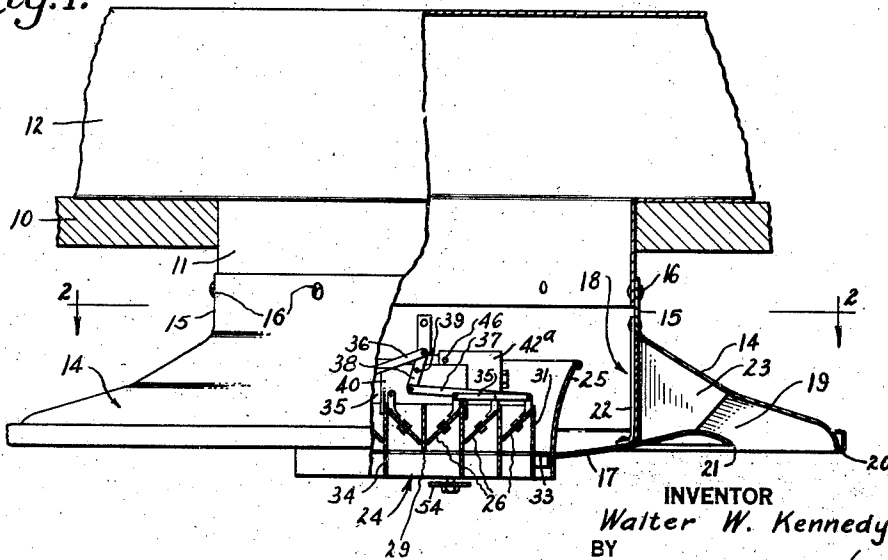


Fig. 1.



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4 Sheets-Sheet 2

Fig. 3.

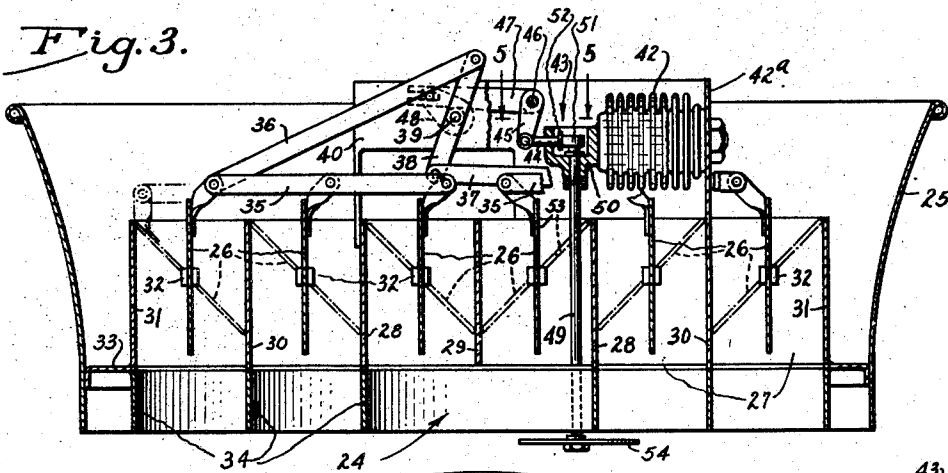


Fig. 4.

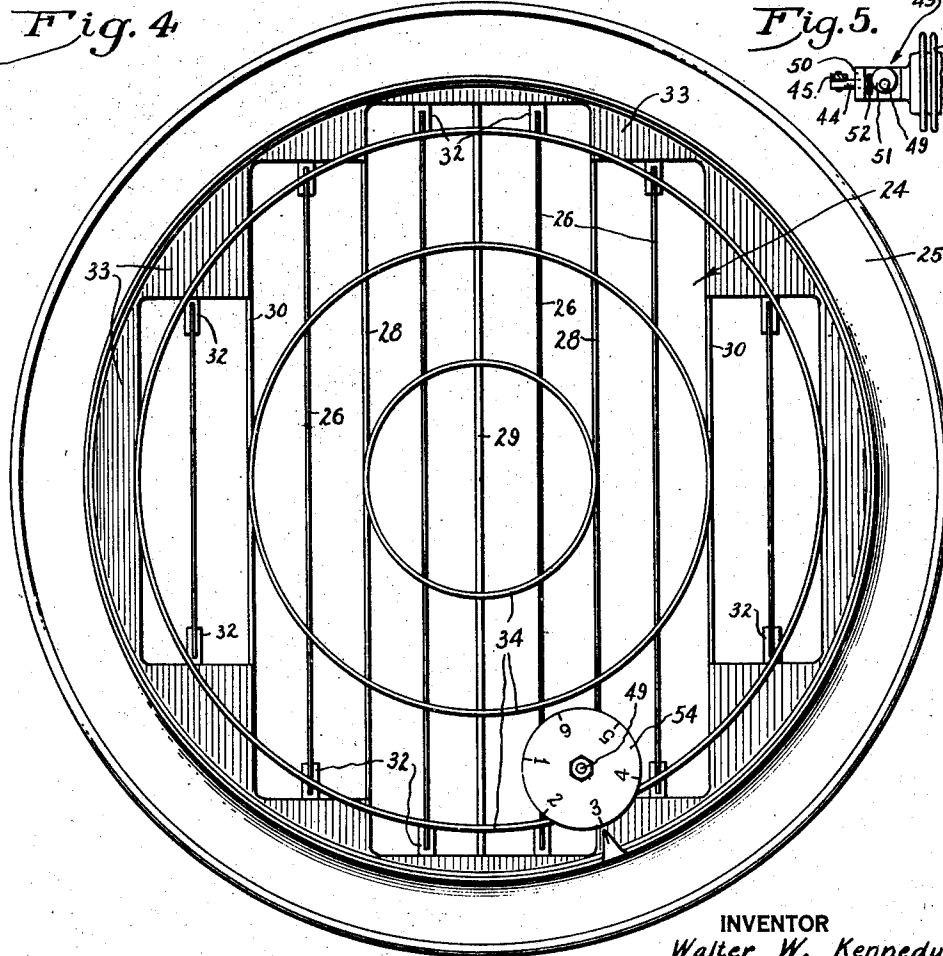
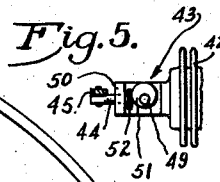


Fig. 5.



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4 Sheets-Sheet 3

Fig. 6.

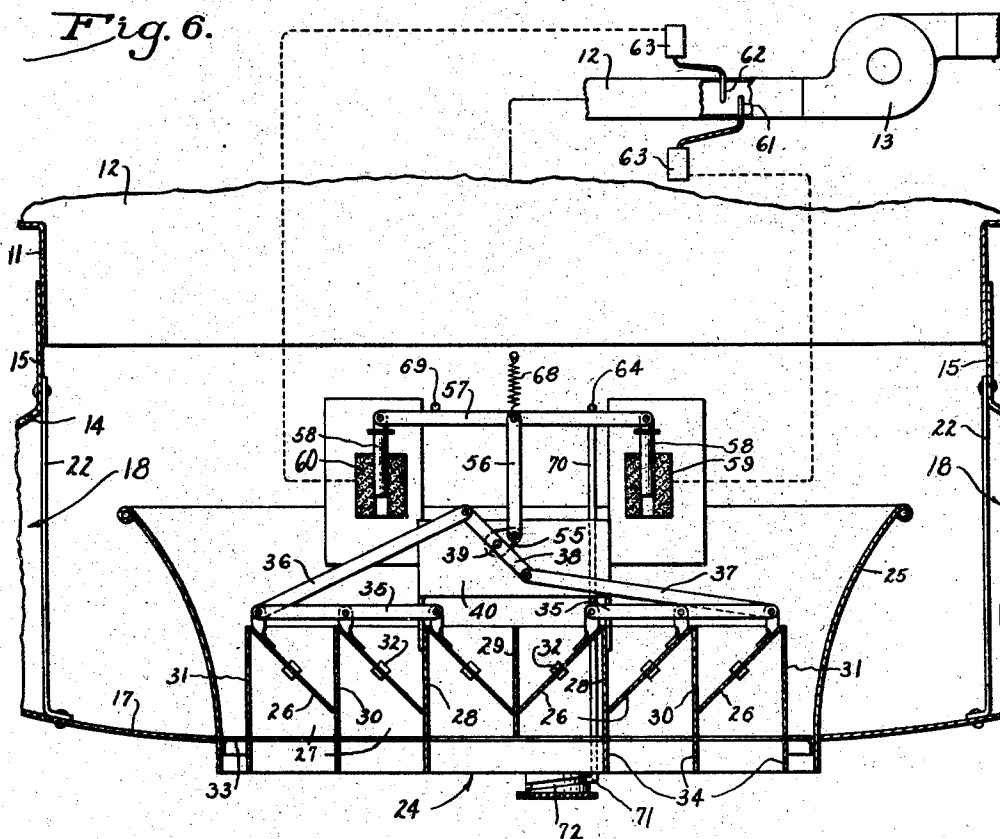
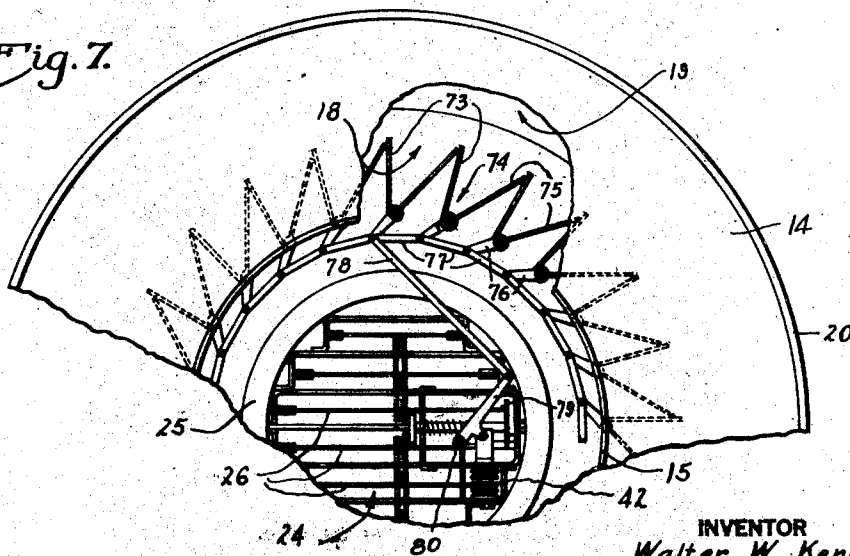


Fig. 7.



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4 Sheets-Sheet 4

Fig. 8.

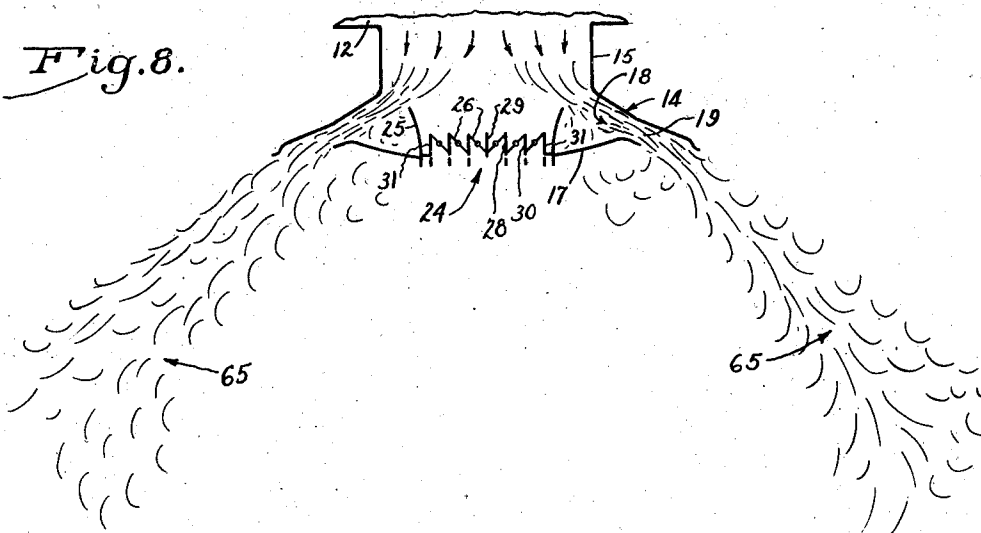
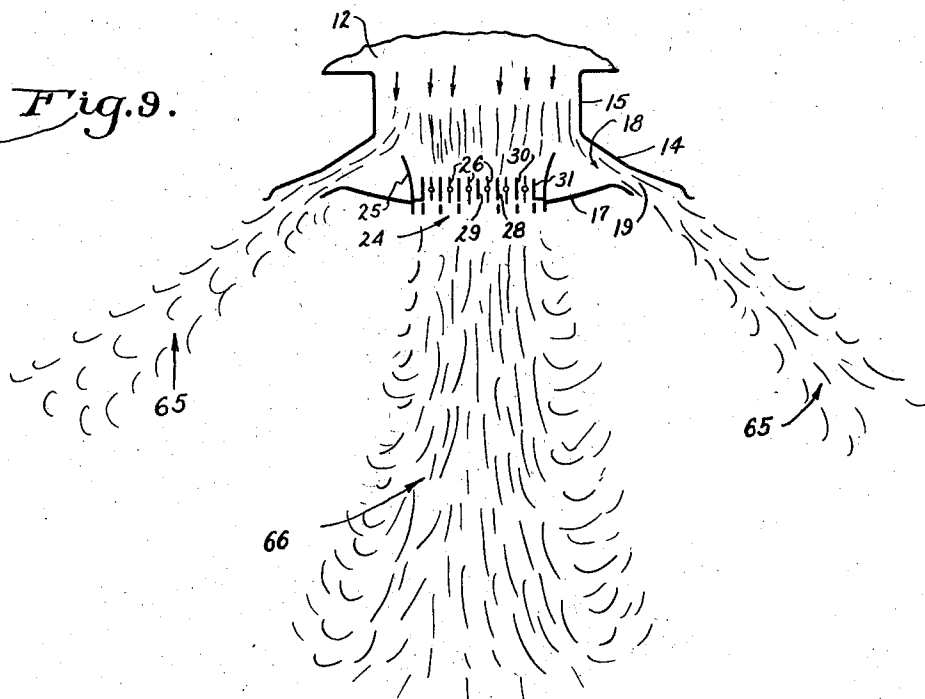


Fig. 9.



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UNITED STATES PATENT OFFICE

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AIR DISTRIBUTION OUTLET

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Application June 20, 1942, Serial No. 447,853

7 Claims. (Cl. 98—40)

1

This invention relates generally to air distribution outlets and more particularly to ceiling outlets.

One object is to provide a novel ceiling outlet adapted for use in factories, theaters, auditoriums, etc. having high ceilings and operable efficiently to distribute either heated or cooled air to the occupancy zone and thereby maintain this zone properly conditioned at all times.

Another object is to provide a novel air distribution unit adapted to be mounted adjacent the ceiling of a room and having a peripheral outlet adapted to direct incoming air laterally and downwardly and a central outlet adapted when open to direct a separate stream of air downwardly in a generally vertical direction.

Another object is to provide a novel mechanism for adapting the unit automatically for the distribution of air at different temperatures.

A further object is to provide a novel arrangement of dampers for controlling the central outlet of the unit.

The invention also resides in certain novel structural features by which the foregoing objects are carried out.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

Figure 1 is a side elevational view of the improved distributing unit supported from the ceiling of a room, the unit being partially shown in diametrical section taken along the line 1—1 of Fig. 2.

Fig. 2 is a plan section taken along the line 2—2 of Fig. 1.

Fig. 3 is an enlarged section taken along the line 3—3 of Fig. 2.

Fig. 4 is a bottom view of that portion of the unit shown in Fig. 3.

Fig. 5 is a fragmentary section taken along the line 5—5 of Fig. 3.

Fig. 6 is a view similar to Fig. 3 showing a modification.

Fig. 7 is a fragmentary view similar to Fig. 2 showing a modification.

Figs. 8 and 9 are diagrammatic views showing the directions of air flow through and from the unit under different operating conditions.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and will herein describe in detail the preferred embodiment. It is to be understood, however, that I do not intend to

2

limit the invention by such disclosure, but aim to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

In the form illustrated, the improved distribution unit is intended to be mounted below the ceiling 10 of a room and may as shown be supported from the downwardly projecting branch 11 of a main duct 12 to which conditioned air is forced by a suitable blower 13 (Fig. 6). The unit includes a generally frusto-conical shell 14 having a cylindrical neck 15 providing an inlet and telescoping with and fastened as by screws 16 to the lower end of the branch duct 11. Disposed in substantially horizontal position within the shell approximately at the level of the lower end thereof is a deflector plate 17 smaller in diameter than the large end of the shell and cooperating therewith to form an annular Venturi passage 18 extending outwardly from the lower end of the neck and then curving downwardly to terminate in an annular outlet 19 defined by the outer upwardly curled edge 20 of the shell and the outer edge 21 of the plate 17. The plate is suspended from the shell by annularly spaced hangers 22.

For a purpose to appear later, pairs of vertical baffle members 23 are disposed in the inlet of the passage 18 and arranged to divide the air stream into a plurality of parts. The members may comprise metal sheets contoured to fit against the opposed surfaces of the plate 17 and the shell 14 with their inner edges abutting against and suitably fastened to one of the hangers 22. Thus the members of each pair provide a V-shaped baffle whose opposite sides diverge radially and outwardly and divide the air stream discharged outwardly and downwardly from the peripheral outlet 19.

To adapt the unit for use alternatively in effecting efficient distribution either of cooled or of heated air, the invention contemplates the provision of a central outlet 24 through which a major portion of the air supplied through the branch duct 11 may, when this outlet is opened, be discharged directly downwardly. For this purpose, the plate 17 is formed with a central opening alined with and nearly as large in diameter as the duct 11, and this opening is arranged to be closed and opened preferably to varying degrees. In the present instance, the outlet 24 is defined by a tube or shroud 25 projecting through the opening in the plate 17 and supported by the latter as by being welded thereto. The shroud flares upwardly and terminates at a point spaced

from the lower end of the neck 15 a distance determined by the proportion of the air which is to be delivered through the central outlet. With the arrangement shown in which the shroud is concentric with the branch duct, about eighty percent of the total volume of air will be discharged through the outlet 24 when the latter is fully open.

The outlet 24 is arranged to be opened and closed by adjusting the vanes 26 of a self-contained damper mechanism mounted on the shroud 25. Herein, the vanes are constructed and mounted in a novel manner to enable the outlet to be of generally circular shape, to provide for discharge of the heated air substantially vertically even though the outlet is only partially open, and to minimize the motion required to effect full opening or closing of the outlet. To this end, the vanes are of different lengths and arranged in two sets with the longest vanes disposed adjacent each other along a diameter of the outlet and the successively shorter vanes are spaced progressively increasing distances from such diameter. Each vane is disposed in a rectangular subdivision of the outlet corresponding in length and width to the individual vanes. Herein, the subdivisions are formed by securing the flanges 27 of two U-shaped metal pieces 28 to a diametrical plate 29, then securing similar but shorter pieces 30 to the pieces 28 and finally securing similar but still shorter pieces 31 to the pieces 30. The pintles 32 at opposite ends of the vanes are journaled in the flanges of the different pieces which are welded to a plate 33 which conforms to the stepped external shape of the assembly so as to fill the shroud opening around the damper assembly. If desired, the assembly may be strengthened by concentric annular ribs 34 welded to the lower edges of the pieces 28, 30 and 31.

The three vanes of the two sets are pivotally connected by bars 35 for movement in unison and the outermost vanes of the sets are connected by links 36 and 37 to opposite ends of a crank 38 fast at its center on a rockshaft 39. The latter is journaled in frame pieces 40 upstanding from two of the partitions 28 and is urged by a torsion spring 41 (Fig. 2) counterclockwise as viewed in Figs. 1 and 3 toward closed position in which the vanes extend diagonally of the outlet subdivisions and their edges lie against the partition plates. By turning the shaft 39 reversely, the vanes are swung clockwise away from the closed positions shown in Fig. 1 and in dotted outline in Fig. 3 to progressively open the sections of the central outlet. It will be observed that in thus opening, the vanes of the two sets turn in opposite directions so that the tendency of one set of vanes to direct the discharging air stream away from the vertical is counteracted and balanced by the tendency of the other vanes to bend the other part of the stream laterally in the opposite direction. As a result of this action, the resultant air stream is discharged directly vertically in all of the degrees of partial opening of the damper.

It will be observed that the damper vanes are wider than the outlet subdivisions or spaces between the adjacent partition plates so that in the closed position, the vanes extend diagonally of the direction of air flow instead of perpendicular thereto, opposite edges of the vanes lying against the adjacent partitions. Thus, to bring the vanes into parallelism with the air flow and thereby open the damper fully as shown in Fig. 3,

it is only necessary to turn the vanes through an angle of forty-five degrees. This is advantageous where, as in the present instance, the damper is actuated by a thermostatic bellows, solenoids or the like.

In the present instance, means is provided for changing the characteristics of the distribution unit automatically and thereby adapt the unit either for heating or for cooling of the room. This means comprises a thermostatic actuator responsive to changes in the temperature of the air delivered through the unit. With the actuator shown in Figs. 1 to 3, opening of the damper is progressive as the air temperature rises above a predetermined value. This actuator comprises a thermostatic bellows 42 having one end fixed to a post 42^a upstanding from one of the plates 39 so that the actuator is self-contained within the distribution unit. The other end of the bellows is joined through an adjustable connection 43 to a link 44 connected to the free end of a crank 45. The latter is on a rockshaft 46 journaled in one frame member 40 and is connected by an arm 47 to a crank 48 on the rockshaft 39.

The connection 43 affords a convenient means, accessible from a point below the unit, to permit of variation in the positions which the damper vanes assume for a given temperature of the bellows. It comprises a vertical shaft 49 (Figs. 3 to 5) journaled in the fitting 50 on the movable end of the bellows and carrying an eccentric cam 51 which acts on the head 52 of the link 44 which is slidable in the fitting. The shaft 49 projects downwardly through a slot 53 in one of the vanes 26 and below the unit carries a handwheel 54 which may be turned manually to change the effective length of the linkage and therefore the temperature at which the vanes will be opened to a predetermined degree.

If preferred, the vanes may be opened in one or more steps by an electric actuator which is controlled by a plurality of thermostats. Such an arrangement is shown in Fig. 6 in which a crank 55 on the rockshaft 39 is connected by a link 56 to the center of an equalizing bar 57 whose ends are pivoted on the plungers 58 of solenoids 59 and 60. A spring 63 urges the bar upwardly against a stationary stop 69 adjacent the solenoid 60 and a stop 64 disposed at the other end of the bar and carried by the upper end of a vertical rod 70. The lower end 71 constitutes the follower of a cam 72 rotatably mounted on the damper frame and accessible from a point beneath the unit.

Thermostatic bulbs 61 and 62 responsive to the temperature of the air supplied through the main duct 12 by the blower 13 actuate switches 63 for energizing the respective solenoids. The solenoid 60 may, for example, be energized when the delivered air rises above 75 degrees Fahrenheit, and the solenoid 59 may be energized above 85 degrees. In such a case, the damper vanes 26 would be closed as shown in Fig. 6 when cooled air is being supplied to the room. When heating is required and the delivered air rises above 75 degrees, the solenoid 60 is energized and the bar 57 pivots about the stop 64 to shift the vanes part way open. A further temperature rise above 85 degrees results in energization of the solenoid 59 and full opening of the damper. The extent of partial opening when the solenoid 60 is energized may be varied as desired by adjusting the cam 72 to change the position of the stop 64. Raising of the latter from the position shown will result in a corresponding decrease in the

5

movement of the vanes by energization of the solenoid 60 alone.

The action of the units above described in distributing cooled or heated air to the room is illustrated in Figs. 8 and 9. For cooling, the central outlet 24 would be closed fully by the vanes 26. Thus, all of the air delivered through the branch duct would be forced through the peripheral opening 19. This air is discharged laterally and somewhat downwardly from the outlet in a generally conical stream 65 as illustrated in Fig. 8. Being cooler than the room air, it diffuses rapidly and descends gradually into the occupancy zone near the floor so as to produce satisfactory cooling of this zone without subjecting the occupants to drafts.

When the temperature of the delivered air rises sufficiently to open the damper controlled outlet 24, the volume of the stream 65 is reduced and a major portion, about 80 percent when the damper is fully open, of the heated air will be discharged directly downwardly in substantially vertical stream 66 as illustrated in Fig. 9. Such division of the air stream is obtained because the central opening is aligned with the branch duct and because it has a larger area than the peripheral outlet. By thus directing the heated air downwardly and vertically, the air will be forced into the occupancy zone by the maintenance of a discharge velocity sufficiently low to avoid drafts within the zone, and this in spite of ceiling heights as great as forty feet.

To insure distribution in this manner during heating of the room, it is desirable to keep the horizontally and vertically discharged streams 65 and 66 separated, particularly near the unit. The baffles 23 above described contribute to this by dividing the upper or conical air stream 65 into annularly spaced parts between which parts there is an area through which air from above the upper stream may flow into the low pressure area created between the two streams. This relieves the low pressure condition and permits the streams to continue descending in the general direction of their discharge without mingling with each other.

Under some service conditions it is desirable to provide for closure of the annular passage 18 so as to effect the discharge of the entire volume of air downwardly through the central opening 24. An arrangement for accomplishing this is illustrated in Fig. 7 wherein the passage is divided by a series of stationary plates 73 extending generally radially of the throat of the Venturi opening 18 and mounted between the shell 14 and the deflector plate 17 in the same manner as the baffles 23 above described. At the inner vertical edge of each plate 73 is the hinge 74 of a damper vane 75 which is swingable from the closed position shown against one plate 73 to open position against the adjacent plate. Cranks 76 rigid with the respective vanes project inwardly from the pivots thereof and are connected at their free ends by links 77. One crank is connected by a link 78 to a crank 79 pivoted at 80 to the damper frame and connected at 81 to the movable end of the thermostatic actuator 42. The connections are such that when the vanes 26 are fully open, the vanes 75 are closed as shown. As the temperature of the incoming air increases and starts to close the vanes 26, the vanes 75 move toward open position. As a result, the opening 18 is opened progressively as the central opening 24 is closed.

6

I claim as my invention:

1. In an air distributing unit, the combination of a tube providing an air discharge outlet, a plurality of plates extending transversely of said tube and dividing said outlet into a plurality of separated openings extending parallel to each other, damper vanes each pivotally supported in one of said openings to turn about a longitudinal axis disposed intermediate the side margins of the vane, means connecting said vanes and operable to swing the vanes in the two halves of said outlet simultaneously in opposite directions between an open position paralleling the axis of the inlet and a closed position in which the vanes of the two sets extend diagonally of said openings and converge toward each other in the direction of air flow through the outlet.

2. In an air distributing unit, the combination of a tube providing an air discharge outlet, a plurality of plates extending transversely of said tube and dividing said outlet into a plurality of separated openings extending parallel to each other, damper vanes each pivotally supported in one of said openings, an actuator arm pivoted intermediate its ends, means pivotally connecting the vanes on one side of said outlet to one end of said arm and the remaining vanes to the opposite end of the arm whereby the two sets of vanes are swung in opposite directions by movement of the arm, the vanes of the two sets converging toward the center of said outlet when the latter is partially open.

3. In an air distribution unit, the combination of a cylindrical tube providing an air passage therethrough, a plurality of parallel plates extending transversely of said tube and having perpendicular end flanges, said plates and flanges dividing said outlet into adjacent rectangular passages of lengths decreasing in steps outwardly from the center, means closing said outlet between the inner wall of said tube and said flanges, damper vanes pivotally supported by said flanges to turn about longitudinal axes lying intermediate the margins of the respective vanes and each controlling the flow of air through one of said rectangular passages.

4. A unit for distributing air having, in combination, a shell flared at one end and having a forced air inlet at the other end, a deflector mounted in the enlarged end of said shell and coacting therewith to define an outer generally annular opening, a tube defining an outlet centrally of said deflector and aligned with said inlet, a plurality of cross-pieces within said tube dividing said outlet into a plurality of parallel parts of rectangular shape, damper vanes pivotally supported in the respective parts, and means for actuating said vanes in unison to control the opening and closing of said unit.

5. A unit for distributing air having, in combination, a casing having a forced air inlet and providing a peripheral outlet operable to direct air in a stream from said unit in the form of an annular cone flaring away from the unit, said casing also providing a central outlet aligned with said inlet to direct a separate stream along the axis of said conical stream, a damper controlling the degree of opening of said central outlet, a plurality of damper vanes arranged in an annular series around said peripheral outlet and each controlling the flow of air through a segmental part of said peripheral outlet, an operating member, and means connecting said member to said damper and said damper vanes and operable to open said damper and close said vanes

7

during movement of the member in one direction.

6. A unit for distributing air having, in combination, a casing having a forced air inlet and providing a peripheral outlet and a separate central outlet within the peripheral outlet, separate sets of damper vanes movably mounted in the respective outlets and movable relative to the defining walls thereof to control the flow of air from said outlets, and means for actuating said damper means in unison to open one outlet and close the other simultaneously.

7. A unit for distributing air having, in com-

8

5 bination, a casing having a forced air inlet and providing a peripheral outlet, a series of plates stationarily mounted in said outlet and dividing the same into a plurality of passageways, vanes each pivotally mounted to swing back and forth between two adjacent plates and control the flow of air through one of said passageways, cranks rigid with the respective vanes, links pivotally connecting said cranks, and means for 10 moving said links circumferentially in unison.

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