May 4, 1965 M. H. KRUGER 3,181,450

VENTILATION AND LIGHTING

Filed March 8, 1962 4 Sheets-Sheet 1

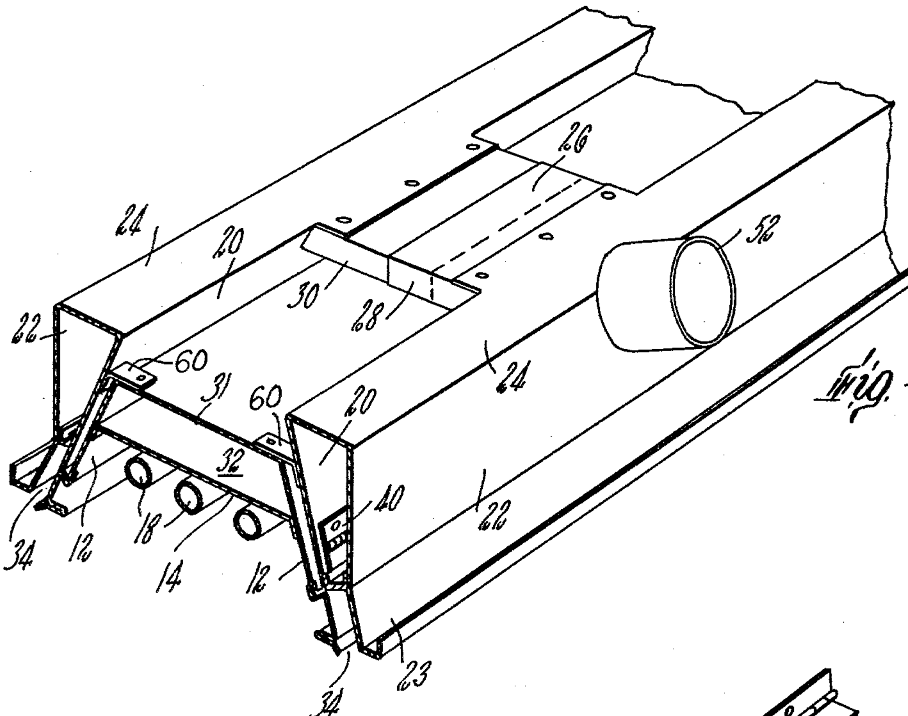


Fig. 1.

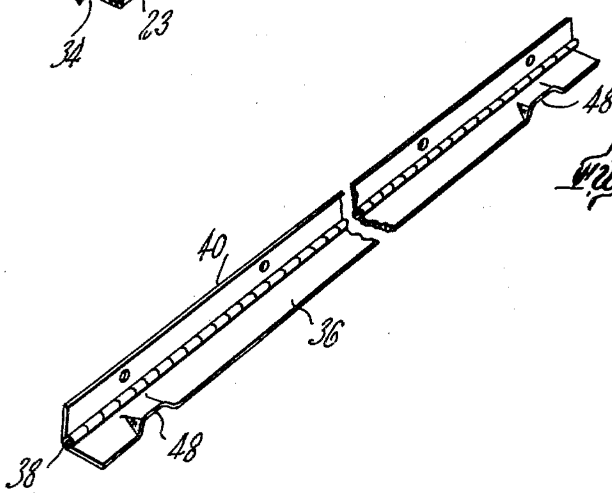


Fig. 2.

VENTILATION AND LIGHTING

Filed March 8, 1962

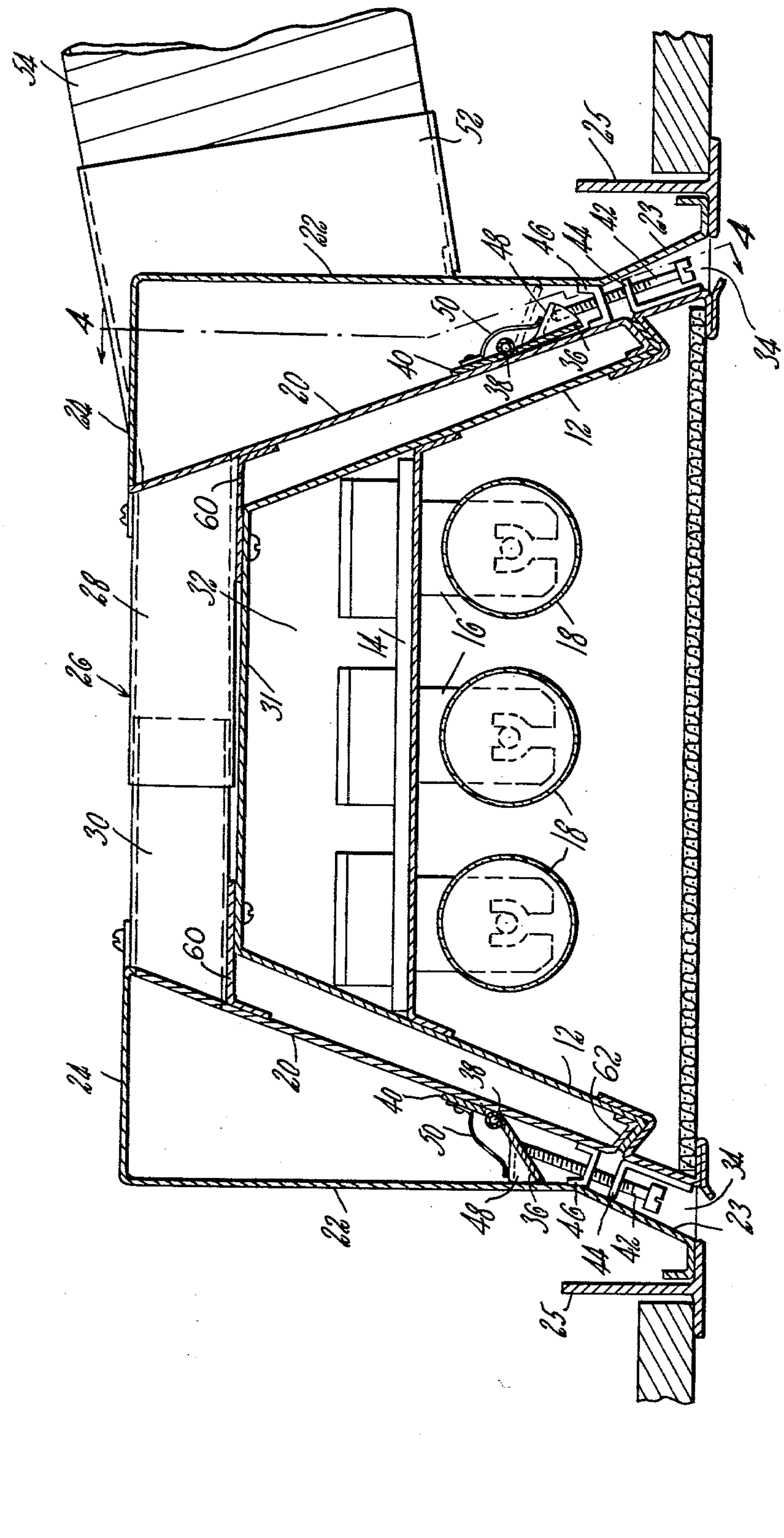


Fig. 3

May 4, 1965 — M. H. KRUGER — 3,181,450

VENTILATION AND LIGHTING

Filed March 8, 1962 — 4 Sheets-Sheet 3

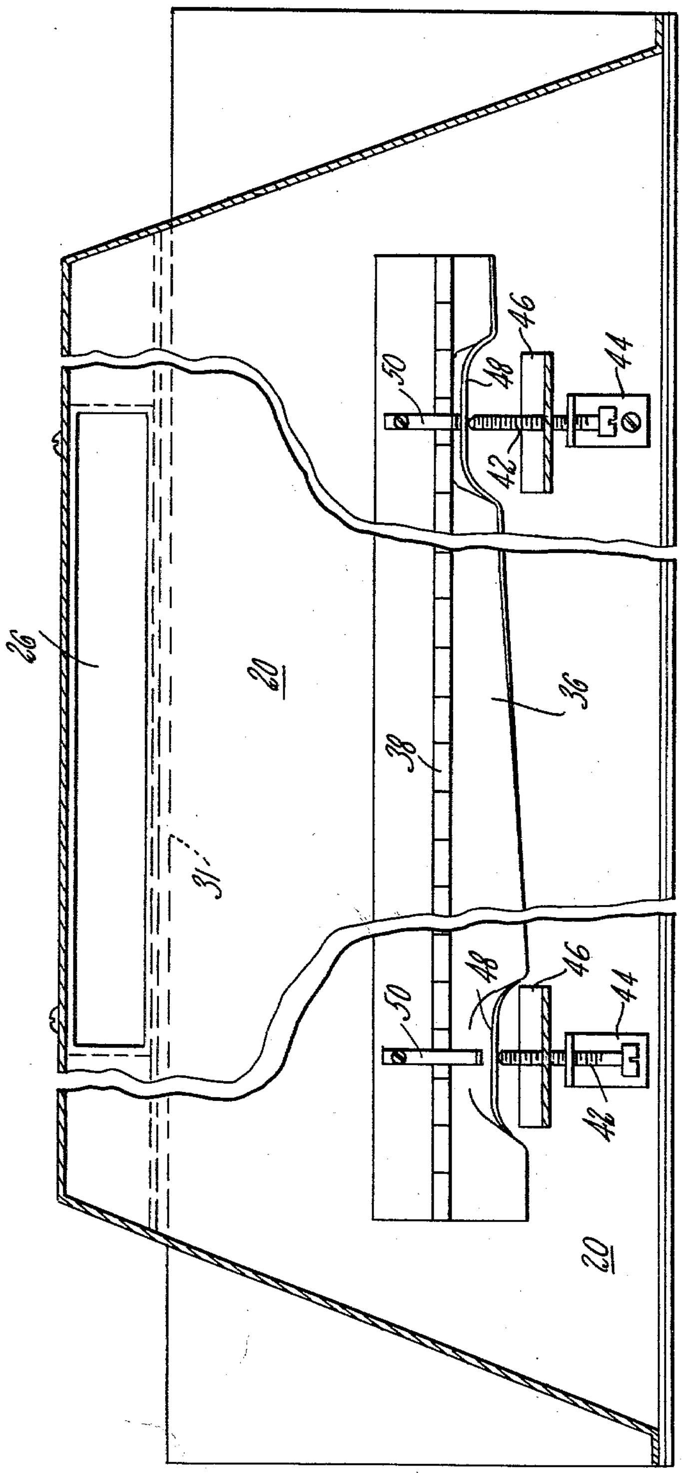


Fig. 4.

VENTILATION AND LIGHTING

Filed March 8, 1962 4 Sheets-Sheet 4

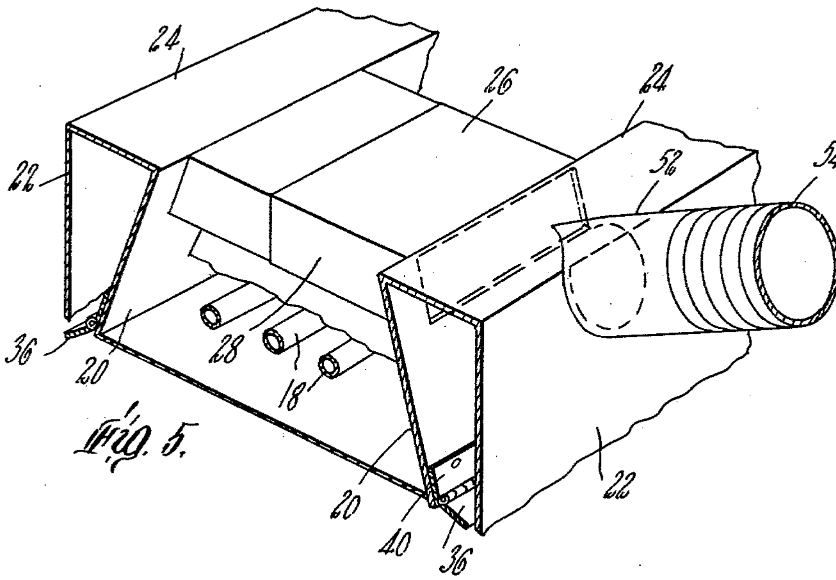
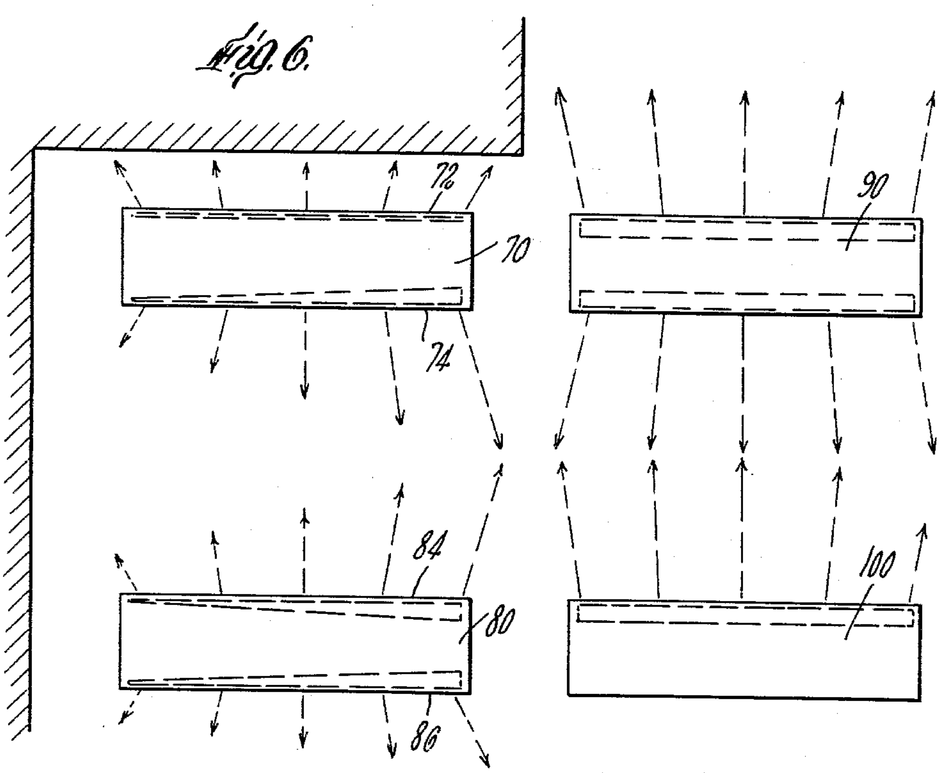


Fig. 5.

Fig. 6.



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VENTILATION AND LIGHTING

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This invention relates to improved distribution of air, to improved means for changing air distribution patterns produced by lighting and ventilating systems, and to improved combination lighting and ventilating units.

A fixed air distribution plan for a building space cannot provide for variable demands caused by changes in the number of personnel working in the space, and in the positions of equipment and furnishings. It is normally necessary to install the ventilation equipment before the space is occupied and to position the air discharge units in the most likely places they will be needed, and hope for the best. After the building space is occupied, it is often found that some areas receive too much air, that others receive too little, and that drafts occur. This is particularly true with combination elongated air and light units of the type commonly installed in a single recess in the ceiling because the position of units is in part dictated by what is best for efficient lighting. Elongated lights of such units are usually arranged in spaced-apart parallel lines for efficient illumination, and the ventilation planner is restricted to choosing positions in these lines for the installation of combination units. Poor air distribution also occurs with lighting and ventilation systems where the lighting fixtures are arranged in parallel lines, and the ventilation fixtures are mounted parallel with the lines of lights, but spaced substantially from them.

The art has employed dampers of one form or another to regulate the gross flow of air from outlets but these do not provide sufficiently good control to insure proper ventilation without drafts.

In the case of combined lighting and ventilation units, the means for operating the dampers has required the removal of part of the unit or adjacent ceiling, making the job of adjustment so unhandy that even gross drafts and stagnant areas are tolerated rather than modified. The art has also provided for repositioning such combination units, but this only enables gross change and does not provide for the sensitive adjustments needed.

When prior art combination units have two elongated outlets, one on each side of a troffer, there has been no easy way of causing one of them to deliver more air than the other. These prior art combination units have required a substantial above cavity space to provide room for connecting the supply ducts, and these combination units have been unduly noisy.

A principal objective of the invention is, therefore, to provide a simple and economical means for adjusting the air flow rate produced by a ventilation outlet. In particular, I have realized that the flow through an elongated aperture can be varied along its length by a practical and simple means, to provide for a wide variety of air flow patterns.

Another objective is to provide a means for adjustment of air flow which is so easily operated and accessible as to be capable of use on a continuing basis, to adjust

the ventilation to the desires of occupants of the building space.

Another objective is to provide a means for controlling air flow which is silent and causes little friction loss.

Another objective is to provide an improved ventilation and lighting system, with parallel elongated bulbs and vent outlets.

Another objective is to provide a combination ventilating and lighting unit having means for adjusting the flow from an air chamber at one side of a troffer relative to that of another at the other side, where they have a common supply.

Another objective is to provide a combination unit which has air outlets on both sides of a troffer, and has means for connecting an air supply which does not require a large cavity space above the unit.

Yet another objective of the invention is to provide such a combination unit which is economical to manufacture and install.

Other objectives and features will in part be obvious and in part appear herein.

Broadly, the invention comprises an elongated air outlet connected to a corresponding air passage connected to a duct, an elongated damper member mounted in the passage, the damper member being flexible along its length to allow warping of it, and a plurality of spaced-apart adjustment means each disposed to engage the damper member and to flex the corresponding portion thereof, to vary the size of the corresponding portion of the air passage. Preferably, the adjustment means comprises threaded members or the like, extending away from the outlet aperture and accessible through it by a screwdriver or the like. The damper member is preferably self-supporting and resilient, formed, for instance, of sheet aluminum or the like. It is preferably biased to either an open or closed position relative to the passage, with the spaced-apart adjustment means adapted to exert forces on the member in opposition to the bias forces to cause flexing of one part relative to another for varying the shape of the control outlet along its length. The total cross-section of the elongated passage at which the damper member is effective is very substantial, so that the velocity of the air passing through this restriction is substantially lower than the velocity in the supply conduit, hence there is little chance for vibration. Also, when the damper member is mounted immediately adjacent the outlet aperture there is no passage downstream for amplifying and propagating noise. For these reasons the unit can control the air silently.

Where air distribution to both sides of a combination ventilation and lighting unit are desired, two connected chambers are employed, one on each side of the light tube and the air chambers and their outlets are preferably shaped to direct air in opposite transverse directions. With the combination of the flexible damper arrangements with such a unit it is possible to feed one chamber laterally with a supply of air, and to close down on its outlet passage so that sufficient air moves to the other chamber. Particularly when the air supply is aligned with the passage connecting the remote chamber, a very balanced flow can be obtained if desired. This does away with the symmetrical vertical supply and the need for cavity space, heretofore thought important.

In a particularly desirable form the two chambers of such a unit are structurally connected by a passage member which comprises two telescopically fitted parts, adapted to be extended or contracted to enable the receiving of one or a number of electric light bulbs between the chambers.

Certain prior art combination units have been objectionable because the wall defining the reflector has been employed to also bound one side of the air chamber. This results in cooling of the corresponding portions of the reflector, and results in discoloring the light bulbs. In the preferred embodiment applicant defines the troffer and the chamber with separate spaced-apart metal walls, providing an insulation space which avoids the discoloring.

The invention will be described in connection with the drawings of a preferred embodiment wherein:

FIG. 1 is a perspective view looking down upon a preferred embodiment of the combination unit;

FIG. 2 is a perspective of the preferred form of the damper member of the invention, employed in the embodiment of FIG. 1;

FIG. 3 is a transverse cross-section of the unit of FIG. 1 when recessed in a ceiling;

FIG. 4 is a partially broken away longitudinal cross-section of the embodiment of FIG. 3 taken on line 4—4 thereof;

FIG. 5 is a partially diagrammatic perspective view of a portion of the embodiment of FIG. 1 illustrating the means of air supply; and

FIG. 6 is a diagrammatic view of an air distribution plan obtainable with the invention.

Referring to FIGS. 1 and 3, the combination unit comprises a fluorescent troffer including an uppermost transverse wall **31**, spaced-apart reflective side walls **12**, top wall **14**, and opposed lamp holders **16** mounted to the top wall, adapted to position and energize lamps **18**. Along each side of the troffer, but spaced from the side walls is an air chamber envelope defined by inner and outer walls **20** and **22** respectively and top wall **24**. A space is defined between troffer wall **12** and air chamber wall **20** to define an air zone for insulating the troffer from the air chamber, thus to avoid temperature variations of the troffer reflective wall which would tend to discolor the lamps. The lower portion **23** of wall **22** of each of the air chambers is bent to engage an inverted **T 25** for support as shown in FIG. 3, the lower portions of walls **22** are bent inwardly into the form of brackets **62** which mount the lower parts of walls **20** to the walls **12** of the troffer and brackets **60** mount the upper parts of the walls **20** to the transverse wall **31** of the troffer. A further bracket **64** mounted to the lower end of each side wall **12** is provided to support a conventional light shield below the bulbs and to mount adjustment brackets **44**. The two air chambers are joined together through a cross-duct **26** extending between the center of the two chambers. Preferably, this duct is defined by two telescoping members, **28** and **30** which enable the adjustment of the air chambers toward and away from each other to accommodate various sizes of the troffer. Each of the troffer walls extends upwardly beyond the lamp holders to transverse wall **31**, parallel to wall **14**, defining therebetween an air chamber **32** which insulates the troffer from the cross duct.

The walls **20** and **22** of each air chamber come together at their lower portion of define a passage leading to the elongated outlet **34**. In this embodiment wall **20** is substantially parallel to troffer wall **12**, while wall **22** is substantially vertical. Near the outlet **34**, in the passage, is mounted a flexible elongated damping member **36** capable of warping along its length and means for pivotally supporting it, here comprising a piano hinge **38** extending along one of the longitudinal edges of said damping member, and a stationary hinge support **40** extending along the hinge, fixed to the wall **20**. The damper member extends substantially parallel with the outlet aperture, and is mounted to extend substantially parallel, against wall **20** as shown in FIG. 3 and to pivot across the passage to close it, to the position shown by the dotted line on the right hand side of FIG. 3. Adjustment screws **42** extend upwardly through the outlet **34**, into engagement with the damper member **36**. For this purpose brackets **44** and **46** are mounted rigidly with respect to the body of the unit, and threaded to receive the adjustment screws **42**. The part of the damper member which directly contacts each adjustment screw is bent to form a camming surface **48**. A plurality of spaced-apart leaf springs **50** are secured to wall **20** of the air chamber and engage the damper member **36** urging it to the open position in which the main portion of the damper member **36** extends downwardly from hinge **38**, and lies parallel with the wall **20**. As indicated in FIG. 3, the damper member is in that position, while the adjustment screw still engages the camming surface **48**. Here the passage defined between walls **20** and **22** leading to the outlet aperture is substantially free from obstruction. By means of a screwdriver inserted through the outlet aperture **34**, turning the screw **42** will carry the camming surface upwardly, and pivot the damping member to the position shown in the dotted line in FIG. 3 where the passage is substantially closed. Due to the flexibilitiy of the damper member with the adjustment screws the member can be warped, one end in the closed and the other in the open position as shown in FIG. 4.

On the outside wall **22** on one of the air chambers, in the center thereof, an air supply opening rim **52** is mounted, communicating with the inside of the chamber. As can be seen in FIG. 5, this is disposed opposite from the opening into the connecting passage **26**. The rim extends substantially horizontally. An air supply conduit, preferably a flexible hose **54** is connected to this.

In installation, the unit is raised into a space between inverted **T** bars, or into a space otherwise defined in the ceiling, and it is supported, either by the lower flanges of the air chambers or from above. No substantial cavity space above the unit is required because the air inlet to the device is substantially horizontal. Referring to FIG. 5, the air supply piping **52, 54** preferably has a diameter of about 5 inches which gives it a cross-section area of about 20 square inches. The cross-passage has a depth of 1 inch and a width of 10 inches, giving it a cross-sectional area of about 10 square inches. Because the air flowing through the inlet **52** is directed towards the cross-passage, a substantial portion of the air moves directly into the cross-passage, across the width of the unit and strikes the opposing wall **22** of the other air chamber. The air stream portions which do not directly enter this passage impinge upon wall **20** of the direct fed chamber, and are thereby deflected in every direction. Portions of this air also enter the cross-passage **26**, further increasing the supply to the remote air chamber. Now, by simply adjusting the damper member **36** on the directly supplied air chamber to a more closed position than that on the remote air chamber, the flow through the two air chambers can be substantially balanced when desired, even though there is no symmetry with respect to the supply connection and the chambers.

The wall **20** upon which the air impinges is substantially parallel with the corresponding reflector wall, flaring away from the position of the bulb. Air striking this wall is deflected to move out of the unit with a horizontal component, transverse to and away from said bulb.

Referring to FIG. 4, simply by adjusting one of the screws **42** upwardly more than the other, the flexible damper member is warped, to change the air flow rate at one end of the air chamber relative to the other. This enables gross changes in the capacity of the air passage so that the air flow can be regulated over a wide range. It will be understood that numerous screw members rather than two as shown can be employed where the lighting fixture is sufficiently long to warrant it.

Also, it will be understood that where air is needed on only one side of the light fixture, only one air chamber need be provided, and an extension can be mounted on the lower edge of the opposite side of the troffer to engage the inverted T or otherwise join the adjacent portions of the ceiling.

Referring to FIG. 6, the arrowed vectors represent quantities of air flowing from the corresponding portions of units **70**, **80**, **90** and **100**. One side **72** of the distributor **70** is disposed adjacent a wall where downdrafts should be avoided. Accordingly, the damper member is uniformly partially closed, limiting the flow but retaining a generally uniform air passage throughout the length of the unit. The air demands on the other side are not uniform, more air being needed in the center part of the room. Accordingly, the damper member on side **74** is warped by appropriate adjustment of the screws **42** so that at one end a great quantity of air flows out of the unit, while on the other end relatively little.

Unit **80** has one side **84** adjusted to direct most of its air from one end of the aperture similar to side **74** of unit **70**. The opposite side **86** is closed down to transmit less air, one end transmitting more than the other. The air flow from the two sides of unit **90** are substantially balanced.

Unit **100** has only one air chamber, and therefore transmits in only one direction, one end transmitting more than the other.

In the preferred embodiment described above, the damper member is preferably an aluminum strip having a width of 1 inch and a thickness of .030 inch. This gives the member resiliency with flexibility, which causes it to tend to return to the unflexed state, and permanent deformation does not occur. In another embodiment one longitudinal edge of the flexible damper member might be rigidly mounted to the troffer, and the inherent resiliency of the strip used to urge the member to one position, either open or close, and the screws opposing that to change the member to the other position. Another embodiment could employ a limp but flexible damping member with the adjustment means carrying the corresponding portions of the damper member opened or closed as desired.

Numerous other modifications are possible within the spirit and scope of the invention.

What is claimed is:

1. A ventilation unit having an extended air outlet, a supply passage for said outlet defined by spaced apart walls and connectable to an air source, an extended, flexible damper member warpable along its extent, said damper member located between said walls and arranged generally parallel with said outlet in a manner to permit control of the flow of air through said passage and outlet, means mounting said damper member for arcuate movement about an axis lying in the direction of extent of said damper member from a first position to other positions relative to said walls defining said passage to effect said control of the air flow, position control means including a plurality of adjustment means spaced apart along the extent of said flexible damper member, each adapted to be adjusted independently, said adjustment means cooperatively constructed and arranged with respect to each other and to said means mounting said damper member to move the corresponding portion of said damper member from said first to said other positions and to flexibly warp the corresponding portion of said damper member about said axis relative to the remainder of said damper member to vary the air flow from point to point along the extent of said outlet.

2. The unit of claim 1 wherein said damper member is comprised of resilient material of predetermined thickness sufficient to be at least partially self-supporting, said means mounting said damper member including spring means provided along said damper member biasing each portion of said damper member to one of said rotatable positions about said axis, and each of said adjustment means adapted to adjustably exert force on the corresponding portion of said damper member in opposition to the biasing force, to rotate said portion toward the other of said positions.

3. A ventilation system comprising a plurality of elongated air outlets, a corresponding plurality of supply passages for said outlets defined by spaced apart walls, said passages adapted to receive air from a common source, at least one elongated, flexible damper member warpable along its length, said damper member located between the walls of one of said passages and arranged generally parallel with the corresponding outlet in a manner to permit control of the flow of air through said passage and outlet, means mounting said damper member for arcuate movement about an axis lying in the direction of the length of said damper member from a first position to other positions relative to said walls defining said passage to effect said control of the air flow, position control means including a plurality of adjustment means spaced apart along the length of said flexible damper member, each adapted to be adjusted independently, said adjustment means cooperatively constructed and arranged with respect to each other and to said means mounting said damper member to move the corresponding portion of said damper member from said first to said other positions and to flexibly warp the corresponding portion of said damper member relative to the remainder of said damper member to vary the air flow from point to point along the length of said outlet and to balance said flow relative to the flow through the other of said outlets.

4. A ventilation system in combination with an elongated lighting unit, said ventilation system comprising a plurality of elongated air outlets, a corresponding plurality of supply passages for said outlets defined by spaced apart walls, said passages adapted to receive air from a common source, at least one elongated, flexible damper member warpable along its length, said damper member located between the walls of one of said passages and arranged generally parallel with the corresponding outlet in a manner to permit control of the flow of air through said passage and outlet, means mounting said damper member for movement from a first position to other positions relative to said walls defining said passage to effect said control of the air flow, position control means including a plurality of adjustment means spaced apart along the length of said flexible damper member, each adapted to be adjusted independently, said adjustment means cooperatively constructed and arranged with respect to each other and to said means mounting said damper member to move the corresponding portion of said damper member from said first to said other positions and to flexibly warp the corresponding portion of said damper member relative to the remainder of said damper member to vary the air flow from point to point along the length of said outlet and to balance said flow relative to the flow through the other of said outlets, one of said elongated air outlets being disposed on each of the long sides of said lighting unit, the entire combination being adapted to be recessed in a ceiling, a connection for the air source provided in one of the side walls of said passages so that air can be supplied in a substantially horizontal flow to said passage and said passage communicating with the other of said passages so that the air flow path from said air source to one of the outlets is of different configuration than for the other of said outlets, the flexible damper member enabling the balancing of air flow through said outlets, the location of the connection for the air source in the side of said passage enabling the combination unit to have substantially no higher vertical extent than that of said lighting unit alone.

5. The ventilation unit of claim 4 in which the passage to which said air source connection is provided is defined by opposed side walls, the outer of said walls having said air source connection and the inner of said walls having an opening connected by a cross-duct to the other of said passages, the air source connection being at least partially aligned with the opening of said cross-duct whereby part of the air can flow into and through said cross-duct, thence to the corresponding outlet, while part of the air flows directly to the other of said oulets.

References Cited by the Examiner

UNITED STATES PATENTS

2,937,589	5/60	Rachlin	98—40
2,991,708	7/61	Falk	98—40
3,010,378	11/61	Geocaris	98—40
3,045,577	7/62	Lazerson	98—40
3,072,038	1/63	Phillips	98—40

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